Behaviour of RC Beams with Openings Strengthened by Externally Bonded Carbon Fiber Reinforced Polymer (CFRP)

Siew Choo Chin[a], Prof. Nasir Shafiq[b] and Prof. Muhd Fadhil Nuruddin[b]

[a]Universiti Malaysia Pahang Faculty of Civil Engineering & Earth Resources, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia

[b]Universiti Teknologi PETRONAS, Department of Civil Engineering, Faculty of Engineering, Bandar Seri Iskandar, 31750 Tronoh, Perak, Malaysia

ABSTRACT

A detailed investigation was conducted to study the behaviour of reinforced concrete (RC) beams with large openings strengthened by externally bonded carbon fiber reinforced polymer (CFRP) laminates. A total of six simply-supported beams consisting of two solid beams and four beams with openings were constructed and tested under four-point bending. Each beam had a cross-section of 120 × 300 mm and length of 2000 mm. A large opening was placed symmetrically in the mid-span of the beams. Test parameters included the opening shape and size as well as the strengthening configuration of CFRP laminates. The study was conducted in both experimental testing and finite element analysis. Experimental results show that provision of a large opening at mid-span reduces the beam capacity to about 50%. Strength gain due to strengthening using CFRP laminate in the experimental results obtained was in the range of 80–90%. Comparison between the finite element and experimental results were performed.

KEYWORDS: large opening; strengthening; cfrp; reinforced concrete beam

DOI: 10.1002/suco.201400111