BEHAVIOUR OF CONCRETE BEAMS REINFORCED JUTE FIBER MAT

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ABSTRAK

Dalam tahun-tahun kebelakangan ini, potensi kegunaan jut sebagai penggantian tetulang dalam konkrit bertetulang telah menarikan perhatian penyelidik, jurutera dan saintis. Penggunaan polimer bertetulang gentian (FRP) sebagai bahan tetulang semakin popular kerana kekuatan mekanikal dan kemurahan kos. Laporan kajian ini adalah mengenai sifat-sifat mekanik jut fiber mat (JFM) serta kelakuan JFM sebagai tetulang keluli dalam rasuk konkrit bertetulang. Gentian jut telah dirawat dengan 5% (w/v) natrium hidroksida, NaOH dalam suhu bilik dengan tempoh 4 jam. Ujian gentian tunggal telah dijalankan untuk mengkaji perbezaan antara dirawat dan tidak dirawat gentian jut dari segi kekuatan tegangan ekapaksi dan pemanjangan. Serat jut yang dirawat telah digunakan dalam fabrikasi JFM dengan kandungan serat yang berbeza 15%, 20%, 25% dan 30%. Semua sampel JFM telah menjalani ujian tegangan dan ujian lenturan denagan menggunakan mesin ujian universal (UTM) untuk menentukan nisbah isipadu gentian optimum. Sebanyak enam (6) sampel rasuk konkrit dengan kekuatan mampatan 25 MPa telah diuji dengan tiga mata loading. Keenam-enam sampel tersebut terdiri daripada dua rasuk kawakan (CB), dua rasuk konkrit bertetulang JFM (JFMB) dan dua rasuk yang diperkuatkan dengan dua keluli dengan diameter 10 mm JFM bertetulang (SB). Rasuk dalam kajian ini mempunyai keratan rentas 100 mm di kedua-dua lebar dan kedalaman serta jumlah panjang 500 mm. Kekuatan tegangan maksimum jut yang dirawat dengan larutan natrium hidroksida didapati meningkat sebanyak 71.3%, manakala pemanjangan pada beban berbuka menurun sebanyak 44.3%. Dari segi sifat-sifat mekanik, JFM dengan 25% kandungan serat menunjukkan bahawa kekuatan tegangan maksimum tertinggi 73.2 MPa, manakala 15% kandungan serat mempunyai kekuatan lenturan yang paling tinggi 75.2 MPa. JFM dengan 25% kandungan serat dianggap sebagai jumlah serat yang optimum dan digunakan sebagai mat tetulang dalam kajian ini. Dari ujian tiga mata loading, JFMB berjaya mengekalkan beban muktamad 10.60 kN dengan pesongan 0.6 mm. Walaupun, kapasiti beban rasuk JFMB adalah 26.34% lebih tinggi daripada rasuk CB tetapi hanya mencapai 28.7% kekuatan rasuk SB. Rasuk JFM telah gagal dengan cara yang rapuh di bawah lentur dengan retak menegak dalam zon ketegangan.

ABSTRACT

Jute fiber has recently become attractive to researchers, engineers and scientists as a potential to be a substitute reinforcement in reinforced concrete. The use of the jute fiber fabric and fiber reinforced polymer (FRP) as the reinforcement materials has gained popularity due to their mechanical strength and inexpensive cost. This research presents a study of the mechanical properties of Jute fibre mat (JFM) as well as the behaviour of the JFM-reinforced concrete beam. Jute fibres were chemically treated with the 5% (w/v) sodium hydroxide, NaOH over 4 hours duration at room temperature, thus the single fiber test was conducted to study the differences between treated and untreated fiber filament in term of uniaxial tensile strength and the elongation. Subsequently, the treated jute fiber was used in the fabrication of the JFM with a different fibre volume ratio of 15%, 20%, 25% and 30%. All the JFM samples were undergone the tensile and flexural test by using the Universal Testing Machine (UTM) to determine the optimum fibre volume ratio. In terms of structural properties, a total of six (6) concrete beams with compressive strength of 25 MPa were tested to failure under three-point loading, which includes two control beams (CB), two JFM reinforced beams (JFMB) and two beams that reinforced by two steel bars with a diameter of 10 mm (SB). The beam had a cross section of 100 mm in both width and depth as well as a total length of 500 mm. By comparing with the untreated fiber, the maximum tensile strength of treated jute fiber with sodium hydroxide solution was found to increase by 71.3%, whereas the elongation at break decreased by 44.3%. In terms of mechanical properties, the JFM with 25% fibre content showed the highest maximum tensile strength of 73.2 MPa, while the 15% of fibre content has the highest flexural strength of 75.2 MPa. JFM with 25% fibre content was considered as the optimum fibre volume and used as the reinforcement mat in this research. From the three-point loading test result, the JFM reinforced concrete beams (JFMB) manage to sustain the ultimate load of 10.60 kN with the deflection of 0.6 mm. Although, the load capacity of beams JFMB is 26.34% higher than the beams CB, only achieves 28.7% strength of beams SB. The JFM beams was failed in a brittle manner under bending with a vertical crack in the tension zone.