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Lateral load resisting facades

Miguel LOPEZ, Joseph BLANCHFIELD, Philip MURRAY, David KAZIBWE, Carolyn BAI, Ramon GILSANZ*

*Gilsanz Murray Steficek
129 West 27th Street, 5th Floor, New York, NY 10001, USA
ramon.gilsanz@gmsllp.com

Abstract

Simple modifications to traditional curtain wall slab anchors allow designers to incorporate a structure's building envelope system into its lateral system, leading not only to improved structural performance, but a reduction in the building construction's carbon footprint. This approach of integrating architecture with structural design to optimize building performance and construction embodies the principles of efficiency, economy, and elegance championed by David Billington. In this paper, the potential benefits of utilizing façade members to contribute to the building stiffness is studied by reanalyzing 510 Madison Avenue, a 2012 Class-A steel high rise office building in Manhattan. The building's lateral system is comprised of moment and braced frames. The building's façade is a unitized aluminum curtain wall system that utilizes traditional curtain wall anchors designed to prevent the transfer of loads between the façade and the structure. If the curtain wall slab anchor is redesigned to allow some fixity of the vertical mullions, then the curtain wall can partly carry out-of-plane loads. The results of the study indicate that a unitized hybrid curtain wall system, consisting of a shallow aluminum extrusion with a steel back-up member, can reduce the sway of the building at the upper floors and reduce the overall building CO^2 footprint for some anchor and installation layouts. The shallow aluminum extrusion provides the exterior finish, glazing cavity, thermal break, and air/water tightness system and the steel back-up member provides the structural capacity. For this case study, based on the spacing and depth of the members the curtain wall may reduce the inter story displacement by 2% to 6%.

Keywords: envelope performance, energy analysis, lateral resisting system, parametric performance modeling, carbon footprint.