



NON-ENGINEERED OPENING GUIDE

To Assist in the Compliance and Measurement Documentation of
Non-Engineered Flood Openings for the Elevation Certificate in
Accordance with the National Flood Insurance Program

TABLE OF CONTENTS

Introduction.....	3
Simplified Guide Definitions Related To Flood Openings	4
Flood Opening Requirements.....	5
Non-Engineered Opening Identifier Notes	7
Non-Engineered Opening Identifier.....	8
Additional Resources	23

To comment on this Guide or if you have identified a Non-Engineered Opening device that is not listed please contact the collaborative team:

Carolina Flood Solutions LLC | Smart Vent Products, Inc.

Phone: (877) 441-8368
fieldguide@floodvent.com

For Non-Engineered Opening vents not listed: send pictures of the vent, dimensions and any markings identifying the manufacturer. The field guide committee will review your submission and work to include the vent in a future edition of the Field Guide.



**Sign up to receive automatic updates to this guide
by sending an email to fieldguide@floodvent.com**

INTRODUCTION

NFIP Floodplain Management Requirements 44 CFR 60.3 C (5)

“Require, for all new construction and substantial improvements, that fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters..... A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.”

This guide was developed by the collaborative efforts of Carolina Flood Solutions LLC, and Flood Risk Evaluator (F.R.E.), a division of Smart Vent Products, Inc.. An engineer conducted an independent evaluation of each Non-Engineered Opening vent included in this guide. Each vent was drawn to scale in AutoCAD® providing a 1/64th of an inch accurate calculation.

The guide assists Surveyors, Floodplain Management, Construction Officials, and Insurance Professionals with identifying the net free area of Non-Engineered Openings found in the field. Utilizing this guide to identify the net free area a Non-Engineered Opening vent provides will ensure sections A8 & A9 of the Elevation Certificate are accurately completed thus supplying the documentation to support compliance with the flood opening requirements.

Structures located in the floodplain (Zones A, AE, A1-A30, AR, AO, and AH or coastal A) with non-conforming flood openings are more susceptible to increased flood damage and increased flood insurance costs for the property owners.

FEMA Technical Bulletin 1 / August 2008

“Example of Enclosures That Require Openings:

- Solid perimeter foundation walls (crawlspaces or under-floor space)
- Solid perimeter foundation walls (below-grade crawlspaces)
- Solid perimeter foundation walls (with full-height under-floor spaces)
- Garages attached to elevated buildings
- Enclosed areas under buildings elevated on open foundations in A zones
- Enclosed areas with breakaway walls under buildings elevated on open foundations in A zones
- Solid perimeter foundation walls on which manufactured homes are installed
- Accessory structures (detached garages and storage shed)”

SIMPLIFIED GUIDE DEFINITIONS RELATED TO FLOOD OPENINGS

(These are not regulatory definitions. Regulatory definitions can be found in Additional Resources starting on page 23.)

FLOOD OPENING – A Flood Opening is a passive opening used to equalize hydrostatic loads on enclosure walls below the Base Flood Elevation. If enclosure walls are not designed to relieve the floodwater pressures with flood openings, the walls can be damaged or fail causing collapse of the building. There are two FEMA/NFIP recognized flood openings, non-engineered and engineered.

NON-ENGINEERED OPENING - A Non-Engineered Opening is an opening or air vent device that is used to meet FEMA/NFIP's requirement of 1 square inch of **net** open area for every 1 square foot of enclosed area.

NET OPEN AREA - The permanently open area of a Non-Engineered Opening intended to provide automatic entry and exit of floodwaters. The measurement of the net open area must take into consideration any obstructions to the flow of flood water such as grills, fixed louvers, or faceplates.

ENGINEERED OPENING – An Engineered Opening is a mechanical opening, which is activated by water during a flood revealing an unobstructed area for which floodwater can flow through to equalize the hydrostatic loads on the enclosure wall. These openings are performance tested and certified to cover a square footage amount. They have an ICC-ES Certificate.

BASE FLOOD – The flood having a 1-percent annual chance of being equaled or exceeded in any given year. The Base Flood is the national standard used by the NFIP and all Federal Agencies for the purposes of mapping and identifying the special flood hazard area, requiring the purchase of flood insurance and regulating new development.

BASE FLOOD ELEVATION (BFE) – The height of the base flood in relation to a specified datum.

ELEVATION CERTIFICATE (OMB No. 1660-0008) – A form developed by FEMA to collect surveyed elevations and other information about a building that is necessary to obtain flood insurance. In addition it is used by municipalities to regulate construction in the floodplain.

ENCLOSURE – Areas created by a crawlspace or full height solid walls that fully enclose areas below the BFE.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) – The Federal Agency that, in addition to carrying out other activities, administers the National Flood Insurance Program.

INTERNATIONAL CODE COUNCIL EVALUATION SERVICE (ICC-ES) - The ICC-ES is a nonprofit company that performs technical evaluations of building products, components, methods, and materials. After performance testing the evaluation process culminates with the issuance of technical Reports, which act as the products certification stating that they meet all of the Acceptance Criteria for the category. Acceptance Criteria (AC-364) has been established for Mechanically Operated Engineered Flood Vents. Products certified as to meeting this criteria are recognized by FEMA/NFIP.

ALERT: *Building Codes require all foundation openings to be covered with a rodent screen. Therefore, all openings and air vent devices that have fixed rodent screens that do not mechanically open to reveal an unobstructed area during a flood will be classified as Non-Engineered Openings.*

FLOOD OPENING REQUIREMENTS

Compliant flood openings are required in all enclosed areas below the Base Flood Elevation (BFE) in Special Flood Hazard Area Zones starting with A. ASCE 24-14 standards require compliant flood openings in all enclosed areas below the Base Flood Elevation in V zones as well. For every 1 sq. ft. of enclosed area, 1 sq. in. of net free area is required if Non-Engineered Openings are used. If Engineered Openings are used, 1 sq. in. is converted to 1 sq. ft. Note that square footage of an enclosed area is measured from the outside of the walls.

Each enclosed area is required to have a minimum of two flood openings on different walls.

The bottom of each opening shall not be more than 1 foot above the **highest** of the final **interior grade** or finished **exterior grade** immediately under each opening.

Flood Openings are to provide passive hydrostatic relief to walls; human intervention is not acceptable to activate a flood opening. Therefore, any air ventilation devices that can be closed manually must be permanently disabled in the open position. Covers are not acceptable at any time over a Non-Engineered opening. If the non-engineered opening device has not been disabled in the open position or has a cover or obstruction in front or behind the opening it will result in a "0" flood ventilation rating for that opening. Windows, entry & garage doors are not acceptable flood openings. See page 19 of FEMA Technical Bulletin 1 / August 2008 for a list of "Unacceptable Measures."

Flood Openings must be below the BFE for them to perform their intended function. If any portion of the opening is above the BFE that area shall be deducted from the flood venting coverage the opening provides.

Warning: *Debris is a fact of flood and because of rodent screens and other grills, Non-Engineered Openings have a tendency to clog. Clogged openings can lead to a build up of hydrostatic pressure causing walls to fail. When possible, professionals recommend to use ICC-ES Certified Engineered Flood Openings to ensure performance.*

ASCE 24-14 Commentary C2.7.2.1

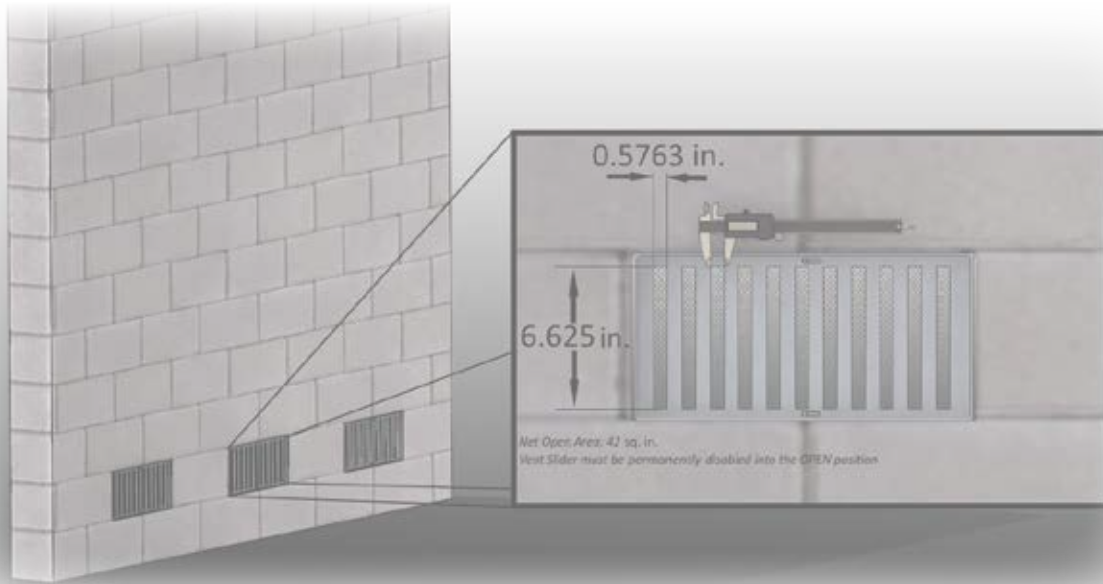
Any louvers, blades screens, and faceplates or other covers and devices should be selected or specified so as to minimize the likelihood of blockage by small debris and sediment. Where experience has shown that a particular device or type of device has been blocked or clogged by flood debris or sediment, use of such devices should be avoided.



Clogged Air Vent Image credit FEMA Technical Bulletin 1, 2008

“Non-Engineered Openings: Communities that administer the International Building Code® (IBC®) or the International Residential Code® (IRC®) should note the requirement to cover ventilation openings to keep animals and insects from entering. These codes provide a list of acceptable covering materials. The commentaries that accompany those codes note that some covering materials may reduce the gross open area of the vent by as much as 50 percent. In areas where floodwaters are expected to carry debris such as grass clippings and leaves, it is notable that screens tend to clog (as illustrated in the photos above). Local officials may determine that additional openings are required to increase the likelihood that openings will perform as expected, even if some become clogged with debris.” *FEMA Technical Bulletin 1 / August 2008 page 20.*

NON-ENGINEERED OPENING IDENTIFIER



Non-Engineered Opening Identifier Notes:

Flood opening documentation is done in sections A8 and A9 of the Elevation Certificate.

Openings and Ventilation devices that meet the following criteria are not acceptable:

- the bottom of the opening is more than 1 foot above highest adjacent grade
- can be manually closed
- have a cover or obstruction over them or behind them, or
- insulation stuffed or other obstruction behind them result in a "0" net free area rating.

Crawlspace access doors or hatches with cover left off or open during inspection results in a "0" rating as it is known that the door or cover will be installed over the opening after inspection.

It is recommended that only those portions of openings that are below the BFE can be counted towards the required net open area. ~ FEMA Technical Bulletin 1 / August 2008

If you identify a Non-Engineered Opening in the field that is not identified below please email pictures of the opening or device, dimensions, and manufacturer distinguishing marks to fieldguide@floodvent.com. The identified opening or device will be located and will be drawn to scale in AutoCAD to provide you with a net open area.

Note: It's recommended to have the owner of the building sign a Non-Engineered Opening Agreement acknowledging that the Non-Engineered Openings must remain free of obstructions at all times. Attached to this guide is an example of an agreement for your use. Submitting a copy to the municipality will assist them with their floodplain management efforts.

Material

White Plastic

Dimensions

Width: 15.56 inches

Height: 7.94 inches (excluding flange)

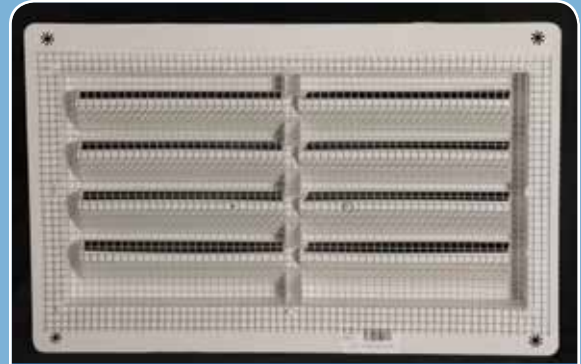
Net Open Area

52.04 sq. in.

Figure 1



FRONT FACE



BACK FACE

Material

Black Plastic

Dimensions

Width: 17.5 inches

Height: 9.5 inches

Net Open Area

44 sq. in.

Figure 2



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

Concrete

Dimensions

Width: 15.5 inches
Height: 7.5 inches
(excluding flange)

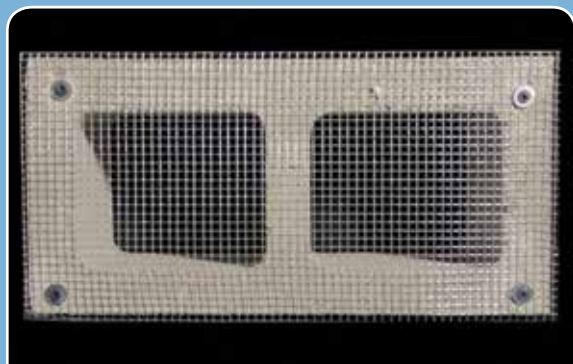
Net Open Area

32 sq. in.

Figure 3



FRONT FACE



BACK FACE

Material

Concrete Block Turned Side Ways

Compliance Notes

If used must have rodent screen attached per ICC Construction Codes.

Dimensions

Width: 15.5 inches
Height: 7.625 inches

Net Open Area

59 sq. in.

Figure 4

Material

Cedar, Wood

Dimensions

Width: 15.81 inches

Height: 8.0 inches

Net Open Area

29 sq. in.

Figure 5



FRONT FACE



BACK FACE

Material

Pictured: black plastic, brown plastic version also

Compliance Notes

Temperature Controlled Louvers

Unacceptable Measure.

REF pg. 19 TB1

Dimensions

Width: 15.125 inches

Height: 7.5 inches

Net Open Area

0 sq. in. for flood opening documentation

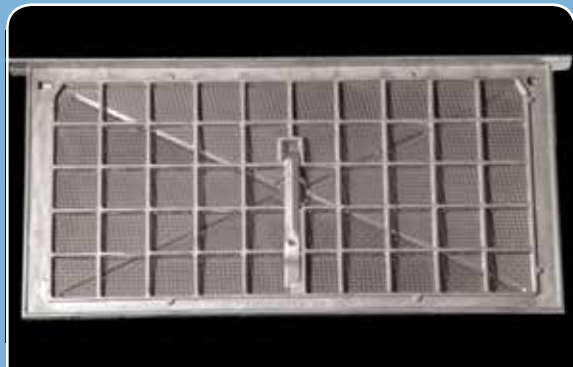
Figure 6



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

Metal

Compliance Notes

Solid metal door must be removed or NET open area is 0.

Dimensions

Width: 15.75 inches

Height: 7.5 inches

Net Open Area

64 sq. in.

Figure 7



FRONT FACE



BACK FACE

Material

Black Plastic

Compliance Notes

Closing Slider must be permanently disabled in OPEN position or removed.

Dimensions

Width: 15.75 inches

Height: 7.5 inches

Net Open Area

45 sq. in.

Figure 8

Material

Metal

Compliance Notes

Closing Slider must be permanently disabled and locked into the OPEN position or removed.

Dimensions

Width: 15.75 inches

Height: 7.5 inches

Net Open Area

42 sq. in.

Figure 9



FRONT FACE



BACK FACE

Material

Grey Plastic

Compliance Notes

Foam Inserts cannot be used. If they are, results in 0 rating. Flaps must be removed.

Dimensions

Width: 16.0 inches

Height: 7.3125 inches

Net Open Area

73 sq. in.

Figure 10



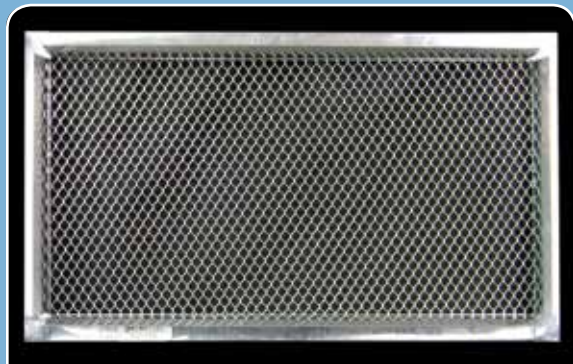
FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

Metal

Dimensions

Width: 13.5 inches

Height: 7.125 inches

Net Open Area

82 sq. in.

Figure 11



FRONT FACE



BACK FACE

Material

Metal

Dimensions

Width: 15.38 inches

Height: 7.38 inches

Net Open Area

30 sq. in.

Figure 12

Material

Metal

Dimensions

Width: 14.63 inches

Height: 5.63 inches (excluding flange)

Net Open Area

29 sq.in

Figure 13



FRONT FACE



BACK FACE

Material

Aluminum

Dimensions

Width: 14.5 inches

Height: 6.59 inches

Net Open Area

43 sq. in.

Figure 14



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

Metal

Compliance Notes

Slider must be permanently disabled into the OPEN position or NET open area is 0.

Dimensions

Width: 15.5 inches
Height: 7.425 inches (excluding flange)

Net Open Area

45 sq. in.

Figure 15



FRONT FACE



BACK FACE

Material

Brown Plastic

Compliance Notes

Solid vent cover must be removed or NET open area is 0.

Dimensions

Width: 15.1 inches
Height: 7.6 inches

Net Open Area

65 sq. in.

Figure 16

Material

Black Iron

Dimensions

Oval Area: 60.99
Max Width: 16.25 inches
Max Height: 8.50 inches

Net Open Area

19.5 sq. in.

Figure 17



FRONT FACE



BACK FACE

Material

White Metal

Dimensions

Width: 15.5 inches
Height: 19.375 inches

Net Open Area

177 sq. in.

Figure 18



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

White Metal

Dimensions

Width: 12 inches
Height: 11.88 inches
(Excluding flange)

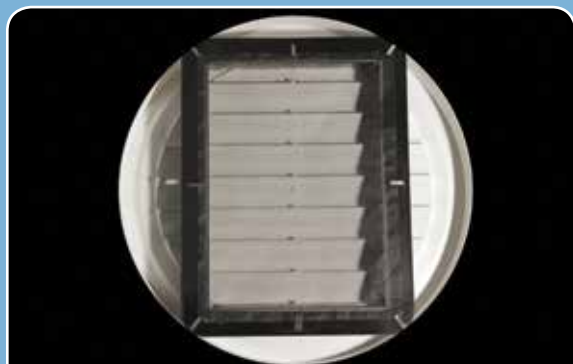
Net Open Area

32.4 sq. in.

Figure 19



FRONT FACE



BACK FACE

Material

White Plastic

Dimensions

21.5 inches Diameter
17.25 inches Diameter
(excluding flange)

Net Open Area

52 sq. in.

Figure 20

Material

White Plastic

Dimensions

Width: 17.73 inches
Height: 17.73 inches
(excluding flange)

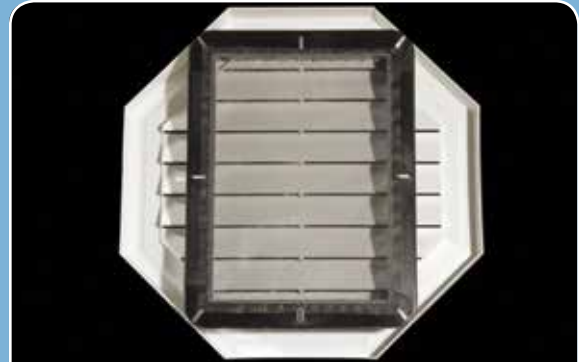
Net Open Area

54 sq. in.

Figure 21



FRONT FACE



BACK FACE

Material

White Metal

Dimensions

Width: 12 inches
Height: 17.88 inches
(excluding flange)

Net Open Area

43.2 sq. in.

Figure 22



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

White Plastic

Dimensions

Width: 11 inches
Height: 15.94 inches
(excluding flange)

Net Open Area

42 sq. in.

Figure 23



FRONT FACE



BACK FACE

Material

White Plastic

Dimensions

Width: 16 inches
Height: 24 inches
(excluding flange)

Net Open Area

88 sq. in.

Figure 24

Material

White Plastic

Dimensions

Width: 11 inches

Height: 11 inches (excluding flange)

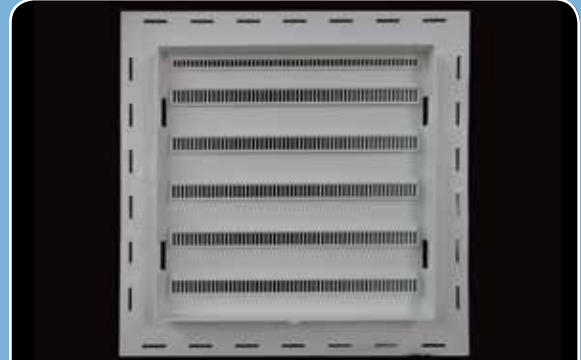
Net Open Area

30 sq. in.

Figure 25



FRONT FACE



BACK FACE

Material

White Plastic

Dimensions

Width: 16 inches

Height: 16 inches
(excluding trim flange)

Net Open Area

54 sq. in.

Figure 26



FRONT FACE



BACK FACE



FRONT FACE



BACK FACE

Material

White Plastic

Dimensions

Width: 14 inches
Height: 20 inches
(excluding trim flange)

Net Open Area

93 sq. in.

Figure 27



FRONT FACE



BACK FACE

Material

Black Plastic

Dimensions

Width: 16 inches
Height: 16 inches

Net Open Area

109.9 sq. in.

Figure 28

Material

Black Plastic

Dimensions

Width: 24 inches
Height: 24 inches

Net Open Area

246.26 sq. in.

Figure 29



FRONT FACE



BACK FACE

Material

Black Plastic

Dimensions

Width: 32 inches
Height: 12 inches

Net Open Area

135.8 sq. in.

Figure 30



FRONT FACE



BACK FACE

ADDITIONAL RESOURCES

NFIP Floodplain Management Requirements - 44 CFR 60.3 C (5) October 1986

- (5) “Require, for all new construction and substantial improvements, that fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or meet or exceed the following minimum criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided. The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of floodwaters.”

NFIP Insurance Requirements - NFIP Manual Lowest Floor Guide October 2014

“One of the following criteria must be met to satisfy this proper openings requirement for rating purposes:

- a. A minimum of 2 openings must be present, with positioning on at least 2 exterior walls, having a total net area of not less than 1 square inch for every square foot of enclosed area. The bottom of all openings must be no higher than 1 foot above the higher of the exterior or interior grade (adjacent) or floor immediately below the openings.
- b. If the enclosure floor is partially subgrade, a minimum of 2 openings must be present, with positioning on a single exterior wall adjacent to the lowest grade next to the building, having a total net area of not less than 1 square inch for every square foot of enclosed area. The bottom of all openings must be no higher than 1 foot above the higher of the exterior or interior grade (adjacent) or floor immediately below the openings.

If engineered openings are used as an alternative, the Write Your Own (WYO) Company or NFIP Servicing Agent must obtain a copy of the following documentation for its underwriting files:

- a. For engineered openings designed for installation in a specific building, a copy of the certification is required. This certification will verify to community officials that the openings are designed in accordance with the requirements of the NFIP, applicable building codes, and accepted standards of practice. The original certification statement must include the design professional’s name, title, address, type of license, license number, the state in which the license was issued, and the signature and applied seal of the certifying registered design professional. In addition, this certification shall identify the building in which the engineered openings will be installed and it shall address the following: (1) a statement certifying that the openings are designed to automatically equalize hydrostatic flood loads on exterior walls by allowing for the automatic entry and exit of floodwaters; (2) description of the range of flood characteristics tested or computed for which the certification is valid, such as rates of rise and fall of floodwaters; and (3) description of the installation requirements or limitations that, if not followed, will void the certification; or

- b. For engineered openings for which the International Code Council Evaluation Service, Inc., has issued an Evaluation Report, a copy of the Evaluation Report is required. The Evaluation Report identifies the model numbers of the engineered openings addressed in the report, specifies the number of engineered openings that are required for a specified square footage of enclosed area below the BFE, and lists installation requirements. Acceptable documentation must include the model numbers of the engineered openings, which must match the model numbers provided in the International Code Council Evaluation Report.”

2015 International Residential Code Requirements - R322.2.2 & R322.2.2.1

R322.2.2 Enclosed area below design flood elevation.

2. “Be provided with flood openings that meet the following criteria and are installed with accordance with section R322.2.2.1:
 - 2.1. The total net area of openings shall be not less than 1 square inch (645 mm²) for each square foot (0.093 m²) of enclosed area where the enclosed area is measured on the exterior of the enclosure wall, or the openings shall be designed as engineered openings and the construction documents shall include a statement by a registered design professional that the design of the openings will provide for equalization of hydrostatic flood forces on exterior walls by allowing for the automatic entry and exit of floodwaters as specified in section 2.6.2.2 of ASCE 24.
 - 2.2 Openings shall be not less than 3 inches (76 mm) in any direction in the plane of the wall.”

R322.2.2.1 INSTALLATION OF OPENINGS. “The walls of enclosed areas shall have openings installed such that:

1. There shall be not less than two openings on different sides of each enclosed area; if a building has more than one enclosed area below the design flood elevation, each area shall have openings on exterior walls.
2. The bottom of each opening shall be not more than 1 foot (305 mm) above the higher of the final interior grade or floor and the finished exterior grade immediately under each opening.
3. Openings shall be permitted to be installed in doors, and windows; doors and windows without installed openings do not meet the requirements of this section.”

2015 International Building Code Requirements - Section 1612.5 1.2

- 1.2. "For fully enclosed areas below the design flood elevation where provisions to allow for the automatic entry and exit of floodwaters do not meet the minimum requirements in Section 2.6.2.1 of ASCE 24, construction documents shall include a statement that the design will provide for equalization of hydrostatic flood forces in accordance with Section 2.6.2.2 of ASCE 24."

ASCE/SEI 24-14 – Flood Resistant Design and Construction (2.7)

2.7.1.1 Openings In Breakaway Walls

"Openings to allow for the automatic entry and exit of floodwaters during design flood conditions shall be installed in breakaway walls in all flood hazard areas. Openings shall meet the requirements of section 2.7.2 and installed in accordance with section 2.7.3"

2.7.2 Design of Openings

"Flood openings can be engineered or non-engineered but should safely allow equalization of hydrostatic pressure outside and inside any enclosure below the DFE. FEMA Technical Bulletin 1, Openings in Foundation Walls and Walls of Enclosures (FEMA 2008d) has an expanded discussion of opening requirements. "

2.7.2.1 Non-Engineered Openings

"Non-engineered openings shall meet the following criteria: (1) The total net open area of all openings shall be at least 1 sq. in. for each sq. ft. of enclosed area, where the enclosed area is measured on the exterior of the enclosure walls; (2) openings shall not be less than 3 in. in any direction in the plane of the wall; and (3) the presence of louvers, blades, screens, and faceplates or other covers and devices shall not block or impeded the automatic flow of floodwaters into and out of the enclosed areas and shall be accounted for in the determination of the net open area."

2.7.2.1 Engineered Openings

"Engineered Openings shall meet the following criteria:

- 1) "Each individual opening shall be designed to allow automatic entry and exit of floodwaters during design flood or lesser flood conditions;
- 2) The performance of engineering openings shall account for the presence of louvers, blades, screens, grilles, faceplates, or other covers and devices;
- 3) Openings shall not be less than 3 in. in any direction in the plane of the wall;
- 4) The performance of engineered openings shall ensure that the difference between the exterior and interior floodwater levels shall not exceed 1 ft."

C2.7.2.2 *The NFIP and building codes require the design of engineered openings to be certified by a registered design professional. Certification requires more than simply applying the equation in this section; it requires consideration of a number of factors that represent expected base flood conditions. Worst case rates of rise and fall must be determined, opening shape and size (which affect flow efficiency) must be assessed, the potential for debris blockage must be evaluated, and the effect of any louvers, blades, screens, grilles, faceplates or other covers and devices must be considered. The best means to certify performance is to test engineered opening devices under*

Company Name _____

Certifier Name _____

Date of Elevation Certificate Completion _____



Non-Engineered Opening Agreement

for Owners of Structures in a Special Flood Hazard Area: A and V type zones

Subject Property Address:

Lot and Block Number:

Property Owner Name(s):

Property is in compliance with Non-Engineered Opening requirements? Yes No

The property owner acknowledges and agrees to the following:

1. That they are an owner of the above property.
2. That they understand that the flood openings identified on the Elevation Certificate under section A8 and A9, when applicable, are Non-Engineered Openings intended for hydrostatic flood relief.
3. That they must remain open at all times and cannot be covered, closed off, or blocked in any way.
4. That modifications to these openings could result in a greater risk to their property and personal safety in addition to increased Flood Insurance costs.
5. At the time of the flood opening survey this property required _____ square inches of net open area. _____ Non-Engineered Openings were identified providing _____ square inches of flood venting relief.

Date

Signature of Property Owner

Date

Signature of Property Owner

DISCLAIMER: A copy of this agreement will be sent to the local municipality office for floodplain management purposes.



NON-ENGINEERED OPENING GUIDE