

Certification of Engineered Flood Openings

In accordance with the Code of Federal Regulations for the National Flood Insurance Program

I hereby certify that I have reviewed the hydraulic flow calculations provided by **Crawl Space Door Systems**® for their **Fixed Louver Flood Vent Model No.'s 816CS, 1220CS, 1232CS, 1616CS, 1624CS, 1632CS, 2032CS, 2424CS, and 2436CS**. The data reviewed for this certification includes (1) Vent opening measurements as measured and certified by Mr. Christopher Mark Loney, Virginia P.E. NO. 029000 and (2) Detailed hydraulic flow calculations as prepared by Dr. Georg Reichard, Associate Professor of Building Construction, Virginia Tech. Based my review of the above data and calculations, I certify that the fixed louver Flood Vent models noted in **Table 1** (below) meet the required criteria of the Code of Federal Regulations for the National Flood Insurance Program (NFIP) to **provide automatic equalization of hydrostatic flood forces by allowing for the entry and exit of floodwaters, when properly installed and sized as set forth below.**

Flood Vent Flow Analysis:

Section 2.6.2.2 of ASCE/SEI 24-05 provides an equation to determine the required net area of engineered openings (A_o) for a given enclosed area (A_e). This equation is based on the hydraulic formula for the flow rate across sharp edged orifices and was used to calculate the following (3) scenarios: (1) the restricted flow rate through the main frame opening in case the louver is blown out during a flood event; (2) the flow rate through the individual openings between louver blades (Weir Theory); and (3) the flow rate through projected openings between louver blades (Hydraulic Short-Tube Theory). The maximum total enclosed area (A_e) that can be serviced by a single vent was determined by utilizing the lowest flow rate (worse case) of the three assessed scenarios for each vent and is listed in **Table 1** (below).

These values are based on the following assumptions:

- In absence of reliable data, the rates of rise and fall have been assumed at a minimum rate of **5 feet/hour**;
- The maximum difference between the exterior & interior floodwater levels not to exceed 1 foot during base flood conditions;
- A factor of safety of 5 has been assumed, which is consistent with design practices related to protection of life and property;
- The net area of openings (A_o) as provided by the manufacturer.

(*)	Model	H x W [in]	A_o [in ²]	A_e [ft ²]
<input type="checkbox"/>	816CS	8 x 16	105	205
<input type="checkbox"/>	1220CS	12 x 20	235	500
<input type="checkbox"/>	1232CS	12 x 32	305	645
<input type="checkbox"/>	1616CS	16 x 16	180	395
<input type="checkbox"/>	1624CS	16 x 24	310	670
<input type="checkbox"/>	1632CS	16 x 32	405	835
<input type="checkbox"/>	2032CS	20 x 32	630	1240
<input type="checkbox"/>	2424CS	24 x 24	570	1230
<input type="checkbox"/>	2436CS	24 x 36	850	1765

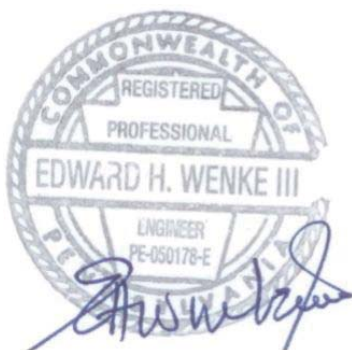
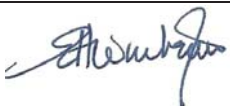
Table 1 Maximum total enclosed area (A_e) that can be serviced by each individual model based on the given net area of engineered openings (A_o)

Installation Requirements and Limitations

This certification will be voided if the following installation requirements and limitations are not enforced:

- There shall be a minimum of two openings on different sides of each enclosed area subject to flooding;
- The bottom of all openings shall be no higher than one foot above the higher of the interior or exterior grade that is immediately under each opening;
- No temporary (e.g. during cold weather) or permanent solid cover may be placed into or over the flood vent that would block the automatic entry or exit of floodwaters at any time;
- Where data or analyses indicate more rapid rates of rise and fall, the required number of openings shall be increased to account for those different conditions.

Certifying Design Professional

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License	PENNSYLVANIA	License No.	PE-050178-E	
Signature:			Date: January 31, 2018	

Identification of the Building and Installed Flood Vents (By Others)

The flood vent models marked in Table 1 (*) above are being installed at the following building:

Building Address