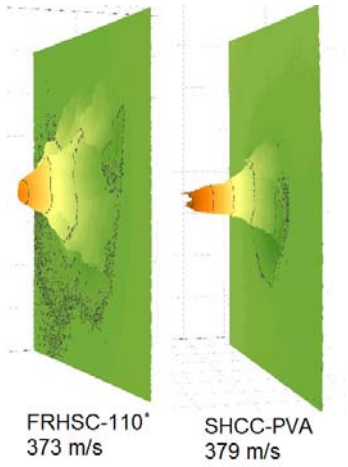
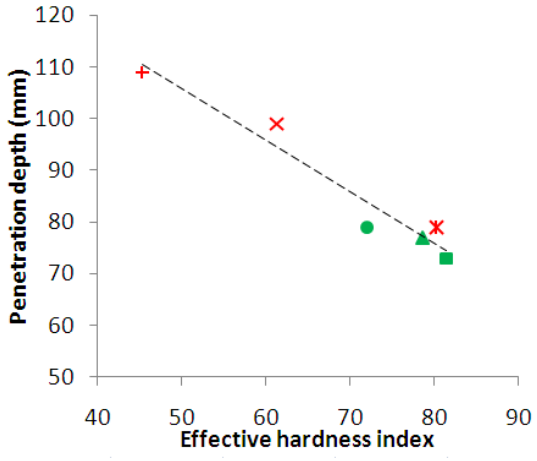
Resistance of High Performance Fiber-Reinforced Cement Composites against High-Velocity Projectile Impact

Resistance of fiber-reinforced cement composites with compressive strengths from 60 to 140 MPa against high-velocity projectile impact is investigated to provide guidance on the selection of materials for protective structures. Seven composites including two strain-hardening cement composites (SHCCs), four fiber-reinforced high-strength concretes (FRHSCs), and one fiber-reinforced high strength mortar (FRHSM) are evaluated. Ogive-nose shaped projectiles, with a diameter of 28 mm and weight of about 250 g, are used for tests with impact velocities of about 400 and 600 m/s. Numerical study is also conducted to simulate the localized damage of the SHCC and FRHSC specimens using a finite element software LS-DYNA.

Experimental results indicate that higher compressive strength and greater toughness of cement-based composites, as well as the presence of strong coarse aggregate and fibers, contribute positively to the impact resistance of composites. In addition, it was found that the penetration depth of the composites subjected to high-velocity projectile impact is reduced with an increase in the "effective hardness index" calculated based on the hardness and proportion of the coarse aggregate and mortar matrix. Numerical simulation results indicate that it takes a longer time to stop the projectile traveling at the same initial velocity in the SHCC specimen than in the FRHSC specimen due to the absence of hard and strong coarse aggregate in the former.



Digitalized images of crater on SHCC and FRHSC specimens



Influence of "effective hardness index" on the penetration depth in the specimens (impact velocity ~400 m/s)

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