STRENGHTENING OF RC BEAMS WITH BAMBOO FIBER REINFORCED COMPOSITE- POLYESTER PLATE

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ABSTRACT

The biodegradability of the natural fibers provides safe and environmental-friendly features toward the ecosystem, with the low cost and good performance of these fibers, it meets the demand of the industries. Bamboo is a massive natural resources in Asia and high mechanical strength of bamboo fiber can be characterised as natural glass fiber. This study presents the findings of an experimental study to investigate the beam performance and the failure modes of reinforced concrete (RC) beams under un-strengthened and strengthening condition using bamboo fiber reinforced composite (BFRC) embedded in polyester resin matrix. Circular openings of diameter 120 mm created at the shear zone were considered for strengthening under shear condition. The experimental work including physical, thermal and mechanical properties of the BFRC-polyester plate were conducted such as Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), tensile test (ASTM D3039) and flexural test (ASTM D790-03). In terms of structural properties, a total of six beams were tested under four-point loading. The variables investigated in this research study included the fiber volume ratio of BFRC-polyester plate (0 wt %, 10 wt %, 20 wt %, 30 wt % and 40 wt %) and strengthened beams (with and without circular opening). Results from the mechanical testing shows that the fiber volume ratio of 40 wt % is found to be the optimum fiber volume loading. Strengthening of RC beams under flexure behaviour shows that BFRC-polyester plate has improved the load-carrying capacity of beam by only 7.3 % in which the effect is not significant. Meanwhile, strengthening of RC beams with BFRC polyester in the shear zone of beam, BFRC-polyester plate was able to restore the ultimate load by 66 % of the un-strengthened openings beam. Crack pattern and failure mode were found to be different between the strengthened and un-strengthened beam.

ABSTRAK

Kos yang rendah, prestasi baik dan sifat biodegradability daripada serat semula jadi menyediakan ciri-ciri yang sihat and mesra alam sekitar menunjuk ke arah ekosistem dan memenuhi permintaan industri. Buluh merupakan sumber alam yang pantas membesar di Asia and kekuantan mekanikal yang tinggi dicirikan sebagai serat kaca semula jadi. Kajian ini membentangkan tentang kajian eksperimen untuk menentukan prestasi ricih dan mod kegagalan rasuk konkrit bertetulang (RC) dengan lubang bulat dan luaran diperkuatkan dengan plat Bamboo Fiber Reinforced Composite (BFRC) yang tertanam dalam resin polyester. Untuk mengaji ciri-ciri plat BFRC dari segi fizikal, haba dan mekanikal, beberapa kerja-kerja ujian telah dijalankan seperti Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), ujian tegangan (ASTM D3039) dan ujian lenturan (ASTM D790-03). Sebanyak enam konkrit rasuk telah diuji melalui ujian empat titik beban untuk menentukan kelakuan rasuk RC yang diperkukuhkan oleh plat BFRC. Pembolehubah yang termasuk dalam kajian penyelidikan ini seperti jumlah serat muatan dalam plat BFRC (0 wt %, 10 wt %, 20 wt %, 30 wt % dan 40 wt %) dan kelakuan rasuk dengan dan tanpa lubang bulat. 40 % jumlah serat muatan dalam plat BFRC didapati merupakan jumlah serat muatan yang paling optimum daripada ujian mekanikal yang dijalankan. Dalam ujian empat titik beban untuk rasuk tanpa lubang bulat, plat BFRC telah meningkatkan hanya 7.3 % keupayaan tanggungan beban rasuk yang kesannya tidak menonjol. Manakala untuk rasuk dengan lubang bulat, plat BFRC telah berjaya memulihkan beban muktamad rasuk sebanyak 66 %. Selain itu, corak retak and mod kegagalan bagi rasuk yang diperkukuhkan dengan plat BFRC juga didapati berbeza dengan rasuk yang tanpa penggunaan plat BFRC.