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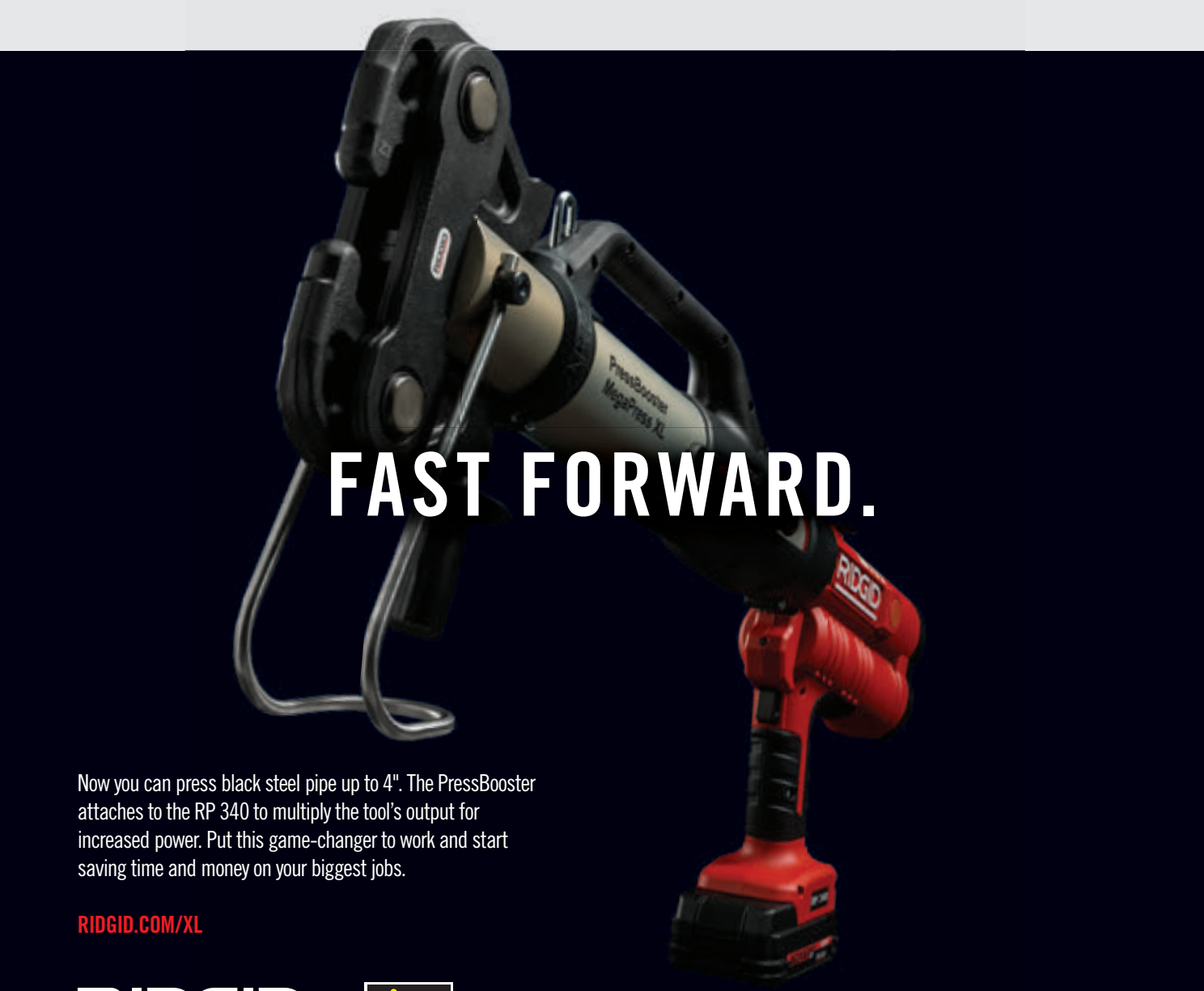

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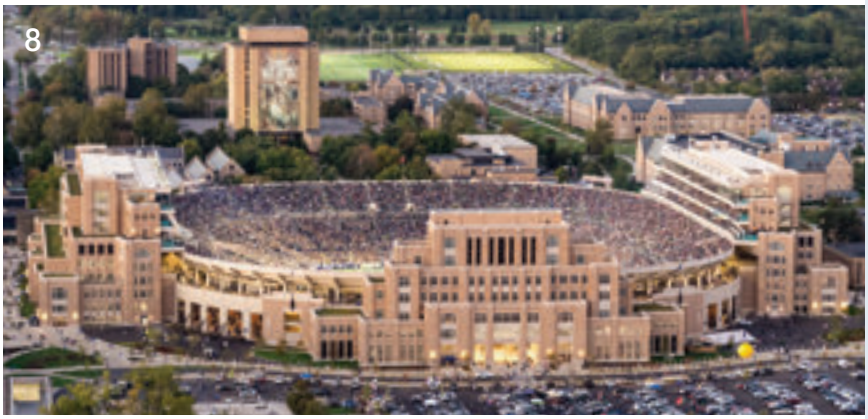

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The Costly Disconnect Between Maintenance and Design

Here's a concept that works: Listen to the people responsible for maintenance of a new institutional or commercial facility during the planning and design process for that facility.

For years, maintenance and engineering managers have preached this message to anyone involved in building design who would listen. Unfortunately, too many architects, engineering firms, and CEOs haven't listened. The results have been predictable — and costly. Building envelopes crumble, roofs leak, and HVAC systems fail to keep occupants comfortable and waste energy and money while doing so.

Managers don't need a government report to prove a disconnect exists. But they have one. A new U.S. General Accounting Office (GAO) report documents the impact on 78 federal facilities of failing to account for operations and maintenance (O&M) during facility planning and design. The findings:

The good. Some building design choices — increased natural light, durable and easily maintained materials and finishes, and low-maintenance landscaping, among them — actually decrease O&M costs.

The bad. Many design choices increase O&M costs. They include inefficiently located mechanical systems, hard-to-reach lights, and tough-to-maintain materials and finishes.

The answer. Per the GAO's recommendations, the U.S. General Services Administration (GSA) should be required to estimate O&M costs of design choices during planning, get input from building managers on the O&M impact of these choices, and share data on the impact on O&M costs of common design choices.

Managers who want ammunition to build the case for a greater role in design and planning can read the full report at https://goo.gl/wCQNhH.

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Andrew Gager — *a.gager@nexusglobal.com — is managing director for North America with Nexus Global Business Solutions. He has more than 28 years of facilities and manufacturing experience, ranging from warehousing operations to plant management. He is a registered CMRP, CPIM, CRL, and Six Sigma Green Belt, and he is formally trained in change-management principles.*

Andrew Gager

Efficiency and Effectiveness: Know the Difference

Professional and personal tasks for managers often are similar. In both settings, managers organize, direct, coach, supervise, and at times, discipline. One of the other common tasks for managers is budgeting and metrics.

It is important that managers understand what to manage, why it's important, and how to do it. This is where efficiency and effectiveness come in. By understanding the difference between these two concepts, managers can achieve success.

Efficiency and effectiveness are not the same thing. Efficiency is defined as the ability to accomplish something with the least amount of wasted time, money, and effort or competency in performance. Effectiveness is defined as the degree to which something is successful in producing a desired result; success. Managers need to appreciate the way each affects an organization.

To illustrate the differences among efficiency, effectiveness, and other measures, I'll use my typical annual activities.

Efficiency measures

One measure of maintenance efficiency is total maintenance costs compared to replacement asset value (RAV). Some refer to this as equipment replacement value (ERV). It is defined as the monetary value that would be required to replace the current assets in the organization. It includes production and process equipment, as well as utilities, support, and all related costs. For example, in the past 12 months, I have had some maintenance expenses. My current RAV is $425,000. Here are my home maintenance expenses for the past 12 months:

- Plumbing, $1,835
- Road repairs, $185
- Mailbox replacement, $160
- Paint the dining room, $75
- Replace light bulbs with LEDs, $150
- Install security system, $600
- Replace roof, $9,400
- Replace freon, $225
- Replace seal on sauna $400.

Total: $13,030

Based on these expenses, the ratio of total maintenance costs to RAV is 3.1 percent — divide $13,030. by $425,000, then multiply the result by 100. This is important because by understanding the costs associated with maintaining assets, managers can determine the best methods to get a company's RAV ratio down to 3 percent, then 2 percent and finally 1 percent of maintenance cost as a percentage of RAV in order to reach operational and maintenance success.

Managers are responsible for determining the most appropriate mix of physical asset policies, work management, and reliability improvement processes to reduce the costs of non-value added or recurring expenses.

In my example, some expenses might be considered capital expense or improvements. For example, I won't replace my roof annually, but there are recurring maintenance costs that I can control. Perhaps I purchase a higher quality shingle, for example.

Another measure of maintenance efficiency is corrective maintenance (CM) versus preventive maintenance (PM). Evaluating total maintenance costs to RAV does not naturally give enough detail to identify where costs are applied. Total man-hours spent on CM versus PM can help managers determine if maintenance practices are effective at preventing unscheduled downtime and reducing CM.

The percentage of work planned as opposed to emergency or corrective repairs is also an effective measure. Remember that emergency work is typically three-four times more expensive than planned work.

PM/CM compliance is a measure that follows closely with CM vs. PM ratios and a good measure for efficiency. The purpose of the PM is to schedule activities so technicians can spot deficiencies before they evolve into more costly problems. So it is important to complete these PMs and to do so them on time. CM includes maintenance done to return items to proper condition. Consider my home PM/CM compliance for April:

- PM — Make coffee; done 27/30 days
- PM — Pick up garbage weekly; 4/4
- PM — Mow lawn weekly; 3/4
- PM — Change oil quarterly; 1/1

- PM — Clean garage annually; 0/1
- CM — Wash laundry as required; 4/5
- CM — Wash truck; 1/1
- CM — Power-wash house; 1/1
- CM — Vacuum; 0/5.

My PM/CM compliance was 78.85 percent — days task completed divided by days task scheduled. Why is this important? What are the consequences of failure by not achieving my schedule compliance? Not making coffee, for example, just means I don't get my morning jolt. Missing a week of cutting lawn means I have an unusually high grass that probably needs to be cut twice. It's essential that managers understand the consequences when deciding whether to perform PM or CM or defer the task.

Effectiveness measures

Managers need to know key measures in order to manage operations effectively.

Backlog management. Many people I work with believe a backlog is bad. They believe backlog is any work past due or incomplete. In fact, backlog is the total amount of hours, — not work orders — in the maintenance schedule that includes PM, CM and predictive maintenance (PdM).

So a backlog is good. Managers want four-six weeks of backlog for each discipline and two-four weeks of so-called ready backlog, which is where the maintenance schedule is developed. If managers can manage backlog and maintain the desired level of work, that indicates the department is effectively managing its workload.

Hours available divided by hours worked. One measure used to determine of the hours available to work is determining how many of those were direct. Nothing is more frustrating for a manger than to have the crew sit around with nothing to do. We typically use this as a measure for maintenance scheduler's ability to use and optimize the hours available for direct work.

Return on net assets (RONA). RONA measures financial performance calculated as net income divided by fixed assets and net working capital. It reveals if a company and its management are using assets in an economically valuable way. If maintenance costs are too high, then the RONA will be impacted by the cost of maintaining the assets, thereby reducing working capital.

Maintenance cost per square foot (psf). This measure is used extensively throughout industry to benchmark against. In July 2016, the Building Owners and Managers Association reported the following benchmarks for U.S. private-sector office buildings:

- total operating expenses: $8.07 psf
- total operating and fixed expenses: $12.47 psf
- security: $0.72 psf
- administrative: $1.45 psf
- cleaning: $1.52 psf
- utilities: $2.16 psf
- parking: $0.61 psf
- roads and grounds: $0.25 psf
- repairs and maintenance: $2 psf

Using my maintenance expenses from last year, my psf costs would be $4.11. Obviously, I'm way out of line.

Managers need to be clear on efficiency and effectiveness to make smart decisions. We can be efficient without being effective, and we can be effective but incredibly inefficient. The challenge is identifying the balance between efficient and effective.

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Institutional Facilities Projects

Running to Savings

Tackling plumbing upgrades at Notre Dame Stadium benefits water conservation, sustainability and the user experience

By Ryan Berlin, Managing Editor

Built and opened in 1930, Notre Dame Stadium is one of the oldest and most storied football venues in college football, and it has seen its share of renovations and upgrades.

In 2014, the university gave the stadium and surrounding facilities an upgrade appropriate for its high profile on campus and beyond. The university tackled a $400 million enhancement that included the addition of three adjacent buildings and a host of plumbing upgrades.

"The Campus Crossroads Project constructed three buildings that connected to our stadium," says Mark Hummel, assistant director of utilities and maintenance at the University of Notre Dame. "The philosophy around that is this is a location that 90 percent of our campus can walk to in less than 15 minutes. What they were finding out is that it is such a large piece of real estate that it was more of a black hole on campus than it was a venue for people.

"The renovation of the stadium was on the shirttails of the project. Within the Campus Crossroads Project, the project was undertaken to renovate the restrooms in the stadium."

Completed in January 2018, the project involved careful plumbing product specification, as well as consideration of football practices and schedules, all with the goals of saving

water, improving restroom hygiene and helping the university become more sustainable.

Focusing on fans

As part of the Campus Crossroads Project, Hummel and his staff worked on renovating nearly 40 total restrooms at Notre Dame Stadium in order to improve the overall user experience. To achieve this goal, the project focused on water conservation and hygiene.

"The primary driver for the project was to upgrade the appearance within the restrooms," Hummel says. "That being said, whenever the university takes on a renovation or an upgrade, water conservation is right there at the forefront.

"Modernizing (the restrooms), getting them to be hands-free and reducing the water consumption are all major objectives and major sustainability tenets for the university."

The modernization began with the removal of functioning trough urinals from the original stadium construction. The renovations included upgrades of lavatories and water closets, as well as faucets, sinks, and urinals.

"Essentially, this was a one-for-one replacement," Hummel says. "There were some other minor modifications, like chases were built (and) carriers were installed, and we concealed the water lines to make it a more attractive space inside of the restrooms.

"Before (the renovation), the appearance of the restrooms were a little utilitarian and concrete," Hummel says. "With updated stadium signage, video boards in the concession stands, fresh paint, and other renovations, that blended into the refixturing and repainting of the restrooms, which then added to the entire fan experience. It really did transform the appearance of a stadium that looked utilitarian and a little tired. It really brought the finishes and experience to be a modern-day stadium inside."

Specifying products

Hummel and his staff specified a range of products designed to help achieve their goals of improved aesthetics, water conservation and hygiene.

Planning for the plumbing renovation portion of the Campus Crossroads Project began several months in advance and involved every member of the team.

"In this case, the project manager on the team is actually our associate vice president for facilities, design and operations," Hummel says. "We hired a design manager, and we started planning on this six to nine months prior to the start date, and we would hold regular design meetings."

The maintenance and engineering staffs were heavily involved in product specification throughout the process.

"The engineering staff was highly engaged with the selection of the

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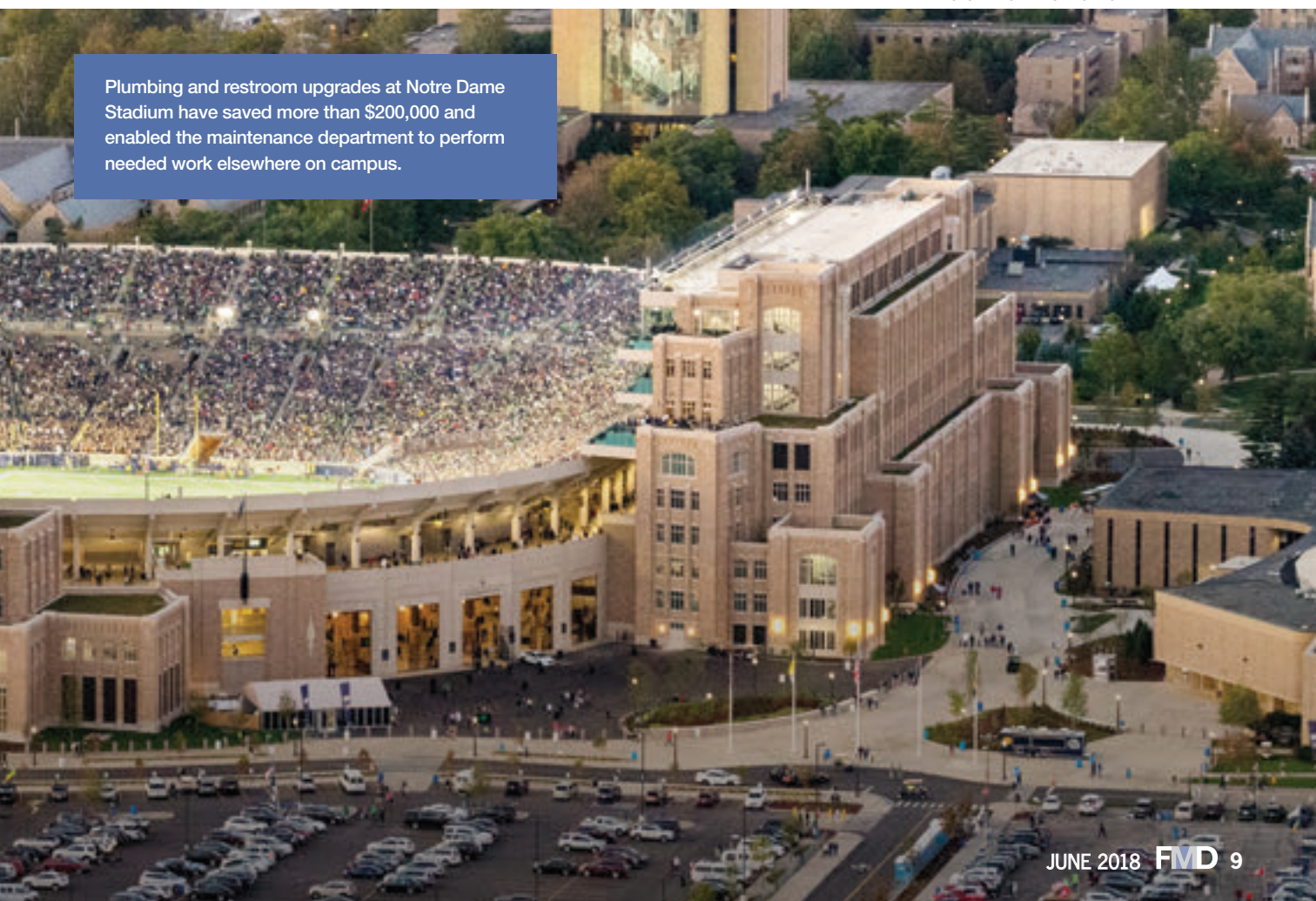

Plumbing and restroom upgrades at Notre Dame Stadium have saved more than $200,000 and enabled the maintenance department to perform needed work elsewhere on campus.

plumbing fixtures," Hummel says. "We have a pretty integrated staff. From a design perspective, we have a pretty thorough design review process. Everybody has a seat at the table and a voice, so they played a very active role, and they were very well represented.

"The engineering staff's concerns were durability, the availability of replacement parts, and just good support from the OEM."

Coordinating the project with Sloan Valve Co., the team specified a total of 2,105 products — including water closets, urinals, flushometers, faucets, and soap dispensers — that were installed by a contractor.

"There were many discussion on the functionality and style of each fixture," Hummel says. "With 88,000 fans on gameday, if they are all touching the same fixtures, it can be a breeding ground for germs, and when everything is touchless, that is an ideal environment from a bathroom standpoint.

"Low-flow fixtures are a key factor in that conservation. The sensor activation feature of the faucets and flush valves provide the most hygienic experience, and they modernize the appearance of restrooms. Both were prime objectives of the stadium renovation."

Challenges and benefits

Taking place over a four year period, the Campus Crossroads Project faced a number of different challenges related to the plumbing and

From 'Black Hole' to Crossroads

In January 2014, the University of Notre Dame launched a $400 million renovation to Notre Dame Stadium and nearby buildings — the Campus Crossroads project. This expansion features three, eight-story buildings and added more than 750,000 square feet of teaching, research, and performance space.

"Not only was the Campus Crossroads Project historic from a size and magnitude for the university, but when you add in the stadium and the other buildings in that construction project, it really was an unprecedented amount of growth for the university in a two- or three-year period of time," says Mark Hummel, who is the university's assistant director of utilities and maintenance. "We added more than 15 percent to campus, which in some ways seems like a small number. But when you consider the campus has been here for 175 years, adding 15 percent in that amount of time is absolutely unprecedented.

"It is just a historic amount of construction for the university, not only from a project basis but blended with the other construction going on at one period of time."

The Campus Crossroads Project was designed bring students to an area of campus that traditionally has been only used seven times a year on Saturday game days in the fall. In addition to engaging with students year round, Hummel and his staff took their sustainability and energy efficiency efforts one step further. The three new buildings attached to Notre Dame Stadium have earned LEED certification.

"All of the new building are LEED certified," Hummel says. "LEED Silver is kind of our standard design criteria. Sometimes, we will get enough points to be gold. The other main benefit was to draw campus users to the areas of that are not used very often.

"This is a location that 95 percent of campus can walk to in 15 minutes. They found that it was such a large piece of real estate that it was more of a black hole on campus than it was a venue for people. With that proximity, the concept evolved to build these three facilities that made it more of a focal point for campus."

— Ryan Berlin

PHOTO: THE UNIVERSITY OF NOTRE DAME

restroom upgrades at Notre Dame Stadium. One major issue related to the demands presented by the needs of the university's football team. Hummel and his staff worked during the college football off-season, and they had to be sure not to encroach on other areas of campus life. Working over an eight-month period, the renovation was completed ahead of schedule.

"From a scheduling standpoint, there were no loss of football games," Hummel says. "All of this had to take place from the first of December, which is after the last home game to August. Quite honestly, we were done well before the Blue/Gold Game, which is the Spring game in late April.

"The large quantity of fixtures and components (we had) to change during that fairly short window was pre-planned and purchased ahead of time. Once the actual window of construction became available, it was able to be completed within that time frame."

Once the renovations were completed, the results began to show right away, Hummel says Among the benefits — the upgrades freed the maintenance staff to focus on other projects, water consumption decreased, and the effects on the bottom line were clear.

The renovations freed up the maintenance staff, allowing them to focus on other essential items that may require maintenance and the need for additional staff also is minimized.

"By refixturing these restrooms, we have decreased our general maintenance," he says "By updating them to a newer product line, it made the operation more efficient for us."

In addition to freeing up the maintenance staff to focus on more general maintenance, the renovations also improved the water conservation at the university.

"Conservation in general is part of the culture at Notre Dame," Hummel says. "We are always looking for ways to save water. Over the past decade, the university has leveled off its water use while expanding campus by over 25 percent. Low-flow fixtures are a key factor in that conservation."

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The financial savings also has been significant for the university.

"For the stadium and Campus Crossroads Project alone, the financial benefit exceeded well over $200,000," Hummel says. "Including all of the project, the savings have been in excess of $250,000 by us being able to reallocate maintenance staff to other projects on campus."

Over an eight-month period, Hummel and his staff renovated more than 2,000 restroom fixtures. While challenging, the process provided Hummel with a valuable lesson.

"'Stay the course' is probably the simplest terms I would use," Hummel says. "I want to build on the fact that we have our sustainable goals, (and) we have the desire to reduce water and provide a durable fixture. I think since we have been successful with that. That is the lesson. We just want to maintain that path going forward." ■

Deciding whether to repair or replace a boiler begins with understanding the unit's condition, so technicians should carefully inspect the equipment.

Renovations and Retrofits

Boilers and the End-of-Life Decision

Managers deciding whether to repair or replace a boiler need to gather, analyze and present solid data to make a smart decision

By Mark A. Pontz, P.E.

Maintenance and engineering managers play an important role in the energy-efficient operation of HVAC systems and components, as well as their eventual replacement. They are responsible for the ongoing testing and monitoring of the systems' performance, and they ensure front-line technicians have access to a reliable supply of replacement parts and tools to perform needed repairs.

Boilers are essential components of these systems, and eventually, their performance lives near the end. As this time arrives, managers need to monitor boiler condition and operation to determine the most appropriate time for replacement. Before getting into the metrics of a boiler replacement, a closer look at boiler inspection and maintenance is in order.

Looking for trouble

Making the decision on whether repair or replace a boiler begins with understanding the unit's condition, so technicians should inspect the equipment. A commercial boiler should be drained and opened annually by a qualified boiler mechanic, preferably one who has been factory trained by the manufacturer.

Whether the unit is a fire tube boiler or a water tube boiler, annual inspection is the first and best line of defense against a catastrophic failure. Where multiple boilers are involved, managers can identify a time of year to take one of the boilers offline for inspection.

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Once the boiler is opened, technicians need to check key components to determine the boiler's operating condition. What condition are the tubes in? Do the tube sheets look warped? Is there any noticeable discoloration to indicate hot spots? Were any existing tubes plugged and, if so, how many? All of these items can help managers assess the condition of the boiler and begin the repair-or- replace assessment.

When it comes time for managers to inform top executives about the decision to replace a boiler, it is essential to have solid information to make a strong case

What about cast iron and condensing boilers? Cast iron boilers typically go from working fine to suddenly cracking, typically due to thermal shock. Cracking tends to happen when it's cold outside and the boiler is essential. The reason cast iron boilers last as long as they do is that, except for the burner, they are large hunks of cast iron.

Maintaining cast iron boilers is more subtle. Water chemistry and operational temperatures are the keys to their longevity, so managers need to make sure they have a trustworthy water treatment professional service the facility and monitor supply and return temperatures regularly.

Operators should avoid thermal shock at all times. Also, if the boiler water temperature is set much below 150-160 degrees, acidic condensate from the flue gases often will cause unwanted corrosion and premature boiler failure.

Technicians should monitor condensing boilers similarly to cast iron boilers. Supply and return temperatures, manufacturers' recommended maintenance procedures, and combustion air and flue conditions are vitally important for the proper and efficient operation of these boilers.

Key metrics

The next step in making the boiler replacement decision is to determine the most applicable metrics for the varying types and applications for boilers. Comfort-heating boilers have different operational characteristics from industrial process boilers. Also, operational and maintenance costs differ between a 15 pounds per square inch (psi) hot-water boiler and a 250 psi steam process boiler. Replacing a large hot water boiler in a school over the summer is a different scenario than replacing a process steam boiler in a paper plant.

Energy and repair costs are relatively easy to catalog and interpret once managers normalize the data. When properly applied and maintained, most boilers are 15- to 30-year investments. Whether a boiler is metered separately or just allocated the principle share of the monthly gas bill, it is important to analyze energy data after it has been normalized.

One burner manufacturer sold quite a few burners to local school districts in the Northeast United States. One school district's technician talked to his peers in other districts about the amount of energy his district saved by converting to this particular burner, and the other districts were amazed by the results.

The bad news is that this area of the country actually had gone through almost a decade of winters with mild temperatures. One simple degree-day analysis showed that the savings were mostly attributable to the drastic departure of the current weather trends from the norm, and that the first cold winter would show there actually had been very little savings from the burners.

Was it worth replacing old cams and linkages with state-of-the-art burners and controls? Maybe for the 20-year-old, well-maintained boilers, but some of the boilers were less than five years old.

Natural gas has become the principal fuel of choice for many managers. It is cleaner than oil, and its delivery is typically instantaneous. But if managers signed up for a curtailable rate, technicians still need to try to tune the oil burner to acceptable performance metrics. Once the call comes to curtail, did technicians soot up tubes to the point where the facility loses all the efficiency gained by tuning up for natural gas?

If it seems that this issue has more questions than answers, that is right. Well-maintained, non-condensing commercial boilers in the United States probably operate at about 78-84 percent efficiency. If a plant produces hot water instead of steam, managers might be able to hit 88 percent with certain boilers.

After that, condensing boilers are most appropriate. Managers need to be aware that if a hydronic heating system is more than 20-30 years old, the ancillary heating equipment might not provide enough heat with the lower temperature hot water required for the condensing boiler to perform at its rated efficiency.

The tipping point

With all this information for managers to consider, when is it time to replace a boiler? Consider two real-world scenarios.

Scenario 1. The boiler is more than 30 years old, the local boiler mechanic visits so often he has a permanent parking spot at the facility, and it is 28 degrees outside. It is amazing the number of institutions that do not have enough money for routine maintenance, but when the boiler dies, they find a way to buy a new one. Many organizations do not have the luxury of being liquid enough to purchase a boiler whenever it ceases to function. Either the managers applies another Band-Aid, or the organization has to cut other programs to fund the replacement boiler.

Scenario 2. The manager has kept detailed cost data on maintenance and repairs. During this year's annual inspection, the technician determines that four more tubes need to be plugged and a tube sheet is warped.

About one-quarter of the tubes now are plugged. The boiler mechanic is more than willing to replace all the tubes and tube sheets for a fee that is about one-third to one-half the cost of a replacement boiler. This is where all of the preceding comes into play.

If it is one of three boilers at the local high school, maybe the manager can get another two or three years out of it so the school board can replace it in a somewhat planned manner. But then at a school board meeting, a parent decides that he knows about boilers and suggests the plugged boiler will operate inefficiently and that it should be replaced as soon as possible.

This is where the manager's records come into play. Burner combustion tests show that the burner is in good working order and the remaining tubes are soot-free and do not show any noticeable degradation. The manager suggests the boiler be placed on standby unless it is needed. Will the boiler make its rated capacity? No, but it will keep the facility operational.

Now change this second scenario to an industrial facility with only one boiler instead of a school with three boilers. The cost of the replacement boiler, its energy efficiency, and operational costs could be moot compared to the lost revenue associated with the plant shutting down. Does the manager roll the dice, plug it and plan on replacing it during the next quarter's scheduled outing? Does the manager rent a temporary boiler and start an immediate replacement? The result is frustrating and presents more questions than answers.

When it comes time to inform decision-makers about replacing a boiler, it is essential to have solid information to make a strong case. Detailed maintenance records, including combustion tests, along with normalized operational data and an understanding of the consequences, if any, of an unexpected boiler failure are essential in explaining the pros and cons of replacement. ■

Mark A. Pontz, P.E., is mechanical department head with Smith Seckman Reid — www.ssr-inc.com — in Houston.

Ask the Drain Brains

By Marty Silverman
General Pipe Cleaners

Video Pipe Inspection can save you money

Q. We've seen the ads for video pipe inspection cameras, but I don't see how I can justify the cost. Why should we own a camera instead of paying a contactor to video our drain lines?

A. Video pipe inspection systems have been the hottest item for plumbing contractors in the last decade. Years ago, only the biggest drain cleaning specialist had a camera system. Now, nearly every plumbing contractor has one – and some are doing the camera work for free – so why should you own one?

Well first, because nothing is free. You're going to pay for an outside contractor one way or other.

Second, owning a sewer inspection camera can save you money.

Example 1:
A school bathroom toilet kept clogging. The maintenance staff repeatedly attempted to clear it, but it would clog up again almost instantly. They finally arranged for a camera inspection and found that a pager had been accidentally flushed down the toilet and was acting like a flapper valve.

Example 2:
A new hotel had one room that had repeated clogged drain problems. They eventually had the line videoed and found that a dry wall nail had gone through a plastic waste line and created a clog

Without a camera, these problems would never have been discovered With a camera, they became an easy fix.

For more information, or to ask a question, visit **www.askthedrainbrains.com** or email i**nfo@drainbrain.com**.

Energy Strategies

Searching for Savings: A Holistic Approach

Smart building controls enable managers and technicians to uncover and address energy waste in HVAC systems

By Ben Shepard, P.E.

Today's institutional and commercial facilities produce a treasure trove of data each day. With the help of state-of-the-art building automation systems (BAS), maintenance and operations technicians can quickly assess the health of a building with a few clicks of a mouse.

Having the current status of nearly every piece of equipment serving the HVAC system at one's fingertips can be empowering but also overwhelming. The challenge for managers and technicians is to understand the technology and options and, most importantly, to put the data to work to produce tangible benefits for the organization.

Diagnosing trouble

Part of an effective operator's daily routine should be to review and prioritize all of the new alarms in the BAS and to carefully scan the graphics and summary pages of major pieces of building equipment for red flags. Alarms speak for themselves in terms of importance, but depending on the sensitivity of the alarms setup by the control vendor, a substantial list of conditions can qualify as poor HVAC performance but would not necessarily trigger an alarm condition.

Similar to a doctor examining a patient, buildings have diagnostics that allow a trained operator to determine its condition. A diagnostic helps determine the cause or nature of a problem. Diagnostic paths typically have to be thoughtfully created because often, the diagnostic the operator might stumble upon could be the result of several upstream diagnostics that were missed.

For example, is the lag chiller running at low loads, or is the lead chiller surging? This could indicate low Delta-T. Why does the building have low Delta-T? Are the primary chilled-water pumps overpumping the secondary loop and returning a lot of the supply water to the chillers? In the variable-primary system, did the design engineer put too many three-way valves at the end of the loop, or did the variable-frequency drive (VFD) start-up technician set the minimum speed too high?

Establishing a thorough diagnostic path can take years of experience, but is crucial in being able to solve problems quickly. It also helps to have years of experience in the same building. This is not a luxury some facility operators have because they might have switched jobs and are now at an unfamiliar facility. Some operators cover several facilities and have varying knowledge of each facility. But even operators with many years of experience at the same facility still must deal with time constraints, which is the last hurdle to formulating effective diagnostic paths.

Operators facing problems often run short on time and use quick fixes. If the problem is hot complaints from occupants on the second floor, the quick response might be to crank down the discharge air temperature on the air handler instead of checking the variable-air volume (VAV) and thermostat in that zone for issues. The actual problems could be that somebody overrode the damper closed earlier in the year when they received a cold complaint from that area.

Logging issues

One solution that would help managers and technicians with all of the HVAC issues they encounter is a diagnostic issues log. Some control system software packages might have this feature. If not, several third-party diagnostic and tracking software applications targeting HVAC operations use the available trend data and reporting features of the BAS, which often go underused.

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AD INDEX

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Lighting design, controls can promote healing

By Randy Thompson/ Special to Healthcare Facilities Today

Think for a moment about the lighting inside a typical healthcare facility or hospital. What often comes to mind is a setting that's cold and sterile, perhaps artificially bright or unnaturally dark and maybe even punctuated by the incessant buzzing of long fluorescent tubes. That, however, is an image from another era.

Thanks to advances in lighting technology, control systems and incorporating natural light and shading, healthcare facilities of today are, no pun intended, casting a completely different light. Healthcare facilities employ advanced lighting design strategies to improve patient and visitor comfort, making it easier for staff to do their jobs and create a much more fitting environment for care overall.

On top of all that, contemporary lighting solutions are helping hospitals and healthcare facilities maximize energy efficiency while meeting energy and building codes. In short, lighting in a healthcare setting is not what it used to be — and for good reason.

Healthcare facilities were once largely typecast as stark, sterile environments — in large part due to lighting. Today there has been a shift toward a more occupant-centric, practical, and energy efficient lighting strategy. While the bottom line is ensuring there is adequate light for staff and patients, there is increased focus on how natural and artificial light affects occupants.

Attention has turned to how to best utilize lighting throughout the entire patient experience, from check-in to check-out and throughout the entire facility. Modern healthcare facilities are looking at lighting from a holistic and strategic viewpoint, one that includes a mix of both artificial and natural lighting in all areas of the facility.

Beyond the practical considerations of adequate lighting, research has shown that proper lighting can actually impact patient outcomes in the healthcare setting.

According to research compiled by the Center for Health Design, proper lighting can help reduce depression in some patients, cut agitation, ease pain and even reduce the length of hospital stays. Evidence has also shown the value of lighting when it comes to the absorption of vitamin D and treating jaundice in newborns.

Lighting is incredibly important when it comes to helping providers care for patients and perform their jobs. Not only does good lighting positively impact providers' moods and stress levels, but a well-lit environment makes it easier for staff to complete tasks effectively.

Studies have shown, for example, that pharmacists make fewer errors when working in proper lighting conditions; similarly, good lighting has been proven to help nurses adjust better to working the night shift.

> Healthcare facilities can employ advanced lighting design strategies to improve comfort, save money

With lighting in a typical healthcare setting accounting for about 40 percent of electricity consumption, proper lighting, controls, and strategies can help reduce energy costs drastically. In fact, incorporating such controls — scheduling, occupancy sensors, dimming and others — can result in energy savings between 30 and 50 percent.

Healthcare facilities are also implementing a few of the latest approaches such as human-centric lighting into their lighting strategies.

Human-centric lighting (HCL) is essentially lighting that is designed and applied to improve occupant well-being such as improving productivity, mood, or sleep. Approaches include the use of modern tunable LED lighting to enable and natural lighting controls.

At one healthcare project, facility directors are looking

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at the application of tunable white in dermatology exam rooms to better simulate daylight which helps doctors examine skin complexions in various lighting conditions.

Another area where they are considering tunable white is in their Infusion Centers to help patients relax as they receive chemotherapy services. Tunable white is a growing topic of conversation in healthcare lighting projects.

In addition to the advances in artificial lighting, healthcare facilities are increasingly utilizing natural light as it is shown to have a positive impact on patients and healthcare staff. For example, many healthcare facilities are incorporating windows and skylights in spaces to let copious amounts of natural light into patient rooms, waiting rooms, and general gathering areas. In addition, daylighting control strategies, like daylight harvesting and incorporating shading systems, are being deployed to help optimize daylight.

Lighting control systems, such as the Wattstopper Digital Lighting Management (DLM) system by Legrand, have become integral to the deployment of these strategies. DLM is an intelligent, distributed control system with room controllers, occupancy sensors, switches, daylighting sensors, plug load controls, lighting control panels, interfaces and accessories.

Together, the system provides healthcare facilities convenient, energy-saving control of lighting and plug loads. It easily meets requirements like daylight harvesting and time-of-day controls.

If this all sounds like a much more advanced and intelligent approach to lighting in healthcare facilities — one that's aimed at an improved environment for patients and providers that also saves energy and improves efficiency — that's because it is.

The days of the cold and sterile hospital are gone. In their place, advanced lighting technologies, natural light solutions, and powerful control systems are all working together to create a new age of healing environments.

Randy Thomas is the director of architectural lighting control sales for Legrand Building Control Systems Division.

Patient satisfaction drives lighting investment decisions

When it comes to lighting investment decisions, patient satisfaction and overall comfort provide a cost benefit that outweighs any electronic dashboard savings.

"Patient comfort embodies the ROI conversation," said Randy Thomas, director of architectural lighting control sales for Legrand Building Control Systems Division in Connecticut.

Rather than focusing on a 24-, 18- or even 16-month return on investment, Thomas said the conversation is on cost benefit. Patient satisfaction and quality reporting scores are where health systems are focusing their attention.

Color Tuning

One area that puts people first is human centric lighting (HCL). Tunable LED lighting controls both the intensity and the color of the light to mimic natural daylight, affecting productivity, mood or sleep patterns.

"HCL gives you the ability to take full spectrum control over the lighting," Thomas said, adding that HCL allows the patient to tune the color to their comfort level, tune another portion of the room to the comfort of family members, or set lighting levels for medical staff during rounds.

A new focus area for lighting control is the operating room – a heavy LED-centric environment. Thomas said with LCD monitors and equipment, some ORs resemble television control rooms.

Lighting trends

Real-time location system (RTLS) integration for color tuning and light activation gives patient rooms their own profile. RTLS provides real-time tracking and management of medical equipment, staff and patients, allowing spaces to be interactive to a particular physician or staff member.

Wearable technology provides the ability for patient and staff profiles to travel with the individual, creating an interactive space wherever they go in a facility.

Intrinsic design systems through open ecosystem apps take lighting controls from the wall to the light fixture.

"All of the intelligence will be there," Thomas said. "Integrated sensors will be part of fixtures. They will have the ability to have occupancy/vacancy sensing, heat mapping capabilities, even as far as cameras inside the fixture. The fixture is going to be the technology Trojan Horse."

Internet of (Medical) Things

Technology has the potential to transform patient care and bring efficiencies to health care, but managing all of that data under the constraints of patient privacy can be an obstacle.

The Internet of Things (IoT) – connecting things with an on/off switch to the Internet, enabling them to send and receive data – is still evolving, but digital lighting management platforms is one way IOT may break the healthcare barrier. The platform collects data and presents energy and data back into facilities. It reports the capabilities of power consumption, lighting consumption and real-time activities.

Thomas predicts that down the road there will be more interest in understanding the ability to learn behaviors of patients and medical staff to increase the work flow and system efficiencies.

— Kimberly Bonvissutto

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Energy retrofit project brings cost savings without patient disruption

The $5.5 million project is calculated to pay for itself in just under three years

By David Lewellen / Special to Healthcare Facilities Today

How can a hospital retrofit its lighting system without affecting patients at all? The strategy that Edward-Elmhurst Health chose was to skip all the lights the patients see.

Edward-Elmhurst, a system in suburban Chicago with three large campuses and several smaller locations, was not particularly in the market for a new lighting system when representatives from Fairbanks Energy Services made a sales call. Although crews would swap in LED bulbs when doing routine changes, Mike Wantiez, facilities manager for Edward-Elmhurst, said that upgrading a whole facility was beyond his staff's budget and expertise.

The improvements have reduced the system's consumption by 15 million kilowatt hours per year.

But Fairbanks, a full-service energy conservation firm based in Massachusetts, was able to offer the health system a turnkey solution in which the outside firm did all the design, project management, installation and filing for incentives. Lighting projects represented about 35 percent of Fairbanks' business last year, Golden said. The company also offers consulting and management of boiler and chiller replacement, but Edward Elmhurst's facilities were too efficient to need upgrades.

The $5.5 million project is calculated to pay for itself in just under three years, and already is saving 30 percent over previous lighting costs, Wantiez said. In terms of electricity, the improvements have reduced the system's consumption by 15 million kilowatt hours per year. The work started and finished in 2017, but Wantiez said that doing it internally would have taken his employees at least two years while taking them away from other responsibilities.

About $120,000 of the cost was covered as an incentive rebate from Commonwealth Edison for upgrading the Elmhurst facility, according to Rob Golden, business development director for Fairbanks' Midwest region. Fairbanks handled all the paperwork and verification for the rebate and took the end payment after deducting the


Mike Wantiez


Ross M. Fairbanks


Rob Golden

amount from Edward-Elmhurst's bill.

The Edward facility, which is served by the municipal power utility of Naperville, Ill., did not get a rebate because the utility's fund was depleted. "There was no point in waiting for the next go-around," Golden said. "The incentive was to save money now."

Because the Elmhurst campus was built only about a decade ago, "we were a little surprised that we could create some efficiencies for them," Golden said. But across their 10 locations, old and new, the system was using 200 different lighting fixtures. Fairbanks replaced as many as possible with LED fixtures.

But most equipment in patient-facing areas was left as is. "We did not want any patient disruption," Wantiez said. "We wanted to do it quickly, without them ever seeing it." Although bulbs will be changed as needed in patient rooms, operating rooms, and other public areas, "that's not our highest-cost lighting," he said. "I would much rather have the parking lot done, because that's more bang for my buck."

> "We did not want any patient disruption. We wanted to do it quickly, without them ever seeing it."
>
> **— MIKE WANTIEZ**

Lights in other "offstage" areas like labs, pharmacy, offices, and laundry were also fully replaced. Some other work was performed during nighttime hours, such as using a lift to replace the fixtures in the two-story atrium.

A two-story atrium with floor-to-ceiling glass, of course, should not need much lighting in the daytime. But the pre-existing control system for "daylight harvesting" did not work well, and as part of its contract, Fairbanks worked with the original manufacturer to recommission the system.

Energy-saving controls for lighting in other areas were also part of the retrofit, such as dimming systems for areas with variable foot traffic, including the parking garage. After seven minutes, lights go down to 50 percent of full. And rather than going from full dim to full bright in a blink, the new system ramps up quickly but gradually.

In addition to using less power, the newest generation of LED bulbs also last much longer; Golden said the fixtures have a five- to 10-year warranty. "I used to have guys who did nothing but replace bulbs," Wantiez said. "I'm happy to see that go," as well as the need for large inventories of replacements.

In past years and decades, many facilities hesitated to do an LED retrofit because of the cost of the bulbs. But since that has been dropping rapidly, "it doesn't make sense to wait any longer," Golden said. Waiting for further drops in the cost of LED fixtures "is pennies now," he said, "but it's going to cost dollars to wait."

Aside from working on the control system for the dimmers, "for the most part it was a pretty straightforward replacement," Golden said. "The technology is mostly at the point where you don't need to rewire." But, he conceded, "With 38,000 fixtures, not everything worked like we hoped it would."

A two-story atrium with floor-to-ceiling glass, of course, should not need much lighting in the daytime.

UV systems part of disinfection arsenal for healthcare

By Larry Bernstein/ Special to Healthcare Facilities Today

As science and medicine continue to progress, people are living longer, healthier lives. Despite gains in medical knowledge and know-how, infectious diseases of various sorts still plague and even kill many people each year. Hospitals and other medical facilities, where nearly any environmental surface is susceptible to contamination with healthcare-associated pathogens, are in a constant battle to be rid of infections and to prevent the spread of them. Despite their best efforts, this is a great challenge for medical facilities

As studies suggest cleaning and disinfection is often suboptimal with healthcare workers treating only about 30 to 50 percent of the surfaces that they should be. Some of the methods hospitals are turning to in the fight against bacteria include ultra-violet (UV) systems, improved cleaning products, and basic hygiene.

How many times were we all told to wash our hands when we came in the house? Well, one of the primary ways that infections spread is through hands and touch. Washing of hands, therefore can be instrumental in the battle against viral infections.

"Frequent, consistent hand washing is vitally important when it comes to preventing infections, and it matters for everyone – staff, visitors and patients - all need to practice good hand hygiene," Laurie Rabens, assistant director of marketing and innovation for Clorox Healthcare, said.

Rabens suggested having hand sanitation stations outside of each room along with signs to remind everyone of the importance of hand washing. This is particularly important during flu season.

Another simple and effective step to fighting the spread of hard to kill pathogens like Clostridium difficile (C. diff.), a leading cause of healthcare-acquired infections, is bleach. In 2016, Clorox Healthcare launched a new type of bleach product, Clorox Healthcare Fuzion Cleaner Disinfectant.

"It has very low odor and uses new technology to eliminate the chemical reaction that can damage surfaces and leave a residue, so it has a much better compatibility profile compared to the typical bleach on the market. Because of these features, hospitals and medical facilities can use it in places where they might have been hesitant to use bleach," Rabens said,

UV disinfection

UV has been used in hospitals and medical facilities for some time. In 2009, UltaViolet Devices, Inc. (UVDI) in partnership with Clorox Healthcare created of the Clorox Healthcare Optimum-UV Enlight System.

Dr. Katherine Velez, a scientist for Clorox Healthcare, described UV as an old technology being used in a new way. While UV had been used in hospitals and medical facilities as a disinfectant for air and water, it's now being used for hard surfaces.

Dr. Velez said the UV system was "one piece of the infection control puzzle. If we can eliminate the environment as a source of infection that part of the equation can have a big impact on infection rates and patient outcomes."

St. Mary's Hospital for Children in Bayside, N.Y., used the system and saw a 44 percent reduction in viral infections over a 12-month period. The hospital used ultraviolet UV-C technology to enhance traditional cleaning and disinfecting protocols. The system was used two to three times per week in patient rooms and bathrooms and three times per week in common areas.

Dr. Velez said this was the first demonstration of UV's efficacy to reduce viral infections. While Dr. Velez said she was thrilled with the results, she was also surprised. Sort of.

"Because St. Mary's is a long-term acute care facility, the patients are constantly interacting with the environment and materials and surfaces in it. When you have a group of patients that is already at high risk of infection, in a healthcare facility for an extended period of time and high levels of contact with surfaces and materials, it can be very difficult to prevent the spread of viral infections – especially when you've got flu and other viruses circulating in the community. They did a great job in implementing the system and achieved really exciting results," she said, adding that the system has worked in a variety of different facilities and been successful.

It's recommended that UV be used as a supplement to manual cleaning.

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Using a diagnostic and tracking tool creates a central repository for common issues, which can include specific notes detailing work performed on a particular issue. After such a system has been in place for a year or more, a new operations employee can get up to speed quickly by reviewing the historical record of work performed on the various HVAC components. Managers also can incorporate it into the standard work order process.

Another situation in which a diagnostic issues log becomes extremely helpful is when a technician uses it to take the individual trends the control system already has available and customize them into HVAC systems so the operator can see many related trends at once for easier troubleshooting. With quick access to easily digestible charts containing data going back months, an operator can see patterns emerge in underperforming equipment. Hydronic coils in air handling units (AHU) that have become dirty over the years might lead to higher fan speeds and wide-open control valves at low loads.

If the operator can quickly review a chart of that AHU from one or more years ago, he or she might see that the chilled water valve historically did not get more than 50 percent open or that the speed of the VFD supply fan never rose above 45 percent but now is at 75 percent speed to deliver the same airflow. These observations or diagnostic triggers can help lead the operator to the root cause of the problem — a dirty coil or filter bank or slipping belt, for instance.

Monitoring for savings

The effort of monitoring, diagnosing, correcting, and tracking is no small task, but the benefits can be considerable — happier occupants, lower equipment loads, and energy savings. In fact, such efforts are one of the general tenets of ongoing commissioning performed by engineering or energy consulting firms.

Monitoring and diagnosis occurs in coordination with an energy measure implementation phase, where the energy engineer has identified ways to enhance the control sequences of HVAC equipment in order to run the equipment more optimally to meet building loads.

For example, instead of resetting the discharge-air temperature on AHUs based on outside air conditions, new programming could be written that monitors the cumulative zone cooling requests and resets static pressure and discharge air temperature in coordination with each other rather than independently.

This could have the benefit of saving significant energy if the ratio of the building surface area — the envelope— to its volume is relatively low and, thus, less affected by external loads. Or it could increase comfort if the ratio of building surface area to its volume ratio is relatively high and, thus, heavily affected by outdoor conditions. These types of comprehensive efforts can save 10-25 percent annually on utility expenses and pay off in under two years.

With trending already set up on all HVAC systems, the operator or energy engineer can easily identify the zones that might have the highest cooling requests and, as a result, will prevent the reset schedules from working fully. If these trouble zones have mechanical issues that prevent them from cooling properly — for example, a failed damper actuator or open hot-water valve — maintenance technicians can respond quickly to prevent excessive energy use for fans and chilled water.

Building buy-in

For maintenance technicians to be fully on board with a monitoring and diagnostics effort, they need to be included as a critical component of the team and updated on progress accordingly. In order to show progress, managers need to track both energy and occupant comfort and report results to the team regularly so they can receive recognition for their efforts when savings are positive and complaints are low.

Over the years, I have listened to maintenance technicians express this sentiment. It is a great feeling for an operator when a dollar figure can be directly linked to an operational problem the technician found and corrected. Managers need to show this benefit as something that would have otherwise had gone unnoticed had the technician not had this new diagnostic process in place.

Ongoing monitoring is relevant for all buildings. Even new construction projects with state-of-the-art control systems can benefit from the approach. I have used diagnostic tools on several new construction projects and newly renovated buildings to identify significant issues that contractors missed at the startup or during the warranty period.

Having a platform in place can help the maintenance staff identify minor issues before they become major headaches. It also can add accountability and tracking to the issues identified. This holistic strategy for assessing building health can give the operations staff confidence, as well as proof that their maintenance solutions are working and sustainable over time. ■

Ben Shepard, P.E., CPM, is a project manager with Smith, Seckman, Reid, Inc. — www.ssr-inc.com. He has been in the demand side management and facility energy consulting business for 10 years.

Finding Savings: Case in Point

At a large children's hospital I have been monitoring for more than a year, I discovered that a discharge static pressure reset program for two of the hospital's largest AHUs serving non-pressure-sensitive areas had not been working, presumably for several years, despite the fact that average zone damper positions were typically 45-55 percent open. Part of the issue was that the programming only required one VAV box damper to be 100 percent open for the logic to reset to maximum pressure.

With my diagnostic software, I was able to chart all of the dampers these AHUs serve on one page and quickly identify those that were 100 percent open at all times. With the help of the maintenance staff, we confirmed that the zones with 100 percent open dampers were very lightly occupied and could safely be removed from the reset logic. This allowed fan speeds to instantly reduce. I estimated this step would save about $25,000 annually, with the two AHUs now operating with a functioning pressure-reset control.

— Ben Shepard, P.E.

New-generation portable cooling units offer lower noise levels, given the range of applications of the equipment throughout facilities.

PHOTO: MOVINCOOL

Supplier Perspectives: Portable Cooling

Cooling When It Counts

Providing cooling for a facility — whether in an emergency or for a special event — means managers must do their homework

By Dan Hounsell, Editor-in-Chief

No one wants to think about worst-case scenarios, but some people have no choice. Maintenance and engineering managers in institutional and commercial facilities have no choice when it comes to preparing for power or equipment issues that threaten the comfort of building occupants. In the case of hospitals, the problem can threaten occupant health.

To plan effectively for emergency cooling or even temporary, event-related cooling, managers need to understand the cooling needs and resources of their facilities, as well as available portable cooling products and technology. Armed with this information, they can work with manufacturers and equipment dealers to keep facilities cool when it counts.

A new generation

The latest portable cooling equipment offers a range of updated features and functions that are designed to address the changing portable and emergency cooling needs of facilities. One set of produce advances the level noise the units generate — a key consideration given the locations that the units operate in.

"One thing we've been working on hard to change and improve is the sound of the units," says Rafael Bombino with Rankin Group. "Some of the complaints have been that the units are noisy. These are mechanical systems, and there's a fan or a blower in there, so they're going to make some noise. But we've worked hard to make these units generally a little bit quieter and a little more efficient."

The changes involve the choice of materials and components manufacturers use in the cooling units.

"The quieter, the better, so (new units) use a blower-wheel assembly that might produce less air noise or compressors that are a little more insulated or soundproofing in the unit itself," says Scott Brainard with Temp-Air.

While some changes aim to improve the units' functionality — easier-to-read LCD displays and electronic thermostats instead of a simple dial — manufacturers also are paying attention to looks.

"Manufacturers also have taken into consideration the units' appearance and have tried to make them durable, depending on the environment they're going to be in but also making them aesthetically pleasing," Bombino says.

Knowing needs

The process of selecting portable cooling units does not start with checking out the features and functions of the latest products. Managers first must assess several important issues related to the space and the facility in question. The first is the available power supply.

"What kind of power do they have available?" Bombino asks. "For instance, you have the typical outlet that runs on 110 volts (V). Some (portable cooling) units can run on that. The most common units are 1-ton or 1.5 ton units, which is 12,000-18,000 Btus. Those are nice because they're plug and play. But they're only putting out 1 or 1.5 tons of cooling. But if you need more cooling, you're going to need to go with a larger units, and that requires an electrician to install the unit.

"You need to know the kind of power is available at the location. Do you have 208 volts or 230 volts or something bigger, like 460 or 480 volts? Is it single-phase? Is it three-phase? Power is always a very important consideration."

Managers also need to understand the specific cooling needs of the space.

"Before they call, they should have a good idea of how many tons have failed or how many tons they're going to need, and the square footage of the area and a description of the area," Brainard says. "In computer server rooms, they hold a lot of equipment that generates heat. That all will help us to determine the total tonnage load because if it's a 30- by 30-foot room, it might take a 5 tons to cool it.

"But if you have all that equipment in there generating heat, it's a direct proportion of the watts produced based on the rating of the unit to the cooling tonnage. You might need 10-15 more tons just because of the extra heat generated. Knowing the equipment and what's going on in the space and how much heat is being generated really helps you get an accurate calculation for the tonnage you're going to need."

The cooling issue needs to go beyond heat generated by equipment and assess the human contribution

"Maybe you want to provide cooling for some event," Bombino says. "Humans are always generating some sort of heat. Let's say the space is 5,000 square feet and you want a temperature of 70-72 degrees, you can calculate that in that space you need 12-15 tons of cooling, depending on the outside temperature.

"But if you're going to have 100 people in that space, you just added 100 mini-heaters, and if that event is a dance, that heat load is going to increase even more. You have to factor in how many people are going to be there, how much heat are they going to give off. So instead of 15 tons of cooling, maybe you're going to need 20 tons of cooling.

The process of cooling a space involves removing hot air, and that air needs to go someplace else. In preparing to research equipment options,

'Before managers call us, they should have a good idea of how many tons (of cooling) have failed or how many tons they're going to need, and the square footage of the area'

managers need to assess the options in the space to be cooled for removing that hot air.

"Air-cooled units pull in the air from the environment and cool that air," Bombino says. "In the process of cooling that air, a byproduct is heat, which needs to be dispersed. So with an air-cooled unit, you have some sort of hot-air exhaust. So you have to remove that hot air from the space you're trying to cool."

Says Brainard, "That place can be out a window or down a hallway with fans blowing it away from the space so the other part of the building can pick it up and take it away."

Finally, managers need to understand options for handling condensate.

"As far as condensate, a lot of AC units come with tanks, and if you're running them over the weekend, you need someone there to empty those tanks," Brainard says. "Or you can talk to the vendor about a condensate pump kit, where you run a drain hose into a sink. The condensate pump is automatic. It just takes over as long as there's power. But you need to know where those areas are in relation to the space you're trying to cool."

Avoiding stumbles

With all of these factors to consider in specifying the most effective portable cooling unit to effectively cool a space, some things are bound to get overlooked. Brainard reminds to managers to keep the human element in mind when making specification decisions.

"Who's going to install it?" he asks. "You must know the power requirements. You need people to help get the units in place, possibly the supplier. Typically, it's good to have somebody on staff because eventually, they're going to have to be familiar with operating the equipment. That's one thing that can get overlooked while everybody is trying to figure out the right equipment.

"You need people to help install it and operate it. You also need an electrician to look at all the power requirements. You might have to tie into an existing panel if it's the larger three-phase power."

Bombino suggests that managers take a realistic view of the performance capabilities of portable cooling units.

"Let's say you're going to use 1-ton units," he says. "The misconception among managers bringing in three of these units is that it's going to be the exact same (cooling) as their permanent system, and that's not the case. If it's a 1,500-square-foot store, it might actually have a 5-ton air conditioning unit. If we bring in three 1-ton units because that's what they're willing to pay for and that's what the available power will allow to be installed, it's not going to put out the same amount of cooling that their rooftop unit did."

"We get calls from customers saying, 'It's still hot in here.' Well, the unit is operating properly. Their notion is that they're expecting it to work like their rooftop unit. But the units have certain parameters that they operate within."

Realistic expectations also extend to the facility's power supply.

"Most circuits in a commercial space are from 15-20 amps, so if you go with a 1-ton unit, it'll operate at about 12 amps," Bombino says. "When you start it up, it uses a little more power, and it might kick up to 13-14 amps. So we'll get service calls on that from a retail location or a restaurant. They plug in a vacuum cleaner, or at a clothing store they plug in a steamer. As soon as you plug that in on the same circuit with the air conditioner, it most likely will blow the fuse, and it trips the breaker, and you don't have power on that circuit."

Bombino's last caveat for managers is to realize that other activities will affect the ability of the portable cooling unit to perform as intended.

"They want these units to run for 24 hours so when the doors are shut to the location, it's still cooling the space so that when you get there in the morning, it's nice and cool," he says. "But one thing that affects the ability to cool the space is, let's say, if you have a store with a high volume of people opening and closing the door. Every time someone opens the door, they're letting the cool air out and letting warm air in. That's going to hamper the unit's ability to cool the space." ■

PHOTO: MOVINCOOL

Specifying the most effective portable cooling for a particular application must include consideration for removing the hot air and condensate that result from the cooling process.

Roof Coatings

High-Level Benefits

Properly specified and applied, roof coatings can help managers extend roof performance life and curtail energy costs

By Thomas A. Westerkamp

Maintenance and engineering managers have a host of questions to answer in specifying the most appropriate roof coatings for institutional and commercial facilities. Coatings have changed a great deal in recent years in response to demands from customers for longer performance life, easier application, and greater durability.

By understanding the various types of roof coatings, keeping up with codes and standards considerations, and quantifying energy-efficiency benefits of coating applications, managers can ensure coatings applications deliver both long-term performance and bottom-line benefits.

Coatings considerations

Determining the most appropriate roof coating to specify depends on the type of roof to which it will be applied. The most common types of roof substrates include: asphalt built-up; metal; single-ply, including ethylene propylene diene monomer (EPDM), polyvinyl chloride (PVC), thermoplastic olefin (TPO), Hypalon, a membrane-based reinforced synthetic rubber, also known as chlorosulfonated polyethylene (CSPE); and modi-

FIRESTONE BUILDING PRODUCTS

Aluminum and white roof coatings are gaining acceptance as viable options to seal and add flexibility to aging roofs while also reflecting ultraviolet light and reducing facility cooling costs substantially.

fied bitumen, which is asphalt roofing with rubberized modifiers in base sheets, interply sheets, and cap sheets.

Today, many roof coatings are compatible with a variety of these materials. For example, acrylic coatings that meet ASTM D6083 can be applied to EPDM, co-polymer alloy, PVC, polymer foam, Hypalon, metal, Neoprene, and TPO roofs. Polyurethane coatings can be applied to all the above, as well as asphalt built-up and modified bitumen systems.

Additional types of coatings include silicone, polyurea and aluminum. Silicone coatings can be applied over concrete, single-ply roofing, metal, and spray-in-place urethane foam roofs. Polyurea coatings are excellent for polyurethane roofs, and some formulations have the Cool Roof Energy Star rating for color and reflectivity. Aluminum coatings protect and seal: previous white or aluminum coated roofs; asphalt built-up roofs; steel, galvanized and tin metal roofs; and EPDM roofs.

Besides traditional roof coatings, manufacturers offer specialized coatings for specific roofing challenges.

For example, managers can check out specialized coatings for areas of ponded water on low- slope roofs more than 48 hours after rain. This adverse situation, caused by either incorrect installation or settling, can occur on a new roof or, more likely, an overlay because the old roof substrate has dips and valleys. Ponding causes rapid aging and deterioration of the roofing membrane due to high ultraviolet (UV) absorption and accumulation of airborne dirt, dust, pollen, tree buds and leaves.

Coatings to fill these depressions are formulated with lightweight fillers and high-build properties. Some offer one-coat application, are suitable for shallower ponds, or are layered with embedded fabric for deeper ponds.

Another special-purpose coating is roof cement formulated for sealing around flashing and other penetrations, as well as addressing traffic-damaged roofing. The tar-based cement used for asphalt built-up roofs is mostly coal tar, with filler and fibers for build and tensile strength, along with proprietary additives. It offers good elasticity and resistance to heat and cold, workers can apply it to wet surfaces, and it is ideal for emergency applications in the rain.

Aluminum and white coatings are gaining acceptance as options to seal and add flexibility to aging roofs while also reflecting UV and reducing cooling costs substantially.

One relatively new application for roof coatings has been extending roof life before the installation of solar panels. Trouble with solar installations when managers do not consider the shorter remaining life of the roof compared to the 25-30-year life span of the solar panels. This disparity can mean replacing the roof before the solar panels have reached the end of their life cycles.

Counting the savings

Roof coatings can deliver a host of benefits. They provide restoration for the underlying roofing, add a layer of insulation, improve emissivity and reflectivity, extend the service life, and reduce life-cycle costs.

They also can contribute to energy savings. Energy-efficiency savings depend on the building design, location and climate. Savings also depend on the type of existing roof, but also the cost of the coating, its emissivity and reflectivity, life span, warranty extension, and fire insurance premium reduction benefits. A quality roof coating designed specifically for the conditions might cost more, but it could be the best cost savings solution.

The annual benefits from black and white roof coatings are a subject of much interest, due to the savings potential of color in heating and cooling loads. Managers might assume that one color is always more beneficial than the other.

The Roof Savings Calculator from Oak Ridge National Laboratory concluded that one color's advantage depends heavily on location and climate. Heating costs in northerly climates are three to five times greater than cooling costs elsewhere. The Roof Savings Calculator found that the cooling benefit from white roofs in 25 northern cities, including as far south as Nashville, is exceeded by the heating penalty due to reflected heat lost.

The conclusion: The most efficient color in these northern areas is black. In southern areas, white is the most efficient. The takeaway is that the optimum roof coating selection varies by region and must take into account building design, location and climate.

As solar installations increase in number and decline in cost, one com-

Emissivity and Reflectivity: A Closer Look

Emissivity is a measure of how well the roof surface emits thermal radiation energy — heat. The recommended emissivity for roof coatings is at least 66 percent, which means 66 percent of the thermal energy striking the surface is emitted, reducing the building's heat load and lowering cooling costs.

Reflectivity measures radiation — light — reflection. It is the ratio of light wave energy reflected from the roof surface to the total light wave energy striking the surface. It is expressed in decimals from 0 to 1, with 0.85 being desirable for good reflectivity.

The energy savings difference between the two characteristics as it relates to roof coatings is that high reflectivity coatings reduce cooling costs by reflecting solar radiation in hot weather. High emissivity coatings lower both cooling costs and heating costs. It reduces the building's cooling load by releasing heat absorbed from the sun, and it reduces heat load in colder weather by retaining heat.

— Thomas A. Westerkamp

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bination that is gaining in popularity in terms of potential gains in energy efficiency is the installation of a solar panel over a roof coating. One major challenge in this type of application is matching the roof's life cycle — averaging about 17 years — with that of the solar panels, which have a performance life of 25-30 years.

Properly specified and installed, elastomeric coatings can improve a roof's service life by 10-20 years, which can help to synchronize services lives of the roof and the solar installation. A Hypalon roof recoated with polyurethane coating can withstand the traffic needed to install, clean, and service photovoltaic (PV) panels. Color coding can be added to more abrasive-resistant coating to help designate walkways for technicians needing rooftop access.

Roof coatings provide restoration for underlying roofing, add a layer of insulation, and improve emmisivity and reflectivity

Solar-array racks are installed in three ways: mechanically attached to the deck with fasteners; ballasted with concrete block weights; and directly adhered with flexible, thin film PV panels. Using a liquid coating to properly prepare the deck after the mounts are attached can produce a tight seal while extending the life of the roof.

Pre-coating the roof can help avoid having to repair the deck under the solar racks or ballast. Repairing or replacing the roof under solar arrays requires disassembling the panels, making a detained inventory, storing them safely, then replacing the roof, and re-assembling the solar arrays. Managers should be aware that during the downtime, electric cost will increase, so they need to factor this increase into the savings-cost calculations when evaluating the benefits of solar.

The roof coating adds to the cost, but it can increase the warranty years and might reduce fire insurance premiums, while solar power can reduce electric costs as much as 60 percent. If the coating and solar installation meet requirements to qualify for a federal renewable energy production tax credit under Production Tax Credit (PTC) 1603, it would receive a tax credit of 30 percent of the combined installation cost and a short depreciation schedule. PTC 1603 was passed under the American Recovery and Reinvestment Act of 2009 to increase investments in clean energy.

Spotlight on standards

Roof coating sampling, evaluation and manufacturing are guided by a range of codes and standards. Most local codes restrict overlays to one before a deck tear-off is required due to the added load, but coatings might be the exception. Some codes might allow an overlay and a coating to extend the life of the overlay before requiring a tear-off. But the authority having jurisdiction or local code has the final say.

ASTM currently has 768 standards covering roof coating manufacturing, sampling, evaluation and application. Also, Energy Star issues its own standards, and it provides resources for specifying roof coatings. The U.S. Department of Energy's Energy Star program offers an online Cool Roof Calculator that estimates cooling and heating load savings for flat roofs.

Even though 30 years of efforts by roof coatings manufacturers have produced a 90 percent reduction in volatile organic compounds (VOC), states continue to further regulate VOC levels to improve air quality.

A range of codes and standards cover specifications for roof coatings combined with solar arrays. These include: assembly of components; array placement with open paths, smoke and heat vents, and labels; fire ratings; hail; seismic activity; weight limits; and wind uplift. By understanding of the relevant codes, managers can ensure a long-lasting, economically viable roof coating application. ■

Thomas A. Westerkamp is a maintenance and engineering management consultant and president of the work management division of Westerkamp Group LLC, www.westerkampgroup.com.

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Landscape Specification

Roll with the Changes

The evolving University of Puget Sound campus creates fleet management challenges and opportunities

By Dan Hounsell, Editor-in-Chief

Nothing is permanent except change, and managers in institutional and commercial facilities can attest to the truth in that adage. Some facilities can change fairly quickly as owners and occupants try to shape their surroundings to their needs. The University of Puget Sound has evolved over years as university planners have reshaped the look and feel of the campus.

"We're tucked between two main streets, and I think they felt that some of these smaller lateral streets going through the center of campus were disruptive," says Joe Kovolyan, the university's manager of grounds and automotive. "So over time, they've been closing them off and putting up buildings."

For Kovolyan and his staff, the nature of the campus has affected the way they maintain the campus and in particular, the vehicles the department uses to carry out its daily activities.

Campus considerations

Founded in 1888, the university sits on a 98-acre urban campus in Tacoma, Wash., that includes 136 buildings, 38 acres of lawn, and 5 acres of sidewalks. Fewer streets and more small paths around campus mean Kovolyan and his staff cannot rely on strictly large trucks or cars.

"Utility vehicles are our primary transportation for people supplies, materials and equipment, due to the lack of interior campus road access for larger vehicles," he says. "From the grounds perspective, it makes things easier. We're not dealing with a lot of street traffic. Accessibility for us is mainly utility vehicles, mowers, and tractors, so not having to deal with vehicular traffic makes our life easier."

For a full version of this article, visit: ***facilitiesnet.com/17800FMD***

facilitiesnet.com

The campus's facilities operations — grounds, building services, mechanical, electrical, plumbing, carpentry, and construction — use utility vehicles. The fleet consists of 11 electric carts, 19 golf carts or small vehicles, 11 full-size vehicles, and 38 cars, trucks, vans, tractors, and mowers. Changes in the campus have led to Kovolyan to reconfigure this fleet.

"We've reduced four pickups, a box truck, and two vans and replaced them with utility vehicles," he says. "For the past seven years, we have tried to stay neutral in overall numbers, but we have reduced our vehicle numbers and replaced them with utility vehicles. Last year, we replaced seven very old golf carts with seven new utility vehicles."

Specification issues

The university relies heavily on utility vehicles to perform daily activities, so Kovolyan is experienced in selecting the most appropriate vehicle for the application in question.

"It starts with the mechanic and I making a recommendation that a vehicle has gone beyond its useful life and get some basic info for what the shop is looking for in a new unit," he says. "We might also demo some units. The mechanic and I will do the research on maintenance, repair, quality, etc., then get the quotes and provide our findings to the associate vice president, and he decides on those recommendations."

The central role of the mechanic in the specification process is based on experience.

PHOTO: JOE KOVOLYAN

The University of Puget Sound has reduced car and truck traffic on campus, so facilities departments have come to rely on a range of other types of equipment, including utility vehicles, to perform daily activities.

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Digging into … Core Competencies

A column on issues of importance to the grounds management profession

By Stephanie Bruno

Recognizing that good site management requires a qualified, innovative grounds manager, the Professional Grounds Management Society (PGMS) developed the Certified Grounds Manager (CGM) program to evaluate a manager's understanding of site materials, needs, costs and problem areas, as well as how to perform their duties promptly and property.

After completing an application test covering general grounds management knowledge, the candidate has up to one year to compile extensive documentation in nine core categories. Known as the Professional Grounds Manager Evaluation (PGME), the comprehensive report explains a candidate's standards, protocols, initiatives and methodology used to ensure best management practices. The PGME categories are based on the primary responsibilities of managers: site inventory; operations inventory; turf management; trees, shrubs, and ground cover; irrigation; pavings; management skills; budgets and finance; and safety standards and regulatory compliance.

Turf management is important for grounds management, and extensive reporting is required in such areas as seeding, fertilization, cost of maintenance per acre, and mowing frequency. Understanding compaction to ensure proper air and water movement, root depth, and chemical balance are essential to successful turf.

Irrigation is a large component of the PGME. Basic water, soil, and plant interrelationships are essential, and a manager must have a working knowledge of irrigation design and practices, including friction loss and gallons per minute for different heads at different pressures. While it might not be a manager's job to design irrigation s, they are likely involved in writing specifications, developing schedules, selecting contractors and supervising installation.

Critical to a grounds manager's success is business acumen. Candidates are expected to have extensive budgeting, management, safety, and leadership skills.

For more information, visit pgms.org.

Stephanie Bruno is executive director of the PGMS, an individual membership society of grounds professionals. www.linkedin.com/groups/4173565; www.facebook.com/ProfessionalGroundsManagementSociety

Landscape Specification

"He's the one that's going to maintain them, and between he and I, we keep up with what's going on with the latest vehicle updates," Kovolyan says. "For example, a utility vehicle might switch motors, and if it's a motor manufacturer we've had issues with in the past, he can nip that in the bud. We've found that if we let other people get involved first, by looking at the bells and whistles and pretty pictures, it's a much harder fight."

At one point, the process did include more input from vehicle users.

"We ordered utility vehicles one time and let each department order," he says. "They basically decided among themselves what they wanted added to each vehicle. We ended up with a hodgepodge of actually silly additions, which drove the cost up and made more issues. We learned from that experience. In general, we need to keep a uniformity and a streamlined procession."

Still, Kovolyan and the department mechanic do consider the needs and request of vehicle users.

"It's more of them giving us a wish list of what it can do and what it can hold and what it can carry, he says. "That's about it. (The requests) vary from department to department, but dependability and enough space and size are close to the top. Towing and hauling weight run a close second. It's also trying to change the mentality that you don't need to carry everything all the time, just what you need for the day."

Beyond the requests of vehicle users, specification also includes careful consideration of two issues that important to Kovolyan and the department — noise and standardization.

"Noise plays a big part in our department and is the number one consideration," he says. "That's why we've gone with the kinds of mowers we have — diesel mowers over gasoline mowers. Most of the utility vehicles are pretty quiet."

Because the department operates such a large fleet of vehicles, buying from a small number of manufacturers helps hold down the number of spare parts the department must keep in inventory and streamlines inspection and maintenance.

"We have also tried to go from a very diverse fleet into a more streamlined system," Kovolyan says. "At one point, we had seven manufacturers of utility vehicles, and keeping up with parts alone was an issue. We are down to four and hopefully soon three brands, with even some of those being able to share certain parts, like oil filters. This saves the university both time and money."

Going green

Sustainability considerations have an impact on the department's decisions when purchasing utility vehicles, including the choice of fuel type.

"Electric units have improved, but so have the diesel and gas versions, so it's still all about right equipment for the right job," Kovolyan says. "We have found here that our electric units actually cost us a little more to operate and have more disadvantages than our fuel vehicles. With the cost of replacement batteries, the cost of recycling the old ones, chargers being driven over, cables pulled out, and electricity prices going up, we haven't seen any advantage.

Electric vehicles also pose some challenges for operators moving across campus among students.

"We have actually had some local residents complain they can't hear the utility vehicle coming up behind them when walking the campus," he says.

Propane also has attracted attention as a fuel option among users of utility vehicles, but Kovolyan has concerns about this option.

"Propane is more of a safety issue," he says. "Having people driving around with propane tanks and filling tanks isn't something we want to get into. We've talked with the local fire department about having a propane station, and that brings a whole new level of safety concerns — safety procedures and cordoned off areas for filling stations. Number one, we don't really have the room for that, and number two, it's not something we're comfortable getting into and allowing that many people to have access."

Kovolyan remains optimistic about the benefits of utility vehicles and the ability of manufacturers to meet the changing needs of their customers.

"The manufactures have been doing a great job in listening to the end users and have come up with some great features and configurations the past few years," he says. "I think the university and municipality market has been overlooked for a while, but they have realized we are a large consumer of the product and only growing." ■

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ROOFING

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MULE-HIDE

Roof adhesive

Helix low-rise offers adhesion of approved roof insulation, thermal barriers, cover boards, and fleece-backed single-ply membranes to a variety of acceptable roofing substrates. The two-component, construction-grade polyurethane foam is applied in one step. Both parts of the adhesive are ready to use from the container and are applied simultaneously in a 1:1 ratio. The adhesive cures fully in minutes.

DURO-LAST

Roof coating

Duro-Shield is designed to enhance the performance of a variety of commercial substrates — single-ply membranes, metal, mineral and granule-surface built-up, smooth-surfaced built-up, and wood. The coating is 100 percent elastomeric acrylic and available in 30, 50.3, and 53.1 percent total solids by volume. The coating is applied with a white finish that reflects the sun's rays.

TROPICAL ROOFING PRODUCTS

Roof restoration products

The accessory products category includes: Ultra-Clean asphalt and tar-remover spray; Ultra-Green concentrated roof wash all-purpose cleaner; and Ultra-Seal MS polymer sealant/adhesive. TRP-1 Ultra-Seal MS is an advanced hybrid sealant/adhesive providing the best properties of modified silane polyether technology. It delivers the strength, durability and paintability of polyurethane with the weathering resistance, elasticity and ultraviolet stability of silicone. It is solvent-free and isocyanate-free, and it offers low-VOC performance in plastic 9.5 ounce tubes with shelf-life stability.

PROGRESSIVE MATERIALS

Silicone coating

The Pro-Eco Sil HS 3200 series includes low-VOC, high solids, solvent-free coatings, that are a dispersion of silicone rubber. The silicone rubber cures in one-four hours at normal temperatures and humidity levels. The coating is resistant to weathering, aging, oxidation, wind-driven sand, rain, snow, ozone, ultraviolet light and temperature extremes, and it offer long-term protection. It can be applied on top of existing roof surfaces that consist of metal, single-ply membranes, existing smooth-surface built-up roofs, granulated cap sheet, well-adhered acrylic coating, and concrete.

For information on roof coatings, see article on page 21

A **GENERAL PIPE CLEANERS**

Trailer jet

The Typhoon delivers 12 gallons a minute at 2,500 psi to remove grease, sediment, and debris from 4- to 12-inch lines up to 400 feet long. A 200-gallon holding tank carries enough water to handle remote locations where access to water is limited. The trailer jet features a 690 cc — 24 horsepower — Honda engine with electric start and 7-gallon fuel tank, as well as electric brakes, a safety strobe light, safety cones, rear fold-down stabilizer jacks, a retractable hose guide arm, and an antifreeze system as standard equipment.

B **HUSQVARNA**

Stand-on mower

V500 mowers are available with a 48- or 54-inch commercial ClearCut deck and are powered by a Kawasaki two-cylinder, 24.5 horsepower engine. All of the controls are at the operator's fingertips, and the deck automatically lowers into position with a tap of the palm. The flip-up platform allows operator to handle difficult terrain and areas of limited maneuverability. Positioning the operator between the wheels instead of behind the wheels reduces the operator effort in staying perfectly balanced, especially during zero-turn maneuvers.

C **E INSTRUMENTS**

Combustion emissions analyzer

The E4500-S can measure nitrogen oxide and sulfur oxide from high-efficiency and condensing boilers, burners, engines, turbines, kilns, furnaces, incinerators and other combustion processes. The analyzer features a color display and expanded internal memory, as well as pre-calibrated, field replaceable sensors that allow for diagnostics and replacement.

D FULHAM

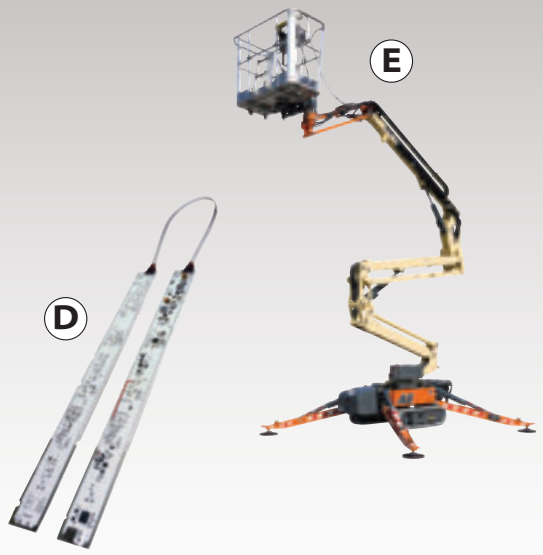
LED controllers

The Vizion power over ethernet (PoE) light engine is a programmable PoE driver that can be integrated into a variety of form factors. Designed to support two-way digital communications, the customizable light engine connects directly to the luminaire rather than issuing commands through a 0-10V interface. The two-way link can issue lighting control commands, such as on/off, dimming, color tuning, and timed lighting. It also can gather data about luminaire performance, including power consumption, operating temperature, and when the luminaire is ready to fail.

E JLG INDUSTRIES

Compact crawler boom

The X430AJ offers a horizontal reach of 21 feet 7 inches and a 500-pound unrestricted platform capacity. With a stowed width of 2 feet 5 inches, the unit can fit through doorways, gates, and yards. The boom features a Lithium-ion 2.0 power system for environmentally friendly operation indoors or outdoors and a tracked wheel carriage that climbs ramps, non-marking tracks for use on sensitive flooring and landscape applications, and auto-leveling outriggers.



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Management TRACK

The Long and Winding Road to Facilities Management

Podcast guest
Liviu Ursachi

Assistant Director, Facilities

JLL Adventist Health, Roseville Calif.

During his college years, Liviu Ursachi worked in a firefighter brigade in Europe. After graduation, he emigrated to the United States, and his desire to learn about facility maintenance grew.

"Once I arrived here, I soon realized that I would have to elevate my knowledge to the industry level to restart my career in the facility and maintenance field," says Ursachi, assistant director of facilities with JLL Adventist Health in Roseville, Calif. "I hold a professional degree in jurisprudence and industrial design."

As his experience and knowledge about facilities maintenance and management grew, has learned what it takes for a maintenance and engineering departments to succeed.

"Success is the result of a planning and execution of measures defined by leadership," Ursachi says. "Time management, timing and education are the basic ingredients to recommend to anyone for a successful career. I've been privileged to work with senior executives that promoted focus as standard requisite quality for success."

Listen to the entire conversation with Liviu Ursachi on career management insights in this month's Management Track podcast at www.facilities/net.com/fiveminuteswith.

Quick Read

School Shooting Raises Security Issues

Each new school shooting raises, among many other issues, one inevitable question: Is there any way for schools to stop them? Can facility managers and other district officials upgrade or install any combination of technology and procedures that will adequately protect students and teachers and staff from an active shooter? The latest shooting in Santa Fe, Texas, does little to offer answers to this question, but it has contributed to the efforts among K-12 districts to try something, anything, to harden their facilities against attack. *Read more at facilitiesnet.com/28-41390*

maintenance alerts

Standard Addresses Use of Drones

The National Fire Protection Association has proposed NFPA 2400, Standard for Small Unmanned Aircraft Systems (sUAS) used for Public Safety Operations. The proposed standard will cover the minimum requirements relating to the operation, deployment, and implementation of small unmanned aircraft systems for public safety operations. *Check out this Maintenance Alert at facilitiesnet.com/115-41227, and Look for Maintenance Alerts every Tuesday and Thursday on facilitiesnet.com.*

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How To Properly Inspect and Test Fire Dampers

Technicians need to test and inspect fire dampers one year after installation and every four years after that, except in hospitals, in which the frequency is every six years, according to NFPA 80. The challenge for maintenance and engineering managers is to understand the gamut of issues related to damper installation and performance, including inspection, testing, and maintenance. *Follow us on Twitter @maintenance_mag*

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5 Keys To Healthy Roofing

Failing to maintain roofs properly can lead to a host of problems, from leaks and blistering to shrinkage and premature failure. No matter the type of roof, comprehensive, effective maintenance is essential for a long performance life. Regardless of the type of roofing system, one key strategy to keeping a healthy roof is to conduct routine inspections twice a year — after spring storms and before rains return in autumn. *Learn more and like our page at facebook.com/fmdmag*

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