ICC 600 – Proposal to Clarify Intent and Resolve Herrenbruck 05 Comment from 1st Public Ballot

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Introduction

This proposal addresses two important objectives for integrity building envelopes:

1. clarifies and explicitly defines consistent performance criteria for all exterior wall coverings, and
2. provides proper wind pressure rating requirements for vinyl siding when used for applications over foam sheathing to prevent envelop failure consistent with the intended performance criteria.

While the intent of Herrenbruck 05 was to permit use of vinyl siding over foam sheathing with proper performance limitations, the original comment and suggested resolution by the proponent lacked detail necessary to ensure adequate performance. Thus, this proposal is intended to provide a detailed solution that correctly addresses performance criteria for exterior wall coverings in general and vinyl siding with foam sheathing backing material in specific.

As will be seen in this proposal, proper performance criteria provide a "self-limiting" solution to prevent the types of failures that have occurred due to a lack of appropriate performance criteria or faulty application of existing criteria, among other factors such as installation quality. With proper performance criteria, it is clearly evident that vinyl siding over foam sheathing is not applicable in many high wind regions with existing products, especially in Exposure C or D and also on gable end roof framing. Thus, this proposal corrects real and perceived problems with this application, yet provides adequate solutions where performance can be achieved with existing products. The proposal will also promote a rational performance basis for innovation and new product development.

In summary, this proposal is in agreement with the committee's determination to deny the Herrenbruck 05 comment. But, it provides a detailed solution that addresses long-standing performance criteria needs. It is the desire of XPSA and the FSC that the ICC 600 committee consider this proposal and take action for approval.

This proposal is based on the 2nd Public Comments Draft dated April 2007. Proposed new text is shown as double underlined; deleted text as double strike-out.

References Supporting Proposal

- ASCE 7 Wind Task Committee Proposal on Pressure Equalization Effects (work in progress – see Attachment A)

- ASCE Special Project Report – *Residential Building Loads: Roadmap for Future Progress* (ASCE, 2006)

- ICC Code Proposal for 2009 IRC (work in progress; basis for this ICC 600 proposal)

Proposal

Part 1 – Revise Section 101.3 as follows to coordinate with proposed performance criteria for exterior wall coverings (envelope) added to Chapter 7 (see Part II):

101.3 INTEGRITY OF BUILDING ENVELOPE
Individual elements of a building not in strict compliance with or addressed by this standard may be engineered without requiring engineering for the entire building. Elements which maintain the structural integrity of the building envelope shall comply with Chapter 6 and Chapter 7. Windows and doors that are not addressed in Chapter 6 shall be designed ~~for~~ and installed to comply with the components and cladding loads of Section 1609 of the *International Building Code*.

Part 2 – Revise Section 701.3 to include wind pressure resistance performance criteria to apply to all exterior wall coverings:

701.3 Load Resistance: All exterior walls, wall coverings and soffits shall be capable of resisting the design pressures specified in Table R301.2(2) of the *International Residential Code* for walls. Wind pressure resistance of the siding materials listed in Table 702.4 or otherwise approved shall be determined by ASTM E330 or other approved wind pressure test method suitable to the siding material and wall assembly under consideration. Where wind pressure resistance is determined by design analysis, approved design standards shall be used to evaluate the siding material and its fastening. All applicable failure modes including bending rupture of siding, fastener withdrawal, and fastener head pull-through shall be considered in the testing or design analysis. For tested assemblies, a minimum safety factor of 1.5 shall be applied to the average ultimate wind pressure resistance of the siding when it is applied over a solid backing material that is capable of independently resisting wind loads in accordance with Table R301.2(2). For conditions where there is no backing material or the backing material is not designed to resist wind load, a safety factor of 2.0 shall apply. When based on approved methods or standards, adjustments to wind loads to account for pressure equalization effects shall be permitted.

Part 3 – Revise Table 702.4 as follows:

TABLE 702.4
WEATHER-RESISTANT SIDING ATTACHMENT AND MINIMUM THICKNESS

Siding Material		Nominal Thickness[a] (inches)	Joint Treatment	Water Resistive Barrier Required	Type of Supports for the Siding Material and Fasteners[b,c]					
					Wood or wood structural panel sheathing	Fiberboard sheathing into stud	Gypsum sheathing into stud	Foam plastic sheathing into stud	Direct to studs	Number or spacing of fasteners
Horizontal Aluminum [d] Vinyl Siding[l]	Without insulation	0.019[e]	Lap	Yes	0.120 nail 1 ½" long	Not allowed	Not allowed	Not allowed	Not allowed	Same as stud spacing
		0.024	Lap	Yes	0.120 nail 1 ½" long	Not allowed	Not allowed	Not allowed	Not allowed	
	With insulation	0.019 0.035 (vinylSiding)	Lap	Yes	0.120 nail 1 ½" long	Not allowed	Not allowed	Refer to Section 705, Table 705 ~~Not allowed~~	Not allowed	
Brick veneer [w] Concrete masonry veneer		2 2	Section R703	Yes (Note k)	See Section R703 and Figure R703.7 [f]					
Hardboard[j] Panel siding-vertical		See Section 702.2	–	Yes						
					See Section 702.4					
Hardboard[j] Lap-siding-horizontal		See Section 702.2	Note n	Yes						
					See Section 702.4					
Steel[g]		29 ga.	Lap	Yes	0.113 nail 1 3/4"	0.113 nail 2 3/4"	0.113 nail[v] 2 ½""	0.113 nail[w]	Not allowed	Same as stud spacing
Stone veneer		2	Section R703	Yes (Note k)	See Section R703 and Figure R703.7[g]					
Plywood panel[i] I (exterior grade)		3/8	–	Yes	0.099 nail-2"	0.113 nail-2 ½"	0.099 nail-2"	0.113 nail[w]	0.099 nail-2"	6" on edges 12" inter. Sup.
Wood[j] Rustic, drop		3/8 Min	Lap	Yes	Fastener penetration into stud-1"				0.113 nail-2 ½"	Face nailing up to 6" widths, 1 nail per bearing; 8" widths and over, 2 nails per bearing
Shiplap		19/32 Average	Lap	Yes						
Bevel		7/16								
Butt tip		3/16	Lap	Yes						
Fiber cement panel siding[p]		5/16	Note p	Yes Note u	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	4d corrosion resistant nail[s]	6" oc on edges, 12" oc on intermed. studs
Fiber cement lap siding[p]		5/16	Note t	Yes Note v	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	6d corrosion resistant nail[r]	6d corrosion resistant nail[u]	Note T

(No change to Table Notes)

Part 4 – Revise Section 705 and add new Table 705 as follows:

705 VINYL SIDING

~~Vinyl siding shall be tested or designed to comply with the wind load requirements of Section 1609 of the *International Building Code.*~~

Vinyl siding. Vinyl siding shall be certified and labeled as conforming to the requirements of ASTM D 3679 by an approved quality control agency. Vinyl siding shall be tested and verified for use in high wind areas as specified in Section 701.3 based on ASTM D 3679 Annex 1. Vinyl siding, soffit and accessories shall be installed in accordance with the manufacturer's installation instructions. Vinyl siding design wind pressure ratings apply to installation over a solid backing material capable of independently resisting the required wind loads in accordance with ASTM D3679. Where foam sheathing is used as a backing material, the required design wind pressure rating for the vinyl siding and its attachment to studs shall comply with Table 705.

(see next page for new Table 705)

(underlining not shown in following new table for clarity)

TABLE R705
REQUIRED DESIGN WIND PRESSURE RATINGS [PSF]
FOR VINYL SIDING APPLICATION OVER FOAM SHEATHING[a,b,c]

SIDING BACKING MATERIAL	SIDING ATTACHMENT[d]	WIND SPEED (MPH) – EXPOSURE B				
		85	90	100	105	110
Foam plastic sheathing applied directly underneath or over solid backing material capable of resisting wind load per Table R301.2(2)[g]	0.120 nail (shank) with a 0.313 head or 16 gauge staple with 3/8 to 1/2-in. crown[e]	17.4	19.5	24.1	26.6	29.1
Foam plastic sheathing with interior side of wall sheathed with gypsum wallboard or equivalent[h]	0.120 nail (shank) with a .313 head or 16 gauge staple with 3/8 to 1/2-in crown[f]	45.1	50.6	62.5	69.0	75.4
Foam plastic sheathing without gypsum wall board or equivalent on interior side of wall or gable roof end framing[i]	0.120 nail (shank) with a .313 head or 16 gauge staple with 3/8 to 1/2-in crown[f]	64.4	72.2	89.3	98.5	107.8
Minimum nail penetration into framing [b,f]		¾"	¾"	¾"	1"	1-1/4"

For SI: 1 mph = 1.609 km/h, 1 psf = 0.0479 kN/m^2

a. Linear interpolation between wind speeds is permitted.
b. The required design wind pressures and minimum nail penetrations are based on a 30' mean roof height located in Exposure B. For Exposures C and D and for other mean roof heights, multiply the above pressures and nail penetrations by the Adjustment Coefficients in Table R301.2(3).
c. Where the basic wind speed per Figure R301.2(4) is 110 miles per hour (49 m/s) or higher, the require design pressure ratings and nail penetration for the 110 mph column in Table R703.11.2 shall be multiplied by a factor equal to $[(\text{design wind speed})/110]^2$.
d. The siding shall be attached directly to the studs. Where permitted by the manufacturer, the siding shall be permitted to be attached to the backing material when the backing material and its attachment are designed to resist the wind loads in Table R301.2(2) and the vinyl siding attachment to the backing material has been tested for wind pressure resistance in accordance with ASTM D3679.
e. Minimum fastener length must accommodate sheathing layers and provide a minimum penetration into stud of ¾ inches or in accordance with manufacturer's installation instructions.
f. Minimum fastener length must accommodate foam plastic sheathing layer and provide a minimum penetration as indicated. Alternatively, fastener size type and penetration into framing shall be in accordance with manufacturer's installation instructions.
g. Required design wind pressure ratings in this row are based on negative (suction) pressures for wall zone 5 (a = 10 ft^2) from Table R301.2(2) and ASTM D3679 Annex A, Section A1.2.2 whereby a safety factor of 1.5 and a pressure equalization factor of 0.36 is applied to the tested (ultimate) wind pressure resistance to determine the vinyl siding's design pressure rating. Design pressure ratings of less than 29.1 psf are not permitted by ASTM D3679 Annex A, Section A1.2, but are included here for application of adjustments in accordance with footnote b.
h. Require design wind pressure ratings in this row are based on ASTM D3679 Annex A, Section A1.2.2, however, the required rating is increased to provide a safety factor of 2.0 and a pressure equalization factor of 0.7.
i. Required design wind pressure ratings in this row are based on ASTM D3679 Annex A, Section A1.2.2, however, the required rating is increased to provide a safety factor of 2.0 and a pressure equalization factor of 1.0.

REASON:

Parts 1 & 2

Parts 1 and 2 of this proposal provide consistent performance criteria for wind resistance of all cladding systems including those recognized in Table 702.4 or by other means (i.e., ICC-ES reports). This change is necessary because the issue of wind pressure resistance is not merely a vinyl siding issue and a "level playing field" for various products based on appropriate levels of performance is needed for all siding materials. The performance criteria included in the proposal are consistent with recommendations in standards such as ASTM E330 and ASTM D3679 as two examples. However, an increased safety factor (e.g., 2.0 instead of 1.5) for applications where there is not a structural siding backer material is necessary to ensure the integrity of the building envelop and to account for the added function of the cladding and non-structural backer in acting as the primary defense against a "through wall" wind pressure failure of the building envelope. Finally, the consideration of pressure equalization effects is included and is based on similar language found in Section 6.5.2.2 of ASCE 7-05. Such effects are currently used for some siding and roofing types.

Parts 3 & 4

Parts 3 and 4 of this proposal resolve performance concerns specifically aimed at vinyl siding and foam sheathing applications. Its focus is on clarifying wind pressure rating (performance) requirements for vinyl siding when applied over foam sheathing. Therefore, this proposal establishes a proper basis for vinyl siding applications with foam sheathing (i.e., non-structural backing material). This proposal increases performance to appropriate levels to prevent wind-related damage due to cladding system failure. Because the vinyl and foam sheathing serve as the primary weather barrier or envelop for the building (when no additional structural sheathing is applied), the vinyl siding pressure rating values have been increased to provide a net safety factor of 2.0 instead of 1.5 as required by ASTM D3679 for applications of vinyl siding over "solid walls". A safety factor of 1.5 is retained when vinyl is used over a solid backing material (e.g., structural sheathing, concrete or masonry wall, foam sheathing applied over or underneath a structural sheathing, etc.). In this case, the solid backing material is designed to independently resist the design wind pressure with or without the presence of vinyl siding and, thus, maintains at least a structural barrier or envelope to protect building contents even in the event of cladding system failure. In the process of making these changes, details such as minimum fastener penetration into studs have also been improved in a consistent manner. The adjustments to pressure equalization factors (also resulting in increased wind pressure ratings for vinyl siding applications over foam sheathing) are based on dynamic wind pressure testing as referenced in ASTM D3679 and reflect the condition where the vinyl siding attachment is also required to resist wind pressures acting across the foam sheathing layer.

This proposal will add cost to construction.

Market Impact Analysis

TABLE 1
Fraction of vinyl products listed in reviewed ICC-ES reports (not all products included) that meet pressure requirements of proposed Table R703.11.2 for 16"oc and 24"oc stud spacing

Wall Assembly Condition	90 mph / Exp B		110 mph / Exp B		120 mph / Exp B	
	16"oc studs	24"oc studs	16"oc studs	24"oc studs	16"oc studs	24"oc studs
Ext. Foam Shtg with ½" GWB int. (typical foam sheathed wall)	87/95	19/36	58/95	6/36	45/95	1/36
Ext. Foam Shtg without GWB int. (typical gable end attic wall)	61/95	6/36	30/95	1/36	13/95	0/36

Thus, the proposed criteria will reduce the availability and selection of vinyl siding products that can be used with foam-sheathed walls (except in the over-sheathing condition where little to no impact will occur). This will have cost impacts in terms of design and enforcement (e.g., verifying appropriate product selections and reconciling architectural preferences with available products that meet pressure criteria, etc.). Cost impacts also will occur to the degree that the higher performing vinyl siding products will generally cost more.

ATTACHMENT A

ASCE 7 Standards Committee
Proposal to Revise the 2005 Edition of ASCE 7

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Submission date: ____3/22/07 (rev 7/14/07)____________

Considered by ASCE 7 Task Committee on: ___Wind_______

Task Committee Action on Proposal: _____________________

SCOPE: ASCE 7-05 Commentary Section C6.1.3 and C6.5.2.2

PROPOSAL FOR CHANGE: (please use strike-out and underline format – please also include related modification/proposed addition to Commentary)

Relevant Existing Text in Standard (no change proposed):

6.1.3 Wind Pressures Acting on Opposite Faces of Each Building Surface. In the calculation of design wind loads for the MWFRS and for components and cladding for buildings, the algebraic sum of the pressures acting on opposite faces of each building surface shall be taken into account.

Add new commentary Section C6.1.3 and Figure C6-1 as follows:

C6.1.3 Wind Pressures Acting on Opposite Faces of Each Building Surface. Section 6.1.3 is included in the standard to ensure that internal and external pressures acting on a building surface are "taken into account" by determining a net pressure from the algebraic sum of those pressures. However, for components and cladding comprising a multi-layered building envelope system, the computed net pressure is actually distributed to each layer according to relative differences in stiffness and porosity or air-permeability of each layer, among other factors related to the characteristics of air spaces between each layer (e.g., volume of the air space and compartmentalization of the air space).

Currently, there is no standardized procedure or test method for determining an appropriate distribution of the computed net pressure to various layers of a multi-layered building envelope system. Such systems often include three dominant layers (e.g., cladding + exterior sheathing + interior sheathing or finish), each of which shares some portion of the computed net pressure differential acting on the building surface or envelope. For some air-permeable cladding types or products, when backed by a relatively stiff and air-impermeable layer (or layers), pressure reduction or equalization effects have been accounted for in the recognized literature as discussed in Commentary Section C6.5.2.2. However, these same principles also apply to other layers of a building envelope system such that the algebraic sum of the pressure differentials acting on each layer should sum to the computed net pressure acting across the building surface as a whole. This principle is conceptually illustrated in Figure C6-1.

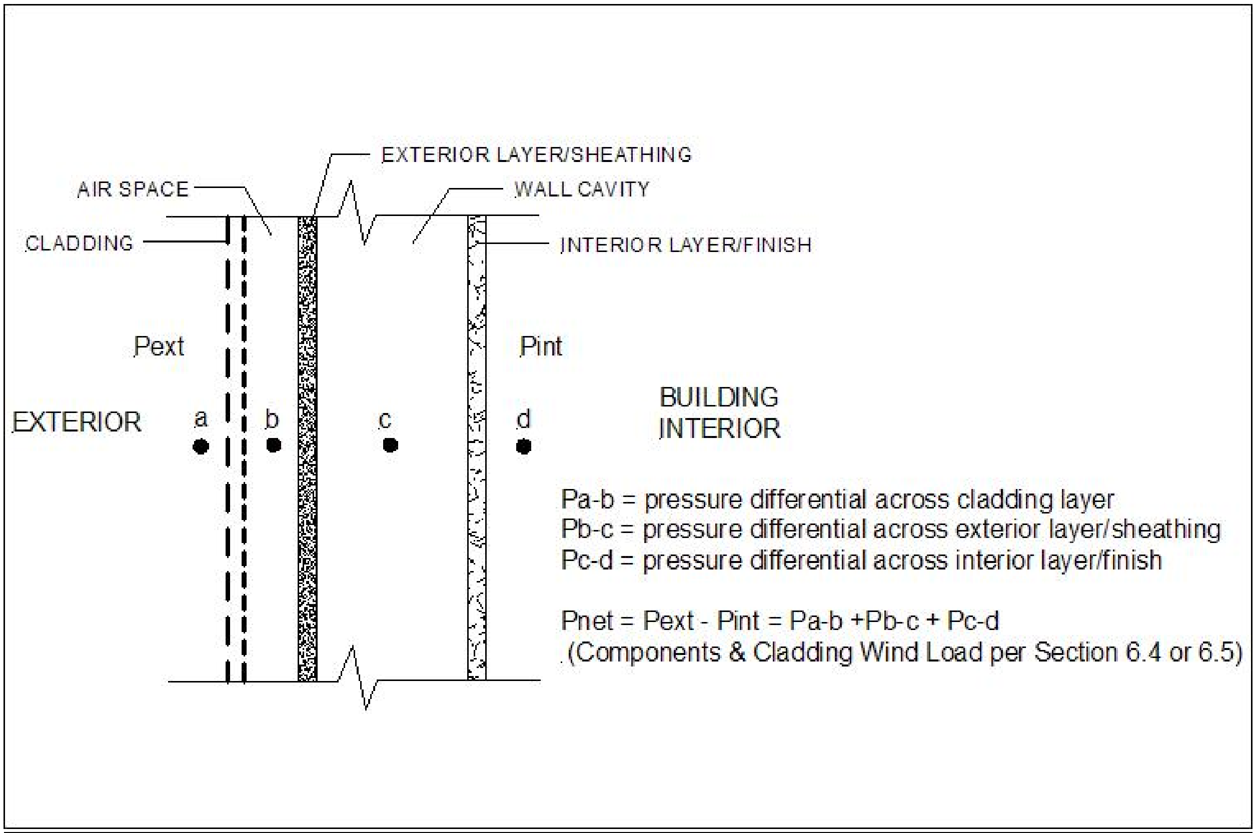

FIGURE C6-1 DISTRIBUTION OF NET PRESSURE ACTING ON A BUILDING SURFACE (BUILDING ENVELOPE) COMPRISED OF THREE COMPONENTS (LAYERS)

Relevant Existing Text in Standard (no change proposed):

6.4.3 Air Permeable Cladding. Design wind loads determined from Fig. 6.3 shall be used for all air permeable cladding unless approved test data or the recognized literature demonstrate lower loads for the type of air permeable cladding being considered.

No commentary exists or is proposed for Section C6.4.3 because, as part of the simplified Method 1, this section derives its basis from Section 6.5.2.2 of Method 2 (analytical approach).

Relevant Existing Text in Standard (no change proposed):

6.5.2.2 Air Permeable Cladding. Design wind loads determined from Section 6.5 shall be used for air permeable cladding unless approved test data or recognized literature demonstrate lower loads for the type of air permeable cladding being considered.

Revise existing commentary Section C6.5.2.2 as follows:

C6.5.2.2 Air-Permeable Cladding. Air-permeable roof or wall claddings allow partial air pressure equalization between their exterior and interior surfaces. Examples include siding, pressure-equalized rain screen walls, shingles, tiles, concrete roof pavers, and aggregate roof surfacing.

The degree of pressure equalization (reduction) experienced by any cladding type depends not only on the characteristics of the cladding itself, but also the relative air-permeability and stiffness of various layers of a building envelope system in response to dynamic (fluctuating) wind loads (see Commentary Section C6.1.3).

To maximize pressure equalization (reduction) across any cladding system (irrespective of the permeability of the cladding itself), the layer or layers behind the cladding should be:

- relatively stiff in comparison to the cladding material, and
- relatively air-impermeable in comparison to the cladding material.

Furthermore, the air space between the cladding and the next adjacent building envelop surface behind the cladding (e.g., the exterior sheathing) should be as small as practicable and compartmentalized to avoid communication or venting between different pressure zones of a building's surfaces. Because all of these features have a relative impact on the pressures experienced by each layer involved, the magnitude of pressure equalization is dependent on the characteristics of the other layers of the building envelope (see Section C6.1.3).

The design wind pressures derived from Section 6.5 represent the pressure differential between the exterior and interior surfaces of the exterior envelope (wall or roof system). Because of partial air-pressure equalization provided by air permeable claddings, the components and cladding pressures derived from Section 6.4 or 6.5 can overestimate the load on air-permeable cladding elements and also the distribution of net pressure differentials acting on other components (layers) of a multi-layered building envelope system.

Therefore, the designer may elect either to use the loads derived from Section 6.4 or 6.5, or to use loads derived by an approved alternative method. One such method, based on dynamic wind pressure testing to determine a standardized Pressure Equalization Factor (PEF), has been implemented for certified vinyl siding products installed on typical "solid" wall systems (Ref. C6-6). The term "solid" implies a relatively low air-permeability of the sheathing or wall construction immediately behind the vinyl cladding (such that the air cavity between the siding and wall system can readily equalize with dynamic pressure changes occurring in ambient exterior air). In this context, the PEF is the proportionate share of the net components and cladding wind pressure (determined from Section 6.4 or 6.5) applicable to an individual cladding or envelop layer.

Theoretically, the sum of PEF values for each layer of a multi-layered building envelope system should add to 1.0 (or, as shown in Figure C6-1, the pressure acting on each layer should sum to 100 percent of the net components and cladding pressure per Section 6.4 or 6.5). For hollow-backed vinyl siding products complying with ASTM D3679-06a, the PEF factor ranges from roughly 0.1 to 0.2, with a standardized value of 0.36 selected for use in ASTM D3679 to cover a variety of products (Ref C6-6). A dynamic pressure test chamber was used with three different dynamic loading conditions to evaluate PEFs for each wall assembly and to determine sensitivity to rate of negative pressure changes and peak magnitude of dynamic pressure differential created across the overall wall system (Ref. C6-7). This procedure resulted in pressure change rates from roughly 80 psf/sec to as much as 240 psf/sec and maximum peak net pressure magnitudes consistent with end zone components and cladding pressures for a 130 mph wind speed. The dynamic pressure testing used to justify the 0.36 PEF for hollow-backed vinyl siding products also indicates a typical PEF range of 0.5 to 0.7 for the exterior sheathing layer and 0.2 to 0.4 for interior gypsum wall board finishes on light-frame walls (Ref. C6-7). In this context, a low PEF value implies substantial pressure equalization and a PEF of 1.0 for a given layer implies no pressure equalization or pressure sharing with other layers (e.g., a single layer building envelope system).

If the designer desires to determine the pressure differential across a specific ~~the air-permeable~~ cladding element in combination with other elements comprising a specific building envelope assembly, appropriate full-scale pressure measurements should be made on the applicable building envelope assembly ~~cladding element~~, or reference be made to recognized literature [Refs. C6-2, C6-3, C6-4, C6-5, C6-6, C6-7] for documentation pertaining to wind loads.

Add references to commentary as follows:

[Ref. C6-6] ASTM D 3679-06a, *Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding*, American Society of Testing and Materials, West Conshohocken, PA. 2006.

[Ref. C6-7] ATI, 2002. *Pressure Equalization Factor Project*, ATI Report No. 01-40776.01, prepared by Architectural Testing Inc. for Vinyl Siding Institute, Washington, DC. September 5, 2002.

REASON FOR PROPOSAL: (a reason statement providing the rationale for the proposed change must be provided – attach additional pages if necessary)

Building envelop design is increasingly becoming the focus of efforts to improve wind-resistant (and wind-driven rain resistant) construction. Therefore, the proper distribution of components and cladding wind loads to multi-layered building envelope systems is very important to efficient building envelop design. This commentary proposal is intended to bring clarity to the principles involved and needed background to this issue. It is intended to establish a basis for future potential improvements to the standard as well as standardized procedures for determining pressure equalization effects on air-permeable claddings, rain-screen cladding systems, and building envelope systems in general.

The following background information is provided for additional information (excerpt from *Residential Building Loads: Review and Roadmap for Future Progress,* ASCE-SEI, 2006, pp24-25):

Topic #10 Air-permeable Cladding Wind Loads

Description: Wind loads on air-permeable claddings are typically less than loads calculated across the entire building wall or roof system in accordance with ASCE 7 provisions. While ASCE 7 recognizes that air-permeable cladding load reductions are valid, guidance is lacking on methods of testing to determine wind load adjustments for air-permeability cladding products, and a generalized calculation method for air-permeable cladding load effects based on the degree of porosity or venting of the cladding system does not exist.

Existing Knowledge: Certain material standards (e.g., ASTM standard for vinyl siding) give recognition of a 50% cladding load reduction due to air-permeability, although the technical justification of this level of reduction is not known *[Author's Note (7/14/07): This value has been changed to 0.36 in ASTM D3679-06a and the dynamic pressure test basis of this value is known]*. Air-permeable cladding load reductions for various other cladding types (e.g. wood lap siding, brick veneer, etc.) is lacking.

The Forest Products Laboratory has conducted full-scale wind pressure measurements on one type of air-permeable cladding (hardboard siding) installed on a test building (TenWolde et al., 1998). The cladding pressures experienced was approximately two-thirds of the total pressure differential across the wall system. Research sponsored by the National Roofing Contractors Association has developed a method for determining roof shingle loads, also relying on full-scale pressure monitoring on a test building (Peterka, et al, 1997). In this full-scale study, air-permeable cladding wind load reductions were as high as 75 percent. Studies of various cladding systems with varying degrees venting and resulting pressure-equalization (known as pressure-equalized or pressure-moderated rain-screen cladding) have also shown cladding load reductions similar to that reported above (CMHC, 2000, 2001, 1998, 1997, and 1996). A simplified computer model has also been developed to predict pressure equalization effects for air-permeable or "rain-screen" cladding systems (CMHCa, 1996). Methods to accurately assess air-permeability wind load reductions are not standardized and often rely on expensive whole building pressure measurements under actual wind loads.

Implementation Progress & Barriers: Current building codes and standards do not give adequate guidance on air-permeable cladding wind loads. In some cases, air-permeable claddings are specifically not permitted to be considered as air-permeable and must be designed for significantly higher loads than actual. This problem affects accuracy and economy of design of claddings as well as attachment methods. For example, 24 CFR Part 3280 is interpreted by HUD to require that vinyl siding cladding loads cannot be reduced for air-permeability. However, the ASTM D3679-96a standard for vinyl siding specifically includes a reduction for air-permeability. Attempts to include available air-permeability data (in terms of cladding load reductions factors) for some exterior finish materials in the ASCE 7 wind provisions have been rejected without clarifying a method by which air-permeability load reductions may be considered in the future.

Recommendations:

- A literature search on the topic of air-permeable cladding wind loads is needed. Methods to calculate wind loads on air-permeable cladding systems or porous wall systems should also be sought in the literature.
- Basic research is needed to develop a suitable general test methodology for determining air-permeable cladding load effects, develop a data set of load characteristics for a variety of air-permeable cladding products with differing degrees of porosity, and evaluate the data to formulate a generalized method for calculating air-permeability load adjustments based on fundamental cladding properties (e.g., degree of porosity or ventilation).
- A proposal should be submitted to the ASCE 7 wind task committee to clarify intentions for the proper characterization of air-permeable cladding loads and in what form air-permeable cladding load adjustments may be recognized for use by the design community and cladding product manufacturers. Any position taken by ASCE 7 wind task committee should be communicated and coordinated with appropriate standards development activities within ASTM.

Other relevant literature include:

Carll, C. et al. 1998. *Performance of Backprimed and Factor Finished Hardboard Siding – Final Report*, USDA Forest Service, Forest Products Laboratory, Madison, WI. February 1998.

Rousseau, M.Z., Poirier, G.F. and Brown, W.C. 1998. Pressure Equalization in Rainscreen Wall Systems, Construction Technology Update No. 17, Institute for Research in Construction, National Research Council of Canada, July 1998. http://irc.nrc-cnrc.gc.ca/pubs/ctus/ctu17e.pdf

Poirier, G.F. and W.C. Brown. Pressure Equalization and the Control of Rainwater Penetration under Dynamic Wind Loading, Construction Canada, March/April 1994, p. 45-47

Inculet, D. and D. Surry. The Influence of Unsteady Pressure Gradients on Compartmentalization Requirements for Pressure-Equalized Rainscreens. Canada Mortgage and Housing Corporation, June 1996.

Skerlj, P.F. and D. Surry. A Study of Mean Pressure Gradients, Mean Cavity Pressures, and Resulting Residual Mean Pressures across a Rainscreen for a Representative Building. CMHC Report, September 1994. Canada Mortgage and Housing Corporation, Ottawa.

A Study of Mean Pressure Gradients, Mean Cavity Pressures, and Resulting Residual Mean Pressures across a Rainscreen for a Representative Building. CMHC Research & Development Highlights Technical Series 96-207, Canada Mortgage and Housing Corporation, Ottawa.

Inculet, D. and D. Surry. Optimum Vent Locations for Partially-Pressurized Rainscreens. CMHC report BLWTSS30-1997, September 1997, 183 p.

Brown et al. Field Testing of pressure-equalized rainscreen walls. ASTM. STP 1034, 1991.

Kumar, K.S., Sathopoulos, T., Wisse, J.A., “Field measurement data of wind loads on rainscreen walls,” Journal of Wind Engr and Industrial Aerodynamics, Volume 91, Issue 11, November 2003, pp 1401-1417.