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AMCA INTERNATIONAL inmotion

THE ONLY MAGAZINE DEDICATED TO THE AIR MOVEMENT & CONTROL INDUSTRY

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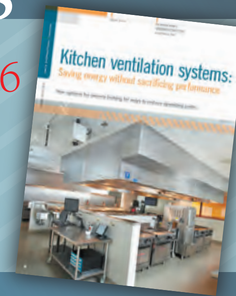
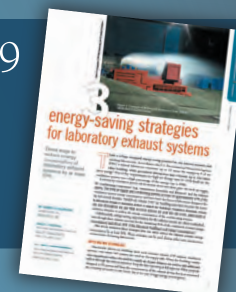
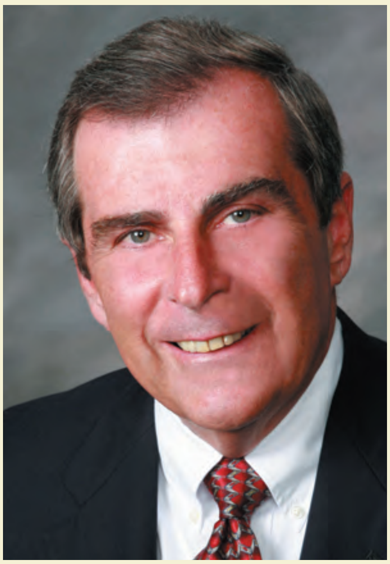




departments

inmotion is published biannually to keep HVAC professionals abreast of rapidly changing codes, requirements, laws, advancements, and best practices in the air movement and control industry.

president's message



inmotion is published specifically for hvac professionals who design, specify, purchase, install, commission, operate, and maintain ventilation systems.

Many economists are reporting an uptick in the U.S. economy, saying the recession and banking issues that have caused so much anguish are starting to turn around. In the construction marketplace, however, we're seeing little signs that this is the case. Apparently, there will be a lag lasting for a year or more after the recession ends, and before commercial construction resumes growth.

But when the market returns, what kind of market will it be? Frankly, I think it will be leaner and greener.

During the slowdown, many companies have been working on their internal processes. Engineering firms, manufacturers, contractors, and owners are making strategic staffing decisions (laying off and hiring) while investing in new software and training. Companies are also moving to compete in new markets while facing increased competition in their traditional markets.

A proof to this observation is that the AMCA International laboratories are busier than ever. This year, the rate of member companies testing products under AMCA's Certified Ratings Program is higher than any of the past five years. The smaller market has compelled companies to get any edge over the competition. So although costs are scrutinized in most area's, R&D costs seem to be an investment in the future.

Another factor is the market is getting greener. With an eye still on costs, the push to make buildings more efficient, comfortable, and healthy for people and the environment is greater than ever.

Leaner and greener – that's where the market is going, and so is AMCA.

Sincerely,

Art LaPointe

2009-2010 President, AMCA International

Vice President and General Manager, Construction Specialties Inc.

AMCA International, Inc. is a not-for-profit association of the world's manufacturers of related air system equipment. For over 80 years, it has led the way in standards development and application research.

ask hans

Q: Please discuss the economics of tax incentives aimed at increasing energy efficiency.

A: In an effort to help stabilize the economy, the federal government has extended tax incentives that encourage energy efficiency. These incentives have a dual purpose: to protect the environment through more efficient use of energy, and to increase capital investment to counter the economic recession. My comments will focus on the latter.

In the interest of the HVAC industry, two particular tax incentives deserve attention. The first tax incentive targets energy-efficient equipment installed in commercial buildings. To receive the deduction, energy savings must be accomplished through energy and power cost reductions for the building's heating, cooling, ventilation, hot water, and interior lighting systems. The amount deductible is up to $1.80/sq ft of building floor area for buildings achieving a 50% energy savings target.[1] Another incentive offers contractors a credit for constructing homes that achieve a 30% or 50% reduction in heating and cooling energy consumption relative to a comparable dwelling. The credit equals $1,000 for homes meeting a 30% efficiency standard, and $2,000 for homes meeting a 50% standard.[2]

The economic effectiveness of any business tax incentive is measured by the additional capital investment that takes place because of the credit. In economic parlance, the incentive is effective if, and only if, a measurable amount of capital investment occurs that would not take place but for the incentive. In the absence of data to analyze, a priori statement of the incentive's effectiveness can be made based on economic theory and knowledge of the tax code.

Assume for instance that a firm is trying to decide whether to make a capital investment in expanding manufacturing capacity. Let's also assume that as part of the plant expansion, the firm wishes to revamp the existing HVAC system. If efficiency targets are hit, the firm may receive a tax deduction. In deciding whether to invest, the firm considers direct costs such as taxes and depreciation as well as the opportunity cost of forgoing an alternative investment.[3] Examining direct costs and opportunity cost, the firm can determine the rate of return necessary for profitability. Economists refer to this concept collectively as the user cost of capital. Tax incentives themselves are effective to the extent that they reduce the user cost of capital. In this instance, the incentive aimed at commercial energy efficiency is a deduction rather than a credit. Deductions have a lesser impact in reducing taxable income because the subtraction is made before the tax rate is applied in the calculation. The firm will only receive an actual reduction in the tax bill, and thus a reduction in its user cost of capital of 65 cents/sq ft of building floor area, not the $1.80 deduction.

Beyond the microeconomic theory, current macroeconomic conditions and the pre-existing corporate income tax structure must be considered. According to the Bureau of Economic Analysis, corporate profits before taxes declined 17.6% in 2008.[4] Even though profits show signs of recovery in 2009, many firms have accumulated significant net operating losses (NOLs) that can be carried forward to reduce future tax liabilities. Firms hardest hit by the economic downturn, such as those in the construction industry, are the ones most likely to accumulate NOLs. If a firm's future tax liability is reduced to zero or a de minimis level under the existing code, additional tax incentives fail to achieve meaningful reductions in the user cost of capital and thus stimulate very little additional investment.

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HANS ZIGMUND is a Chicago-based economist who frequently works with AMCA International, Inc. Have a question? Mark it "Ask Hans" and send to mvambreck@amca.org.

BY BRIAN RIVET,
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Kitchen ventilation systems:

Saving energy without sacrificing performance

New options for owners looking for ways to reduce operating costs.

Photo: Greenheck Fan Corp.

BRIAN RIVET is product manager, kitchen ventilation systems, for Greenheck Fan Corp.

Commercial kitchens consume a significant amount of energy in restaurants and other establishments that have food service operations. The typical constant-volume kitchen exhaust system generates 20 to 30 air exchanges per hour. If that air is being heated or cooled, money is being spent not only on operating costs, but to condition the air as well.

To help promote energy efficiency, manufacturers have been asked to apply their products in a way that reduces the exhaust rate, which in turn reduces the required supply rate and the number of air exchanges per hour. While testing has provided the industry with information on improved performance at lower exhaust rates with greater overhangs, end skirts, appliance positioning, variances in hood design, etc., a point of diminishing returns exists where some lose sight of the kitchen exhaust system's purpose.

The ventilation system has to capture the heat and other effluent generated by the cooking equipment, oftentimes in imperfect conditions. For example, the simple act of walking by a cooking battery generates enough draft to interrupt the capture and containment if there is not enough capture velocity on the hood edges. Even if the hood appears to be capturing the smoke, it may not be capturing all the invisible heat. This heat gain to the space decreases comfort and will ultimately find a return vent, then end up being cooled by the HVAC system, requiring even more energy. Other examples of situations where unwanted air currents may be created include pass-through windows, doorways, supply air distribution configurations, and drive-through windows.

Figure 1: A proximity kitchen exhaust hood.

Photo: Greenheck Fan Corp.

It's not that using what we've learned from testing is a bad approach to saving energy—but it is limited. Excessive constant-volume exhaust rate reductions may sacrifice performance and could lead to additional energy spending. Alternative products and technology can be used to generate greater savings with sustained performance and comfort, some of which are described below.

PROXIMITY HOODS

Proximity hoods (see Figure 1), sometimes referred to as backshelf hoods, can effectively reduce the net airflow through the space while maintaining performance. These hoods are designed to be hung in close proximity to the cooking appliance when compared to standard canopy hoods. The height from the cooking surface will vary depending on the manufacturer but, as an example, might range from 17 to 36 in. Due to the closeness to the cooking surface, these hoods have less vulnerability to cross drafts and can generally exhaust at lower exhaust rates. Furthermore, proximity hoods take up less space because in most cases the equipment can extend beyond the front edge of the hood (underhang) as determined by the manufacturer's UL 710 Listing. The best applications for these types of hoods are light- and medium-duty applications such as fryers, griddles, and ranges. The use of proximity hoods with char-broilers is not recommended, due to their excessive heat loads. Another limiting factor may be appliance size, so other technologies should be considered to complement other ventilation products.

DEMAND VENTILATION

Demand ventilation, also known as variable volume, is capable of generating operating savings and a quick payback. This technology has been available in the market for several years and is now gaining traction. And with several new variations of products available from different manufacturers, these systems are more affordable than ever.

Demand ventilation systems are based on the premise that cooking loads vary throughout the day. Some operations, such as supermarkets, may have batch-style cooking only a few times throughout the day, while restaurants might have breakfast, lunch, and dinner rushes with idle periods in between. Regardless, most operations are not cooking at full capacity the entire time the kitchen staff is in the building and the ventilation system is operating.

Demand ventilation systems monitor the cooking operation and adjust the exhaust, supply, and rooftop unit fans so that when the cooking load is reduced, the fans operate at a reduced level and save energy, especially considering the heating and cooling loads mentioned earlier. These systems typically use a temperature sensor to monitor heat load from the cooking equipment and send a signal back to the control system, which then provides a signal to a variable frequency drive (VFD). The VFD then adjusts the fan speed. Other systems may have additional sensing technologies, but all are intended to monitor the current state of the system and adjust it accordingly.

Figures 2 and 3 illustrate how these systems reduce airflow. Note that in keeping with our goal discussed above, airflow rates are reduced only to a point that maintains proper performance (capture and containment) and meets minimum code requirements such as minimum duct velocities and UL-listed

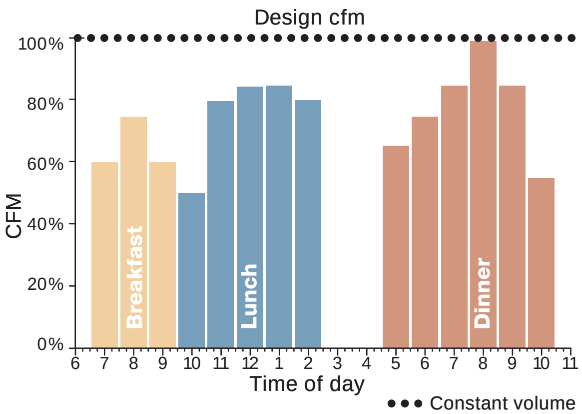

Figure 2: A constant volume system operates at 100% all day, while the cooking activity varies.

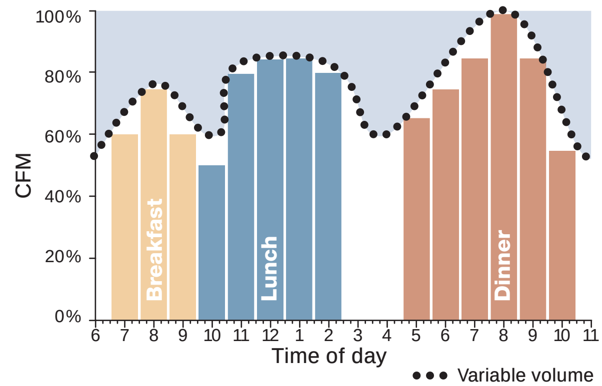

Figure 3: Aligning the exhaust and supply rates with the current cooking activity results in significant savings.

hood limits. Reductions of airflow up to 50% during idle cooking periods are achievable. Furthermore, using AMCA-certified fans will improve performance of demand ventilation systems by assuring that the fans operate as specified. Additional benefits include reduced sound levels in the kitchen and soft-starting motors with VFDs that decrease wear and tear on fan belts and bearings.

If a facility is considering or attempting U.S. Green Building Council LEED certification, the use of demand ventilation may help qualify for up to two points depending on the facility and application. Use of a demand ventilation system alone cannot assure LEED points; however, when used with other products in the same category it is likely to contribute positively to the overall performance required to earn points. The areas where these products typically apply are:

- Innovation and Design Process: ID Credit 1—Innovation in Design
- Energy and Atmosphere: EA Credit 1—Optimize Energy Performance.

In addition, the payback period can be decreased by offsetting some of the upfront costs through rebates and credits. These, too, are not guaranteed or available in all areas, but many state and local governments have rebate programs for which demand ventilation systems will qualify.

ELECTRICALLY COMMUTATING MOTORS

Electrically commutating motors use their internal circuitry to convert 115 V single-phase power to a controllable DC voltage. The result is increased efficiency and full-speed control. These motors can be used on direct-drive fans that are UL 762 Listed for cooking applications and applied to kitchen systems, and are easily adjusted during test and balance for optimum performance. These motors have up to 80% usable turndown, significant power use reductions, no belt or pulley losses, no belt maintenance, and no requirement for a VFD to adjust the speed of the fan when used in conjunction with a demand ventilation system. These motors are soft-starting, which increases motor and bearing life, and run much cooler than typical motors and permanent-split capacitor motors. Again, because of the significant energy savings realized by these motors, they too may contribute to acquiring LEED points. The limiting factor to using these motors in some cases is size, but manufacturers are continuing to develop larger horsepower motors that deliver value to the industry.

Source for all graphics: CPP Wind Engineering and Air Quality Consultants

Figure 1: Example of an exhaust dispersion study being conducted in a wind tunnel.

3 energy-saving strategies for laboratory exhaust systems

Three ways to reduce energy consumption of laboratory exhaust systems by at least 50%.

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There is a huge untapped energy saving potential in our nation's research and teaching laboratories. According to the U.S. Environmental Protection Agency (EPA), a typical laboratory consumes up to 10 times the energy/sq ft of an office building, while specialized laboratories may consume up to 100 times more energy.[1] Due to the requirements for high air change rates of 100% fresh air, the ventilation system uses a high percentage of this energy (up to 80%).

A laboratory ventilation system can be broken down into three parts: the fresh air supply, the conditioning components (e.g., temperature, humidity, and filtration), and the exhaust system. The fresh air supply and conditioning systems account for approximately 60% of the ventilation system energy consumption and have been the focus of laboratory designers for the last several decades. Variable air volume (VAV) air handling units have become the norm in laboratory design to minimize airflow to match the building's ventilation demands, which can vary throughout the day. Heat recovery systems are now also the norm, particularly in northern climates, to reduce the energy consumption of the conditioning systems.

Unfortunately, energy-saving opportunities for the exhaust system are often overlooked, even though these systems account for the remaining 40% of the ventilation system's energy consumption (and about 30% of the laboratory building's total energy consumption).

This article examines three strategies that can safely reduce the exhaust system's energy consumption by at least 50%. These strategies can be used during either new construction or renovation of existing laboratories.

APPLYING VAV TECHNOLOGY

Historically, laboratory buildings have used constant volume (CV) exhaust ventilation systems, even when VAV systems are used on the supply side. When the building ventilation requirements reduce the need for supply air, bypass dampers are used to add additional airflow through the exhaust system to keep the fans operating at full capacity. When properly designed, a CV system will limit the concentration of the exhaust plume that is re-entrained into a nearby air intake to safe levels, but at the cost of high energy consumption.

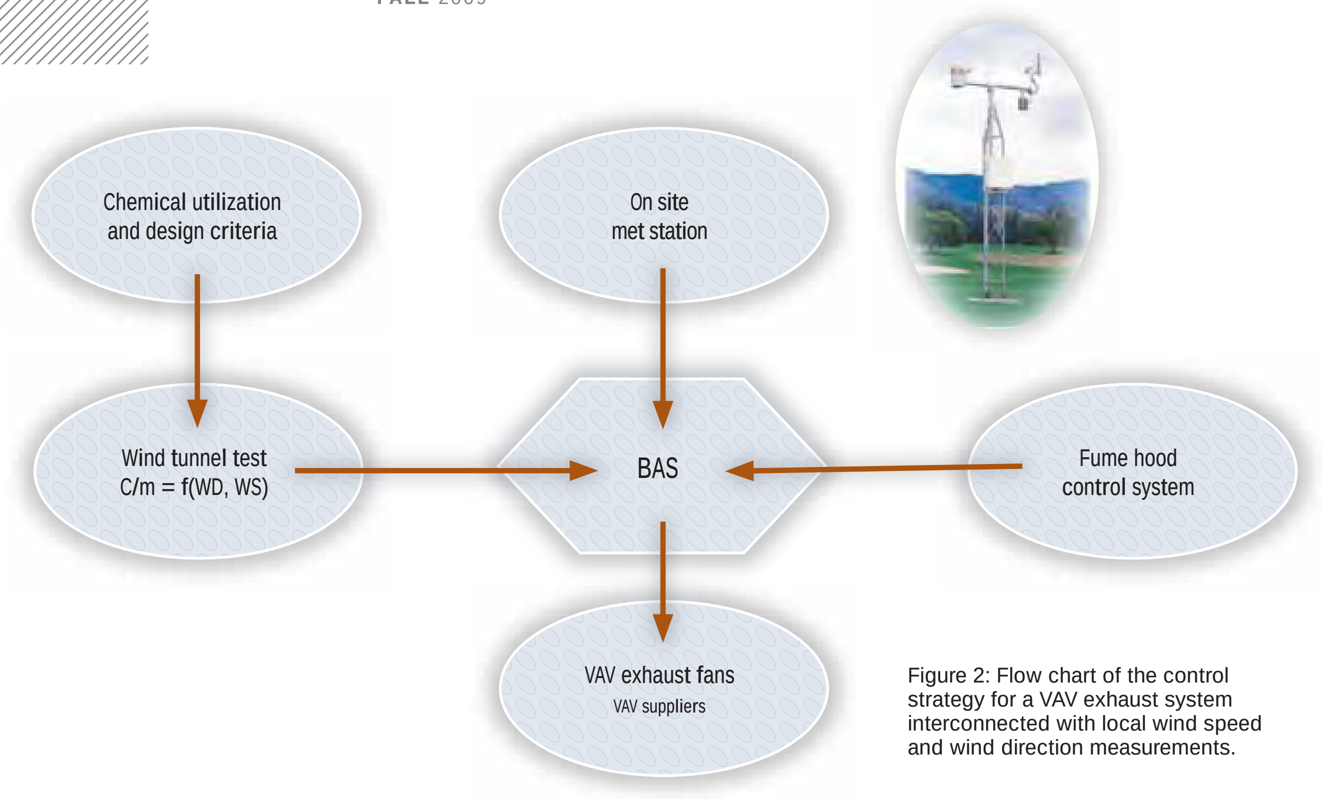

Figure 2: Flow chart of the control strategy for a VAV exhaust system interconnected with local wind speed and wind direction measurements.

Using state-of-the art engineering techniques, controls, and exhaust fans, exhaust ventilation systems can now optimize energy consumption by applying VAV technology to the exhaust side. However, the VAV system must be designed so that it does not compromise the air quality present at nearby air intake locations or other sensitive locations. Building exhaust may be re-entrained if existing CV systems are blindly converted to VAV systems without a clear understanding of how the system will perform at the lower volume flow rates.

In order to safely employ a VAV system, one must understand the entire purpose of the exhaust ventilation system. An exhaust system not only removes contaminated laboratory air from the building, it also serves to discharge the exhaust away from the building so that fumes do not re-enter though air intakes or affect sensitive locations. This is achieved through the proper combination of stack height and the accurate calculation of exhaust discharge momentum. So how do you determine the proper combination of stack height and exhaust discharge momentum? By using an engineering technique called exhaust dispersion modeling.

The preferred state-of-the-art method for conducting an exhaust dispersion study is through the use of physical modeling in a boundary-layer wind tunnel. Wind tunnel modeling is conducted by releasing a precise amount of tracer gas from exhaust stacks on a scale model of a laboratory building and measuring air intakes and other sensitive locations. Figure 1 shows an example of an exhaust dispersion study being conducted in a wind tunnel.

Using information from the wind tunnel modeling, three different strategies can be applied to maximize the energy-saving potential of a VAV

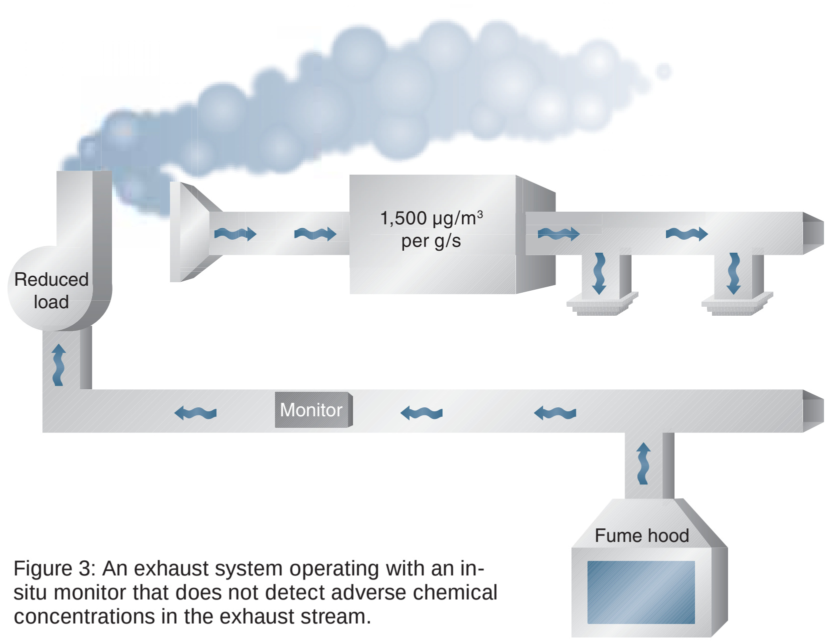

Figure 3: An exhaust system operating with an in-situ monitor that does not detect adverse chemical concentrations in the exhaust stream.

STRATEGY ONE: STANDARD VAV EXHAUST

The first design option is a standard VAV system where no bypass air is used and the exhaust flow rate is based entirely on the building's airflow demand. These systems must be designed so that safety is maintained at the minimum volume flow rates. This typically involves either using taller stacks or optimizing the placement of air intakes to minimize re-entrainment of the exhaust. For a 50% turndown ratio, which can typically be achieved during unoccupied hours, this might result in an increase of 5 to 10 ft in the stack height. From a controls standpoint, this is likely the simplest system to use, particularly for retrofit of existing laboratories, but it will produce only limited energy savings.

STRATEGY TWO: VAV EXHAUST WITH WIND SENSOR

The second design strategy involves connecting the Building Automation System (BAS) to nearby wind speed/direction sensors. The performance of an exhaust stack is impacted by the wind speed at the top of the stack. For high-volume flow stacks there is a direct relationship between downwind concentrations of the As the wind speed increases, the plume rise decreases, increasing downwind concentrations. For lower volume flow stacks there is a critical wind speed that results in the maximum downwind concentration (the wind speed that results in limited or no plume rise). Similarly, when the wind is blowing from directions where there are no sensitive receptor locations nearby, the volume flow rates through the system can be reduced.

During a typical exhaust dispersion study, the exhaust stacks are designed to achieve acceptable plume concentrations at the critical wind speed and wind direction. Thus, by definition, the systems are over-designed for all other wind speed/wind direction combinations. When this design strategy is used, the exhaust dispersion study is expanded to provide the minimum exhaust flow rates as a function of the local wind conditions. The BAS determines the current building loads and the minimum exhaust flow rate based on the current wind conditions and then sets the exhaust volume flow rate based on the larger of these two values (see Figure 2). To ensure the reliability of the system, multiple wind speed/direction sensors may be used and yearly calibrations

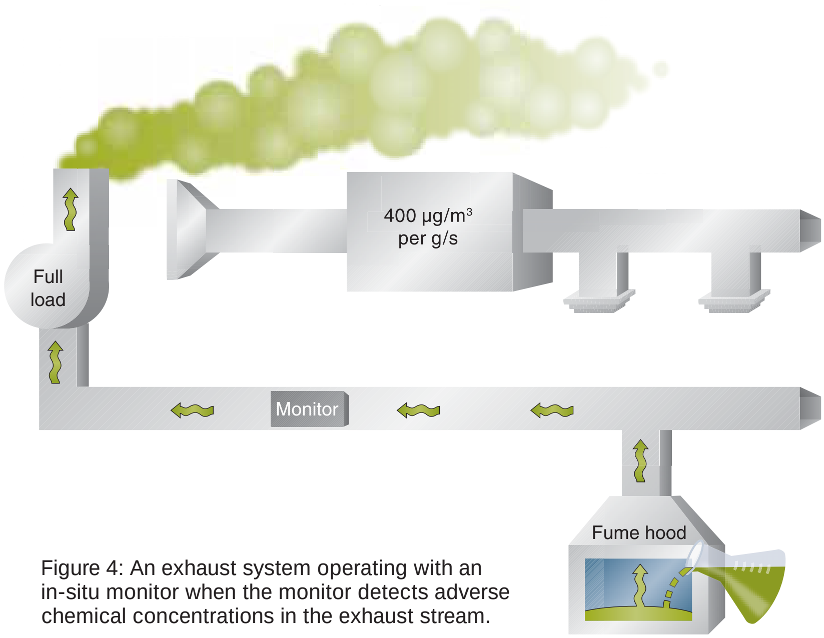

Figure 4: An exhaust system operating with an in-situ monitor when the monitor detects adverse chemical concentrations in the exhaust stream.

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STRATEGY THREE: VAV EXHAUST WITH IN-SITU MONITOR

The third approach includes the use of a VAV system with in-situ concentration measurements in the exhaust duct. When the monitor does not detect any adverse chemicals in the exhaust stream (see Figure 3), the exhaust system is allowed to operate at a reduced volume flow rate. While there may be an increase in the plume concentrations at the nearby air intakes, air quality will not be adversely impacted since the exhaust plume is essentially "clean." When adverse chemical concentrations are detected in the exhaust stream (see Figure 4), the system increases the exhaust volume flow rate to achieve acceptable levels at the air intakes.

When the plume is "clean," the volume flow rate can typically be reduced by 50% to 75% and more closely correspond to the building load.

Data collected at operating research laboratories with in-situ monitors indicate that emission events that would trigger the higher volume flow rate requirements typically occur no more than approximately one hr/month. Thus, a typical system will be able to operate without the need for bypass air more than 99.9% of the time, resulting in significant energy savings.

The cost for installing an in-situ monitoring system will be somewhat greater than the wind speed/direction sensors, if the monitoring system is not already used within the laboratory. If a monitoring system is already installed, the additional cost to add sensors within the exhaust stream is minimal.

ENERGY CONSUMPTION CASE STUDY

The energy consumption for a typical laboratory was calculated for each of the three VAV operating strategies described above along with a CV system. The case study laboratory is configured with four exhaust stacks operating at a maximum volume flow rate of 40,000 cfm each, and a maximum building load of 120,000 cfm and a minimum turndown ratio of 50% during off-hours. For the CV system this corresponds to an n+1 system where only three of the four stacks are in operation. For the three VAV scenarios all four stacks are used. (If one fan is down for maintenance, the system can still operate at 100% load with just three of the four stacks operating.)

System type	Annual energy consumption	Annual cost (assumed $0.12/kWh)
Constant volume	814 MW hrs/yr	$122,200/yr
Standard VAV (20% system turndown)	321 MW hrs/yr	$48,100/yr
VAV w/ wind sensors (up to a 50% system turndown)	200 MW hrs/yr	$30,000/yr
VAV w/ in-situ monitor (up to a 50% system turndown)	163 MW hrs/yr	$24,400/yr

Table 1: Annual energy consumption for a laboratory exhaust ventilation case study.

Table 1 demonstrates the energy savings that can be achieved for this case study laboratory. It is assumed that the standard VAV system is designed to allow the volume flow rates to be reduced to 60% of full load (24,000 cfm/fan, 96,000 cfm for the system). For the VAV systems with the wind sensors and with the in-situ monitors, the minimum flow rates were set at 37.5% of full load (15,000 cfm/fan, 60,000 cfm for the system).

In general, the annual energy savings that one can reasonably expect from employing a standard VAV system is approximately $0.50/cfm of total exhaust flow. By adding either wind sensors or in-situ monitors the savings can increase to around $0.75/cfm/yr. The savings with the wind sensors will vary depending on the local wind speed distribution, with greater savings for areas with lower-mean wind speeds and less for those areas with higher-mean wind speeds.

CONCLUSION

Laboratories possess a tremendous potential for energy savings. As stated earlier, the exhaust system accounts for 30% of a lab's total energy consumption. A properly applied VAV exhaust ventilation system has the potential to reduce that total energy consumption by 15%. When properly designed, a VAV system can provide these savings without adversely impacting the air quality at downwind air intake locations or sensitive locations. A wind tunnel-based exhaust dispersion study will identify the specific energy-saving opportunities available for a new or existing laboratory.

AMCA STANDARD 260-07

The Air Movement and Control Assn. International, Inc. (AMCA) recently approved a new Test Standard and Certified Ratings Program that can help assure the accurate calculation of exhaust discharge momentum when using induced flow fans. AMCA Standard 260-07, Laboratory Methods of Testing Induced Flow Fans for Rating, defines test methods for determining the outlet airflow and velocity, both of which are crucial to accurate momentum and plume rise calculations.

REFERENCE

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Air movement keeps evolving with leadership from Greenheck.

Greenheck's innovative energy recovery ventilators are just one of over 20 different products that can help support efforts to earn LEED credits.

As today's building owners, mechanical engineers and contractors undertake new projects they face an ever-changing set of challenges. Whether it's satisfying new energy guidelines, meeting the demand for products that support sustainable-design initiatives, finding ways to offset rising labor costs, or managing to work within tighter budgets, the marketplace is moving faster than ever — and in need of answers.

Simply reacting to market needs isn't good enough; innovators can't play catch-up — they must anticipate, engage in ongoing product research and development, and provide timely solutions. That's why, for many years, the industry has turned to Greenheck for leadership.

Green / LEED Leaders

In 2005, Greenheck was one of the first air movement equipment manufacturers to join the U.S. Green Building Council. If a project specifically calls for products that help earn LEED certification, or simply specifies a need for energy efficiency, the company's manufacturing representatives fulfill a vital role in the planning process for innovative buildings.

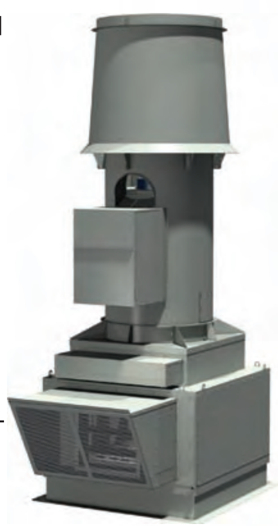
A Systematic Approach

Greenheck's product line is vast and varied, from the industry's best-selling rooftop and wall-mount exhaust fans and ventilators, to an ever-growing selection of special-purpose products such as super-efficient energy recovery ventilators, dampers, louvers, make-up air units, variable-volume kitchen ventilation systems, centrifugals and vane axials, high-velocity laboratory exhaust systems and more.

Greenheck's wide range of products supports engineers who strive for integrated, whole-building solutions. Project planners who try to build ventilation systems by mixing equipment brands may lose time and money due to installation incompatibility and field assembly, while sacrificing performance and long-term reliability.

Innovative Product Development

Greenheck maintains on-site laboratories to test products against the latest industry performance requirements issued by AMCA, ANSI, ASHRAE, UL and others. On-site testing also allows the company to continuously develop reliable new products and to enhance performance of existing products by adding important new features.



Laboratory Exhaust Systems

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JAMES LIVINGSTON,
RUSKIN CO., KANSAS CITY, MO.

Louver design guidelines for non-traditional areas

Today's wind-driven rain, hurricane, and noise control louvers offer practical solutions for demanding building conditions.

Traditional louvers in building designs include a common horizontal blade mounted in the intake or exhaust path on the envelope of the building. This approach has been used for decades with varying degrees of success. While traditional louvers can provide good free area and pressure drop characteristics, they can fall short of providing acceptable performance in severe or non-traditional applications. Today's wind-driven rain, hurricane, and acoustical louvers all provide solutions. These louvers can achieve desired objectives through frame, blade, and installation modifications and still maintain good airflow characteristics.

WIND-DRIVEN RAIN LOUVERS

Traditional horizontal blade louvers are designed and tested for water penetration in non-storm ("still air") conditions (i.e., when the water or rain falls vertically in front of the louver). When subjected to wind-driven rain conditions where the water or rain approaches the louver at an angle or even horizontally, they offer little rain protection. Most storms, in any part of the world, fall into the latter category.

To provide better rain protection for this application, manufacturers have developed unique extrusions for blade construction that actually prevent water infiltration in even the most severe storm conditions. These louvers have a closer blade spacing and more complex blade profiles than their traditional counterparts. They usually incorporate hooks and drains to collect water from the airstream before it can enter the building.

To validate the wind-driven rain water penetration effectiveness of louvers, the Air Movement and Control Assn. Internationa, Inc. (AMCA) developed test setup 5.11 (see Figure 1) and redefined the louver Certified Ratings Program (CRP) to capture this extraordinary performance.

This stringent test subjects louvers to exterior wind and simulated rain injected into the airstream. This is a significantly more severe test than the original "still air" test setup 5.6 (see Figure 2) that uses system airflow only (no wind) and simulates rain that originates out of the airstream.

Louvers are categorized from Class A to Class D on their ability to reject water (see Figure 3). Class A performance is the highest classification possible and signifies 99% or better rain rejection. In many cases, these louvers have been tested for 100% effectiveness indicating that no water from the "outside" passed though the louver to the "inside" in the test environment.

Test 5.11 is performed at two rain and wind levels: first at 3 in. rain/hr @ 29 mph wind conditions, and second at 8 in. rain/hr @ 50 mph wind conditions.

To give you an idea of the amount of rain involved, in the first condition (3 in. rain/hr @ 29 mph), 21 gallons of water are applied to the louver in one hour. To certify Class A performance, the louver must not allow more than 27 fluid ounces of water penetration.

For comparison's sake, Table 1 shows the results when a traditional 6-in. deep drainable louver that meets the maximum performance as tested in "still air" 5.6 was subjected to 5.11 conditions. This "high-performance" louver's effectiveness was Class D @ 67%. In terms of water amount, that is nearly 7 gallons when subjected to the lower wind-driven criteria of 3 in. rain/hr @ 29 mph.

Note that while the AMCA wind-driven rain test is an excellent simulation of "real world" conditions, it does not represent every possible weather and installation scenario. Louvers that provide 100% rain rejection in the test environment may allow some water penetration in certain field applications. These applications usually involve unusual external wind patterns or internal system airflow characteristics. Based on results from these AMCA tests, wind-driven rain louvers clearly outperform traditional louvers in these unique circumstances.

Wind-driven rain testing also allows for higher velocities through the louver. Due to the added rain protection, more airflow can be achieved through the same size louver, or if using the same airflow, the size of the louver opening can be drastically reduced.

The first wind-driven rain louvers were limited to a handful of horizontal and vertical blade models with relatively large frame depths and little mullion appearance flexibility. Louver manufacturers now offer a wide variety of blade styles, with frame depths ranging from 2 to 8 in., with hidden mullions for continuous blade construction. Vertical blade models generally provide the best overall performance because water does not pool on the blade surface. If, however, vertical blade models don't conform with the building's aesthetics, horizontal blade models are a suitable alternative.

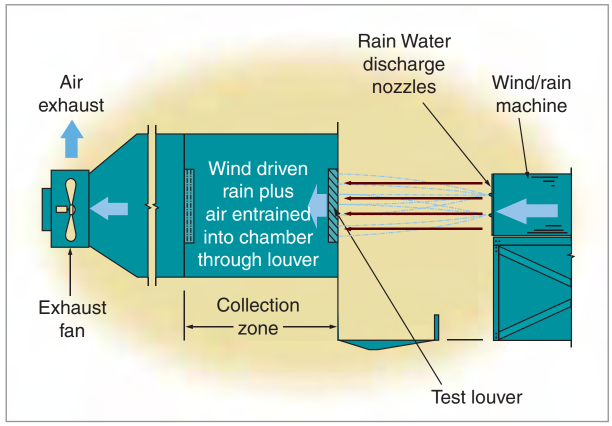

Figure 1: AMCA's test setup 5.11, Water Rejection Wind-Driven Rain, validates the wind-driven rain water penetration effectiveness of louvers.

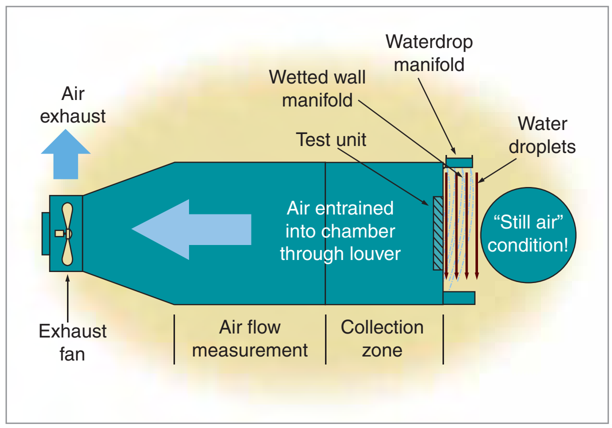

Figure 2: AMCA's original "still air" test setup 5.6 uses system airflow only (no wind) and simulates rain that originates out of the airstream.

Source for all graphics: Ruskin Co. using information obtained from AMCA Standard 500-L.

AMCA 5.11 Effectiveness Classes	
Class A	99% to 100%
Class B	95% to 98.9%
Class C	80% to 94.9%
Class D	Below 80%

Figure 3: Louvers are categorized from Class A to Class D on their ability to reject water.

Due to the closer blade spacing, the cost per square foot of louver is higher for wind-driven rain models; however, reduced sizing as well as the assurance that water problems are resolved can reconcile these costs.

HURRICANE LOUVERS

Hurricanes and other severe weather events create some of the most demanding conditions that a building must endure. Missile impacts from flying debris can puncture the building envelope, allowing wind and rain to penetrate the structure. These forces can produce catastrophic damage to a building.

Frequency (Hz)	63	125	250	500	1k	2k	4k	8K	STC
Transmission loss	10	8	9	13	17	17	13	13	15
Noise reduction	16	14	15	19	23	23	19	19	

Figure 4: A typical noise spectrum. Louver sound performance is determined through testing to the ASTM E 90 Standard, and is given in decibels of Free Field Noise Reduction (NR), which indicates noise reduction through the louver when measured in an open area (no reverberant room).

Louver style	Free area/ sq ft (48x48 in.)	Max. free area velocity fpm	Volume cfm	Wind-driven rain penetration gph*	AMCA wind-driven rain rejection % and class
6-in. vertical blade wind-driven rain resistant	6.8	2,100	14,400	0	100%, Class A
6-in. traditional drainable	9.0	1,000	9,000	6.93	67%, Class D

*3 in. rain/hr @ 29 mph wind conditions.

Table 1: A performance comparison of the two types of louvers subjected to 5.11 conditions. Under the less stringent 5.6 testing, the 6-in. traditional drainable louver is considered high-performance; under 5.11 it is rated at 67%, Class D.

Acoustical louver style	Free area/sq ft (48x48 in.)	Max. free area velocity fpm	Volume cfm	Free field noise reduction at 125 Hz	Free field noise reduction at 8,000 Hz
4-in. formed steel model	4.75	703	3,340	11	16
12-in. formed steel model	3.70	1,126	4,166	13	24
6-in. extruded aluminum model	4.85	1,019	4,942	7	19

Table 2: A performance comparison of typical formed steel acoustical louvers versus extruded aluminum acoustical louvers.

For envelope protection, the building codes in Florida and much of the southeast United States now require elements such as louvers, glass, and walls to be constructed to more rigorous test standards. Hurricane louvers are structurally enhanced to survive in high wind loads, high pressures, and missile impacts. A fourth test, the hurricane rain test, incorporates very high-velocity wind and heavy rain effects.

In Florida, all louvers installed as part of a building envelope generally must have a Florida Product Approval number; if they are used in Broward and Dade counties, they also must be Miami-Dade Approved. The product approvals validate that the products were successfully tested to the appropriate test protocols, and that the manufacturer is producing the products per the tested configurations. The installation method used for the product is also part of the product approval, and installing contractors must adhere to the manufacturer's approved installation instructions. Building inspectors then review the installations to verify compliance.

Hurricane louvers provide one or more of the following:

- High-velocity wind resistance
- High-pressure differentials
- Large-missile impact resistance
- Wind-driven rain resistance

In hurricane zones where the area behind the louver can handle rain penetration and wind pressure, louvers alone are tested to withstand the pressure and wind. There is no need for additional dampers. In applications where the room behind the louver is not designed for the pressure generated by high-velocity wind infiltration, louvers with integral operable blades or stationary louvers with dampers are required so they can be closed to protect the structure in the event of a hurricane.

Many times, the areas behind the louver cannot manage rain infiltration. In these applications, in Florida specifically, the louver/damper assemblies must pass the strenuous Miami-Dade TAS-100(A), Wind-Driven Rain Resistance test before they can be installed. In many cases, louvers that meet these tests also will be AMCA-certified for air and water penetration performance, as well as for wind-driven rain performance.

The Atlantic seaboard and the Gulf regions require these louvers by code (the ICC stands as the national code, but the impact-resistant requirement is regional to the coastal areas). However, they are ideal in any location where elevated envelope protection is desired. Specifiers for structures such as data centers and high-security facilities often select these products for added defense against weather or vandal damage. With a wide variety of blade styles and installation methods available, hurricane louvers are an excellent choice for many applications.

JAMES LIVINGSTON is louver product marketing manager at Ruskin Co.

ACOUSTICAL LOUVERS

Acoustical louvers not only provide water penetration protection, but also offer a noise-attenuating solution for building owners. These louvers incorporate sound-deadening material installed on the underside of the blades to absorb noise that would otherwise radiate from the opening. Louver sound performance is determined through testing to the ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements. Performance is given in decibels of Free Field Noise Reduction (see Figure 4), which indicates noise reduction through the louver when measured in an open area (no reverberant room). AMCA includes sound performance in the CRP program per testing to the ASTM standard.

Acoustical louvers constructed of formed steel or aluminum components are available with frame depths ranging from 4 to 12 in. Because the sound performance improves with more sound material, the deeper models generally provide the best noise reduction. However, the characteristics that make these louvers good at reducing noise also reduce their free area. Acoustical louvers generally provide slightly over half the free area of traditional "still air" wall louvers. This means that acoustical louvers usually need to be larger than standard louvers to handle the same amount of airflow. The initial cost of acoustical louvers, which is slightly higher than traditional louvers, will be insignificant when compared to the remedial costs of a noisy application after the building is completed.

Architecturally, formed steel acoustical louvers have vertical visible mullions at 4 to 5 ft on center. As a rule, they do not use hidden blade supports, so the frame depth is generally the overall louver depth. Tall assemblies made of multiple stacked sections require additional supports for structural integrity. Extruded aluminum acoustical louvers look more like traditional wall louvers and therefore have a preferred aesthetic quality. The extruded blades feature sound-absorbing material on the rear and incorporate traditional louver blade spacing. The sound-absorbing material is thinner and therefore noise reduction capability is lower. But again, with the use of hidden mullions, a continuous blade appearance is possible, which is not the case with formed acoustical louvers. Table 2 compares the performance between typical formed and extruded aluminum acoustical louvers.

Typical applications for acoustical louvers include schools, hospitals, performing arts centers, emergency-generator buildings, fresh- or waste-water pump buildings, mechanical rooms in commercial and industrial buildings that are near residential areas, and all types of factories; acoustical louvers can even be used as equipment screens.

PERFORMANCE ASSURANCE

In the battle against the elements—wind, rain, and noise—louvers can and do come out on top, all while enhancing the building's architecture. And with AMCA's Certified Ratings Program, specifiers get assurance that product performance has been tested and verified. Whether increased rain protection, severe wind resistance, impact resistance, or noise reduction is required, there are louvers tailor-made to provide superior performance.

BY STEVEN R. LYNCH,
CONSTRUCTION SPECIALTIES INC.,
CRANFORD, N.J.

Sunshade considerations

Passive sunshades help save energy and improve worker comfort. They also can reduce capital investments in electrical and air conditioning equipment and enhance a building's appearance.

Shielding windows from the direct rays of the sun is nothing new. Sunshades in one form or another have been around for centuries. So what has changed to bring them into the spotlight? An increased desire to save energy, protect the environment, and create more sustainable buildings.

Sunshades are made of strong, durable screens; they are strategically installed to block out the sun's glare and heat in the summer, yet admit the sun's energy in the winter. Consider the following benefits:

- Sunshades can help create dramatic savings in air conditioning requirements. In addition, smaller (less expensive) air conditioning units can be specified.
- Sunshades enable building occupants to use more natural, and less artificial light. They eliminate the need for interior window treatments or expensive, tinted or darkened glass, all of which increase artificial light requirements.
- Because there is more natural light, worker comfort and productivity are enhanced.
- Once installed, passive sunshades are virtually maintenance-free.
- Sunshades lower peak electrical demand. Smaller (less expensive) electrical switch gears can be installed because the building requires less power.
- Sunshades produce continual savings year after year with little or no additional expenditures.

SUNSHADES AND LEED POINTS

Under the U.S. Green Building Council's LEED v3.0 there are three areas where passive solar controls can be used to help achieve credits:

- **Under Energy and Atmosphere Credit 1 Optimizing Energy Performance (p. 270)—The use of solar shading can help reduce energy consumption through reduced HVAC capital cost as well as operating cost.**
- **Under Material and Resources Credit 4.1 Recycled Content (p. 369)—Most architectural sunshades are aluminum, a highly recyclable material.**
- **Under Indoor Environmental Quality Credit 8.1 and 8.2 Daylight and Views (p. 554)—Here, designers are specifically asked to consider adding interior light shelves, exterior fins, louvers, and adjustable blinds as daylighting options to control glare.**

INCREASED DAYLIGHTING

The amount of energy required to provide artificial lighting can be reduced further when exterior sunshades are coupled with interior light shelves to bring more natural daylight deeper into the interior space.

Fixed exterior shades have traditionally been installed to project 3 to 4 ft from the head of a window. Moving an exterior sunshade down approximately one-third of the height of the window and introducing an interior element (a light shelf) of approximately the same projection enables the building to achieve the same amount of shading as shaded glass; however, light can now be harvested through the upper third. This light is then reflected off the top of the interior light shelf, and is "pushed" deeper into the interior space.

Studies show that using daylighting to reduce task or general lighting can produce energy savings as high as 80% during daylight hours. Bringing natural ambient daylight deeper into a building's interior also can have positive benefits on the building occupants. Studies show that increased daylight helps patients recover faster, improves test scores for children, and leads to more purchases in stores.

ORIENTATION AND LOCATION

There are three basic types of exterior sunshades: cantilevered, horizontal line, and vertical line. Geographic location and building orientation will determine which type to use when designing a sunshading system.

Cantilevered sunshades are most effective on southern elevation during

Interior light shelves push daylight deeper into the space.

Source for all photos: Construction Specialties Inc.

the midday hours when the sun is at its highest point in the sky. These systems are most often comprised of a series of slats or blades, available in many styles that provide a visually appealing application. The slats/blades allow for wind, and in some cases snow, to pass through. A suspended system distributes the load from the exterior sunshade to the building structure.

Horizontal line sunshades are most effective when used on tall expanses of glass or on curtain walls where attaching a series of cantilevered sunshades on top of each other is not practical.

Vertical line sunshades are most effective on east and west elevations to block the low sun angles in the early morning and late afternoon. Typically, a hollow extruded shape sets either perpendicular to the building or at a slight rotation to maximize solar protection while providing occupants with the maximum amount of visibility to the outside.

Many factors must be taken into account when designing a sunshade system. AMCA Publication 504-08, External Shading Devices in Commercial Buildings—The Impact on Energy Use, Peak Demand, and Glare Control offers guidance. In particular, Part 6.0, Sunshade Selection, lists the following “key factors to aid in selection:”

- Geographic location (latitude and longitude)
- Building exposure to be shaded (south, east, or west)
- Time of year for complete or partial shading
- Critical time of day to be shaded
- The sun’s position, azimuth, and altitude based on the location.

Consider the following example:

The sun’s apex in Miami on June 21 at solar noon is just about 84 deg above the horizon. In Manhattan on June 21, the sun’s altitude is about 72 deg. A simple 3 ft 0 in. cantilevered sunshade on a south-facing widow would be very effective on a typical window in either location.

However, if we look at Dec. 21 using the same sunshade, while still effective in Miami, it would block only 50% of the window in Manhattan from receiving direct sun at its most effective time of the day (noon). A more effective approach in Manhattan would be to use a horizontal line sunshade, dropping its front edge to block the sun from some of the lower sun angles. This would help minimize solar heat gain as well as glare.

Elsewhere in the country on June 21, the sun rises in Houston at 6:21 a.m. with an azimuth of 62 deg/9 ft/56 in., or almost 30 north of due east. At 9 a.m., the sun’s position is 31 deg/37 ft/3 in. in altitude, with an azimuth of 79 deg/18 ft/46 in. The sun’s angle of attack is still north of due east, but it is not until just before 11 a.m. that the sun is striking the building from south of east.

The same scenario is played out all across North America. With these lower sun angles, the traditional cantilevered sunshade cannot block direct sun and minimize glare. Vertical fins become a much more effective solution for east and west elevations. The designer can use the size, spacing, and rotation of the fins to optimize their effectiveness for these low sun angles.

In summary, when properly applied, sunshade systems enable buildings to use less energy and bring in more natural light, which benefits the occupants. In addition, they visually enhance a building’s appearance.

LYNCH is technical sales manager of Construction Specialties Inc., Cranford, N.J.

BY VICKIE LOVELL
AND ANDY FRAME,
INTERCODE INC.,
DELRAY BEACH, FLA.

Life safety damper inspections

Regular inspections and testing are vital to protecting property and saving lives.

A building's life safety systems constantly stand ready to protect the structure and its occupants from catastrophe; their successful operation can mean the difference between a nuisance fire and a catastrophic event.

A building's HVAC system generally penetrates every space of a building. Without effective life safety systems in place, these pathways can carry fire, smoke, and toxic gases throughout the building, causing property damage, injuries resulting from smoke inhalation, and even death.

The smoke and fire components of the HVAC system, particularly the fire and smoke dampers, are therefore crucial components of the fire protection design.

OPERATIONAL REQUIREMENTS

To ensure that life safety systems serve their intended purpose, periodic inspection and testing are not only essential, they are mandatory.

The International Codes and the NFPA 101 Life Safety Code are specific about the frequency and requirements of periodic inspection and testing. Virtually every jurisdiction in the country has adopted these requirements, or some variation of them. The Authority Having Jurisdiction (AHJ) typically requires the building owner to test all life safety dampers within 1 year of the acceptance test being conducted and/or the building being occupied. Figure 1 identifies standards and guidelines that specify periodic inspection and testing requirements and are adopted by reference in a code by a jurisdiction.

Within 1 year after acceptance testing in new construction or after remodeling, a typical mandated periodic inspection and testing schedule can include the following:

- Every 6 months—Cycle test (open and close) all motorized fire and smoke dampers, and test all dedicated smoke control systems
- Every 12 months—Test all nondedicated smoke control systems
- Every 2 years—Visually inspect all fire dampers, ceiling radiation dampers, smoke dampers, and combination fire/smoke dampers
- Every 4 years—Manually operate (open and close) all fusible link-operated fire dampers and ceiling radiation dampers.

(Note: Routine maintenance is not typically required by manufacturers unless a periodic inspection or test identifies the need for maintenance.)

Inspection and testing should be performed by qualified personnel who have expertise in fire protection or mechanical engineering, or are certified to inspect life safety dampers or smoke control systems in accordance with an ANSI third-party accreditation program.

INSPECTION PROCEDURES

Inspectors typically observe components in operation to verify that the equipment or construction is installed properly and that it is appropriate for the system design. The specific tests, and the most efficient order of testing, depend on the:

- Type of system
- Number of systems

Figure 1: Relevant standards and guidelines that specify periodic inspection and testing of life safety systems and their components.

National Fire Protection Association (NFPA)	
NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems
NFPA 90B	Standard for the Installation of Warm Air Heating and Air-Conditioning Systems
NFPA 92A	Standard for Smoke Control Systems Utilizing Barriers and Pressure Differences
NFPA 92B	Standard for Smoke Management Systems in Malls, Atria, and Large Spaces
NFPA 80	Standard for Fire Doors and Other Opening Protectives
NFPA 105	Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives
American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)	
ASHRAE Guideline 5-1994	Commissioning of Smoke Management Systems
ASHRAE Guideline 1-1996	The HVAC Commissioning Process
Underwriters Laboratories Inc. (UL)	
UL 555	Standard for Fire Dampers
UL 555S	Standard for Smoke Dampers
UL 555C	Standard for Ceiling Dampers
Marking and Application Guide	Dampers for Fire Barrier and Smoke Applications & Ceiling Dampers
Air Movement and Control Association (AMCA) International, Inc.	
AMCA Publication 502	Damper Application Manual for Heating, Ventilating, and Air Conditioning
AMCA Publication 503	Fire, Ceiling (Radiation), Smoke and Fire/Smoke Dampers Application Manual Inspection, Testing, and Maintenance Guidelines
Other	
	Individual manufacturers' Web sites and technical support hotlines

VICKIE LOVELL AND ANDY FRAME are consultants of Intercode Inc., a building code consulting firm.

- Progress of new construction or remodeling
- Relationship between building systems and specific tenant work
- Degree of interaction between other systems
- Complexity of the controls sequence
- Impact of system failures on fire or life safety and other factors.

Determining the procedures for periodic inspection and testing is a critical component of the overall process. One option is to locate an existing inspection procedure that has already been approved by the AHJ. If an existing procedure exists, it must be followed implicitly. If a procedure cannot be located or does not exist, one must be developed by a qualified professional whose credentials are acceptable to the AHJ. Some AHJs provide the testing and inspection procedure.

Establishing and approving an inspection procedure involves research, including:

- Obtaining any existing inspection documents, including any previous inspections or testing reports
- Locating relevant information from the overall building design, including design objectives and construction documents
- Determining the specifications and location of every life safety damper that is installed in the building.

Once the inspection and testing have been completed, meticulous records must be maintained. Records verify that the proper inspection and testing have been completed and that the building complies with local inspection requirements. These records should contain key information about each damper, such as make or model number, ratings, date installed, observations made during periodic inspection and testing, and any corrective actions taken. Whether handwritten or in electronic format, the records of all inspections and tests must be maintained on-site for at least 3 years, as stated in the codes.

CONCLUSION

Life safety systems are in place to ensure that disastrous scenarios do not occur; however, these systems are worthless if they don't function as intended in an emergency. Therefore, conducting periodic inspections and testing of life safety dampers and other life safety systems is vital to protecting both property and human lives.

LaPointe named AMCA president

Art LaPointe, vice president and general manager of Construction Specialties Inc., Cranford, N.J., was elected president of AMCA International at the association's annual meeting held this past September.

LaPointe has been an enthusiastic supporter of AMCA and has helped develop and improve many product performance guidelines and standards; he also has helped further efforts to have AMCA standards written into architectural specifications.

Construction Specialties Inc. has been an AMCA member company for more than 30 years. LaPointe has been involved with AMCA since 1996. He has served as chairman and co-chair of the Air Control division, and as an AMCA Bylaws Task Force member. Additionally, he has been a longtime member of the Statistical Program committee. In the last six years he has served as a member of the AMCA Board of Directors, and more recently as a member of the Executive Board holding the positions of director-at-large, treasurer, and vice president.

Neitzel receives distinguished service award

Emery (Pete) Neitzel received AMCA International's Distinguished Service Award at the association's annual meeting held this past September. Neitzel is a former AMCA president and retired vice president of engineering and manufacturing for Greenheck Fan Corp., Schofield, Wis. The award recognizes service to AMCA and the entire HVACR industry as a whole.

Neitzel has served on several of AMCA's technical committees and helped develop many AMCA publications and standards. He also helped develop standards for other trade organizations including ASHRAE, UL, and ASTM. He has published and presented many papers on HVAC equipment design, testing, and application.

Korean lab accredited to perform AMCA testing

The Korea Machinery-Meter and Petrochemical Testing and Research Institute (MPI) laboratory in Pyeongtaek-City, South Korea, has been accredited by AMCA International to perform both air and sound tests in accordance with AMCA International's test standards 210 and 300 and other international standards. The agreement is part of AMCA International's continued efforts to expand its Certified Ratings Program (CRP) in Korea. MPI will act as AMCA International's authorized CRP agent for the Korean regions and in other areas of the Pacific Rim.

The laboratory was accredited on Aug. 26, 2009. AMCA Executive Director Barbara Morrison and MPI President and CEO Kim Yeon Kwong signed the licensing agreement. Also present were Mr. Lee, vice president of MPI, and Mark Stevens, AMCA deputy executive director.

The MPI testing laboratory is equipped with the latest state-of-the-art equipment to perform air and sound tests. It also can provide third-party verification for product testing in the HVAC industry; testing capacities will range from air volumes of 650 cmh to 140,000 cmh. Going forward, the facilities will be used to help verify the energy efficiency of ventilation and air conditioning equipment; promote green building; verify compliance with environmental sustainability standards; and ensure that environmental quality and comfort are not compromised.

Present at the MPI signing were, from left to right: Mark Stevens, AMCA deputy executive director; Barbara Morrison, AMCA executive director; Kim Yeon Kwong, MPI president and CEO; and Mr. Lee, MPI vice president.

PUBLICATION UPDATES

AMCA Publication 502-06 (R2009), Damper Application Manual for Heating, Ventilating, and Air Conditioning, was reaffirmed by the AMCA membership on Sept. 11, 2009. Publication 502-06 (R2009) provides general information and important points to consider when designing or specifying HVAC installations requiring dampers in specific temperatures and pressures.

To order this publication, visit www.amca.org. For more information, contact Tim Orris at torris@amca.org.

AMCA International approved the July 2009 revision to AMCA 311, Certified Ratings Program—Product Rating Manual for Fan Sound Performance. Products that can be licensed by AMCA to bear the AMCA Certified Ratings Seal are centrifugal fans, axial fans, power roof ventilators, air curtains, agricultural fans, and other air moving devices within the product scope of AMCA.

The AMCA 311 manual is intended to prescribe the technical procedure used in connection with the AMCA Certified Ratings Program for Fans—Sound Performance. The program applies only to complete air moving devices that are already licensed to bear the AMCA Certified Performance Seal for Air Performance.

To order this publication, visit www.amca.org. For more information, contact Joe Brooks at jbrooks@amca.org.

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AMCA International's 2009/2010 Event Calendar

U.S. Green Building Council (USGBC) Greenbuild
Phoenix
Nov. 10-12, 2009

Big 5 Expo
Dubai, UAE
Nov. 23-27, 2009

AHR Expo
Orlando
Jan. 25-27, 2010

AMCA Spring Meetings
Marriott Plaza, San Antonio
Feb. 28-March 3, 2010

Mostra Convegno Expo Comfort (MCE)
Milan, Italy
March 23-27, 2010

AMCA International's 55th Annual Meeting
Fairmont Turnberry Isle Resort & Club
Aventura, Fla.
Oct. 14-17, 2010

AHR Expo Mexico
Mexico City
Oct. 26-28, 2010

Our assignment for the school project:

the [air]

This illustration highlights the various Greenheck products available for school buildings; it does not represent an actual ventilation application.

1. Sunscreens
2. Louvered Gravity Ventilator
3. Energy Recovery Ventilator
4. Laboratory Exhaust System
5. Equipment Screen
6. Spun Aluminum Roof Exhaust
7. Ceiling Exhaust Fan
8. Utility Fan
9. Make-up Air Unit
10. Upblast Roof Exhaust
11. Utility Distribution System
12. Kitchen Hood Variable Volume
13. Sunscreens
14. Indoor Air Handling Unit
15. Hooded Gravity Ventilator
16. Centrifugal Inline Fan
17. Fire Smoke Damper
18. Intake Damper
19. Louver
20. Plenum Fan

We're equipped to handle it all.

School air-control needs are varied and interrelated. When you must equip for all applications — classrooms, labs, kitchen, cafeteria, pool, auditorium, gym — trying to mix and match HVAC brands is not a value proposition. Greenheck products are designed to work as complete, integrated ventilation systems that deliver value — with quick, cost-saving installation; energy efficiency; quiet operation; comfortable staff and students; and a satisfied school board. Our extensive testing ensures that you can select more products with certifications from AMCA, UL, ETL, CSA and ULC than from any other manufacturer. Engineering expertise and industry knowledge pay off, with value you can depend on every school day. School project? Contact your Greenheck representative today.

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