ABSTRACT

This study examines the behavior of rectangular cross-section reactive powder concrete beams reinforced with carbon fiber reinforced polymers. The search included the flexural behavior and shear strength of these composite materials for both serviceability and ultimate limit states. Although no international codes are available for this composite type of beams, the mechanical properties of those materials (CFRP bars and RPC) were used after studying them in details for preparation of the theoretical equations.

The American concrete institute code considered as the main reference in design of rectangular cross –sections of normal concrete beams reinforced with FRP bars. Five international codes such as Japanese, American, French, Australian and Canadian codes were used for evaluation ultra high performance concrete used in this study.

The theoretical equation for predication the ultimate flexural strength of beams that prepared had taken into consideration two types of failure which are rupture of CFRP bars and concrete crushing. The Japanese code was adopted in the predication of shear strength equation with approximated tensile strength of steel fiber contribution.

Twelve specimens were cast to study the ultimate and service flexural strength for all three groups. Four beams with conventional steel rebars, four beams with smooth CFRP rebars and the last of four beams reinforced with sand –coated CFRP rebars. The dimensions of the beam are 2400×150×250 mm.

Eighteen specimens were cast for studying the shear behavior with dimensions 1500×150×150 mm. The main parameter are shear span to depth ratio, amount of main tensile reinforcement, existing of web reinforcement and its contribution on the shear capacity. The comparison between upper – bound of yield line theory with experiment result was carried out.

A study has been displayed the most important service attributes (SLS) for elements reinforced by the carbon fiber reinforced polymers and analyze the impact of limitation of stresses in materials, the cracking and allowable deflection. Then, provide the

effective moment of inertia equation based on the equation of the effective moment of inertia of the Federal Highway Administration Code.

The finite element models for flexural and shear beams has been prepared using commercial software of finite element analysis ANSYS 11. The study focused also on the representation of steel fiber which a major issue on the numerical results of the program. The comparsion between the experimental results and those by the program of deflections, ultimate flexural loads, ultimate shear and cracking loads were examined.

As well as it can be concluded that the strength reduction factors in American code (ACI-440.1R-06) and for different cases of the reinforcement cannot be used. Instead, the strength reduction factor of (Φ=0.9) gave a good results for calculation the flexural capacity of sand-coated CFRP beams.

In the case of shear strength, the use of the Japanese Code equation requires the provision of a safety factor of (1.3) when the steel reinforcement was used while the sand-coated CFRP reinforcement provided a strength reduction factor for shear of (Φ=0.75). The use of shear reinforcement in the same traditional way is considered safe in such a type of member because the stress generated in stirrups is less than their yielding stress. It is also found that the Yield line theory gives a shear strength equal of three times the shear strength for beam reinforced with steel bars and (4.5) for beams reinforced with sand-coated CFRP rebars.