IMPACT RESISTANCE OF FOAMED CONCRETE SLAB AND ITS MODIFICATIONS SUBJECTED TO HEMISPHERICAL IMPACTOR

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In the name of Allah, the most gracious and most merciful.
This thesis I dedicated for my beloved,

Fetra, my wife who always patient and gives me the support
Athhar and Fatharani my children who always give me support with
their happiness and cheerfulness

In memory, my beloved parent, RA. Siti Roniyun and Wignya Widjaya

My parent in law, Zamanhuri and Risnidar

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ABSTRACT

This research work examined the interplay between three main methods: experimental works, analytical model and numerical simulation. The three methods employed slabs of foamed concrete and its modifications. The modifications of foamed concrete included foamed concrete substituting sand with Rice Husk Ash (RHA) and foamed concrete reinforced by Polypropylene fibre (PF). Experimental work produced properties data of density, compressive strength, tensile strength, modulus of elasticity and Poisson’s ratio of slab specimens. The experiment of impact was conducted by using falling-weight impact tower method to get the depth of penetration data. The depth of crater as product of impact is called penetration depth. The basic properties of materials were used to run the numerical simulation and analytical model. The simulation applied the FE/DE method, whilst the analytical model was conducted by applying various theories and all its support from previous researchers both in empirical and non-empirical. The slab target subjected to hemispherical impactor with 7.7, 8.9 and 9.9 m/s impact velocity produced the crater without spalling or scabbing. This impact phenomenon was due to effect of porosity in matrix of foamed concrete and its modifications as foam material. Foamed concrete modifications were stronger than foamed concrete, which gave the shallower penetration depth than penetration depth of foamed concrete. Resistance of slab specimens subjected to impact loading can be predicted by its penetration depth. It can be determined by the assumption, when impactor hit the slab target, the diameter of impactor shank entirely into target due to porosity. The dimensional of penetration depth was derived when the impactor had kinetic energy and target initiate gave a reaction by its compressive strength against the force of impact. The dimensional penetration depth can be used as a formula to predict penetration depth of foamed concrete and its modification slabs subjected to hemispherical impact loading. The numerical simulation results were validated by the experimental results. Those three of analyses methods showed a tendency the same results for penetration depth.

ABSTRAK

Kajian ini dijalankan bagi mengkaji pengaruh antara tiga analisis utama: kerja-kerja kajian makmal, model analitik dan simulasi berangka. Perubahsuaian konkrit berbusa termasuklah konkrit berbusa dengan mengganti pasir dengan Abu Sekam Padi (RHA) dan konkrit berbusa diperkuat oleh Fiber Polipropelin (PF). Pengubahsuaian terhadap konkrit berbusa ini melibatkan tiga kaedah analisis. Kajian makmal menghasilkan sifat-sifat ketumpatan, kekuatan mampatan, kekuatan lenturan, modulus elastik dan nisbah Poisson konkrit berbusa dan pengubahsuaiannya. Ujikaji hentaman dilakukan dengan menggunakan kaedah berat jatuhan menara hentaman untuk mendapatkan data kedalaman penembusan. Sifat-sifat asas bahan digunakan bagi menjalankan simulasi berangka and model analitik. Simulasi tersebut mengaplikasikan kaedah FE/DE bagi teknik analisis untuk simulasi hentaman. Model analitik dilakukan dengan menggunakan pendekatan analisis pelbagai teori dan kesemuanya disokong oleh penyelidik-penyelidik terdahulu sama ada empirical atau bukan empirical. Hentaman terhadap konkrit berbusa dan pengubahsuaian oleh penghentak hemisfera dengan kelajuan hentaman 7.7, 8.9 dan 9.9 m/s menghasilkan kawah tanpa ‘spalling’ atau ‘scabbing’. Fenomena kesan hentaman disebabkan oleh keliangan konkrit berbusa. Perubahsuaian konkrit berbusa lebih kuat daripada konkrit berbusa dimana konkrit perubahsuaian mempunyai penembusan lebih dangkal daripada konkrit berbusa. Rintangan konkrit berbusa terhadap beban hentaman boleh diramalkan melalui penembusannya. Kedalaman kawah hasil hentaman dipanggil sebagai kedalaman penembusan. Ianya boleh ditentukan dengan anggapan apabila penghentak mengenai konkrit berbusa, keseluruhan diameter penghentak memasuki sasaran disebabkan oleh keliangan. Dimensi kedalaman penembusan diperolehi apabila penghentak mempunyai tenaga kinetik untuk menghentam sasaran dan konkrit berbusa memberi tindakbalas melalui kekuatan mampatannya bagi melawan daya yang dikenakan. Dimensi kedalaman penembusan boleh digunakan sebagai formula bagi meramalkan kedalaman penembusan konkrit berbusa dan pengubahsuaian oleh beban hentaman hemispera. Hasil simulasi berangka disahkan oleh hasil kajian makmal. Ketiga kaedah analisis menunjukkan kecenderungan mendapat keputusan yang sama bagi kedalaman penembusan.

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