

Ballistic Performance of Magnesia Panels and Modular Wall Systems

Authors : Khin Thandar Soe, Mark Stephen Pulham

Abstract : Ballistic building materials play a crucial role in ensuring the safety of the occupants within protective structures. Traditional options like Ordinary Portland Cement (OPC)-based walls, including reinforced concrete walls, precast concrete walls, masonry walls, and concrete blocks, are frequently employed for ballistic protection, but they have several drawbacks such as being thick, heavy, costly, and challenging to construct. On the other hand, glass and composite materials offer lightweight and easier construction alternatives, but they come with a high price tag. There has been no reported test data on magnesium-based ballistic wall panels or modular wall systems so far. This paper presents groundbreaking small arms test data related to the development of the world's first magnesia cement ballistic wall panels and modular wall system. Non-hydraulic magnesia cement exhibits several superior properties, such as lighter weight, flexibility, acoustics, and fire performance, compared to the traditional Portland Cement. However, magnesia cement is hydrophilic and may degrade in prolonged contact with water. In this research, modified magnesia cement for water resistant and durability from UBIQ Technology is applied. The specimens are made of a modified magnesia cement formula and prepared in the Laboratory of UBIQ Technology Pty Ltd. The specimens vary in thickness, and the tests cover various small arms threats in compliance with standards AS/NZS2343 and UL752 and are performed up to the maximum threat level of Classification R2 (NATO) and UL-Level 8(NATO) by the Accredited Test Centre, BMT (Ballistic and Mechanical Testing, VIC, Australia). In addition, the results of the test conducted on the specimens subjected to the small 12mm diameter steel ball projectile impact generated by a gas gun are also presented and discussed in this paper. Gas gun tests were performed in UNSW@ADFA, Canberra, Australia. The tested results of the magnesia panels and wall systems are compared with one of concrete and other wall panels documented in the literature. The conclusion drawn is that magnesia panels and wall systems exhibit several advantages over traditional OPC-based wall systems, and they include being lighter, thinner, and easier to construct, all while providing equivalent protection against threats. This makes magnesia cement-based materials a compelling choice of application where efficiency and performance are critical to create a protective environment.

Keywords : ballistics, small arms, gas gun, projectile, impact, wall panels, modular, magnesia cement

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