

**DEVELOPMENT OF BLENDED CEMENTS FOR WATER
PROOFING APPLICATION**

**(MEMBANGUNKAN SIMEN TERUBAHSUAI UNTUK KEGUNAAN
SIMEN KALIS AIR)**

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ABSTRACT

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The application of mineral admixtures as partial cement replacement in concrete leads to a reduction in construction cost. Usually single mixture has limitation and some have contrasting influences on properties of concrete. The combination of more kinds of mineral admixtures is postulated to improve concrete properties. Since RHA is highly reactive pozzolan, it has led to the idea of focusing the study on the performance of Multi-blended pozzolan as partial cement replacement in mortar. Over 8 different mixes were produced in which four mixes contained varying percentages of admixtures (Multi Blended Cement, MBC) and the remainders were single mix (Binary Blended Cement, BBC) containing optimum percentages (based on literature study) of 20% PFA, 20% RHA, 50% SLAG, and 10% POFA. Three samples for each mix, curing period and parameter tests were prepared. This work initially deals with compressive strength characteristics, water absorption, and total porosity on mortar cured (standard curing) for 7, 28, 60 and 90 days. The performance of optimum MBC mortar was studied in terms of ultimate compressive strength, water absorption and total porosity. The strength properties of the optimum mixes of MBC mortars was also examined at different curing regimes. This research also focuses on studying some durability aspects of the optimum mix of MBC mortars namely acid attack, and carbonation. Besides, the effects of saline seawater were investigated for short term exposure. Finally attempt in brief study on suitability of the optimum mixes of MBC mortars as face sheets to produce lightweight non-load bearing sandwich block was conducted. From the results obtained, it was found that the strength of control and BBC mortars at early age on average were 20% higher than MBC mortars, and at final age both were comparable with MBC mortars. The strength of all mortars at 90 days on average was 59MPa. However, the MBC system produced low permeability mortar compared to control, and BBC mortars at all ages. The total porosity and water absorption of control and BBC were 28% and 21%, and 9% and 14%, respectively. The strength of MBC mortar after 45 cycles of wet and dry curing in seawater exhibited 24% higher than control mortar. The initial water curing for 7 and 14 days and continuous air curing also exhibited 13% and 19%, and 21% and 26%, higher early strength than

continuous water and air curing, respectively. The strength and durability properties of MBC mortar are more pronounced than control when it is provided with adequate curing. After exposure to chemical attack, the MBC mortar exhibits better resistance than control mortar. With adequate curing the MBC mortar was higher in durability than control mortar when subjected to chemical attack.

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ABSTRAK

Prestasi mortar berasaskan pelbagai bahan tambah mineral dan sisa industri sebagai bahan gantian separa simen merupakan fokus utama dalam kajian ini. Dalam kajian ini, terdapat 8 jenis campuran bahan tambah (terdiri daripada beberapa peratus campuran) untuk dibandingkan prestasinya dengan mortar yang mengandungi 100 peratus simen (mortar kawalan). Empat campuran daripadanya terdiri daripada pelbagai peratus campuran bahan tambah dengan simen (pelbagai bahan tambah, PBT). Manakala empat jenis campuran lagi adalah campuran simen dengan satu jenis bahan tambah (satu bahan tambah, SBT), di mana peratus kandungan PFA, RHA, SLAG dan POFA yang optimum digunakan dalam kajian ini (berdasarkan kajian ilmiah terdahulu). Bahan buangan ini adalah diperolehi dari sumber tempatan. Pada peringkat awalnya, kajian ini menumpukan kepada ciri-ciri kekuatan bahan, kadar penyerapan air dan jumlah peratus keliangan sesuatu campuran mortar. Mortar diawet dengan air selama 7, 28, 60 dan 90 hari dan diuji bagi mendapatkan campuran PBT yang optimum. Mortar PBT juga diuji kekuatannya dengan pelbagai jenis pengawetan. Kajian juga mengambilkira aspek kebolehtahanlasakan mortar PBT seperti serangan asid, pengkarbonatan, dan kesan terhadap air laut (perubahan tercepat) pada tempoh dedahan yang singkat. Kajian secara umum kesesuaian penggunaan mortar PBT sebagai lapisan yang mengapit blok ringan juga dikaji. Hasil daripada keputusan ujikaji, kekuatan mortar SBT dan kawalan adalah lebih tinggi dari mortar PBT pada awal umur, tetapi kekuatan semua mortar adalah setara pada peringkat akhir umur. Namun, mortar PBT menghasilkan peratus kadar penyerapan air dan jumlah keliangan yang lebih rendah berbanding mortar SBT dan kawalan. Mortar PBT menghasilkan kebolehtahanlasakan yang tinggi sekiranya diawet dengan sempurna. Mortar PBT yang diawet dengan permulaan 7 atau 14 hari di dalam air dan kemudian di udara menghasilkan kekuatan mortar yang tinggi pada awal umur berbanding dengan awetan secara terus di dalam air mahupun udara. Blok konkrit ringan berudara terapit dengan lapisan mortar PBT lebih berprestasi berbanding dengan blok sediada di pasaran dan blok konkrit ringan berudara.

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