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Extending Building Façade Performance Requirements for Blast: Hazard and Injury Assessment Investigations

Kirk A. Marchand, Carrie E. Davis, Edward J. Conrath and Michalis Hadjioannou

Protection Engineering Consultants, TX, USA

William R. Earl

United States General Services Administration, Greater Southwest Region, Ft Worth, TX, USA

Contact: kmarchand@protection-consultants.com

Abstract

Existing criteria for protection of occupants in government owned and/or occupied facilities in the US is largely based on estimates of damage limits for conventional façade structures and materials such as concrete, brick and concrete masonry, and glass. These damage limits are commonly based on extent of damage as a function of lateral deformation or ductility and the extent to which that deformation requires subsequent repairs or allows re-use. This approach works well for new construction where modest strength and mass increases can provide sufficient capacity at minimal cost so as to not exceed deformation limits. For existing buildings and historic facades, the approach can be onerous and inefficient, since retrofits to large sections of the façade may be required.

This paper describes initial efforts to define blast performance requirements for existing buildings in terms of occupant hazard based on injury potential rather than on deformation limits. Existing injury data and simplified façade failure and debris kinematics and analytics are used to relate applied blast load to actual occupant hazards. The approach provides information to building owners and stake holders that can provide much more efficient and cost effective extents for façade retrofits. The retrofits required are also more efficiently localized to lower levels and higher threat locations near the building.

Keywords: Performance Based Design, Natural and Man-made Hazards, Design Criteria, Resilient Infrastructure.

1 Introduction

US Government design criteria currently include requirements for increased resilience (hardening) of the building envelope for critical facilities. This hardening is typically accomplished through enhanced glazing strength, enhanced glazing ductility (glass interlayer ductility) and improvements in opaque façade component strength, ductility and attachment capacity. The goal of the increased strength and ductility is to prevent injuries in the event of an aggressor attack by allowing glazing failure while limiting the injury potential of any flying glass debris and by controlling the deformation of opaque components to prevent the generation of any debris that could enter occupied spaces.

These criteria make no distinction between newly constructed or existing facilities; both must satisfy the resilience performance requirements. Generally, the improvements can be incorporated into new construction for increases of 10-15% of envelope cost. Improvements to existing buildings can be problematic in cost and practicality, however. Glazing improvements in existing buildings tend to be cost effective since they are typically accomplished as a part of a planned glazing improvement project designed to increase both efficiency and resilience and because they can be completed with minimal disturbance of exterior and interior finishes. Replacements of opaque façade components such as precast panels and masonry generally happen much less often, if at all, thus upgrades tend to be impractical and cost prohibitive because both the building exterior

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