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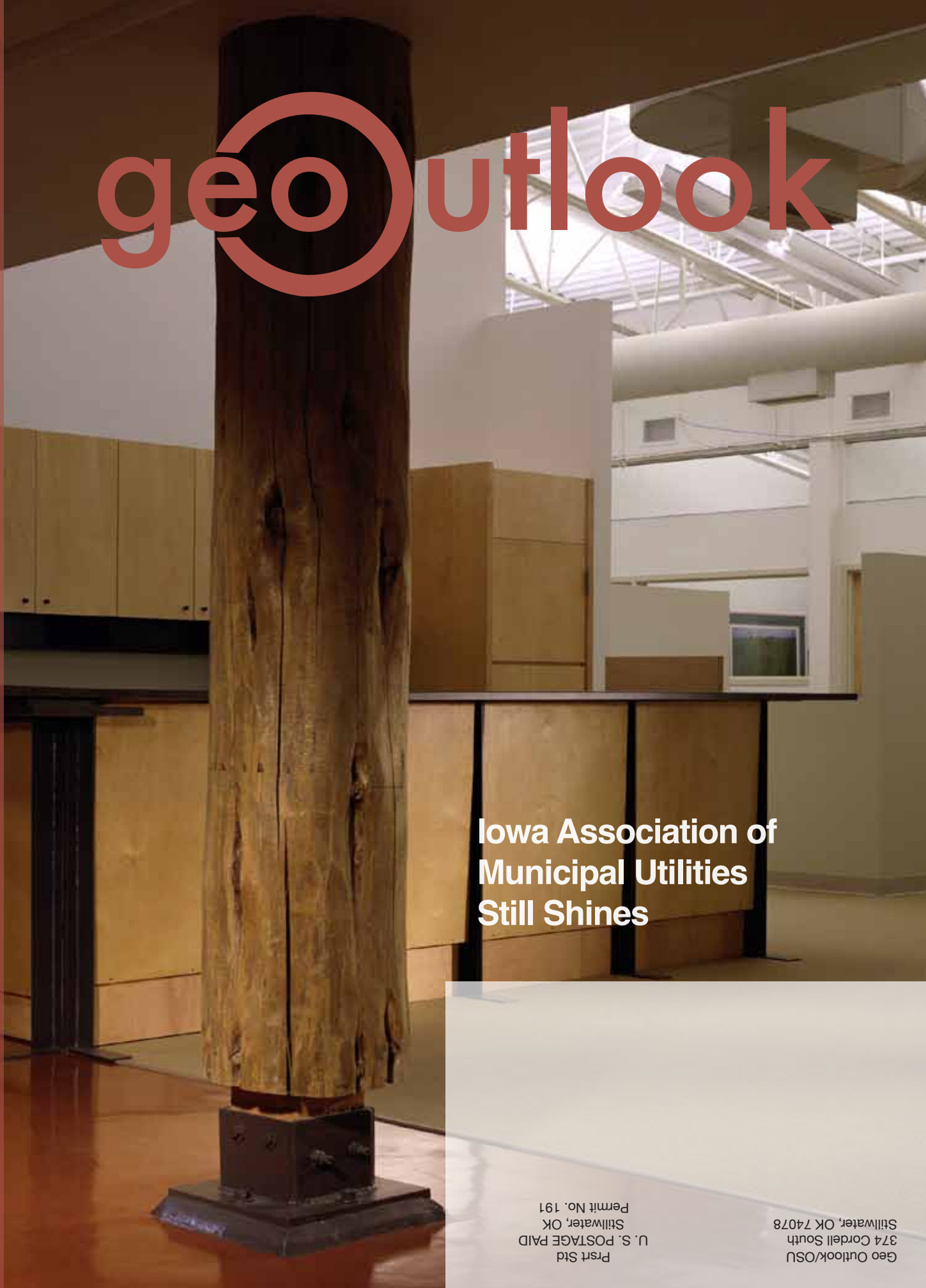

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Iowa Association of Municipal Utilities Still Shines

Portland International Jetport First With Geothermal

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DIRECTORS' FORUM

NOTES FROM IGSHPA

By Jim Bose

Executive Director:
International Ground Source Heat Pump Association

Larger or multiple buildings connected in a synergistic manner are competing on a first or installed cost bases when compared with conventional cooling tower and boiler type systems. This can be attributed to good design and the old adage KISS (keep it simple and small) and keep it modular. It is not a surprise that most ground source heat pump system designs come from experienced designers whose experience is much like the interior systems straight from their college day experience where "just make it a little larger since it doesn't cost much more." That's true but won't work economically with GSHP's. Oversizing is expensive. Today's design tools allow very accurate sizing and the obvious advantage of keeping costs under control.

Modularity with multiple fields will reduce costs and field temperatures from getting out of control. This is smart business since spreading out the thermal loads by avoiding multiple bore holes in a single large grid is a design advantage. Designing piping systems with small header diameter piping is smart since the labor and size of equipment is reduced. Rental or ownership costs of equipment should be carefully evaluated.

Controls can be expensive and the data gathering should be justified before it is specified. Flow controls on individual ground loops should be questioned. Don't be afraid to find someone who is doing a good job about how to do it.

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Kirk T. Mescher, P.E., LEED® AP Principal
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Kirk Mescher is a licensed professional engineer and founding partner of CM Engineering, Inc., Columbia, MO. He has been with the firm since 1993. Mescher has been a certified LEED® accredited professional with the United States Green Building Council (USGBC) since 2004.

An active member of ASHRAE since 1979, he has participated as a member of the following committees: TC 6.8 Geothermal Energy Utilization; TC 9.4 Applied Heat Pumps; TC 5.5 Air to Air Energy Recovery, 1997-1999; SSPC 84 Committee; ASHRAE Program Committee and the ASHRAE Conference and Expositions Committee. He received the 2009 ASHRAE Award for Distinguished Service.

Mescher's professional accomplishments include product development for SEMCO Energy Recovery, and development of a "One-Pipe" geo-exchange HVAC system. Mescher is co –patent holder of 5,496,397, USA, "Application of desiccants to aluminum foil substrates."

His specific areas of expertise include geo-exchange systems, as well as air-to air energy recovery, hot and chilled water systems, various types of lighting systems and commissioning.

Mescher says the "One-Pipe" geo-exchange system was developed as a cost effective, highly efficient, simplified application of heat pump systems. The simplified control and water distribution system has reduced installation costs substantially. Documented energy consumption savings in excess of 40 percent over ASRAE 90.1 requirements have been demonstrated.

Numerous elementary schools have been retrofitted with Mescher's system. All retrofitted schools have experienced substantial energy reductions while adding air conditioning to their facilities. In several cases, energy consumption is less than half of previous heating only energy consumption levels. Several of these schools have earned Energy Star ratings in excess of 90.

Due to its quiet operation and much-improved comfort level in all months of the school year, Mescher's "One-Pipe" system creates an indoor environment conducive to teaching and learning, and helps support improved educational outcomes for students.

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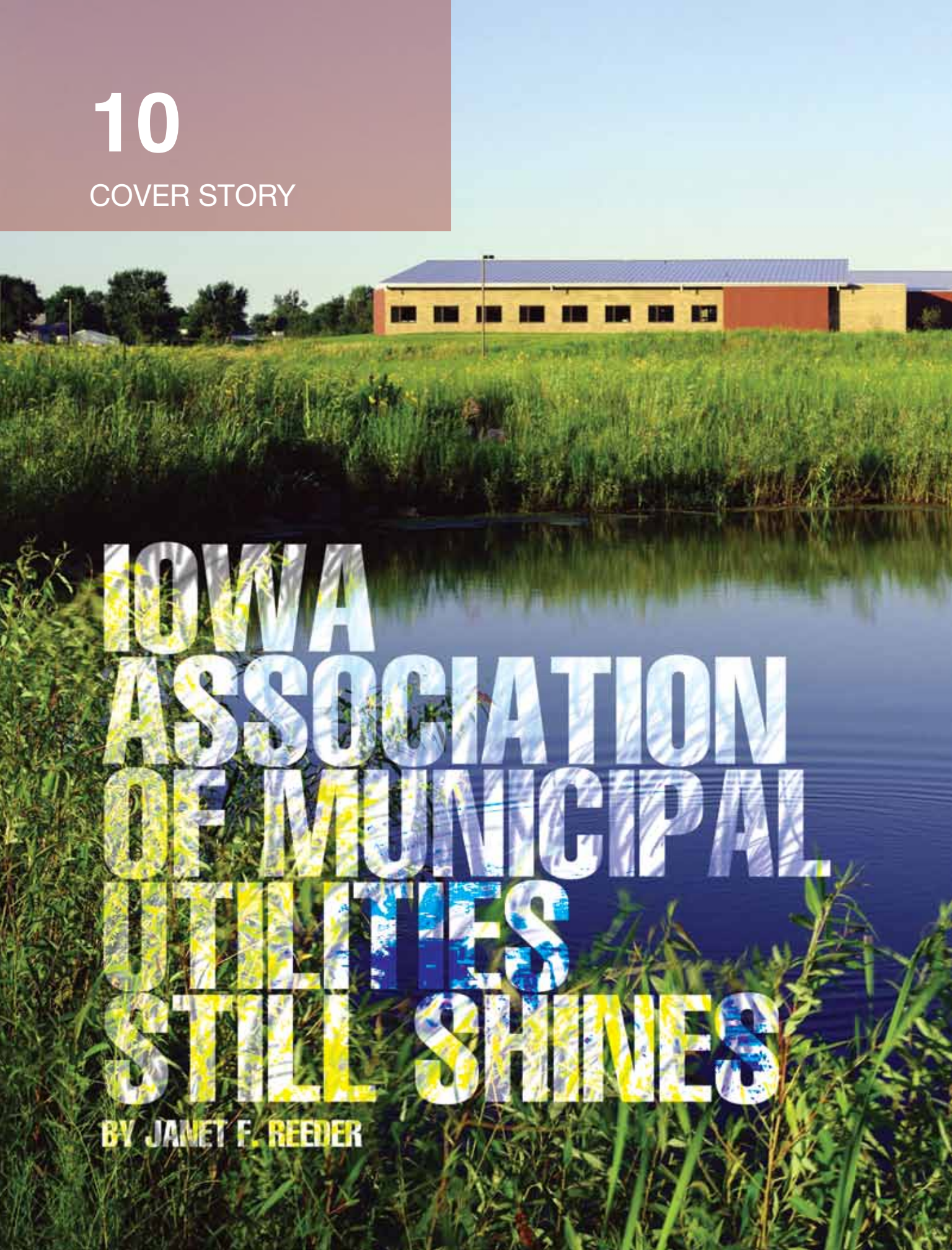


IOWA ASSOCIATION OF MUNICIPAL UTILITIES STILL SHINES

BY JANET F. REEDER

The Iowa Association of Municipal Utilities office and training facility is still an environmentally sustainable building showcase, even though design for it dates back to 1997.

As rewarding as that is, IAMU Executive Director Bob Haug says he still finds the fact particularly frustrating.

The 12,500 square-foot multi-use building finished in 2000, is located in the Des Moines suburb of Ankeny. It includes office space for the association, a large auditorium and extensive outdoor training areas where the association's 136 member electric utilities and 51 member municipal gas utilities receive training.

Haug had just finished a conference call about possible plans for a district geothermal system right before his Geo Outlook interview. The discussion has been about an Iowa community IAMU works with that is considering utilizing geothermal technology. Haug finds it interesting that he has finished up that two-hour phone call promoting geothermal technology and then moved on to a magazine interview about the geothermal installation at IAMU. But, he likes talking about geothermal and energy efficient buildings.

The Iowa Association of Municipal Utilities new facility is located in a setting that compliments the building's sustainable features.

(Photo by Farshid Assassi, Courtesy of RDG Planning and Design)

The IAMU mechanical area shows the variable frequency drive that varies the pump speed and fluid flow of the circulating pump on the left and the motor and circulating pump that moves working fluid between the ground loop and the heat pumps on the right.

(Photos by John Burnett, IAMU Communications Manager)

"My frustration is that we have proven the systems that we relied on to get the kind of efficiency we have — the daylighting, the geothermal and the other details in the overall package, showed incremental costs were something like $30,000 with a payback of less than three years," Haug says. "Why every other building, at least around us, hasn't been built at least to that same standard is one of my greatest frustrations," Haug says.

The purpose of the IAMU is to support and strengthen Iowa's municipal utilities. The top priority for the association from the inception of the building design in 1997, through the construction to the opening, was to demonstrate to their members how an energy efficient and environmentally sound facility could be built and operated economically.

Haug mentions that prior to the construction of IAMU's new facility, two of their energy specialists went to Atlantic, Iowa, to convince those designing the community's new high school to install a geothermal system. "We'd like to think we influenced them. That was before we had our own system," Haug said.

"Anyone who knows anything about that community now, knows that school is a center for year-round activity," he said. "That just wouldn't have been the case before that, because they wouldn't have been air conditioning the school building."

Haug says he thinks now all of the schools in Ankeny, Iowa, where IAMU is located, have been built with geothermal or retrofitted with geothermal systems.

While the efficiency measures included in the IAMU project are not that different from those highlighted in today's LEED® certified projects. IAMU's project preceded those standards as LEED® was still in a pilot stage and not well known. The design team, in fact, had no knowledge of the early efforts the United States Green Building Council (USGBC) was working on to get LEED® off the drawing board.

"This project was focused on all as-

pects of sustainable design, and one of its most successful outcomes has been its energy performance," says Tom McDougall with The Weidt Group. "This one had a lot of focus on energy." The Weidt Group joined the design team through the architecture firm, RDG Planning and Design. McDougall says that The Weidt Group specializes in energy and environmental design for buildings, collaborating with architects, engineers and owners to produce high performance projects.

"The owner had clear values and goals in mind, wanting a building with low energy consumption and an improved interior environment," McDougall said. The Weidt Group was the energy design consultant. McDougall said they started to develop energy goals early on in the design process.

AWARDS FOR THE IAMU PROJECT

Polk County Conservation Board-Outstanding Conservation Demonstration 1998

Governor's Iowa Environmental Excellence Award 2001

American Institute of Architecture (AIA) Sustainable Design 2001

American Institute of Architects (AIA) Top 10 Green Projects Award in 2002

Boston Society of Architects Sustainable Design Award 2003

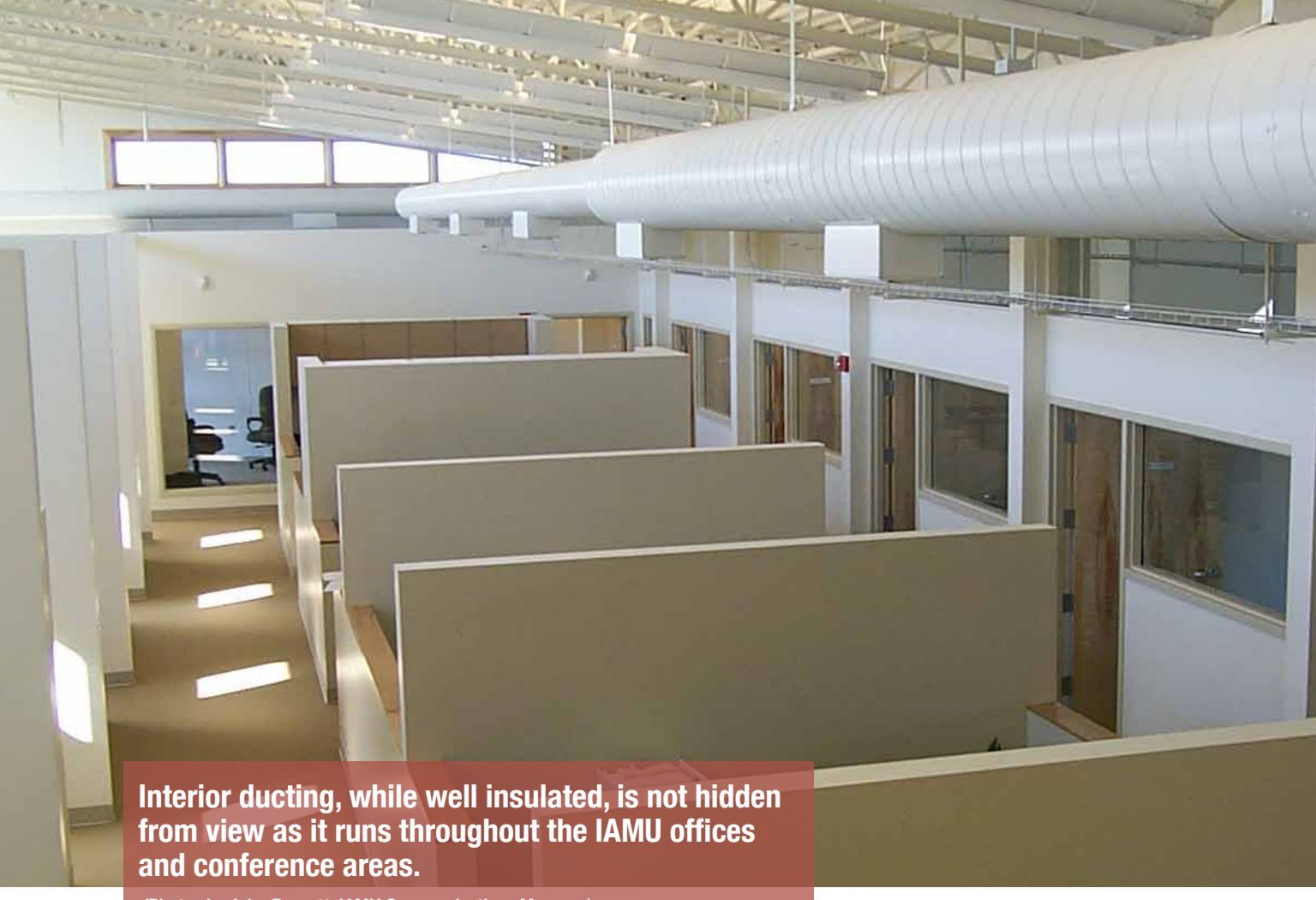
1,000 Friends of Iowa-Best Commercial Development 2003

Sustainable Construction Exposition, Barcelona, Spain - 1 of 30 projects representing Great Britain, United States and Spain

American Public Power Association 2007 Energy Innovator Award for Sustainable Technology Pioneer

2008 Flashback Award from ECO Structure for Enduring Performance

(Photo by Farshid Assassi, Courtesy of RDG Planning and Design)



Interior ducting, while well insulated, is not hidden from view as it runs throughout the IAMU offices and conference areas.

(Photos by John Burnett, IAMU Communications Manager)

"The team set an energy performance target of less than 30,000 Btu/ft2/year, a major goal to be at that level of performance for this building and climate," McDougall said.

"There are not very many buildings built and operated to that level of performance, even today," McDougall added.

"Today there are more ratings. Back in the 90s there wasn't too much in the way of ratings," he said. The IAMU project is still relevant as an example of energy efficiency and sustainable building practices.

"Our firm develops an energy simulation model of the building and works with the architects, engineers and owners to develop a host of alternative strategies to reduce the building's energy consumption," McDougall said.

"We can put in the windows for a zone and know at any hour of the day and year how much solar gain is coming through the window, and what the cooling system needs to provide to keep that zone within its thermostat set points," he said.

"We can evaluate different kinds of mechanical systems such as the geothermal heat pump systems, against conventional heat and air systems. All kinds of things can be looked at," McDougall said.

"We have processes in place to do this type of analysis. For the IAMU project, we probably looked at over a hundred different strategies from different glazing types, amounts of window area, different orientations and daylighting control strategies like design strategies to reduce lighting power," McDougall said.

"We looked at the mechanical HVAC systems. We looked at quite a few different things and we cost all of those out," McDougall said. "So we can see how much more it might cost for a geothermal system compared to a conventional system. But we also see how much more that would save. That had a certain feedback level with what the owner was willing to invest."

McDougall said that he has done a number of presentations and case

studies on the project, as well as several ASHRAE papers.

The IAMU project still garners a fair share of attention and awards while it continues to display and educate about the sustainable and energy saving building practices it utilizes.

IAMU's Energy Services Engineer, Joel Logan and Curtis J. Klaassen, who was manager of the Energy Resource Station for the Iowa Energy Center, presented a paper titled "Low Energy Building Case Study: Toward Net Zero Energy," at the 2006 ACEEE Conference.

That study states the average annual energy use of the IAMU office building from 2002 through 2007 was 366,000 kBtu, which is equivalent to an energy use index (EUI) of 29,300 Btu/ft2. Thus, the building used nearly 55 percent less energy than it would if it had been built to the Iowa energy code in effect during building design: ANSI/ASHRAE/IESA 90.1-1989 (ASHRAE 1989).

Over the same time period, lighting made up 20 percent of the annual energy use, general equipment made up 32 percent, and HVAC energy use made up 48 percent.

Logan, who did his university thesis on a study of the IAMU building, found and corrected three areas where improvements could be made based on end use monitoring by the Iowa Energy Center (IEC). The study of seven years of monitoring by IEC resulted in a recommissioning of the IAMU facility in 2007, seven years after it opened.

Changes included installation of a variable frequency drive (VFD) on the circulating pump for the geothermal system. Logan said that shut off valves to each pump were also installed at that time in order to allow the VFD to work properly. During design of the GHP system, a constant speed continuous pump arrangement with a wet standby pump was specified to circulate working fluid between the ground loop heat exchanger and the heat pumps.

"We don't have any sort of building automation system. A pressure sensor sends the pressure at one location in the geo loop, and based off that, the valves close and it sends that signal to the variable speed pump and allows it to slow down," Logan said.

Another area where possible energy savings were revealed involved retro commissioning the energy recovery ventilator defrost heater, which had been initially set to an unnecessarily high temperature at installation.

"It was just a simple issue with the heat recovery ventilator," Logan said. "It has an enthalpy wheel type heat recovery ventilator and it uses a defrost unit to prevent frost from affecting the heat exchanger under extreme conditions. That was set to 46 degrees F. The recommended setpoint was 0 degrees F. That was just a simple readjusting of that thermostat down to the recommend value." The adjustment brought a three to four percent building energy savings with no cost incurred, he said.

A final area identified was unoccupied general equipment energy use for the building. Monitoring revealed 16 percent of IAMU's building energy fell into this area. Logan said that plug loads of the building when unoccupied were also studied and a number of recommendations have been implemented.

Logan says education plays a role in finding solutions for occupants to pursue. Inexpensive timers have been added where applicable, including one to the office coffee maker that maintained a tank of hot water at all times. Annual savings from that effort alone were 800 kWh and $52.

"The project was just a little bit ahead of the time," says Kevin Nordmeyer, who was the architect on the project while he worked with RDG Planning and Design.

"It would have done very well in the LEED® system. At that time LEED® was still in a pilot phase. We were doing all of the right things there," Nordmeyer says. "Our goals were to be 50 percent better than the 1997 code."

Nordmeyer, who now serves as director of the Iowa Energy Center at Iowa

Left: **Drilling for the IAMU facility was done by Emery Inc., of Ottumwa, IA.**

Right: **Pipe fusion for the ground loop and connections for the system is accomplished with special equipment.**

(Photos courtesy of IAMU)

State University, says that the success of the project wasn't just from the design team. "Our design team was responding to a good owner. If not operated properly, a building won't respond as designed," he said. Nordmeyer feels that the building continues to improve its energy performance as IEC continues monitoring the facility's systems and ongoing energy usage.

One of the real benefits of the project still lies in the fact that incremental first costs for the environmentally sustainable practices and technologies utilized, along with an ability to show their payback through long-term energy savings, continues to provide documentation to support adoption of those building practices.

The building was sited along an east-west axis, and uses planned control of direct sunlight to provide comfortable and productive workspaces using natural daylighting from north and south windows. The daylighting is a strong organizational element for the IAMU building's architectural concept. Other energy efficiency features besides the daylighting, include lighting controls, passive solar heating, high performance windows and a high efficiency-building envelope.

Alvine and Associates Engineering of Omaha, Nebraska contracted the engineering. The forced air system was sized for 360,000 Btu per hour. Mechanical contractor on the project was L. A. Fulton & Sons. Dahl Air Conditioning installed the ground-source heat pumps. Eight 4-ton Water Furnace Spectra SX Series units provide 1600 cubic foot per minute each to the building's eight zones.

The geothermal exchange system includes 33 boreholes at 175 feet. Caution was taken to not drill into void areas of old coal mines abandoned decades ago. Story Construction was the general contractor.

The project received an $8,000 rebate from the utility company and an all-electric rate. It is estimated to save more than $4,000 annually in energy costs.

With the project, IAMU also saw to the restoration of a vacant farmland and coal mining area in 40-acres of wetland that includes 60 native plant species.

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A mockup of the Portland International Jetport, set to be finished in the fall of 2011.

(Courtesy of Assistant Facility Manager, Cuyler Feagles, AIA, LEED AP)

PORTLAND INTERNATIONAL JETPORT FIRST WITH GEOTHERMAL

BY KENDRA MANN

In an effort to reduce nitrous acid, one of the most harmful greenhouse gases, Portland International Jetport, in Portland, Maine, has become the first airport in the country to install a geothermal closed loop heating and cooling system. The Voluntary Airport Low Emissions (VALE) program, run by the Federal Aviation Administration (FAA) funded the project with a $2.37 million grant.

A large base slab was poured to hold the vault for the geothermal system's tie-in and header piping.

(Courtesy of National Geothermal)

"We put in 120 geothermal wells 500 feet deep for a total of 1,000 foot of loop per well. This added up to about 26 miles of piping," says Assistant Facility Manager for the Portland International Jetport, Cuyler Feagles, AIA.

Norfolk Ram Group, LLC, a leading environmental engineering firm with a wide range of geothermal experience through its National Geothermal Division, worked on the geothermal installation of the Jetport as part of a $75 million Terminal Expansion Project.

The original Jetport building was about 160,000 square feet, and the owners of the Jetport are planning to double the size of the building at the project's completion.

The VALE program allows airport sponsors to use Airport Improvement Program funds to make airport air quality improvements, and moderately finance up to 95 percent of major capital investments that reduce tonnage of ozone emissions.

"Our architect discovered a grant offered through the U.S. General Services Administration, which provides substantial funds for airports striving to become more energy efficient," Feagles said.

With the VALE grant the expected payoff rate for this system will be two to three years instead of 15 without the grant, said Jim Stanislaski, AIA, of Gensler, a global

The vault has been finished and placed on the slab in order to bring the piping from the wells to system.

(Courtesy of National Geothermal)

architecture, design, planning and consulting firm in Boston, Mass.

All of the geothermal loop work was completed in a field, which was then converted into a parking lot for the facility. Piping goes from the parking area into the building where there is a series of heat pumps designed and built by Multistack, in Sparta, Wisconsin.

"This was the largest amount of units Multistack has designed," Feagles said. There are a total of eight Multistack heat exchange units in the building.

The company's modular systems are nearly always compliant with ASHRAE 15 and CSA B52 because of the micro-charge of refrigerant. As a result, ventilation, monitoring, and other equipment will probably not be required. This eliminates a significant cost and installation delay usually associated with chiller replacements in older buildings, according to Multistacks website.

Another benefit of using Multistack, is its service is often less demanding and less costly. Modular systems do not require oil changes. Maintenance generally involves keeping the water unpolluted and treated.

Multistack also puts a heavy emphasis on proving products that are environmentally friendly. They have the lowest refrigerant charge per ton, the lowest overall weight per ton, and several models are available with heat pump capabilities, according to the website.

"Multistack makes a top flight product," Feagles said.

The vertical closed loop system has 3-inch high density polyethylene pipes with a 15 percent polyethylene glycol circulation fluid.

Drilling conditions on the surface of the ground for the geothermal system proved difficult.

"We had a layer of mud, basically saturated clay just below where we were drilling. It was 15- feet to 20-feet thick," National Geothermal Division Manager, Dan Everett said. National Geothermal is a division of Norfolk Ram Group LLC, in Portland, Maine.

Everett said when drilling in those conditions, the only option is to add a lot of water. As a result, there was a lot of mud and water to deal with. Because they had so much mud, Everett and his team used huge tanks and enclosed containers, and had to haul everything off site.

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Geothermal with Confidence

National Geothermal provided the drilling needed for the geothermal system at the Portland International Jetport.

(Courtesy of National Geothermal)

"It was quite a project as for keeping the site clean," Everett said.

Installation of the geothermal closed loop system began June 14, 2010, and was completed in November of 2010, Everett said.

"We were only able to support four drill rigs at a time on this site. And we were averaging about three holes a day per rig," Everett said.

Because the site was in a confined area, Everett and his team were drilling right up against the site's edges. Putting 120 boreholes in place was also a challenge because of the constraints of the airport site itself.

With plans from the VALE grant, the Jetport noticed a significant reduction in their equipment use. The change included a boiler capacity cut of 52 percent, circulation pump capacity cut of 50 percent, and two cooling towers and two chillers were reduced to one each, Stanislaski said.

"The Jetport saves 1,000 tons of carbon dioxide emissions a year, which is 1.02 tons of nitrogen oxides," Stanislaski said. A typical installation of a geothermal system can reduce harmful greenhouse gases by 1.1 tons per year, and cut energy costs by 80 percent.

The Portland International Jetport has applied for U.S. Green Building Council LEED® certification and is hoping to receive silver.

The building has an energy efficient glazing system for the glass in the building created by Ipswich Glass Ltd. The Jetport also provides alternative transportation and bicycling storage with changing rooms.

A water efficient landscaping system reduces water use by 50 percent. Also, there is no potable water use or irrigation. One site hydrant may count as permanent irrigation.

All the extra steps taken to make the building more eco friendly have added points to help meet the requirements

for a Silver LEED® award. Feagles said the building has been designed to LEED® standards and is a high performance building.

"Watching the entire geothermal well system go in," Feagles says, was his favorite part of the project. "You have a bunch of well drillers drilling wells and it is a down and dirty process. Yet, the final result is quite spectacular and it is fun seeing that."

The Jetport is the largest in Maine. It has 871,000 enplanements, six regional air carriers and two low-cost carriers. There has been a 55 percent growth in passenger traffic the past 15 years.

The Jetport also received funding from the American Recovery & Reinvestment Act of 2009 (ARRA), for two projects. The first is a $9.19 million award for the addition of an inline baggage handling system, a part of the Jetport's Terminal Expansion Project.

The second is a $2.13 million award from the American Recovery and Reinvestment Act of 2009 (ARRA), for the rehabilitation of one of the Jetport's aprons, part of the runway-taxiway system. It also allows for Phase I of the construction of a deicing fluid recapture facility. This facility will allow the Jetport to capture used aircraft deicing fluid for recycling purposes, according to the Portland International Jetport website.

Although the geothermal closed loop system is completed, the Jetport is still under construction and is expected to be open to the public in the fall of 2011.

(Courtesy of National Geothermal)

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national ground water association

(Edward Kodet, Kodet Architectural Group)

WEST ST. PAUL MAINTENANCE FACILITY WARMS UP

By Dara McCoy

In June 2009, the West St. Paul City Council approved the construction of a new Public Works and Parks facility after it became clear that the city's maintenance headquarters was itself beyond maintaining. The Public Works and Parks' 18-person staff is responsible for maintaining public parks, streets, and the sewer system for the 19,624 citizens who reside in West St. Paul, Minn.

The West Saint Paul Maintenance Facility has improved the work environment for maintenance employees with the addition of geothermal heat. (Courtesy of Matt Samm)

Until the new maintenance facility opened in November 2010, the Public Works and Parks staff was headquartered in a cramped, 1969-era building that "had a number of inadequacies and issues from a safety and efficiency standpoint," said Matt Saam, Public Works and Parks director and city engineer. The mechanic's garages, where Public Works staff service a fleet of 75-plus city police and maintenance vehicles, lacked drive-through vehicle bays and old sectional garage door operation caused significant heat loss during Minnesota's four to five month winter season. Limited space at the old facility—less than half the size of the new one—also meant snow plows and other equipment had to be stored outside.

"You can imagine people coming into work early in the morning to plow the streets in the winter and having to hook up snow plows outside when it's below zero," said Saam. "It just wasn't the best way to do things." Finally, the 40-plus year old facility's natural gas-powered HVAC system was a major safety concern.

"We never got written up by OSHA, but that was a fear and one of the driving reasons behind why we built the new facility," Saam said.

When the city council went through the approval process for the new maintenance facility project, they set a goal of constructing an energy efficient and sustainable building us-

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ing Dakota County Design Standards. The 52,000-square-foot, $7 million facility features concrete and brick construction, high R-value insulation in the roof and walls, highly efficient indoor and outdoor lighting, hydraulic, bi-fold garage doors that minimize heat loss, permeable pavement in the parking lot, rainwater gardens to handle site storm water runoff, and a geothermal heating and cooling system.

Though the city council decided against paying the costs for official LEED® certification, Saam estimated the building was built far above minimum building code and possibly to a standard equal to Bronze in the LEED® ratings.

Within the past five years, Saam had begun to learn about geothermal technology from industry conferences, reading about other geothermal projects, and discussing it with his peers in city engineering and public works. After considering space for vertical well placement, weighing the estimated eight-year pay back versus higher up-front costs, and considering long-term maintenance savings, Saam determined geothermal would align with the city council's goal of energy efficiency and sustainability. "We're planning on another 50-plus year building; so we want something that's going to last," he said.

Geothermal heating—through in-floor radiant heat—and cooling controls the climate for 3,350 square feet of office space and provides heat for 8,000 square feet of mechanic's area, a utility shop, carpentry shop and sign shop. A lack of space for geothermal wells and the lower climate control needs of the garage space prevented geothermal climate control for the entire building.

"It wasn't a good fit for the entire building, mainly because of area needed for the wells," Saam said. "Also, the 40,000-square-foot garage is a huge open space, with a two-story high ceiling and is kept at a lower temperature than the other areas."

The geothermal system, designed by Brian Michelson of Gausman and Moore in St. Paul, Minn., was installed

Equipment in the mechanical area for the new West Saint Paul Maintenance Facility shows the pumps and the workings for the facility's geothermal system.
(Courtesy of Matt Samm)

The site plan for the West Saint Paul Maintenance Facility shows the geothermal bore field.
(Kodet Architectural Group)

as a split bore field consisting of 40 vertical wells at 250 feet deep. "The final layout got shifted to where it was wrapping around a corner of the site," said Michelson. "It was not nice, neat rows."

Michelson said a tight construction site and state laws that mandate vertical heat exchangers and horizontal piping to be located no closer than 10 feet from a water supply main called for a unique design. Michelson said the Department of Labor and Industry and the Public Health Department in Minnesota view the boreholes as a potential source of contamination and risk to aquifers and have stringent guidelines on bore placement and grouting.

"Overall, the well field has performed very well and the contractor, Mineral Service Plus of Green Isle, Minn., did an excellent job," Michelson said. Twelve tons of WaterFurnace water-to-air units provide cooling for the office space and two 30-ton, WaterFurnace water-to-water units were installed for the in-floor radiant heat system.

The geothermal system helped earn the city an energy rebate from their local utility and will help provide an estimated $54,000 in annual energy savings. The system also provides far better temperature and air quality than their old facility.

"Everybody's very pleased with the environment in the office area," said Street and Utilities Superintendent, Mike Salmanowicz, who supervises the facility. "When you've got that heat coming off the floor it makes a world of difference." Mechanics, who spend a lot of the time under vehicles and near the floor on crawlers, truly appreciated the in-floor radiant heat this winter, Saam said.

Salmanowicz said the in-floor radiant heat has also provided additional safety benefits by keeping the garage floor dry. "It's so extremely cold in the winter time that cement slabs form moisture; you don't have that with in-floor heat," he said. "Then, you have wet vehicles coming in and out, and it seems to dry the floor quicker."

Though the facility has only been in operation since November, Saam and Salmanowicz are pleased with the overall performance through Minnesota's harshest season. Saam did indicate that the sub-zero temperatures and constant opening and closing of the garage doors in the mechanic space were creating significant heat loss. "We may need to provide some additional make-up heat in that area," he said. "We're considering adding water-to-air units to provide a little boost to bring

the temperature up faster after the doors have been opened."

The West St. Paul Public Works and Parks facility was one of six projects featured for its energy efficiency—all utilized geothermal technology—in the Sierra Club North Star Chapter's 2010 survey of Dakota County, Minnesota. According to the report, the six projects will save a combined $200,000 annually in energy costs and be a strong step toward the county's goal of becoming the only designated "Green County" in Minnesota. For West St. Paul, the maintenance facility was the city's first experience with a geothermal system in a government building, but it may not be their last.

"If we have the area for the wells, payback within that eight to 12 year time frame, and initial capital outlay isn't that much greater, I don't see why we wouldn't seriously consider it in the future," said Saam. "Overall, we're very pleased with the building, and we're excited that we were able to use geothermal."

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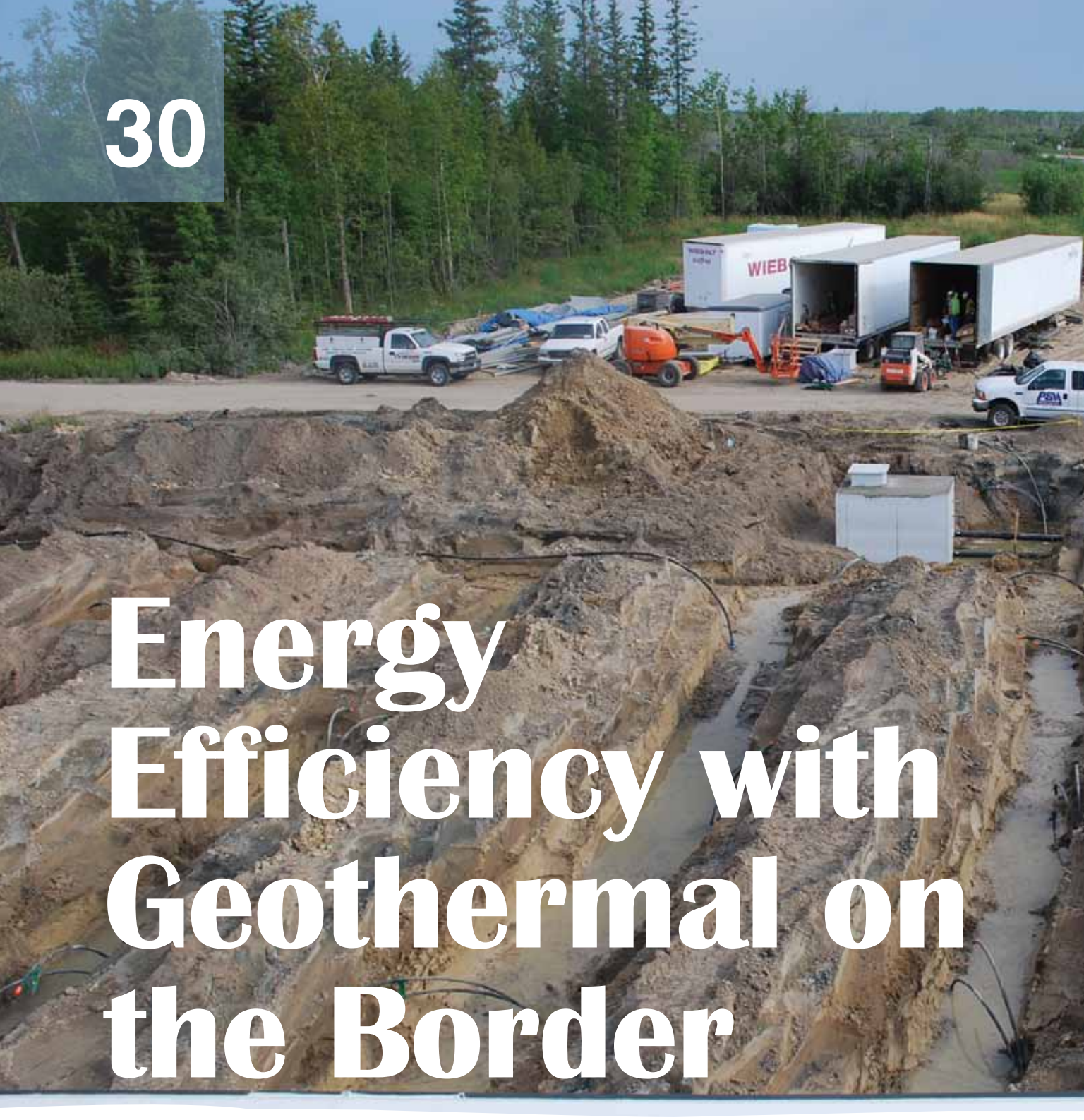

Energy Efficiency with Geothermal on the Border

By Davod Nematpour

(Photo Courtesy of Julie Snow Architects)

The new Warroad Land Port of Entry was built to protect the United States border and to also facilitate international trade and traffic. Warroad houses office and inspection areas, as well as secure holding and interview rooms. The facility also has a training area and a large-scale garage inspection area for its tenant, U.S. Customs and Border Protection.

Located in Warroad, Minn., the facility is winning awards, including an Honor Award from the 76th American Institute of Architects Minnesota Annual Convention and Exhibition in 2010. The Honor Awards program, a tribute to architectural excellence, encourages a high level of architecture, recognizes the clients and architects who have distinguished themselves, and informs the public of these important architectural contributions. Julie Snow Architects, of Minneapolis, designed the United States Land Port of Entry at Warroad, Minn., for the United States General Services Administration.

Julie Snow Architects supported the client's mission of secure international trade and traffic throughout the design process with consideration for efficient operation of the facility, while also giving consideration to the potential for future growth of the facility, which serves the American border between the United States and Canada. Matthew Kreilich, AIA, LEED® AP, a design principal at Julie Snow Architects, was the project designer on the Warroad Land Port of Entry project. Kreilich is known for his innovation and creativity, as well as for the collaborative nature of his design. He has received many awards for his work, including recent national recognition as one of the American Institute of Architects Young Architect's of 2009. Kreilich's design includes what he calls a three-foot "duck and cover" strategy with bullet resistant glazing in public areas that enhances the safety of officers while also creating a welcome image to the public. Other design considerations in the building's form include clear site lines throughout the port. The turning radii of large trucks and recreational vehicles also had to be considered and accommodated for the busy port.

Another important design consideration involved the placement and construction of the borefield area for heat exchange, which was influenced by the remote wetland bog location.

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The new Warroad Land Port of Entry is an attractive facility that fits carefully into the rugged surroundings of the American and Canadian border.
(Photo copyrighted by Paul Crosby, Paul Crosby Architectural Photography)

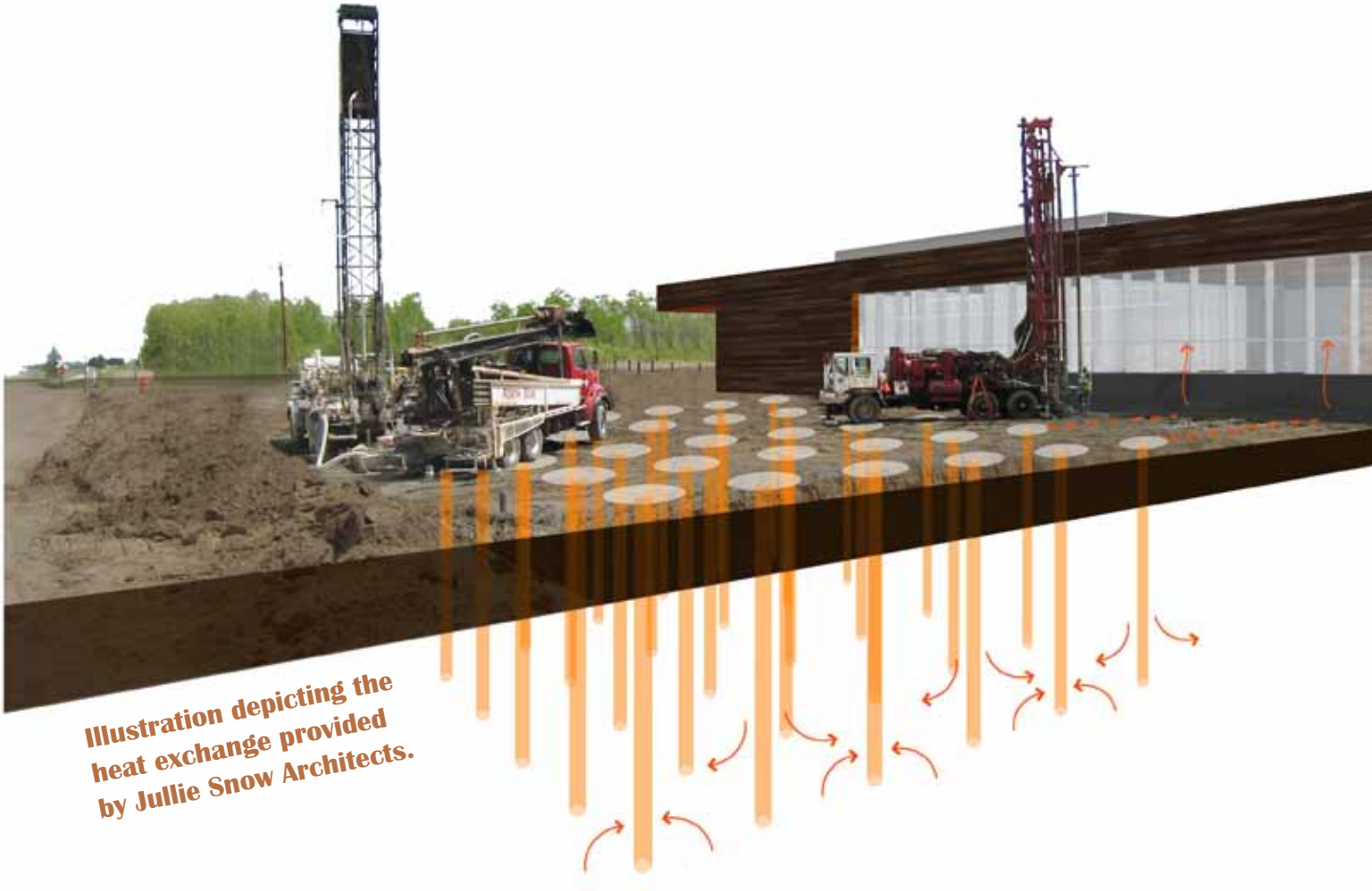

Illustration depicting the heat exchange provided by Jullie Snow Architects.

Jeff Urlaub, with MEP Associates, the design subcontractor for the project explains, "The original design was set so that we would drill 100-foot bores in a series. That design originally was over the bog, which doesn't freeze really well, because it is a swampy area. We ended up redesigning it to 400-foot bores in the bed rock."

Urlaub said that added an additional cost because of requirements for drilling through bedrock in Minnesota. Drillers doing so are required to use a cement-sand mix for grouting, which Urlaub said could be quite costly. MEP Associates designed the geothermal system for the facility. Peterson Sheet Metal handled installation.

Thought also had to go into the building's orientation and placement

A view of work in progress on the horizontal trenching shows the area where North Star Drilling set the loopfield .
(Courtesy of Julie Snow Architects)

of canopies because of the severe climate conditions of the northern Minnesota area. A local tradition that played into the port's design and final appearance included the strong influence of what is known as a "north wood's culture" in the region.

While not many federal buildings are built with either wood siding or logs, Tyson McElvain, AIA, LEED® AP, CDT, of Julie Snow Architects Inc., said that plans had to take into consideration that Warroad was a very "woods-based town." With a window factory that produces all-wood windows and a hockey stick factory nearby, the Warroad border building project needed to be a reflection of the culture and how local people and visitors perceived the area.

"There are not many people in Warroad, though of those people, a majority are sportsmen that enjoy hunting, fishing and snowmobiling. It is kind of a vacation destination for hunting and fishing," McElvain said. "There's a lot of a reference to wood in the culture of the area."

McElvain also said that while the locals originally had wanted a log cabin style structure, the design team went with a more modern building design that still incorporated the desired feeling of natural wood. The entire facility is clad in sustainably harvested cedar siding, supporting the identity of the region. Using dark stains on the facility's exterior helped to create strength in the structure's presence. Warroad is located in an area where snow blankets buildings in white for long periods of time through the winter. A warm heartwood color glows from the underside of the canopy and entrances where vehicles must stop and interact with officers, and aids in countering the snow's cold starkness.

Sustainability was an important consideration from the beginning of the

Loop ends for part of the 76 wells utilized by Warroad's geothermal system have been marked. **(Photo Courtesy of Julie Snow Architects)**

Warroad project, which also included a move toward reliable energy efficient technologies and a concern for the larger landscape the facility would occupy. Geothermal heating and cooling was seen as a large contributing factor toward a solution to those concerns.

"There was no natural gas out there," said Jaime Quello, with Peterson Sheet Metal.

"The other choice was to go straight electric," Quello said. "We do have electric problems in the winter, and we often don't have enough electricity to heat. So it was good to reduce the electric load." Asked if there were any problems with the system, Quello said, "Not really, we had a pretty cold winter and the system worked pretty well without any hiccups."

GHP work was contracted to Verzieg Consulting and Management Services, LLC, of Little Falls, Minn. Scott Freitag with Verzieg's Geothermal Specialists area was on the project. MEP Engineering designed the loop. The borefield was specified for 76 wells to a depth of 400 feet, that were drilled by North Star Drilling, a fifth-generation company with offices in Brainerd, Bemidji and Little Falls, Minn. Sebesta Blomberg, Inc., headquartered in Roseville, Minn., provided engineering for the project. Sebesta Blomberg has regional and national offices throughout the country and is known for building system design engineering for intensive specialized environments.

The GHP system itself utilizes 30 heat pumps, manufactured by Florida Heat Pump, to heat and cool the building. According to Quello, the geothermal system uses water-to-water pumps and water-to-air pumps. The water-to-water pumps are primarily to handle the air handling units, vented radiation and floor heat. The water-to-air system is used to cool the interior space during the summer. The system also utilizes nearly three miles of snowmelt piping to keep approaches and parking areas clear.

North Star Drilling keeps the drilling for the wells on schedule.

(Photo Courtesy of Julie Snow Architects)

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To support sustainability, rainwater collection is also utilized for toilet and urinal operations. Daylighting is a well thought out planned effort managed through automated lighting controls and the coordinated placement of skylights and windows for daylight in the facility's work areas. Along with daylighting, a high-performance back-ventilated rainscreen envelope was also incorporated into the building plans.

Even with some set backs, the project completed construction under budget. Design work started in December of 2005 while the construction of the Warroad project started in June of 2008. The Warroad project was substantially completed in February of 2010. It is on track to receive LEED® Silver Certification. The Warroad facility was a GSA Design Excellence contract project, and was the winner of two honor awards and three citations in the 2010 GSA Design Awards Program.

General contractor for the Warroad facility was Kraus-Anderson Construction, headquartered in Minneapolis. Their Bemidji office handled the Warroad project. Kraus-Anderson has managed dozens of national LEED® projects and has been ranked consistently among the top Green Contractors in the U.S. by Engineering News Record magazine.

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In The News: Tulsa's Brady District Goes Geothermal

By Janet F. Reeder

Drilling has begun for The Park on Brady project in Tulsa, Okla., where a geothermal well field of 120, 500-foot wells will supply 600 tons of heat and air to the Tulsa Paper Company building and the Visual Arts Center.

The geothermal field is the next step in the construction of the urban green space and park in The Brady Arts District that will include gardens, fountains, a café and an 11,000 square-foot covered pavilion, all on top of the finished geothermal well field.

The upscale developments in downtown Tulsa are in proximity to the location for the 2011 IGSHPA Technical Conference and Expo held at the downtown Tulsa Convention Center on October 5-6. The IGSHPA Technical Conference will feature a special track on the Brady Arts District project. For more information on IGSHPA's Conference visit www.igshpaconference.com.

IGSHPA Director, Dr. James Bose, shakes hands with Ken Levit, George Kaiser Family Foundation executive director, at the site of the geothermal well field for The Park on Brady project.

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EARTH INSIGHTS

If you have a question about geothermal installation, design or troubleshooting, send it to Phil Rawlings in care of *Geo Outlook,* Oklahoma State University, 374 Cordell South, Stillwater, OK 74078

In last issue's article, I addressed perceived barriers to GSHP application success. Now it's time to discuss similar issues driven by the industry's long term growth – experience and expertise – or the lack thereof.

The growth our industry has experienced, especially in the midst of this economic downturn, has resulted in a new slogan for many companies that have decided to enter the GSHP industry – "Yeah, we can do that!! In truth, they CAN do that – with training and education, but not without it. I want to impress upon all readers considering geothermal projects that as you qualify your engineers, energy experts, designers, contractors, etc., do so based on evidence of actual GSHP training, experience, and expertise. And by the way, those qualifications are for individuals that will be working your project, not someone in the company on a different team or in a different office that will never participate in your project.

Training for designers and installers is readily available – take advantage of it. Whether you are in the industry or planning to enter the industry, you need the appropriate training! If you don't think it's necessary, check these out:

A prison ground heat exchanger designed by an individual with a good loop field design program but insufficient training. The result – the loop field was much larger than it needed to be – and – the design also used a tower and boiler because "only a hybrid system will work". When it came out for bid, value engineering by the successful bidder significantly reduced the hybrid system's cost and kept cost overruns from killing the project. The result – a professional VE ground heat exchanger design and reduced system cost while still satisfying the building's space conditioning requirements.

An "energy expert" provided an energy evaluation of a planned geothermal heat pump project and recommended against geothermal because "it doesn't perform much better than air source heat pumps, costs about the same to maintain, and you have to replace the loop field in about 50 years." Those of us in the industry know how wrong this information is, but a client often does not. Discussions are still under way to attempt to salvage this project.

A project where only peak heating and cooling loads were used to design its ground heat exchanger has failed to perform as specified. Unfortunately, the facility's energy intensity information was never defined. Requests for additional load information and operation time frames were deemed unnecessary and a copy of the designer's preliminary loop designs was used for the installation while additional load information was still being requested. The result – inadequate ground heat exchanger performance and a hot or cold building.

These are actual or potential horror stories that could have led to disaster. The prison could have used something besides geothermal, but the General Contractor and owner would have remembered how outrageously expensive the cost of a geothermal system was. The project with the "energy analysis" may yet be salvaged, but how much other bad information has this "professional" given out? And finally, there's a reason the ground heat exchanger programs require detailed load information and fact based equipment selection before proceeding with the ground heat exchanger design – without accurate load and equipment information, all you have is a train wreck.

Mr. Rawlings has more than 30 years experience in the geothermal industry. He is a Certified GeoExchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.

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