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Penetration Resistance of Ultra-High-Strength Concrete Protected with Layers of High-Toughness and Lightweight Energy Absorption Materials

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Abstract: Aluminium foam has advantages of excellent shock absorption, cyclic utilization, and lightweight. Ultra-high-molecular-weight polyethylene (UHMWPE) fibre has a low density, a high specific strength, a high modulus and a great capability in energy absorption. Steel wire mesh has high toughness and elongation properties and has a good effect on energy-absorption. In the present study, UHMWPE fibre, steel wire mesh and aluminium foam were used to protect ultra-high-strength concrete (UHSC) targets to resist DT300 high-strength alloy-steel projectile penetration with striking velocities from 550 m/s to 800 m/s. High-speed impact tests on normal-strength concrete were also conducted for comparison. Testing results including failure mode, depth of penetration (DOP), crater dimensions and damage area of protected concrete, indicate that the new composite material protective cover has an outstanding performance in shock wave absorption, especially in reducing crack propagation and debris spatter of protected ultra-high-strength concrete, as well as increasing the deviation angles of projectile terminal ballistic trajectory. It is a successful demonstration of anti-penetration properties research for new concrete composite structures.

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