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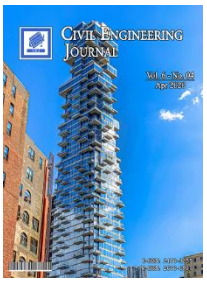

Experimental Study of Large-scale RC Beams Shear-Strengthened with Basalt FRP Sheets

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Abstract

Over the last three decades, many experimental studies have been conducted to investigate the behavior of Reinforced Concrete (RC) beams, shear strengthened with externally bonded Fiber-Reinforced Polymer (FRP) composite. However, the majority of experimental studies have focused on small- to medium-scale beam specimens. As a result, most design equations that have been developed as part of these studies may thus not be accurate at predicting the shear strength of large-scale RC beams shear-strengthened with FRP sheets. This study thus involved performing tests on six specimens to study the effect of the larger scale, along with new variables such as beam width, new varieties of FRP sheets (basalt FRP (BFRP)), and the strengthening configuration (U-jacketing), on the prediction of the ultimate load of RC beams strengthened with externally bonded FRP composite. The experimental results were analyzed and showed that all these variables affected the lateral strain along the bottom and the top of the beams. It was found that variations in the depth to width ratio of the beams caused the failure angle to vary as well. For beams strengthened with BFRP sheets, both the cracking and ultimate load increased to 1.19 and 1.94 times the cracking and ultimate load of the control beams under identical conditions.

Keywords: Large-scale RC Beams; BFRP Sheets; Shear Strengthened; Beam Width; Lateral Strain.

1. Introduction

The technique of applying various types of Fiber-Reinforced Polymer (FRP) sheets to strengthen concrete structures has become a well-recognized method, particularly for strengthening Reinforced Concrete (RC) beams. This is clearly shown by the development of design codes associated with the technique [1]. This technique is used to strengthen RC beams in the shear zone. However, studying the shear behavior of these RC beams is complicated because the mechanisms are complex making the prediction of the shear strength and behavior of these beams difficult. For this reason, in the last three decades, many experimental and numerical studies have been conducted on RC beams strengthened with externally bonded FRP sheets to provide data through which design equations and models can be developed that can predict shear force as accurately as possible [1-3].

Some previous research has taken into account the effect of debonding between the concrete surface and the FRP in suggesting models [4-6]. Several models have also been proposed based on an analytical study carried out on many experimental and numerical tests to provide a database through which to verify the accuracy of the models [7-9]. Because the RC beams in the resistance to shear are complex, therefore many researchers have focused on studying the behavior of RC beams in the shear zone [10-12]. Also from the useful and new properties of basalt BFRP, many

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