FINITE ELEMENT ANALYSIS OF RC BEAMS WITH BAMBOO FIBER REINFORCED COMPOSITE PLATE USING ABAQUS

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ABSTRAK

Kajian ini bertujuan untuk mengkaji sifat rasuk konkrit bertetulang dengan dan tanpa bukaan, rasuk yang tidak diperkukuhkan serta rasuk pengukuhan luaran dengan menggunakan Plat Serat Buluh Perkukuhan Komposit (BFRCP) di zon lenturan dan ricih. Objektif kajian ini adalah untuk menentukan sifat rasuk RC pepejal dan RC rasuk dengan bukaan dari segi beban-pesongan dan retak corak dalam analisis unsur terhingga serta kesan pengukuhan selepas menggunakan plat serat buluh diperkukuh dengan poliester dan vinil ester masing-masing dalam lenturan dan zon ricih. Akhir sekali, keputusan analisis unsur terhingga akan disahkan dengan yang keputusan eksperimen. Sebanyak sembilan rasuk dengan dimensi 120 x 300 x 1500 telah dimodelkan sebagai rasuk mudah disokong dalam analisis tiga dimensi menggunakan ABAQUS 6.14. Dalam kajian ini, dua bukaan bulat yang mempunyai diameter 120 mm terletak di zon ricih rasuk. Bar tetulang yang dimodelkan adalah dua bar 10 mm diameter untuk kedua-dua bahagian atas dan bawah serta stirrups yang diameter 6 mm dengan jarak 100 mm antara satu sama lain. Dalam analisis unsur terhingga, beban muktamad bagi rasuk kawalan adalah 247.5 kN, dengan pengurangan sebanyak 14.4 % apabila pautan ricih dalam zon lenturan telah dikeluarkan. Selain itu, terdapat pengurangan sebanyak 64.8 % apabila bukaan telah dihasilkan pada rasuk. Dari segi pengukuhan luaran dengan BFRCP, ia telah didapati bahawa terdapat permulihan sebanyak 4.6 % dan 3.5 % apabila menggunakan BFRCP diperkukuhkan dengan polyester dan vinil ester masing-masing. Di samping itu, apabila plat komposit yang ditambah panjang telah digunakan, terdapat peningkatan sebanyak 8.7 % dan 6.1 % masing-masing. Bagi rasuk dengan bukaan, kapasiti beban telah meningkat sebanyak 52.6 % dan 52.1 % selepas pengukuhan luaran telah disimulasikan dengan menggunakan resin poliester dan vinil ester masing-masing. Pengesahan dengan keputusan eksperimen menggunakan analisis unsur terhingga menunjukkan keputusan yang kurang bersetuju, walaubagaimanapun, corak retak menunjukkan perjanjian yang baik antara keputusan analisis unsur terhingga dan keputusan eksperimen.

ABSTRACT

This research aims to investigate the behavior of reinforced concrete beams with and without openings, un-strengthened beams and beams strengthened using Bamboo Fiber Reinforced Composite Plate (BFRCP) externally at the flexural and shear zones. The objectives of this research was to determine the behavior of solid RC beams and RC beams with openings in terms of load-deflection and crack pattern in finite element analysis as well as the effect of strengthening after using bamboo fiber plate reinforced with polyester and vinyl ester in bending and shear zone. Lastly, the finite element analysis results were validated with the experimental results. A total of nine beams with a dimension of 120 x 300 mm and a length of 1500 mm were modelled as simple-supported beams in a three dimensional analysis using ABAQUS 6.14. In this research, two circular openings having diameter of 120 mm were located at the shear zone of the beams. The reinforcement bars were modelled as 10 mm diameter bars for both top and bottom reinforcement as well as 6 mm diameter stirrups with spacing of 100 mm center to center. From the finite element analysis results, the ultimate load for control beams was 247.5 kN, with a reduction of 14.4 % when shear links in the flexural zone were removed. On the other hand, a reduction of 64.8 % when openings were created in the beams. In terms of external strengthening with BFRCP, it was found that there was a regain of 4.6 % and 3.5 % when using BFRCP reinforced with polyester and vinyl ester, respectively. In addition, when an additional length of the composite plate was used, there was an increment of 8.7 % and 6.1 %, respectively. As for beams with openings, the load capacity had increased 52.6 % and 52.1 % after the external strengthening was simulated using polyester and vinyl ester resins, respectively. The validation with experimental results using finite element analysis showed a less than agreeable results, however, the crack patterns showed good agreement between the results of finite element analysis and experimental results.