UHPFRC APPLICATIONS FOR MODULAR WALL OF HARDENED BUNKER SYSTEM

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ABSTRACT

The recent conflict between Armenia and Azerbaijan over the Nagorno-Karabakh region and the more recent Russia-Ukrain conflict has shown the world a glimpse of ever-evolving modern warfare. Azerbaijan's well-organized 21st-century fighting force displayed a large fleet of drones. Similarly, the weapons systems' advances are also evident from the Russia and Ukraine conflict. While the advancements in weapon systems, electronics and telecommunication have witnessed exponential growth, research on advanced materials for protective structures is limited. Concrete and steel remain the most widely used material for infrastructure; however, they offer limited protection during and after construction. Ultra-high performance concrete (UHPC) has excellent potential to improve defensive structures' resistance to extreme load effects from impact and blast events. In addition, lightweight modular panels may allow easier handling and faster deployment. This paper presents a study on the protection level offered by UHPFRC modular wall against ballistic impact and blast loads. Experimental tests were conducted on UHPFRC panels of varying thicknesses subjected to ballistic impacts. Furthermore, interlocking UHPFRC modular units were used to construct concrete masonry unit (CMU) walls with different specifications and subjected to hemispherical blast loading. The study shows that 75-mm thick UHPFRC panels performed better than the NSC panels and were able to resist multiple impacts. A numerical model was developed on LS-DYNA, and an empirical equation has been presented to predict a projectile's penetration depth in a UHPFRC panel. The efficacy of interlocking patterns, joint mortar material and carbon fibre-reinforced polymer (CFRP) composite wrapping in CMU walls against blast loads were also investigated experimentally. The provision of epoxy joint mortar material and CFRP wrapping of the distal face improved the CMU wall's blast response compared to the benchmark wall.