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Executive Summary

Purpose

According to Eve Hinman, “hardening structures against weapon effects has been, until recently, of concern almost exclusively of the military. However, with the increase of terrorist activities directed against civilian targets, there is a growing interest in applying these principles to the design of non-military structures.” The Monongalia General Hospital has decided to research and integrate higher levels of structural safety against blast and progressive collapse due to accidents or terrorist attacks to ensure that catastrophic events due to blast and collapse can be prevented to the greatest extent possible. This thesis will study different blast, collapse, and design scenarios and compare the results to choose the most effective approach to mitigating such events.

Building Description

The Monongalia General Hospital is a 405,994 square feet hospital located in Morgantown, West Virginia. The building project includes a 280,000 square feet addition as well as a 60,000 square feet renovation to the existing structure. The building envelope is a brick façade tied to structural concrete walls with openings for punch windows and curtain wall systems. Aluminum curtain wall systems can be seen all around the Hospital, oriented around lobbies and other major openings on plan. The system consists of insulated tempered spandrel glass framed by aluminum mullions which is tied into the concrete structural system. The main structural system of the Hospital consists of two-way flat slab supported by columns that follow a typical grid and edge beams located in the perimeter of each floor. The loads carried by the columns are transferred to the foundations. The lateral loads are resisted by twelve shear walls of varying height and width located in three portions of the building.

Blast and Progressive Collapse Analysis

Various design methods and approaches have been conducted to test the adequacy of the Monongalia General Hospital’s structural system against blast and progressive collapse scenarios. Through the analyses, two viable design methods were compared in terms of structural integrity, cost, and its effects to the schedule proposed by the construction manager. Through further investigation of the two design methods, the Monongalia General Hospital’s existing conditions with slight changes to the reinforcement in the concrete has proved to be adequate to resist a progressive collapse scenario induced by a blast event.

Alongside the structural analysis and design, other elements such as the curtain walls have also been analyzed against blast loads and the necessary design changes have been investigated. The investigation yielded two alternatives which are both more than adequate to resist the blast loading found by following the procedure on ASTM E1300-04. The alternatives were also analyzed in terms of conductive properties as well as the cost to implement the design on the Hospital.

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