Experimental Investigation of Flexural and Impact Behavior of Flexible FRC Slabs

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1-Introduction

Concrete is widely used in civil engineering constructions due to its significant and proper characteristics. Though concrete is convenient and inexpensive to be made, its brittle behavior upon tensile loading is one of its adverse properties that lead to the development of fiber reinforced concretes (FRCs) and some types of fibers such as steel, carbon, glass and polymer fibers are added to the concrete mixture to overcome these deficiencies. The brittle behavior of concrete is due to the fast growing of a single crack that leads to the uncontrollable failure of the specimen. High tenacity and modulus of elasticity are the notable characteristics of these fibers which are specifically focused in this research. The results revealed good performance of the specimens reinforced with such fibers. The amount of fibers which are expected to be added mainly depends on the functions of the elements which are going to be casted. Adding less than one percent of the fibers to the concrete mixture is suggested to restrain possible shrinkage therein while structural improvement such as flexural enhancement requires more amounts of fibers.

2- Experimental Program

This research aims to investigate the static and impact behavior of some types of FRC specimens casted with Poly Vinyl Alcohol (PVA) and Poly Propylene (PP) fibers that involve suitable mechanical properties as reinforcing materials for concrete. In the present study, drop weight test and static load test were implemented on fifty six specimens in order to investigate the properties of PVA & PP reinforced concretes. The characteristics of PP and PVA FRC specimens under impact and flexural tests with totally 56 specimens were investigated in this paper. The output results were simultaneously recorded by a digital data logger to derive the required parameters in order for input into the related diagrams namely Load-Deflection curve to be drawn and interpreted and consequently the values of energy absorption to be determined. The used material is shown in Figure 1.

Fig. 1. Used material

The details of impact test support with drop weight is shown in Figure 2.

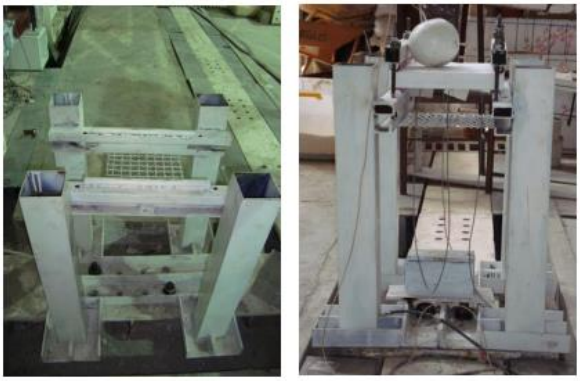

Fig. 2. Details of impact test support

3-Experimental Results

The results revealed a significant increase in effective parameters namely impact strength and energy absorption at tested specimens. In fact, the whole results demonstrate a good performance of concrete specimens reinforced with the above mentioned fibers. The strength and energy absorption of rectangular specimens were respectively increased by 54 and 200% when the PVA fiber percentage was twice. Final strength PVA specimen with 3% fiber was 87% higher than that of PP specimen with same fiber percentage. The impact strength of specimens reinforced with PVA fiber was three times that of same specimen reinforced with PP fiber as shown in Table 1.

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Table 1. The impact numbers on regular and fiber reinforced panels

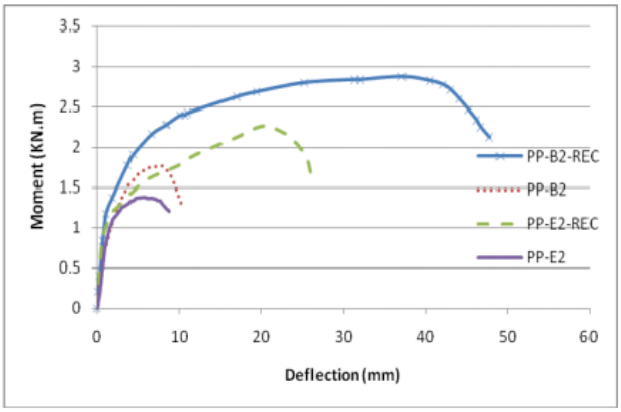
Design Number	Specimen Dimension(cm)	First cracking	Final crushing
		number	number
NC-C1.1	30*30*2.3	1	1
NC-C1.2	30*30*2.3	1	1
NC-C2.1	30*30*4	1	1
NC-C2.2	30*30*4	1	1
PP-B1.1	30*30*2.3	1	4
PP-B1.2	30*30*2.3	1	3
PP-B2.1	30*30*4	1	47
PP-B2.2	30*30*4	1	55
PVA-A1.1	30*30*2.3	1	4
PVA-A1.2	30*30*2.3	1	4
PVA-A2.1	30*30*4	17	156
PVA-A2.2	30*30*4	19	163

As show in Figure 3, the maximum moment tolerated by rectangular panels was higher than that of square shape panels. And also it is clear that increasing fiber percentage had the important role in improving of performance at concrete specimens reinforced with PP fibers.

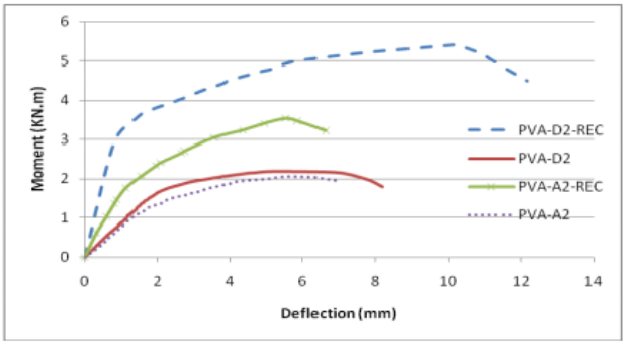
4- Conclusion

The compressive and flexural static plus impact tests were conducted on regular and also fiber reinforced concrete specimens and the following results were obtained:

- The load capacity and tensile and impact strengths of concrete slabs were significantly increased by adding PVA and PP fibers.
- The impact strength of specimens reinforced with PVA fiber was almost three times that of specimens with PP fibers.
- The strength and energy absorption of rectangular specimen reinforced with PVA were increased up to 54% and twice after increasing the fiber percentage up to 50%.
- The strain at maximum stress capacity and maximum collapse stain of fiber reinforced concrete cylinder specimens were increased up to 4 and 6 times after adding 2% fiber compared with regular concrete specimens.
- The maximum static load capacity of specimens reinforced with PVA fibers was higher that other specimen strengths indicating higher impact capacities of these specimens compared with the other specimens.



a. PP Fiber



b. PVA fiber

Fig. 3. Moment – Displacement curve of square and rectangular 4 cm thickness specimens reinforced with PP and PVA fibers