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BEHAVIOR AND ANALYSIS OF SELF COMPACTED CONCRETE DEEP BEAMS REINFORCED BY CFRP BARS

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ABSTRACT

The utilization of Fiber Reinforced Polymer, (FRP) in the construction fields has received a special attention in Egypt during the last decade. An experimental program was carried out to investigate the behavior of self compacted concrete deep beams reinforced by CFRP bars. The experimental program consists of three self-compacted reinforced concrete deep beam models that have a constant cross section of 10×50 cm and of a total length 120cm. These models were classified into two groups. The first group contains one control beam without opening. The second group contains two beams with opening. The failure loads and deflections at different loading stages as well as the crack propagation patterns for the tested beams were recorded. The main conclusions and recommendations for practical applications were introduced.

Keywords: CFRP rods, deep beams, self compacted concrete, shear strength.

INTRODUCTION

Current studies indicate that the use of advanced composites for structural application is expected to increase exponentially in the next decade [1]. The market growth will mainly stem from the increased need for repair / strengthening of deficient structures and for new infrastructure systems that last longer and cost less to maintain. [2]. FRP composites can be manufactured in many shapes and forms. Applications of FRP composites in civil/infrastructure engineering are diverse and may include internal reinforcement, structural elements, and externally bonded reinforcement. For concrete reinforcement, the most popular forms of FRP are smooth and deformed bars, prestressing tendons, and pre-cured and cured in place laminates shells. FRP bars and tendons are currently produced with sizes and deformation patterns similar to those of steel bars and strands. FRP composites are light in weight, which means they are easier to transport and install. They are corrosion resistant and there fore perform well in terms of long term durability and maintenance cost. FRP pre-cured and cured in place laminates shells and sheets are used for external concrete reinforcement and FRP shells have been used as jackets for columns. [1] The literature is currently available on RC deep beams behavior for traditional, high strength, and fiber concrete [2-5].

RESULTS AND CONCLUSIONS

Table 1 gives the test results for the ductility and the energy absorption for different self compacted reinforced concrete beams. In general, deflections of RC deep beams are small compared with shallow beams.

Table 1 - Results of cracking, ultimate loads, ratio of first bending, maximum deflection, reinforcement ratio, ductility and energy absorption of reinforced concrete deep beams.

Group	Specimen	Cracking Load, P_{Cr} (ton)	Ultimate Load, P_u (ton)	Ratio of first crack load to ultimate load	Max. Deflection (mm)	Ratio of reinforcement %	Ductility Ratio	Energy Absorption (mm . ton)
Group A	BC1	20.0	45	0.444	2.80	0.47%	2.22	63.0
	BC2	25.0	60	0.417	3.20	1.68%	2.93	96.0
Group B	BOC1	22.5	55	0.409	3.26	1.68%	3.22	89.6
	BOC2	20.0	45	0.444	3.35	0.47%	2.57	75.4
	BOC3	20.0	50	0.400	2.91	0.94%	2.85	72.8

Figure 1 shows the load rotation curves at end support for all reinforced concrete deep tested beams. It is noticed that the beams which have a higher percentage of reinforcement ratio recorded maximum values of rotations BC2 and BOC1.

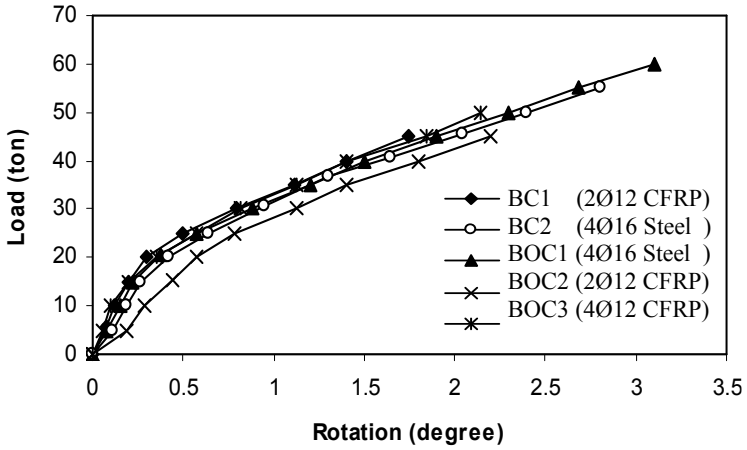

Fig. 1 - Load Rotation curves at end support of all tested beams

From the experimental investigation reported in this research, we can conclude that: Central openings with proper dimensions in deep beams have small effects wherever shear stresses dominant the failure. Using CFRP rods for reinforcement decrease the values of deflection at the mid span of RC deep beams.

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