Behavior of Carbon Fiber Polymer Concrete

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Abstract

The properties of polymer concrete with and without carbon fiber were investigated using destructive and nondestructive testing techniques. Their performances were compared in terms of compressive strength, flexural strength, static modulus, dynamic modulus and damping ratio.

1. Introduction

Polymer concrete (PC) is formed by polymerizing a mixture of monomer and aggregates. High strength, chemical resistance, and ductility of polymer concrete make it an attractive material for construction and rehabilitation of civil infrastructure. And its properties can be improved greatly by adding fibers. There have been recent studies on glass, steel, polypropylene fibers in polymer concrete, but the effect of carbon fiber on polymer concrete has not been investigated. The purpose of this study is to compare the behavior of PC and PC reinforced with carbon fiber by using destructive and nondestructive tests.

2. Materials and Experiments

The constituents of polymer concrete were polyester resin (14%) and Ottawa blasting sand (86%). PC was reinforced with up to 6% carbon fiber. Compression tests were performed using a 400 kips capacity Tinius Olsen universal testing machine in load control mode, and flexural tests were performed using a 50,000 pounds capacity Instron testing machine in displacement mode. Pulse velocity and impact resonance test was performed according to ASTM C 597 and C 215, respectively.

3. Results and Discussion

3.1 Nondestructive Tests

3.1.1 Pulse Velocity Test

Carbon fiber decreased pulse velocity and dynamic modulus of polymer concrete.

3.1.2 Impact Resonance Test

A lower dynamic modulus obtained with fiber polymer concrete. The dynamic modulus from impact resonance test agreed well with the static modulus.

3.2 Destructive Tests

3.2.1 Uniaxial Compressive Test

Carbon fiber can improve the compressive strength of polymer concrete. A ductile failure mode was observed for fiber polymer concrete.

3.2.2 Flexural Test

Carbon fiber can increase the flexure strength of polymer concrete, and the change in mode of failure from a brittle failure to ductile failure was observed for carbon fiber polymer concrete.

4. CIGMAT Standards

CIGMAT standards for making polymer concrete and fiber polymer concrete were used.

5. Conclusions

Adding carbon fiber decreased the unit weight of polymer concrete. Carbon fiber provides much higher compressive strength, flexure strength and ductility of polymer concrete. Fiber addition decreased the dynamic modulus of elasticity of polymer concrete. The dynamic modulus of elasticity from pulse velocity and impact test agreed well with the static modulus.

6. Acknowledgement

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7. References

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