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Retrofit of Concrete Members with CFRP Rod Panels (CRP 195)

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Abstract

Recently, a novel technique comprising small diameter carbon FRP (CFRP) rods arranged in a panel form (known as CRPs) has been developed and deployed. One of the technique's advantages is the segmental construction, achieved by using short-length rod panels made continuous via an overlap (or finger joint). In this study, four-point bending tests were performed to assess the effectiveness of the rod panel system in strengthening RC beams. The rod panel investigated here is called CRP 195 and is fabricated from CFRP rods with diameter of 4 mm (0.16 in.) and spacing between rods of 9.4 mm (0.4 in.). The tests include: a control beam; and three beams strengthened with one of the following reinforcements: continuous CRP 195; overlapped CRP 195; and overlapped CRP 195 anchored at ends with U-shaped FRP fabrics. Results showed that the capacity increase of strengthened specimens as compared to the control beam is as follows: 104% for the continuous CRP 195; 95% for the overlapped CRP 195; and 195% for the overlapped CRP 195 with end anchorage.

Keywords: concrete, rehabilitation, FRP, laminate, Rod panels, four-point bending.

1 Introduction

During the last few decades, externally bonded reinforcement (EBR), such as fiber reinforced polymer (FRP) composites, have gained wide attention and recognition in retrofit applications of concrete, steel, masonry, and timber structures [1-3]. This was helped by the development of strong bonding agents, in conjunction with a better understanding of the concepts governing the behaviour of bonded, dissimilar components, and the development of powerful numerical and analytical tools (e.g. finite element method) [4].

Prior to utilizing FRP material for strengthening and repair applications, the EBR system was implemented using adhesively bonded steel plates [5-7]. The technique was attractive at first because it offered many advantages, including cost-effectiveness, compared to conventional retrofit methods. These include: Small to negligible changes in the member's geometry, tangible increase in strengthened post-cracking stiffness, and reduction in deflections and cracks [8-10]. However, the technique has some disadvantages: (1) corrosion of steel material and deterioration of the steel/concrete bond interface; (2) welded plate splices under moisture or harsh environmental exposure; (3) difficulties in transportation and installation of the plates due to the relatively heavy weight of steel; and (4) high labour and equipment costs required for attaching the plates into the structural substrate [11-13]. Furthermore, the lack of flexibility of steel makes the technique extremely difficult in applications on curved or uneven surfaces [11].

Due to the FRP's excellent attributes of high strength and stiffness to weight ratio, resistance to corrosion, good fatigue performance, and ease of

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