Good News
From the Doctor

Louvers
Louvered Penthouses
AMCA Certification
Wind Driven Rain
Puddles

During the past few years, AMCA took on the responsibility of developing test procedures for air flow resistance and water penetration of louver blades. This test procedure was distributed to the louver manufacturers who used it to test their louvers and publish certain data for the design engineer to use in selecting louver blade shapes and overall physical sizes.

Whoa right here! Just because the louver manufacturer's data says there will be no water penetration for a certain velocity does not mean it will be so. Let's look a little further into this abyss.

Do all who read this understand the difference between an AMCA certified laboratory and the actual conditions that exist on Bumwhop Elementary School in Any Town, Kentucky? There are big differences! Let's look at a few of them.

In the lab, a louver is mounted in a wall that contains a sealed plenum on the back side to which a fan is connected. This fan discharges into a duct that contains instruments that will read the exact CFM that is flowing through the louver. Draft gauges connected to the plenum will read the pressure drop across the louver. A pan with punched holes in the bottom into which nails have been inserted is placed at the head of the louver. The fan is turned on and the pan is filled with water, which runs out the holes, down the nails, and drips in front of the louver, "simulating rain".

Have you ever seen rain fall straight down? Does everyone know what a "no-loss stack cap" is? If you don't, refer to figure 6-24 in the Industrial Ventilation Guide and you will see that it works on the principle that rain does not fall "straight down" but rather at a slight angle due to wind.

Wind . . . . . . does the AMCA test procedure mention "wind"? . . . . . . Nope!

Worse than that, water will probably penetrate the louver during "wind driven" rains at wind velocities less than 10.8 miles per hour if:

1. The louver is installed in a west wall that is being impacted with large amounts of kinetic energy causing a pressure bubble to build up on the wall before it relieves over or around the wall - remember, it's not only wind velocity impacting on the louver face that will force water through the free area, but atmospheric pressure caused by this "pressure bubble" that

will develop because there is no instantaneous place for the wind to go.

2. The Louver is situated near the bottom of a high wall in a location that is being subjected to rain water draining down the face of the wall and cascading over the face of the louver. This abnormal amount of water flowing over the face of the louver could then be drawn in through the blades because it in no way resembles an "AMCA lab test" of water dripping off of nails placed in front of a louver. The louver is situated near the bottom of a high wall in a location.

Is the situation hopeless? What precautions can the design engineers of America take to prevent or minimize the possibility of having water drawn in through louvers where it is not wanted?

A. If the louver is located in the mechanical room in an outside air intake for the central AC system, then, anticipate water being drawn in and provide a floor drain.

B. If the louver has a duct connected to the back of it, then anticipate water being drawn in, and:

   1. Oversize the louver in the vertical dimension and provide a 3'0" or so long sloped bottom connection to the louver so that when any water is drawn in, it will fall out because of the slower velocity in the oversized duct and drain back toward the louver.

   2. Seal the inside of this duct with solder or 100 year mastic.

   3. Provide a detail indicating that the bottom and sides of this duct be installed through the wall and flush with the outer surface of the wall, so that any water accumulating behind the louver will drain back to the outside of the building.

   4. Have the contractor provide "weep holes" in the bottom frame of the louver so that any water collecting behind the louver will have a passage to drain to the outside.

C. Use common sense and inspect carefully what has been installed before water damage has occurred.

Back to our roll-around stools with coffee-cup-in-hand in our clinical AMCA lab; we are observing "rain" being sheltered and not passing through the louver blades at such-and-such velocity. The fan CFM is increased to even higher levels until water begins to be drawn through the blades and collects in the plenum behind the louver. The amount of water is measured versus free area velocity and tabulated for several data points and a curve is developed. Hence the "AMCA certified water penetration data" is published and turned loose on all unsuspecting design engineers to use as Gospel . . . . . . Holy Smoke!

Let's look at one manufacturer's published literature concerning "AMCA certified water penetration data."

The blade is the conventional drainable blade set on a 37.5 degree angle, spaced on approximately 3" centers . . . . . . your typical drainable blade louver that is rated for zero water penetration at 950 feet per minute velocity through the free area. This data indicates that if you installed a 48" x 48" louver in a wall and pull 7,600 CFM through it (8.0 square feet of free area and 950 feet per minute velocity is 7,600 CFM), you would not have any water penetrating the louver blades . . . . . . in the AMCA certified lab!

These free area velocities vary from manufacturer to manufacturer and vary due to blade shape, blade angle and blade spacing. These free area velocities for the "threshold of water penetration" can be as low as 700 feet per minute and as high as 1,200 feet per minute.

In the case of our frequently specified 37.5 degree drainable blade on 3" centers, just how fast is 950 feet per minute?

(950 feet per minute x 60 min/hr) / (5,280 ft/mile) = 10.8 miles per hour

Whoa! You mean to say if we have a "wind driven" rain exceeding 10.8 miles per hour, we can have rain passing through the louver and into our building where it doesn't belong? . . . . . .You betcha!

So much for louvers . . . . . . How about louvered penthouses?

Let's take the case of a 120" long x 24" wide x 72" high louvered penthouse utilizing the 37.5 degree drainable blade on 3" centers. This is not a made up size but one that exists on a real job in the tornado area of Western Kentucky. (Tornadoes are sometimes defined as 125 MPH wind-driven rain.) Not only is there one (1) of these louvered "billboards" on this roof, there are six (6) of these "puppies" being used as 50,000 CFM (each) outside air intakes for make-up air requirements.

Let's see what the free area charts would tell us about these units:

Size	Free Area	Both Sides	Total Free Area
24" x 72"	5.87 sq. ft.	x 2	11.74 sq. ft.
120" x 72"	31.66 sq. ft.	x 2	63.32 sq. ft.
		Total:	75.06 sq. ft.

(50,000 CFM) / (75.06 sq. ft. free area) = 667 feet per minute through the free area, which is well below the 950 feet per minute indicated for the water penetration threshold point.

At this flow, the throat velocity would be:

(50,000 CFM / (10'-0" x 2'0") = 2,500 feet per minute

Now, picture this:

Since the throat velocity will be 2,500 feet per minute, the suction static pressure required in the throat to cause 50,000 CFM to flow into a 120" x 24" duct will be approximately 0.40" of negative static pressure; therefore, with a 0.40" of negative pressure being applied to the base of the 120" long x 24" wide x 72" high louvered penthouse, this negative pressure inside the louvered penthouse will be unevenly distributed across the height; i.e., the lower louver blades will be subjected to the 0.40" negative static, the middle blades will be subjected to approximately 0.20" negative static, while the upper blades will be subjected to approximately 0.05" negative static. This uneven distribution of negative static inside the louvered penthouse will cause a disproportionate amount of air to flow through the lower blades; i.e., one would expect 1,800 feet per minute through the lower blades, 1,400 feet per minute through the middle blades, and 700 feet per minute through the upper blades.

This will provide disastrous results even in a "no-wind" rain.

One method to alert you to this potential problem is not to let the length be more than twice the width and the height should not exceed 1/2 the width. "Square and squatty" is better than "rectangular and tall".

Example: 48" long x 24" wide x 24" high does not exceed this guideline.

Also, if you are using a rectangular unit, rotate the short dimension so it points towards the prevailing wind, i.e., the 24" width should face west.

In addition, provide a sealed plenum under the penthouse with a sloped bottom having a drain piped to somewhere the water can be disposed.

If a plenum below is not possible, then another thought to thwart wind driven rain would be to provide a windband of sheet metal (galvanized or aluminum) mounted on standoffs about 6" to 8" in front of the louver faces with the top and bottom left open. In this manner, wind driven rain would strike the windband before it impacted the louver blades, causing the rain to fall harmlessly on the roof.

One final piece of information concerning louvered penthouses - louvered penthouses do not restrict the penetration of wind driven rain as well as wall mounted louvers. A wall mounted louver that has a plenum or duct connection behind it has a "cushion of air" that has to be "compressed" before a gust of wind can penetrate the louver blades. A rectangular shaped louvered penthouse offers the possibility of having wind driven rain "blow directly through the unit" allowing the rain to fall out once it passes the leading side. The "cushion of air" inside the louvered penthouse is not sufficient to restrict the sudden burst of energy created by a gust of wind, and consequently, it is more susceptible to allowing wind driven rain to penetrate the blades.

Always remember . . . .

(1) part empherical formula + (2) parts horse sense =

"good design techniques"

Doc

"Good news from the Doctor" is an occasionally written letter based on "Bad News" experiences we have encountered while trying to earn the groceries. This letter is intended to make you aware of certain pitfalls we have already enjoyed and recommend that you perform your own research and draw your own conclusions so you won't blame us if it doesn't work! Be aware that your school days education is the cheapest education you'll ever get!