11 Prevent Wind Damage to Existing Buildings

I. Summary

Issue:
High winds can cause walls, windows, doors, and building equipment to come loose. Loose stones on rooftops can become small missiles. While new buildings must meet strong wind standards, new installations on existing buildings do not.

Recommendation:
Require that equipment and structures added to existing buildings meet the same wind standards in effect for installations on new buildings. Require heavy pavers on rooftops and impact-resistant windows in high wind zones.

II. Proposed Legislation, Rule or Study

Amendments to the New York City Building Code:

1. Amend Section 1609.1 as follows:

   1609.1 Applications. Buildings, structures, and parts thereof, shall be designed to withstand the minimum wind loads prescribed herein. Decreases in wind loads shall not be made for the effect of shielding by other structures. Curtainwall elements, windows, doors, building mounted equipment such as cooling towers, fans, tanks, air conditioning units, hoods, louvers, antennae, plumbing fixtures, gas appliances, and equipment enclosures installed at any point in the life of any such building or structure, shall be designed to remain intact and firmly attached to such building structure or part thereof when subjected to such minimum wind loads. The design of the above described attachments shall be verified either by engineering calculations or by the manufacturer's certified design criteria. For any such attachments intended to withstand wind loads through gravity or friction, engineering calculations or manufacturer's certified design criteria shall demonstrate the ability of such attachments to withstand the minimum wind loads.

2. Add a new Section 1504.9 as follows:

   1504.9 Aggregate. Aggregate shall not be used as surfacing for roof coverings and neither aggregate, gravel nor stone shall be used as ballast on roofs of buildings.

   EXCEPTION: The use of a ballasted roof is permitted if it is justified by an engineering study that takes into consideration: the height and location of the building, the use of concrete or

stone pavers at the perimeter, the parapet height, the Exposure Category, the topography of the neighborhood and the surrounding buildings and any other pertinent factor.

3. Amend Section 2402 by adding the following definition:

   DESIGNATED SPACES. Areas of assembly for 300 or more persons or areas of in-place shelter.

4. Add a new Section 2403.7 as follows:

   2403.7 Wind-Borne Debris. Glazing in buildings in Structural Occupancy Category IV, as defined in Table 1604.5, located in wind exposure C or D, as defined in Section 1609.4, and Glazing in Structural Occupancy Category III buildings located in exposure D enclosing the designated spaces shall be protected with an impact resistant covering or be impact-resistant glazing according to the requirements specified in ASTM E1886 and ASTM E1996 or other approved test methods and performance criteria. The levels of impact resistance shall be a function of Missile Levels and Wind Zones specified in ASTM E1886 and ASTM E1996.

   EXCEPTION: Glazing located shall be permitted to be unprotected if it is both:
   (1) Over 60 ft above the ground
   (2) Over 30 ft above aggregate-surfaced-roofs, including roofs with gravel or stone ballast, located within 1,500 ft of the building

   [Modified Excerpt from ASCE 7-10, Chapter 26 Section 26.10.3]

Amendments to the New York City Mechanical Code:

1. Add a new Section 401.5.4 as follows:

   401.5.4 Wind-Driven Rain Rating. All exterior louvers for building ventilation and exhaust systems shall comply with one of the following:

   1. Shall receive a Rating of A when tested under ACMA Standard 500L for wind-driven rain penetration for a 50 mile per hour wind velocity with a rainfall rate of eight inches per hour; or
   2. Shall be installed on a plenum configured to intercept any wind driven rain penetrating the louver and to prevent the rain from entering the building ductwork system. Such plenum shall be waterproofed and equipped with a drainage system to convey water penetrating the louver to storm or sanitary drains.

III. Supporting Information

Expanded Issue and Benefits:

The recommendations of this proposal apply to both new construction and renovations of existing buildings.

Windows and Doors
Pressure-related failures of windows and doors during high winds can greatly increase storm damage. By allowing wind-driven rain and other water infiltration to reach the interior, materials can be damaged or ruined. Wet materials often lead to mold growth and even materials that do not appear damaged can harbor enough moisture to contribute to mold growth later.

Storm-Proof Attachments
Items that are loosely attached to the building, like satellite dishes and window AC units, would benefit from engineered securement capable of resisting high winds. This proposal does not address furniture or other loose items, which should be secured as part of a building's Emergency Action Plan prior to a storm event.

Roof Ballast
During storm events, pea gravel and stone ballast on rooftops can be lifted by high winds and become dangerous projectiles capable of breaking windows, harming people and other damage. Eliminating these ballasts will reduce damage and injuries and shorten the recovery time of buildings.

For the construction of new roofs and the replacement of existing roof systems, this proposal recommends adoption of the IBC 2009 and 2012 Section 1504.8 requirements which outlaw gravel and stone ballast in hurricane prone areas such as New York City.

Louvers
Wind-driven rain can penetrate building louvers, entering ductwork or mechanical spaces. This issue may become more common with the expected increases in storm events and rainfall as a result of climate change. Water infiltration into these mechanical systems can lead to pervasive dampness and significant mold or microbial growth, primary drivers of poor indoor air quality and a threat to public health.

Implementation:

Windows and Doors
Windows and doors that satisfy the wind resistance requirements of this proposal are readily available, though some manufactures may have long lead times.

Storm-Proof Attachments
Methods to properly secure rooftop equipment or other items to buildings are readily available and widely used.

Roof Ballast
Roof cover assemblies that do not require pea gravel or stone ballast are commercially available and have been installed throughout New York City. Aesthetics may be a concern for roof

setbacks that can be viewed from upper floors, in which case a stone ballast is typically preferable for its appearance.

Louvers
Louvers that withstand wind-driven rain are typically a direct replacement, although they may have a slightly greater depth. The pressure drop across intake or exhaust systems may be increased slightly by the protected louvers so fans, fan motors and other equipment should be calibrated against this potential change.

The free area of louvers rated for wind-driven rain is generally less than that for standard louvers (40-50% versus 50-60%). To provide the same rated flow capacity as a standard louver, a rain-resistant one would be 10-20% larger. The pressure drop differential between the two types of louvers also varies, but the maximum difference is only about 0.06 inches of water column. The running cost differential due to this greater pressure drop for a 10,000 cfm ventilation fan running continuously all year long would be about $165, compared with its overall running cost of about $11,100 (about 1.5% increase).

The operating cost impact of raising the velocity through the louver by 10%, to provide the same flow without increasing the louver area would be in the range of 20%, so the cost differential would rise from about $165 to about $200. Depending upon the louver, the water rejection capability of the louver might be compromised by the higher face velocity.

Cost:

Turner Construction Company prepared cost estimates based upon several standardized building typologies. Due to the innate variances in construction costs between projects, the complexity of the Task Force proposals, and the wide range of buildings to which the proposals may apply, these cost estimations should only be used as rough order-of-magnitude guides. The cost analysis is presented at the end of this proposal; more information about the cost methodology is given at the end of the full report.

The following analysis was performed by the authors of this proposal:

Windows and Doors
Impact-resistant glazing systems are readily available but the additional costs are significant. If required in a market the size of New York City, costs would be expected to come down.

Impact-resistant window coverings are readily available and less expensive but have a significant aesthetic impact on the building. Coverings also have a shorter lifespan than integrated window systems.

In either case, the costs of damage to the building and interior finishes from a single storm likely outweighs the additional costs of robust window systems and greatly increases the likelihood that the building will remain habitable following a major storm event.

Storm-Proof Attachments
The cost premium for storm-proof attachments of equipment is very small, and almost insignificant relative to the overall cost of the equipment. The cost for engineering calculations of more robust attachments is minimal and, if required, would likely be borne by the manufacturers.

Roof Ballast
For new construction, the increased cost of non-ballasted roofing systems is modest, and includes the cost of removing the old ballast (which is typically used again in a like-for-like replacement). For existing buildings, in addition to the costs of replacing the ballast roof with a non-ballast roof, there may be additional costs for modifications to flashings, perimeter conditions or penetrations.

Louvers
The cost difference for wind-protected louvers is negligible.

NEW CONSTRUCTION

		Commercial High Rise				Commercial Low Rise				Residential High Rise				Residential Low Rise			
		Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total
11	**Prevent Wind Damage to Existing Buildings**																
	Premium to use wind resistant connections on rooftop equipment				IN CODE				IN CODE				IN CODE				IN CODE
	Premium to increase wind performance of curtain wall system				IN CODE				IN CODE				IN CODE				IN CODE
	Premium to include A-rated louver selection	1	LS	$5,000.00	$5,000	1	LS	$5,000.00	$5,000	1	LS	$5,000.00	$5,000	1	LS	$5,000.00	$5,000
	Premium to use roof pavers in lieu of ballast	20,000	SF	$20.00	$400,000	2,000	SF	$20.00	$40,000	11,000	SF	$20.00	$220,000				$0
	Premium to use impact resistant glazing in curtain wall system (100% exterior wall to elevation 60' above ground for high rise buildings)	41,400	SF	$15.00	$621,000				$0	24,780	SF	$15.00	$371,700				$0
	Premium to use impact resistant glazing in curtain wall system (40% exterior wall for low rise buildings)				$0	2,412	SF	$15.00	$36,200				$0	5,500	SF	$15.00	$82,500
	Premium for added louver water resistance requirements			Cost is minimal				Cost is minimal				Cost is minimal				Cost is minimal	
					$0				$0				$0				$0
	SUBTOTAL DIRECT WORK				**$1,026,000**				**$81,200**				**$596,700**				**$87,500**
	Contingency		10%		$102,600		10%		$8,120		10%		$59,670		10%		$8,750
	SUBTOTAL				**$1,128,600**				**$89,320**				**$656,370**				**$96,250**
	GC Mark-ups		20%		$225,720		20%		$17,864		20%		$131,274		20%		$19,250
	TOTAL	**620,000**	**GSF**	**$2.18**	**$1,354,320**	**4,000**	**GSF**	**$26.80**	**$107,184**	**231,000**	**GSF**	**$3.41**	**$787,644**	**15,000**	**GSF**	**$7.70**	**$115,500**

EXISTING BUILDINGS

		Commercial High Rise				Commercial Low Rise				Residential High Rise				Residential Low Rise			
		Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total	Quantity	Unit	Unit Cost	Total
11	**Prevent Wind Damage to Existing Buildings**																
	BEST PRACTICE																
	SUBTOTAL DIRECT WORK																
	Contingency																
	SUBTOTAL																
	GC Mark-ups																
	TOTAL				-				-				-				-