News of Plumbing, Hydronics, Fire Protection and PVF

PHCP PROS

February 2022

Plumbing Engineer

@PHCPPros

Restoring the Corcoran School of the Arts & Design

INTRODUCING

ARMADA℠

HOT WATER SYSTEM FOR HEALTHCARE

SUPERIOR USER SAFETY, INFECTION CONTROL AND COMPLIANCE, FROM MECHANICAL ROOM TO POINT OF USE

Armstrong brings you a total, end-to-end domestic hot water solution, engineered to mitigate incubation of waterborne pathogens, resist infection surface transfer and reduce scald risk, while supporting hospital accreditation requirements and compliance with Standards of Care.

Discover Armada℠ Smarter Hot Water for healthcare at

ArmstrongInternational.com/Armada

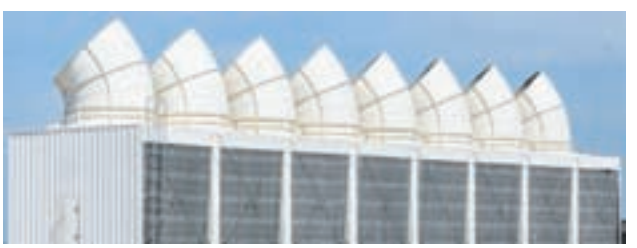
Armstrong

INSIDE THIS ISSUE

Volume 50, Number 2 - February 2022

Cover Photo Credit: LEO A DALY

FEATURES



The opinions, beliefs and viewpoints expressed by the various authors in this magazine do not necessarily reflect the opinions, beliefs and viewpoints of PHCPPros or its staff.

Plumbing Engineer

PHCP PROS

COLUMNS

DEPARTMENTS

LegendPress®

SIMPLY THE BEST

Meet the newest addition to the LegendPress product line, the P-521NL Boiler Drain. It features a durable full-pattern forged brass body and a packed stem for superior blowout protection.

LegendPress valves and fittings are simply the best, combining the latest design innovations with expert engineering. Deeper tube sockets enhance stability during installation, saving you time, labor, and callbacks.

At Legend, we back all of our products with an industry-leading 5/25 product warranty. We've got your back.®

(800) 752-2082 | www.legendvalve.com

LEGEND®
PLUMBING • INDUSTRIAL • COMMERCIAL • HYDRONICS

Editor's Letter

Amalia Deligiannis, Editor
amalia@phcppros.com

Plumbing at the Forefront

As we are all aware, plumbing is a vital system within any kind of structure, used to distribute and provide potable water within buildings and to remove waterborne waste. Articles and columns in *Plumbing Engineer* aim to provide insight into common problems for commercial plumbing systems, highlighting ways that plumbing engineers use the latest developments in their commercial buildouts to solve issues while adhering to current codes and standards. We also periodically include insights from manufacturers and associations for their ideas on how to resolve plumbing-related issues.

Our February issue shines a spotlight on a recent retrofit of a commercial building and how drainage issues can impact plumbing systems.

Karen Schulte, PE, CPD, LEED AP BD+C, writes about how her engineering firm Mueller Associates tackled the retrofit of the 123-year-old Corcoran School of the Arts & Design in Washington, D.C., to bring its plumbing and mechanical systems up to today's standards.

Meanwhile, monthly columnist Ron George pulls double duty in this month's issue. His feature provides insights into how plumbing systems are impacted when commercial buildings settle and lean, while his monthly column delves into recent activities from IAPMO, ICC and SFPE.

Our other columnists are once again providing compelling content. In this issue, you will hear from Jay Egg, BF Nagy and Manuel Silva.

In the winter months, frozen pipe can be an issue. Lance MacNevin from the Plastics Pipe Institute has written a timely article on freeze-break resistance of PEX piping and the benefits of piping insulation to help prevent water in piping systems from freezing.

In this month's issue we also include an application spotlight from AquaRex, where Jonny Seccombe delves into new technologies for treating cooling towers.

I hope you enjoy this issue. I believe that it's full of material that will help you do your job better. As always, feel free to contact me with questions, concerns and suggestions at amalia@phcppros.com.

Until next time,
Amalia

Let us know how we're doing. Email your letters to the editor about articles and columns run in *Plumbing Engineer* to amalia@phcppros.com.

PLUMBING ENGINEER
(USPS 567-950) ISSN 0192-1711

PLUMBING ENGINEER (USPS 567-950) ISSN 0192-1711 is published monthly by TMB Publishing Inc., 6201 W. Howard St., Suite 206, Niles, IL 60714. Phone (847) 564-1127, Fax (847) 564-1264. Magazine is free to those who design and specify plumbing/piping systems in commercial, industrial, institutional and governmental buildings; as well as government officials and plumbing inspectors. Subscription rates for U.S. and Canada: $50 for one year, $90 for two years. Periodical postage paid at Northbrook, IL, and additional mailing offices. POSTMASTER: Change of address should be sent to Omeda Customer Service, 125 Schelter Rd #350, Lincolnshire, IL 60069-3666, plr@omeda.com. The publisher cannot assume responsibility for any claims made by advertisers. **Volume 50, Number 2.** *Plumbing Engineer* is microfilmed by University Microfilms, Ann Arbor, MI, and indexed by Engineering Index Inc. Publications Mail Agreement No. 41499518. Return Undeliverable Canadian Addresses to PO Box 503, RPO West Beaver Creek, Richmond Hill ON L4B 4R6

News of Plumbing, Hydronics, Fire Protection and PVF PHCPPROS

Plumbing Engineer

PHCPPros

6201 W. Howard St.,
Suite 206, Niles, IL 60714
(847) 564-1127 • Fax: (847) 564-1264

Chairman of the Board
Tom M. Brown

Editorial, Production, Admin
Cate C. Brown, *Vice President/Principal*
Amalia Deligiannis, *Editor*
Mark Bruno, *Premedia Specialist*
Christopher Garcia, *Designer*
Steve Smith, *Senior Director of Content Development*
Nicole Meyer, *Digital Strategy Manager*

Contributors
Jay Egg, Geothermal HVAC
Ron George, Code Classroom
BF Nagy, The Future is Now
Jonathan Franzese, Water Reclamation
John Gregory, Collaborative Health Care Design
Steven Nudelman, Legal Pipeline

Sales
Brad Burnside, *East sales*
6201 W. Howard St., Suite 201,
Niles, IL 60714
Phone: (847) 564-1127
Fax: (847) 564-1264
E-mail: brad@phcppros.com

David Schulte
Midwest, South and E. Canada sales
6201 W. Howard St., Suite 201,
Niles, IL 60714
Phone: (847) 564-1127
Fax: (847) 564-1264
E-mail: dave@phcppros.com

Laura Schulte
Sales Service Manager
6201 W. Howard St., Suite 201,
Niles, IL 60714
Phone: (847) 564-1127
Fax: (847) 564-1264
E-mail: laura@phcppros.com

A safer, intelligent alternative.

LEONARD®
WATER TEMPERATURE CONTROLS

Mixing safety and performance... For over 100 years.

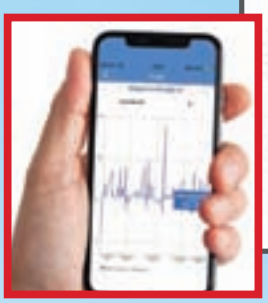
VIRTUAL STATUS CHECKS!

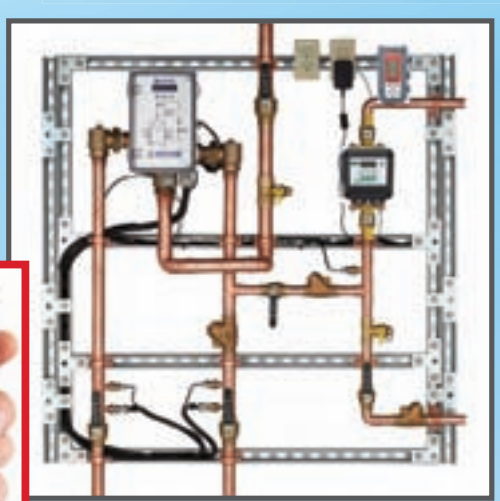
Tired of routine maintenance checks?
Want lower maintenance costs?

NUCLEUS IS THE ANSWER!

NUCLEUS®
DIGITALLY CONTROLLED MIXING VALVE

- ASSE 1017 Listed
- Precise digital control +/- 2°F
- Daily Self Cleaning = reliability & longevity
- Self Balancing
- Disinfection Mode
- Six Standard Protocol Languages
- High Efficiency circulator on most Megatron pre-piped models
- Service alerts and notifications right to your smart phone





"It's been up and running flawlessly... money well spent."

JEFFERSON COUNTY CORRECTIONS, LOUISVILLE, KY

NSF 372 COMPLIANT
Made in the USA with domestic and imported parts

1360 Elmwood Avenue Cranston, RI 02910 | T: 401-461-1200 F: 401-941-5310
TF: 800-222-1208 | www.leonardvalve.com | Revit available on BIMObject.com

Omega Flex Announces First-Ever Seismic Certification for Piping System

Omega Flex Inc., a leading innovator in the corrugated tubing industry, proudly announces the first ever seismic certification for a piping system by the International Code Council Evaluation Service (ICC-ES). ICC-ES has just published a listing for the Omega Flex TracPipeCounterStrike, MediTrac and DoubleTrac corrugated tubing products based on the Acceptance Criteria AC-156 for non-structural building components.

TracPipe CounterStrike (fuel gases), MediTrac (medical gases), and DoubleTrac (liquid fuels) have already proven to be break-through technologies in their respective application areas allowing engineers, designers, and professional installers to innovate beyond the textbook approaches to designing and installing piping systems. For buildings in any seismic zone, the ICC-ES certification will simplify the requirements for pipe supports and seismic bracing of these piping systems.

All three Omega Flex products can eliminate all intermediate piping system joints (that historically have been the leading cause of leakage after earthquakes), reduce installation time, reduce the seismic bracing demand, and lower the final system cost compared to all other traditional rigid metallic piping products. Installation of Omega Flex flexible piping can also contribute to the functional recovery and resiliency of buildings by reducing the downtime after an earthquake.

The ICC-ES ESR-4565 Report represents the seismic certification by shake-table testing for these flexible piping systems as an alternative to code-prescribed requirements. Omega Flex tubing systems proved indestructible under severe earthquake simulations that surpassed all the intensities

and seismic forces ever recorded as well as the design forces specified in the current building codes. The seismic certifications for the three Omega Flex products are consistent with the technical requirements of the major US seismic codes and standards including: *International Building Code*, the *ASCE-7 Standard, FEMA 461* as well as the City of Los Angeles Department of Building Safety, and the State of California Division of State Architect and OSHPD.

For Medical Gas and Vacuum specifiers view the ICC-ES report at https://meditrac.us/meditrac/codes-standards-compliance-quality-statement/.

For Natural Gas and Propane specifiers view the ICC-ES report at https://www.tracpipe.com/technical/icc-es-esr-4565-seismic-resilience/.

For Diesel and Biofuel specifiers view the ICC-ES report at https://www.doubletrac.net/doubletrac/#listings.

SFPE Names Beth Tubbs President

The Society of Fire Protection Engineers (SFPE), a leading professional society for fire protection and fire safety engineering, has named Beth Tubbs, PE, FSFPE, as its 2022 president.

Beth Tubbs at the International Code Council (ICC), headquartered in Washington D.C., serves as a key engineering resource and contributor to the *International Existing Building Code* (IEBC), the *International Fire Code* (IFC), the *International Building Code* (IBC), and the *ICC Performance Code* (ICCPC) as a Senior Staff

Introducing **CENTURION®**

PVI's Most Powerful Water Heater Yet!

- **Compact, 2000 MBH water heater**
  - Up to 65% less footprint vs. the competition
- **Advanced Edge® Controller with O_2 Trim technology**
  - Self-adjusts and maintains optimal air-fuel ratios for peak efficiency, low emissions and maximum reliability
- **Durable, corrosion-resistant AquaPLEX® duplex stainless steel**
  - Fire tube heat exchanger backed by a 15-year warranty

PVI®
A WATTS Brand

(817) 335-9531 | PVI.com

Engineer with the Codes and Standards Development Department.

Tubbs has been an SFPE member since 1995, elected a Fellow of SFPE in 2010, and has served on and/or chaired numerous SFPE committees and boards. She holds degrees in fire protection and civil engineering from Worcester Polytechnic Institute. As SFPE president, Tubbs is currently serving as the program committee chair of the SFPE International Conference on Performance-Based Codes and Fire Safety Design Methods scheduled for March 2022, and the SFPE Annual Conference and Expo scheduled for October 2022 in Detroit, among other SFPE committees.

Jimmy Jönsson, director with JVVA in Madrid, Spain, was named president-elect. Jonsson has worked on a wide range of fire- and life-safety projects internationally over the last 20 years, with extensive experience in developing performance-based fire engineering design and analysis. He has been an SFPE member since 2002, past president of SFPE Europe, and current president of the SFPE Spanish Chapter. Christopher Butts, PMSFPE, Elizabeth Pennacchio, PE, PMSFPE, Michael Wojcik, PE, PMSFPE, and John Denhardt, PE, FSFPE, have joined the SFPE Board of Directors effective January 2022.

"SFPE has benefited from exceptional leadership in recent years, and we are so fortunate to have leaders like Beth, Jimmy, and our entire Board of Directors to guide us in 2022 and beyond," said Nicole Boston, CAE, CEO, SPFE. "With plans this year to reach more fire protection engineers through our industry-leading education programs, to publish our first standard since being accredited by ANSI, and to increase the recognition and competencies of fire protection engineers, our leadership has the depth and diverse experience to advance the Society and the profession of fire protection engineering."

Amanda Kimball, PE, FSFPE, Jack Poole, PE, FSFPE, John Campbell, PE, PEng, CFPS, FIFireE, PMSFPE, Shaun Kelly, PEng, CEng, MIEI, PMSFPE, Bob Libby, PE, FSFPE, Albert Simeoni, PhD, PMSFPE, and Shamim Rashid-Sumar, PE, FSFPE, continue their service on the SPFE Board of Directors. SFPE will be establishing its 2022 Nominating Committee and soliciting nominations for its future leadership roles in the coming months. ●

HIGH TEMP DRAIN PUMP
DUPLEX SERIES

Sanicom® 2

Designed to **pump up to 32 feet vertically**. **(Shut-off head: 53 Ft)**.

Capable of **handling up to 194° F** gray water from multiple fixtures. Equipped with **external wired control panel w/motor override buttons** and power/alarm LED indicators.

2-HP alternating motors discharge gray water from commercial kitchens, washing machines, etc. **Easy access to all major components while installed to ease service** if needed.

Able to **handle liquids with highly acidic properties** as system activates with a **fail-proof air pressure switch system with triple redundancy**.

Sanicom® 1 simplex drain pump also available for residential and commercial applications.

800-571-8191

Saniflo SFA GROUP

3 YEAR LIMITED WARRANTY

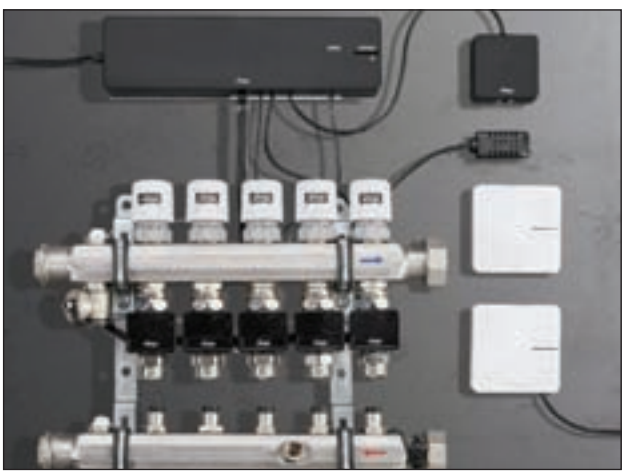
saniflo.com

Product News

CircuitSolver Union Cold Water Valve

In unbalanced and non-recirculated cold-water systems, low fixture usage can result in stagnant water that creeps above 67 F, significantly increasing the risk of *Legionella* bacteria colonization. The CircuitSolver Union Cold Water Valve is a thermostatic, self-actuating balancing valve that automatically adjusts flow through a cold-water recirculation system to maintain a specific temperature at the end of each supply branch. This keeps water moving, keeps water cold, and discourages *Legionella* growth even in periods of low use. **www.circuitsolver.com**

Viega Radiant Auto-Balancing System



Viega's new Radiant Auto-Balancing System (RABS) delivers an unprecedented level of control and consistency in radiant heating systems. RABS gives users for the first time the ability to independently control each zone in a radiant heating system. Balancing valves are not required and installers can commission as many as eight thermostats and 12 circuits per control unit. RABS achieves the desired temperature in each zone by analyzing the supply water temperature, each circuit's return temperature and zone air temperatures where a wireless thermostat is used. The system offers four operation methods that complement each other. **www.viega.us**

Bradford White Tankless Electric Water Heaters

KwickShotTankless Electric Water Heaters from Bradford White deliver a continuous stream of hot water at any one location with no storage capacity to run out – ever! They're

compact, easy to install in any plumbing orientation (with no-sweat connections) and deliver reliable and efficient performance. Two types are available – KwickShot Tankless Thermostatic and KwickShot Tankless Single Point Flow-Controlled. **www.bradfordwhite.com**

Sloan Online Sink Configurator

Sloan has introduced its Sink Configurator, an online resource designed to help streamline and customize sink specification. The Sink Configurator equips architects and designers with a tool to quickly determine what kind of sink will look best in their restroom. Customers can explore the possibilities with visual real-time updates to sink features, faucets, soap dispensers, and hand dryers with associated pricing. The configurator also includes some options for background environments for sink context. **www.sloan.com**

MERIT PRESS TECHNOLOGY

CopperPress® and IsoTubi-USA, StainlessPress®, by Merit Brass Co.

- CopperPress® with VIP (Visually Indicates Pressed) Band
- Box, Bag and Band are Easy to Identify for the Application
- Both Alloys Carry a 50-Year Warranty

LEARN MORE

85 Years ANNIVERSARY CELEBRATION MERIT BRASS

800.726.9800 • contactus@meritbrass.com • www.meritbrass.com

Code Events Roundup

A summary of recent developments and activities in the plumbing code world.

By Ron George, CPD

This month, I'll be catching you up on the code activities over the last few months. We'll start off with the International Association of Plumbing & Mechanical Officials (IAPMO), which sought Canadian input in the development of *IAPMO Z1117, Press Connections*, and *IAPMO Z1154, Shower and Tub/Shower Enclosures, Bathtubs with Glass Pressure-Sealed Doors, and Shower/Steam Panels*, as national standards of Canada.

The IAPMO Z1117 press connections standard covers press connections made with:

- Copper or copper alloy fittings and Type K, L and M copper tube;
- Carbon-steel fittings and Schedule 10 and 40 carbon-steel pipe;
- Stainless-steel fittings and Schedule 5, 10, and 40 stainless-steel pipe;
- Stainless-steel fittings and stainless-steel pipe complying with the dimensions specified in the standard.

Z1117 specifies requirements for materials, physical characteristics, performance testing and markings. It includes products such as fittings, tube and pipe with press connection ends combined with other types of connections (e.g., threaded, soldered and push-fit). Keep in mind that carbon-steel fittings and pipe covered by Z1117 are not intended to be used in plumbing systems.

IAPMO Z1154 covers shower/steam panels, enclosures for showers and tub/shower combinations, bathtubs and tub/shower combinations with glass pressure-sealed doors, and floor-mounted shower stalls intended for new and retrofit applications. It also specifies requirements for materials, physical characteristics, performance testing and markings.

Shower/steam panels and enclosures covered by Z1154 can include:

- Factory-installed supply and waste fittings;
- Factory-formed shower thresholds;
- Factory-plumbed shower doors.

UPC Adoptions

• In December, Lincoln, Neb., adopted the 2018 edition of the *Uniform Plumbing Code* (UPC), updating from the 2012 editions of the UPC, and was effective Dec. 27, 2021.

"After careful review of the plumbing code, amendments were drafted to fit the needs of the industry and citizens the code serves," said Rex Crawford, Lincoln chief plumbing inspector. "The 2018 UPC with amendments embodies the provisions, guidelines and innovative methods that will best serve our residents. We recognized our industry prefers using the UPC and feel this code, as adopted, brings the greatest benefits for residential and commercial buildings."

• The Sedgwick County, Kan., Board of Commissioners voted to end the adoption of a dual plumbing code, which allowed residents to choose which code they wanted to follow. The code officials had previously used the UPC, and there was a trial period allowing the choice of either the *International Plumbing Code* or the UPC. The commissioners chose to follow the *2021 Uniform Plumbing Code*, with county-specific amendments, because they were familiar with the UPC and the liberties it offers them with respect to approvals.

Soon after the action, the city of Wichita, Kan., also voted to adopt the 2021 UPC and align its plumbing code with the surrounding county.

New Sanitary Facilities for Munazi Primary School

On Nov. 30, the International Water, Sanitation and Hygiene Foundation (IWSH) worked with the Rwanda Plumbers Organization (RPO) to launch the construction of new toilet and hand-washing facilities for Munazi Primary School in Gisagara District, Southern Province.

Throughout 2021, with assistance from IWSH, the RPO teams visited numerous potential project sites, and selected this site for a new IWSH project. Plans are for volunteers to go to Munazi Primary School with a group that includes RPO volunteers, IWSH staff, the Munazi Primary School principal, and plumbing, architectural and engineering volunteers who worked together to develop plans over various digital platforms as part of a remote design workshop — a first of its kind for IWSH.

Through the funds raised by the #GivingTuesday campaign and the IWSH/RPO collaboration, more than 800 children will soon have access to safe and clean drinking water, wastewater and hygiene facilities. The school's old outdoor pit toilets did not have doors, and there are no hand-washing facilities near the toilets.

The IWSH/RPO work calls for seven toilets for girls, five for boys (plus four urinals), two for disabled students, and one each for female and male staff members. The girls' and boys' hygiene facilities will each have seven hand-washing taps and a low tap at each end, as well as ramps leading into the buildings. About 14,000 liters of water will be drawn from wells, disinfected and stored nearby in a water tower for flushing and hand-washing.

RPO is now finalizing engineering plans and construction drawings and will then connect its volunteers with local contractors to build the facilities.

I had a chance to spend the month of November in Ghana, Africa, a few years ago doing a similar project through the Rotary Foundation (Monroe Chapter and the Windsor/Essex Canada Chapter). The mission trip


CHARLOTTE
PIPE AND FOUNDRY COMPANY
You can't beat the system.
When we make a promise you better believe it's as good as done.
COUNT ON IT
CharlottePipe.com/CountOnIt

was very rewarding, and I was planning on going back in 2020, but the trip was cancelled because of the COVID-19 pandemic.

The trip has been rescheduled and I will be returning with the president of a local college who grew up in Ghana. Over the last several years, he has been leading an effort to build a project there called "Angel City," which has a school, housing for an orphanage, a medical clinic and housing for teachers. The plans for the campus include water wells, a water tower and a water distribution system to plumbing facilities, and a waste treatment and disposal system.

The rescheduled trip is tentatively scheduled for the summer of 2023. This would be a good venue for a future IWSH project.

ICC News

• The International Code Council (ICC) hosted a Dec. 7 virtual discussion on existing building maintenance and inspections. The goal was to bring the dialogue to a global audience and to help clarify the types of resources that the building community, building owners and code administration professionals will need to ensure the continued safety of existing buildings moving forward.

One of the key takeaways from the discussion, which was attended by more than 600 people, was that while some jurisdictions already have protocols in place for existing building maintenance and inspections, most still do not.

"Overall, we are very pleased with the outcome and the discussions that arose from this event," states Sara Yerkes, ICC senior vice president of government relations. "In the months to come, we'll be developing nonmandatory guidelines for building safety professionals and jurisdictions to assist them in managing maintenance and inspections for existing buildings."

One of the things I find lacking in all HUD inspections, existing building inspections and property maintenance code inspections is checking to see if the hot water temperatures are safe. The codes require the premises to be free of any unsafe conditions and this would be an easy one to require for rental housing or the sale of property to ensure the hot water flowing from bathing or showering fixtures does not exceed a safe temperature.

I find many times there is a limit-stop present that could limit the temperature, but the owner does not adjust the limit stop because it is not required after the initial installation, even though the manufacturers' installation instructions require seasonal adjustments because of changing cold water temperatures.

The council expects to share a

GEN5 PLATFORM

The Gen5 Platform supports up to five different plumbing systems: Booster Pump, Pump Bypass, Backflow Prevention, DWV, and Flood Control.

THE BENEFITS INCLUDE:

- Saving in material and labor costs.
- Specifying single product saves time for everyone.
- Mitigating dead-legs and biofilm.
- Improving ASHRAE 188 compliance.
- Eliminating building shutdowns for RP testing.

SPACE SAVING FOOTPRINT

ONLY 29" X 40"

A fresh approach to boosters, backflow prevention, and mechanical room design.

CONTACT US TODAY TO DISCUSS YOUR SPECIFIC APPLICATION.

TOWLE WHITNEY
Water Booster Pump Systems

TOWLE-WHITNEY.COM | 800-807-9827

A Veteran-Owned Company

working document with interested parties in early 2022.

• Development of the 2024 international codes continue with Part B codes. The plumbing codes were part of the Part A code changes, but the administrative sections will be located in Part B.

The proposed code changes will be processed and published in a proposed code change document that will be uploaded to the ICC website on or after Feb. 23, 2022.

The 2022 Part B code change hearings/committees for the 2024 International Codes will include:

1. Administration. Chapter 1 of all the international codes except the *International Energy Conservation Code* (IECC), the *International Green Construction Code* (IgCC) and the *International Residential Code* (IRC). Also includes the update of currently referenced standards in all of the 2021 codes, except the IgCC.

2. International Building Code structural provisions (IBC-S). IBC Chapters 15–25 and the *International Existing Building Code* (IEBC) structural provisions. Definitive tracks, codes, order of codes and track end date(s) may change based on code change volume and the creation of the hearing schedule.

3. International Existing Building Code. IEBC nonstructural provisions. Definitive tracks, codes, order of codes and track end date(s) may change based on code change volume and the creation of the hearing schedule.

4. International Energy Conservation Code (IECC-C). IECC commercial energy provisions.

5. International Energy Conservation Code (IECC-R/IRC-E). IECC residential energy provisions and IRC energy provisions in Chapter 11.

6. International Green Construction Code. Chapter 1 of the IgCC. Remainder of the code is based on the provisions of *ASHRAE Standard 189.1 Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings*.

7. International Residential Code (IRC-B). IRC building provisions, Chapters 1-10.

Be sure to consult the updated document for procedures to follow for the code change submittals and at the code change hearings. The document is titled "Council Policy 28 (12/3/20)" and often referred to as CP-28 for procedural revisions applicable to the code action hearings (CAH). The code hearing schedule as well as all other updates will be posted on a dedicated webpage to keep participants apprised of the in-person or virtual CAH progress/logistics.

Due to the current COVID-19 pandemic and recent variants, it is possible that the code hearings could get changed to virtual-only. Currently, the hearings are scheduled for March 27-April 6, 2022, at the Rochester Riverside Convention Center in Rochester, N.Y.

The New Hydrotek 8200 Series Flush Valve

Sleek. Modern. Functional.

Aesthetically pleasing, but not overbearing. A look to compliment any commercial restroom whether it be a standard public restroom or a high-end, luxurious one.

The 8200 Series isn't just an aesthetic upgrade, we've made some thoughtful improvements under the hood:

Foward Removable Top Cap

The 8200 Series top cap simply removes forward eliminating the need for special concessions where ADA handicap bars are required.

Enduratek Technology

1,500,000+

Cycles

Our optimized energy management technology finally comes to a flush valve line allowing up to 1.5 MILLION cycles from a set of 4 AA batteries. That's nearly 4 times the longevity of our already energy-efficient offerings.

Simplified Flow Rate Adjustment

We have made flow rate adjustment unique to Hydrotek flush valves even simpler in the 8200 Series with a dial selector that selects between preset flow rates.

True Mechanical Override

A feature that has proven again and again to be indispensable in the cases where the electronics fail. It is a feature you cannot afford to not have.

Water Resistant Components

For areas that utilize a spray down of the entire restroom for cleaning and sanitation, the sealed sensor assembly and water-resistant battery holder and connectors provide superior protection from water damage.

Foolproof Maintenance

Maintenance made so simple literally anyone can do it. Individual parts now come together into assemblies that require nothing but a simple replacement that only requires a screwdriver to accomplish.

Hydrotek

Sensor Faucets and Flush Valves

www.hydrotekintl.com

1-800-922-9883

Fire Safety for Very Tall Buildings

• The ICC, the Society of Fire Protection Engineers (SFPE) and Springer Publishing have announced a new energy guide "Fire Safety for Very Tall Buildings."

The guide highlights solutions to the unique safety challenges of tall, very tall, and super tall buildings. I was in the volunteer fire service for more than 33 years and served as a fire chief, fire investigator, fire officer and emergency medical technician in addition to designing fire suppression systems for buildings. This guide provides good design information learned from many recent high-rise fire incidents.

According to CTBUH, there is no absolute definition of what constitutes a tall building; the definition is subjective.

Topics featured in the 2021 edition include emergency egress, fire resistance, building envelope, suppression, detection, alarms, and smoke control, with new guidance on considerations for existing buildings, energy storage systems, aerial vehicle platforms, and unique building features such as observation decks and fireworks displays.

Additional information in the guide consists of performance-based design and international practices.

"We know that very tall buildings impose unique fire protection challenges and require new engineering solutions above and beyond traditional methods [in the current codes]," notes Nicole Boston, CAE, chief executive officer of SFPE. "This engineering guide provides fire safety engineers and fire protection professionals with specific and necessary engineering principles to overcome the challenges of fire and to protect very tall buildings, their occupants, and first responders."

• The Council on Tall Buildings and Urban Habitat (CTBUH) developed the international standards for measuring and defining tall buildings, and the definitions are generally recognized in the industry.

According to CTBUH, there is no absolute definition of what constitutes a tall building; the definition is subjective. It must be considered against one or more of the following categories:

1. Height context relative to neighborhood buildings. A high-rise building may be defined in the building codes differently in different jurisdictions. Some codes address buildings in excess of 75 feet (where a building exceeds the height of a fire department ladder truck) to be considered a high-rise. (A 100-foot ladder truck when extended at a proper climbing angle can typically only reach a maximum of 75 feet.)

Buildings that are considered high rise, tall, super-tall and mega-tall buildings are typically beyond the height of fire department rescue operations and typically require additional fire protection components and fire egress considerations.

2. Proportion. The proportion or volume of a building versus its height is another consideration.

3. Embracing technologies relevant to tall buildings. A building may contain technologies which can be attributed as being a product of tall, super-tall or mega-tall buildings.

— Vertical transport elevator technologies
— Structural wind bracing
— Additional fire resistance of egress stair walls
— Stairwell pressurization systems
— Fire standpipe pressure ratings
— Firefighter breathing air replenishment system stations and air risers
— Fire sprinkler systems
— Pressure-reducing valves or orifices on fire risers
— Areas of refuge for handicapped persons
— Multiple egress stairways
— Fire separations or compartments
— Water piping pressure as a product of height
— Water pressure zones (break tanks vs. high press piping)
— Pressure zones for water heaters
— Linear thermal expansion of pipe
— Horizontal sway movement of pipe
— Shear forces on pipe at wall penetrations and lower floor horizontal pipe supports

If a building can be considered as subjectively relevant to one or more of the above categories, then it may be considered a tall building. Although number of floors is a poor indicator of defining a tall building due to the changing floor-to-floor height between differing buildings and functions (e.g., office vs. residential usage), a building of 14 or more stories — or more than 165 feet (50 meters) in height — could typically be used as a threshold for a tall building.

Energy Code

• ICC and ASHRAE have combined efforts to assist the Massachusetts Department of Energy Resources in the publication of a base and stretch code titled, "2020 Massachusetts Energy Code." The streamlined energy code is fully integrated.

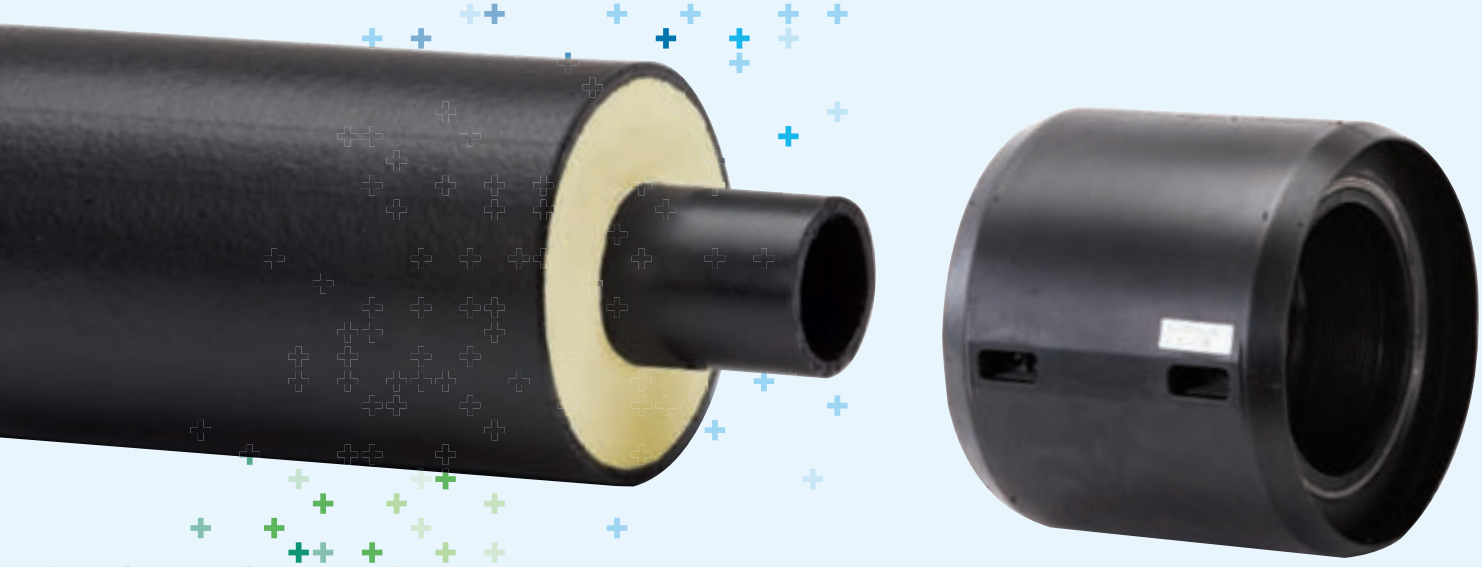
Improving the energy efficiency of buildings is a key component in Massachusetts achieving its climate and energy goals, and the adoption of new and improved building codes is an integral part of its strategy. The ninth edition of the *Massachusetts Building Energy Code* is based on the *2018 International Energy Conservation Code* and *ANSI/ASHRAE/IES Standard 90.1-2019*.

• The ICC's Plumbing, Mechanical and Fuel Gas (PMG) Technical Resources Team is growing. Recently it added Richard Anderson and Mark Fasel as technical directors to the team. Matt Sigler, PMG Executive Director for the ICC is part of the PMG Team.

The PMG Team consists of Rich Anderson, director, PMG technical resources; Jim Cika, director, PMG technical resources; Mark Fasel, director, PMG technical resources; Gary Gauthier, director, PMG technical resources; and Fred Grable, ICC senior staff engineer, Technical Services Department. ●

Ron George, CPD, is president of Plumb-Tech Design & Consulting Services LLC. Visit www.plumb-techllc.com for more information.

GF Piping Systems



COOL-FIT® PE Plus

Your pre-insulated piping solution for Glycol, Brine & Chilled water installations.

- **100%** maintenance-free
- **50%** faster installation
- **65%** less weight

- Low-temperature PE carrier piping system
- Pre-installed PUR insulation
- Pre-installed outer HDPE jacket

GF Piping Systems
9271 Jeronimo Road, Irvine, CA 92618
Phone (714) 731-8800 • Toll Free (800) 854-4090 • e-mail: us.ps@georgfischer.com

gfps.com

You *Can* Mix Water and Electricity

Using electronically activated fire sprinklers in high-ceiling storage facilities.

By Manuel Silva

Automatic fire sprinklers were developed in the 19th century as a response to the Industrial Revolution. Some of the first factories and mills built in the early 19th century were also first to burn to the ground. Early attempts at providing fire protection involved bucket brigades and perforated pipe.

In 1876, Henry Parmelee, the owner of a Connecticut piano factory, developed what has been recognized as the first automatic fire sprinkler. The Parmelee sprinkler used a low-temperature melting metal (solder) to activate the sprinkler. The solder would melt at a temperature of about 165 F/74 C when exposed to the heat released from a fire and allow water to discharge from the sprinkler to address the fire.

Over the next 100-plus years, significant improvements were made to the automatic fire sprinkler to increase its effectiveness in fighting fires. In addition to solder thermal elements, triggering devices made of glass bulbs were developed. Sprinklers were made to respond faster and discharge more water to address higher hazards.

The industry is now to the point where ceiling-only fire protection exists up to a 55-foot ceiling in warehouse applications using automatic sprinklers.

Until recently, the operation of an individual automatic sprinkler occurred when its thermal element reached its specific set temperature. The use of electrical devices to activate sprinklers has been primarily used in pre-action systems, whereby electric detectors and electric solenoids are used to open a valve to allow water to flow into the sprinkler piping network.

In pre-action systems, closed or open sprinklers can be used. With closed sprinklers, once the valve is opened, water discharge from a sprinkler will be predicated on the release of its thermal element, whereas with open sprinklers, water will discharge from all of them.

The storage industry continues to evolve and presents unique fire hazards that require customized detection and suppression solutions. For example, modern lift technology allows for higher storage heights, increasing the need for fire protection systems that can monitor and help protect these increasingly larger and denser areas.

In addition, the storage of exposed expanded group-A plastic (EEP) materials creates a particular challenge since they produce fires that grow much faster than similar products stored in cardboard containers. EEP materials do not absorb water as readily as cardboard, making fires difficult to contain.

Typically, fire protection schemes used to protect EEP rack storage arrangements have required the use of intermediate-level, in-rack automatic fire sprinklers. Fire testing conducted by the Fire Protection Research Foundation led to the incorporation into NFPA-13 of a ceiling-only protection scheme using early suppression fast response (ESFR) automatic fire sprinklers to protect EEP in single-, double- and multi-row rack storage arrangements up to a 40-foot ceiling height and 35-foot storage height.

Photo: iStock.com/3DFOX

The protection scheme requires the use of ESFR sprinklers with a nominal K-factor of 25.2 at a minimum pressure of 60 psi flowing through 12 sprinklers. In addition, the scheme requires the use of solid, vertical barriers for the full storage height and limits the aisle width to 8 feet.

Electronically Activated Fire Sprinklers

To address the need for better ceiling-only fire protection for EEP storage applications, Johnson Controls developed and launched the first UL-listed, electronically activated sprinkler, the EAS-1; the 16.8 K-factor sprinkler offers earlier fire detection. It requires less water and reduces smoke damage compared to a traditional storage-space fire protection plan — using only 52 psi flowing through nine sprinklers.

The EAS-1 technology is designed to avoid sprinkler "skipping" and react more efficiently to a fire. It is suited for high-rack storage applications containing more complex group-A EEP, which requires more water per square foot than other commodity classes. The ceiling-only sprinkler system allows more flexibility with storage racking arrangements and helps meet the height requirements for protecting group-A EEP. And it makes retrofits easier as the sprinklers use the same thread size compatible with piping infrastructure found in older storage facilities.

The sprinkler system uses an intelligent operation of an array of sprinklers around a point of origin. This is accom-

Protect Against Legionella With Dynamic Cold Water Recirculation Balancing

From the industry leaders in dynamic & thermostatic balancing...

Why Recirculate Domestic Cold Water Systems?

Unbalanced cold water systems with stagnant, warm water are nurseries for Legionella bacteria. The CircuitSolver (CSU-CW) valve automatically balancing cold water systems to keep water cold, keep water moving, and discourage bacteria growth while accounting for fluctuations in demand and periods of low or no use.

www.CircuitSolver.com/cold-water-balancing | 877-379-8258

CircuitSolver®
A ThermOmegaTech® brand

plished through various system components, including a sprinkler with metron activator, heat sensor and a suppression-releasing panel wired to all heat sensors. A number of full-scale fire tests were conducted at UL to validate the effectiveness of the EAS-1 system.

It detects the fire location faster than traditional protection systems through the sensors that gather data on the rate of rise in the surrounding air temperature. This temperature spike allows the system to select the most accurate sprinklers to activate.

Based on the grid pattern design, between six and nine sprinklers activate simultaneously to address the fire location. This design targets the fire with a "surround-and-drown" approach, which activates only the required sprinklers earlier in the development of the fire. This is a critical part of combatting fires quickly in high-rack storage while ensuring other areas of the facility remain unharmed.

This type of sprinkler system allows for a significant update in fire protection without upgrading the fire pump and installing vertical or horizontal barriers. It provides the minimum upgrade cost while maximizing operational flexibility.

Johnson Controls also launched a 25.2 K-factor, UL-listed EAS-1 to protect automated storage and retrieval system (ASRS) arrangements. The controls manufacturer partnered with an ASRS manufacturer to develop a ceiling-only protection scheme. It uses the 25.2 K-factor sprinkler and a customized algorithm; the ceiling-only fire protection scheme not only provides effective fire control but extinguishment as well.

The EAS-1 sprinkler system is designed for the ever-changing world of warehousing and logistics. With two-day, overnight and same-day delivery now commonplace, e-commerce has dramatically changed the way warehouses operate. This new paradigm makes fire protection paramount to keep business moving.

The increased plastic content in packaging used to transport and store products creates new, higher-risk challenges. Companies must adapt to meet customer expectations — and electronically activated sprinkler systems are ready to meet that demand.

You really can mix water and electricity. ●

With more than 32 years of engineering experience, Manuel Silva is the chief engineer for Johnson Control's fire suppression products business. For 21 years, he has developed numerous products for use in fire sprinklers systems and is named on 37 U.S. patents related to fire suppression devices. In his current role, Silva is involved with the research and development of new fire protection products and is a member of the NFPA 13, 30B and 1910 technical committees.

GAS

CARBON STEEL PRESS FITTINGS

CARBON STEEL PRESS FITTINGS WITH DUOFLEX™ TECHNOLOGY.

200% BETTER. WE'RE 100% SURE.

INTRODUCING **CARBON STEEL PRESS FITTINGS** FROM MUELLER STREAMLINE.

Streamline, the leading brand in piping systems, now offers a complete line of Carbon Steel Press Fittings (STL-G) for LP and natural gas applications. Manufactured to specific ASTM standards, our fittings have been engineered with several innovative features and industry firsts to provide unmatched joint integrity, system flow, and installer ease of use. Among these is our DuoFlex™ Technology – a proprietary (patent-pending) seal designed to deliver twice the surface contact of traditional O-rings as well as superior surface adaptation to help with any tube wall imperfections. Choose only the best for your projects.

Streamline®

Streamline Your System

Collierville, TN 38017

www.muellerstreamline.com

Plumbers Protect Our Health and Pipe Our Thermal Energy

Sustainable thermal energy networks can reduce peak electrical consumption in the summer and eliminate electrical spikes in the winter.

By Jay Egg

I arrived in Chicago on Nov. 17, 2021, to take part in a three-day "train the trainer" course at UA Local 130. I had no idea what to expect, except that Egg Geo was asked to prepare a two-hour session on thermal energy networks (TENs). The first thing I noticed when my wife, Kristy, dropped me off in front of the building was the electronic reader board with the classic pipe wrench and the slogan, "Plumbers Protect the Nation's Health."

The full name of the UA is the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada, but most call it the UA. The first truly successful national plumbers' union body, the UA was officially founded Oct. 11, 1889. With many iterations over the past 130-plus years, the UA currently represents more than 365,000 plumbers, pipefitters, sprinkler fitters, service technicians and welders in local unions across North America.

With the current U.S. administration's infrastructure plans and the inclusion of thermal energy networks within our communities throughout the United States and Canada, union numbers are expected to swell considerably.

When the information is coupled with the knowledge that TENs (which represent 40 percent of the energy consumption in U.S. buildings) will be installed beneath the streets in our communities and cities throughout the nation, the growth of pipefitter trades is and will continue to be unprecedented.

Among the esteemed guests at the UA presentation on TENs was Colo. Sen. Chris Hansen. He sent me a quote to share:

"Thermal energy networks, or district heating and cooling networks, are important advances in our built environment that provide reliable heating and cooling while eliminating emissions from traditional technologies. TENs are integral to the clean energy future, using waste heat sources and renewable energy during peak production times to provide economically efficient heating and cooling. I am excited about UA's efforts toward this sustainable infrastructure, and I plan to introduce legislation in Colorado this upcoming session that provides ground-source and air-source heat pump incentives to speed the adoption of this technology."

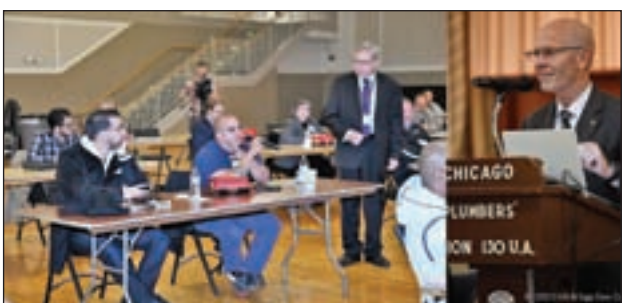


Figure 2. My thermal energy network presentation at the UA Local 130 facilities in Chicago. Photo: Egg Geo Consulting

Figure 1. The Chicago UA Local 130 with training trailer. Photo: Egg Geo Consulting.

It's clear the government and authorities having jurisdiction in the United States understand that 40 percent of the energy used in buildings is for heating, hot water and cooling (https://bit.ly/PlumbersCleanHeating). An extraordinary amount of heat is exhausted from buildings through cooling towers and other rooftop equipment.

The path forward is obvious. TENs enable us to pipe that heat to other buildings and apartments needing it, under city streets and parking lots requiring de-icing, and to manufacturing processes that need clean energy.

Learning Labs

The UA is intimately involved in the development of building codes, and my first involvement with leadership there came from my time serving with the International Association of Plumbing and Mechanical Officials (IAPMO) on the *Uniform Mechanical Code* committee. Rich Benkowski of UA's department of education and training and James Pavesic, UA's director of education and training, are two of the individuals with which Egg Geo has worked over the last half dozen years at IAPMO.

About a year ago, the UA asked Egg Geo to begin the process of creating a formal training program to educate the UA members on TENs infrastructure (http://bit.ly/2nhBfBx).

The infrastructure in New York City is a great learning laboratory for these efforts. UA Local 1 is in New York City and has been key to these educational efforts. It's ironic to be asked if the installation of TENs is possible with the tangled mess of massive infrastructure underneath NYC streets.

Before trying to answer that question for anyone, it seems

WOODFORD

MODEL 68 UNDERCOVER COMMERCIAL WALL HYDRANT

FREEZELESS.
ANTI-BURST.
AUTOMATIC DRAINING.
SECURE.

- Includes high-flow, double-check, field-testable 50HA backflow preventer
- 16-gauge steel, locking, flip-down cover
- Sleek profile; protrudes one inch
- Easier to install than recessed box hydrants
- ASSE 1053 listed

WOODFORD

Excellence. *Always.*

WOODFORD MANUFACTURING COMPANY

800.621.6032 • www.woodfordmfg.com

Figure 3. Penn South. Photo: Egg Geo Consulting

appropriate to note that more than 2 million miles of natural gas pipelines were installed under U.S. city streets over the last 100 years, not to mention massive aqueducts, subway systems and new fiber-optic networks. Infrastructure will always find a way.

Like Egg Geo, many mechanical/electrical/plumbing firms are working toward solutions such as the thermal energy network designed for the 15 Penn South 22-story apartment buildings. Penn South, also known as Mutual Redevelopment Houses, is an affordable housing cooperative located in Manhattan's Chelsea neighborhood.

The complex has a co-generation plant that uses waste heat from its generators to provide residents heat, hot water and air cooling.

UA's VIPs

The UA offers a military transition program that is 100 percent self-funded by the union called the United Association Veterans in Piping Program, or UA VIP (www.uavip.org). This program is for military members transitioning out to the civilian world. During the transition period, members of the U.S. military can take part in an 18-week, 720-hour hands-on technical training program for one of three areas: welding, HVAC or sprinkler fitting.

Figure 4. Empire State thermal energy networks Photo: New York State Energy Research and Development Authority

Attendees to this program are guaranteed a five-year paid apprenticeship in their chosen field. They apply for three locations and usually get their first choice in one of the 243 union locals across the country.

During my phone interview with program manager Mike Hazard, he said our military personnel deserve to live with dignity in high-paying jobs that can sustain a family. I would have taken advantage of this program if it were available in the late 1980s when I got out of the military and started my HVAC career.

Pipefitting for thermal energy networks might be the most important infrastructure job in the world right now. They are second only to the maintenance of clean and healthy drinking water, and safe wastewater handling and treatment. We are all aware of what happens when electrical infrastructure is tapped beyond its capability. We saw that last winter in Texas when the grid nearly collapsed under the stress of the heating load from one singular cold snap.

The UA's VIP and programs like it can help shore up our industry's skilled labor problem by recruiting former military personnel to help fill the gaps at the engineering and contractor levels.

By the way, drinking water and wastewater infrastructure components have a tremendous amount of energy transfer capabilities for our nation's TENs (https://bit.ly/PHCP-DrinkingWaterEnergy).

Decarbonization programs require the full beneficial electrification of buildings. Wintertime electrical grid spikes will cripple our country unless TENs are installed to transfer heat energy from our cooling-dominant office buildings and factories to the light commercial and residential buildings that most need heat in the winter. TENs allow load diversification and effectively pipe about 40 percent of our energy to where it's needed most.

UA's Benkowski told attendees in Chicago's training session that the big data companies (data centers) have asked the UA to prepare for unprecedented growth.

With the remarkable increase of data center construction, hyperscale data centers are rejecting incom-

RIIFO
PEX-A TUBING

PEX-a tubing is manufactured using the Engle method of hot crosslinking because the polyethylene molecules are linked during the extrusion process when polyethylene is above the melting point. This method results in the highest degree of crosslinking of all PEX types of up to 85%. This combination creates the highest chlorine resistance (Class-5 listing) in the industry.

With RIIFO's frontier extrusion and inline QC technology along with a multi-component gravimetric dosing technology, RIIFO PEX-a tubing goes through some of the most rigorous testing to produce quality tubing. RIIFO uses a short-wave infrared technology to create high speed, uniform and stable crosslinking during production.

FEATURES & BENEFITS

- **Available in red, blue, and natural coils and sticks**
- **Composite up to 5 layers**
- **Crosslinking degree up to 85% to create consistent tubing**
- **More flexible than tubing produced by the traditional Engel process**
- **Kinks in the tubing can be repaired with proper use of a heat gun**
- **Maximum temperature and pressure: 73.4°F at 160 psi, 180°F at 100 psi and 200°F at 80 psi Strongest, most durable, and most flexible option in PEX tubing**
- **Rated for continuous operation at 200°F at 80 psi**
- **RIIFO PEX-a tubing uses the most advanced technology of infrared crosslinking**
- **Offers great flexibility, allowing the tightest bend radius for less fittings with changes in direction in a plumbing system**
- **Offers a unique thermal and elastic memory – kinks in the tubing can be repaired with the use of a heat gun**
- **Only PEX-a can be repaired – you cannot do this with other PEX types**
- **Offers a greater durability in freeze/thaw cycles while keeping the integrity of the pipe intact**
- **Little to no coil memory for easier layout of the tubing**
- **UV stabilized & chlorine resistant**
- **Perfect option for any hydronic application**

VISIT
WWW.RIIFO.US
TO LEARN MORE

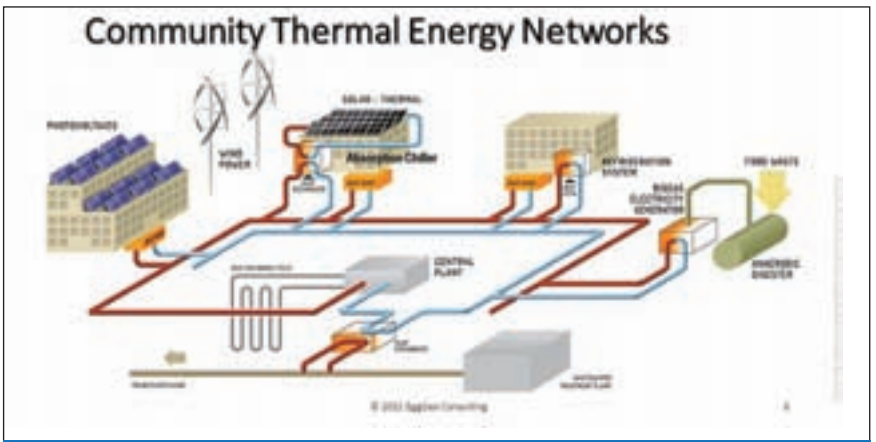


Figure 5. Photo: Egg Geo Consulting

prehensible volumes of energy, which could be effectively piped (hydronically) to areas needing that heat energy for manufacturing, heating, greenhouses or even absorption chiller energy facilities that recycle the heat into much-needed air-conditioning capacity (https://bit.ly/GeoDataCentersSaveEnergyWater).

Imagine that; when we are faced with peak cooling capacity needs in the middle of the summer, we can harness the waste heat energy from cooling our commercial buildings and residential customers. It is recycled as heat energy that drives absorption chillers. You can see an example in Figure 5.

Properly implemented, these thermal energy networks will fill our city centers with sustainable energy solutions that will reduce peak electrical consumption dramatically in the summertime and eliminate electrical spikes in the wintertime.

Existing electrical infrastructure can be stabilized throughout the year, CO_2 emissions will be dramatically reduced, energy costs will stabilize, and we will be prepared to see our nation's plumbers truly take their place as stewards of the nation's thermal energy networks. ●

Jay Egg is a geothermal consultant, writer and owner of Egg Geothermal (www.egggeo.com). He sits on several international technical code committees and is currently a member of the Legionella Task Group for the 2024 IAPMO Uniform Mechanical Code. Egg co-authored two McGraw-Hill textbooks focused on geothermal HVAC technologies.

Touch-Free with Reliability

20 Years of Proven Technology

MICRO-CAM TECHNOLOGY

It Just Works.

At AMTC our philosophy is simple:
Innovate and Manufacture the Most Reliable Touch-free and Water Conservation Commercial Plumbing Products.

When we started the company in 2002, our first goal was to develop a line of touch-free plumbing fixtures that would not only be reliable and aesthetically pleasing but would also require the least amount of maintenance. We consulted with hundreds of industry professionals including architects, engineers, plumbers, and maintenance personnel at various facilities throughout the nation to uncover the most common issues with the brands they were using. According to our extensive research, the most consistent problem was fixture downtime due to faulty solenoids. Therefore, AMTC set out to develop its product line where we didn't just concentrate on improving current designs, but also focused to eliminate the solenoid problem forever. With that goal in mind, our founder and head engineer (having a vast technical background in the industrial sewing machine industry), developed a mechanism using Micro-Cam Technology that would become revolutionary in plumbing automation. Today, 20 years later, we are proud to say that AMTC's patented Micro-Cam Technology platform has set a new standard of reliability for touch-free and water conservation plumbing products. Learn more about AMTC's unique product line today!

The next generation of reliability was here 20 years ago!

Toll-Free Tel: 800.874.7822 • Email: sales@amtcorporation.com • Web: www.AmtCorporation.com

Clean Tech Solutions We're Ramping Up Fast

Like virtually every technical challenge in human history, we have already developed ingenious technical solutions to deal with climate change.

By BF Nagy

In 2014, President Barack Obama said, "We are the first generation to feel the impact of climate change and the last generation that can do something about it." That sounds about right. It has been followed in recent years by many observers suggesting that this decade, the 2020s, will be definitive in terms of our response to the challenge.

Professionals working in the built environment have a key role to play in laying the groundwork for new ways to approach energy and water use in buildings that allow them to exist in harmony with nature, rather than as environmentally damaging blights on the planet's surface.

In the lead up to AHR Expo 2022, held at the beginning of February, the world's biggest event for mechanical professionals, the show published a report on current trends: clean energy, decarbonization, electrification, low-GWP refrigerants. It's our highest priority.

To support your efforts as we push toward the 2030s, I've compiled some of the most critical building technologies that are being adopted as quickly as possible. This is not something I invented, it's the product of 15 to 20 years of talking to hundreds of engineers, other building professionals and climate scientists about what they've learned.

Throughout the process, my bias has been to ask the advice of people who have completed working, economically viable projects with measured results, or who have taken similar evidence-based approaches.

I've learned that engineers in our industry know how to solve climate change, know it's not really complicated and, in virtually all cases, today's clean energy technology pays for itself. Some systems take a little longer than others, but they all pay out because they are state-of-the-art tech with new features that solve problems and cost less to operate, It's natural technological progress.

Two Climate Problems

We have a climate emergency along with a misinformation problem.

The misinformation is caused deliberately by fossil-fuel companies, their lobbyists and the politicians to whom they provide big donations. And this is exacerbated by a large contingent of sincere but misinformed and genuinely confused decision-makers, and a group of hydrogen, CCS, biofuels and biomass believers who are aware of semi-working applications in these areas.

I think they will come to realize that within a few decades, the field of viable applications is likely to narrow for these, rather than to grow, as economic and climate reality continue to assert themselves. I have not included these applications here because they already receive unjustified high-level hype from lobbyists who are not shy about making exaggerated claims. Hydrogen has been touted as the "next big thing" for 40 years.

History shows that democracy and stability have often deteriorated in countries after politicians repeatedly attacked the credibility of the free media which holds them to account, or scientists which present facts they don't like,

HVAC SYSTEMS

- **Air source heat pumps** - including VRFs and other air source heat pump configurations for varying applications. Air source is quickly becoming a dominant solution in the marketplace as it has been in Europe and Asia for many years. North American models are more capable than ever, however, in cold places air source should not be seen as a straight swop for a gas or oil furnace, especially for structures with poor building envelopes.
- **Ground / water source heat pumps & geothermal fields** - Ground source heat pumps (GSHPs) with geothermal fields are a straight swop and are about the most capable and luxurious heating and cooling options in the world. Period. Without financing or incentives, their up-front costs are prohibitive, but the return on investment is superb. Payback in most places is about 10 years, GSHPs last about 20 or 25 years and geothermal fields last 50-100 years. In numerous places up front government incentives and financing are now available, making geothermal among the most sensible options.
- **Heat recovery ventilators & ERVs** - HRVs are dedicated outdoor air systems, retaining heat and cooling energy while expelling stale air and bringing in 100% fresh filtered air. ERVs do the same plus some humidity management.
- **Other energy recovery** from refrigeration, data centers, drain and sewage.
- **Space conditioning** - Hydronics in ceiling panels, floors, improving electric radiant devices and systems – better building envelopes are creating the opportunity to innovate with equipment and to review load calculations and business cases for different solutions.

Credit: BF Nagy

such as the damage fossil fuels are doing to the planet.

When it comes to climate change, we have seen plenty of examples of this kind of attack here in America. Although such manipulation has often been accompanied by rhetoric about protecting the economy and free enterprise, the fossil-fuel industry has long been the largest recipient of free money from our governments. It's corporate welfare. I think it's time to use our votes and voices wisely.

The climate problem is a technical challenge and, like virtually every technical challenge in human history, we have already developed ingenious technical solutions. The technical problem would be a lot more quickly and cheaply resolved without the misinformation problem. Many times in history — overcoming German military might, repairing the hole in the ozone or heading off Y2K — we simply adopted new and better solutions.

There is probably nobody in the United States whose region has not been hit with weird hot weather, droughts, unprecedented downpours, more and stronger wildfires, floods, mudslides, melting, and more lung illnesses and allergies in children and elderly parents. We are all frustrated with the continuing pandemic, yet some of us suspect that as climate scientists have predicted, COVID-19 could be the first of many such diseases in the future.

In recent history, the adoption of no-brainer solutions such as global immunization against the pandemic or switching from fossil fuels to renewable options have become political messes because of social media confusion and the agendas of entrenched interests.

Donations flow to weak people in influential positions to preserve the status quo. Funds also flow to hack writers to create rational sounding arguments against obvious technical pathways to a clean future, designed to engender doubts and delays, and support ridiculous regulations.

Insofar as climate is now, after COVID-19, the world's highest priority, I think the time has come to stop allowing people who work for fossil-fuel companies to donate to political parties and to be invited onto task forces, code committees, professional conferences, governing bodies and climate think tanks.

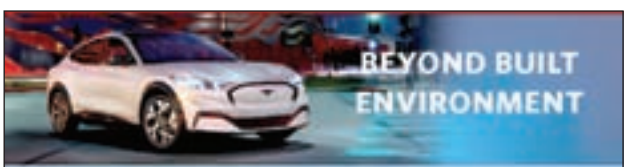
You may call this extreme, but I call the misbehavior of fossil-fuel companies extreme. They could have chosen to move with the times, become energy companies and make just as much or more money the way others are doing. Orsted is just one example of an oil company that became an energy company.

Bad oil and gas company behavior has been exposed in detail in "The New Climate War," a book by renowned scientist Professor Michael Mann from Penn State. Some of the details of the technical misinformation being spread in our own industry can be found in an earlier column I wrote at this link: https://tinyurl.com/23ekdu3v.

OTHER BUILT ENVIRONMENT

- **Heat pump water heaters** have returned to popularity along with combo units that do HVAC, air cleaning, humidity management and domestic hot water all in one. There is increased innovation activity now in the latter area.
- **Rainwater and grey water systems** will soon be at the top of the priority list in many jurisdictions, if they are not already.
- **Water conservation fixtures** – Options for low flow, electronic, and smart water fixtures are multiplying.
- **Natural refrigerants,** related systems and ensuring responsible processes for replacement and destruction of old refrigerants.
- **Electric induction cooktops** – Not sure on the payback but chefs and environmentalists love them.
- **Envelopes** - Efficient, non-emiting insulation systems, windows, doors, air curtains, prefab building components, sections, small self-contained homes, 3D printed concepts.
- **Materials and supply chain management** – Embedded carbon refers to emissions created in the manufacture and distribution of construction materials, the processes that result in construction waste and end-of-life disposal. Progressive construction companies are tracking and managing these in order to win bids.

Credit: BF Nagy



BEYOND BUILT ENVIRONMENT

- **Electrified transportation** – Electric, cars, trucks, buses, trains, short haul airplanes, drones, autonomous ground delivery vehicles, numerous other electrics on one, two, three, four and more wheels. Demand for bicycles, electric bicycles, and numerous other kinds of 'cycling' vehicles is exploding worldwide.
- **Renewable grid power & big energy storage** - Wind, solar, batteries, load management software, other kinds of big electricity storage.
- **Biodiversity protection** - Progressive governments are discussing legal protection for 25% - 33% of the world's natural environment from industrial and agricultural development. Let's do it.
- **Democracy** - It's not a technology but we can use our voices to support critical technological progress. We need to counter the flood of misinformation spread by compromised politicians and paid lobbyists, who are doing the bidding of oil companies.

Credit: BF Nagy

We should more often ask ourselves, "What is this person's agenda?" when they offer advice that discourages clean energy or clean water. And we should get on with the job of simple technological progress.

Credit: BF Nagy

It's worth considering that pretty much all the other living creatures on our planet adapt within the limits of the natural ecosystem. The few outliers eventually evolve in harmony with it, or they perish.

It is quite different with our species, which has continuously posed a threat to the natural environment, our only true collective wealth. With 8 billion of us here, it may be time for a rethink.

Most of us are not destructive and suicidal individually, so why should we be destructive and suicidal collectively as a species, simply to serve the interests of a few people who are driven by greed, or an inability to change with the times? ●

BF Nagy is becoming a renowned climate solutions specialist, author of the critically acclaimed book "The Clean Energy Age," and more than 200 articles on clean energy, clean water technologies, green government programs and energy economics. A podcast host and broadcast personality, he has traveled all over North America interviewing experts in climate science, government, engineering, architecture, clean transport, renewables and storage. Nagy also is a consultant to governments, corporations, trade organizations and research bodies.

Restoring the Corcoran

Modern technology aids renovation efforts for historic building.

(left) Built in 1897, the historic beaux-arts Corcoran building needed a significant modernization to upgrade systems, improve accessibility, and create state-of-the-art classrooms, studios and galleries. (above) The Corcoran School of the Arts and Design now features contemporary spaces for instruction and galleries to display artwork. New piping follows the curves of coves and moldings. Photos: Ron Blunt Photography

By Karen Schulte, PE, CPD, LEED AP BD+C

Among the most iconic buildings in Washington, D.C., the Corcoran School of the Arts & Design is located on the Ellipse across from the White House. The grand beaux-arts building, designed by Ernest Flagg and constructed in 1897, was placed on the National Register of Historic Places in 1971. Many of the interior spaces were also landmarked in 2015.

Flagg designed the building in the classical tradition of European galleries, with a large central atrium or colonnade featuring an array of Doric and Ionic columns and elegant neoclassical details. For more than a century, the building welcomed patrons to view the collections of the Corcoran Gallery, one of the city's premier institutions for the arts.

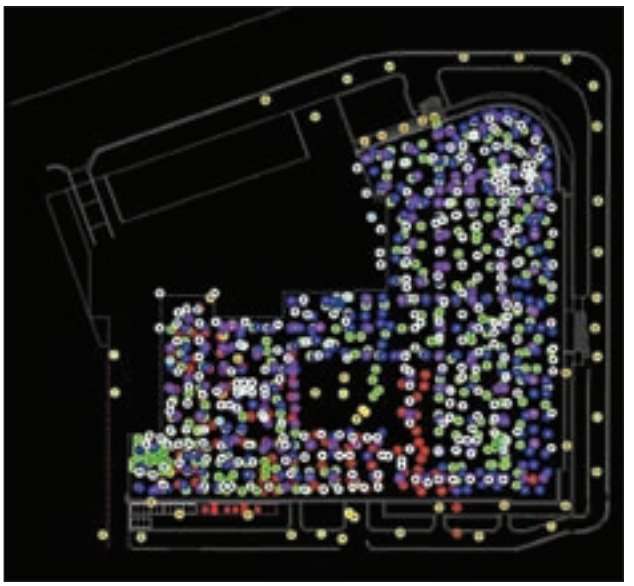
In 2014, George Washington University bought the 169,600-square-foot building to create a new home for the university's arts program. Almost simultaneously, the National Gallery of Art (NGA) purchased the former Corcoran Gallery's collection, worth $2.4 billion, with plans to return and display the collection in the historic building.

University administrators recognized that a significant renovation was needed to meet modern code, ADA and educational programming requirements. Central to the rehabilitation would be the creation of modern, light-filled classrooms and studios; expansive fabrication and exhibition space; new HVAC and plumbing systems; updated fire suppression and life safety systems; and accessible ramps, restrooms and elevators. In addition, these upgrades had to meet the NGA's rigorous climate control standards.

Researching Building History: Old Drawings and New Technology

The university tapped the team of LEO A DALY as the architect of record to lead the high-profile modernization, working with Mueller Associates for mechanical, electrical and plumbing engineering; GHD for fire suppression and life safety systems design; and Robert Silman Associates for structural engineering. The Whiting-Turner Contracting Co. served as construction manager.

The team's first challenge involved understanding existing building conditions. There were very few records or drawings of the building's original design and construction, with only a few torn and weathered floor plans discovered in the building's basement. Multiple renovations through the years resulted in a jumble of active and



Point clouds, created from laser scans, produced a 3D model of the building and its existing condition, enabling the team to work much more efficiently. By the project's conclusion, the team's data-gathering efforts had helped reduce site visits by at least 75 percent. Photo: LEO A DALY

abandoned pipe, conduit, wires and ductwork — often unlabeled or mislabeled.

With no reliable as-built information available, the design team's challenge was to incorporate large equipment, route new systems, and modernize and reconfigure interior spaces to support contemporary education and events. The team turned to five different data collection methods — the latest technology in building analysis — to create a comprehensive 3D building information model:

• Laser scanning and the development of a 3D point cloud model helped reveal details of the building's interior construction, saving trips to the site and allowing for a more efficient design process.

• A hygrothermal wall analysis measured the effectiveness of the wall material as an insulator (U-value).

• Computational fluid dynamics modeling aided in the design of the mechanical systems.

• Ground penetration radar scanning assisted in locating structural components and identifying locations for additional supports. The radar identified locations of the wires and tie rods within the circa-1890s "Metropolitan Floor System" to avoid cutting the wires for new penetrations, ensuring that the structural integrity of the slab was maintained.

• CCTV camera surveying within pipe interiors assisted in locating and determining the condition of the existing below-slab piping for the plumbing systems.

The data ecosystem generated through these technologies proved crucial to designing the new and upgraded building systems. The extensive CCTV camera surveys of the pipe interiors, for example, enabled the team to better understand the location and condition of the century-old below-slab gravity piping.

A Subbasement Scavenger Hunt

The building used a combined storm and sanitary sewer system. To ensure the building met the *International Plumbing Code (2015 edition)* sections 703.6 and 1109.1, the systems had to be separated. This required that all of the areas where the piping systems were interconnected be located, intercepted and routed to either the dedicated stormwater or dedicated sanitary system.

Mueller removed the underslab piping in certain areas and provided new dedicated sanitary and stormwater mains. The piping was intercepted above the floor slab and separated into separate dedicated systems in other locations.

In addition, pipe sizes were not reduced. They were either maintained or increased. Increased pipe sizes on the sanitary system were often due to increased fixture quantity in the building. Stormwater size was analyzed and sized to ensure that the system pipe sizing complied with the current IPC sizing requirements.

(left) Before the renovation, the subbasement was a confusing maze of piping and ductwork, with some of the low piping used as storage shelves. (right) Following the renovation, the ductwork and piping in the subbasement were coordinated to allow maximum head height. Photos: Mueller Associates.

The multilevel equipment platform within the courtyard houses multiple air-handling units, a generator and an egress stair tower allowing access for maintenance. Photo: Ron Blunt Photography

Moreover, the subbasement was a dense maze of piping and ductwork — difficult to walk through and assess — making the investigation and retrofit all the more challenging.

The information from the CCTV camera surveys helped the team determine the piping's location and distance below the building's slab, which prevented unnecessary and potentially destructive interventions to the building's historic fabric and the integrity of the structural slab. The information proved critical to minimizing the contractor's trenching work in the courtyard to replace the combined storm and sanitary sewer piping with separate systems.

The building also needed to be brought up to code in terms of the number of toilet room fixtures. New fixtures entailed automatic, sensor-operated (hands-free), low-flow fixtures (water closets, urinals and lavatories). The building had multiple domestic water feeds; however, these were inadequate to serve the new fixture quantity.

This requirement involved the replacement of two existing meters with one new service and a meter in a new location. The phased nature of the project — essential while the building remained occupied — meant that the engineering team needed to back feed this service so that no area would be cut off, even in areas that had not been renovated yet.

The first significant phase of construction focused primarily on the building's infrastructure, including the new domestic water service and the addition of centralized domestic water heaters. Much of the piping was distributed, with valves and caps left for connections during the subsequent stages.

This aspect of the project required extensive planning and coordination with Mueller's HVAC engineers and Silman's structural engineers regarding where the piping penetrations should go and to co-locate services in tight spaces to maximize available headspace. Here, the point cloud was a valuable reference, providing information on points of connections and existing conditions, including ductwork and piping that had yet to be renovated. The technology significantly reduced the need for site visits.

While the Corcoran's modernization has proven transformative throughout the building, the makeover of the subbasement was a highlight for the engineering team. The dim and crowded space is now larger and more organized with adequate headspace and easier access to equipment for maintenance.

A Spatial Puzzle: Minimizing Intervention

The modernization required the installation of new HVAC systems to meet current energy codes. The existing steam service and associated steam and condensate systems were in poor condition.

Mueller designed a new, high-efficiency, heating hot water boiler plant composed of three natural gas-fired condensing boilers (each sized at 50 percent of total building load, or 1,800 MBH) and a variable volume distribution system. The natural gas-fired condensing boiler plant was designed for a maximum 140 F supply and a maximum 110 F return temperature, which is reset on non-design days for improved energy efficiency.

Mueller was challenged to fit the new, larger mechanical equipment into the minimal space available. For instance, space was extremely restricted in the building's attic. New equipment could not block the natural daylight into the galleries or create shadows impacting the viewing of art in the exhibition areas below. The design carefully threaded the equipment, ductwork and piping through the attic in the limited places outside the view planes of the original lay lights and skylights in the historic structure.

A sightline easement also prevented the installation of a large mechanical penthouse on the roof. Mueller's engineering team designed a multilevel equipment platform within the courtyard that houses multiple air-handling units, a generator and an egress stair tower allowing access for maintenance.

Below the elevated platform, outdoor units associated with a variable-refrigerant flow system with heat recovery serve the basement studios and classrooms and outdoor dust-collection units for the subbasement metal and wood shops.

The first elevated platform level accommodates three air-handling units with exhaust air energy recovery, also serving the basement and subbasement academic and shop spaces. At the second elevated platform level, a large VAV-type air-handling unit with exhaust air energy recovery serves the first-floor academic and atrium spaces, including an auditorium, seminar rooms, galleries and additional studios. The top elevated platform level accommodates a gas-fired emergency generator and provisions for future air-handling units.

In addition, Mueller designed a new direct digital central building automation system to control and monitor new and existing HVAC systems. It was subsequently integrated into the campus supervisory control and data acquisition system.

Meeting Dual Needs:
A Public Museum and Arts School

The Corcoran is not only an academic building for George Washington University's School of Arts and Design; it is also a public museum that displays art from the NGA collection. Mueller's engineers developed several creative solutions to meet these dual needs. Understanding that the NGA would continue to use the

building's historic galleries to host traveling art and other exhibitions, Mueller's design team proposed solutions that addressed the NGA's stringent air and light quality requirements for the art galleries.

However, decades of deterioration complicated efforts to design mechanical and wall-system improvements to meet the NGA's environmental standards. The building's skylight system had sprung multiple leaks. Much of the uninsulated exterior stone walls allowed excessive air and moisture infiltration and exfiltration with inadequate thermal control. Where leaks were not coming from the exterior, they came from unidentified piping and ducts.

Mueller's team used hygrothermal wall analysis to analyze the building's envelope for air leakage, moisture ingress and degradation of the building envelope. Then, the team incorporated computational fluid dynamics modeling to determine whether MEP and architectural design solutions would achieve the NGA's criteria. This iterative process continued until NGA's goals were met.

Plumbing Design: A Pivotal Role

The renovation of the Corcoran has earned multiple design awards and created a vibrant space for active learning, with specialized studio environments, labs, classrooms and galleries.

"The success of the project was based on the careful planning and collaboration between the plumbing design engineers and the construction team," says Andrew Graham, AIA, senior architect with LEO A DALY. "Surveying the existing systems with closed-circuit video cameras revealed unknown pipe connections while minimizing investigative demolition — a major plus in a historic renovation."

Rather than attempt to remove the 120-year-old ornamental plaster ceiling, piping follows the curves of coves and moldings, artistically blending into the architecture. To meet student demand, new plumbing fixtures were added while not significantly reducing usable space.

"The plumbing discipline is an often overlooked and yet key component of all building systems' proper design and function," Graham continues. "Because of its broad connection to all systems and its placement throughout the project, it played a pivotal role in the project's successful delivery." ●

Karen Schulte, PE, CPD, LEED AP BD+C, is a project manager and mechanical engineer specializing in the design of plumbing systems for cultural and higher education facilities. A graduate of Penn State University with a degree in architectural engineering, she joined Mueller Associates in 2006. Karen is active with the Baltimore Chapter of ASPE, and is a registered engineer, LEED accredited, and a Certified Plumbing Designer.

What Happens to Plumbing When the Building Leans? Part 1

Photo credit: iStock.com/Jim_Pintar

With modern buildings, leaning just a little amount can affect the flow of waste in sloping drains.

By Ron George, CPD

Most of us have heard about the famous Leaning Tower of Pisa in Italy. Unfortunately for the builders of that tower, the soil under the foundation was not solid ground or bedrock, so the building began to settle. It developed a slight lean during the late stages of its construction because of the massive weight of the stone structure and a small footprint.

The Tower of Pisa was not intended to lean. However, the 541-foot-tall Montreal Tower, whose 45-degree lean makes it the tallest tilted building in the world — is intentionally inclined. When a building settles and leans and the building systems are not designed to accommodate the settling or leaning, it can be problematic for an owner or developer.

The freestanding Tower of Pisa was built for ringing the bells to announce the upcoming church services at the adjacent Pisa Cathedral. It was the tallest and heaviest structure built in the city's Cathedral Square — 186 feet 3 inches tall on the low side and 185 feet 11 inches on the high side, with 8-foot-wide walls at the base and a weight of 16,000 short tons.

The tower began to lean during construction in the 12th century, and worsened through the completion of construction in the 14th century. By 1990, the tilt had reached 5.5 degrees (https://bbc.in/3qVwsWZ). The structure was stabilized between 1993 and 2001, which reduced the tilt to 3.97 degrees.

The builders of the Pisa tower were not likely to have had the knowledge or experience with foundation systems design that today's engineers do, so their work was likely with little knowledge of soil types, bearing capacity of various types of soils or knowledge of the weight of the building versus the soil type and design of different foundation systems.

Why Does a Building Lean?

Generally, a lean in a tall building structure is a result of the massive weight of the building pushing down on the ground under the foundation of the building, causing the building to settle into the soil. When the soil is not of an even density, or if the foundation footings are not distributed evenly, the settling can be more on one side or another, causing a building to lean.

If the ground under the building is not bedrock, or if the pier foundations do not go all the way to bedrock, and the soil under the building is not of a uniform soil density, or if organics are in the soil or fault lines or variations in the soil type from one side of a foundation to the other, this could lead to uneven settling of the building foundation.

The taller a building is, the heavier it is, with more potential for a settling foundation; the leaning can be more pronounced with a building's height. When a building

SPEC LAARS® FOR PERFORMANCE, EFFICIENCY, AND DEPENDABILITY.

Laars commercial boilers and water heaters deliver solutions for whatever commercial job you need to spec.

No matter what solution you choose, Laars products offer proven performance, outstanding efficiency and toughness to handle even the harshest commercial and industrial conditions. When you spec Laars, you're providing years of trouble-free operation.

The Laars commercial product family includes:

- **Gas Boilers and Water Heaters** including MagnaTherm®, OmniTherm®, NeoTherm®, and Laars U.H.E.®
- **Electric Boilers**
- **Electric Tankless Water Heaters**

Get all the technical details, specification and submittals information you need for Laars Commercial Heating Solutions.

Visit **laars.com**

LAARS® Heating Systems Company

Built to be the Best®

CONDENSING • NEAR CONDENSING • ELECTRIC • BOILERS • VOLUME WATER HEATERS • TANKS

- **RightSpec Sizing**
- **Revit and CAD Drawings**
- **Master Spec**

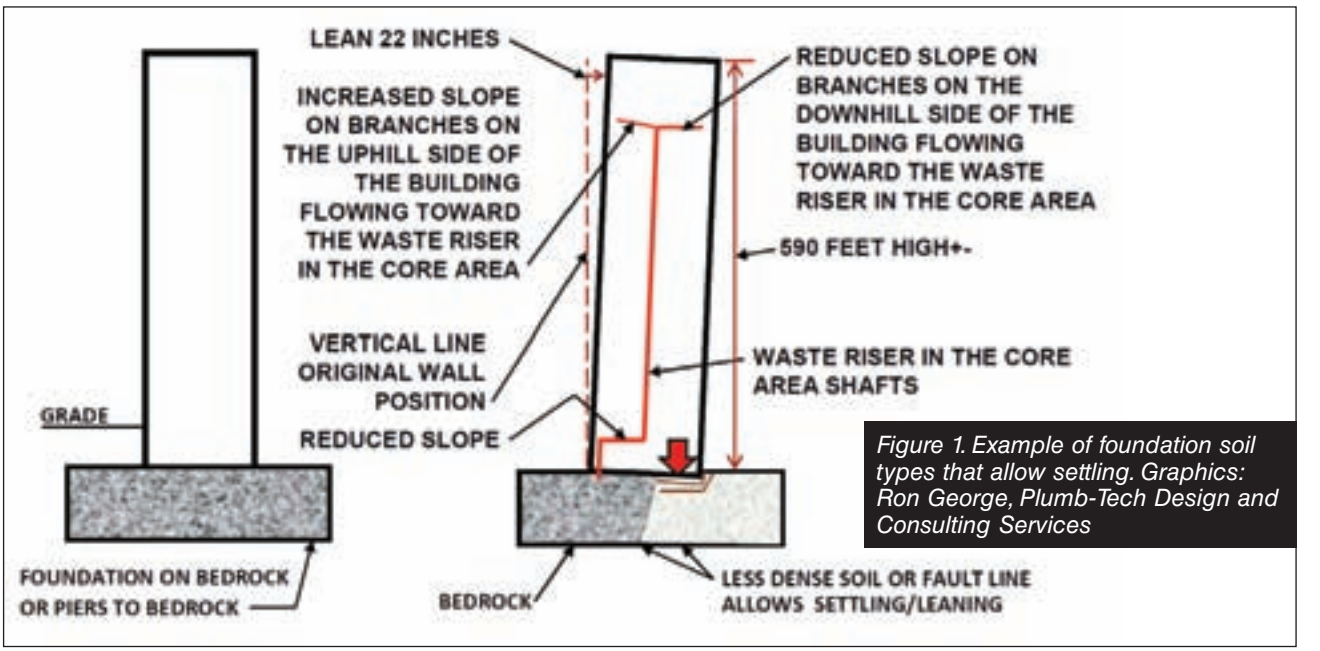


Figure 1. Example of foundation soil types that allow settling. Graphics: Ron George, Plumb-Tech Design and Consulting Services

leans, the uphill branch increases in slope and the downhill branch flattens or decreases in slope as shown in Figure 1.

Settling and tilting or leaning of buildings is an age-old issue; many of the older and ancient towers have significant leaning issues. Many of the older, taller, leaning structures are heavy stone towers for the purpose of a lookout, church steeple, bell tower or clock tower. However, they do not have plumbing in these tall towers, so there has not been much issue with leaning buildings in modern times.

In some cases, the tilt of a building is measured in inches or millimeters of offset from vertical at the top of the building. Another way is to measure the degrees of leaning from vertical. Sometimes the bedrock is so deep, the structural engineers will choose to design a structural mat foundation or a pier foundation with a series of holes drilled deep enough where the friction of the soil against the walls of the pier is enough to resist the weight of the building pushing down from above with some safety factor.

Since the earthquake in San Francisco, we learned that the soil in many parts of the city turned to liquid. We all became familiar with the term liquefaction as we watched many buildings in the bay area collapse because of the soils there.

This is something that should be considered when constructing a building in seismic areas or areas with poor soil quality. The bedrock can be very deep, and building a foundation to bedrock can drive up the cost of a foundation that is designed to hold up a heavy building.

Some famous leaning buildings are listed below.

How Does Leaning Affect Plumbing Systems?

If a building starts to lean and has drains that slope to an interior waste stack, then the sloping drain branches on one side of the stack will see increased slope while the sloping drain branches on the other side of the stack will see decreased slope. Depending on several factors, including the initial slope and other variables, the amount of leaning to cause drainage problems could vary. When a tall building settles and leans, it can cause plumbing drainage problems.

With modern buildings, leaning just a little amount can affect the flow of waste in sloping drains. Settling drains can create shear stresses and rupture pipe penetrating foundation walls; they also can cause pipe to lose slope or experience reverse slopes.

The Millennium Tower in San Francisco has had a lot of press about its leaning condition. The reported lean was 22 inches for a 590-foot-tall building, which works out to be 0.0033 degrees of lean for the tower. It is not that significant compared to the Tower of Pisa, but it is reportedly enough to affect the flow of waste in the drains.

Using mathematical models, we can calculate what

Building Name (Country)	Year Built	Degrees of offset from vertical (Height)	
Tiger Hill Pagoda (China)	960 AD	3.0	(44 m)
Two Towers of Bologna, short (Italy)	1119 AD	4.0	(47 m)
Two Towers of Bologna, tall (Italy)	1119 AD	1.3	(95m)
Tower of Pisa (Italy)	1370 AD	3.97	(56 m)
Bad Frankenhausen Church Tower (Ger.)	1382 AD	4.8	(55 m)
Suurhusen Church Tower (Ger.)	1450 AD	5.19	(27 m)
Nevyansk Tower (Russia)	1732 AD	3.0	(57 m)
Big Ben Clock Tower (London, England)	1858 AD	0.26	(90 m)
Millennium Tower (San Francisco, USA)	2016 AD	0.00316	(176 m, 590 ft)

would happen to a theoretical drain that is installed at the minimum slope required by code. Then we can subtract the reduction of slope associated with a leaning building and input the information into the Manning Formula to see if it effects the flow velocity in a negative way.

Using the Manning Formula on a 3-inch or 4-inch branch drain installed at the minimum slope of 1/8 of an inch of fall for each foot of run, it is equal to a slope of 0.0104 percent, or approximately 1 percent slope. If a building is tilted 0.0033 degrees, we would subtract the degrees of tilt from the minimum degrees as installed (or as mandated by code) to get the resulting slope. If we use the code minimum, the resulting slope after deducting for the lean would be 0.0071 percent.

We could then plug that slope into the Manning Formula, along with the other variables, and determine if the flow velocity would be sufficient.

The Manning Formula is used to calculate cross-sectional average velocity flow in open channels and drainage pipes:

v = (kn/n) Rh2/3 S1/2

Where:

v = cross-sectional mean velocity (ft/s, m/s)

kn = 1.486 for English units and 1.0 for SI units

n = Manning coefficient of roughness; cast iron is approximately 0.012

Rh = hydraulic radius (ft, m)

S = slope or gradient of pipe (ft/ft, m/m)

In the formula, we would input the following numbers:

n = 0.012 = cast iron CI or ductile iron DI, new. (Plastic or stainless-steel pipe may have a slightly better n value, but there are many considerations for plastic pipe in high-rise buildings that require firestopping. There are also noise issues with plastic pipe and, to a lesser degree, stainless-steel tubing that meets the standard ASME A112.3.1. Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below-Ground.)

Rh = 4-inch CI pipe = 0.33 feet

S = 1/8 inch/foot minimum = 0.0104 percent (Subtract 0.0031 percent from the minimum slope to input the resulting slope value of 0.0071 percent slope.)

Hydraulic radius can be expressed as

Rh = A/Pw

Where:

A = cross-sectional area of flow (ft2, m)

Pw = wetted perimeter (ft, m)

The flow quantity in cubic feet per second in a sloping pipe can be solved with this formula:

Q = A x V

Where:

Q = the flow in cubic feet per second, which can be converted to gallons per minute.

A = The cross-sectional area of flow (ft, m) (Sanitary drains are designed to flow no more than half-full to prevent siphoning of traps.)

V = Velocity of flow calculated from the Manning Formula

To correct for the loss of slope in a tilting building, we would subtract the percent of lean from the original slope of the pipe. Assuming a 0.0104 minimum slope at installation per the plumbing code, minus the lean because of the settling or tilting of a building, it would be 0.0033 percent, resulting in a slope of 0.0071 percent.

If you plug the slope of 0.0073 percent into the Manning Formula, the resulting velocity will be just under 2 feet/second and would allow solids to fall out of suspension in longer pipe runs. A velocity under 2 feet/second is not adequate for a good scouring action and will promote solids settling to the bottom of the drain.

Of course, this is just a calculation. I have not examined the building, the actual installed pipe slopes, the pipe materials, the condition and the roughness of the interior of the pipes or the pipe diameters, but the laws of physics and the variables can be determined and updated as slopes change. The performance of the plumbing system will change if the slope changes and this can all be refined and calculated.

How Does Leaning Affect Drain Line Transport?

As a building leans, the slope of the drains change. The slope of a drain effects the flow velocity and capacity of a drain and the ability of a drain to transport solid wastes. Sloping drains are calculated using the Manning Formula to determine the velocity of sloping drains; another formula can be used to determine the capacity in gallons per minute based on the drain flowing half-full.

The minimum velocity in the drain is important to calculate to keep solids in suspension in a flowing drain. If a drain is too flat, then the velocity of the waste water flow can be below 2 feet/second, which will be too low to keep solids suspended and have a scouring action.

The Manning Formula is used to calculate the velocity in sloping drains and then we convert to volume in gallons per minute for a given pipe size, coefficient of roughness and slope to maintain a minimum velocity. This formula is the basis for the plumbing code sanitary drainage tables for various-sized pipe and minimum slopes, and fixture unit values for sanitary drains to not exceed one-half full flow.

If a drain flows too full, then air may not move through the top of the drain, creating positive and negative pressures that can blow out or siphon fixture traps.

If the drains are installed too flat, the velocity will be too low and solids will fall out of suspension and settle on the bottom of the horizontal drains. This creates a condition where drains will block up over time, and on a continuing basis, requiring constant drain cleaning.

Low-Flow Fixtures Compound the Problem

When you consider the reduced flows associated with new ultra-low-flow (ULF) fixtures that are mandated in California for water conservation to flush with no more than 1.28 gallons/flush, there will, more likely than not, be some areas where some drain configurations with long horizontal runs will not perform very well as pipe slopes decrease.

In the past, plumbing fixture standards required water closets to flush solids 40 feet down a branch drain line. Today, with water conservation efforts and ULF fixtures, proper drain line transport and clearing a branch drain with a single flush is extremely difficult. So, the 40-foot

drain line transport of all solids in the fixture branch was removed from the fixture standards performance testing with the understanding that subsequent fixture uses will help move solids down the drain.

When there is no subsequent use or there is a seldom-used fixture or long horizontal runs with only a few plumbing fixtures, drain blockages are more likely to occur. In some of these extreme cases, an engineer may consider installing a solenoid valve in a water supply line to occasionally flush water through an air gap into a hub drain to periodically flush critical horizontal branches and prevent solids from settling in a branch drain and creating an unsanitary condition.

Fixture usage, length, size and slope of the horizontal branch line and flow required for an adequate flush and water conservation should all be considered by the design engineer.

Drains should be cleaned with professional drain cleaning machines. Drain cleaning chemicals should never be used to clean out plugged-up drains because chemicals can create a hazard to the workers and building occupants. Also, chemicals can damage drain piping and create very costly repairs to replace horizontal drains and stacks.

Taller buildings move more at the top than shorter buildings when the foundation settles. For example: Given a building that is 100 feet wide at the base and 100 feet tall, the building would be similar to a cube. If the foundation settles downward on only one side for 1 inch, theoretically, if the height is the same as the width, the top of the building would lean 1 inch in the direction of where the settling occurred.

Or, given a building that is 100 feet wide at the base and 500 feet tall, the building would have a height-to-width ratio of 5-to-1. If the foundation settles downward on only one side for 1 inch, then the top of the building would lean only 1 inch at the 100-foot elevation. At the 500-foot elevation, the building would move or lean five times as much, but the slope will be the same in both buildings.

Of course, this is a simple explanation, and the settling can be dynamic, occurring in multiple directions. If settling is uniform, or even, the building could still be vertical, it will just sink. There could be little to no leaning, but the settling creates shear forces and stress at exterior wall penetrations that could shear off utilities or damage seals in the foundation wall, allowing groundwater intrusion around pipe passing through basement walls.

In part 2, we'll discuss a case study of soil settling under a building and shear forces acting on piping near foundation walls. ●

Ron George, CPD, is president of Plumb-Tech Design & Consulting Services LLC.

Product Application

Treating Cooling Towers with New Technologies

Examining the benefits of chemical-free technologies.

Photo: iStock.com/boonsom

By Jonny Seccombe

Current and future water shortages throw a spotlight onto water use in cooling towers. More than ever, it is vital to maximize the benefits and mitigate the negative side effects of cooling water.

Scale, corrosion and bacteria contamination are the issues. The defense against them invariably involves chemical dosing with resulting discharge of detrimental chemicals into the environment during blowdown.

Nonchemical treatment is an attractive proposition — but only if it can be made to work reliably. That keyword is the one that crops up again and again when studies are done using alternative, nonchemical treatment technologies.

There is no doubt that most of these physical water conditioners (PWCs) work, the problem is understanding the parameters within which they work, how long they work for and what maintenance they require to keep them working. Many manufacturers are very reticent on those last subjects.

The issue is further complicated because drinking water has well-defined parameters according to EPA guidelines, but cooling tower water can differ very markedly from "normal" water. Therefore, these parameters need greater understanding.

Various devices have been tried but many have overclaimed their capabilities, which is compounded by a lack of understanding of the governing parameters. The results, on the whole, have been disappointing.

The potential benefits that effective chemical-free technologies could deliver mean that some devices merit further evaluation. To do that, it would be helpful to identify the mechanisms of PWCs generally. Before that, however, we need to understand a little about the mechanics of scaling.

Mechanics of Scaling

Most scale is calcium carbonate, the same material as limestone, marble and chalk, and it derives from calcium in solution in the water, principally as calcium bicarbonate.

These ions have two unusual characteristics. They are less soluble in hot water than cold water — the opposite of commonly used items such as salt and sugar — and secondly, when they precipitate from solution, they have to form onto, or nucleate onto, another surface.

This means they form scale and stick to surfaces of cooling towers, providing a habitat for bacteria such as *Legionella*. They also act as an insulation layer to reduce the rate of heat transfer. Calcium scale is 400 times less conductive of heat than copper and 65 times less than stainless steel.

Scale Reduction

PWCs reduce scaling by generating nucleation seeds that provide alternative nuclei in suspension in the water. The "scale" therefore forms in suspension in the water rather than encrusting surfaces.

Two common mechanisms used by PWCs generate either zinc or calcium carbonate nucleation seeds. Both of these mechanisms are negatively impacted as the water quality deteriorates. In addition, the treatment takes place at the point of entry during blowdown, so there is no continuous effect on the circulating water.

Electromagnetic treatment, especially those using radio

Figure 1. Tubes pre-treatment and heavily scaled. Photo: Aqua-Rex LLC

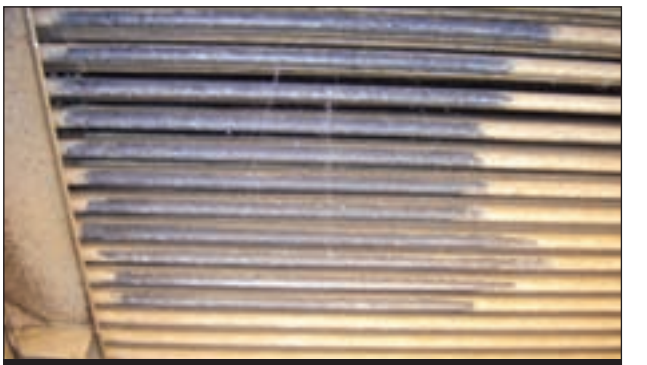


Figure 2. Tubes pre-treatment with a section cleaned off. Photo: Aqua-Rex LLC

waves, is better installed on the circulating system, ideally just at the discharge points at the top of the cooling towers. For some of these devices, the worse the quality of the water, the more effective they can be in inhibiting scale formation.

Independent, third-party evaluation of scale inhibition can be demonstrated using the IAPMO IGC 335 Rapid Scaling Test, which for one product demonstrated a reduction of scaling of 83 percent at 176 F (80 C) in Las Vegas water of 19 grains hardness. At the lower temperatures found in cooling towers, the effectiveness of the device can approach 100-percent reduction.

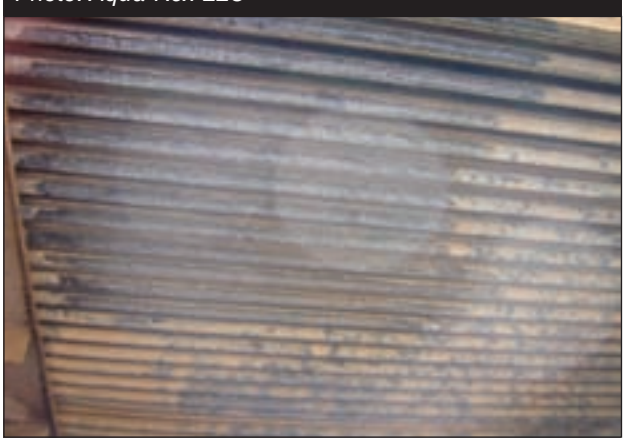
Where scaling has already occurred, efficacious descaling can also take place. The mechanisms involved are less understood but the effectiveness is easily demonstrated.

The scale does not dissolve back into the water, it exfoliates from the surface where it is encrusted. The mechanism that causes the exfoliation is resonance; this will only act on resistant surfaces and not so well on the internal fill, which is frequently flexible plastic.

The flexing plastic absorbs the resonance rather than transmitting it to the adhesion layer of the scale. However, once clean, the matrix will remain clean as new scale is inhibited from forming.

As well as generating nucleation seeds for calcium carbonate formation, other flocculating mechanisms can also occur. These are most easily seen where a device is used on a swimming pool where phosphate levels can be dramatically reduced by nonchemical flocculation.

Figure 3. Same section of tubes after two months treatment with PWC. No new scale on the cleaned section and scale is falling away from the uncleaned section. Photo: Aqua-Rex LLC



This means that total dissolved solids (TDS) can be reduced in favor of total suspended solids (TSS). As the TSS increases, it invites treatment by filtration such as cyclonic systems to remove the solids. With lower TDS and TSS, less blowdown is required and water is saved. If the chemical dosing can be cut back, the wastewater will have a lower residual chemical load, reducing damage to the environment.

It has been claimed that some devices can replace the need for biocides. These claims are controversial but it is well established that PWCs can enhance the effect of biocides, thus reducing the level of dosing to achieve the same benefit.

The biological effect of PWCs can be seen in a paper published by Imperial College London (https://bit.ly/3eUDxRG). While this effect has been seen and recorded in swimming pools and Koi carp ponds, little information is currently available from cooling tower studies.

This lack of reliable data for cooling tower treatment is a recurring theme and can only be addressed by properly controlled and monitored field studies. It is all very well proving mechanisms in the laboratory for scale prevention and biocide enhancement, but the real world demands real data.

Aqua-Rex and its U.K. based owner, Lifescience Products, has pioneered many breakthroughs in domestic and swimming pool water treatment using PWCs and is willing to work with partners at no cost to gather reliable data in real world applications for cooling towers.

The potential benefits to the community and the environment are significant, and the cooling tower operator has the potential to save money when compared to the cost of current technologies. ●

Jonny Seccombe studied geography and geology at Oxford University and has worked in the water treatment industry investigating the performance of physical water conditioners over the last 27 years. He is president and owner of Aqua-Rex LLC, the U.S. distributor of Aqua-Rex softener alternatives. Seccombe has collaborated with Oxford University in investigating PWCs for the last 19 years. He is an ASPE-certified CPD provider on the subject of physical water conditioners.

The Austin suburbs were covered in snow after dangerous and deadly Winter Storm Uri left Texas without power and in the cold February 19, 2021. Photo: iStock.com/RoschetzkyIstockPhoto

Protecting Plastic Pressure Pipes Against Freezing

Pipe insulation buys time to hopefully prevent water in piping systems from freezing until heat is restored.

By Lance MacNevin, P.Eng.

During February 2021, 69 percent of Texans lost electricity during Winter Storm Uri, and almost half lost access to running water for an average of more than two days, according to a report released by the Hobby School of Public Affairs at the University of Houston. Texas was just one of several states battered by sub-freezing temperatures, snow and ice, but suffered the most from widespread power outages. This extreme weather was unprecedented.

In the immediate aftermath, as buildings warmed up and frozen pipes thawed, it was revealed that thousands of pipes had burst due to freezing, resulting in extensive property damage. Nearly one-third of residents reported water damage in their homes.

Plumbers from across the nation raced to affected areas with supplies, tools and expertise to help repair plumbing systems of all types, but some homeowners and building owners had to wait three weeks or more to have their pipe repaired so that water could be restored.

It was not just plumbing pipe that was affected — fire protection and hydronic heating/cooling systems were also frozen and sometimes broken by the deep freeze unless they were protected by adequate antifreeze solutions.

This extraordinary weather event and catastrophic damage in homes and businesses across the southern United States has placed a greater focus on several issues related to plumbing pressure pipe installations, such as:

- Should plumbing pipe be insulated? If so, by how much?
- What plumbing pipe materials are the most freeze-break-resistant?

The Plastics Pipe Institute (PPI), a nonprofit trade association based in Irving, Texas, had already been working to answer these questions for the plastic pressure pipe materials that its members manufacture (CPVC, HDPE, PEX, PEX/AL/PEX, PE-RT, PP-R, and PP-RCT). Thanks to the collaborative work of its members, two recent PPI publications help to address these questions.

Should Plastic Plumbing Pipe Be Insulated?

Even without the consideration of power outages, there are several situations where plastic pressure pipe materials should be insulated for protection against freezing.

Plastic piping materials are inherently better insulators of heat energy and, therefore, worse conductors of heat as compared with traditional metal pipe materials.

However, in the situation of a prolonged power outage when entire buildings freeze up, pipe insulation buys time to hopefully prevent water in piping systems from freezing until heat is restored.

Insulation also reduces heat transfer through the walls of piping materials, improving system efficiency and performance in a wide range of applications.

Requirements and guidance for insulating all types of piping materials for energy conservation are provided in plumbing, mechanical and energy codes, as well as industry standards such as *ASHRAE 90.1, Energy Standard for Buildings Except Low-rise Residential Buildings*, and handbooks such as those published by the American Society of Plumbing Engineers (ASPE).

The new document, PPI Technical Note (TN) 65, "Insulation Recommendations for Plastic Pressure Piping Materials in Residential Applications," focuses on insulating plastic pressure piping materials from the perspective of freeze protection.

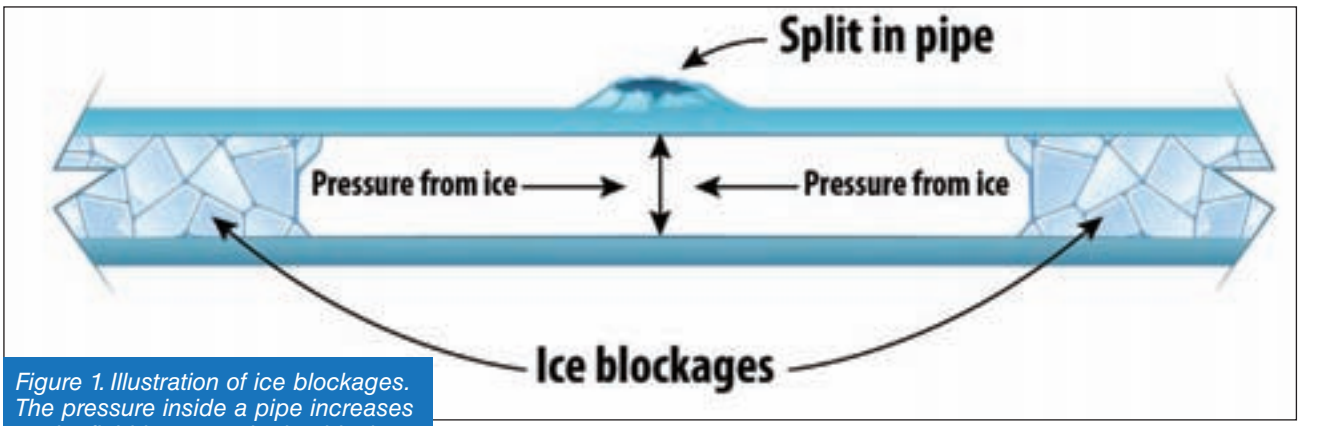


Figure 1. Illustration of ice blockages. The pressure inside a pipe increases as the fluid between the ice blockages continues to freeze, creating a piston effect on the water; this may exceed the elastic limits of the pipe and cause a split. Photo: PPI

PPI TN-65 provides recommendations to prevent freezing in a variety of applications (e.g., plumbing, hydronics and fire protection). It also addresses the use of heat trace cable and shares techniques for thawing frozen plastic pipe. It's intended for plumbers, builders, designers, inspectors and others.

Model plumbing and mechanical codes address the need for piping insulation and freeze protection in a variety of ways. To help readers identify the freeze protection requirements that exist in codes, TN-65 also includes excerpts from IAPMO's *Uniform Plumbing Code, Uniform Mechanical Code* and *National Standard Plumbing Code; ICC's International Plumbing Code; Canada's National Plumbing Code*; and other model codes.

Neither the model codes nor PPI, however, can instruct anyone about exactly how much insulation to apply in general terms. The authors of TN-65 ultimately realized that the exact amount of insulation that is needed to protect pipe depends upon so many variables that it is impossible to provide accurate requirements in a prescriptive format, such as a chart or table.

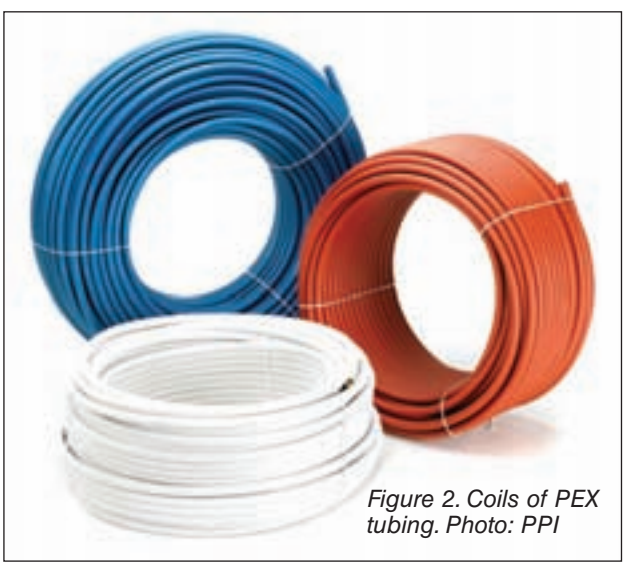


Figure 2. Coils of PEX tubing. Photo: PPI

For example, considerations include:

- What is the expected coldest ambient temperature for a given building?
- What is the tightness of the building to prevent infiltration of cold air?
- What is the exact position of every pipe within a structure and its surrounding air temperature?
- How to rely on historical weather data for a geographical location when extreme weather events are breaking records?

There is an old saying that "rules of thumb only work if everyone has the same size thumb." The only safe way to provide specific R-values for insulation in a code would be to recommend levels of insulation that could be excessive for many projects and possibly insufficient for others. In the end, builders, plumbers, engineers and inspectors should collaborate to discuss the expected exposures for each pipe and the most appropriate insulation protection on a case-by-case basis.

What Plumbing Pipe Materials Are the Most Freeze-Break-Resistant?

Contrary to common belief, pipe bursting isn't normally the result of water expanding in volume by 9.1 percent as it freezes into ice. Instead, pipe bursting occurs when freezing temperatures create ice blockages or "ice dams" at places within the pipe, and then additional ice growth applies extremely high pressures to the confined water volume.

Water is not compressible and acts as a hydraulic fluid when compressed. Experience has shown that even the strongest pipe materials can burst when liquid inside is frozen.

This situation can occur when uninsulated pipes are exposed to slightly different air temperatures or exposures, such as portions of pipe being installed in a colder area than other portions. The most exposed sections of pipe freeze first, creating ice blockages that pressurize the unfrozen water. As more ice forms, that water becomes more highly compressed.

Figure 1 shows the end result with the release of water pressure through a pipe wall. A flexible pipe can do a better job at resisting bursting than a rigid pipe.

PPI's other new publication, Technical Report 52, "Resistance of PEX Pipe and Tubing to Breakage When

Table 1: R-value of PEX Tubing by Nominal Tubing Size (i.e. diameter)

	Nominal Tubing Size (NTS)						
Property	**3/8**	**1/2**	**3/4**	**1**	**1 ¼**	**1 ½**	**2**
Wall Thickness (in)	0.070-0.080	0.070-0.080	0.097-0.107	0.125-0.138	0.153-0.168	0.181-0.200	0.236-0.260
R-value ($ft^2 \cdot °F \cdot h/BTU$)	0.0277	0.0277	0.0383	0.0494	0.0604	0.0715	0.0932

Note: Normalized R-values are based on standardized material thickness of 1 inch

Graphics credit: PPI

Frozen (Freeze-Break Resistance)," addresses research that has been conducted on PEX tubing, regarded as a highly freeze-break-resistant piping material, and provides several types of data.

1. Thermal conductivity. According to PPI Technical Report 48, "R-Value and Thermal Conductivity of PEX and PE-RT," the normalized thermal conductivity (K-factor) for PEX is 2.86 BTU·in/ft_2·hr·°F, and for PE-RT it is 3.15. This compares with a thermal conductivity for copper tubing of 196 BTU·in/ft_2·hr·°F.

Another way of expressing the relatively low thermal conductivity of PEX is to covert this to an R-value of 0.38 ft_2·°F·hr/BTU, expressed as per inch of material thickness. The higher the resistance value, the slower the rate of heat transfer through the insulating material (see Table 1).

This means that for similar material thickness, PEX is 68 times less conductive than copper, which will significantly delay heat transfer through the wall of PEX tubing. This property can delay the freezing of fluids and potentially prevent many freeze events.

2. Material elasticity. "Elasticity" has been defined as "a measure of material stiffness or the ability of the material to stretch or deform temporarily under a load." We use the modulus of elasticity to quantify the strength and flexibility of a material. A higher modulus of elasticity means the material is more rigid.

According to the Copper Development Association, the modulus for annealed copper tubing is 17,000,000 psi. The modulus of elasticity for PEX (see Figure 2) or PE-RT tubing is typically less than 150,000 psi, more than 100 times more flexible than copper. So, while copper tubing is many times stiffer than PEX and PE-RT, these plastics have elastic properties that allow them to expand somewhat and then return to their original diameter.

Since water expands when frozen, this elastic property is beneficial during a freeze event, as the pipe can expand with the water. CPVC, PP-R and PP-RCT pipes and fittings have some ability to withstand the freezing of fluids without breaking.

3. Cold weather behavior. Even at temperatures below -40 F (-40 C), both PEX and PE-RT tubing retain their flexibility. In fact, the so-called "glass transition temperature" for PEX materials, meaning the temperature below which the material becomes brittle and can shatter, has been published as below -148 F (-100 C).

This flexibility means that if water-filled PEX or PE-RT tubing freezes solid, the elasticity of the material typically allows them to expand without cracking or splitting.

4. Research. The topic of PEX tubing's freeze-break resistance has been studied by several institutions and research centers during the past decades. PPI TR-52 references specific studies that have analyzed the behavior of PEX when subjected to repeated freeze/thaw cycles.

One of these reports notes that "PEX pipe was conclusively shown to be freeze tolerant up to 400-plus cycles" and "PEX piping materials are experimentally and analytically shown to be reliable under repeated freezing conditions."

Based on the research, it appears that PEX tubing is one of the most highly freeze-break-resistant plumbing materials. Although a similar study has not yet been performed on PE-RT tubing, the results could be expected to be similar, based on its material properties.

Despite the ability of PEX or PE-RT to withstand freezing in certain situations, the freezing of water or other fluids within any pressure pipe should be prevented because a piping system with frozen fluid cannot perform as expected. For example, a frozen plumbing system cannot deliver water; a frozen fire protection system will not activate to extinguish a blaze; a frozen hydronic system will not provide heat to occupied areas.

Finally, fluid-filled pipe that freezes inside a concrete slab may not be able to expand evenly and may suffer localized damage, such as splitting. Even if the embedded pipe doesn't burst, it could be damaged, and the concrete surrounding it could crack due to the expansion forces of the ice.

The information found in the new PPI publications TN-65 and TR-52 provide insight into how to install and protect plastic piping materials safely. Installers, builders, inspectors, engineers and designers should always refer to local regulations to determine the most appropriate requirements for protecting all types of plastic pipe and tubing against freezing.

PPI TN-65 and TR-52 can be downloaded from www.plasticpipe.org/buildingconstruction. ●

Lance MacNevin, P.Eng., is director of engineering, Building & Construction Division (BCD) of the Plastics Pipe Institute Inc. During his nearly three decades of experience in the plumbing and hydronics industries, he has authored numerous articles and has been called on frequently to give keynote presentations and educational seminars.

Meet Our Instagram Ambassadors!

@PHCPPros

Theresa McFaul
@theresamaivu
Mai Vu Plumbing and Construction

Mike Flynn
@flynnstone1
Michael Flynn HVAC & Plumbing

Travis P. Abaire
@t.a.p.plumbingandheating
T.A.P. Plumbing And Heating

PHCP PROS
YOUR PROFESSIONAL PLUMBING, HEATING, COOLING & PIPING COMMUNITY

phcppros.com

The look and function of QuickDrain's WallDrain provide an excellent fit with curbless showers, whose popularity continues to grow. Photo: QuickDrain

The Trend Toward Curbless Showers

Appreciated for enhanced functionality, the demand for curbless showers continues to grow.

By Evan Novak

Curbless, walk-in showers are becoming all the rage in bathroom design. While freestanding soaking tubs remain a popular choice in residential applications, a stylish yet functional shower has now taken center stage as the focal point of the new spa bath.

Revised standards in bathroom design have come into play as a result of the COVID-19 pandemic. Wellness is now a primary concern as people are increasingly focused on how the bathroom can impact their health and well-being. People are seeking thoughtful bathroom design focused on functionality rather than exclusively concentrating on style.

Inspired by European design, curbless showers are becoming increasingly popular in residential and commercial applications, thanks to their combined functionality and style.

Trending Curbless Applications

Most curbless showers currently can be found in healthcare applications, such as hospitals and senior living facilities, because they offer ADA compliance. But the curbless shower is finally making an appearance in the American home, thanks to its spa-like luxury and added functionality.

While roll-in showers are a given in ADA-compliant hotel rooms, we're slowly seeing a trend toward curbless in other hotel rooms for the functionality it adds. Most hotels will still use a curb, but owners are starting to bridge the gap with semi-curbless showers; i.e., a shower door and partial curb, with a curbless entry.

The next step is eliminating the curb entirely, creating a zero-threshold wet room with the drain located at the entrance, along the wall or inside the shower footprint.

Higher-end properties with the available space for larger shower footprints are more likely to incorporate curb-

less showers. That's because higher-end developments tend to place more emphasis on design and functionality.

Why Curbless?

A curbless shower means cleaner lines in the bathroom, less visual clutter and added accessibility, all of which enhance well-being.

• **Versatility in design.** A curbless shower is achievable with various drainage points, offering versatility in design. It provides flexibility regarding its location in the room since the designer and specifier are not tied to placing the drain in a specific spot.

• **Added safety and accessibility.** Curbless showers provide an open feel and make the shower experience a lot safer any time you eliminate a curb. Curbless showers offer a universal design. Homeowners or guests benefit anytime safety measures can be taken into consideration within an upgraded bathroom design.

Linear drains in curbless showers are the ideal design solution for creating ADA-compliant showers and wet spaces that are universally accessible. The floor more easily accommodates a freestanding bench, a wheelchair or other mobility aid with no barrier to cross.

• **Style.** Curbless showers need not look institutional like so many ADA bathrooms do. This is especially so with options that disappear into the wall, such as QuickDrain USA's WallDrain; or feature high-end designer drain covers, such as QuickDrain's decorative drain covers. The latter are available in a wide range of finishes: brushed and polished gold; polished rose gold; oil-rubbed bronze; and matte and polished black.

What to Consider When Specifying Curbless Showers

While architects are more likely to specify a curbless shower, it's usually up to the plumbing engineer or plumber to select a manufacturer and do the research to identify what will work best for the application and conditions.

When opting for a curbless shower, it's important to consider the design and location of drainage and how that affects the rest of the room. The most important aspects to consider are the following:

• **Product selection.** An efficient way to install a curbless shower is to use a complete shower solution and a system designed to be customized for any given plumbing configuration or enclosure size and condition.

For example, QuickDrain's integrated PVC drain, combined with a pre-sloped shower panel and waterproofing accessories, represents a total shower solution for promoting effective and efficient drainage.

A product that offers field flexibility is ideal for a curbless installation. ShowerLine linear drains allow for the construction of roll-in showers that do not have to be recessed into the floor. Instead, shower pans can be set flush to the subfloor, resulting in a high-performing shower.

Onsite adjustability is another factor to consider when choosing a product for curbless installation. For example, models such as ShowerLine include stackable spacers that allow installers to adjust the height of the drain cover to ensure it is flush with the shower floor.

Likewise, trough extensions and covers can be trimmed on site after the PVC body is installed. This makes it easy to provide wall-to-wall coverage, which helps minimize standing water or water traveling beyond the curbless shower entry (more on that below).

• **Drain type:** linear or center point. Curbless showers could feature striking linear drains to add a contemporary European feel. Or they could use center-point-style drains, such as QuickDrain's SquareDrain.

While there are various drain options to consider for curbless applications, linear drains are the ideal design solution because they use a single slope toward the drain rather than four different slopes required of a center-point drain. A wall-to-wall linear drain maximizes drainage and offers a clean look that enhances the shower experience.

The linear drain should be located along a wall or at the entrance of the shower. This improves drainage, giving water a uniform path to the drain while minimizing installation errors and unsafe standing water; i.e., "dead spots."

A one-directional slope has less chance of water pooling or running out of the curbless shower. Shower floors without enough pitch usually puddle and hold water. Soap scum and water deposits form in these wet areas, making the tile and grout look dirty.

Linear drains offer the convenience of lower maintenance because they can be integrated with larger-format tiles. This results in fewer grout joints to impede movement or drainage, minimizing the number of opportunities for mold, mildew and grime to take hold.

• **Drain location.** Whether it be at the entrance, along the wall or centered, the drain location will impact a curbless shower's flow rate capacity. For example, if the drain is installed at the entry to a curbless shower, the shower's flow rate capacity will drop to 5 gallons/minute. QuickDrain recommends calculating 10 gpm/outlet for all curbless back-wall shower drain installations.

• **Labor savings.** The use of linear drains in curbless showers also saves labor, as installers need to create only a one-directional slope toward the drain located at the entry or the back wall. Compare that with a four-way, compound slope used with center-point drains.

Including a curbless shower in a bathroom remodel or tub-to-shower conversion creates an accessible and restorative space. Plus, the lower maintenance of large-format tile and wet spaces minimizes time spent on cleaning and maintenance.

Add these advantages to the high functionality and spa-like style of incorporating a curbless shower, and you're well on your way to meeting the fast-changing priorities in modern bathroom design — particularly in a world where health and well-being are top of mind. ●

A 15-year veteran of the plumbing industry, Evan Novak has served as senior manager of commercial sales at Oatey Co. since September 2018. A graduate of Ohio University, Novak holds a master's degree in business administration from Clemson University. He can be reached at: ENovak@oatey.com.

Advertiser Index

Classifieds

ZEP™ LPS

Low Pressure Sewer Systems

- Poly basins
- Integral pressure relief valve
- Stainless steel check valve & discharge pipe
- Pump systems with built in level control
- Optional stainless steel anti-siphon device
- 1 HP, 230 volts, 60 Hz, 7.0 FLA, 150' TDH
- 2 HP, 230 volts, 60 Hz, 10.5 FLA, 240' TDH or 200 volts, 60 Hz, 12.0 FLA, 240' TDH
- Electrical Quick-Disconnect (EQD) Plug*
- Stainless steel hydraulic rotor with protective deflector plate

100% factory tested.

(Certified testing available. Consult factory representative for more information.)

*Model 6932 Free-Standing Replacement 7020 (1 HP) 7021 (2 HP)

ZOELLER®
ENGINEERED PRODUCTS

THE BUILT-TO-ORDER DIVISION
OF ZOELLER COMPANY SINCE 1991

3649 Cane Run Rd. Louisville, KY 40211 800-928-7867 zoellerengineered.com

High Performance. Low Maintenance.

10-YEAR BATTERY LIFE

Hydro•X Power harvests energy with just a few activations per day. The technology extends the faucet's battery life for up to 10 years or more of uninterrupted power.

HIGH-EFFICIENCY DESIGN

Maximize power without impact to flow volume. High-efficiency design delivers consistent flow volumes from 0.35 gpm to 1.5 gpm and above.

SIMPLIFIED INSTALL

No special wiring means contractors can skip the upfront costs and extra steps typically required for high-use applications.

ZURN

Take charge with sustainability at the sink.