AMCA International

Rain and Hurricane Resistant Louvers

Jim Smardo

Director Architectural Systems, Ruskin, Kansas City, MO.

jsmardo@ruskin.com

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Professional Development Hours (PDH) Certificates

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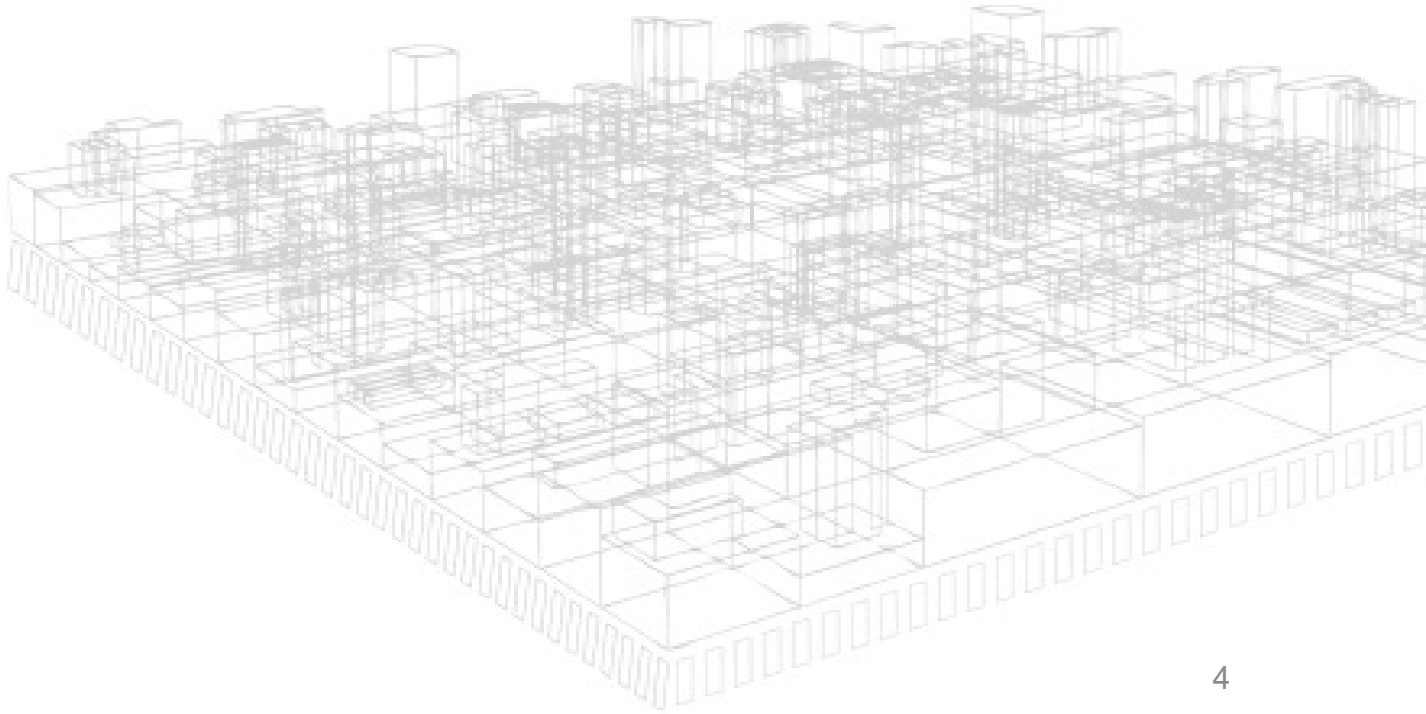
Learning Objectives

- Transition from traditional louvers to wind driven rain louvers
- Driving specification changes to WDR louvers
- Origin of Code and louver requirements in coastal area's
- Agencies that regulate
- Building Risk categories
- Test Methods



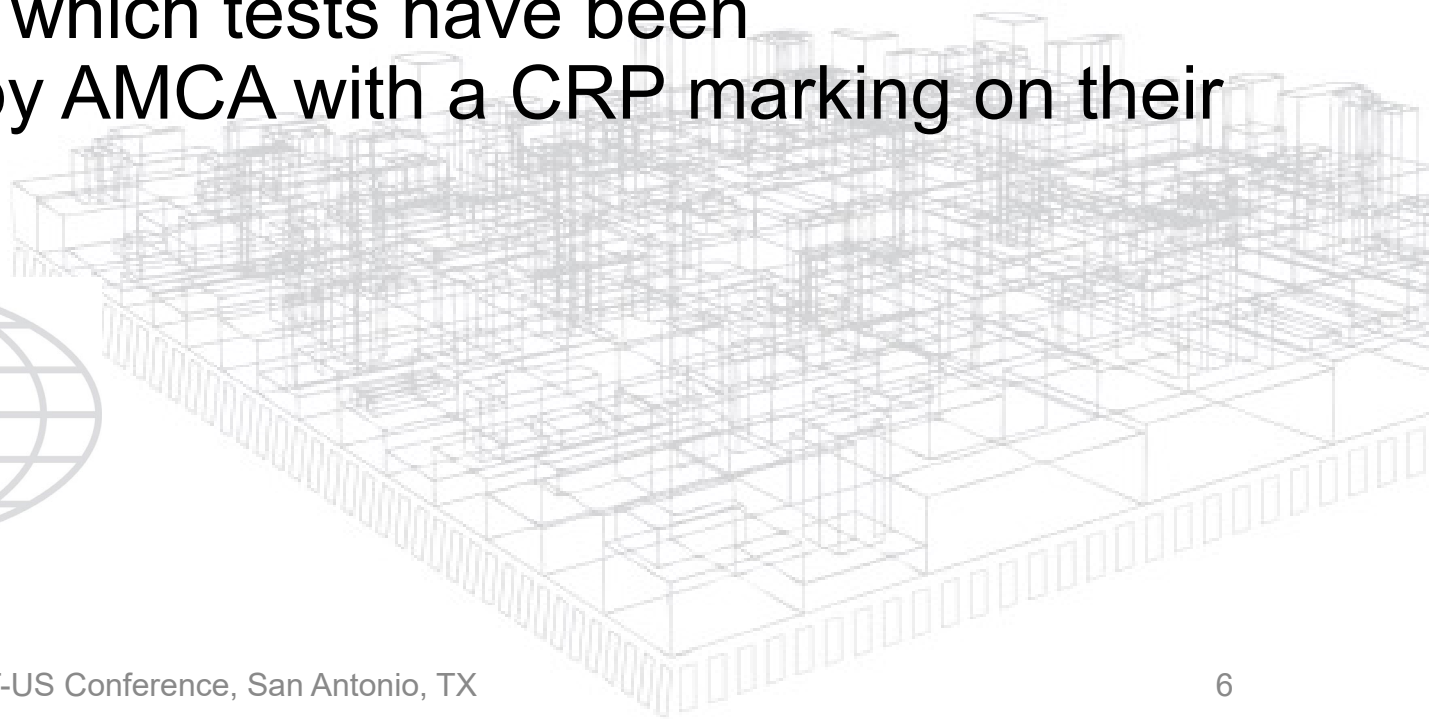
AMCA 500-L

- 500-L consists of five different testing protocols for testing louvers
  - Pressure Drop
  - Airflow Leakage
  - Water Penetration
  - Wind-Driven Rain
  - Wind-Driven Sand

AMCA 500-L gives you the testing parameters for testing louvers and confirms performance, AMCA 511 was written to give guidance on how to certify the louvers that are tested

AMCA 500-L

- Upon testing, manufacturers can show that their louver has been part of AMCA's certified ratings program (CRP)
  - Important because not all manufacturers certify product
- Manufacturers can identify which tests have been independently conducted by AMCA with a CRP marking on their submittal page

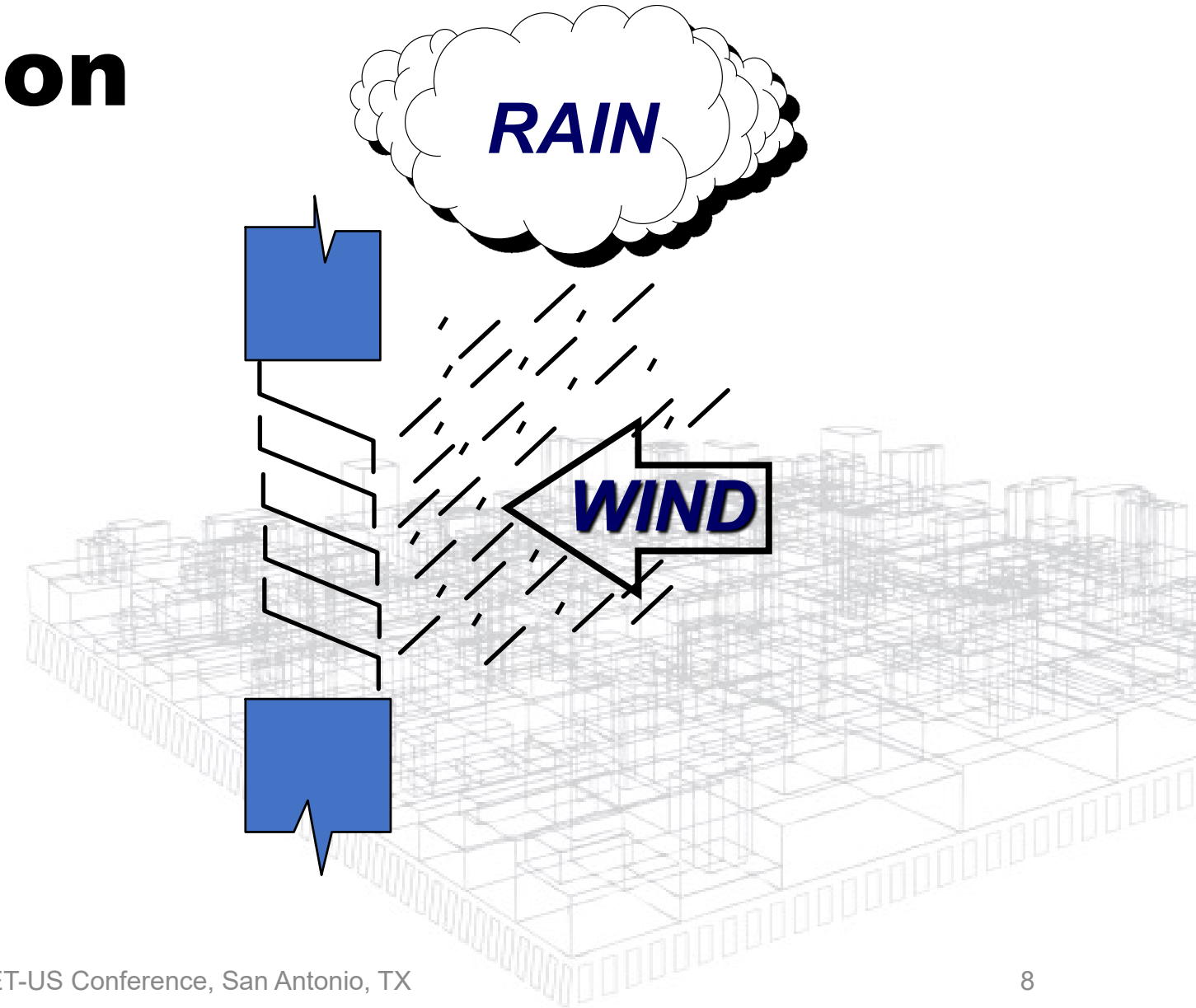


Traditional Louvers

- Typically sized at 600 to 800 fpm intake velocity
- Drainable blades for intake applications
- Some very high performing traditional models
- How much water is allowed?
  - Adequate drainage
  - Equipment that needs to be kept dry

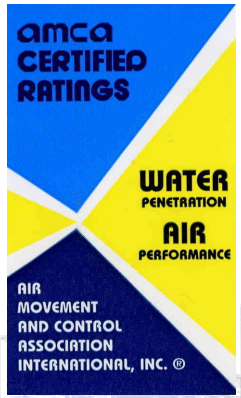
Rain Penetration

- Problems
  - Generators
  - Electrical
  - Switchgear
  - Mold Growth
  - Ceilings, Drywall
  - Slick Floors
  - Standing water



Traditional Louver Technology

- Design Characteristics
  - Wide Blade Spacing
  - High Free Area
  - Low Cost
  - Low Pressure Drop
  - Not Effective In Storms



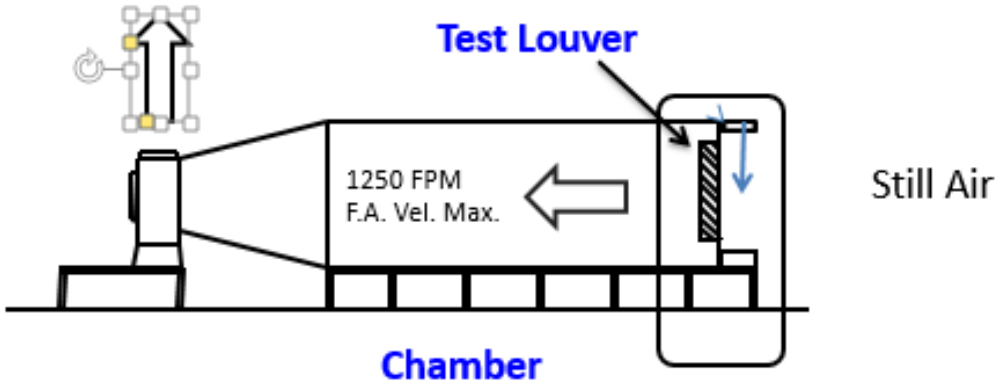
Wind Driven Rain Louver Technology

- Design Characteristics
  - Close Blade Spacing
  - Lower Free Area
  - Greater Velocities
  - Higher Pressure Drop
  - Effective water rejection in storm conditions

Still Air Test

- Test Conditions
  - 4” per hour rain - light vertical rain
  - 1250 fpm max free area velocity
  - Approx. 14 mph
  - Tested for beginning point of water penetration based on free area velocity
  - 48” x 48” sample size
  - No screen

Still Air Test

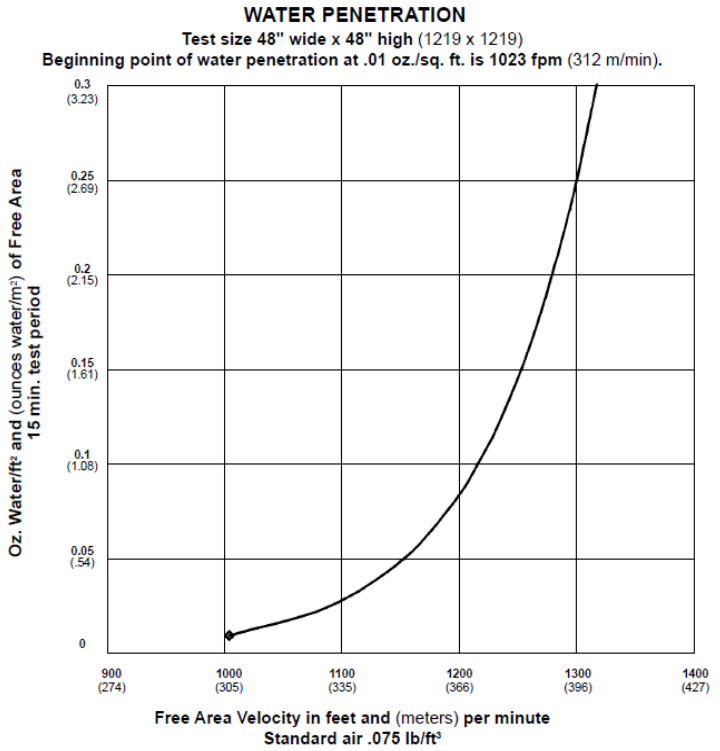


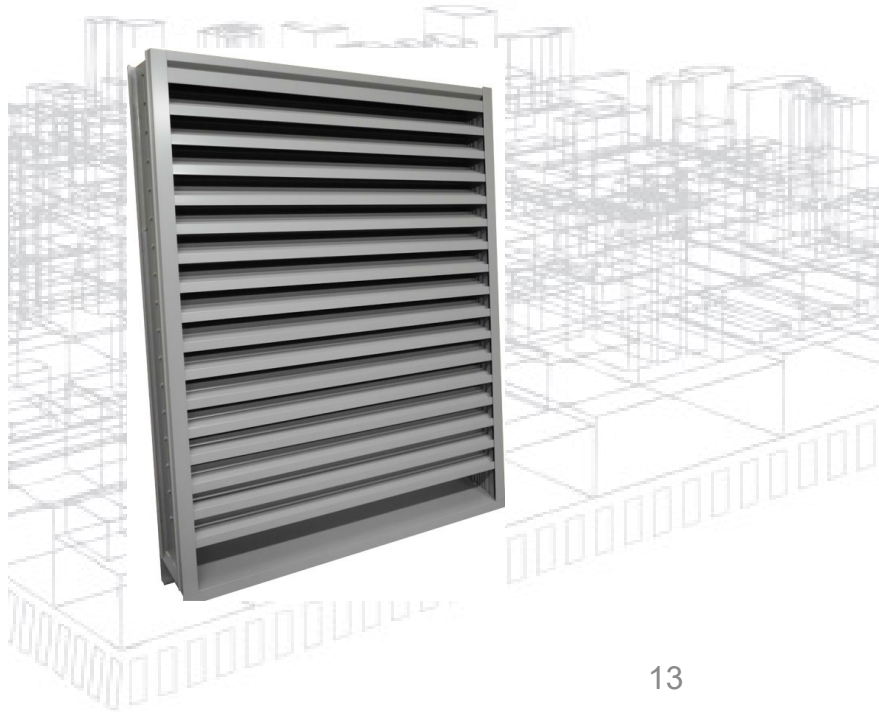
Still Air

Beginning Point of Water penetration-
.01 oz. of water per sq/ft. at X FPM F.A. Vel.

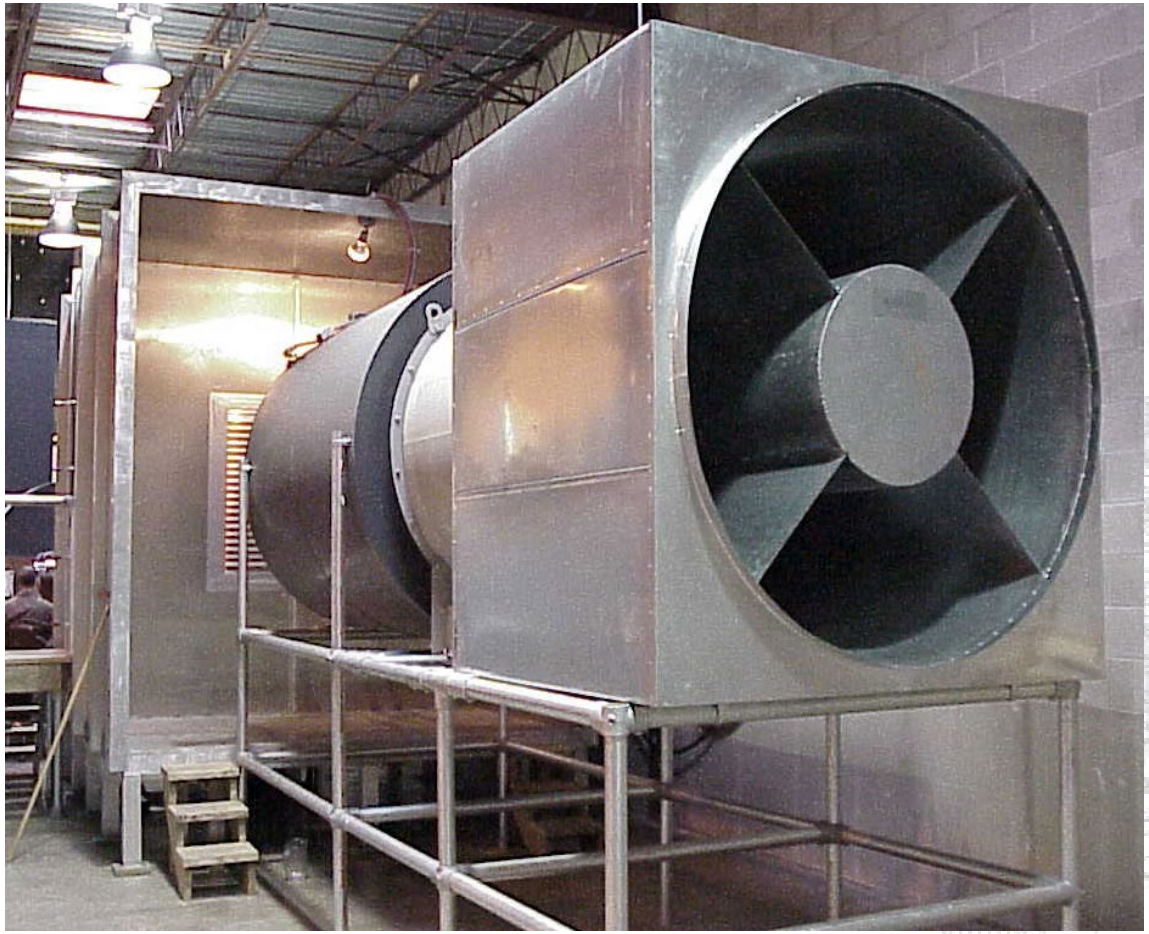
AMCA 500-L Still Air Test Louvers

- Defines the beginning point of water penetration by intake air velocity where water begins to penetrate the louver
  - Not meant to give water penetration under service conditions (wind-driven rain)



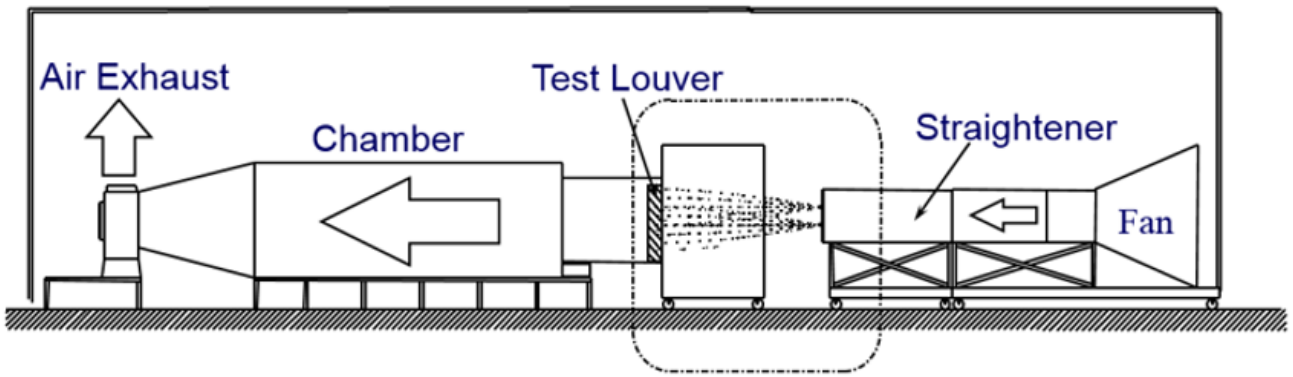


Wind Driven Rain Technology



AMCA 500-L Wind-Driven Rain Test for Louvers

- The chamber behind the louver is fully pressurized with an exhaust fan trying to draw water through the louver's blades during the testing procedure (30 minute testing period)
  - Test values are noted at regular intervals and are not more than 10 minutes apart
  - The test procedure is completed when a minimum of 4 consecutive readings within the steady state of tolerance has been noted



WDR Test

AMCA500-L Wind Driven Rain Test

WIND-DRIVEN RAIN PERFORMANCE – AMCA 500-L WIND-DRIVEN RAIN TEST

Test size is 1m x 1m (39" x 39") core area, 1.05m x 1.08m (41 1/4" x 42 5/16") nominal. Free Area of test louver is 4.86 ft² (.45m²).

Wind Velocity mph (kph)	Rain Fall Rate In./hr. (mm/hr.)	Core Velocity$_1$ fpm (m/s)	Airflow cfm (m³/min)	Free Area Velocity$_2$ fpm (m/sec.)	Effectiveness Ratio	Class$_{3,4}$	Discharge Loss Class$_5$ Intake
29 (46.4)	3 (76)	970 (5)	10,444 (295)	2,149 (10.9)	99.9%	A	2
50 (80.5)	8 (203)	982 (5)	10,570 (298)	2,175 (11.0)	99.8%	A	2

NOTES

1. Core area is the open area of the louver face (face area less louver frames).
   Core Velocity is the airflow velocity through the Core Area of the louver (1m x 1m). 5 m/s is the maximum core velocity utilized in this test.
2. Free Area of test size is calculated per AMCA standard 500-L.
3. Wind Driven Rain Penetration Classes:

Class	Effectiveness
A	1 to .99
B	0.989 to 0.95
C	0.949 to 0.80
D	Below 0.8

4. The EME6625 provides class A performance at all velocities up to and including 5 m/s core velocity.
5. Discharge Loss Coefficient is calculated by dividing a louvers' actual airflow rate vs. a theoretical airflow for the opening. It provides an indication of the louvers' airflow characteristics.

Class	Discharge Loss Coefficient
1	0.4 and above
2	0.3 to 0.399
3	0.2 to 0.299
4	0.199 and below

(The higher the coefficient, the less resistance to airflow.)

6. The AMCA Wind Driven Rain Test is performed in a laboratory environment and incorporates controlled wind, water and system airflow effects. In actual field installations, storms may create conditions not considered by the AMCA test. Penthouse and similar applications where wind can pass through multiple louvers in an enclosure is another condition that is not simulated by AMCA tests. These applications can create elevated water penetration rates through any louver. Because of these uncontrolled situations it is recommended that provisions to manage water penetration through louvers be included in the building design.

amca CERTIFIED RATINGS AIR PERFORMANCE WIND DRIVEN RAIN AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC.

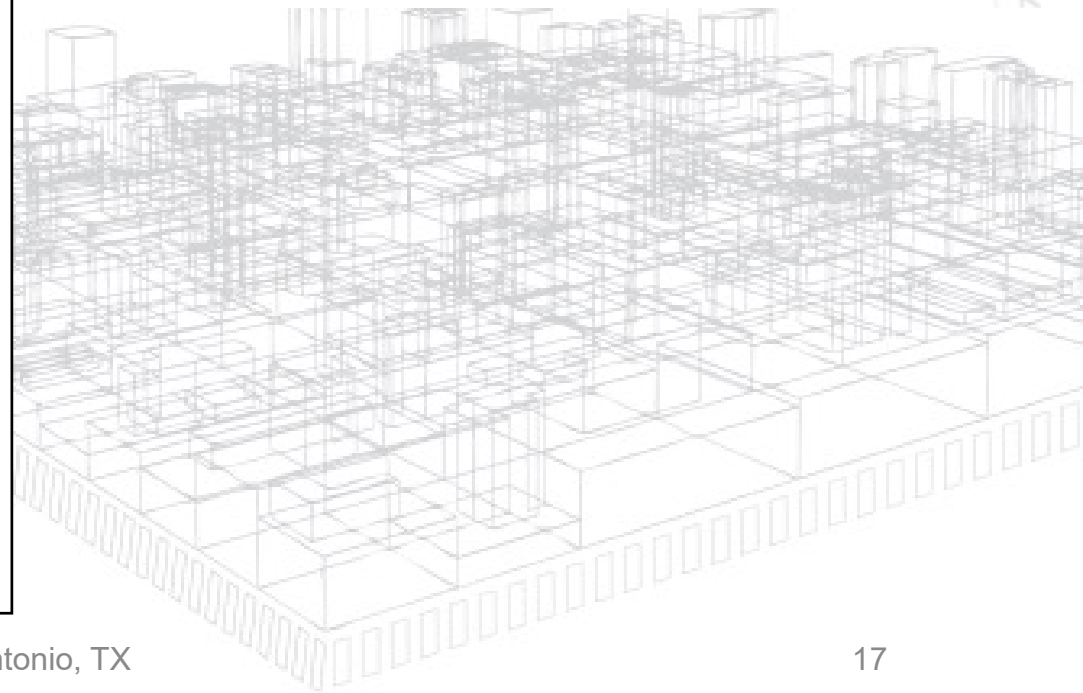
Ruskin Company certifies that the Louver shown herein is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 511 and comply with the requirements of the AMCA Certified Ratings Program. The AMCA Certified Ratings Seal applies to air performance ratings and wind driven rain ratings only.

Class A – 99% to 100% effective

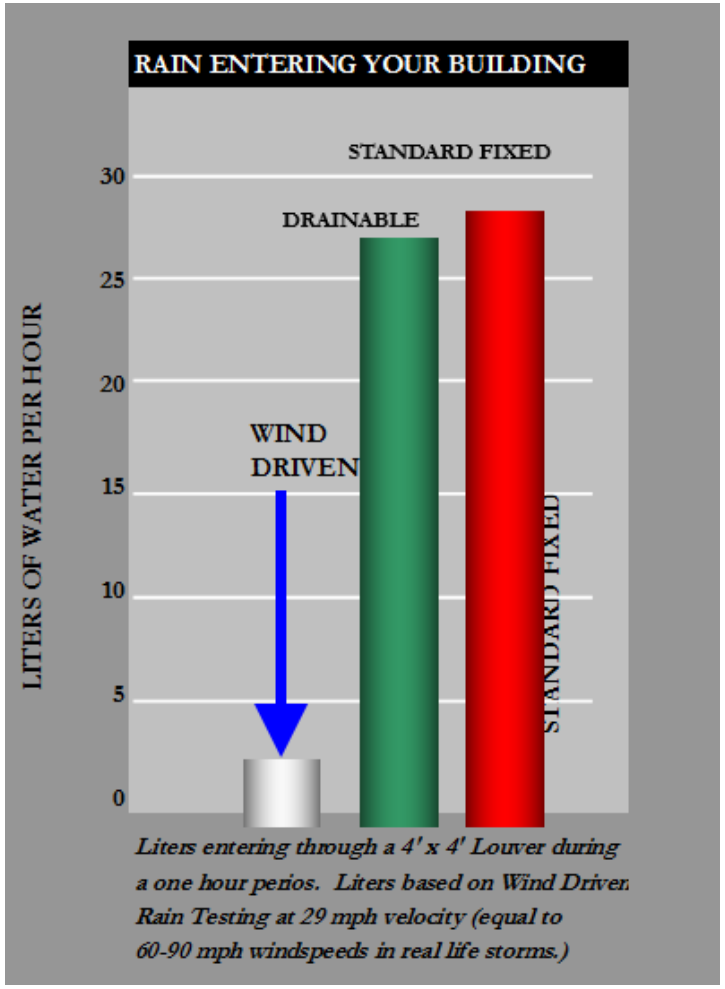
Class B – 95% to 98.9% effective

Class C – 80% to 94.9% effective

Class D – Anything below 80% effective



Still Air VS WDR



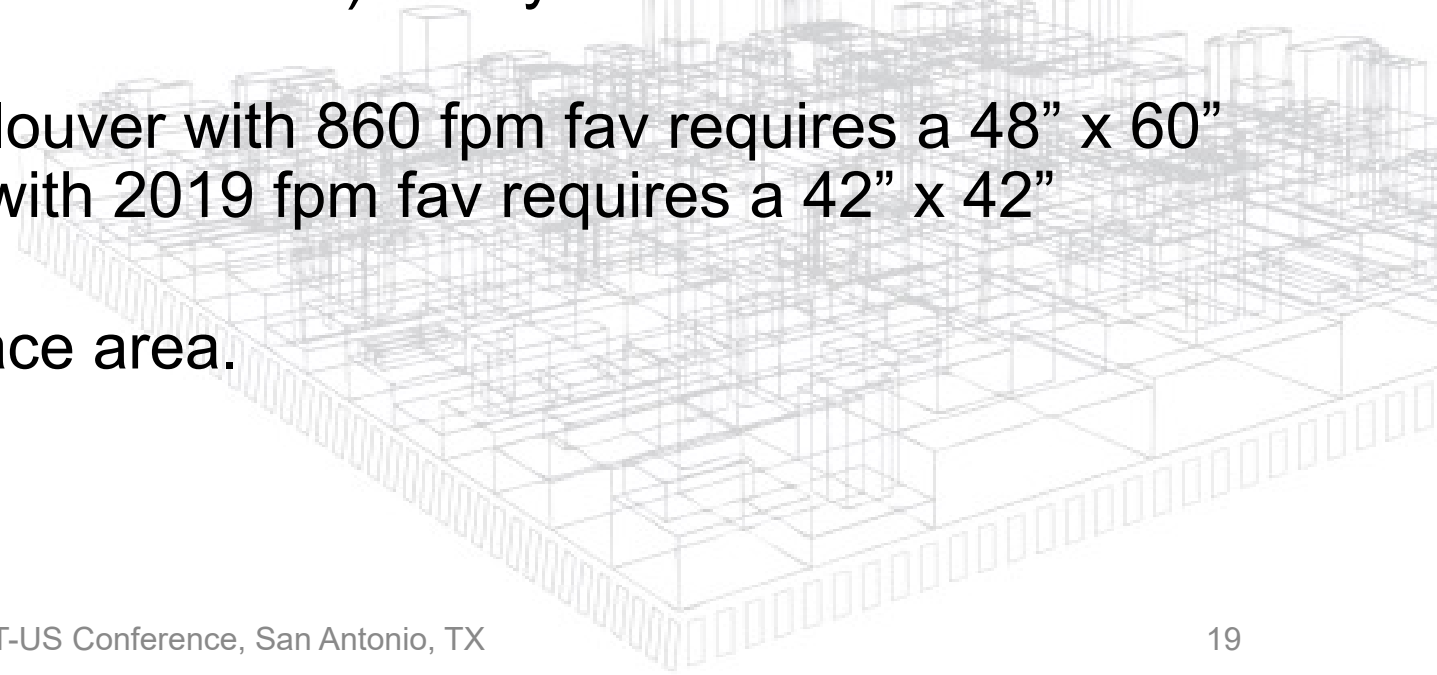
AMCA Wind Driven Rain test

Based on Wind Driven Rain test- 3" per hour at 29 mph wind velocity, wind tunnel pulling 1300 FPM

29 liters = Approximately 7 gallons

Sizing Tips

- Free area not necessarily the most important characteristic
- Pressure drop generally becomes the limiting factor
  - Low free area can be offset by low pressure drop
  - Still area louvers require a (15% to 25%) safety factor – WDR louvers do not
  - At 10,000 CFM a 6” still air louver with 860 fpm fav requires a 48” x 60” louver – A 6” vertical WDR with 2019 fpm fav requires a 42” x 42” louver
  - A difference if 7.75 sq. ft.. face area.



Sizing Louvers – 48” Sq.

6” Horizontal Still Air

- Free Area: 9.08 ft² - 57%
- F.A. Vel.: 870 fpm
- Volume: 7,900 cfm
- .13” Δp
- No W.D. Rain Resistance

5” Horizontal WDR

- Free Area: 6.99 ft² - 44%
- F.A. Vel.: 1327 fpm
- Volume: 9,276 cfm
- .25” Δp
- 99.7% Rain Resistance (29 mph/3” hr)
- 17% More Volume!

Sizing Louvers – 48” Sq.

6” Horizontal Still Air

- Free Area: 9.08 ft² - 57%
- F.A. Vel.: 870 fpm
- Volume: 7,900 cfm
- .13” Δp
- No WDR resistance
- Best Still Air 65% @ 3” 29mph

6” Vertical WDR

- Free Area: 6.80 ft² - 43%
- F.A. Vel.: 2175 fpm
- Volume: 14,790 cfm
- .35” Δp
- 99.8% Rain Resistance (50 mph/8” hr)
- 87% More Volume!

Hurricane Louvers

Organizations associated with Florida & Coastal codes for louvers

Miami-Dade
http://www.miamidade.gov/building

ICC
http://www.iccsafe.org/

AMCA
https://www.amca.org/

Florida Building Code
https://floridabuilding.org

What Started the Code Requirements in Florida

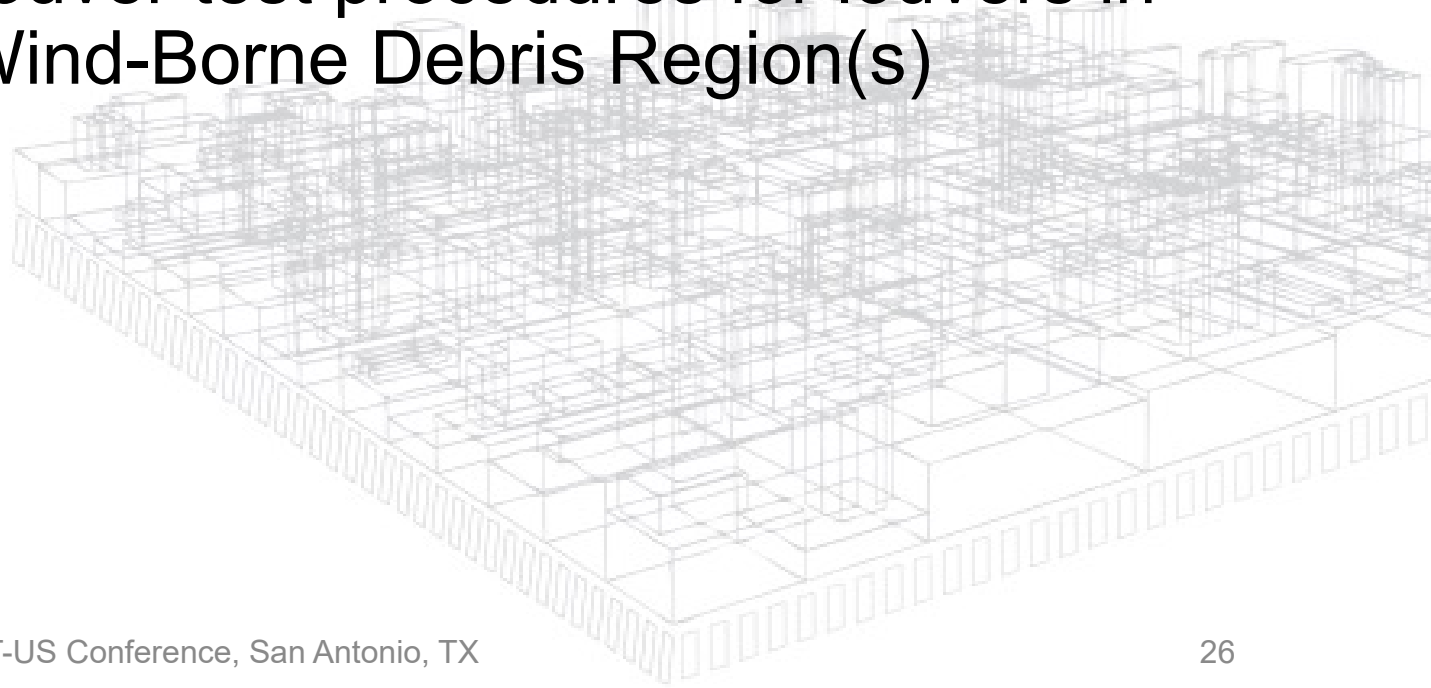
- Hurricane Andrew made land fall in South Florida in August of 1992
- Only one of three hurricanes to hit land while still a Category 5 Hurricane
- 165 mph winds sustained/over 200 mph wind gusts

The Aftermath of Andrew

- $26.5 Billion in damage - In Todays Dollars $50 billion

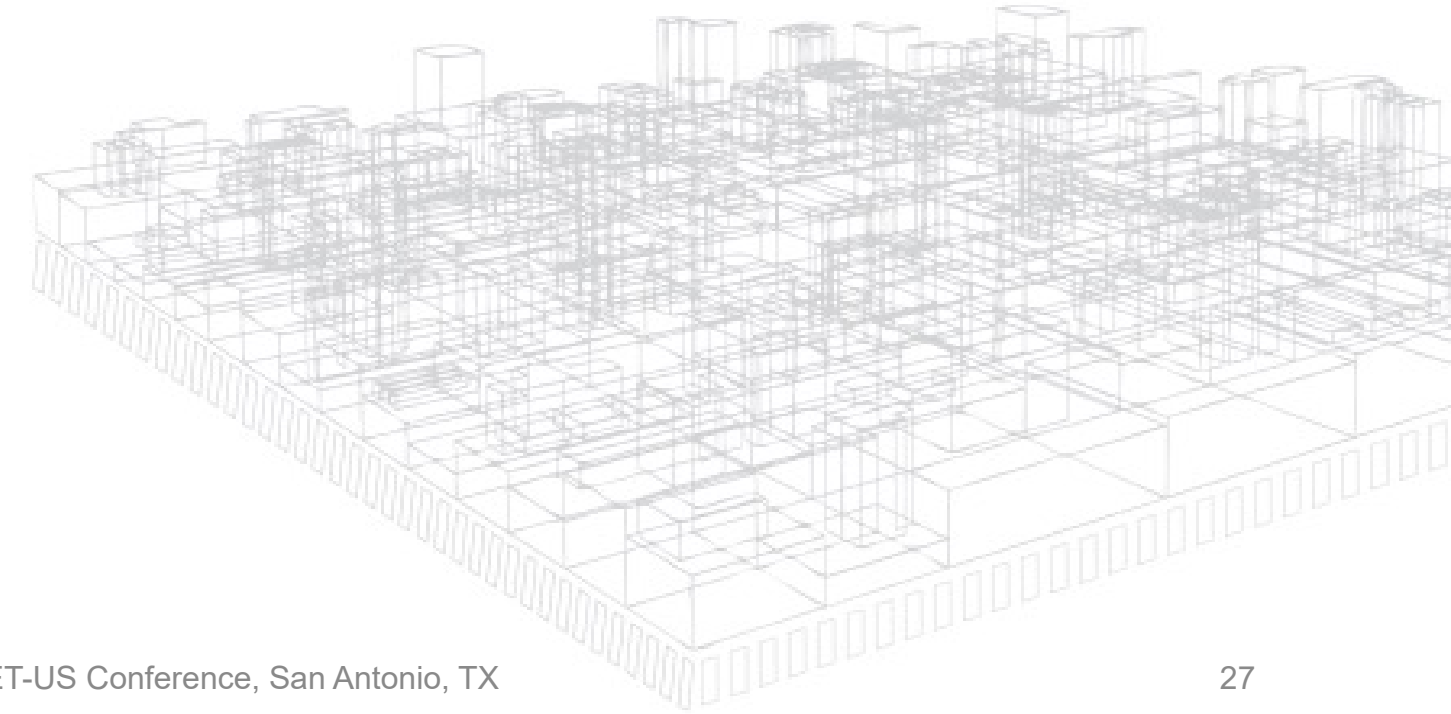
Hurricane Louvers

- Understanding the International Building Code and International Mechanical Code Requirements for louvers in the Hurricane-Prone and Wind-Borne Debris Region(s)
- Explanation of applicable louver test procedures for louvers in the Hurricane-Prone and Wind-Borne Debris Region(s)
  - AMCA 540 and AMCA 550



International Code Council (ICC)

- Standards for construction
  - No testing protocols
  - Does reference AMCA 540/550 for coastal regions along the Atlantic and gulf coast

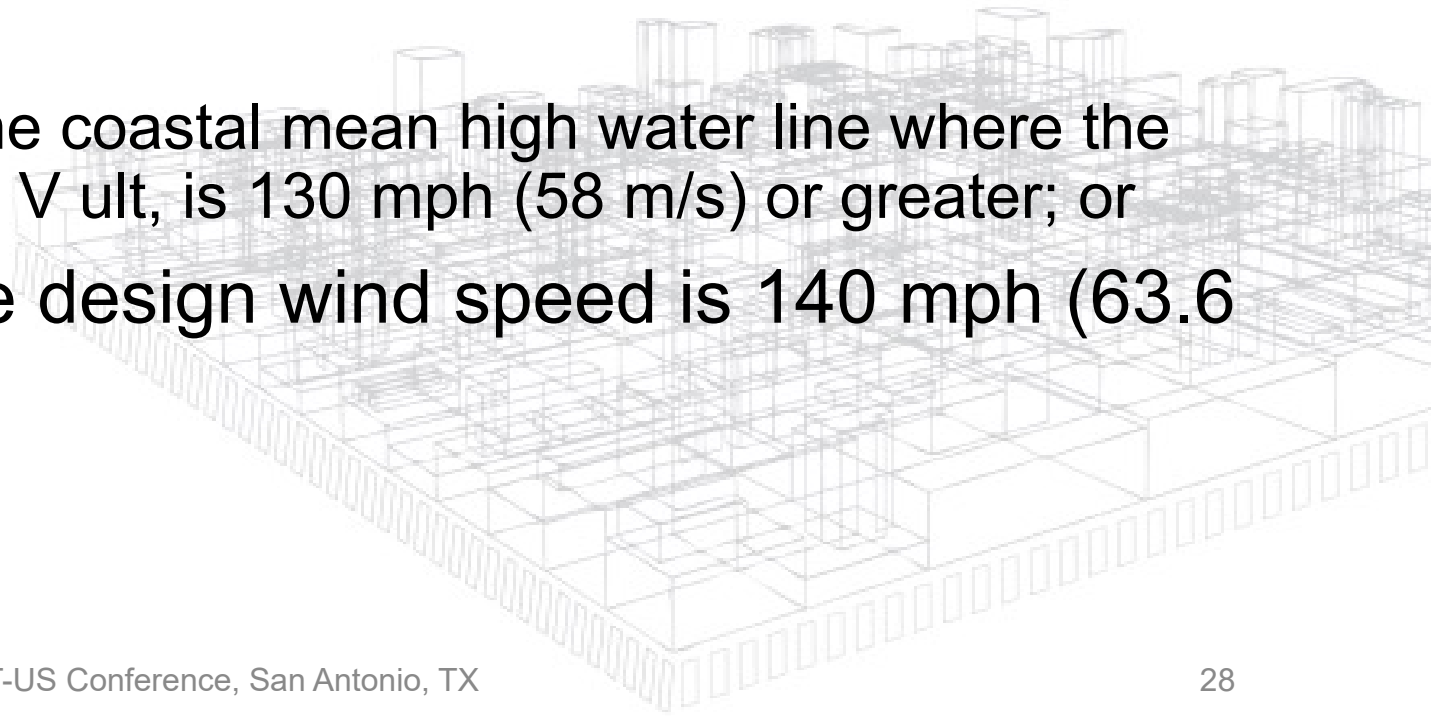


IBC 2012/2015 Building Code Language

IBC 2012/2015 Building Code

Chapter 2: Definitions

- Wind-Borne Debris Region. Areas within hurricane-prone regions located:
  - Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, V ult, is 130 mph (58 m/s) or greater; or
- In areas where the ultimate design wind speed is 140 mph (63.6 m/s) or greater.



IBC 2012/2015 Building Code Language

IBC 2012/2015 Building Code

Chapter 16: Structural Design

- 1609.1.2.1 Louvers. (as it pertains to the Wind-Borne Debris Region)
- “Louvers protecting intake and exhaust ventilation ducts not assumed to be open that are located within 30 feet (9144mm) of grade shall meet the requirements of AMCA 540.”

2017 Florida – 6th Edition

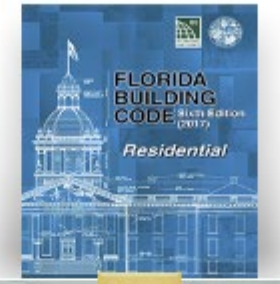
- Plumbing
- Residential
- Energy Conservation
- Building
- Mechanical
- Test Protocols
- Accessibility
- Existing Building
- Fuel Gas
- Went into effect Dec. 31st 2017

2017 Florida 6th Edition

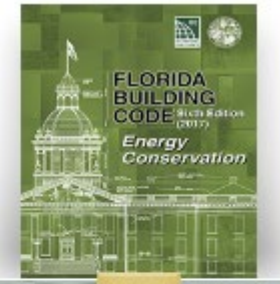
FBC, Mechanical
(First Printing: Jul 2017)

FBC, Plumbing
(First Printing: Jul 2017)

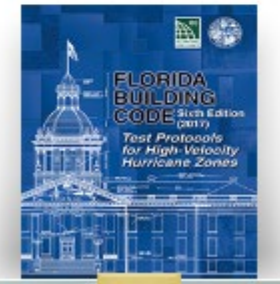
FBC, Residential
(First Printing: Jul 2017)



FBC, Energy Conservation
(First Printing: Jul 2017)



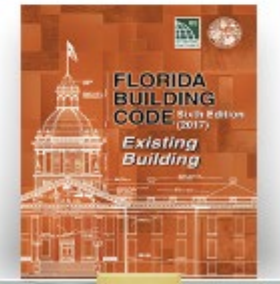
FBC, Test Protocols
(First Printing: Jul 2017)



FBC, Building
(First Printing: Jul 2017)

FBC, Accessibility
(First Printing: Jul 2017)

FBC, Existing Building
(First Printing: Jul 2017)



ANSI/AMCA 540-Test Method of Louvers Impacted by Wind Borne Debris

- Test procedure measures a products capacity to withstand impact from wind borne debris in hurricane wind velocities
  - Test Missile: 9 lb 2 x 4
  - Distance: 12-feet (9 ft.. long missile)
  - Impact Velocity:
    - 3 units tested
    - Shortest blade span
    - Longest unsupported span
    - Mullion location

AMCA Testing Standards - 540

- AMCA 540
  - Pass/Fail Criteria
    - No penetration of the blade material by the excepting fragments
    - Fragments produced by the missile shall not exceed five per cent of the missile's weight
    - Louver must remain attached to adjacent parts or components

AMCA Testing Standards - 540

- AMCA 540
  - Minimum of three specimens impacted
    - Requires the minimum and maximum sections to be tested
    - Can be one single-section and one multi-section

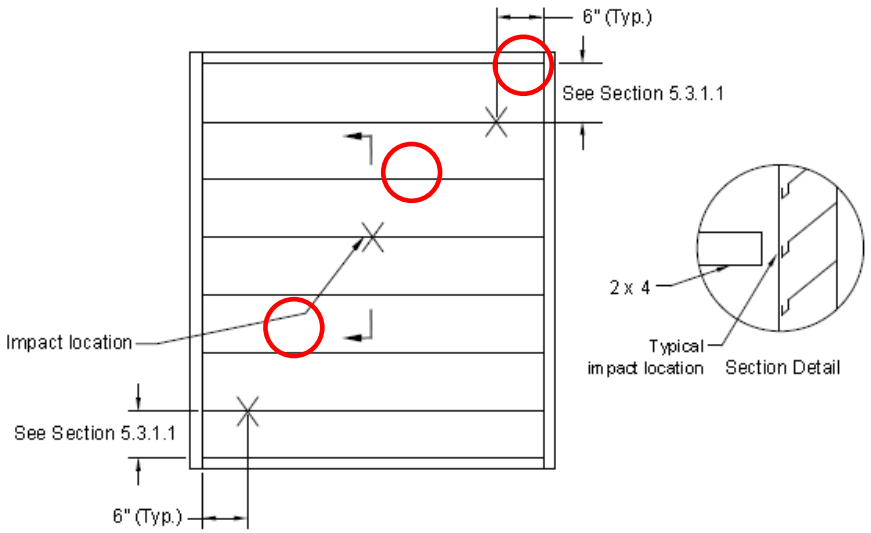


Figure 1
Impact Locations for Testing Single Section, Horizontal Blade Louver

Horizontal

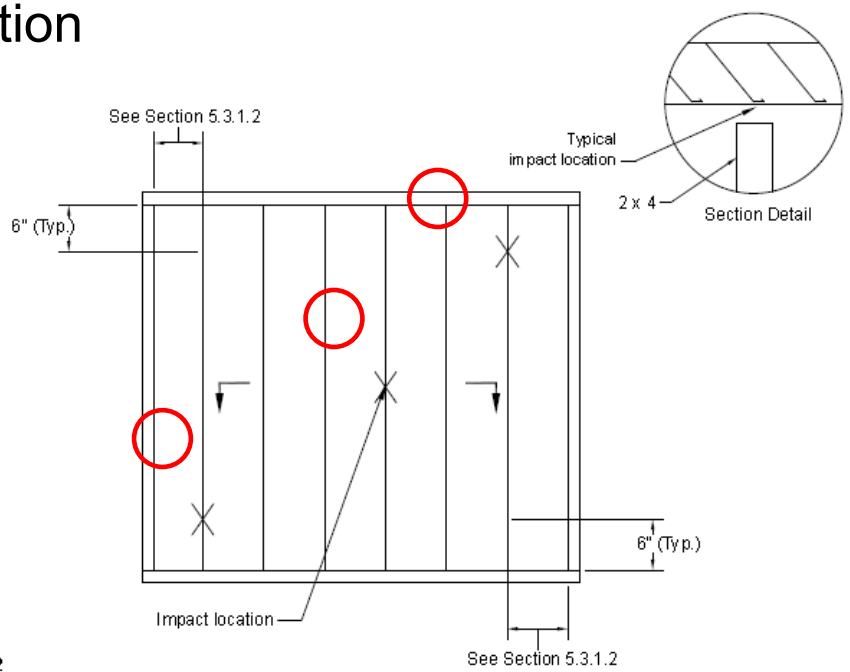
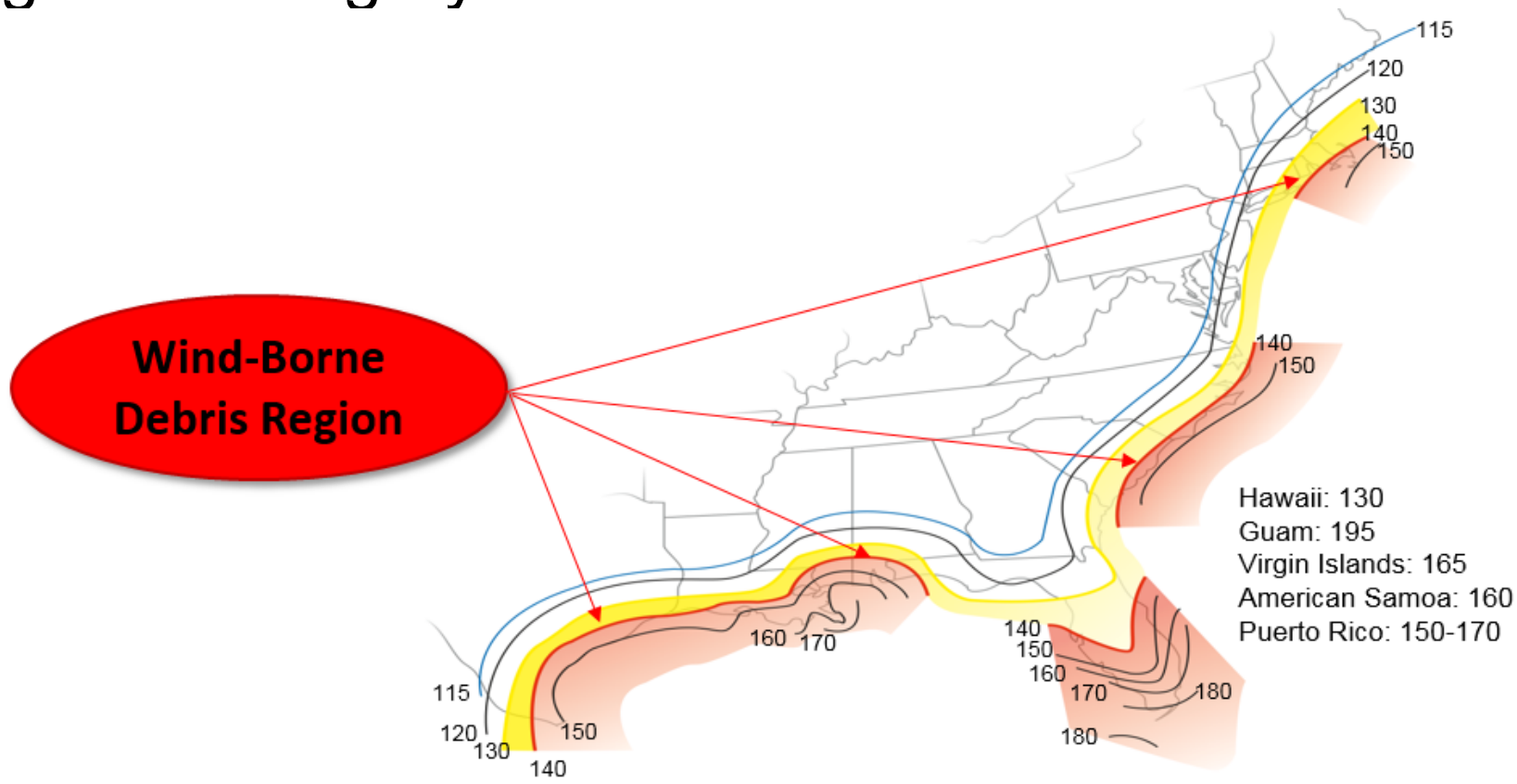


Figure 2
Impact Locations for Testing Single Section, Vertical Blade Louver

Vertical

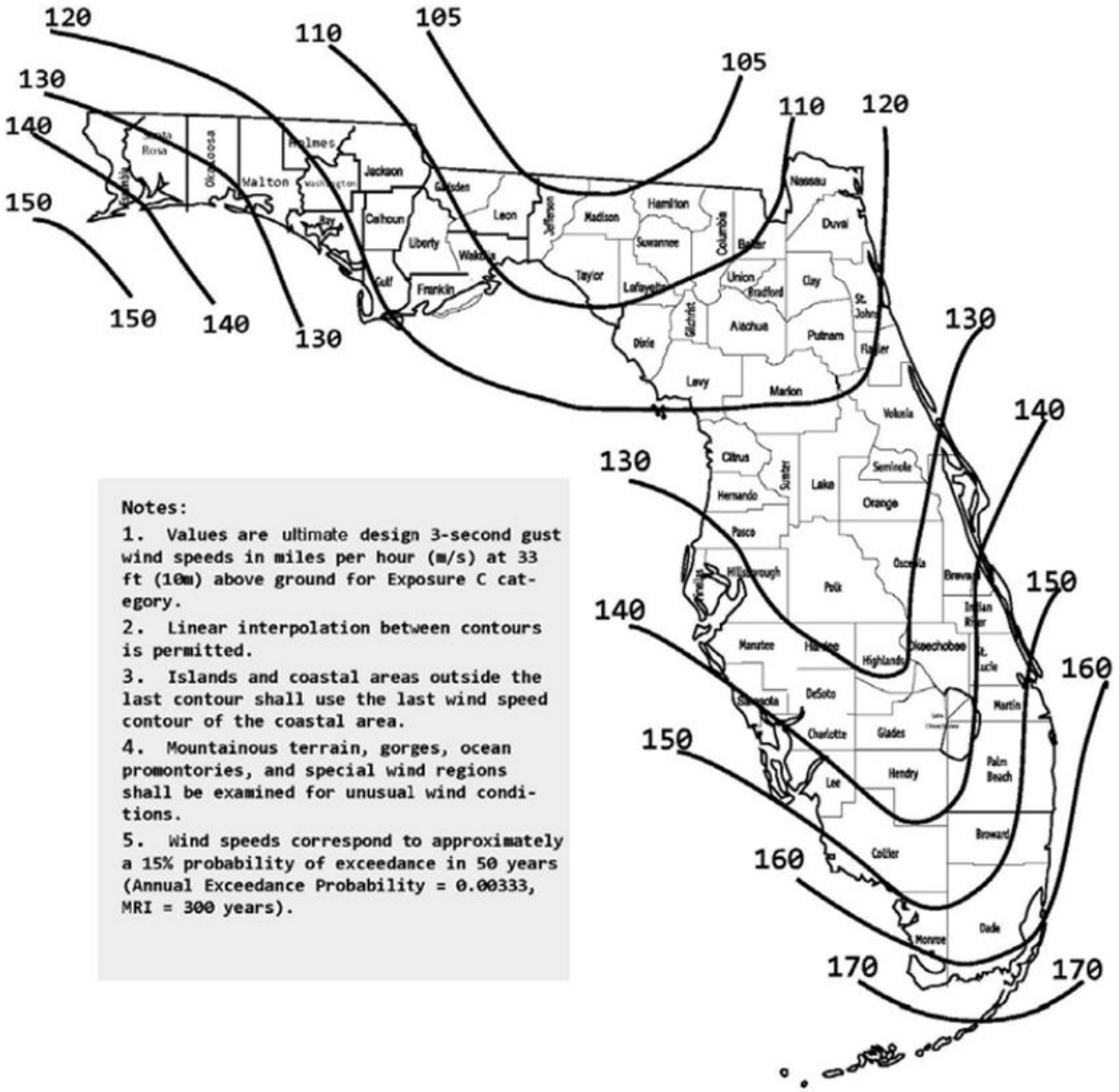
IBC 2012/2015

- Building Risk category I & II



IBC 2012/2015

- Building Risk category I & II



Risk Categories of Buildings and Other Structures

Category I

- Buildings and structures that represent a low hazard to human life in the event of failure
- Wind velocity (3-second gusts) used in calculations are 165 mph (Miami-Dade) and 156 mph (Broward)
- Includes but not limited to:
  - Agricultural facilities
  - Certain temporary facilities
  - Minor storage facilities
  - Screen enclosures

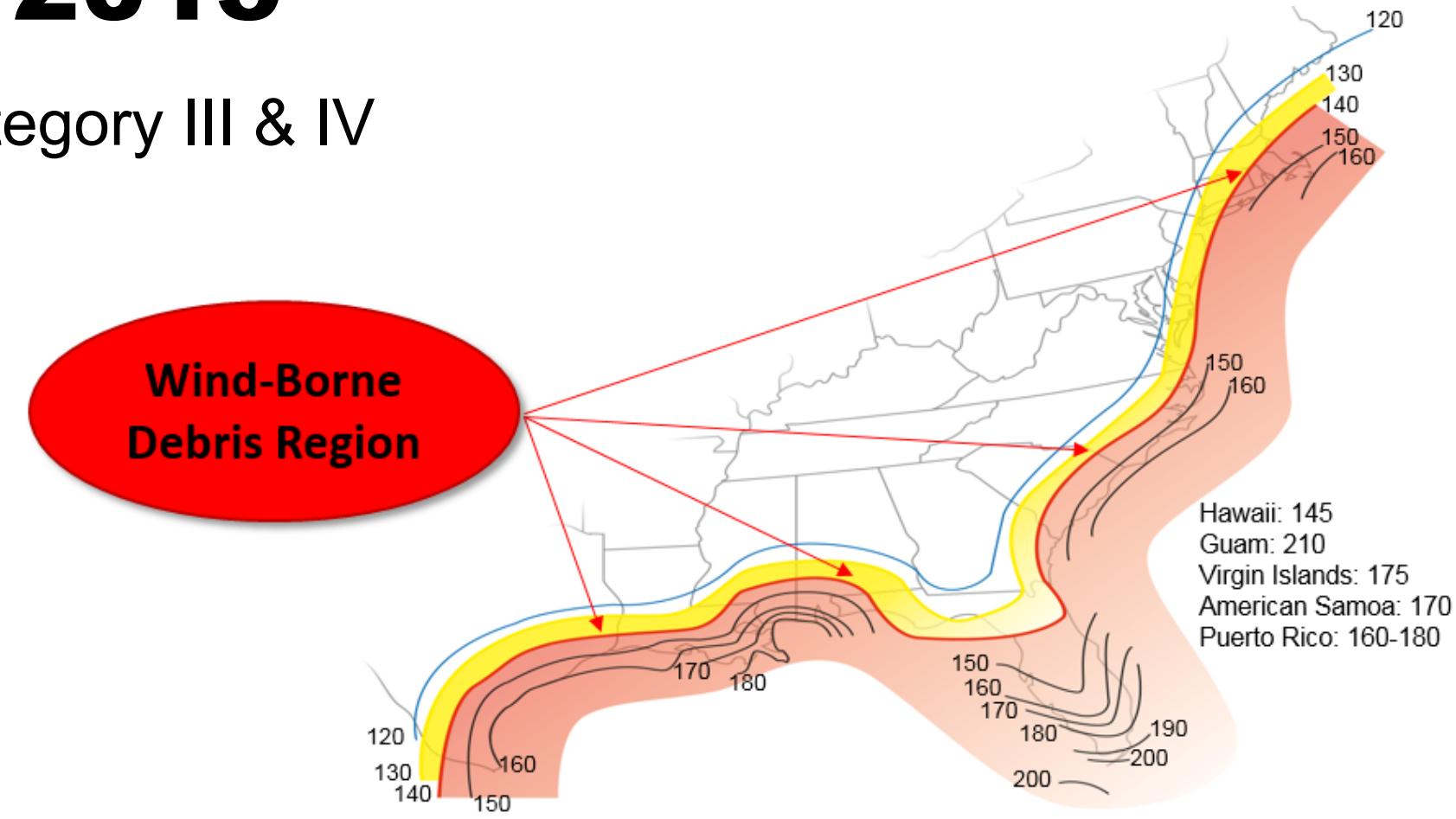
Risk Categories of Buildings & Other Structures

Category II

- Buildings and other structures except those listed in Risk Categories I, III, and IV
- Wind velocity (3-second gusts used in calculations are 175 mph (Miami-Dade) and 170 (Broward)
- Examples:
  - Typical business with occupancy load less than 300
  - Non-essential facilities

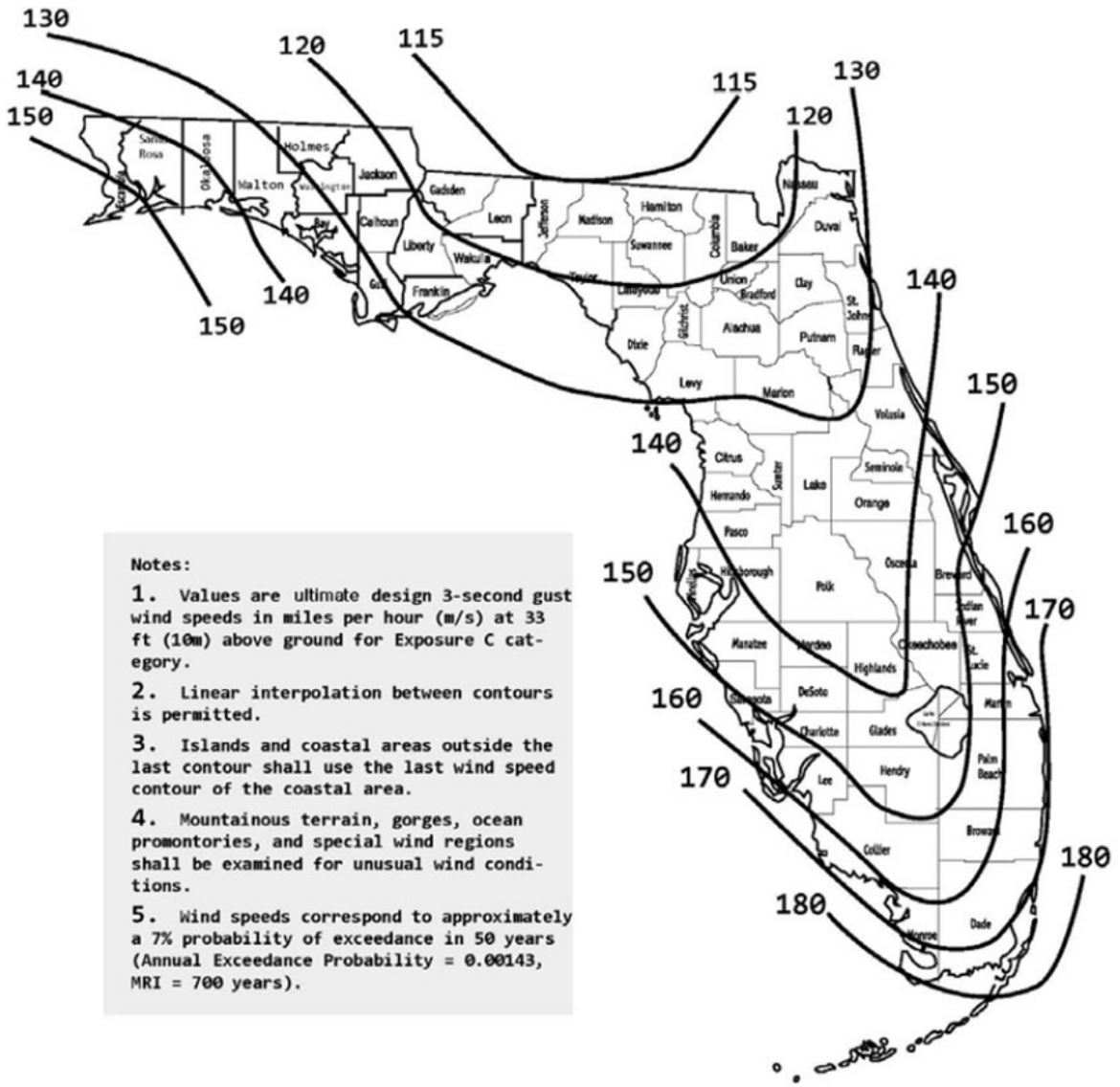
IBC 2012/2015

- Building Risk category III & IV



IBC 2012/2015

- Building Risk category III & IV



Risk Categories of Buildings & Other Structures

Category III

- Buildings and other structures that represent a hazard to human life in the event of failure
- Wind velocity (3-second gusts) used in calculations are 186 mph (Miami-Dade) and 180 mph (Broward)
  - Examples include but are not limited to:
    - Buildings or structures whose primary occupancy is public assembly with an occupant load greater than 300
    - Buildings or structures containing elementary schools, secondary schools or day care facilities with an occupant load greater than 250
    - Adult education facilities such as colleges and universities with an occupant load of greater than 500
    - Power-generating stations, water treatment facilities for potable water, waste water treatment facilities, and other public utility facilities not covered by Category IV
    - Occupancies with occupant loads of 50 or more resident patients but not having surgery or emergency treatment facilities

Risk Categories of Buildings & Other Structures

Category IV

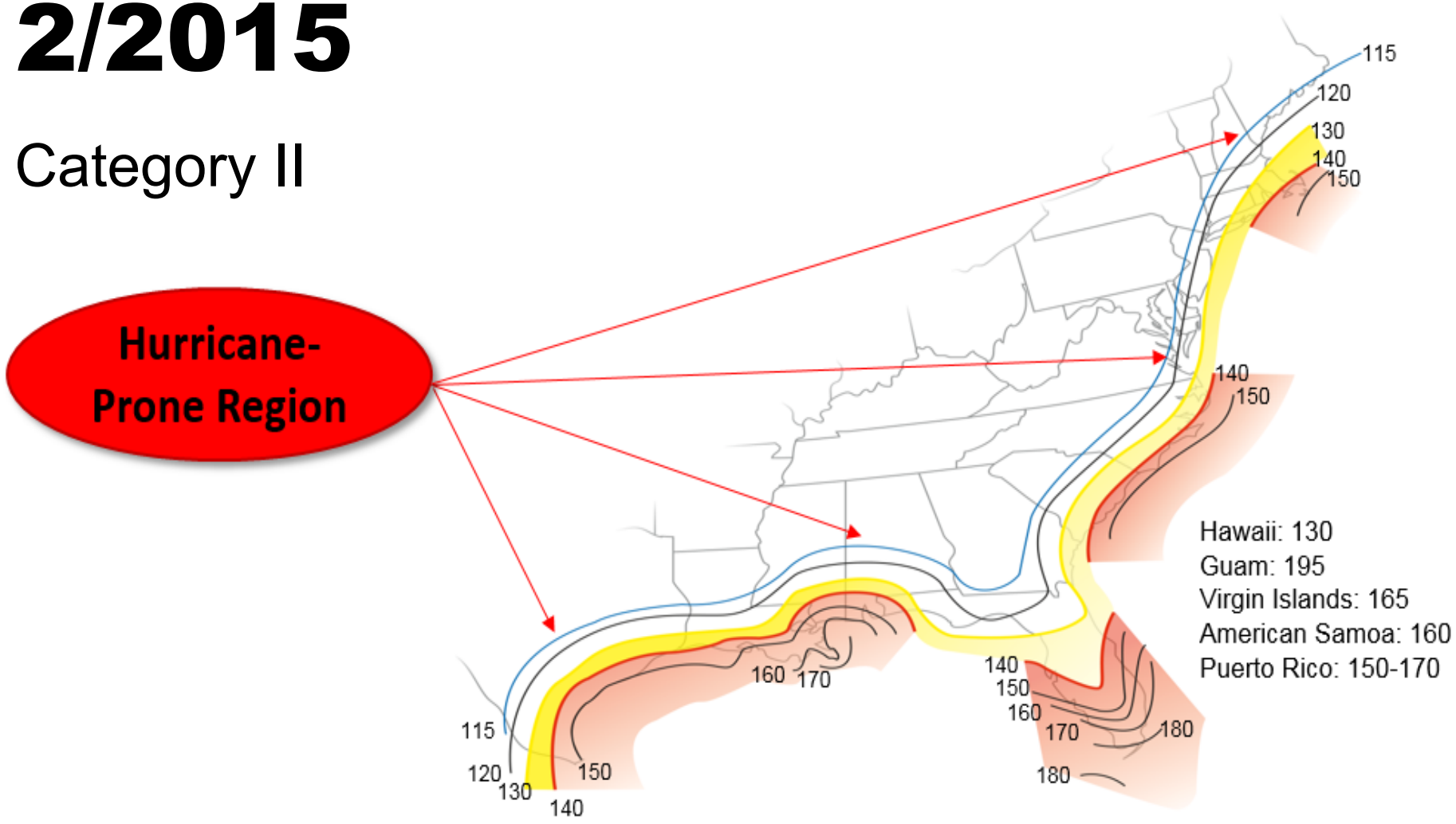
- Buildings and other structures designated as essential facilities
- Wind velocity (3-second gusts) used in calculations are 186 mph (Miami-Dade) and 180 mph (Broward)
  - Examples include but are not limited to:
    - Fire, rescue, ambulance and police stations
    - Emergency treatment facilities
    - Designated earthquake, hurricane or other emergency shelters
    - Power-generating stations and other public utility facilities required as emergency backup facilities for Risk Category IV structures
    - Aviation control towers, air traffic control centers, and emergency aircraft hangers
    - Buildings critical for national defense
    - Water storage facilities and pump structures required to maintain water pressure for fire suppression

Know the Difference

- Missile Level D
  - 9 lb 2 x 4 at 34 MPH
  - Required for “Basic Protection” where louvers are required to be impact qualified per FBC 2014
- Missile Level E
  - 9 lb 2 x 4 at 55 MPH
  - Required for “Enhanced Protection” where louvers are required to be impact qualified per FBC 2014 for Critical or Essential Facilities
-

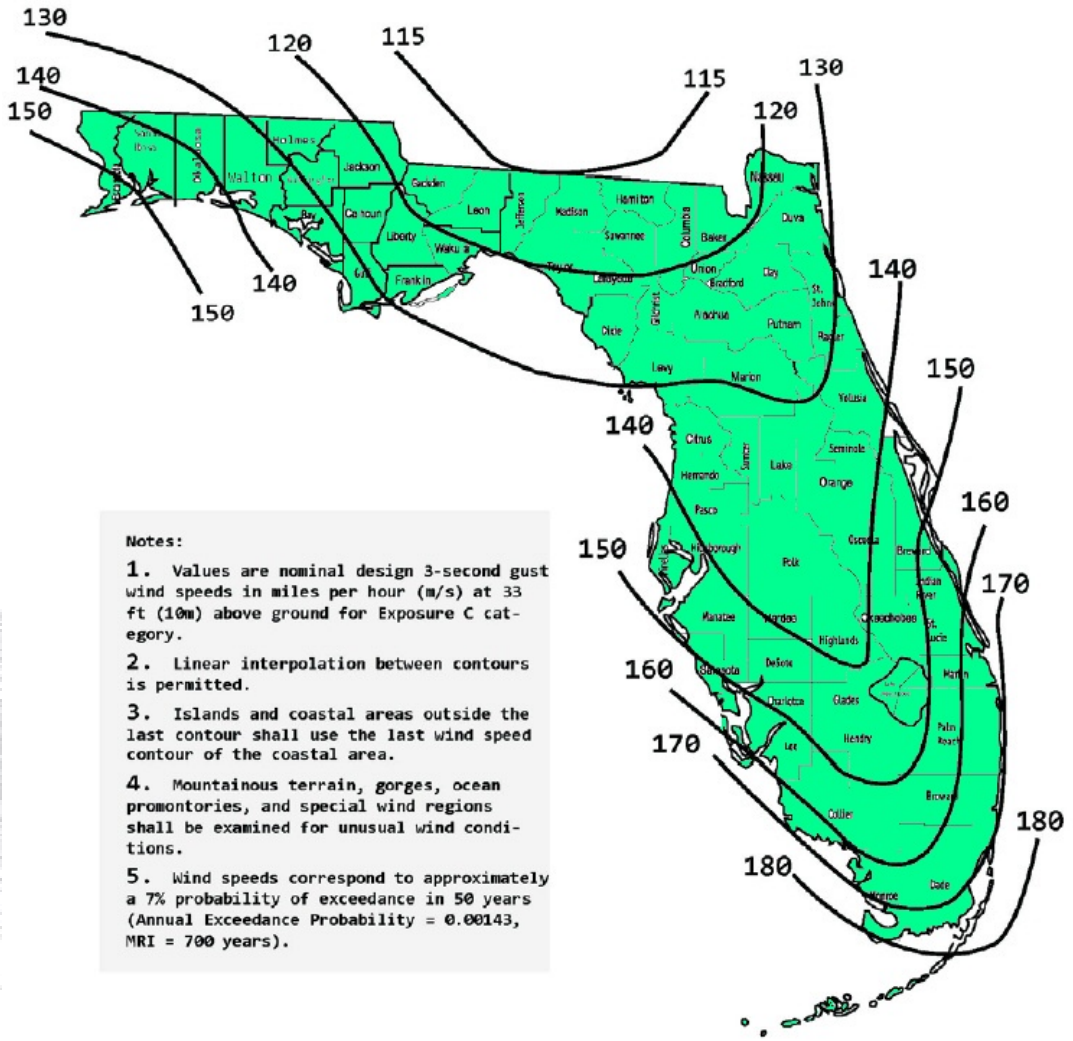
IBC 2012/2015

- Building Risk Category II



Hurricane zone

- Florida 2010 declared entire state of Florida hurricane zone
- Must have AMCA 550



IBC 2012/2015 Building Code Language

2012/2015 International Mechanical Code

Chapter 2: Definitions

- Hurricane-Prone Regions. Areas vulnerable to hurricanes defined as:
  - The U.S. Atlantic Ocean and Gulf of Mexico coasts where the ultimate design wind speed, V ult, for Risk Category II buildings **is greater than 115 mph (51.4 m/s)**; and
  - Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

IBC 2012/2015 Building Code Language

2012/2015 International Mechanical Code

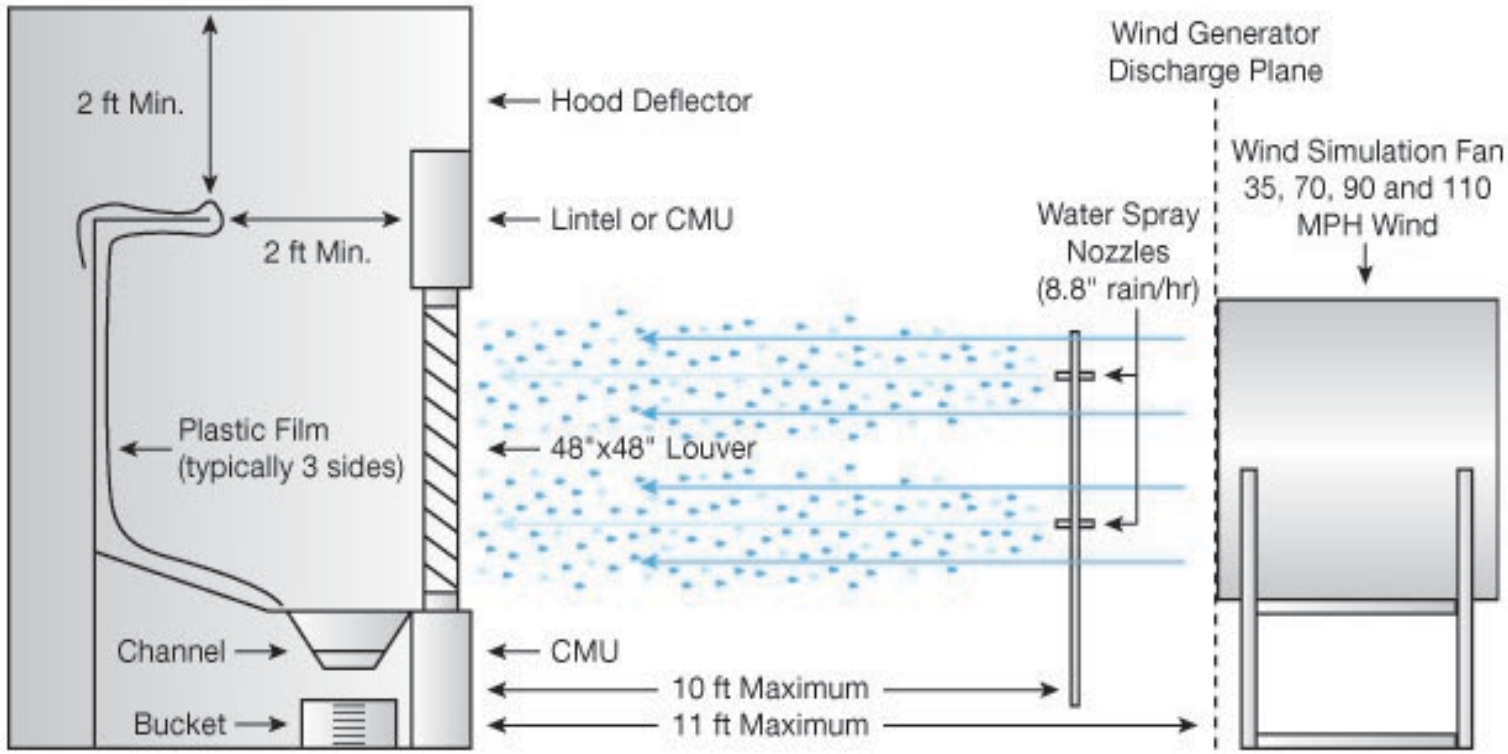
Chapter 4: Ventilation

- 401.5 Intake opening protection.
- “Louvers that protect air intake openings in structures located in the hurricane-prone regions, as defined in the International Building Code, shall comply with **AMCA 550**.”

AMCA Listing Standards - 550

- AMCA 550
  - Water shall be supplied to the wind stream using a sprinkle pipe system simulating a uniform 8.8 inches/hour (223.5 mm/hour) over the test specimen
  - Eight intervals of testing
    - Five to fifteen minutes
    - Wind Speeds from 0 mph to 110 mph
  - Pass/Fail is determined by whether or not the louver exhibits water infiltration in excess of 1% of the total water sprayed

ANSI/AMCA 550-Test Method for High Velocity Wind Driven Rain Resistant Louvers



- Louver test specimen size must exhibit a 1m x 1m “core” area
- No more than 1% of the total sprayed water volume may penetrate the louver to pass

Interval	Wind Speed	Duration	Water Spray
1	35 mph	15 min	On
2	0 mph	5 min	Off
3	70 mph	15 min	On
4	0 mph	5 min	Off
5	90 mph	15 min	On
6	0 mph	5 min	Off
7	110 mph	5 min	On
8	0 mph	5 min	Off

Miami-Dade County Product Approval

- Miami-Dade County Department of Regulatory and Economic Resources governs the safety and vitality of local businesses and shopping areas in Broward and Miami Dade counties
  - Responsible for enforcing the requirements necessary for commercial construction in South Florida
    - Products that are approved for Miami-Dade construction carry an NOA (Notice of Acceptance)

Different with some Similarities

MIAMI-DADE COUNTY

- Required for projects that are in Dade or Broward county in Florida
- Miami-Dade Notice of Acceptance (NOA)
- Requires TAS 201, TAS 202, TAS 203
- Currently requires AMCA 540 and AMCA 550 which is recognized in coastal states

- Required throughout the state of Florida
- Created test protocols for TAS 201, TAS 202, and TAS 203
- Currently 6th edition - 2017
- 2017 FBC requires AMCA 540 and AMCA 550 which is recognized in coastal states

MD Louver Testing Requirements

- TAS 201 – Missile Impact Test – Referenced from FBC (ASTM Standards)
  - Southern pine 2 x 4 between seven and nine feet
  - Weight must be between 9 and 9.5 pounds
  - Missile impacts the surface at 50 feet per second
  - Three test specimens (Two can be multi-section louvers)
  - Each test specimen must be impacted twice
  - Requires that TAS 203 is run after TAS 201 testing is completed
  - Pass/Fail test

AMCA 540 vs TAS 201

- Distance of cannon to sample
- Smallest louver size offered
- While initial velocity is same, distance traveled means more severe impact

Test Standard	AMCA 540	TAS 201
Missile Material	2 x 4 timber	2 x 4 timber
Missile Weight	9 lb (4.1 kg)	9 lb (4.1 kg)
Missile Velocity	50 fps (15.2 m/s)*	50 fps (15.2 m/s)
Distance from cannon to sample	1.5 x length of missile (ft) 10.5 feet in this example	9 feet + length of missile 16 feet in this example
Minimum Sample Size	Smallest section louver to be offered	N/A
Maximum Sample Size	Maximum unsupported blade span by maximum height	Maximum width offered x maximum height offered
Mullion Impact Required on Maximum Height Multi-section Assembly	Yes	Yes

- TAS201-Distance from cannon to test sample- 17 ft...@ 34 MPH
- AMCA 540 level D- Distance from cannon to test sample-12 ft...@ 34 MPH
- AMCA 540 level E - Distance from cannon to test sample-12 ft...@ 55 MPH

MD Louver Testing Requirements

- TAS 202 – Static Pressure Test – Referenced form FBC (ASTM Standards)
- The unit is tested in both directions up to 1.5 times the rated load
  - For example, a louver rated for 150 psf would be tested in TAS 202 at 225 psf
- Pass/Fail test

MD Louver Testing Requirements

- TAS 203 – Cyclic Wind Pressure Test
  - Follows TAS 201 testing
  - Consists of supplying air to and exhausting air from the chamber in accordance with a specific test loading program at the rate required to maintain the test pressure differential across the specimen and observing the distress or failure of the specimen
  - Load must be applied in both positive and negative directions 150 PSF LOUVER TESTING
  - 40% DESIGN LOAD = 60 PSF - 600 cycles
  - 60% DESIGN LOAD = 90 PSF – 70 cycles
  - 130% DESIGN LOAD = 195 PSF
  - Pass/Fail test

MD Louver Testing Requirements

- TAS 100A – Wind-Driven Rain
  - Required for louvers within 33 feet of grade where the room behind the louver is NOT designed to drain water penetrating into the room or the room will not house non-water resistant or weather proof equipment
  - Simulates an external 35, 70, 90, and 110 miles per hour wind speed with a simulated rainfall rate of 8.8 inches per hour
  - During the 35 and 70 miles per hour wind simulation, no water penetration is allowable
  - During the 90 and 110 miles per hour wind simulations, an amount of water not greater than 0.05% of the overall sprayed water volume is allowed beyond the louver and damper assembly
  - Testing protocol is same as AMCA 550
  - Very few louvers pass by themselves (Vertical in design)
  - AMCA 550 is accepted by MD and allows 1% vs .05% TAS 100A

How do I identify FBC louvers?

Ratings

Free Area: [48" × 48" (1222 × 1222) unit]: 7.4 ft² (0.69 m²)
46.3%

Performance @ Beginning Point of Water Penetration

Free Area Velocity: Above 1250 fpm (6.35 m/s)

Air Volume Delivered: Above 9250 cfm (4.37 m³/s)

Pressure Loss: 0.22 in.wg. (55 Pa)

Velocity @ 0.15 in.wg. Pressure Loss: 1030 fpm (5.24 m/s)

AMCA 540 (impact resistance) and AMCA 550 (high velocity wind-driven rain) listed.

Miami Dade County: NOA No. 15-0428.01 (Expires 10/23/2018)
Approved to FBC TAS202-94, TAS201-94
and TAS203-94

Florida Building Code Approval (2014-FBC): No. FL17876

Design Load: 150 psf

Florida Product Approval No: FL12941.1
Miami-Dade NOA No.: 14-0624.16, EXP. 8/5/19
TDI Approval No.: LVR-06
Maximum Wind-load: 110 PSF

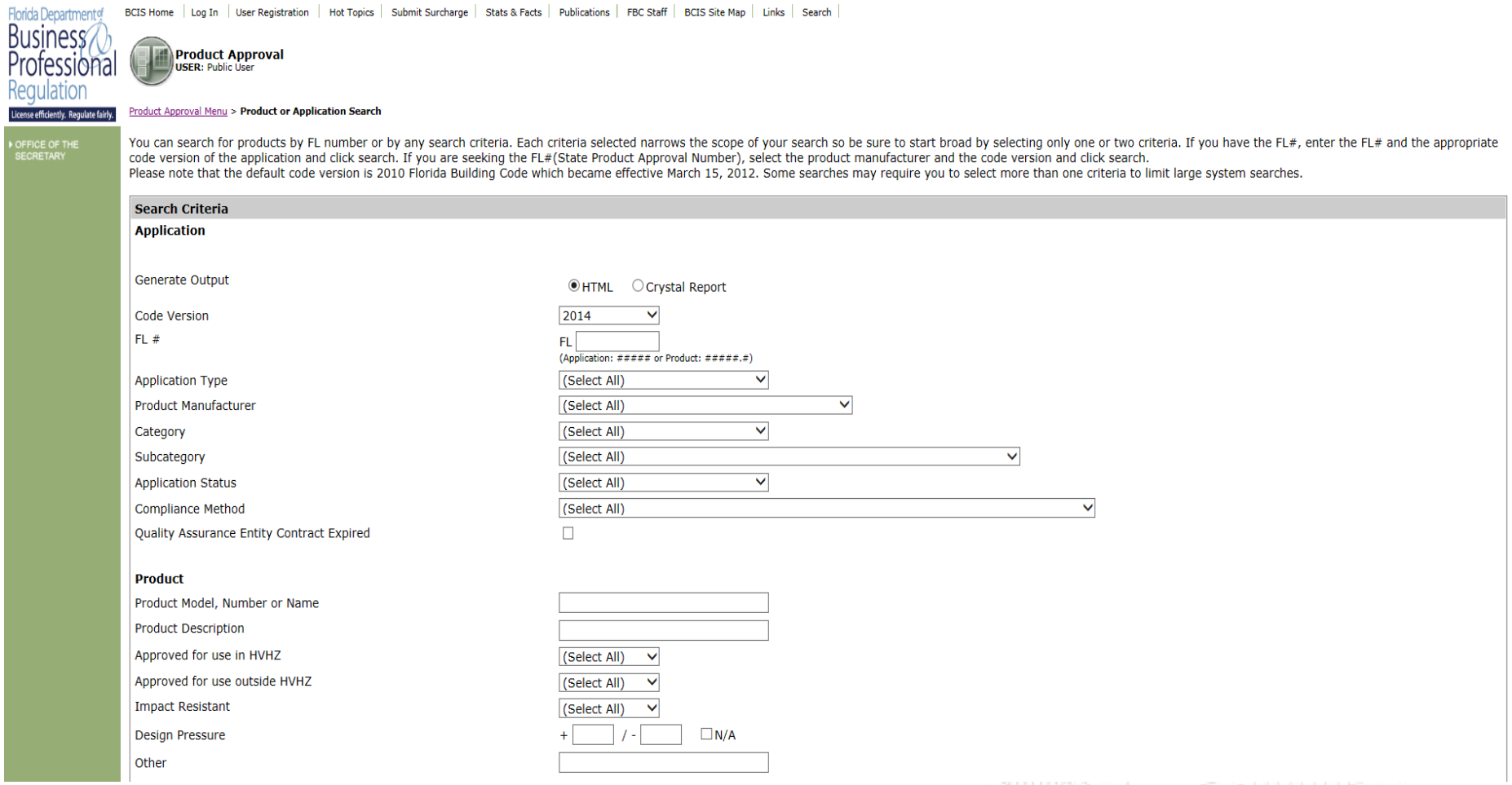
MIAMI-DADE APPROVED

FLORIDA PRODUCT APPROVAL # FL3268.1

MIAMI-DADE COUNTY, FLORIDA NOTICE OF ACCEPTANCE NUMBER: 12-0628.06 (1/28/17)

MIAMI-DADE APPROVED
MIAMI-DADE COUNTY, FLORIDA NOTICE OF ACCEPTANCE #: 15-0420.04 (EXPIRES 01-17-16)
FLORIDA BUILDING CODE PRODUCT APPROVAL #: FL3284-R4

Searching for approved FBC louvers



Source: https://floridabuilding.org/pr/pr_app_srch.aspx

How do I identify Miami-Dade NOA louvers?

Ratings

Free Area: [48" × 48" (1222 × 1222) unit]: 7.4 ft² (0.69 m²)
46.3%

Performance @ Beginning Point of Water Penetration

Free Area Velocity: Above 1250 fpm (6.35 m/s)
Air Volume Delivered: Above 9250 cfm (4.37 m³/s)
Pressure Loss: 0.22 in.wg. (55 Pa)

Velocity @ 0.15 in.wg. Pressure Loss: 1030 fpm (5.24 m/s)

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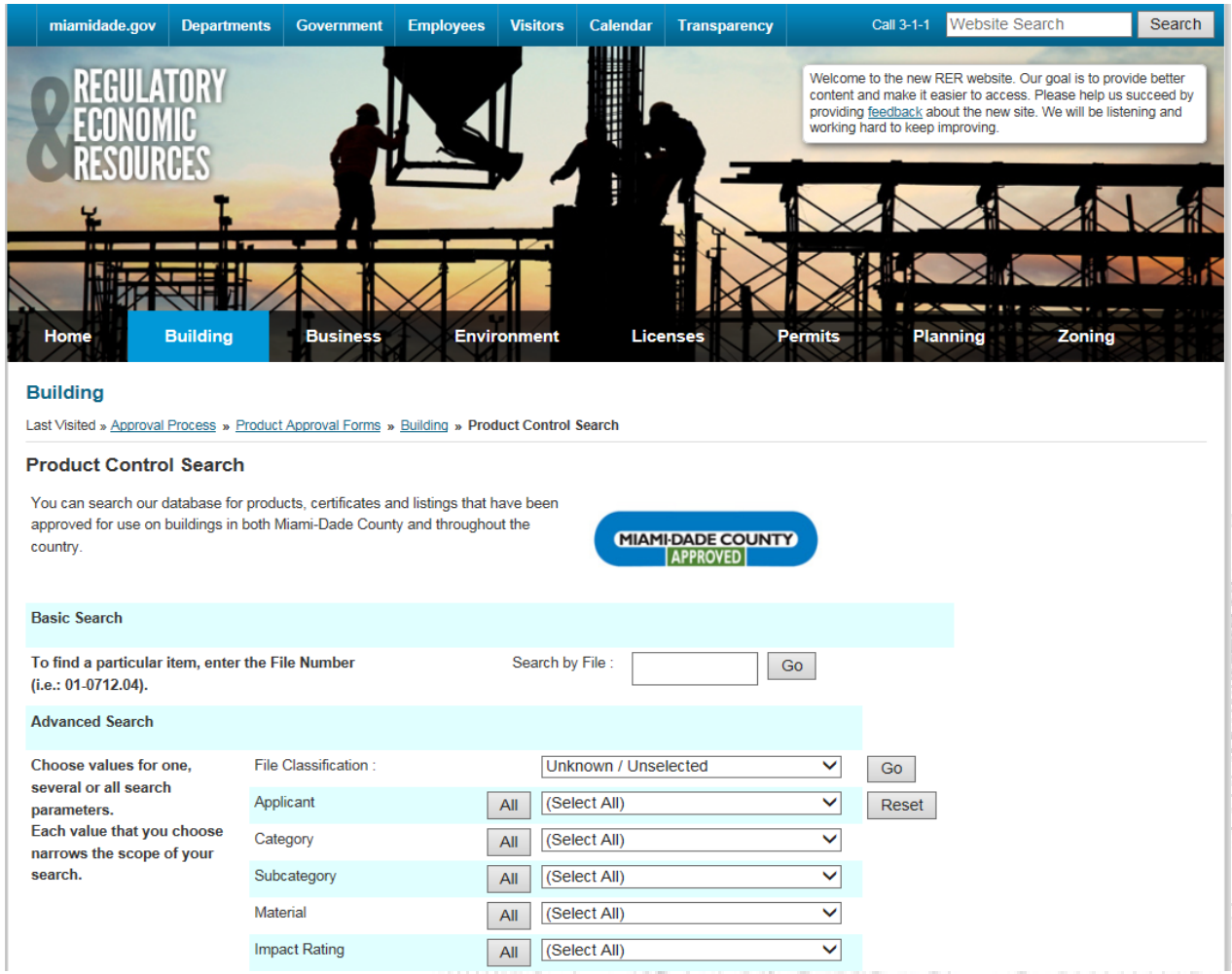
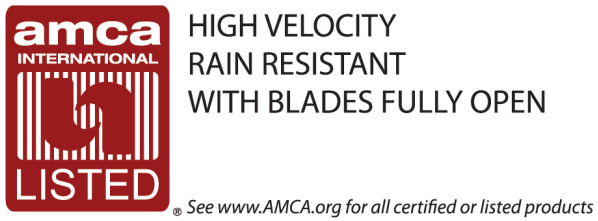


Source: http://www.miamidade.gov/building/pc-search_app.asp

How do I identify louvers that are AMCA 540/550 listed?

Cat I, II, and III buildings and structures

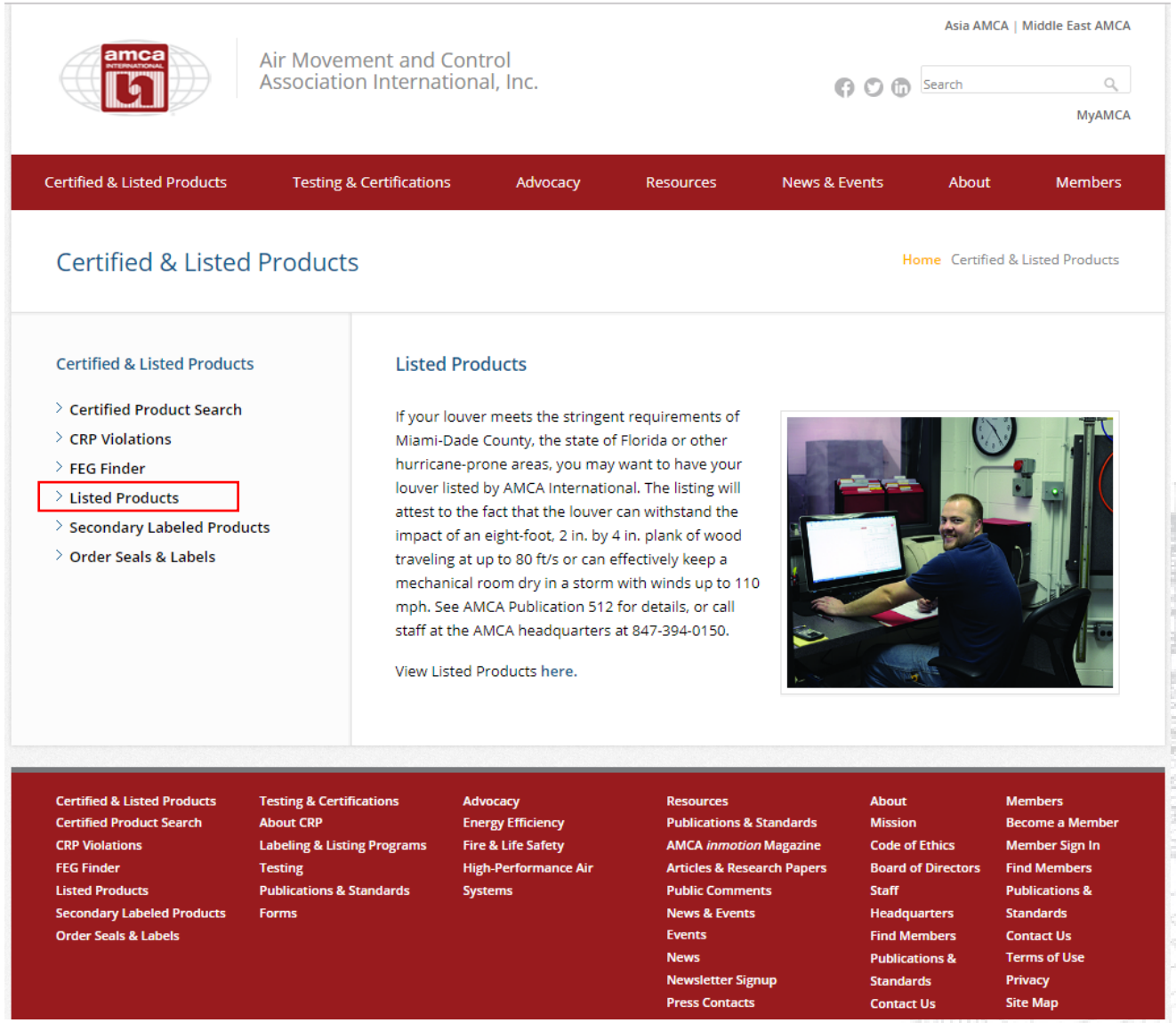
Cat IV buildings and structures



Cat I, II, III, and IV buildings and structures

- **Not a requirement for Miami-Dade for FBC 2014**
- **Listing adds credibility to the testing conducted on the louver**

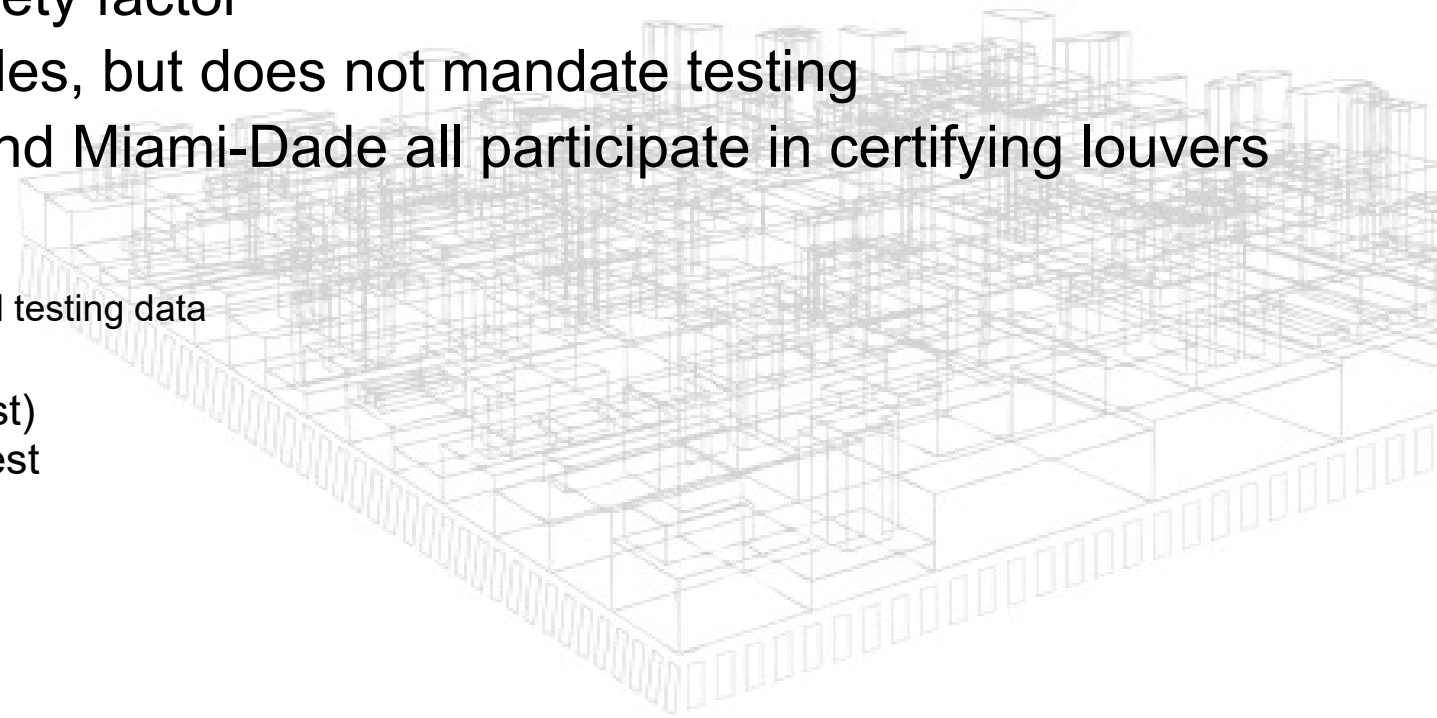
Searching for AMCA 540/550 louvers



Source: http://www.amca.org/certified-listed/listedproducts.php

Summary

- Traditional louver's offer high FA and low pressure drop but do not provide WDR performance
- WDR louvers stop water penetration and allow greater FA velocities
- WDR allows for smaller footprint of louver sizes
- WRD louvers do not require a safety factor
- ICC is a guideline for building codes, but does not mandate testing
- Agencies such as AMCA, FBC, and Miami-Dade all participate in certifying louvers
  - Miami Dade
    - NOA for acceptable louver products
      - Based on calculations supplied and testing data
  - AMCA
    - 540 (basic and enhanced impact test)
    - 550 High velocity wind driven rain test
  - FBC – 2017
    - AMCA 540
    - AMCA 550



Questions?

Jim Smardo
Director Architectural Systems
Ruskin Company/JCI
jsmardo@ruskin.com