

Your Guide to the
ASHRAE Winter Conference
 January 21-25, 2012

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PERSONAL PROGRAM—PLAN YOUR OWN MEETING SCHEDULE!

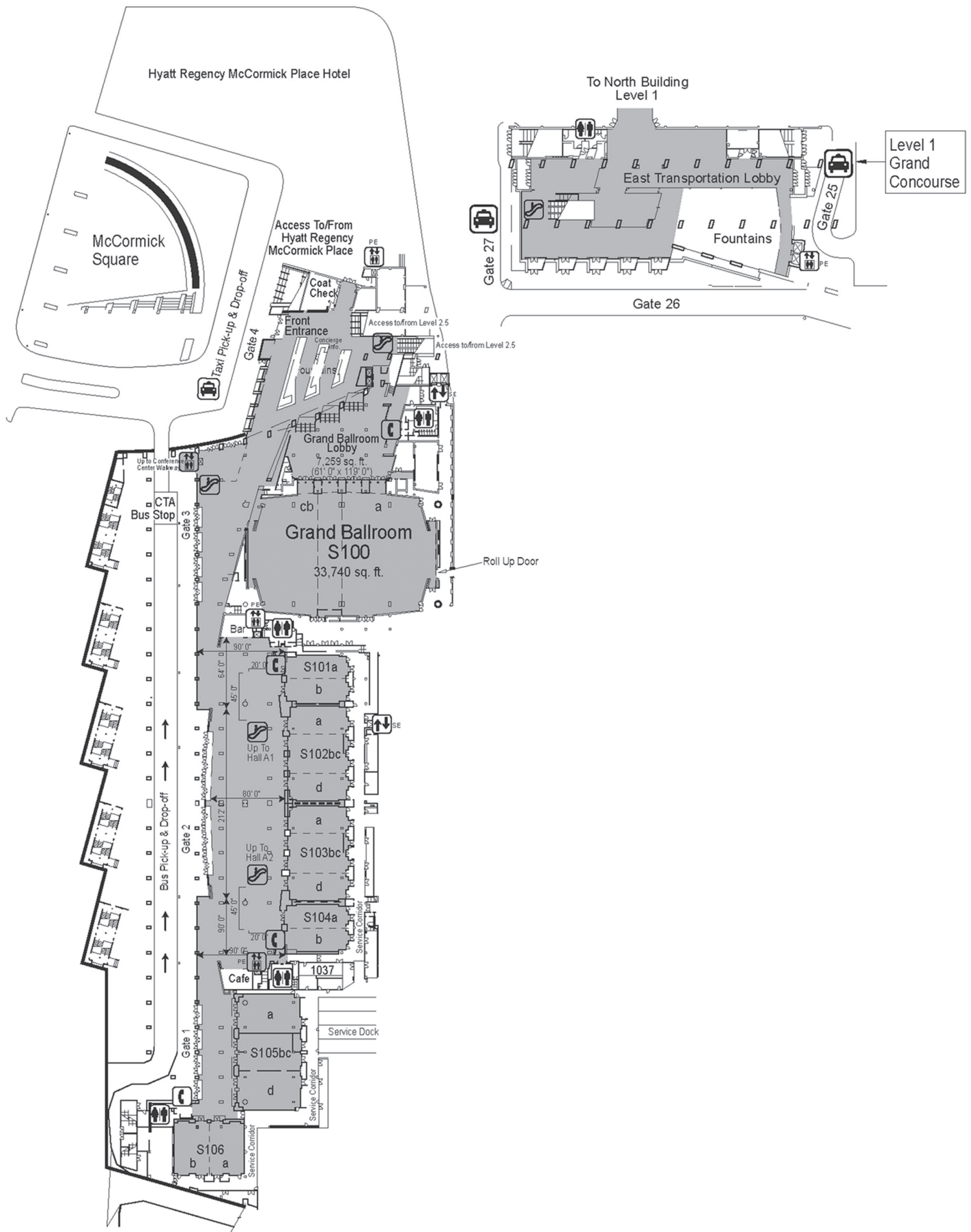
| FRIDAY, JANUARY 20 | SATURDAY, JANUARY 21 | SUNDAY, JANUARY 22 |
|--------------------|--|--------------------|
| 8:00 am–12:00 noon | 8:00 am–12:00 noon | 8:00 am–9:30 am |
| 1:00 pm–5:00 pm | 8:00 am–3:00 pm | 8:30 am–12:00 noon |
| 5:00 pm–10:00 pm | 1:00 pm–3:00 pm | 9:45 am–10:45 am |
| | 3:15 pm–5:00 pm | 11:00 am–12:30 pm |
| | | 1:30 pm–3:00 pm |
| | 6:30 pm–8:30 pm Welcome Party Art Institute of Chicago | 3:00 pm–7:00 pm |

NOTES:

PLAN YOUR OWN MEETING SCHEDULE!—PERSONAL PROGRAM

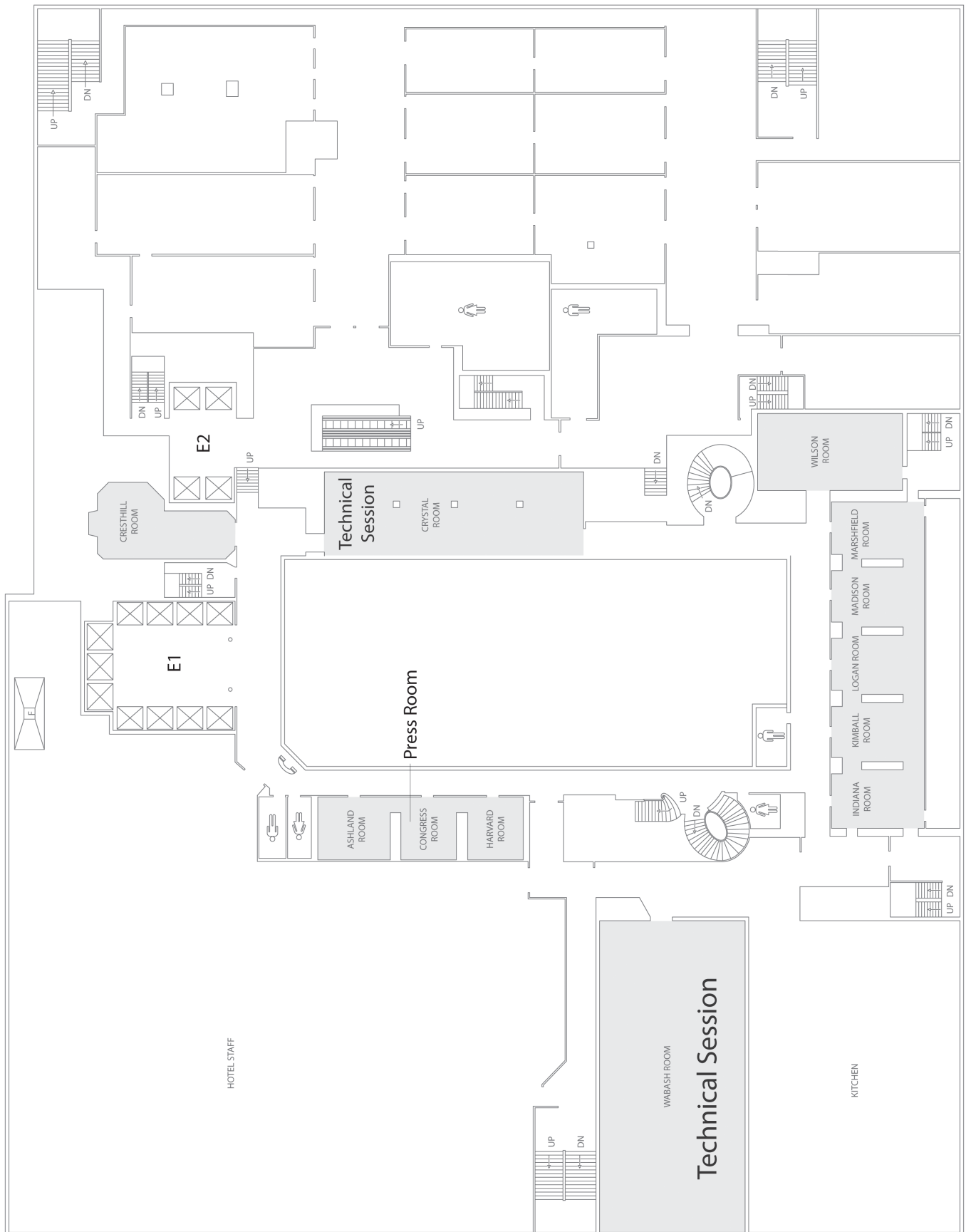
| MONDAY, JANUARY 23 | TUESDAY, JANUARY 24 | WEDNESDAY, JANUARY 25 |
|---|--|------------------------------|
| 8:00 am–9:30 am | 8:00 am–9:00 am | 8:00 am–9:30 am |
| 9:45 am–10:45 am | 9:45 am–10:45 am | 9:45 am–10:45 am |
| 11:00 am–12:00 noon | 11:00 pm–12:30 pm | 11:00 am–12:30 pm |
| 12:15 pm–2:00 pm President’s Lunch Grand Ballroom | 1:00 pm–3:30 pm | 1:00 pm–5:00 pm |
| 2:15 pm–4:15 pm | 3:30 pm–6:00 pm | |
| 4:15 pm–6:30 pm | 6:15 pm–10:30 pm Members’ Night Out Grand Ballroom | |

M^CCORMICK PLACE



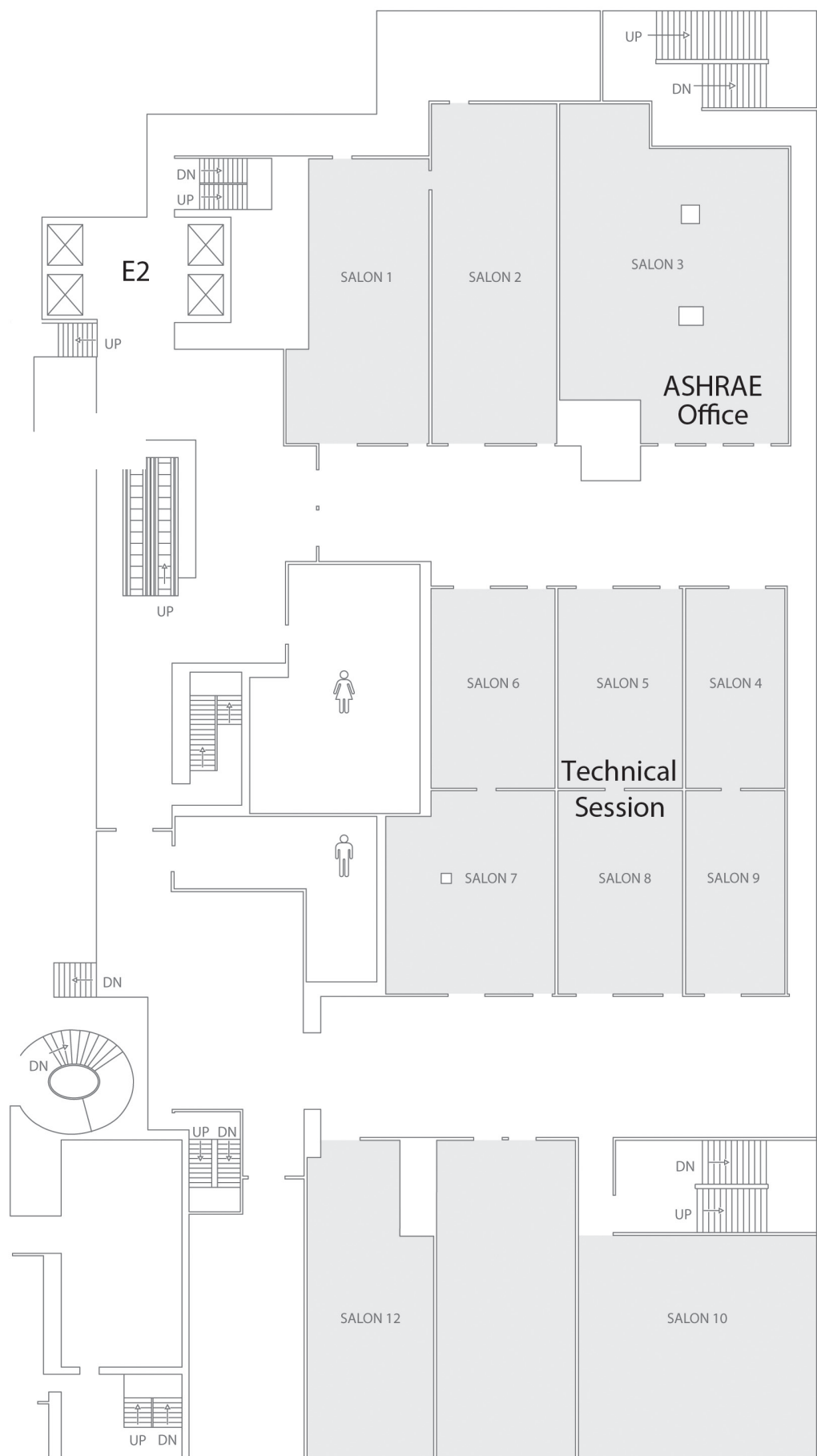
PALMER HOUSE HILTON

3RD FLOOR



PALMER HOUSE HILTON

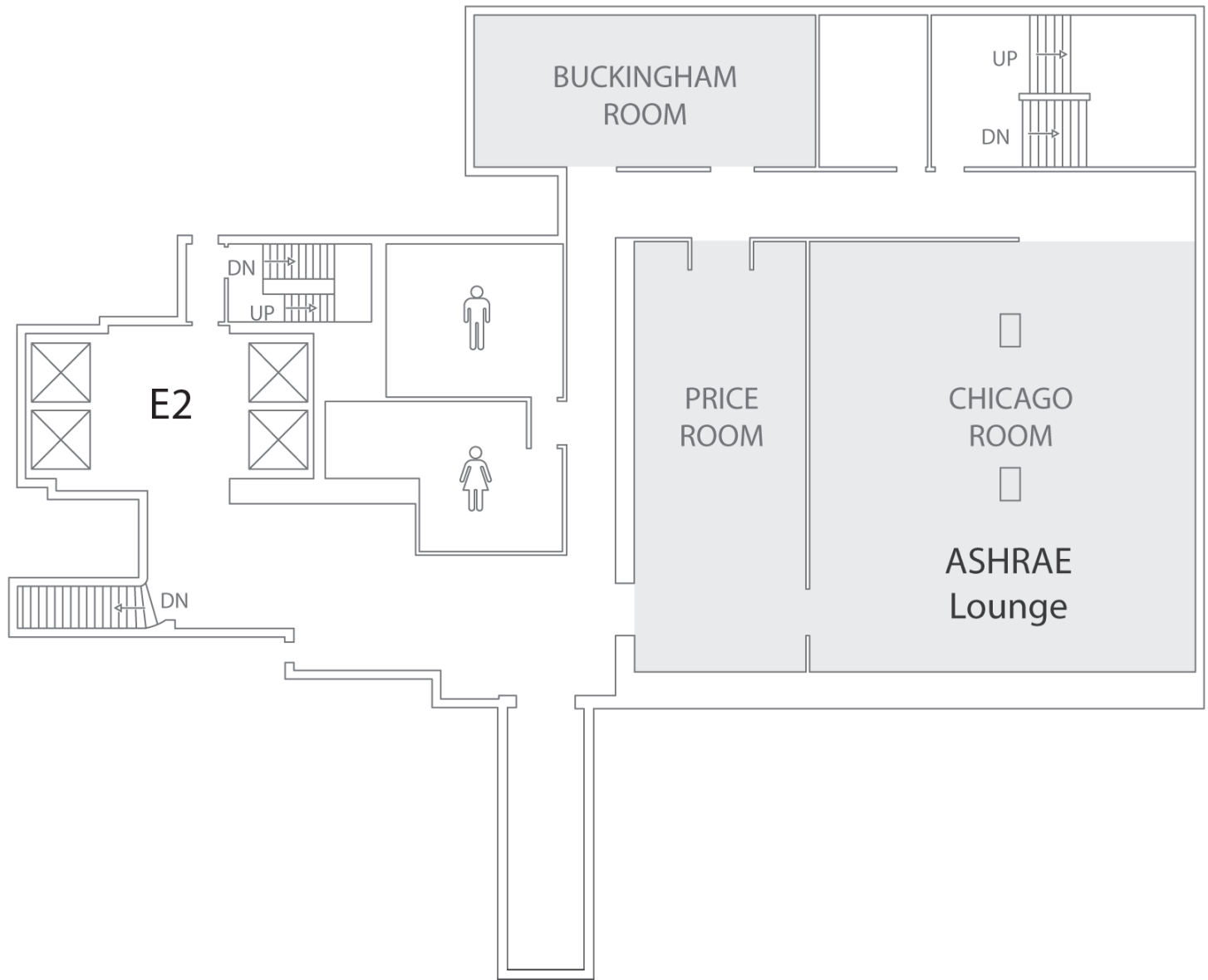
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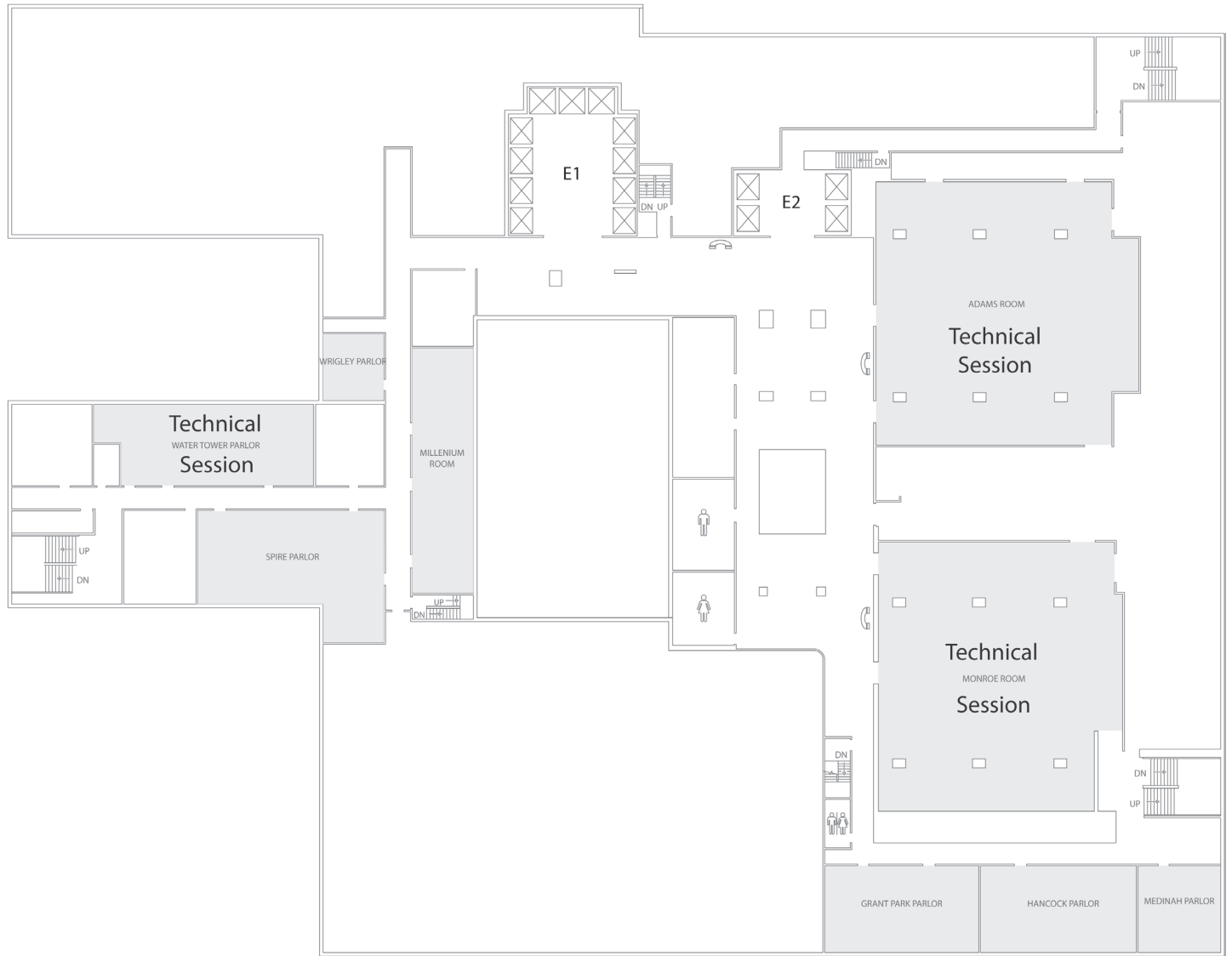
PALMER HOUSE HILTON

5TH FLOOR



PALMER HOUSE HILTON

6TH FLOOR



PALMER HOUSE HILTON

7TH FLOOR



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CHAPTER AND SOCIETY OFFICIALS

A special thanks to all the members in the Illinois Chapter who helped make the conference a success!

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Laura C. Michel, Secretary

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Jim Vallort, Vice Chair
Cindy Hart, Tech Tours
Mark Hegberg & Mike McDermott, Entertainment
Laura Michel & Mike Kuk, Sessions
Bill Ammons, Spouse Tours
Ron & Carolyn Vallort, Hospitality
Benny Skelton, Web site

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Monte G. Troutman
A. Damon Gowan

GENERAL INFORMATION

BADGES MUST BE WORN FOR ADMISSION TO SESSIONS

Your ASHRAE Conference badge is required for admission to the technical program. Room monitors will be checking and scanning badges at the rooms. The scanning process will provide you with a summary of all sessions attended at the conclusion of the conference and will be sent directly to you by email. The room monitors will also distribute evaluation forms for each session. Please complete the form and return it to the monitor when you leave the session. Room monitors will also distribute and collect comment cards on which attendees are encouraged to submit written questions regarding papers presented at Technical Paper Sessions. Questions are given to the authors for reply and published in *ASHRAE Transactions*.

HOTEL ADDRESS, TELEPHONE

Palmer House Hilton
17 East Monroe Street
Telephone: 312-726-7500
Guest Fax: 312-263-2556

INTERNET ACCESS

Internet access for e-mail is available in the Cyber Café located in the registration area during operating hours. Please be considerate to others and limit your usage to five minutes.

NOTICE

ASHRAE regards the materials presented at these sessions to be the unique work of ASHRAE and exercises control over the dissemination and/or use of such products in the future. Accordingly, videotaping and recording of this program are not allowed without ASHRAE's prior written consent.

CELL PHONES/PAGERS

Please be considerate and turn off your phones and pagers in committee meetings and technical paper and conference paper sessions, seminars, forums, and the poster session.

COMPANY-SPONSORED HOSPITALITY SUITE POLICY

Hospitality suite hours must not conflict with ASHRAE meetings or social functions. Product displays, literature handouts, posting of signs in hotel lobbies or hallways, and commercial advertising or recruiting are not allowed in the Palmer House Hilton, ASHRAE's headquarters hotel.

SALE OF MERCHANDISE

Sale of merchandise, or the solicitation to sell merchandise, of any type at the Annual and Winter Conferences will only be permitted by prior approval of the Conferences and Expositions Committee and any surplus will go to the Society.

SIGNS/DISPLAY OF AFFILIATE MEETING INFORMATION

Signs and information concerning affiliate or related organizations must be approved by the Society prior to display. No signs are to be attached to walls, and all signs must be professionally printed. All affiliate meeting information must be displayed in the literature kiosk. No literature will be displayed on tables.

PHOTO RELEASE

Photographs will be taken at the ASHRAE Winter Conference. By registering for this conference, you agree to allow ASHRAE to use your photo in any ASHRAE-related publications or Web site.

WHAT TO WEAR



Normal business attire is appropriate for meetings and social events; however, the Welcome Party will be casual. For Members' Night Out, sport coat and sport shirt; tie optional.

INVITATION TO ALL NEW MEMBERS, FIRST-TIME ATTENDEES AND NON MEMBERS

2:45-3:45, Chicago Room, 5th floor, January 22

If you've never attended an ASHRAE meeting before, join us and meet some of your fellow first timers. New Member, non-members and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee.

TECHNICAL PROGRAM PDHs

All of the sessions presented in the technical program are approved for professional development hours (PDHs), including State of Florida PDHs. In addition, some sessions are approved for the State of New York PDHs and AIA Learning Units. Those programs are indicated with a  symbol. Others are approved for LEED AP credits and are indicated with a  symbol. Certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. In order to report your attendance at the session, PDH and AIA sign-in sheets in the session room. *Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session.*

SCANNING

Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference. The scanning process may take a little longer to get into the room so have patience. Please keep track of the sessions that you attend at the conference.

MEETING PAPERS

Abstracts of all poster papers and sessions are included in this program. During the conference, papers presented at the poster session and technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore. After the conference, papers will be posted in the online ASHRAE Bookstore. Papers are not available for seminars or forums. Poster and technical paper session papers will be published with discussion in ASHRAE Transactions. Conference papers will be published in ASHRAE Transactions without discussion. Other meeting papers can be purchased in the online Bookstore at www.ASHRAE.org or searched online in the Abstract Center – a searchable database of abstracts on everything ASHRAE has published since 1980. This service is free to ASHRAE members, but a subscription fee will be charged to nonmembers. For ordering information, contact ASHRAE Customer Service at 1-800-527-4723.

VIRTUAL CONFERENCE *Free for Paid Conference Registrants*

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Chicago Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Chicago. If you do not have your password and link Go to www.ashrae.org/chicago/virtual and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar presentations
- Access to all technical paper session presentations
- Access to posters presented in the poster session
- Ability to post questions or answers for selected sessions through Friday, Feb. 17. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 23, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 25.

On-site registration is available for those who would like to purchase the Virtual Conference. To sign up, go to ASHRAE Registration, Hilton, Upper Exhibit Hall, 4th floor.

\$299 ASHRAE member

\$464 non member

If you register on site, your password will be emailed to you within 24 hours of your registration.

AHR EXPO®

McCormick Place, North & South Halls
2301 South Lakeshore Drive

Hours:

| | |
|-----------------------|----------------------|
| Monday, January 23 | 10:00 a.m.–6:00 p.m. |
| Tuesday, January 24 | 10:00 a.m.–6:00 p.m. |
| Wednesday, January 25 | 10:00 a.m.–4:00 p.m. |

If you have registered for the ASHRAE Conference, your conference badge is your admission into the exposition.

If you are attending the exposition only and you did not register in advance, the fee for admission is \$20.00 and can be paid at McCormick Place. **Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 22. Starting Monday, you can register one hour before the doors open.**

You must be 18 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult. Shuttle service to and from the McCormick Place will be provided from the Palmer House Hilton all day Monday through Wednesday. Shuttle pick-up will be at the Wabash Street exit of the Palmer House. Signs will advertise the shuttle schedule, which will begin on Monday, January 23.

Shuttle service does not operate from hotel to hotel. Shuttles will run from 7:00 am – 7:00 pm on Monday, 8:00 am – 7:00 pm on Tuesday and 8:00 am – 6:00 pm on Wednesday.

SOME COMMON SENSE SAFETY TIPS

Street Safety. The streets of any city at any time can be unsafe. When you leave your hotel to go out during day or evening, make sure you take off your badge. Wearing a badge is an advertisement that you are a visitor to the city and that you are probably unfamiliar with your location. Walk “smart” when you leave the convention site—know your destination and the best way to reach it. Walk along lighted sidewalks at night and don't walk alone. Trust your instincts—if you're uncomfortable with a situation, get out of it.

Hotel Safety. Some general safety tips include: Don't answer the door in a hotel room without verifying who it is. If a person claims to be an employee, call the front desk and ask if a staff person is supposed to have access to your room and for what purpose. Use the hotel safe-deposit box. When you're in your hotel room, use all of the locking devices provided. Don't reveal your room number or discuss plans for leaving the hotel within earshot of strangers.

EMERGENCY SITUATIONS

Hotel emergencies should be directed to the hotel operator; for police and fire department emergencies dial 911. Hotel security is trained in emergency response and can get to the scene of an emergency quickly if medical assistance is needed. The closest hospital is Northwestern Memorial, 251 East Huron Street. General Information: 312-926-2000, Emergency: 312-926-5188.

Fire Emergency... Preparedness in Hotels

The hotel's PA system will advise you of the need to evacuate in the event of a fire. The PA system is used on all sleeping and meeting room floors. Plan ahead—when you check into your room, check the location of exits. Walk to the nearest exit; learn the route, obstacles, etc. Keep your room key on the night stand when you are in your room. Examine your room. Check the windows to see if they open and how. Examine the area outside your window.

notes

SPOUSE/GUEST GUIDE

A very gracious thank you from ASHRAE to Margaret Harrison and Carolyn Gowan for providing the unique lanyards for the spouses attending the conference.

SATURDAY, JANUARY 21

7:30 a.m.-3:00 p.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

The ASHRAE Lounge is open daily for all individuals who are registered for the meeting. Refreshments are available from 7:30 to 9:30 a.m. each day and beverages are available all afternoon. Members of the Chicago Host Committee will be present to answer questions about local activities. Detailed information on the city including brochures and maps can be found at the Host Committee Desk located in the ASHRAE Registration area in the 4th Floor Exhibit Hall in the Hilton.

SUNDAY, JANUARY 22

7:30 a.m. – 4:00 p.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

MONDAY, JANUARY 23

7:30 a.m. – 4:00 p.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

MONDAY, JANUARY 23

9:30 a.m. – 11:00 a.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

ASHRAE Meet and Greet – Neighborwood

Urban trees provide a welcome touch of green on otherwise harsh city backdrops, and it's always sad to see these trees fall due to storms, wind or other safety reason. Brian Post, founder of Neighborwood, is helping return these fallen trees to the general location in which they first took root and once brought shade, but in a surprising new format. Downed trees are gathered locally, milled, dried and turned into serving or cutting boards, tracked with a zip code where the tree once grew and sold within specific geographic regions. Join Brian as he shares the inspiration, history and reasoning behind this innovative new company located in Chicago. Several serving boards will be raffled, so you have the chance to take a little piece of Chicago home with you.

TUESDAY, JANUARY 24

7:30 a.m.-4:00 p.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

WEDNESDAY, JANUARY 25

7:30 a.m.-1:00 p.m.

ASHRAE Lounge

Palmer House Hilton, Chicago Room, 5th Floor

FUTURE ASHRAE MEETINGS

| Winter | Date | Annual |
|---------------------------|------|---------------------------|
| Chicago January 21-25 | 2012 | San Antonio June 23-27 |
| Dallas January 26-30 | 2013 | Denver June 22-26 |
| New York January 18-22 | 2014 | Seattle June 28-July 2 |

PAST ASHRAE MEETINGS

| | | |
|---------------|------|----------------|
| Los Angeles | 1980 | Denver |
| Chicago | 1981 | Cincinnati |
| Houston | 1982 | Toronto |
| Atlantic City | 1983 | Washington |
| Atlanta | 1984 | Kansas City |
| Chicago | 1985 | Honolulu |
| San Francisco | 1986 | Portland |
| New York | 1987 | Nashville |
| Dallas | 1988 | Ottawa |
| Chicago | 1989 | Vancouver |
| Atlanta | 1990 | St. Louis |
| New York | 1991 | Indianapolis |
| Anaheim | 1992 | Baltimore |
| Chicago | 1993 | Denver |
| New Orleans | 1994 | Orlando |
| Chicago | 1995 | San Diego |
| Atlanta | 1996 | San Antonio |
| Philadelphia | 1997 | Boston |
| San Francisco | 1998 | Toronto |
| Chicago | 1999 | Seattle |
| Dallas | 2000 | Minneapolis |
| Atlanta | 2001 | Cincinnati |
| Atlantic City | 2002 | Honolulu |
| Chicago | 2003 | Kansas City |
| Anaheim | 2004 | Nashville |
| Orlando | 2005 | Denver |
| Chicago | 2006 | Quebec City |
| Dallas | 2007 | Long Beach |
| New York | 2008 | Salt Lake City |
| Chicago | 2009 | Louisville |
| Orlando | 2010 | Albuquerque |
| Las Vegas | 2011 | Montreal |

WELCOME PARTY

Saturday, January 21 • 6:30-8:30 p.m.
The Art Institute of Chicago

The Art Institute of Chicago will provide a very unique backdrop to this year's Welcome Party. In addition to great food and friends, the European Modern Collection (Galleries 389-399) will be open for viewing. Enjoy a brief stroll to the Art Institute which is approximately 1 ½ blocks from the hotel. Please refer to the map on your ticket. Limited shuttle service will be available for those unable to make the walk.

Menu for the evening:

Taste of Chicago Neighborhoods

35th Street (Bronzeville)

Shrimp and Grits
Aged Cheddar, Tomato, Onion and Mini Chive Biscuit
Buttermilk Fried Chicken
Hot Sauce, Cole Slaw and Corn Bread Madeleine
Pork and Beans
Braised Pork Shoulder with Chickpeas and Seasonal Vegetables

Taylor Street (Little Italy)

Twisted Spaghettini Fork
Crème Fraiche, Caviar and Chives, topped with a Grilled Jumbo Prawn
Prosciutto and Arugula Flat Bread
Heirloom Cherry Tomato Flat Bread

Wentworth AV (Chinatown)

Chicken Satay
Steamed Pork Buns served with House Made Hoisin Sauce
Chicken Drummetts, Scallion Blue Cheese Dipping Sauce, Celery and Carrots
And,
The Mediterranean Meatball Sandwich
Cabrales and Date Croquettas

Coffee and Sweet Station

Red Velvet Cupcakes with Cream Cheese Frosting
Cheese Cake Lillipops
Espresso Marshmallows
Pistachio Panna Cotta
Chocolate Popcorn Balls
Mixed Berry Short Cakes

Two drink tickets included *Dress: Casual*

Note: \$67 ticket per person required. Tickets may be purchased/picked-up at the ASHRAE registration desk; advance purchase tickets may be picked up at the door after registration has closed. Tickets may be purchased at the door of the Art Institute if available. Online ticket sales will close at 4:30 p.m. on Saturday.

ASHRAE thanks Xylem for their sponsorship of the event. Their sponsorship made it possible to have the reception at the Art Institute.



Bell & Gossett

a xylem brand

Price Per Entrée:

\$=\$5-\$10 \$\$=\$10-\$15 \$\$\$=\$15-\$25 \$\$\$\$=\$25 & up

RESTAURANTS NEAR THE PALMER HOUSE

Atwood Café: 1 W. Washington (Continental / American)
(\$\$) ** 312-368-1900 (GF) *Reservations Suggested*
Exit the **State Street Door**, turn right and walk 2 ½ blocks north to **Washington**. The **Atwood Café** is on the southwest corner of **State & Washington**.

Berghoff: 17 W. Adams (German American)
(\$\$) ** 312-427-3170 *Reservations Suggested*
Exit the **State Street Door**, turn left on **State** and walk 1 block south to **Adams**. At **Adams** turn right and cross the street. **Berghoff's** is on your left. (Closed on Sunday)

Catch 35: 35 W. Wacker (Seafood)
(\$\$ – \$\$\$) ** 312-346-3500 (GF) *Reservations Suggested*
Exit the **State Street Door** and turn right. Walk north on **State** for approx. 5 blocks to **Wacker Drive** and turn left. **Catch 35** is on your left.

Elephant & Castle: 185 N Wabash (English Pub)
(\$ – \$\$) ** 312-345-1710 *Reservations Not Necessary*
Exit the **Wabash Street Door**, turn left and walk 4½ blocks north on to the Pub. **Elephant & Castle** is on your right.

Flat Top Grill: 30 S Wabash (Asian / American)
(\$\$) ** 312-726-8400 (GF) *Reservations Not Necessary*
Exit the **Wabash Street Door** turn left and cross the street. **Flat Top Grill** will be on the left

The Gage: 24 S. Michigan Ave (Gastro Pub)
(\$\$ – \$\$\$) ** 312-372-4243 (GF upon request) *Reservation Suggested*
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan** turn left and cross the street The **Gage** is ½ block up on the left.

Giordano's: 135 E. Lake (Pizza)
(\$\$) ** 312-616-1200 *Reservations Not Accepted*
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan** and turn left. Cross the street (**Monroe**) and walk north to **Lake Street**. At **Lake** turn right and cross **Michigan**. The restaurant is on the right.

Grillroom: 33 W. Monroe (American)
(\$\$\$ – \$\$\$\$) ** 312-960-0000 (GF upon request) *Reservations Suggested*
Exit the **Monroe Street Door** turn left and cross the street. The **Grillroom** will be on left, across from the **Bank of America Theatre**.

Heaven On Seven: 111 N. Wabash – 7th fl (Cajun)
(\$\$) ** 312-263-6443 *Open only for Breakfast & lunch*
Exit the **Wabash Door** and turn left. Walk 1 ½ bocks north on **Wabash**. It will be on your right across from **Macy's**.

Henri: 18 S Michigan (American/French)
(\$\$\$ – \$\$\$\$) ** 312-578-0763 *Reservations Suggested*
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan Ave.**, turn left. and cross the street. **Henri** is ½ block up on the left side.

Hot Woks / Cool Sushi: 30 S Michigan (Sushi / Pan Asian)
(\$\$) ** 312-345-1234 *Reservation Not Necessary*
Exit **Monroe Street Door** turn right and walk 1 ½ blocks to **Michigan**. At **Michigan** turn left, cross the street and walk ½ block north. **Hot Woks / Cool Sushi** is on your left.

Italian Village: 71 W. Monroe (Italian)
(\$\$ – \$\$\$) ** 312-332-7005 (open late) *Reservations Suggested*
Exit the **Monroe Street Door** turn left and walk approx 1 ½ blocks. **Italian Village** is on the left.

Khyber Pass: 233 E. Wacker Dr (Indian Cafe)
(\$\$ – \$\$\$) ** 312-856-1810 *Reservation Suggested*
Exit the **Monroe Street Door** and turn right. Walk 1 block east to **Michigan Ave** and turn left. Walk 6 blocks north to **Wacker Drive** and turn right. **Khyber Pass** will be on the right side.

Lou Malnati's: 805 S. State (Chicago style pizza)
** 312-786-1000 *Reservations Not Accepted*
Exit the **State Street Door** and turn left. Walk south on **State** for approx.7 blocks. **Lou Malnati's** is on your left.

Mercat a la Planxa: 638 S. Michigan (Spanish Tapas)
(\$\$ – \$\$\$) ** 312-765-0524 (GF) *Reservations Suggested*
Exit the **Monroe Street Door** and turn right. Walk 1 block to **Michigan Ave** and make a right. Proceed 6 blocks down **Michigan Ave**. **Mercat a la Planxa** is located on the right, inside of the **Blackstone Hotel**.

Morton's: 65 E. Wacker Place (Steak)
(\$\$\$\$) ** 312-201-0410 (GF) *Reservations Suggested*
Exit the **Wabash Street Door** and turn left. Walk approx.4 ½ blocks north to **Wacker Place (South Water Street)** and turn right. **Morton's** is on the right.

Park Grill: 11 N. Michigan (American)
(\$\$-\$\$\$) ** 312-521-7275 (GF upon request) *Reservations Suggested*
Exit the **Monroe Street Door** and turn right. Walk 1 ½ blocks to **Michigan**. Turn left, cross the street (**Monroe**) and walk approx. 2 blocks north. **Park Grill** will be on your right in **Millennium Park**.

Petterino's: 150 N. Dearborn (Italian Steak House)
(\$\$\$) ** 312-422-0150 (GF) *Reservations Suggested*
Exit the **Monroe Street Door** and turn left. Walk 1 ½ blocks west to **Dearborn** and make a right. Walk 3 blocks north to **Randolph** and cross the street. **Petterino's** will be on the left.

Pizano's: 61 E. Madison (Chicago style Pizza)
(\$\$) ** 312-236-1777 (GF) *Reservations Suggested*
Exit the **Wabash Street Door** turn left and walk 1 ½ blocks north to **Madison**. Turn right and cross the Street. **Pizano's** will be on the right.

Rhapsody: 65 E. Adams (American)

(\$\$ – \$\$\$) ** 312-786-9911 (GF upon request)

Reservations Suggested

Exit the **Wabash Street Door** turn right, walk to the corner (**Adams**) and cross the street. Turn left and cross the street (**Wabash**). Walk ½ block east, **Rhapsody** will be on your left.

Rosebud Prime: 1 S. Dearborn (Steak)

(\$\$\$\$) ** 312-384-1900 (GF)

Reservations Suggested

Exit the **Monroe Street Door** turn left, walk 1 ½ blocks west to **Dearborn** and turn right. Cross the street (**Monroe**) and walk ½ block north. **Rosebud Prime** will be on the right.

Rosebud Theatre District: 70 W. Madison (Italian)

(\$\$ – \$\$\$) ** 312-332-9500 (GF request)

Reservations Suggested

Exit the **Monroe Street Door** turn left and walk 1½ blocks west to **Dearborn**. At **Dearborn** turn right and cross the street (**Monroe**). Walk 1 block north (**crossing Madison**). **Rosebud Theatre District** will be on your left. (Closed on Sundays)

Russian Tea Time: 77 E. Adams (Russian / Veg)

(\$\$ – \$\$\$) ** 312-360-0000 (GF upon request)

Reservations Suggested

Exit the **Wabash Street Door** and turn right. Walk south to the corner (**Adams**). Turn left, cross the street (**Adams**) and walk ½ block east. The **Russian Tea Time** will be on your right.

Sweetwater Tavern & Grille: 225 N. Michigan

(\$\$\$) ** 312-698-7111

(American Grill / Sports Bar)

Exit the **Monroe Street Door**, turn right and walk 1 ½ blocks east to **Michigan**. Turn left, cross the street (**Monroe**) and walk north on **Michigan** for approx. 4 – 5 blocks. **Sweetwater Tavern & Grille** will be on your right.

Tamarind: 614 S. Wabash (Pan Asian/Sushi)

(\$\$) ** 312-379-0970

Reservations Suggested

Exit the **Wabash Door**, turn right and walk 5 blocks south on **Wabash**. **Tamarind** will be on the right.

Terzo Piano: 159 E Monroe (Cont. Italian)

(\$\$ – \$\$\$) ** 312-443-8650 **Reservations Suggested (Lunch)**

Exit the **Monroe Street Door**, turn right and walk approx 2 blocks east crossing **Michigan**. **Terzo Piano** is on the right inside the **Modern Wing of the Art Institute**.

Tavern at the Park: 130 E. Randolph (American)

(\$\$ – \$\$\$) ** 312-552-0070 (GF upon request)

Reservations Suggested

Exit the **Monroe Street Door**, turn right and walk 1½ blocks east to **Michigan**. Turn left, cross the street (**Monroe**) and walk 3 blocks north to **Randolph**. **Tavern at the Park** is on the right.

Trafforia #10: 10 N. Dearborn (Northern Italian)

(\$\$\$) ** 312-984-1718 (GF request)

Reservations Suggested

Exit the **Monroe Street Door**, turn left and walk 1 ½ blocks west to **Dearborn**. At **Dearborn** turn right and walk 1-½ blocks north. **Trafforia #10** is on the left. (Closed on Sundays)

** (GF) = Gluten Free, **

PRESIDENT'S LUNCHEON

Monday, January 23, 12:15 pm – 2:00 pm
(doors open at noon)
Palmer House, Grand Ballroom

President Ronald E. Jarnagin will present his State of the Society address. Major Research Promotion Investors will be recognized.

Menu:

Classic Cobb Salad
Stuffed Free Range Chicken
Organic chicken breast stuff with garlic and sun dried tomatoes, arugula, mozzarella cheese and pine nuts
Crème Brulee
Coffee, tea and decaffeinated coffee

Ticket required. \$47

MEMBERS NIGHT OUT

Tuesday, January 24

Reception, Cash Bar, 6:15 p.m. – 7:00 p.m.
State Ballroom

Dinner, 7:00 p.m.– 9:00 p.m.
Grand Ballroom

Menu:

Wild Mushroom Bisque
Grouper
Ratatouille and Grilled Artichoke
Compressed Garlic Cream Yukon Gold Potato

Dessert:

Bite-size Sampler

Cheesecake
Palmer House Brownies
Seasonal Fruit Tartlet
Chocolate Mousse
Raspberry Sauce

Entertainment:

Speakeasy Chicago
State Ballroom

OK, so we've tried to live it down for 90 years, enough is enough! Come embrace Chicago's storied past of the roaring twenties on Members Night Out while we warm up the Palmer House with Dinner, Jazz, some roving entertainers and a little "back room" action! It's sort of a casino party with a theme and music. There will be some prizes for those that are skilled at the tables, and for those that don't, stay and enjoy a gin, the jazz and the entertainment.

Tickets for the event may be purchased at the ASHRAE registration desk, Palmer House, 4th floor exhibit hall. Online ticket purchases will be available until 4:15 p.m. on Tuesday.

Cost: \$52

ROOMS/HOURS

FINDING THE ASSIGNED MEETING ROOM

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. All meetings are scheduled in the Palmer House Hilton. Meeting room names are listed in this program followed by parentheses indicating the number of the floor the room is located on.

CONFERENCE REGISTRATION

Palmer House Hilton, Upper Exhibit Hall, 4th Floor

Registration is required for all conference participants. Official badges must be worn at all functions and for admission into the AHR Expo and ASHRAE technical sessions. ASHRAE conference registration will be open during the following hours:

| | |
|-----------------------|------------------------|
| Friday, January 20 | 11:00 a.m. – 5:00 p.m. |
| Saturday, January 21 | 7:15 a.m. – 6:00 p.m. |
| Sunday, January 22 | 7:00 a.m. – 5:00 p.m. |
| Monday, January 23 | 7:00 a.m. – 4:00 p.m. |
| Tuesday, January 24 | 7:30 a.m. – 4:00 p.m. |
| Wednesday, January 25 | 7:30 a.m. – 10:00 a.m. |

Computers with internet access will be available for E-mail.

ASHRAE BOOKSTORE

Palmer House Hilton, Upper Exhibit Hall, 4th Floor

More than 300 books, conference papers, and other recent publications will be available for purchase in the ASHRAE Bookstore. The bookstore provides HVAC&R technical literature from ASHRAE and other publishers. The ASHRAE Bookstore will be open during the following hours:

| | |
|-----------------------|------------------------|
| Friday, January 20 | 11:00 a.m. – 5:00 p.m. |
| Saturday, January 21 | 7:15 a.m. – 6:00 p.m. |
| Sunday, January 22 | 7:00 a.m. – 5:00 p.m. |
| Monday, January 23 | 7:00 a.m. – 4:00 p.m. |
| Tuesday, January 24 | 7:30 a.m. – 4:00 p.m. |
| Wednesday, January 25 | 7:30 a.m. – 1:00 p.m. |

There will be a Demo Center near the Bookstore where visitors can preview ASHRAE CD-ROMs and other electronic products. ASHRAE's eLearning system, from the ASHRAE Learning Institute, will also be demonstrated at the bookstore. Find out how you can participate in a hands-on demonstration and learn about new ways to earn CEUs on demand online.

Make the bookstore your meeting place!!

AHR EXPO®

McCormick Place, North & South Halls
2301 South Lakeshore Drive

Hours:

| | |
|-----------------------|------------------------|
| Monday, January 23 | 10:00 a.m. – 6:00 p.m. |
| Tuesday, January 24 | 10:00 a.m. – 6:00 p.m. |
| Wednesday, January 25 | 10:00 a.m. – 4:00 p.m. |

If you have registered for the ASHRAE Conference, your conference badge is your admission into the exposition.

If you are attending the exposition only and you did not register in advance, the fee for admission is \$20.00 and can be paid at McCormick Place. Registration for the AHR Expo® will be open from Noon to 4:00 p.m. on Sunday, January 22. Starting Monday, you can register one hour before the doors open.

You must be 18 years or older to be admitted to the show floor. Ages 16 and 17 will be admitted only if accompanied by an adult. Shuttle service to and from the McCormick Place will be provided from the Palmer House Hilton all day Monday through Wednesday. Shuttle pick-up will be at the Wabash Street exit of the Palmer House. Signs will advertise the shuttle schedule, which will begin on Monday, January 23. Shuttle service does not operate from hotel to hotel. Shuttles will run from 7:00 am-7:00 pm on Monday, 8:00 am – 7:00 pm on Tuesday and 8:00 am – 6:00 pm on Wednesday.

AHR BAR CODES

Exhibitors will scan your badge if you have interest in receiving product information from an exhibitor. This is another step toward greening our events. Contact information provided on the bar code may be distributed to all AHR exhibitors.

ALI COURSES

Registration for the ASHRAE Learning Institute courses being held at McCormick Place can be done at either ASHRAE registration at the Palmer House Hilton or at McCormick Place, North Hall Registration Lobby, 3rd Floor. Registration will open at McCormick Place on Sunday from 9:00 a.m.-3:00 p.m., Monday from 8:00 a.m.-6:00 p.m. and Tuesday from 8:00 a.m. -6:00 p.m. Online registration will close at midnight on the evening prior to the course.

Shuttle Service for the Sunday courses will operate from 1:00-1:30 p.m. on Sunday from the Palmer House Wabash entrance to McCormick and will operate from McCormick to Palmer House from 5:00-5:30 p.m.

ASHRAE LOUNGE

Palmer House Hilton, Chicago Room, 5th Floor

The ASHRAE Lounge is open to all individuals who are registered for the conference. Admission to the lounge is by badge only. Chicago Host Committee members will be available to answer questions.

This room will be open during the following hours:

| | |
|-----------------------|-----------------------|
| Saturday, January 21 | 7:30 a.m. – 3:00 p.m. |
| Sunday, January 22 | 7:30 a.m. – 4:00 p.m. |
| Monday, January 23 | 7:30 a.m. – 4:00 p.m. |
| Tuesday, January 24 | 7:30 a.m. – 4:00 p.m. |
| Wednesday, January 25 | 7:30 a.m. – 1:00 p.m. |

Coffee and pastries will be served from 7:30 a.m. to 9:30 a.m. each morning.

TOURS

For information on the tours offered during the Winter Conference, see general tour information in the Tours section of this program.

SPEAKERS' LOUNGE

Palmer House Hilton, Upper Exhibit Hall, 4th Floor

The Speakers' Lounge will be open during the following hours:

| | |
|-----------------------|---|
| Saturday, January 21 | 1:00 p.m. – 3:00 p.m. |
| Sunday, January 22 | 7:00 a.m. – 5:00 p.m. |
| Monday, January 23 | 7:00 a.m. – 12:15 p.m. and 1:30 p.m. – 4:30 p.m. |
| Tuesday, January 24 | 7:00 a.m. – 5:00 p.m. |
| Wednesday, January 25 | 7:00 a.m. – 1:00 p.m. |

PRESS ROOM

Palmer House Hilton, Congress Room, 3rd floor

The Press Room will be open during the following hours:

| | |
|-----------------------|------------------------|
| Saturday, January 21 | 8:00 a.m. – 3:00 p.m. |
| Sunday, January 22 | 8:00 a.m. – 5:00 p.m. |
| Monday, January 23 | 8:00 a.m. – 5:00 p.m. |
| Tuesday, January 24 | 10:00 a.m. – 5:00 p.m. |
| Wednesday, January 25 | 7:30 a.m. – 10:00 a.m. |

HEADQUARTER OFFICE

Palmer House Hilton, Salon 3, 3rd floor

The ASHRAE Headquarter Office offers members complimentary copying, services of a typist, and access to printers for laptop computers. The Headquarter Office will be open during the following hours:

| | |
|-----------------------|-----------------------|
| Friday, January 20 | Noon – 5:00 p.m. |
| Saturday, January 21 | 8:00 a.m. – 5:00 p.m. |
| Sunday, January 22 | 8:00 a.m. – 5:00 p.m. |
| Monday, January 23 | 8:00 a.m. – 5:00 p.m. |
| Tuesday, January 24 | 8:00 a.m. – 5:00 p.m. |
| Wednesday, January 25 | 8:00 a.m. – 1:00 p.m. |

MEMBERSHIP INFORMATION DESK

Palmer House Hilton, Upper Exhibit Hall, 4th Floor

A Membership Information Desk is available for paying dues, applying for membership, updating membership information, and purchasing ASHRAE logo items. This desk is open during the same hours as registration, so feel free to stop by if you have any questions concerning your ASHRAE membership.

YOUNG ENGINEERS IN ASHRAE (YEA)

HOSPITALITY SUITE

Palmer House Hilton, Salon 1, 3rd Floor

Attention members age 35 and younger! You are invited to visit the Young Engineers in ASHRAE (YEA) Hospitality Suite to be held on Sunday, January 22, from 4:00 p.m. – 7:00 p.m. The suite offers social and networking opportunities and light refreshments will be available.

A YEA/student mixer will be held Saturday, January 21, from 5:00 p.m. – 6:30 p.m. in the Chicago Room 5th floor of the Palmer House Hilton. Come join us to meet other young ASHRAE members!

STUDENT ACTIVITIES

Red Lacquer, 4th Floor, Palmer House Hilton

Plan to join the Student Welcome and Orientation on Saturday, January 21 from 2:00 p.m. to 3:00 p.m. in the Red Lacquer room, 4th floor, Palmer House Hilton

The Student Program will be held in the Red Lacquer room at the Palmer House Hilton on Sunday, January 22 from 9:00 a.m. – 2:00 p.m. Take advantage of this opportunity to learn more about ASHRAE while becoming acquainted with your fellow students and ASHRAE members. There will be a speaker, design competition and grant award presentations, and a career panel. Don't miss the free student items and the raffle for your chance to win cool prizes! Activities for students are a unique feature of the ASHRAE Winter Conference—a foundation on which to build your network of resources for your future in the HVAC&R industry.

The Student Tour to the University of Chicago Mansueto Library will depart from the Wabash entrance at 2:30 p.m.

INVITATION TO ALL NEW MEMBERS, FIRST TIME ATTENDEES AND NON-MEMBERS

Sunday, January 22, 2:45 p.m. to 3:45 p.m.

Chicago Room, 5th Floor

If you've never attended an ASHRAE conference before, join us and meet some of your fellow first timers. New members, non-members, and first time meeting attendees are invited, and feel free to bring your family members. The event is sponsored and hosted by the ASHRAE Membership Promotion Committee,

CHICAGO HOST COMMITTEE INFORMATION DESK

Upper Exhibit Hall, 4th Floor, Palmer House Hilton

The Host Committee will have an information desk located at the ASHRAE registration area. General information about the sights of the city will be available, and a host committee member will be present to answer questions about Chicago.

Information Desk hours will be Saturday and Sunday from 8:00 a.m. – 2:00 p.m. and Monday and Tuesday from 8:00 a.m. – Noon. Please take a few minutes to stop by and discover some of the activities available to you in Chicago.

SAN ANTONIO CONFERENCE INFORMATION

Palmer House Hilton, Upper Exhibit Hall, 4th Floor

Information on the upcoming Annual Conference June 23 – June 27, 2012, in San Antonio, TX, will be available in the registration area.

SCHEDULE

Location of Meetings

To assist you in finding your meeting room at the Winter Conference, please refer to the floor plans located in the front of this program. All meetings are scheduled in the Palmer House Hilton.

Meeting Schedule

FRIDAY, JANUARY 20

- 8:00 am – 5:00 pm **Committee Meetings**
See listing on pages 54 – 68
- 11:00 am – 5:00 pm **Registration, ASHRAE Bookstore,**
Palmer House Hilton, Upper Exhibit Hall,
4th Floor

SATURDAY, JANUARY 21

- 7:30 am – 3:00 pm **ASHRAE Lounge,** Palmer House Hilton,
Chicago Room, 5th Floor
- 7:15 am – 6:00 pm **Registration, ASHRAE Bookstore**
Palmer House Hilton, Upper Exhibit Hall,
4th Floor
- 8:00 am – 3:00 pm **Press Room,** Palmer House Hilton,
Congress Room, 3rd Floor
- 8:00 am – 5:00 pm **Committee Meetings**
See listing on pages 54 – 68
- 1:00 pm – 3:00 pm **Speakers' Lounge,** Palmer House Hilton,
Upper Exhibit Hall, 4th Floor
- 2:00 pm – 3:00 pm **Student Orientation,** Red Lacquer Room,
4th Floor

Special Event

- 3:15 pm – 5:00 pm Meeting of the Members,
Plenary Session, Palmer House Hilton,
Grand Ballroom (4th floor)
- Opening and Welcoming Remarks by
ASHRAE President **Ronald E. Jarnagin**
- Welcome by Director and Chair,
Region VI, **Tina M. Brueckner**
- Secretary's Report by Executive Vice
President **Jeff H. Littleton**
- Awards Presentation**
See page 22 for details

- 5:00 pm-6:30 pm **YEA/Student Mixer,** Chicago Room,
5th Floor

Special Event

- 6:30 pm – 8:30 pm Welcome Party, Art Institute of Chicago
See page 15 for details
- Note:** \$67 ticket per person required.
Tickets may be purchased/picked up
at the ASHRAE Registration Desk;
advance-purchase tickets may be picked
up at the door if after registration hours.

SUNDAY, JANUARY 22

- 7:00 am – 5:00 pm **Speakers' Lounge,** Palmer House Hilton,
Upper Exhibit Hall, 4th Floor
- 7:00 am – 5:00 pm **Registration, ASHRAE Bookstore,**
Palmer House Hilton, Upper Exhibit Hall,
4th Floor
- 7:30 am – 4:00 pm **ASHRAE Lounge,** Palmer House Hilton,
Chicago Room, 5th Floor
- 8:00 am – 4:45 pm **Technical Sessions**
See Technical Program on pages 30 – 53
- 8:00 am – 5:00 pm **Press Room,** Palmer House Hilton,
Congress Room, 3rd Floor
- 8:00 am – 5:00 pm Committee Meetings
See listing on pages 54 – 68
- 9:00 am – 2:00 pm **Student Program,** Palmer House Hilton,
Red Lacquer, 4th floor
- 9:30 am – 10:30 am **Technical Plenary Session,**
Palmer House Hilton, Adams Ballroom,
(6th floor) Conference badge required.
See page 31 for details
- 1:00 pm – 4:00pm **Technical Tour:** North Central College
See description on page 24
- 1:30 pm – 4:30 pm **Tour: A Glimpse of Chicago**
See description on page 24
- 2:45 pm – 3:45 pm **New Member Social,** Chicago Room,
5th Floor
- 4:00 pm – 7:00 pm **Young Engineers in ASHRAE (YEA)**
Hospitality Suite, Palmer House Hilton,
Salon 1, 3rd floor

*Attention members age 35 and younger—
you are invited to visit the YEA Hospitality
Suite, offering social and networking
opportunities Light refreshments will be
available. See page 19 for more details.*

MONDAY, JANUARY 23

- 7:00 am – 4:30 pm **Speakers' Lounge,** Palmer House Hilton,
Upper Exhibit Hall, 4th Floor
- 7:00 am – 4:00 pm **Registration, ASHRAE Bookstore,**
Palmer House Hilton, Upper Exhibit Hall,
4th Floor
- 7:30 am – 4:00 pm **ASHRAE Lounge,** Palmer House Hilton,
Chicago Room, 5th Floor
- 8:00 am – 12:00 pm **Technical Sessions**
See Technical Program on pages 30 – 53
- 8:00 am – 5:00 pm **Press Room,** Palmer House Hilton,
Congress Room, 3rd Floor
- 8:00 am – 5:00 pm **Committee Meetings**
See listing on pages 54 – 68

10:00 am – 6:00 pm **AHR Expo®**, McCormick Place
Convention Center,
2301 South Lakeshore Drive

If you are registered for the ASHRAE Conference, your conference badge is admission into the exposition; if attending exposition only and not registered in advance, admission is \$20.00 at the exposition. Note: No one under 16 admitted; ages 16 and 17 will be admitted only if accompanied by an adult. Shuttle service to and from the McCormick Convention Center will be provided from the Palmer House Hilton. Shuttle pick-up will be at the Wabash Street entrance. Shuttle service will begin at 7:00 a.m. Signs will advertise the shuttle schedule. Shuttle service does not operate from hotel to hotel. See page 16 for more details.

10:15 am – 11:45 am **Student Congress**, Palmer House Hilton,
Clark 5 (7th floor)

Special Event

12:15 pm – 2:00 pm **President's Luncheon**
(doors open at noon), Palmer House
Hilton, Grand Ballroom (4th floor)

President Ronald E. Jarnagin will speak on the State of the Society and the Golden Circle Awards will be presented “in honor of contributors who have consistently and significantly supported ASHRAE research.” Spouses and guests are cordially invited to attend. **Note:** *Ticket required.* [See description on page 17](#)

2:15 pm – 3:45 pm **Technical Sessions**
[See Technical Program on pages 30 – 53](#)

2:30 pm – 5:00 pm **Tour: Chocolate Chicago**
[See description on page 24](#)

2:30 pm – 4:30 pm **Technical Tour:** Loyola University
[See description on page 24](#)

After 5:00 pm **Regional Dinners**
Sign up in ASHRAE registration area.

TUESDAY, JANUARY 24

7:00 am – 5:00 pm **Speakers' Lounge**, Palmer House Hilton,
Upper Exhibit Hall, 4th Floor

7:30 am – 4:00 pm **Registration, ASHRAE Bookstore**,
Palmer House Hilton, Upper Exhibit Hall,
4th Floor

7:30 am – 4:00 pm **ASHRAE Lounge**, Palmer House Hilton,
Chicago Room, 5th Floor

8:00 am – 4:45 pm **Technical Sessions**
[See Technical Program on pages 30 – 53](#)

10:00 am – 5:00 pm **Press Room**, Palmer House Hilton,
Congress Room, 3rd Floor

8:00 am – 5:00 pm **Committee Meetings**
[See listing on pages 54 – 68](#)

10:00 am – 6:00 pm **AHR Expo®**, McCormick Place
Convention Center,
2301 South Lakeshore Drive

10:00 am-11:30 am **Life Members' Brunch**, Suite 20150
Note: *Ticket required.*

1:00 pm-3:00 pm **Technical Tour:** University of Chicago
Mansueto Library
[See description on page 25](#)

3:15 pm – 5:00 pm **Technical Tour:** Rush University Central
Energy Plant
[See description on page 25](#)

Special Event

6:15 pm – 7:00 pm **Reception**, Palmer House Hilton,
State Ballroom, 4th floor

7:00 pm – 11:00 pm **Members' Night Out**, Palmer House
Hilton, Grand Ballroom, 4th floor
[See page 13 for details](#)
Note: *Ticket required.*

WEDNESDAY, JANUARY 25

7:30 am – 10:00 am **Press Room**, Palmer House Hilton,
Congress Room, 3rd Floor

7:30 am – 10:00 am **Registration, ASHRAE Bookstore**,
Palmer House Hilton, Upper Exhibit Hall,
4th Floor

7:30 am – 1:00 pm **ASHRAE Bookstore**, Palmer House
Hilton, Upper Exhibit Hall, 4th Floor

7:30 am – 1:00 pm **ASHRAE Lounge**, Palmer House Hilton,
Chicago Room, 5th Floor

7:00 am – 1:00 pm **Speakers' Lounge**, Palmer House Hilton,
Upper Exhibit Hall, 4th Floor

8:00 am – 12:30 pm **Technical Sessions**
[See Technical Program on pages 30 – 53](#)

8:00 am – 5:00 pm **Committee Meetings**
[See listing on pages 54 – 68](#)

10:00 am – 4:00 pm **AHR Expo®**, McCormick Place
Convention Center,
2301 South Lakeshore Drive

notes

AWARDS PRESENTATION

Saturday, January 21, 3:15-5:30 p.m.
Plenary Session, Palmer House Hilton
Grand Ballroom

STUDENT DESIGN PROJECT COMPETITION

“Given in recognition of outstanding student research and design projects.”

HVAC System Selection

First Place: **Lynn Gualtieri, Evan Oda, Kristin Porter, Navid Saiidnia, Jeffrey Wong, Cameron Young**
California Polytechnic State University

HVAC System Design

First Place: **Holly Brink, Michael Crabb, James Dougherty, Andrew Gilliam, Gina Halbom**
University of Nebraska–Omaha

Integrated Sustainable Building Design

First Place: **Qi Te, Zhang Qiqi, Chen Yuanyu**
Tianjin University

TECHNOLOGY AWARDS

“Given in recognition of innovative designs that comply with ASHRAE standards for indoor air quality and energy efficiency.”

First Place

Category I – Commercial Buildings – New

Roland Charneux for Mountain Equipment Co-op
The building is owned by Mountain Equipment Co-op

Category I – Commercial Buildings – Existing

Ken Sonmor for IKEA Brossard Distribution Center
Jean Nolin, representing the building owner,
IKEA Distribution Services CA LP

Category II – Educational Facilities – New

René Dansereau for Université de Sherbrooke –
Campus de Longueuil
René Alarie, representing the building owner,
Université de Sherbrooke

Category III – Health Care Facilities – New

Paul Marmion for Abbotsford Regional Hospital
and Cancer Centre
Colm Place, Project Representative, Laing Investments
Management Services. The building owner is Abbotsford
Regional Hospital and Cancer Centre

Category IV – Industrial Facilities or Processes – New

Blake E. Ellis for Thermal Energy Corporation –
Thermal Energy Storage
Stephen K. Swinson, representing the building owner,
Thermal Energy Corporation

Category IV – Industrial Facilities or Processes – Existing

Luc Simard for Arena Marcel Dutil
The building owner is the Municipalite St-Gédéon-de-Beauce

E.K. CAMPBELL AWARD OF MERIT

presented by the Life Members' Club

“Given in recognition of outstanding service and achievement in teaching”

Wayne A. Helmer, Ph.D.

Arkansas Tech University, Russellville, AR

JOHN F. JAMES INTERNATIONAL AWARD

“Given to an ASHRAE member who has done the most to enhance the Society's International activities.”

Edward Ka Cheung Tsui

Hong Kong

ASHRAE FELLOWS

“Given in recognition of distinction in the arts and sciences of heating, refrigeration, air conditioning and ventilation.”

Constantinos A. Balaras, Ph.D., P.E., Vrilissia, Greece

Van D. Baxter, P.E., Oak Ridge, TN

Vinod P. Gupta, P.E., Saint Paul, MN

Mark P. Modera, Ph.D., P.E., Davis, CA

Darin W. Nutter, Ph.D., P.E., Fayetteville, AR

Thomas H. Phoenix, P.E., Greensboro, NC

Arshad S. Sheikh, P.E., Lahore, Pakistan

Edward A. Vineyard, P.E., Oak Ridge, TN

Iain Walker, Ph.D., Berkeley, CA

Brian P. Warwicker, London, UK

William M. Worek, Ph.D., Chicago, IL

Arshad S. Sheikh, P.E., Lahore, Pakistan

Xudong Yang, Ph.D., Beijing, China

Jianshun Zhang, Ph.D., Syracuse, NY

ASHRAE HALL OF FAME AWARD

“Given to honor deceased members who have made milestone contributions to the growth of ASHRAE-related technology”

Presidential Member **Roderick R. Kirkwood, P.E.,**

Fellow ASHRAE, Life Member

notes

INSTALLATION, OPERATION AND MAINTENANCE OF HVAC SYSTEMS MINI-CONFERENCE SESSIONS

Sunday, January 22

8:00am - 9:30am **Seminar 5** Wabash Rm

“What Is the Right Degree of Automation in Building Operations: A Debate and Discussion”

11:00am - 12:30pm **Seminar 7** Wabash Rm

“Has Your TRAINing Left the Station?”

3:15pm - 4:45pm **Conference Paper Session 6** Crystal Rm

“Fault Detection and Energy Audits”

Monday, January 23

8:00am - 9:30am **Seminar 16** Wabash Rm

“Air-Handling System Leakage: Benefits and Costs of Field Tests”

9:45am - 10:45am **Seminar 21** Wabash Rm

“Maximizing the Benefits of Commissioning: Incorporating Design Reviews and the Building Envelope into the Commissioning Scope”

11:00am - 12:00pm **Conference Paper Session 14** Wabash Rm

“Energy Savings and Performance Improvement through O&M”

11:00am - 12:00pm **Seminar 25** Adams Rm

“Vibration Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance”

11:00am - 12:00pm **Seminar 26** Crystal Rm

“YEA for Air Cleaning!”

3:00pm - 4:30pm **AHR Expo Session 1** McCormick Place, Rm S106A

“Selection, Operation & Maintenance and Water Treatment for Multi-Metal Boilers”

UPCOMING CONFERENCES

High Performance Buildings: A Focus on Deep Energy Savings

Presented by ASHRAE's High Performing Buildings Magazine

March 12-13, 2012

San Diego, CA

Energy Modeling Conference:

Tools for Designing High Performance Buildings

October 1-3, 2012

Atlanta, GA

ASHRAE/NIST Refrigerants Conference:

Moving Towards Sustainability

October 29-30, 2012

Gaithersburg, MD

7th International HVAC Cold Climate Design Conference

November 16-18, 2012

Calgary, Alberta, Canada

IAQ 2013: Environmental Health in Low Energy Buildings

October 14-16, 2013

Vancouver, British Columbia, Canada

Information on these ASHRAE Conferences can be found on ASHRAE's website under Events – www.ashrae.org

GENERAL TOURS

All tours depart from the Wabash Street entrance of the Palmer House Hilton.

Tour tickets may be purchased at the ASHRAE Registration desk in the Hilton, 4th Floor Exhibit hall.

Stand-by tour tickets are distributed after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of no-shows or last minute cancellations. If you have a stand-by ticket, please have the exact amount of the ticket cost available to pay at the bus.

A Glimpse of Chicago

Sunday January 22

1:30 p.m.-4:30 p.m.

Chicago Hog Butcher for the World, Tool Maker, Stacker of Wheat, Player with Railroads and the Nation's Freight Handler; Stormy, husky, brawling, City of the Big Shoulders, a city of legend and acclaim, great sights and neighborhoods. This three hour tour will take in some of Chicago's legendary locations, and help give a few ideas on how to spend some of your quality time in the Windy City. Join us for this charming bus tour on board a Chicago Trolley as it winds its way through the sights, leaving and returning from the Palmer House. Enjoy a famous bag of Garrett's Popcorn along the way.

Cost \$32

Chocolate Chicago

Monday January 23

2:30 p.m.-5:00 p.m.

On this chocolate & cupcake tour, you'll visit amazing chocolate shops, bakeries, and cafes, to sample Chicago's favorite flavor in many different forms. Join us as we walk to Chicago's best chocolate, cupcake shops and bakeries and other locations to sample many forms and flavors of this one wonderful treat! Along the way there will be a little history of these treats, and why cupcakes have catapulted to massive popularity in recent years. And, enjoy a cupcake to go, plus lots of samples on the spot!

Learn about fine chocolates, the world history of chocolate, and Chicago's beautiful architecture as you savor the flavors, and walk off the calories!

Cost \$52

Assemble for this walking tour in the lobby of the Palmer House.

TECHNICAL TOURS

All tours depart from the Wabash Street entrance of the Palmer House Hilton.

Tour tickets may be purchased at the ASHRAE Registration desk in the Hilton, 4th Floor Exhibit hall.

Stand-by tour tickets are distributed after a tour sells out. Stand-by tickets are provided to ensure that a tour is filled in the event of no-shows or last minute cancellations. If you have a stand-by ticket, please have the exact amount of the ticket cost available to pay at the bus.

North Central College Residential & Recreation Center

Sunday January 22, 2012

1:00 p.m.-4:00 p.m.

North Central College Residential & Recreation Center is a 200 thousand square foot building designed to achieve LEED Silver status. The four-story structure not only houses a 265-bed dormitory but also an indoor recreation facility with a 200 meter indoor track, raised walking track, multi-use courts and other athletic training facilities. The new, four-story structure is heated and cooled by a geothermal system that pumps water through a series of 60 underground wells and then through almost 17 miles of tubing within the building's concrete floors.

Cost \$27

Loyola University Information Commons

Monday January 23, 2012

2:30 p.m.-4:30 p.m.

Loyola University's new Richard J. Klarchek Information Commons Buildings, was constructed in 2009 and totals 60,000 sq.ft of new digital library located on Chicago's lakefront. The state-of-the-art building was built to be energy efficient but because of its large glass exposures on the east and west sides, many innovative designs were required to achieve that goal. Some of the applied design concepts include radiant ceilings for both heating and cooling, a double ventilated facade, digitally integrated operable blinds and windows for natural ventilation, a green roof, daylight harvesting and heat recovery - all of which are meant to comfortably handle the heating and cooling fluctuations in the most energy-efficient way possible. The energy model for the building predicted 52 percent lower energy consumption than ASHRAE 90.1 (2001) and was modeled for 24/7 occupancy. After observations for a two-week period in August 2009, the building was either in a natural ventilation or hybrid mode 37 percent of the time. The natural ventilation mode is so effective that the indoor temperature could be maintained within approximately one half of a degree of the outdoor temperature. Because of its innovative design and sustainable characteristics, the Information Commons Buildings was rated as LEED silver. Loyola Information Commons is the recipient of the 2009 ASHRAE Illinois Chapter and Region VI Excellence in Engineering Technology Award. It has also received a first place ASHRAE award at the Society (international) level.

Cost \$27

University of Chicago Mansueto Library

Tuesday January 24, 2012

1:00 p.m.-3:00 p.m.

Mansueto Library will be intellectual and social hot spot futuristic facility within the University of Chicago campus. This is a one of a kind structure, with an underground rare book archival vault that is 55 ft underground, 45 ft below Chicago water table. The rare books vault is managed by programmed robotics, with book retrieval delivering the books to the upstairs reading or preservation area via automated cranes and special elevator bins. Visitors of this futuristic library will experience no waiting period for their requested rare book and will be able to experience plenty of natural light to enjoy their reading and research experience through a unique glass dome; Ample natural light, yet critically controlled to preserve rare and historic books. The facility will officially open on October 2011. Some of the engineering associated with this interesting and unique structure to be discussed are:

- The strategically situated mechanical rooms, with two that are within the rare book vault situated 55 ft below ground floor.
- A total of 13 units that are sequenced together to maintain proper conditions in this glass enclosure and the multiple critical areas.
- Strategically located air distribution kiosks.
- Perimeter air handlers control the ground floor radiant and conductive perimeter loads.
- Desiccant system with high pressure steam serves the vault to maintain critical parameters
- Multiple stages of filtration maintain clean air conditions within critical spaces such as the book vault and restoration/preservation areas.

Cost \$27

RUSH University Medical Center Central Energy Plant

TUESDAY January 24, 2012

3:15 p.m.-5:00 p.m.

Rush University Medical Center is one of Chicago's premier teaching hospitals, and a fixture of the near west side. In a multi phased project both new hospitals and supporting infrastructure are being developed to support the hospitals mission. The Chilled Water plant is designed for 5600 ton initial capacity, and an ultimate capacity of 12600 tons, in an N+1 configuration. The main chilled water distribution piping is installed to handle ultimate design capacity, with 24" chilled water distribution mains leaving the plant in two directions. Plate and frame heat exchangers incorporate free-cooling application in swing seasons, utilizing condenser water from roof mounted cooling towers. Power supply to the chillers is arranged with two legs, so that only half of the chillers are subject to a power failure from separate utility sources. Additionally, all the chillers can be supported by emergency generator power. Building rainwater is collected and stored in underground tanks to reduce the amount of domestic make-up water that is purchased. Also, cooling coil condensate is collected from nearby buildings to supplement cooling tower make-up.

The Boiler Plant is designed for an ultimate capacity of 5000 BHP, with an initial capacity of 2500 BHP installed, in an N+1 configuration. Boilers are dual fuel (gas - #2 fuel oil), and furnish 140 psig steam to the campus. Steam is distributed via redundant and cross-connected high pressure steam mains, and redundant pumped condensate return mains.

The boiler plant is located directly above a 25 megawatt diesel generator room that provides emergency power to the campus. Outdoor air for generator cooling is directed via shaft from intakes near the roof, and discharge via shafts that exit above the roof. 60,000 gallons of fuel oil is stored in two underground vaults to support generators and boilers.

Cost \$27

notes

ASHRAE 2012 LEARNING INSTITUTE WINTER CONFERENCE COURSES – Full-Day Seminars & Half-Day Courses for In-Depth Instruction

All ASHRAE Learning Institute (ALI) courses will be held at either the Palmer House Hilton or McCormick Place. Courses will carry Continuing Education Units (CEUs), Professional Development Hours (PDHs), and/or American Institute of Architects Learning Units (AIA LUs) which can be applied toward maintaining your P.E. licensure.

Registration for the ASHRAE Learning Institute Courses being held at McCormick Place can be done at either ASHRAE registration at the Palmer House Hilton or at McCormick Place, North Hall Registration Lobby, 3rd Floor. Registration will open at McCormick Place on Sunday from 9:00 a.m.-3:00 p.m., Monday from 8:00 a.m.-6:00 p.m. and Tuesday from 8:00 a.m.-6:00 p.m. Online registration will close at midnight on the evening prior to the course.

Shuttle Service for the Sunday courses will operate from 1:00-1:30 p.m. on Sunday from the Palmer House Wabash entrance to McCormick and will operate from McCormick to Palmer House from 5:00-5:30 p.m. On Monday and Tuesday the shuttle service will run to McCormick all day. Please refer to the schedule located at the entrance of Wabash.

Please refer to the map in this program to assist in finding the rooms for the ALI Courses. All courses are in the South building.

FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS

Registration fees: \$485 per course

\$395 for ASHRAE members

Completion of the seminar earns 6 PDHs/AIA LUs or .6 CEUs
(check with your state for their continuing education credit requirements)

SATURDAY, JANUARY 21, 2012

The Commissioning Process in New and Existing Buildings (code 60)

**8:00 am – 3:00 pm, Palmer House Hilton
Adams Ballroom 6th Floor**

This introductory seminar focuses on how the building commissioning process can be applied cost-effectively to new construction and existing facilities. The seminar describes the fundamentals of the commissioning process through each step of a new construction project from pre-design to occupancy and operations. Also discussed is how the commissioning process in existing facilities differs from new construction. Learn about the benefits of commissioning and understand how the process can improve the built environment, reduce environmental impacts through responsible resource utilization, improve the quality of design and construction, and raise the professional reputation of the entire commissioning team. Commissioning documentation, including an overview of commissioning specifications for new construction, is discussed.

Instructor: Rick Casault, P.E., Member ASHRAE

Data Center Energy Efficiency (code 61)

8:00 am – 3:00 pm, Palmer House Hilton

Monroe Ballroom 6th Floor

Data centers are using an increasing amount of the total energy used by commercial facilities. However, these increases have a downside in that they cause a significant increase in the power required and the heat dissipated by the computing equipment, such that it is becoming very difficult to power and cool these systems in data centers or telecommunication rooms. This seminar examines the best practices for data center energy efficiency by focusing on thermal guidelines for data processing, datacom facility energy efficiency, and actual high density data centers in operation today. The seminar discusses equipment environment specifications and the methods for measuring performance and developing means to evaluate effectiveness of data center cooling. The use of the U.S. DOE's DCPro web-based energy modeling tools for data centers is discussed.

Instructors: Don Beaty, P.E., Member ASHRAE; and Roger Schmidt, Ph.D., P.E., Member ASHRAE, HFDP

Integrated Building Design (code 62)

8:00 am – 3:00 pm, Palmer House Hilton

Grant Park 6th Floor

This seminar provides a working knowledge of the integrated building design process, explaining the basic concepts involved and outlining the fundamental application of this approach. Course content explains the advantages and benefits of integrated building design, and how this process differs from conventional design practice. The seminar structure identifies the necessary sequencing and scope of activities that should be implemented to support development of collaborative solutions. In addition to design related philosophy, the seminar explores the critical elements of TEAM activity and management of collaborative teams. This seminar benefits any person who has a role in the planning, design, construction and operation of a built solution. Attendees are able to strategically position themselves in the marketplace by understanding the value of project fundamentals and the importance of holistic interdependencies. Emphasis is placed on transitioning traditional processes that aggregate isolated silos of knowledge into collaborative thought and shared outcome.

Instructors: Charles Gullledge, P.E., Member ASHRAE, HFDP; and Lisa Rosenow, Member ASHRAE

TUESDAY, JANUARY 24, 2012

Using Standard 90.1 to Meet LEED® Requirements (code 72)

9:00 am – 4:00 pm, McCormick Place, Room S105a

Appendix G, an informative appendix in Standard 90.1 added in 2004, is the focus of this course. Targeted toward design professionals and building owners, it provides specific guidance on the rules and procedures to simulate building energy use when the objective is to substantially exceed the requirements of 90.1. Appendix G is especially useful for energy simulations connected with LEED credits and U.S. energy tax credits. This course presents an overview of Appendix G and explains its use through several examples using eQUEST.

Instructors: Joseph Deringer, AIA, Member ASHRAE; and Mack Wallace, P.E., Member ASHRAE

Energy Modeling Best Practices and Applications (code 73)

(Co-sponsored by IBPSA-USA and RMI)

9:00 am – 4:00 pm, McCormick Place, Room S105bc

This seminar focuses on topics critical to the effective delivery of energy modeling services, including modeling fundamentals, ASHRAE Standard 90.1 Performance Rating Method, modeling best practices, modeling to inform design, and measurement and verification. With an objective to improve building energy modeling quality and consistency, this seminar combines methods with examples, case studies, tools and online resources that relate concepts to applications. The seminar objective is to improve building energy modeling quality and consistency.

Instructors: Kendra Tupper, P.E., Associate Member ASHRAE; and Erik Kolderup, P.E., Member ASHRAE

HALF-DAY SHORT COURSES

Registration fees: \$159 per course

\$119 for ASHRAE members

Completion of the course earns 3 PDHs/AIA LUs or .3 CEUs
(check with your state for their continuing education credit requirements)

SUNDAY, JANUARY 22, 2012

Understanding Air-to-Air Energy Recovery Technologies and Applications (code 63)

2:00 pm – 5:00 pm, McCormick Place, Room S105a

As we move towards net-zero energy buildings, air-to-air energy recovery provides one of the most cost-effective and efficient ways to recycle waste energy and create superior indoor environments. Unfortunately, these technologies remain underutilized and misunderstood. This course examines current and proposed standards, codes and guidelines, reviews commercially available technologies and explores how they can be employed in various configurations and applications to meet today's stringent energy and indoor environmental quality requirements.

Instructor: Paul Pieper, P.Eng., Member ASHRAE

Understanding & Designing Dedicated Outdoor Air Systems (DOAS) (code 64)

2:00 pm – 5:00 pm, McCormick Place, Room S105bc

This course presents some of the issues that emphasize the advantages of separate dedicated outdoor air systems (DOAS) and the disadvantages of delivering the ventilation via single all-air variable air volume systems. The course discusses the consequent issue of the thermodynamic state of delivered ventilation air that arises from the design paradigm of a separate DOAS.

Instructor: Stanley Mumma, Ph.D., P.E.,
Fellow/Life Member ASHRAE

Application of Standard 62.1-2010: Multiple Spaces Equations & Spreadsheet Calculations (code 65)

2:00 pm – 5:00 pm, McCormick Place, Room S105d

Applying ASHRAE Standard 62.1-2010 to multiple spaces can be challenging even for advanced HVAC practitioners. This new, advanced course covers the new Appendix A method and focuses on using the new spreadsheet from the 2010 Users Manual. The subject material includes both constant volume and VAV applications

and then examines certain cases where secondary recirculation applies. The course intent is to develop proficiency in using the spreadsheet tool for improving design solutions that will comply with the 2010 Standard. A copy of the spreadsheet will be provided and attendees are strongly encouraged to bring their laptops to learn the power of the spreadsheet and the effect on total outdoor air required when changing different design parameters. In-class exercises will be conducted, so attendees will benefit from using their own PC.

Instructor: Hoy Bohanon, P.E., Member ASHRAE

MONDAY, JANUARY 23, 2012

Basics of High-Performance Building Design (code 66)

8:30 am – 11:30 am, McCormick Place, Room S105a

This course focuses on the basic applications of Standards 90.1 and 189.1 to achieve High-Performance Building Design. The intent of this course is to explain the differences in purpose and requirements between 189.1 and 90.1. Course content should be suitable for architects and engineers.

Instructor: Tom Lawrence, Ph.D., P.E., Member ASHRAE

Complying With the Standard 90.1-2010: Envelope/Lighting (code 67)

8:30 am – 11:30 am, McCormick Place, Room S105bc

This course provides an overview of the entire standard and emphasizes the envelope and lighting topics and methods of compliance. Design professionals, code officials and building owners will benefit from this course. The 2010 standard is a major revision to 90.1 with a goal of saving 30% more energy than 2007 version.

Instructor: Joseph Deringer, AIA, Member ASHRAE

Energy Management in New and Existing Buildings (code 79)

8:30 am – 11:30 am, McCormick Place, Room S105d

This hands-on seminar prepares participants to apply energy management principles to their own facilities. The seminar discusses several energy management examples, allows additional time for questions, and includes 14 hands-on exercises. The examples include: a healthcare organization; a Chicago high-rise building; a Wisconsin insurance company; a Wisconsin convention center; and a Chicago elementary school. The 14 exercises reinforce the concepts and terminology presented in the seminar's lecture portion. The exercises include: energy management assessment; EUI and ECI questions; monthly electric and gas profiles; using motor logger data; evaluating impact of lighting changes; and weather normalization. The final exercise asks participants to outline what actions they can take immediately to improve the state of energy management in buildings under their care.

Instructor: Richard J. Pearson, P.E.,
Fellow/Life Member ASHRAE

Advanced High-Performance Building Design (code 68)

2:30 pm – 5:30 pm, McCormick Place, Room S105a

This course focuses on advanced concepts involved in applying Standards 90.1 and 189.1 to achieve High-Performance Building Design. More emphasis will be placed on specific case study examples in this portion of the course in order to help the students go beyond the minimum requirements of these standards. Course

content should be suitable for architects and engineers.
Instructor: Jeff Ross-Bain, P.E., Member ASHRAE, BEMP

The Commissioning Process & Guideline 0 (code 69) (co-sponsored with BCA, IES, NEBB)

2:30 pm – 5:30 pm, McCormick Place, Room S105bc

This course targets building owners, facility managers, design engineers, building designers, architects, equipment manufacturers, and others interested in the commissioning process as outlined in Guideline 0. The course focuses on process intent, activities and deliverables. It is intended as an entry-level course that will provide attendees with a fundamental background of the ASHRAE-promoted commissioning process—which may then be supplemented by attending a more advanced course (such as ASHRAE's existing full-day commissioning course).

Instructor: Walter Grondzik, P.E., Fellow ASHRAE

Complying with Standard 90.1-2010: HVAC/Mechanical (code 70)

2:30 pm – 5:30 pm, McCormick Place, Room S105d

This course presents the mechanical requirements from Standard 90.1-2010. Design professionals, code officials and building owners will benefit from this course, which presents the HVAC requirements and methods of compliance. The 2010 standard is a major revision with a goal of saving 30% more energy than the 2007 version. The HVAC/SWH sections of the standard, included in this course, have more than 50 updated requirements including first-time requirements for piping sizing.

Instructor: Mack Wallace, P.E., Member ASHRAE

Evaluating the Performance of LEED®-Certified Buildings NEW! (code 71)

2:30 pm – 5:30 pm, McCormick Place, Room S104b

This course provides an overview of performance verification methods under LEED EB/O&M and BD&C 2009 as well as a preview of LEED 2012. Existing buildings earn Energy & Atmosphere credits by achieving or exceeding a specific Portfolio Manager score based on actual energy use. For BD&C, projected energy use must be less than a particular threshold and can earn additional points through further energy reductions. This course describes the Energy & Atmosphere prerequisites and credits available related to achieving and verifying performance of LEED certified buildings under the EB/O&M and BD&C programs.

Instructor: Mark Stetz, P.E., Member ASHRAE

TUESDAY, JANUARY 24, 2012

Combined Heat & Power NEW! (code 74)

9:00 am – 12:00 pm, McCormick Place, Room S104b

Combined Heat and Power (CHP) is an efficient, clean and reliable approach to generating power and energy from a single fuel source. CHP is one of the most efficient ways to burn fuel since little energy is lost as waste heat. This course focuses on the fuel savings, emissions reduction, and decentralization of energy and power supply. The basic CHP terms and definitions, rating parameters, and energy conversion systems are discussed. The focus of this course is to understand thermal design for CHP systems and the types of technology that exist.

Instructor: Lucas Hyman, P.E., Member ASHRAE

Healthcare Facilities: Best Practice Design (code 75)

9:00 am – 12:00 pm, McCormick Place, Room S104a

Based on ASHRAE's publication *HVAC Design Manual for Hospitals and Clinics*, the fundamentals of healthcare heating and cooling systems design, basic methodology of HVAC design for isolation rooms, intensive care units and imaging rooms are introduced. The course will explain how healthcare HVAC systems can be designed with energy conservation strategies. Dealing with existing facilities, smoke and life-safety design issues complete the course. Attend the short course, Healthcare Facilities: Best Practice Applications, for additional information that is also covered in this ASHRAE publication.

Instructors: Robert Cox, P.E., Member ASHRAE; and
Daniel Koenigshofer, P.E., Member ASHRAE, HFDP

Project Management for Improved IAQ (code 76)

9:00 am – 12:00 pm, McCormick Place, Room S105d

This course covers the five strategies of Objective 1 of the *ASHRAE IAQ Guide, Best Practices for Design, Construction and Commissioning*. These strategies are: integrate design approach and solutions; commission to ensure that the owner's IAQ requirements are met; select HVAC systems to improve IAQ and reduce the energy impacts of ventilation; employ project scheduling and manage construction activities to facilitate good IAQ; and facilitate effective operation and maintenance for IAQ.

Instructor: Hoy Bohanon, P.E., Member ASHRAE

Healthcare Facilities: Best Practice Applications (code 77)

1:00 pm – 4:00 pm, McCormick Place, Room S104b

A must-attend for HVAC designers and engineers in the healthcare field. Based on ASHRAE's publication *HVAC Design Manual for Hospitals and Clinics*, this course introduces best practice HVAC applications in healthcare facilities. Air distribution design for surgical and patient rooms is a major focus. Various control and energy efficiency techniques for cooling and heating plants are presented along with O&M and other commissioning topics.

Instructors: Robert Cox, P.E., Member ASHRAE; and
Daniel Koenigshofer, P.E., Member ASHRAE, HFDP

Designing Toward Net-Zero Energy Commercial Buildings (code 78)

1:00 pm – 4:00 pm, McCormick Place, Room S105d

Net-zero energy buildings are those which, on an annual basis, use no more energy from the utility grid than is provided by on-site renewable energy sources. These buildings use 50% to 70% less energy than comparable traditional buildings. The remaining energy use comes from renewable sources, like solar panels or wind turbines incorporated into the facility itself. The course provides application knowledge of the design and operating principles for energy efficient buildings and available technologies and systems to achieve net-zero energy building design. Building design strategies, review of current policy and regulation, energy, environmental and economic assessment of building's performance, energy efficiency in HVAC, lighting and appliances, and on-site renewable energy sources are reviewed.

Instructors: Dunstan Macauley, P.E., Member ASHRAE, HBDP;
and Frank Mills, P.Eng., Member ASHRAE

ASHRAE WINTER CONFERENCE TECHNICAL PROGRAM Chicago – January 2012

Earn Professional Development Hour (PDH) credits by attending sessions listed in the Technical Program. Each hour attended in a session equals one PDH. For forums and other one-hour sessions, you must be present for the entire 50-minute program to earn a PDH. Sign-in sheets will be available in all session rooms for attendees to complete. New York State PDHs, AIA LUs and LEED AP credits are awarded for select sessions. Also, certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org. Your badge will be scanned as you enter the session and a summary of sessions attended will be emailed to you upon conclusion of the conference. The new scanning process may take a little longer to get into the room so have patience. Please keep track of the sessions that you attend at the conference.

Technical sessions are in the Palmer House Hilton. All sessions listed as starting at the same time are concurrent.

ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2012 WINTER CONFERENCE

Four types of sessions are presented:

Technical Paper Sessions.

These sessions present papers on current applications or procedures, as well as papers resulting from research on fundamental concepts and basic theory. Papers presented in these sessions have successfully completed a rigorous peer review. You are invited to comment on these papers. Forms for written comment are available at each session, and if received by February 10, 2012, comments will be sent to respective authors for reply and publication in ASHRAE Transactions. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference Preprints of papers and a Meeting Preprints CD are available for purchase in the ASHRAE Bookstore.

Conference Paper Sessions.

These sessions present papers on current applications or procedures, as well as papers reporting on research in process. These papers differ from technical papers in that they are shorter in length and undergo a much less stringent peer review. PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints of conference papers and a Meeting Preprints CD are available for purchase in the ASHRAE Bookstore. Conference papers will be published in ASHRAE Transactions but without comments.

Seminars.

Seminars feature presentations on subjects of current interest. Papers are not available from the Society; however, seminar PowerPoint presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Access is free for attendees who purchase a conference registration. Additional Virtual Conference registrations can be purchased in the ASHRAE Registration.

Forums.

Forums are “off-the-record” discussions held to promote a free exchange of ideas. Reporting of forums is limited to allow individuals to speak confidentially without concern of criticism. There are no papers attached to these forums.

VIRTUAL CONFERENCE

Free for Paid Conference Registrants

ASHRAE is offering a virtual conference option so you won't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program. The Chicago Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All conference attendees paying the full registration fee should have received via email their password and link prior to arriving in Chicago. If you do not have your password and link Go to www.ashrae.org/chicagovirtual and click on the link to access the Virtual Conference and put in your email address to request your password.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations
- Access to all seminar, technical paper and conference paper presentations
- Access to posters presented in the poster session
- Ability to post questions or answers for selected sessions through Friday, Feb. 17. Presentations available online for 18 months.

A full slate of technical programs will be posted beginning Monday, Jan. 23, of the sessions that were presented the previous day, with additional content posted through Wednesday, Jan. 25.

On-site registration is available for those who would like to purchase the Virtual Conference. To sign up, go to ASHRAE Registration, Hilton, Upper Exhibit Hall, 4th floor, \$299 ASHRAE member; \$464 non member. If you register on site, you will be able to log on the www.ashrae.org/chicagovirtual to request your password within 24 hours of your registration.



Winter Conference CD (All Papers on CD)

Technical Paper, Conference Paper and Poster Session papers as presented at this Conference

\$98 (includes five FREE hard copies of preprint papers)

Available at the Conference Bookstore



Conference Seminar DVD

54 Seminars (PowerPoint files synced with speakers' audio)

\$109 (ships April 2012)



Conference Preprints (Individual Papers, In Print)

Technical Paper, Conference Paper and Poster Session papers as presented at this Conference

\$6 each

Available at the Conference Bookstore



ASHRAE Transactions (Print Volume)

Technical Paper and Poster Session papers with discussion questions and answers for papers in bound, library-quality form. Includes Conference Papers without discussion.

\$119 (ships May 2012)



Approved for New York State Professional Development Hours (PDHs) and American Institute of Architect Learning Units (LUs)



GBCI LEED AP CE Credits

Packages

1. Winter Conference CD and ASHRAE Transactions
(See descriptions at left.)

Get five FREE hard copies of preprint papers when you purchase this package

\$159 – Available at the Conference Bookstore

2. Winter Conference CD and Seminar DVD

\$159 – Purchase in the Conference Bookstore

3. Winter Conference Package

(Seminar DVD, Conference CD and ASHRAE Transactions)

\$199 – Purchase in the Conference Bookstore

All prices are special conference-only member prices.

Sunday, January 22

8:00 AM-9:30 AM

Technical Paper Session 1 (Advanced)

Estimating Potential Energy Savings in Central Energy Plants, Cooling Tower Fans and HPWH by Simulation Modeling

Track: Energy Modeling Applications



Room: Crystal

Chair: Bill Dean, National Research Council of Canada, Saskatoon, SK, Canada

This session investigates the opportunity to look at potential energy savings in central plants by looking at two central chilled water sites using simulations to determine potential savings opportunities. In addition, HPWH modeling is examined to compare the existing modeling method to a laboratory study. In addition this session will also attempt to answer a question on cooling tower fans from the 2007 ASHRAE Applications Handbook.

1. Heat Pump Water Heater Technology Assessment Based on Laboratory Research and Energy Simulation Models (CH-12-001)

Kate Hudon, Bethany Sparn, Dane Christensen, Ph.D. and Jeff Maquire, National Renewable Energy Laboratory, Golden, CO

2. Simulation Modeling of a Central Chiller Plant (CH-12-002)

Kirby P. Nelson, P.E., Life Member, KBTU, Springfield, MO

3. Simulation Modeling of Central Chilled Water Systems (CH-12-003)

Kirby P. Nelson, P.E., Life Member, KBTU, Springfield, MO

4. Modeling Results of Proposed Changes to SIUC Central Heating, Air Conditioning, and Power Plant Incorporating Variable Frequency Drives and High Efficiency Turbine (CH-12-004) (WITHDRAWN)

Heyin Su, James Mathias, Ph.D. and Justin Harrell, Southern Illinois University, Carbondale, IL

Technical Paper Session 2 (Intermediate)

Fundamentals and Applications

Track: HVAC&R Fundamentals and Applications



Room: Water Tower

Chair: Julia Keen, Member, Kansas State University, Manhattan, KS

This session combines two topics relevant to HVAC&R Fundamentals and Applications: The first presentation covers correlation equations that can be used to determine thermodynamic properties of ammonia water mixtures for analysis of adsorption system performance. The second presentation establishes the impact of short periods of high metabolic rates on thermal comfort.

1. New Correlation Equations for Ammonia Water Vapor-Liquid Equilibrium (VLE) Thermodynamic Properties (CH-12-005)

Syed Said, M. A. El-Shaarawi, Ph.D. and Muhammad Umar Siddiqui, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia

2. An Empirical Thermal Comfort Model for Transient Metabolic Conditions (CH-12-006)

Ahmet Ugursal, Ph.D. and Charles Culp, Ph.D., Member, Texas A&M University, College Station, TX

Seminar 1 (Intermediate)

2011 Solar Decathlon:

Lessons for Net Zero Residential Structures

Track: High Performance Buildings



Room: Salons 4/5

Sponsor: 06.07 Solar Energy Utilization, 02.08 Building Environmental Impacts and Sustainability

Chair: Janice K. Means, P.E., Member, Lawrence Technological University, Southfield, MI

Representative teams from the 20 international entries in the 2011 Solar Decathlon present the design, construction and performance of their high performance residential building entries. Students present their experience in the competition, their employment of computerized energy analysis and

automation systems, integrated new solar (and other) technologies and techniques to maximize utilization of small living spaces while minimizing their impact on the environment. ASHRAE is one of the sponsors of the U.S. Department of Energy's 5th Solar Decathlon, which was first held in the fall of 2002 and then biennially in Washington, DC., beginning in 2005.

1. **University of Tennessee's Living Light House – the Design and Analysis of a Net Zero Energy Home for the 2011 Solar Decathlon**
Steven E. Coley, Student Member, University of Tennessee, Knoxville, TN
2. **Team China's Y Container 2011 Solar Decathlon House**
Lei Yong, Tongji University, Shanghai, China
3. **Chip: A Californian Net-Zero Energy House**
Fei Yang, California Institute of Technology, Los Angeles, CA
4. **Ohio State Solar Decathlon Encore House: Design, Implementation, and Performance of An Integrated Solar Thermal Hot Air System with Desiccant Dehumidification and Phase Change Material Thermal Storage**
Matthew O'Kelly, Student Member, Ohio State University, Columbus, OH

Seminar 2 (Intermediate)

Highly Energy Efficient Buildings, Part 1: Case Studies of Highly Energy Efficient Buildings in Various Countries: Impediments and Opportunities

Track: High Performance Buildings

Room: Monroe

Sponsor: ASHRAE Associate Alliance Society

Chair: Branislav Todorovic, Ph.D., Life Member, University of Belgrade, Belgrade, Serbia



In different parts of the world there are newly constructed buildings with very high levels of energy performance. These buildings have low needs of energy and use renewable sources, resulting not only in low energy consumption but also achieve high levels of thermal comfort, daylighting, and good acoustics. Embodied energy in building materials is considered in life cycle energy use. Case studies of new buildings in India and Latvia are presented along with the study of a building in Pakistan from over 400 years ago which could be cited as one of the first high efficiency buildings in history. It features an array of passive systems, including natural ventilation with venturi effects for air distribution, daylighting and reflective lighting as well as superb acoustics.

1. **ECO Commercial Building: Case Study of India's First Net Zero Energy Building**
Ashish Rakheja, P.E., Member, Chief Operating Officer of Spectral, New Delhi, India
2. **The Most Energy Efficient Building in Latvia**
Egils Dzlezitis, Dr. Ing., Member, Latvian Enterprise of Advanced Heat, Riga, Latvia
3. **High Performance Buildings from the Past: The Mughal Fort at Lahore in Pakistan**
Farooq Mehboob, P.E., Member, S.Mehboob & Company, Karachi, Pakistan

Seminar 3 (Intermediate)

Liquid Cooling Technologies to Enable High Density and Improve Energy Efficiency of Information Technology Data Center Facilities

Track: Specialized Applications – Healthcare, Laboratories, and Data Centers

Room: Empire

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: Roger R. Schmidt, Ph.D., P.E., Member, IBM Corporation, Poughkeepsie, NY



Information Technology (IT) data centers consume a large amount of electricity in the U.S. and worldwide of which cooling use about one third. Thus, the thermal management and energy efficiency of data center systems is of growing importance. In addition to their energy related challenges, the heat flux of electronic devices and the volumetric heat density of servers and the racks that house them are also rapidly increasing for many applications. Technologies like liquid cooling that enhance energy efficiency and cooling

performance of the electronic equipment and data centers will be critical to the future success of the IT industry.

1. Liquid Cooling Guidelines Developed by the ASHRAE TC 9.9 Committee

Roger R. Schmidt, Ph.D., P.E., Member, IBM Corporation, Poughkeepsie, NY

2. Economizer Based Server Liquid Cooling to Enable Significant Data Center Energy Savings

Madhusudan Iyengar, Ph.D., Member, IBM, Poughkeepsie, NY

Seminar 4 (Basic)

Water-Cooled VRF Systems: An Introduction

Track: HVAC&R Systems and Equipment

Room: Adams

Sponsor: 08.07 Variable Refrigerant Flow

Chair: David Heckler, Associate Member, Comfort Supply Inc, Pittsburgh, PA



The session reviews the fundamentals of water-cooled variable refrigerant systems as utilized for comfort heating/cooling applications in buildings across North America. The seminar also evaluates the performance potential of the system from a comfort and energy efficiency perspective.

1. Water-Cooled VRF: The Fundamentals

Dermot McMorro, P.Eng., Member, Mitsubishi Electric Canada, Markham, ON, Canada

2. Water-Cooled VRF: Design and Application Potential

Kenny Smith, P.Eng., Associate Member, Stantec Consulting, Toronto, ON, Canada

3. Water-Cooled VRF Systems: A Case Study

Claude Routhier, P.Eng., Member, Poly-Energie Inc, Quebec, QC, Canada

Seminar 5 (Advanced)

What Is the Right Degree of Automation in Building Operations: A Debate and Discussion

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Wabash

Sponsor: 07.03 Operation and Maintenance Management, 01.04 Control Theory and Application

Chair: Angela Lewis, Student Member, University of Reading, Alexandria, VA



We depend on increasingly intelligent controls to work automatically -- from the simple night setback by a programmable thermostat to implementation of much more complex algorithms by a BAS. However, is there such a thing as too much automation? How does automation apply to building operations and maintenance tools to support high performance, sustainable buildings? Should all building operations and management practices be automated? Or, will some practices always require some level of human interaction? Perhaps there is a balance point? A debate and discussion of opposing views of automation practices versus the need for building operator intervention is presented.

1. The Role of Automation in Building Operations

Michael R. Brambley, Ph.D., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA

2. The Role of Human Interaction in Building Operations

Michael F. Bobker, CEM, Member, Cuny Building Performance Lab, New York, NY

Sunday, January 22

9:45 AM-10:45 AM

Technical Plenary (Basic)

Industry Impact: Chicago's Energy-Efficient, Economic Model for Sustainability

Track: High Performance Buildings

Room: Adams

Chair: Ben Leppard, P.E., Member, Leppard Johnson & Associates, Tucker, GA

Industry Impact: Chicago's Energy-Efficient, Economic Model for Sustainability

Erin Lavin Cabonargi, Public Building Commission of Chicago, Chicago, IL

Reaching Mayor Emanuel's goal of doubling the number of LEED buildings may capture the headlines in the Chicago newspapers, but the real story is the 100+ existing building capital program to increase energy savings through energy efficiency improvements. Based on the successful retrofit of the Richard J. Daley Center energy service company (ESCO) project, the Public Building Commission (PBC) has launched a Multi-Agency Guaranteed Energy Performance Contracting Program to retrofit municipally-owned buildings throughout the City of Chicago. These initiatives focus on the City's greatest concern, help drive the market in the understanding and use of green design and reinforce ASHRAE's efforts in High Performance Buildings.

Sunday, January 22

11:00 AM-12:30 PM

Conference Paper Session 1 (Advanced)

Data Centers: Energy Recovery, Static Pressure Control and Hydrothermal Potential

Track: Specialized Applications – Healthcare, Laboratories, and Data Centers



Room: Empire

Chair: Nick Gangemi, P.E., Member; Data Aire, Maitland, FL

Data Centers account for an ever increasing consumption of energy. With continued advances in server technology the requirements for power and cooling will increase, almost exponentially, over the next several years. Continuing to do things in the same fashion will no longer be an option. This session will explore three areas that offer significant increase in energy efficiency, if understood and properly used. First we'll discuss divorcing the control of the fans in CRAH or CRAC units from the control of the coil or coil and compressors. When done properly we can much closer match CRAH/CRAC cfm to server cfm. Secondly we will take an in depth look at several means of recovering the waste heat from servers. Different data centers offer different opportunities and the ability to match the correct technology determines the degree of savings and simplicity of control. Lastly we will explore the opportunities offered by utilizing hydrothermal energy. The possibility for a "net-zero" energy data center will be discussed and analyzed.

1. The Benefits of Static Pressure Control In Data Centers (CH-12-C001)

David L. Moss, Member, Dell, Roundrock, TX

2. Data Center Air Energy Recovery Techniques (CH-12-C002)

John C. Peterson, P.E., Member¹, Doug K. McLellan, P.E., Member² and Ecton English, P.E., Member³, (1)Hewlett Packard, Takoma Park, MD, (2) Hewlett Packard, Herndon, VA, (3)Department of Defense, Ft. Meade, MD

3. The Prospect of Hydrothermal Net-Zero Energy Data Centers (CH-12-C003)

Tadeusz Jagusztyń, Member, Cotherm of America Corporation, Fort Lauderdale, FL

Conference Paper Session 2 (Advanced)

Heat Pump Optimization

Track: HVAC&R Systems and Equipment



Room: Adams

Sponsor: TGI Optimization

Chair: Ram Narayanamurthy, PVT Solar, Berkeley, CA

The session deals with design and testing of energy efficient heat pump design. Three different research facets of heat pumps are evaluated here. The first deals with improving efficiency through control system optimization using MATLAB. The second looks at improving the efficiencies of two key heat pumps applications – one being ground source heat pumps and the other being heat pumps for cold climates. Heat pumps suffer from much reduced efficiencies in cold climates, and this paper discusses how to optimize the design to improve capacity and efficiency in these cold climates. The simulations are then compiled into a pareto of options to improve system efficiencies. The third paper discusses long term monitoring of a combination of ground source heat pumps with water heating. The paper looks at the comparison to manufacturer

listed COPs and the actual as-observed performance. The water heating efficiency is improved through a desuperheater operated with the ground source heat pump.

1. Real Time Optimization of Building Combined Heat and Power Systems (CH-12-C004)

Payam Delgoshahi, Ph.D., Associate Member¹, Stephen J. Treado, Ph.D., P.E., Member¹ and Andrew W. Windham, Student Member², (1)The Pennsylvania State University, University Park, PA, (2)The Pennsylvania State University, State College, PA

2. Cold Climates Heat Pump Design Optimization (CH-12-C005)

Omar Abdelaziz, Ph.D., Associate Member and Bo Shen, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

3. Residential Ground Source Heat Pumps with Integrated Domestic Hot Water Generation: Performance Results From Long Term Monitoring (CH-12-C006)

David A. Stecher¹ and Kate Allison², (1)IBACOS, Inc., Pittsburgh, PA, (2) University of Connecticut, Storrs, CT

Seminar 6 (Intermediate)

Cutting-Edge Japanese Technologies, Part 1: Japan After the Earthquake Crises and SHASE Awarded High-Performance Buildings

Track: High Performance Buildings



Room: Monroe

Chair: Shinsuke Kato, Ph.D., Fellow ASHRAE, University of Tokyo Institute of Industrial Science, Tokyo, Japan

The purpose of this session is to explain the latest Japanese HVAC and environmental technologies. However, first, we explain the situation in Japan after the terrible earthquake that occurred on March 11, 2011. Then, we discuss two high-performance buildings that were awarded the SHASE Annual Award in 2011. One is a library building that uses natural energy and thermal environmental properties for meeting its energy requirements. The other is a new shopping center that was designed as a "model eco shopping mall" by using a variety of environmental technologies, including passive energy, recycled materials and greenery use.

1. Report on the Damage Caused by the Great East Japan Earthquake, and Power Management in Tokyo

Masaya Okumiya, Ph.D., Member, Nagoya University, Aichi, Japan

2. Evaluation of the Environment Symbiotic Library Building: "the FUKUYAMA Project"

Kitaro Mizuide, Ph.D., P.Eng., Nikken Sekkei, Osaka, Japan

3. Environmental Planning of High-Performance Shopping Mall in Kusatsu-City

Takashi Shinojima, Takenaka Corporation, Osaka, Japan

Seminar 7 (Intermediate)

Has Your TRAINING Left the Station?

Track: Installation, Operation & Maintenance of HVAC Systems



Room: Wabash

Sponsor: 07.03 Operation and Maintenance Management

Chair: Thursten D. Simonsen, P.E., Member, Johnson Controls Inc., Austin, TX

As the industry moves toward green high performance buildings, HVAC equipment and systems are becoming more specialized and customized. Core operating knowledge incubated by design engineers during the design and build processes must be organized, documented, and transferred to the building owner, operation and maintenance staff to ensure systems will be understood, and operated as designed. This seminar provides guidance about how to bring the O&M staff on-board, provides initial and on-going training to maintain high performing systems throughout the building life cycle, and how the Federal Buildings Personnel Training Act may impact some of these processes.

1. Lessons Learned: A Facility Manager's Perspective on Training and Commissioning

Steven Pataki, Member, Toronto Cricket Skating And Curling Club, Toronto, ON, Canada

2. GSA Leads Response to the Federal Buildings Personnel Training Act: Aligning Core Competencies to Complex High Performance Buildings
Martin Weiland, P.E., Member and John Simpson, P.E., Member, General Services Administration, Washington, DC

3. Lessons Learned From Building Re-Tuning Training
Srinivas Katipamula, Ph.D., P.E., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA

Seminar 8 (Basic)

Make the Most of Your ASHRAE Experience

Track: Professional Skills

Room: Water Tower

Sponsor: Conferences and Expositions Committee

Chair: Alan Veeck, Member, MVA Inc., Virginia Beach, VA

What's the purpose of ASHRAE? How is it structured? What's a TC, SPC and all the other acronyms I hear? Where is the AHR Expo? And, how does this all fit together? This seminar is perfect for first-time attendees or anyone else who would like to get more out of their ASHRAE Winter Conference experience.



Seminar 9 (Basic)

Streamlining BIM through Open Information Exchanges, Part 1

Track: Integrated Design

Room: Crystal

Sponsor: 07.01 Integrated Building Design

Chair: Angela Lewis, Student Member, University of Reading, Alexandria, VA

Defining standard BIM requirements for HVAC-related systems and products is an important step in streamlining the information in BIM. This session introduces a two-part series on building information modeling, with a focus on information exchanges. This seminar starts with an overview of the buildingSMART alliance, which supports collaboration and the development of open standards. Then, two open information exchanges are discussed, COBie and LCie. The construction operations building information exchange (CO-Bie) supports information handover between designs. Life cycle information exchange (LCie) supports information exchanges across the building life cycle.

1. buildingSMART Alliance Overview

Deke Smith, buildingSMARTalliance, Washington, DC

2. Life Cycle Information Exchange

Bill East, Ph.D., P.E., Engineer Research and Development Center, Champaign, IL

3. Construction Building Information Exchange

Danielle Love, Construction Engineering Research Laboratory, Champaign, IL



Seminar 10 (Intermediate)

The ASHRAE Certification Program: Here to Help You

Track: Professional Skills

Room: Salons 4/5

Sponsor: Certification Committee

Chair: David B. Meredith, P.E., Member, Penn State Fayette, Uniontown, PA

Many ASHRAE members are not aware of the value that ASHRAE certification can add to their professional credentials. This session informs the attendees on how they can benefit from certification, what topical areas are currently available, where to obtain study materials to prepare for an exam, how to register for an exam and where they can take it. Background on how the "body of knowledge" is defined, how the questions are written and exams are assembled and scored are provided.

1. ASHRAE's Certification Programs

Tim Wentz, Ph.D., Member, University of Nebraska – Lincoln, Lincoln, NE

2. Certification Exam Development: Behind the Scenes

Amy Musser, Ph.D., P.E., Member, Vandemusser Design, PLLC, Asheville, NC



3. How and Why I Became an ASHRAE Certified Professional
George Austin, Engineering, David Shultz Associates, Charlotte, NC

Sunday, January 22

1:30 PM-3:00 PM

Conference Paper Session 3 (Intermediate)

How Regulations and Policies are Promoting Sustainable Energy Use and High-Performance Buildings Around the World

Track: Energy Efficiency –
New Technologies and Applications

Room: Monroe

Sponsor: 06.07 Solar Energy Utilization,
ASHRAE Associate Alliance Society

Chair: Marija S. Todorovic, Ph.D., University Of Belgrade, Belgrade, Serbia



Sustainable energy use based on the inextricable linkage of energy efficiency and renewable (solar and other RES) implementation, as well as the thermal and electrical energy are to be covered. Session goal is to answer the question "How regulations and policies, at the governmental and municipal level, can promote sustainable energy use and high performance buildings around the world. Is buildings sector (urban and rural) strategic energy planning worldwide appropriate or should it be more "offensive" concerning the current RES technologies and RES technical potential status, demonstration and commercialization, as well as successful decades of RES systems reliable operation, particularly in buildings sectors. Special attention will be drawn to the high IEQ-HVAC (high indoor environment-HVAC) buildings and their further "greening to approach NZEB" dependence on the further commercialization and implementation of RES technologies and RES integrated approach (from modeling through end designs and construction to the operational optimization via BEMS). Not less important are complex energy systems of the combined RES based central utilities energy generation and buildings distributed pure RES or hybrid (fossil and RES based) co-generation. Solar and other RES natural and technical potentials, locally available, are mainly in all world regions well determined and consequently many Governments Strategic Energy Plans are predicting important target - percentage growth of RES utilization in building sector and total.

1. Large Scale Residential/Municipal RES Integrated Refurbishment Construction and HVAC Systems Engineering R&D Needs (CH-12-C007)

Marija S. Todorovic, Ph.D., University Of Belgrade, Belgrade, Serbia

2. Status of Renewable Energy Systems in the United States (CH-12-C008)

Kent Peterson, P.E., Presidential/Fellow Life Member, P2S Engineering, Inc., Long Beach, CA

3. The Role of Solar and Other RES (Renewable Energy Sources) On the Strategic Energy Planning: Africa's Status and Views (CH-12-C009)

Essam E. Khalil, Ph.D., Fellow ASHRAE, Cairo University, Cairo, Egypt

4. Renewable Energy Sources within Urban Areas: Results from European Case Studies (CH-12-C010)

Ursula Eicker, Ph.D., University of Applied Science, Stuttgart., Germany

Conference Paper Session 4 (Intermediate)

ID: Goals, Obstacles and Lessons Learned

Track: Integrated Design

Room: Salons 4/5

Sponsor: 07.01 Integrated Building Design

Chair: Michel Tardif, P.Eng., Member, CanmetENERGY Natural Resources Canada, Ottawa, ON, Canada



This session wants to highlight some of the obstacles that an IPD can raise among the design team. Facilitation, contracts and insurability are issues that are thoroughly investigated. The lessons learned from two different case studies also are presented. The two high performance buildings show how they were built on Integrated Design to achieve this outstanding result.

1. Integrated Building Design In Tropical Climates: Lessons Learned from the ENERPOS Net Zero Energy Building (CH-12-C011)

Francois Garde, Ph.D., P.E., Member¹, Srinivas Katipamula, Ph.D., P.E., Fellow ASHRAE² and Eric Ottenwelter, P.E.³, (1)University of La Reunion, Le Tampon, France, (2)Pacific Northwest National Laboratory, Richland, WA, (3)Inset, St-Denis, Reunion

2. Integrated Project Delivery: The Obstacles of Implementation (CH-12-C012)

Amanda J. Fish and Julia Keen, Member, Kansas State University, Manhattan, KS

3. Aggressive Building Performance Goals Met Through Integrated Design-Build Delivery Process (CH-12-C013)

Duane D. Allen¹, Todd Stine², Christopher Flint Chatto³, Jack Avery³, Charles Chaloeicheep, P.E., Member⁴, **Kimberly Paulson, P.E., Associate Member⁵** and Tom Boysen, P.E.⁶, (1)U.S. General Services Administration, Auburn, WA, (2)ZGF Architects LLP, Seattle, WA, (3)Sellen Construction Company, Seattle, WA, (4)Built Ecology, San Francisco, CA, (5)WSP Flack + Kurtz, Seattle, WA, (6)University Mechanical Contractors, Mukilteo, WA

Conference Paper Session 5 (Intermediate)

HPB: Retrofit, Passive House, Performance Measurement Protocol

Track: High Performance Buildings

Room: Water Tower

Chair: David S. Eldridge, P.E., Member, Grumman Butkus Associates, Evanston, IL

The evolving field of design of high performance buildings requires advancing the use of technology on multiple fronts to provide building owners with facilities that meet their performance goals. The session will provide examples of strategies in several areas. A case study will be presented relating to quantifying the results of a performance evaluation according to ASHRAE's Performance Measurement Protocols. Another paper presents an evaluation of a residential low-energy standard at a location in Urbana, IL including applicability to the standard as shown by monitoring in the subject building. One paper discusses potential methods of retrofitting a historic university building to achieve low energy usage during a modernization project. Energy savings strategies included for envelope, lighting, and HVAC systems. Another aspect of high-performance building will be discussed pertaining to providing cost effective methods of smoke control, including natural ventilation. Natural venting is a growing area of interest in green buildings, with several design approaches to be considered based on project constraints. By saving project costs related to smoke control, investment in other low energy building features may be enhanced.

1. Atrium Smoke Management Natural Venting Challenges (CH-12-C014)

Ray Sinclair, Ph.D., Member and Xiangdong Du, Dr.Eng., P.Eng., RWDI, Guelph, ON, Canada

2. How to Make a 155 Year Old Building a High Performance Building (CH-12-C015)

Michael E. Lubbehusen, P.E., Member¹ and Terry Thornsbury², (1)Primary Engineering, Inc., Fort Wayne, IN, (2)Viridian Architectural Design, Fort Wayne, IN

3. Maximum Residential Energy Efficiency: Performance Results from Long Term Monitoring of a Passive House (CH-12-C016)

David A. Stecher¹ and Kate Allison², (1)IBACOS, Inc., Pittsburgh, PA, (2)University of Connecticut, Storrs, CT

4. Field-Test of the New ASHRAE/CIBSE/USGBC Performance Measurement Protocols for Commercial Buildings: Basic Level (CH-12-C017)

Hyojin Kim, Student Member and Jeff S. Haberl, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX

Seminar 11 (Intermediate)

Exergy Analysis for Sustainable Buildings

Track: High Performance Buildings

Room: Empire

Sponsor: 07.04 Exergy Analysis for Sustainable Buildings

Chair: Diotima von Kempfski, Member, DVK, Dusseldorf, Germany



There is an obvious and indisputable need for an increase in the efficiency of energy utilization in buildings. Heating, cooling and lighting appliances in buildings account for more than one third of the world's primary energy demand. In turn, building stock is a major contributor to energy-related environmental problems. The low exergy approach entails matching the quality levels of exergy supply and demand, in order to streamline the utilization of high-value energy resources. According to the U.S. DOE statistics, healthcare buildings are one of the most energy-extensive buildings all over the world.

1. Describing the Real Energy Efficiency of a Fuel Cell Based Micro-CHP Unit in Residential Buildings

Klaus Sommer, Ph.D., Institute of Building Services Engineering, Cologne University of Applied Sciences, Germany, Cologne, Germany

2. Exergy-Based Optimum Tri-Generation Retrofit for a Hospital Building for Sustainability

Birol Kilkis, Ph.D., Fellow ASHRAE, Baskent University, Ankara, Turkey

3. Integration of Low Exergy Systems in High Performance Buildings and Communities

Dietrich Schmidt, Ph.D., Member, Fraunhofer-Institute for Building Physics, Kassel, Germany

Seminar 12 (Intermediate)

Streamlining BIM through Open Information Exchanges, Part 2

Track: Integrated Design

Room: Crystal

Sponsor: 07.01 Integrated Building Design

Chair: Elyse Malherek, Associate Member, McQuay, Minneapolis, MN

Defining standard Building Information Modeling (BIM) requirements for HVAC related systems and products is an important step in streamlining the information in BIM. This session completes a two-part series on information exchanges developed to support BIM. The seminar includes research on applying open standard data models for HVAC systems throughout the life cycle using widely available software tools, explains how to assemble high performance building product manufacturer data for use in BIM, and explores how to incorporate sensor and meter data into BIM models after building occupancy for analysis and comparison with facility design.

1. Building Information Modeling for HVAC Systems Design to Operations

Robert J. Hitchcock, Member, Hitchcock Consulting, Kelsey, CA

2. High Performance Product Information Exchange

Kristine Fallon, Kristine Fallon Associates, Chicago, IL

3. Smart Resource Utilization Architecture

Chris Bogen, Ph.D., U.S. Army Corps of Engineers, Vicksburg, MS

Seminar 13 (Intermediate)

Sustainability in Commercial Buildings: Integration Measures for Bridging the Gaps in Performance from Design to Operations

Track: High Performance Buildings

Room: Wabash

Sponsor: 07.03 Operation and Maintenance Management

Chair: Om Taneja, Ph.D., P.E., Member, US, General Services Administration, Manhattan Service Center, Manhattan, NY

This seminar presents various qualitative and quantitative measures that can be practiced to improve and sustain performance of all building systems and infrastructure elements. All too often a building's energy performance does not meet design expectations, particularly a new building's energy savings projection that overstates achievable performance. Across the high-performing building industry, these unrealistic energy performance goals have come from, among other things, inadequate modeling and benchmarking practices, unreliable monitoring and equipment controls systems, significant changes in space usage and processes during occupancy and tenant improvements and failure to include operations staff in goal setting.

1. High Performance and Green Buildings Energy Performance Gaps: Liabilities and Ways to Bridge the Gaps

Larry Spielvogel, P.E., Fellow Life Member, Consulting Engineer, Bala Cynwyd, PA



2. Integrated Measurements, Operations and Maintenance Practices for Sustenance of High Performance for Buildings

Om Taneja, Ph.D., P.E., Member, US, General Services Administration, Manhattan Service Center, Manhattan, NY

3. Commissioning for New and Existing Buildings

Ronald Wilkinson, P.E., Member, AKF Engineers, New York, NY

Seminar 14 (Intermediate)

Why Are We Overcooling Buildings in Summer?

Track: HVAC&R Fundamentals and Applications

Room: Adams

Sponsor: 02.01 Physiology and Human Environment, ASHRAE Standard 55

Chair: Hui Zhang, Ph.D., Member, University of California, Berkeley, CA

Studies conducted by Lawrence Berkeley National Laboratory and Carnegie Mellon have found that many office buildings are being overcooled in summer, consuming large amounts of energy and making occupants uncomfortable and even sick. The summer overcooling happens in both hot/humid and hot/dry climates, in the U.S., Singapore, and elsewhere in the world. In this seminar, panelists discuss engineering challenges that may necessitate a relook at the way air-conditioned buildings in such climates are designed. The presentations 1) look at the possible reasons why the summer overcooling is happening, from social, cultural, operational, system and control design, and psychological and physiological reasons, 2) review some of the fundamental issues of cooling and dehumidification facing the HVAC designer, leading to the inevitable oversized system and its undesirable consequences in terms of an overcooled indoor environment, 3) discuss possible solutions to creating a more thermally comfortable and healthy indoor environment that can also save energy, and 4) discuss how ASHRAE and international standards might be involved to stop the summer overcooling happening in practice.

1. Oversized Air-Conditioning Systems and Overcooled Buildings in Hot and Humid Climates

Chandra Sekhar, Member, National University of Singapore, Singapore, Singapore

2. International Perspectives, Avoidance of Overcooling and Developing Appropriate Thermal Comfort Standards

Kenneth C. Parsons, Ph.D., Member, Loughborough University, Loughborough, United Kingdom

3. Why Is it too Cold? Explanations and Solutions

Gwelen Paliaga, Member, Taylor Engineering, LLC, Alameda, CA

Sunday, January 22

2:00 PM-3:00 PM

Forum (Basic)

What Should Be Included in the Handbook Chapter on Optimization?

Track: HVAC&R Fundamentals and Applications

Room: Price

Sponsor: TGI Optimization

Chair: Vikrant Aute, Ph.D., Member, University of Maryland, College Park, MD

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. The term optimization is generally defined as the act or method of making something as effective as possible. The rigorous definition refers to the use of systematic mathematical techniques to find the minimum or maximum value of a function. This function could be energy efficiency, first cost, etc. In the HVAC&R community, the term optimization is largely used to describe a trial and error or parametric analysis approach. TGI Optimization focuses on HVAC&R optimization and is working towards increasing the membership awareness of available optimization techniques. TG seeks members' feedback on the scope of an ASHRAE handbook chapter on Optimization Techniques.

Sunday, January 22

3:00 PM-4:00 PM

Forum (Intermediate)

Low GWP Refrigerants: Current Status and Future Path

Track: Refrigeration

Room: Salons 4/5

Sponsor: 01.03 Heat Transfer and Fluid Flow, 08.05 Liquid-to-Refrigerant Heat Exchangers

Chair: Omar Abdelaziz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. There is a resurgence of efforts to find alternative low global warming potential (GWP) refrigerants to replace HFCs. The driver for previous refrigerant transition was ozone depletion Potential (ODP); hence a clear target was set to use zero ODP. In the current effort, the target is to reduce the GWP associated with direct and indirect emissions. This resulted in a complex target: lower life cycle climate performance. Low GWP refrigerants' performance is still debatable; it is not clear which refrigerants to use. This forum brings ideas and experts together to open avenues for future ASHRAE research towards low GWP systems. The moderators are Lorenzo Cremaschi for TC 1.3 and Omar Abdelaziz for TC 8.5.

Sunday, January 22

3:15 PM-4:15 PM

Seminar (Basic)

ASHRAE Foundation: Creating a High Performance Legacy

Track: Professional Skills

Room: Water Tower

Chair: Margaret Smith, Associate Member, ASHRAE, Atlanta, GA

OPEN SESSION. NO BADGE REQUIRED. Have you considered a planned gift to ASHRAE Foundation? Perhaps you haven't considered a gift, but you're curious about the current state of the economy as it relates to your estate plans. Join ASHRAE Foundation for an informative hour dedicated to helping you get the most out of your plans for the future. Experts will be on hand to assist you with questions from the basics of writing a will to very complicated giving options that could provide income for you and your family for life!

ASHRAE Foundation: Creating a High Performance Legacy

Jeff Lydenberg, J.D., PG Calc, Cambridge, MA

Sunday, January 22

3:15 PM-4:45 PM

Conference Paper Session 6 (Intermediate)

Fault Detection and Energy Audits

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Crystal

Chair: Steven Rosen, Member, EYP Architecture & Engineering, P.C., Boston, MA

This session will have four papers discussing methods of auditing energy analysis through traditional means and new statistical analysis vs. traditional DDC controls. Discussion of achieving high energy savings thru rated high efficiency equipment, i.e. EER 12, and the use of energy balancing methods to predict energy use utilizing energy models to determine if there is compliance with ASHRAE 90.1. A review of comparative measuring and monitoring approaches in modeling and in reality – can they possibly match up with so many variables? Are we viewing practical approaches that will address true energy savings if we can have utilities and governing authorities work together?

1. Energy Audit Analysis of Residential HVAC Systems in Austin, Texas (CH-12-C018)

Joshua Rhodes, Student Member, Brent Stephens and Michael E. Webber, University of Texas – Austin, Austin, TX

2. Using CUSUM Method to Diagnose Faults In Secondary HVAC Systems (CH-12-C019)

Zhengwei Li, Student Member, Godfried Augenbroe and Christiaan J.J. Paredis, Georgia Institute of Technology, Atlanta, GA

3. Improving the Energy Performance of a University Building through Fault Detection and Building Systems Diagnostics (CH-12-C020)

Zara Fahim, Student Member¹ and Xinlei Wang², (1)ARUP, Los Angeles, CA, (2)University of Illinois at Urbana-Champaign, Urbana, IL

4. Use of First Law Energy Balance as a Screening Tool for Building Energy Data, Part 2: Experiences on its Implementation As a Data Quality Control Tool (CH-12-C021)

Juan-Carlos Baltazar, Ph.D., Member¹, David E. Claridge, Ph.D., P.E., Member², Jing Ji, Ph.D., P.E., Associate Member³, Hiroko Masuda, Student Member³ and Song Deng, P.E.³, (1)Texas A&M University, College Station, TX, (2)Texas A&M University, College Station, TX, (3)Energy Systems Laboratory, Texas A&M University, College Station, TX

Seminar 15 (Intermediate)

Chicago Smackdown: Air Source vs. Ground Source or Best Practices for Air Source vs. Ground Source Heat Pump Systems

Track: HVAC&R Systems and Equipment

Room: Empire

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Lisa M. Meline, P.E., Member, Meline Engineering Corporation, Sacramento, CA

As engineers we are inundated with claims by sales people that their equipment is more efficient, more sustainable or ‘greener’ than the competition’s. Renewable and conventional technologies compete against each other for the ever shrinking mechanical equipment budget. Which system is best? Which is most efficient? Who do you believe? Air-source vs. ground source: which is better? Neither heat pump system is a one-size fits all solution. As engineers, we need to understand how each system is rated for capacity and efficiency. We need to understand this so that a baseline can be established from which to fairly compare different mechanical systems for our clients. To correctly select equipment it is important to understand the technology’s limitations and its applications. With this information an ‘apples to apples’ comparison of system installed and operating costs may be prepared.

1. Correcting Ratings to Compare ASHPs to GSHPs

Steve Kavanaugh, Ph.D., Fellow ASHRAE, University of Alabama, Tuscaloosa, AL

2. Air-Source Heat Pump Water Heaters for Domestic Hot Water Applications

Chris Gray, Member, Southern Company Services, Inc., Birmingham, AL

3. Actual System Operating Cost: Air vs. Ground Source

Kirk T. Mescher, P.E., Member, CM Engineering, Inc., Columbia, MO

Monday, January 23

8:00 AM-9:30 AM

Technical Paper Session 3 (Advanced)

Low Energy Design for Army Facilities Buildings

Track: High Performance Buildings

Room: Water Tower

Chair: Alexander Zhivov, Ph.D., Member, U.S. Army Corps of Engineers, Champaign, IL

The Army is required by law (EPACT 2005, EISA 2007) to reduce overall facility energy usage by 30% by 2015 and to eliminate fossil fuel use in new and renovated facilities by 2030. Army policy is to achieve eight net zero energy pilot installations by 2020. Results of studies for new construction and major renovation projects which will be presented at this session show that

utilization of high performance building envelopes, advanced lighting strategies, and efficient HVAC systems result in significant energy savings (site and source) in Army buildings in all climates. For example, barracks site energy can be reduced by 50–70% (depending on climate) compared to the EPACT 2005 baseline; maintenance facilities by 77–85%, etc. However, source energy use reduction goals of EISA 2007 (65% reduction by 2015) cannot be achieved by efficiency measures alone in any type of building except for maintenance facilities in some climate zones. Additional savings may be achieved with measures related to improved efficiency of power generation supplied to the building (co- and tri-generation), and to the use of energy supplied from renewable energy sources. Connecting a building to a Combined Heat and Power (CHP) plant can further reduce the building’s fossil fuel usage by 10–25% depending on the thermal-to-electric load ratio.

1. Net Zero Building Cluster Energy Systems Analysis for U.S. Army Installations (CH-12-007)

Alexander Zhivov, Ph.D., Member¹, Richard J. Liesen, Ph.D., Member¹, David M. Underwood, Member¹, Stephan Richter, Ph.D.², Reinhard Jank, Ph.D.³, Dieter Neth⁴, Alfred W. Woody, P.E.⁵, Curt Bjork, Ph.D.⁶ and Scott Duncan⁷, (1)U.S. Army Corps of Engineers, Champaign, IL, (2)GEF Ingenieur AG, Liemen, Germany, (3)Völswohnung GmbH, Karlsruhe, Germany, (4)Senergy GmbH, Mossingen, Germany, (5)Ventilation/Energy Applications, LLC, Norton Shores, MI, (6)Curt Bkork Consulting, Naxos Island, Greece, (7)Retrofit Originality, Inc, Lake Forest, CA

2. Extremely Low Energy Design for Army Buildings: Barracks (CH-12-008)

Alexander Zhivov, Ph.D., Member¹, Peter Ellis, Member², Dale Herron, Member¹ and Richard J. Liesen, Ph.D., Member¹, (1)U.S. Army Corps of Engineers, Champaign, IL, (2)Big Ladder Software, Denver, CO

3. Extremely Low Energy Design for Army Buildings: Dining Facility (CH-12-009)

Michael Deru, Ph.D., Member¹, Rois Langner, Associate Member¹, Alexander Zhivov, Ph.D., Member², Richard J. Liesen, Ph.D., Member², Dale Herron, Member² and Vernon A Smith, P.E., J.D., Associate Member³, (1)National Renewable Energy Laboratory, Golden, CO, (2)U.S. Army Corps of Engineers, Champaign, IL, (3)Smith Energy Engineers, Niwot, CO

4. Extremely Low Energy Design for Army Buildings: Tactical Equipment Maintenance Facility (CH-12-010)

Rois Langner, Associate Member¹, Michael Deru, Ph.D., Member¹, Alexander Zhivov, Ph.D., Member², Richard J. Liesen, Ph.D., Member² and Dale Herron, Member², (1)National Renewable Energy Laboratory, Golden, CO, (2)U.S. Army Corps of Engineers, Champaign, IL

Conference Paper Session 7 (Intermediate)

Integrated Design: Case Studies to Achieve Net-Zero

Track: Integrated Design

Room: Red Lacquer

Chair: Oliver Baumann, Associate Member, Ebert & Baumann Consulting Engineers, Inc., Washington, DC

This session presents the approach and outcome of Integrated Project Delivery processes for energy efficient and even net-zero energy projects. Different methodologies, lessons-learned, and specific results are shown using real world examples for new construction and major renovation.

1. Maintenance and Repair of Building 4, Fort Benning, Georgia: Bringing Integrated Design to Existing Buildings (CH-12-C022)

John P. Castelvocchi Jr., P.E., Member and Robert W. Mayfield, P.E., Member, AECOM, Roanoke, VA

2. A Case Study: Using Integrated Approach to Design a Net-Zero Bank Branch (CH-12-C023)

Bing Liu, P.E., Member, Rahul A. Athalye, Yulong Xie and Michael Baechler, Pacific Northwest National Laboratory, Richland, WA

3. Comprehensive Climate Analysis and Passive Architecture to Achieve an Off Grid Laboratory (CH-12-C024)

Alissa Nicole Feucht and Joshua Gassman, Lord, Aeck & Sargent, Atlanta, GA

Conference Paper Session 8 (Advanced)

Complex Facility Design Advances

Track: *Specialized Applications – Healthcare, Laboratories, and Data Centers*



Room: Empire

Chair: Peter B. Gardner, P.E., Member, Torcon, Inc., Red Bank, NJ

The conference papers address the latest in technology for understanding design tools for energy intensive highly complex facilities including subway stations and convention centers. Attendees will understand how to approach these complex projects and develop designs that meet owner requirements sustainably.

1. Experimental and Computational Investigation of Flow Regimes and Thermal Patterns In a Subway Station (CH-12-C025)

Essam E. Khalil, Ph.D., Fellow ASHRAE and Esmail ElBially, Ph.D., Cairo University, Cairo, Egypt

2. Exhibition and Convention Centre Sustainable Design (CH-12-C026)

Brian Warwicker, Member¹ and John Daniel Cash, P.E., Affiliate², (1) Brian Warwicker, London, United Kingdom, (2) Breathing Buildings Ltd., Cambridge, United Kingdom

Conference Paper Session 9 (Intermediate)

Hot and Humid Schools and Housing: Occupancy Assumptions on Energy Performance Simulation

Track: *Energy Efficiency – New Technologies and Applications*



Room: Monroe

Chair: Ray Patenaude, P.E., Member, The Holmes Agency, Tierra Verde, FL

This session assists the attendee to understand how occupancy affects energy performance in office buildings, schools and residences. Assumptions of determining occupancy are analyzed along with other factors, such as dew point, to determine accurate energy consumption models. Regression models are explored and compared for estimating energy consumption. Finally, a design guideline to reduce energy consumption is recommended for low-income, low-energy housing in hot and humid climates.

1. Occupancy of Australian Offices Buildings: How Accurate Are Typical Occupancy Assumptions Used In Energy Performance Simulation and What Is the Impact of Inaccuracies (CH-12-C027)

Aileen Marie Egan, P.E., Student Member, Australian National University, Canberra, Australia

2. Regression Models for Estimating Monthly Energy Consumptions in Schools in Hot and Humid Climates (CH-12-C028)

Nabil Nassif, Ph.D., P.E., Associate Member, North Carolina A&T State University, Greensboro, NC

3. Occupancy Based Heating/Cooling for Low Energy Affordable Housing in Hot-Humid Climates (CH-12-C029)

Singe Andolsun, Student Member and Charles Culp, Ph.D., Member, Texas A&M University, College Station, TX

Seminar 16 (Intermediate)

Air-Handling System Leakage: Benefits and Costs of Field Tests

Track: *Installation, Operation & Maintenance of HVAC Systems*

Room: Wabash

Sponsor: 05.02 Duct Design, 04.03



Ventilation Requirements and Infiltration

Chair: Stephen A. Idem, Member, Tennessee Technological University, Cookeville, TN

SMACNA together with ASHRAE is developing a new standard that will contain test procedures and requirements for total HVAC system air leakage in commercial buildings. This activity is needed because as much as one third of a system's airflow can leak through the air distribution system, which in turn causes a loss of comfort and heating or cooling capacity. System air leakage also significantly increases air conditioning and heating bills, and can contribute to indoor air quality problems. This seminar focuses on the benefits and costs of performing system leakage tests from the perspective of a TAB

contractor, an association of sheet metal contractors, and researchers. Steps needed to achieve widespread reductions in leakage and improved air-handling system efficiency are also presented.

1. Testing for Duct Leakage

Roger Gaylon Richardson, Engineered Air Balance, Spring, TX

2. Energy Impacts of Air-Handling System Leakage in Large Commercial Buildings: Measurements and Simulation

Craig P. Wray, P.E., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

3. The Need for Field Ductwork Leakage Tests

Mark Terzigni, SMACNA, Chantilly, VA

4. Duct Leakage: Measured Magnitudes and Calculated Impacts

Mark Modera, Ph.D., P.E., Fellow ASHRAE, University of California, Davis, Davis, CA

Seminar 17 (Basic)

Increase the Impact of Your Presentation

Track: *Professional Skills*



Room: Crystal

Chair: Alan Veeck, Member, MVA Inc., Virginia Beach, VA

Speaking to an audience or presenting your ideas to a group can be intimidating. The good news is you have the skills it takes to present and win your audience! This working session provides attendees with methods and techniques to more effectively present information, especially of a technical nature to groups. Topics covered include better use of PowerPoint® and other visuals along with creating a memorable opening and closing. Gain more credibility as a presenter and run a powerful Q & A at the summary. Your audience will thank you for attending this session.

Seminar 18 (Basic)

Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling

Track: *Energy Modeling Applications*



Room: Adams

Sponsor: 04.07 Energy Calculations

Chair: Chris Balbach, P.E., Member, Performance Systems Development of NY, LLC, Ithaca, NY

Standard 205P (Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment) will shortly be available for public review. The standard formalizes how data about equipment capacity and efficiency are represented for a range of operating conditions. This lays the groundwork for automated import into software applications such as energy simulation models, eliminating the need for laborious and error-prone transfer from printed documents. The session presents general background on the standard and introduces proposed schemes for chiller and unitary equipment performance data.

1. An Overview of Standard 205P

Charles S. Barnaby, Member, Wrightsoft Corp., Lexington, MA

2. Obtaining Accurate Chiller Models, A 15-Year Odyssey

Mark Hydeman, P.E., Fellow, Taylor Engineering, LLC, Alameda, CA

3. Representing the Performance of Unitary Air Conditioning Equipment for Energy Models

Neal Kruis, National Renewable Energy Laboratory, Golden, CO

Seminar 19 (Intermediate)

The Role of Fossil Fuels in Future Sustainable Buildings

Track: *Energy Efficiency –*

New Technologies and Applications



Room: Salons 4/5

Sponsor: 02.08 Building Environmental Impacts and Sustainability,

07.06 Building Energy Performance

Chair: David Ellis, P.E., Member, HDR Architecture Inc., Bethesda, MD

The Energy Independence and Security Act of 2007 requires DOE to issue revised Federal building energy efficiency performance standards that specify

a 55% reduction in fossil fuel-generated energy consumption in new and renovated federal buildings immediately and complete elimination of fossil fuel-generated energy consumption by 2030. This seminar provides a unique format to review the EISA requirement, discusses DOE's planned implementation strategy, identifies potential pathways to achieve the goals, and describes the significant challenges related to this requirement. Speaker presentations are followed by an interactive panel discussion.

1. Implementing the EISA Fossil Fuel Reduction Requirements for Federal Buildings

Cyrus H. Nasseri, Member, US Department of Energy, Washington, DC

2. Fossil Fuel Reduction Opportunities in Federal Buildings

Harvey Sachs, Ph.D., Member, ACEEE, Washington, DC

3. Challenges with Implementation of EISA Fossil Fuel Reduction Requirements

Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

Monday, January 23

9:45 AM-10:45 AM

Conference Paper Session 10 (Intermediate)

Modeling to Improve DHW and Hydronic Systems

Track: Energy Modeling Applications

Room: Adams



Sponsor: 06.01 Hydronic and Steam Equipment and Systems

Chair: Kyle Larson, Associate Member, VaCom Technologies, San Luis Obispo, CA

Understanding and properly applying the inputs is an important requirement for any useful simulation model. Covered in this session is a case study showing how modeling was used to improve performance for the domestic hot water (DHW) system on a large campus and a simulation method is introduced for using energy modeling software to calculate savings associated with hydronic system improvements.

1. Using Measured Utility Data to Verify Energy Models (CH-12-C030)

Jared A. Higgins, P.E., Member, Stephen D. Foster and J. Ryan Bailey, Associate Member, Parkhill, Smith, & Cooper, Inc., Lubbock, TX

2. Domestic Hot Water System Performance Improvement at a Large University Campus (CH-12-C031)

Hui Chen, P.E., Member, Homer Bruner, Associate Member, Robert Henry, P.E., Les Williams and James Riley, Texas A&M University, College Station, TX

3. A New Approach to Modeling the Energy Performance of Hydronic Systems with Pressure Dependent Control Valves (CH-12-C032)

McHenry (Mack) Wallace, P.E., Member, WiseWatt LLC, Crystal Beach, TX

Conference Paper Session 11 (Advanced)

Impact of Neural Networks on Energy Consumption Predictions and Shading Systems on Thermal Performance

Track: Energy Modeling Applications

Room: Monroe



Chair: Eunice Hameyie, Member, Viridity Energy, Inc., Philadelphia, PA

The ability to accurately predict building thermal dynamics and energy performance has gained momentum in recent years. This conference paper session will present neural networks as a tool to model building energy use, with an emphasis on variability of model accuracy depending on parameter inputs. The session will also examine various dynamic shading systems and determine their effectiveness in reducing thermal loads in buildings. A combined dynamic shading system will also be proposed for improved control.

1. Neural Networks Approach for Energy Consumption in Air-Conditioned Administrative Building (CH-12-C033)

Essam E. Khalil, Ph.D., Fellow ASHRAE¹, Ahmed Medhat, Ph.D., Member², Samy M. Morkos, Ph.D.¹ and Mohamed Yafai Salem, P.Eng.¹, (1)Cairo University, Cairo, Egypt, (2)HBRC, Cairo, Egypt

2. The Impact of a Combined Dynamic Shading System on the Thermal Performance of Building Perimeter Zones (CH-12-C034)

Sagar Rao, Student Member and Athanasios Tzempelikos, Purdue University, West Lafayette, IN

Conference Paper Session 12 (Intermediate)

Design, Application and Commissioning Issues Related to Emergency Smoke Management Fans for Tunnel Applications

Track: HVAC&R Fundamentals and Applications

Room: Empire



Sponsor: 05.09 Enclosed Vehicular Facilities, 05.01 Fans

Chair: Mark P. Colino, PE, Member, Parsons Brinkerhoff Inc, New York, NY

This session examines the existing high-temperature air exposure requirements for emergency ventilation equipment from the standpoints of engineering design and equipment procurement. The first paper evaluates the feasibility of the current industry standards, and offers alternative design possibilities. The second and third papers consider the manufacturing and testing aspects, respectively, of the related equipment procurement process. The contents of this session are expected to be beneficial to both design engineers and equipment manufacturers.

1. Design and Application Considerations for Smoke Management Fans (CH-12-C035)

Robert Z. Smith, Member, Innerquest LLC, Dowagiac, MI

2. Commissioning, Field Testing and Maintenance of Fans for Life Safety Applications in Tunnels (CH-12-C036)

Michael Feuser, Twin City Clarage, Inc., Pulaski, TN

Seminar 20 (Basic)

Back to Basics: Selection of Proper Chiller Technology

Track: HVAC&R Systems and Equipment



Room: Red Lacquer

Sponsor: 08.02 Centrifugal Machines, 08.01 Positive Displacement Compressors

Chair: Riyaz Papp, P.E., Member, Hudson Technologies Co., The Woodlands, TX

This session discusses what chiller applications are better suited or more appropriate for centrifugal chillers, and which may be better served by positive displacement chillers. Possible considerations, including surge, lift, noise, and energy are discussed in this Back-to-Basics Seminar.

1. Selecting Equipment to Ensure Verifiable Energy Savings

Scott McDonough, Associate Member, Carrier Corporation, Charlotte, NC

2. Centrifugal Chiller Selection

Fred W. Betz, PE, Member, PEDCo E&A Services, Cincinnati, OH

Seminar 21 (Intermediate)

Maximizing the Benefits of Commissioning: Incorporating Design Reviews and the Building Envelope into the Commissioning Scope

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Wabash



Sponsor: 07.09 Building Commissioning

Chair: Gerald J. Kettler, P.E., Life Member, AIR Engineering and Testing, Carrollton, TX

Functional performance testing and post-occupancy evaluation of HVAC systems are commonly thought of tasks in the commissioning process. However, commissioning is most beneficial when it is begun early in the design process, and if it includes other building systems beyond HVAC. This seminar covers design phase commissioning and commissioning of the building envelope. Design phase commissioning tasks are discussed, as are suggestions for realizing maximum benefits from commissioning design reviews. The seminar also reviews envelope commissioning, the unfortunate state of the envelope quality if envelope commissioning is not done, and the resulting impact on HVAC operation.

1. Strategies for a Meaningful Commissioning Design Review

Thomas Anderson, Member, Cx Associates, Burlington, VT

2. Air Barrier Design and Commissioning: Details for Success

Meghan McDermott, Member, Southern Energy Management, Morrisville, NC

Seminar 22 (Basic)

PE Exam Seminar

Track: HVAC&R Fundamentals and Applications

Room: Crystal

Sponsor: YEA Committee

Chair: Bo Twumasi, Associate Member, Brandt, Carrollton, TX

A general informational session on the PE Exam for young members and students. The seminar begins by covering general questions, educational requirements, the application process, and eligibility. Attendees are given a chance to get information on some of the specifics of the exam structure, including some sample questions from the practice exam. A discussion describing the benefits, and responsibilities of becoming a PE concludes the session. This seminar empowers young members and students by giving them proper knowledge of a very important role in our industry.

PE Exam Seminar

David B. Meredith, P.E., Member, Penn State Fayette, Uniontown, PA



Forum 1 (Intermediate)

How to Specify Seismic Certification

Track: HVAC&R Fundamentals and Applications

Room: Water Tower

Sponsor: 02.07 Seismic and Wind Restraint Design

Chair: James A. Carlson, Seismic Source Intl, Springfield, NE

Equipment certification of compliance is an International Building Code Requirement for equipment identified to operate after an earthquake. Many manufacturers have already performed testing and are issuing a seismic certification. But not all certifications are equal. The requirements for certification in the code are not totally clear. What do engineers have to specify to get the level of confidence that the certification meets the intent of the code? And what do manufacturers need to do for the certificate of compliance?

Forum 2 (Intermediate)

Stop Wasting Energy! Optimization of Air Pre-filter and Final Filter for Commercial and Industrial HVAC Systems

Track: HVAC&R Systems and Equipment

Room: Salons 4/5

Sponsor: 02.04 Particulate Air Contaminants and Particulate Contaminant Removal Equipment

Chair: Monroe Britt, Green Leaf Technologies, Finchville, KY

This forum discusses the need for standardized methods that will be used to evaluate the efficiency performance and energy usage of air filters used in combination. The purpose is to minimize overall energy usage and the optimization of service lives of the filters. Information gained during this forum will assist in determining the need for establishing a SPC or GPC committee to develop standard test methods and analysis procedures for combined air particulate filters.

Monday, January 23

11:00 AM-12:00 PM

Technical Paper Session 4 (Advanced)

Ventilation Applications: Hybrid System for High-Rise and Measured Rates in Bars

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers

Room: Water Tower

Chair: M. Ginger Scoggins, P.E., Member, Engineered Designs Inc., Raleigh, NC



This session will include two presentations. The first presenter will be discussing the results of a case study involving the comparison of actual ventilation rates found in Minnesota bars and restaurants to ASHRAE 62.1

guideline criteria. Carbon dioxide tracer gas levels were measured to determine the effective ventilation rates in bars and restaurants in this state prior to implementation of a statewide smoking ban. 65 bars and restaurants were studied, and the results of this study are presented in this session. The 2nd presenter for this session will be discussing a case study involving a hybrid ventilation system applied to a super high-rise building in Tokyo, Japan, focusing on the indoor environment in the building and the effects of the system on the variation of thermal load.

1. Effect of Hybrid Ventilation System on Indoor Environment and Annual Cooling Load in a High-Rise Building (CH-12-011)

Katsuhiko Miura, Dr. Ing., Member¹, Yuichi Takemasa, Dr. Ing., P. Eng., Member¹, Masahiro Katoh¹ and Masaya Hiraoka², (1)Building Environment Group, Kajima Technical Research Institute, Tokyo, Japan, (2)Kajima Corporation, Tokyo, Japan

2. Measured Ventilation Rates in Minnesota Bars and Restaurants (CH-12-012)

David T. Grimsrud, Ph.D., Fellow ASHRAE¹, David Bohac, P.E., Member², Martha Hewett, Member² and Kristopher I. Kapphahn, Ph.D.², (1)Grimsrud & Associates, Minneapolis, MN, (2)Center for Energy and Environment, Minneapolis, MN

Conference Paper Session 13 (Intermediate)

Technology Advancements

Track: Energy Efficiency –

New Technologies and Applications



Room: Salons 4/5

Chair: Stanley Mumma, Ph.D., P.E., Fellow Life Member, Pennsylvania State University, University Park, PA

Technologies are presented that lead to both improved IEQ and efficient energy utilization.

1. An Innovative Dedicated Outside Air Applications for A Government Office Tower (CH-12-C037)

Michael D. Hallenbeck, P.E., Member, Southland Industries, Irvine, CA

2. Metal-Foam Enhanced PCM Storage System:

The Cylinder-In-Cylinder Geometry (CH-12-C038)

Nihad Dukhan, Ph.D., Member and Chun-Long Chen, University of Detroit Mercy, Detroit, MI

Conference Paper Session 14 (Intermediate)

Energy Savings and Performance Improvement through O&M

Track: Installation, Operation &

Maintenance of HVAC Systems



Room: Wabash

Chair: Michael R. Brambley, Ph.D., Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA

To operate efficiently and at high levels of performance, commercial buildings require careful attention to achieving efficient operation and then maintaining it persistently over time. This requires effective operation and maintenance practices. Without monitoring of performance and regular maintenance, the performance of building systems degrades, resulting in increased energy use and cost, inadequate indoor conditions, and potentially uncomfortable occupants. The two papers in this session present information on: 1) using building automation system data to guide continual commissioning of built-up building systems and 2) training operators as a means to achieving central plant energy savings.

1. Ongoing Commissioning Based on BMS Data Logs (CH-12-C039)

Cheng Chang, Yiming Feng and Qingpeng Wei, Dr. Ing., Department of Building Technology and Science, Tsinghua University, Beijing, China

2. Central Plant Energy Savings by Operator Training (CH-12-C040)

Brandon S. Field, Ph.D., Associate Member and Dave J. Ellert, P.E., Associate Member, University of Southern Indiana, Evansville, IN

Conference Paper Session 15 (Advanced)

Considerations for Chiller Life Cycle Evaluations Including Comparisons to ARI 550/590 IPLV

Track: HVAC&R Systems and Equipment

Room: Red Lacquer

Sponsor: 08.02 Centrifugal Machines

Chair: Rick M. Heiden, Trane, La Crosse, WI

Chillers are typically one of the largest, if not the largest energy consumers in the building envelop. Getting this selection right during the design process will pay off over the life of the building. Papers will be presented from the standpoint of a chiller manufacturer, an AHRI representative and a consulting engineer giving an overview of methods that will result in the lowest energy design for your building.

1. AHRI 550-590 Overview (CH-12-C041)

Saunders C. Smith, Member, AHRI, Arlington, VA

2. Easy-to-Use Methods for Multi-Chiller Plant Energy and Cost Evaluation (CH-12-C042)

Stephen W. Duda, P.E., Member, Ross & Baruzzini, Inc., St. Louis, MO



Seminar 23 (Intermediate)

Design Best Practices from the Server to the Data Center, What the Operator Should Know

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers

Room: Empire

Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment

Chair: Michael K. Patterson, Ph.D., P.E., Member, Intel Corporation, Hillboro, OR

Today's data centers and IT equipment have complex thermal management schemes to enable optimization of power and performance, while ensuring the reliability required in data center applications. This seminar covers the IT equipment and the data center. Data center designers and operators often have misconceptions on how the IT thermal management and available features work. This seminar reviews these and how data center environmental conditions affect them. It also reviews best practices for air-cooled data centers; reporting on a first-of-its kind direct comparison of hot and cold aisle containment. The attendee gains an advanced understanding of best practices.

1. IT Equipment Thermal Management: What Should a Data Center Operator Know?

Robin Steinbrecher, Intel, New York, NY

2. A Comparison of Hot-Aisle and Cold-Aisle Containment Strategies, Which Is More Efficient?

Michael K. Patterson, Ph.D., P.E., Member, Intel Corporation, Hillboro, OR



Seminar 24 (Intermediate)

How to Communicate Professionally in a Technical World with Technical Information

Track: Professional Skills

Room: Monroe

Sponsor: Student Activities

Chair: Joel Primeau, P.Eng., Member, GENIVAR, Ottawa, ON, Canada

Many in our industry struggle with how to communicate effectively with technical information, keeping on target, providing the reader with a proper roadmap of information, delivering all necessary information in a logical & clear format, and doing so such that anyone within our industry can understand the objective and the solution to a given situation or problem. This session illustrates a thought process along with a structure such that anyone can present a technical problem or situation and provide a clear and logical solution in written communication for others.

How to Communicate Professionally in a Technical World with Technical Information

Douglas F. Zentz, Associate Member, Ferris State University, Big Rapids, MI



Seminar 25 (Intermediate)

Vibration Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Adams

Sponsor: 02.06 Sound and Vibration Control

Chair: Patrick C. Marks, Member, Johnson Controls Company, York, PA

This seminar explains how vibration isolation should be specified and installed. Case studies and real world experiences are discussed. Also, proper HVAC equipment balancing is discussed for low noise and reliable operation. Lastly, use of machinery vibration signatures to indicate potential equipment failures is discussed.

1. How to Use Vibration Isolation to Minimize Vibration Induced Noise

Richard Sherren, P.E., Member, Kinetics Noise Control, Dublin, OH

2. Machinery Diagnostics and Balancing for HVAC&R Equipment

John Kuchler, Johnson Controls, Milwaukee, WI



Seminar 26 (Basic)

YEA for Air Cleaning!

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Crystal

Sponsor: 02.04 Particulate Air Contaminants and Particulate Contaminant Removal Equipment, YEA, 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Alan Veeck, Member, MVA Inc., Virginia Beach, VA

Air cleaning through filtration is increasingly one of the critical factors in sustainability and energy efficiency of an HVAC system and facility occupant health. Most courses in HVAC give passing reference to this critical factor. LEED requires it, ASHRAE standardizes it, and TC 2.4 and TC 2.3 have it. Here it is, everything you need to know about air filtration for both particles and gas-phase contaminants. This seminar provides the young engineer (and slightly older ones also) with the best overall view of air filtration including types of media filters, molecular media and special applications.

1. Getting Those Particles Out of the Airstream

Chris Zaker, Glasfloss Industries, Dallas, TX

2. How To Remove Odors and Nuisance Gases From The Airstream

Paula Levasseur, Cameron Great Lakes, Inc., Portland, OR

3. You May Not Have Seen These: Special Applications for Air Filters

Alan Veeck, Member, MVA Inc., Virginia Beach, VA



Monday, January 23

2:15 PM-3:45 PM

Seminar 27 (Basic)

Approaching Net-Zero and Maintaining Your Course: O&M Tools to Maintain Building Performance

Track: Installation, Operation & Maintenance of HVAC Systems

Room: Crystal

Sponsor: 07.03 Operation and Maintenance Management

Chair: Sonya Pouncy, Member, Member, Detroit, MI

The moniker "net-zero energy building" does not just refer to building design. Building operation and maintenance are equally, if not more, important in today's energy conscious environment. As we embrace a future with building performance labeling, net metering and sustainability criteria, O&M are playing an increasingly more visible role. This seminar reviews three ASHRAE tools—the recently updated Chapter 39 in the Applications Handbook, Standard 180, and the newly introduced Guideline 22—that are available to assist designers, owners and operators in planning and implementing O&M practices that ensure investments in high performance buildings retain their value.



1. HVAC Applications Chapter 39: Significant Updates in Operation and Maintenance Management

Richard A. Danks, Member, NASA, Cleveland, OH

2. Standard 180: A New Approach to HVAC System Maintenance

Robert G. Baker, Fellow, BBJ Environmental Solutions, Tampa, FL

3. Introducing Guideline 32: O&M for Sustainable, High Performance Buildings

Michael F. Bobker, CEM, Member, Cuny Building Performance Lab, New York, NY

Seminar 28 (Intermediate)

Improving Energy Modeling Consistency

Track: Energy Modeling Applications

Room: Water Tower

Sponsor: 04.07 Energy Calculations

Chair: Joe Huang, Member, Whitebox Technologies, Moraga, CA

Credible, whole-building energy analysis that is reliable and consistent will help the U.S. achieve increasingly aggressive performance targets established for buildings. Some headway has been made to promote modeling consistency through standardizing methods but many aspects of modeling can still benefit from a structured model development processes. This session presents best-practice methods that support BEM reliability and consistency, namely: informing modeling assumptions using published BEM resources, incorporating benchmarking procedures to check results, and effectively using measured data for model calibration.

1. Standardizing Model Inputs Using Published BEM Resources

Erik Kolderup, P.E., Member, Kolderup Consulting, San Francisco, CA

2. Incorporating Benchmarking Into BEM Quality Assurance Procedures

Thomas White, P.E., Green Building Services, Portland, OR

3. Effective Model Calibration Using Measured Data

Ellen Franconi, Rocky Mountain Institute, Boulder, CO



Monday, January 23

3:00 PM-4:30 PM

AHR Expo Session 1 (Basic) at McCormick Place

Selection, Operation & Maintenance and Water Treatment for Multi-Metal Boilers

Track: Installation, Operation & Maintenance of HVAC Systems

Room: S106A

Sponsor: 03.06 Water Treatment, 06.01 Hydronic and Steam Equipment and Systems

Chair: Reid Alan Spence, P.E., Member, Emcor Facilities Services, Arlington, VA

Modern boilers made from Aluminum may make them lighter to carry and obtain higher efficiencies, especially when under less than full load. Incorporating different metals into multi-metal systems requires selection and specification of system components and water treatment specific to the desired system metallurgy. This seminar explores why ASHRAE membership should recommend aluminum, condensing boilers to increase hydronic system efficiency, special commissioning considerations, how to address multi-metal systems from a water treatment approach and assist ASHRAE membership with specifying both of the aforementioned system components.

1. Aluminum Condensing Boiler Efficiencies When Used in Conjunction with Multi-Metal, Hydronic Heating Systems

Alfred H. Lyon, Member, Harsco Industrial / Patterson-Kelley, East Stroudsburg, PA

2. Commissioning Aluminum Boilers in HVAC Systems

Dan Weimar, Member, NCH, Charlotte, NC

3. Components of a Proper Water Treatment Specification for Any Multi—Metal System

Jon J. Cohen, H-O-H Water Technology, Inc, Palatine, IL



Tuesday, January 24

8:00 AM-9:30 AM

Technical Paper Session 5 (Intermediate)

Laboratory Testing of Heat Pump Water Heaters

Track: Energy Efficiency –

New Technologies and Applications

Room: Red Lacquer

Sponsor: 06.06 Service Water Heating Systems

Chair: Ben Schoenbauer, Associate Member, Center for Energy and Environment, Minneapolis, MN



When we think of hot water and water heating efficiency we often think of the big tank in our basements or garages, but that is only part of the story. Service hot water is a system consisting of not only a water heater, but piping, fixtures, and people too. In this session authors will discuss field and lab work that characterized hot water usage, distribution system effects and how these whole system approaches effect how we think about efficiency. Heat Pump Water Heaters (HPWHs) have been around for a long time. New product offerings indicate renewed interest in this technology. This session presents laboratory performance results from testing of the residential tank-integrated HPWHs available currently on the US market, and discusses climate-region-specific opportunities for energy savings in residential buildings. The HPWHs are evaluated with both standard and non-standard performance metrics, over a range of operating conditions and usage patterns.

1. Parametric Laboratory Evaluation of Residential Heat Pump Water Heaters (CH-12-013)

Paul Glanville, P.E., Associate Member, Douglas Kosar, Member and Daniel Suchorabski, Gas Technology Institute, Des Plaines, IL

2. Measured Residential Hot Water End Use (CH-12-014)

Ben Schoenbauer, Associate Member¹, David Bohac, P.E., Member¹ and Martha Hewett, Member¹, (1)Center for Energy and Environment, Minneapolis, MN

3. Water and Energy Wasted During Residential Shower Events: Findings from a Pilot Field Study of Hot Water Distribution Systems (CH-12-015)

James Lutz, P.E., Lawrence Berkeley National Laboratory, Oakland, CA

4. Comparison of Heat Loss and Water Waste Characteristics of Bundled vs Single Pipe Hot Water Distribution Systems (CH-12-016)

Carl Hiller, Ph.D., P.E., Applied Energy Technology, Davis, CA

Conference Paper Session 16 (Intermediate)

Integrated Design Energy Retrofits

Track: Integrated Design

Room: Wabash

Sponsor: 07.01 Integrated Building Design

Chair: Gregory Dobbs, Ph.D., Member, Pennsylvania State University, Philadelphia, PA

Commercial, institutional and large multi-family building account for about 25% of primary U.S. energy. The average energy use for all existing buildings has essentially remained flat since the early 1980s at about 88,000 Btu/ft² (277.4 kW/m²). Furthermore, 98% of all buildings are less than 100,000 ft² (9,290 ft²) with the distribution heavily weighted to buildings between 25,000 and 50,000 ft² (4,645 and 2,323 m²). These conference papers define the problem facing adoption of deep energy retrofits, the multifaceted plan of attack to transform a fragmented market and the modeling, technology and integrated design approach to deliver results.

1. The Current State of Energy Retrofits for Small and Medium Buildings (CH-12-C043)

Timothy C. Wagner, Ph.D., Member, UTRC, E Hartford, CT

2. Retrofit Energy Efficiency Modeling, Assessments, and Integrated Technologies: Seeking Solutions for Small and Medium Sized Buildings (CH-12-C044)

Richard Sweetser, Member, Exergy Partners Corp., Herndon, VA



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3. Advancing from the Current State of Energy Retrofits to the Future State (CH-12-C045)

James Freihaut, Ph.D., Member¹ and **Paul Hallacher, Ph.D.²**, (1)The Pennsylvania State University, State College, PA, (2)Penn State University, University Park, PA

Conference Paper Session 17 (Advanced)

Radiant, Boilers, Ductless AC and Microchannel Evaporators

Track: HVAC&R Systems and Equipment

Room: Crystal

Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

This session includes papers that offer in-field performance information of condensing boilers, introduction of ductless task air conditioning system concept, and understanding of two-phase refrigerant distribution in a parallel microchannel evaporator.

1. In-Field Performance of Condensing Boilers (CH-12-C046)

Lois B. Arena, Associate Member¹, **Carl Shapiro¹**, **William Zoeller¹** and **Thomas A Butcher, Ph.D., Member²**, (1)Steven Winter Associates, Inc, Norwalk, CT, (2)Energy Sciences and Technology, Brookhaven National Laboratory, Upton, NY

2. Ductless Task Air-Conditioning (CH-12-C047)

Teen Onn Law, University of Tasmania, Launceston, Australia

3. An Experimentally Validated Modeling of Refrigerant Distribution In a Parallel Microchannel Evaporator (CH-12-C048)

Hanfei Tuo, Ph.D., Student Member¹, **Algirdas Bielskus, M.D., Student Member¹** and **Predrag Hrnjak, Ph.D., Fellow Member²**, (1)University of Illinois at Urbana Champaign, Urbana, IL, (2)University of Illinois, Urbana, IL

Conference Paper Session 18 (Advanced)

Complex Fenestration Systems

Track: HVAC&R Fundamentals and Applications

Room: Salons 4/5

Chair: Filza Walters, Lawrence Tech University, Detroit, MI

This session focuses on the building heating and cooling load calculations. Two of the papers concentrate on the building envelop while the other discusses climatic data used in the load calculation process. The topic of envelope concentrates on alternate methods of improving building performance beyond the more conventional method of increasing insulation or decreasing window area. The climate discussion explores why the more traditional climate data is not consider accurate for today's building design. Each of these topics is important as they influence the overall building performance and the accuracy of design.

1. Exploring Alternatives to the Typical Meteorological Year for Incorporating Climate Change into Building Design (CH-12-C049)

Ulrike Passe, Associate Member, Gene Takle, Ph.D. and Shannon Rabideau, Iowa State University, Ames, IA

2. Practical and Policy-Relevant Performance Metrics for Complex Fenestration Systems (CH-12-C050)

Shreya Dave, Student Member¹ and **Marilyne Andersen, Ph.D.²**, (1)Massachusetts Institute of Technology, Cambridge, MA, (2)École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

3. A Comprehensive Review of Radiant Barrier Research including Laboratory and Field Experiments (CH-12-C051)

Mario A. Medina, Ph.D., P.E., Member, The University of Kansas, Lawrence, KS

Seminar 29 (Intermediate)

HVAC&R Research Journal: Controls

Track: HVAC&R Fundamentals and Applications

Room: Water Tower

Sponsor: 08.08 Refrigerant System Controls and Accessories, HVAC&R Research Journal

Chair: Reinhard Radermacher, Ph.D., Fellow, University of Maryland, College Park, MD

This session, chaired by University of Maryland mechanical engineering professor and HVAC&R Research Journal editor, Reinhard Radermacher, is comprised of three papers selected from recently published works of the ASHRAE HVAC&R Research Journal.

1. A Review of Virtual Sensing Technology and Application in Building Systems

Daihong Yu, Student Member¹, **Haorong Li, Ph.D., Associate Member¹** and **James E. Braun, Ph.D.²**, (1)University of Nebraska-Lincoln, Omaha, NE, (2)Purdue University, West Lafayette, IN

2. Design Specifications for Wet-Bulb Aspirator Apparatus, RP-1460

Jacob Brenner, Ph.D., P.E.¹, **G.F. Nellis²** and **Dr. Douglas T. Reindl, Ph.D., P.E., Fellow³**, (1)University of Notre Dame, Notre Dame, IN, (2)University of Wisconsin, Madison, Madison, WI, (3)Engineering Professional Development, University of Wisconsin-Madison, Madison, WI

3. Variable-Speed Heat Pumps Model for a Wide Range of Cooling Conditions and Loads

Tea Zakula, Student Member¹, **Dr. Nicholas T. Gayeski, Ph.D., Associate²**, **Leslie K. Norford, Member³** and **Peter Armstrong, Ph.D., Member⁴**, (1) Massachusetts Institute of Technology, Cambridge, MA, (2)Massachusetts Institute of Technology, Watertown, MA, (3)MIT, Boston, MA, (4)Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates

Seminar 30 (Basic)

Humidification: Why Is It Necessary and How to Do It Safely

Track: HVAC&R Systems and Equipment

Room: Adams

Sponsor: 05.11 Humidifying Equipment

Chair: Raul Simonetti, Member, CAREL INDUSTRIES S.r.l., Brugine, Italy

Air contains humidity because this is the way our world is! Humidity is nothing else than water vapour, mainly coming from the natural evaporation of sea water, lakes and rivers; part of it is also generated by mankind's processes. It's fundamental for all living creatures, human beings included, both for surviving and, for humans and animals, for well-being. It's also necessary for a number of industrial processes, which usually require the proper control of the humidity level. Humidification systems add vapour to the air in a controlled way so as to reach and maintain the desired humidity level. They can add vapour into ventilation systems or directly into the ambient and in both cases this can be done in hygienically safe ways provided the relevant guidelines and best practices are followed. The seminar presents the requirements of German norm VDI 6022 for humidification systems.

1. Some Relevant Installations with Humidification Systems

Raul Simonetti, Member, CAREL INDUSTRIES S.r.l., Brugine, Italy

2. Humidification: It is a Matter of Control

L. Gary Berlin, Member, Nortec, Ottawa, ON, Canada

3. Basic Principles for Clean, Green Evaporative Cooling and Humidification

Annette Dwyer, Associate Member, Munters Corporation, Fort Myers, FL

4. Safe Humidification Based on German Norm VDI-6022

Raul Simonetti, Member, CAREL INDUSTRIES S.r.l., Brugine, Italy

Seminar 31 (Advanced)

Magneto-Caloric Refrigeration: Are You Attracted to Cool Ideas?

Track: Refrigeration

Room: Empire

Sponsor: 01.01 Thermodynamics and Psychrometrics

Chair: Ron M. Nelson, PE, Ph.D, Member, Iowa State University, Ames, IA

Active magnetic regenerative systems represent a potentially attractive alternative to vapor compression technology. Recent research has focused on developing high-frequency and higher cooling capacity machines. The talks cover magnetic refrigeration materials (refrigerant), novel systems recently developed, and scaling requirements for commercial HVAC applications (10 tons and larger). Theoretical and experimental results are presented.

1. Magnetocaloric Materials: Where We Are Today, and What Does the Future Hold?

Vitalij K. Pecharsky, Ph.D.¹, Karl A. Gschneidner Jr., Ph.D.¹, Yaroslav Mudryk, Ph.D.² and Durga Paudyal, Ph.D.², (1)Iowa State University, Ames, IA, (2)The Ames Laboratory, Ames, IA

2. Development and Performance of a High-Frequency Rotary Magnetocaloric Refrigerator

Kurt Engelbrecht, Ph.D., Risø DTU, Roskilde, Denmark

3. Feasibility Analysis of Magnetic Refrigeration for Systems Having Over 35 Kw Cooling Capacity

Boyd Evans, Ph.D., David West, Ph.D., Anne Mallow and Omar Abdelaziz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

Seminar 32 (Intermediate)

Thermal Displacement Ventilation Applications for High Performance Buildings, Part 1

Track: High Performance Buildings



Room: Monroe

Sponsor: 05.03 Room Air Distribution

Chair: Mike McDermott, Member, Grumman Butkus Associates, Evanston, IL

This seminar explores recent developments in Thermal Displacement Ventilation (TDV) systems and describes their performance in combination with complimentary cooling as well as heating systems. The audience learns how TDV can improve building energy performance and Indoor Environmental Quality (IEQ). TDV applications, control strategies and impact on ASHRAE Standards 55-2010 (thermal comfort) and 62-2010 (indoor air quality) are presented.

1. Fundamentals of Thermal Displacement Ventilation

Andrey Livchak, Ph.D., Halton Group Americas, Bowling Green, KY

2. Case Study: KU Endowment Building, Displacement Ventilation in Office Settings

Jim Megerson, P.E., Member, Burns & McDonnell, Kansas City, MO

3. Thermal Displacement Ventilation in North American Building Applications

Kenneth J. Loudermilk, P.E., Member, TROX USA, Cumming, GA

Tuesday, January 24

9:45 AM-10:45 AM

Technical Paper Session 6 (Intermediate)

Modeling the Performance of Terminal Units in Single Duct VAV Systems

Track: HVAC&R Systems and Equipment



Room: Wabash

Chair: Gus Faris, Member, Nailor Industries Inc., Houston, TX

Electronically commutated motors (ECMs) have significantly improved the performance of Fan Powered Terminal Units (FPTUs). This session provides comparisons of the estimated performance of systems employing ECM versus PSC controlled motors for series and parallel terminal units in five different U.S. cities. The simulations were based on experimental data from three terminal unit manufacturers and two motor manufacturers that were used to develop semi-empirical models of FPTU airflow and power. The papers in this session are an extension to the prior work on FPTUs with SCR controllers in 1292-RP.

1. Modeling the Performance of ECM and SCR Series Fan Powered Terminal Units in Single-Duct VAV Systems (CH-12-017)

Dennis L. O'Neal, Ph.D., P.E., Fellow ASHRAE¹, John Bryant, Ph.D., P.E., Member² and Michael Davis, Ph.D., Associate Member³, (1)Texas A & M University, College Station, TX, (2)Texas A&M University at Qatar, Dohar, Qatar, (3)New York University, Abu Dhabi, United Arab Emirates

2. Modeling the Performance of ECM and SCR Parallel Fan Powered Terminal Units in Single-Duct VAV Systems (CH-12-018)

Dennis L. O'Neal, Ph.D., P.E., Fellow ASHRAE¹, John Bryant, Ph.D., P.E., Member² and Michael Davis, Ph.D., Associate Member³, (1)Texas A & M University, College Station, TX, (2)Texas A&M University at Qatar, Dohar, Qatar, (3)New York University, Abu Dhabi, United Arab Emirates

Conference Paper Session 19 (Advanced)

Net-Zero Labs and Data Center Cooling System Design

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers



Room: Adams

Chair: Jeff Trower, Data Aire Inc., Huntington Beach, CA

Process loads are unique and differ from comfort cooling and heating loads in many ways. Safety, mission critical, climate and regulatory requirements are among the factors that relate to options and opportunities and in some cases constraints to achieving efficiencies above and beyond traditional designs. In this session we take a look at specific aspects of two different process load scenarios that can be considered when designing. In labs, we discuss heat recovery, building envelop and horsepower reduction. For data centers, we cover how best to select cooling equipment, and what to take into consideration when deploying a containment solution.

1. Toward Net-Zero Labs in Northern Climate: Montreal Examples (CH-12-C052)

Roland Charneau, P.E., Pageau Morel and Associates inc., Montreal, QC, Canada

2. Cooling System Design for Data Centers Utilizing Containment Architecture (CH-12-C053)

Davis Wilson, Data Aire Inc., Orange, CA

Conference Paper Session 20 (Advanced)

Multi-Zone VRF

Track: HVAC&R Systems and Equipment



Room: Monroe

Chair: Andrew Moore, Associate Member, Mitsubishi Electric, Duluth, GA

Variable Refrigerant Flow (VRF) systems are continuing to advance in the HVAC market due to their flexibility, individual zone control, and capability for energy efficient operation. This session monitors ongoing efforts to suitably characterize the performance of VRF systems by two different measures: modeling and testing. The modeling study tackles a five-zone VRF system and simulates the performance using a structured approach, identifying key variables and comparing the simulated results to an actual equipment model. A new methodology for testing VRF systems in a laboratory environment is also explored in detail and contrasted against a more traditional dual room psychrometric chamber approach.

1. Multiple-Zone Variable Refrigerant Flow System Modeling and Equipment Performance Mapping Method (CH-12-C054)

Bo Shen, Ph.D., Member and Rice Keith, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

2. Multi-Zone Test Facility for Variable Capacity Multi-Split Heat Pump Systems (CH-12-C055)

Harshal Upadhye, Associate Member¹, Ronald Domitrovic, Ph.D., Associate Member² and Ammi Amarnath³, (1)Electric Power Research Institute, Knoxville, TN, (2)Electric Power Research Institute, Knoxville, TN, (3)Electric Power Research Institute, Palo Alto, CA

Seminar 33 (Basic)

Basics of Computational Fluid Dynamics (CFD) for the Built Environment

Track: HVAC&R Fundamentals and Applications



Room: Empire

Chair: Kishor Khankari, Ph.D., Member, Fluent, Inc., Ann Arbor, MI

With increased emphasis on high performance and energy efficient building operations, the use of Computational Fluid Dynamics (CFD) as a design and analysis tool is increasing. Although the colorful pictures are compelling and usually informative to experienced practitioners, there is frequently a lack of understanding about the basics, benefits, limitations and pitfalls of CFD simulation and analysis. This session provides nuts and bolts of CFD to practicing engineers and managers to help them separate substance and value out of CFD simulations and discusses a few selected applications of CFD for improved design of the built environment.

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1. Nuts and Bolts of CFD

Kishor Khankari, Ph.D., Member, Fluent, Inc., Ann Arbor, MI

2. Applications of CFD for Built Environment

Robert Bolin, P.E., Member¹ and Kishor Khankari, Ph.D., Member², (1) Syska Hennessy Group, Chicago, IL, (2)Fluent, Inc., Ann Arbor, MI

Seminar 34 (Intermediate)

HVAC&R Research Journal: Heat Exchangers

Track: HVAC&R Systems and Equipment

Room: Water Tower

Sponsor: HVAC&R Research Journal

Chair: Reinhard Radermacher, Ph.D., Fellow, University of Maryland, College Park, MD

Chaired by Prof. Reinhard Radermacher of the University of Maryland, this session features two recently published papers on heat exchanger technology, in ASHRAE's HVAC&R Research Journal.

1. Waterside Fouling Performance in Brazed-Plate Type Condensers for Cooling Tower Applications (ASHRAE RP1345)

Lorenzo Cremaschi, Ph.D., Associate Member, Jeffrey Spittle, Ph.D., P.E., Ellisa Lim, Associate Member and Annamalai Ramesh, Student Member, Oklahoma State University, Stillwater, OK

2. Numerical Simulation and Optimization of Single Phase Turbulent Flow in Chevron-Type Plate Heat Exchanger with Sinusoidal Corrugations

Weizhe Han, Ph.D., Member¹, Vikrant Aute, Ph.D., Member², Khaled H. Saleh, Student Member², Gou-liang Ding, Ph.D., Member³, Yunho Hwang, Ph.D., Member² and Reinhard Radermacher, Ph.D., Fellow¹, (1)Shanghai Jiaotong University, Institute of Refrigeration and Cryogenics, College Park, MD, (2)University of Maryland, College Park, MD, (3)Shanghai Jiao Tong University, Shanghai, China, (4)Dept of Mech Eng /CEEE, University of Maryland, College Park, MD

Forum 3 (Intermediate)

Protecting Your Design Against Changing Requirements

Track: Professional Skills

Room: Crystal

Sponsor: 01.07 Business, Management & General Legal Education

Chair: Norm Maxwell, P.E., Member, Environmental Air Quality, Great Neck, NY

With constantly changing laws, regulations, ASHRAE Handbook chapters, codes, standards, addenda, amendments and interpretations, how are designers and contractors to determine which ones apply to each project? Further complicating matters are variances and interpretations by building code officials. Since subsequent owners and occupants can complain that what was designed and built does not comply with their view of legal requirements, how can one protect themselves?

Forum 4 (Intermediate)

Update on the Energy Targets for Commercial Buildings

Track: Energy Efficiency – New Technologies and Applications

Room: Salons 4/5

Sponsor: Commercial Buildings Energy Targets Ad Hoc

Chair: Don Brandt, Member, Trane Co, Phoenix, AZ

This forum provides ASHRAE members with an update on the accomplishments of the Ad Hoc Committee Report on Commercial Buildings Energy Targets to Technology Council. It addresses a definition of gross square feet in commercial buildings for the purposes of calculating an EUI, a research plan to develop the EUI and to establish the maximum technologically achievable energy efficiency using energy modeling, and a draft of the federal legislation to establish a national set of EUI using energy modeling. This forum requests comments, input, complaints, etc.

Tuesday, January 24

11:00 AM-12:30 PM

Technical Paper Session 7 (Advanced)

Effect of Typical Inlet Conditions on Air Outlet Performance

Track: HVAC&R Systems and Equipment

Room: Water Tower

Sponsor: 05.03 Room Air Distribution

Chair: David John, P.E., Metal Industries, Inc., Clearwater, FL

Building air distribution system designers and installers require accurate quantitative information on the performance of the installed system to achieve optimum efficiency and occupant comfort. This session covers an ASHRAE research project that established both baseline performance according to ASHRAE Standard 70-2006, and the field installation adjustment values for throw, pressure loss, and sound generation. Testing covered the air output performance of six types of ceiling diffusers each with three inlet sizes at three inlet velocities. Results include predictive models and look-up tables that can be used to easily predict performance of the installation configuration compared to published data.

1. Installation Effects on Air Outlet Performance, Part 1: Ideal Performance Testing Optimization and Results (RP-1335) (CH-12-019)

Zaccary Poots, Member¹, Brian Landsberger, Ph.D., Member² and Douglas Reynolds, Ph.D., Member³, (1)Nailor Industries, Houston, TX, (2)MIT Alum, Las Vegas, NV, (3)University of Nevada Las Vegas, Las Vegas, NV

2. Installation Effects on Air Outlet Performance, Part 2: Field Air Outlet Throw and Pressure Loss Performance Difference From Ideal (RP-1335) (CH-12-020)

Brian Landsberger, Ph.D., Member¹, Douglas Reynolds, Ph.D., Member² and Zaccary Poots, Member³, (1)MIT Alum, Las Vegas, NV, (2)University of Nevada Las Vegas, Las Vegas, NV, (3)Nailor Industries, Houston, TX

3. Installation Effects on Air Outlet Performance Part 3: Field Air Outlet Sound Generation Performance Difference from Ideal (RP-1335) (CH-12-021)

Douglas Reynolds, Ph.D., Member¹, Brian Landsberger, Ph.D., Member² and Zaccary Poots, Member³, (1)University of Nevada Las Vegas, Las Vegas, NV, (2)MIT Alum, Las Vegas, NV, (3)Nailor Industries, Houston, TX

Conference Paper Session 21 (Advanced)

Surgical Operating Theaters, Healthcare Worker Exposures and Controlling Pressurization

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers

Room: Adams

Chair: Wayne Lawton, P.E., Member, Merrick & Company, Aurora, CO

This session has 3 papers: The first paper covers the investigation of the influence of the surgical operating theatre architecture design on the efficiency of the flow of air-conditioned supply to create sterile and comfort environment in the theatre. The present work is devoted to investigate the relation between airflow movement and air age and the operating room architecture. The second paper examines the effectiveness of a currently used Airborne Infection Isolation Room (AIIR) in protecting health-care workers (HCWs) from airborne-infectious (AI) exposure. The goal is to assess ventilation design to mitigate this exposure for the HCW. The research also compared HCW AI exposures within an AIIR and a traditional patient room, and assessed ventilation design options for the two rooms. The third paper analyzes the effect of mechanical parameters, especially the envelope leakage as it ranges from tight to effectively zero. When the room is sealed, or nearly sealed, mechanical coupling between air flows in and out of the room complicates control loop dynamics. Flow and pressure loops that are ordinarily almost independent become tightly coupled with the potential to destabilize one another.

1. Energy Efficiency, Air Flow Regime and Relative Humidity in Air-Conditioned Surgical Operating Theatres (CH-12-C056)

Essam E. Khalil, Ph.D., Fellow ASHRAE, Cairo University, Cairo, Egypt

2. Assessment of Health-Care Worker Exposure to Pandemic Flu in Hospital Rooms (CH-12-C057)

Urmila Ghia, Ph.D.¹, Santosh Konangi¹, Aravind Kishore¹, Kenneth R. Mead, Ph.D., P.E., Member², Michael Gressel, Ph.D., Member² and G. Scott Earnest, Ph.D., P.E., Member², (1)University of Cincinnati, Cincinnati, OH, (2)CDC- National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH

3. Control of Space Pressurization for Sealed or Tight Rooms (CH-12-C058)

Jim Coogan, P.E., Member, Siemens Building Technology, Buffalo Grove, IL

Conference Paper Session 22 (Basic)

UK Perspectives on Incentives for Technologies to Reduce Energy Use

Track: High Performance Buildings



Room: Monroe

Sponsor: CIBSE

Chair: Tim Dwyer, P.E., Fellow ASHRAE, The Holt, Benenden, EN, United Kingdom

The EU carbon reduction commitment is a legally enforceable target to reduce the carbon impact of the built environment by 80% by 2050. The aim is not only to reduce carbon emissions but improve energy security. This has accelerated the implementation of legislation in all states across Europe and specifically, in the case of the studies in this session, in the UK. The four presentations consider the incentives that are being used to encourage development and application of technologies to not only reduce the need for energy use in buildings but also in delivering heat and power from renewable sources. By considering both existing and new build projects the reality of prediction, costing, assessment and integration of renewable technologies are discussed, supported by real world case studies undertaken in metropolitan London.

1. Legislative Aspects of Enforcing Renewables Integration and Success of Implementation (CH-12-C059)

Hywel Davies, Ph.D., Member, Chartered Institution of Building Services Engineers, London, England

2. Developing Advanced Virtual Models of Combined Buildings and Systems for Energy Reduction and Integrating Renewables (CH-12-C060)

Andy Ford, Ph.D., Mott MacDonald Fulcrum, London, United Kingdom

3. Performance Evaluation of the Centre for Efficient and Renewable Energy in Buildings (CH-12-C061)

Jeya Bavan, Ph.D., Member, London South Bank University, London, United Kingdom

4. An Analysis of Photovoltaic Performance within Existing Fire Station Buildings (CH-12-C062)

Tony Day, Ph.D.¹ and Dan Clark², (1)EAA Ltd, Milton Keynes, United Kingdom, (2)Hampshire County Council, Hampshire, United Kingdom

Conference Paper Session 23 (Intermediate)

Modern Treatment of Water and Ice Based TES Systems

Track: HVAC&R Systems and Equipment

Room: Salons 4/5

Sponsor: 06.09 Thermal Storage

Chair: Jon J. Cohen, H-O-H Water Technology, Inc, Palatine, IL

Sensible heat thermal storage systems are efficiently used to cool large thermal loads. Water treatment for such systems can be achieved through various methods. Proper water treatment maintains the many advantages of thermal storage by reducing corrosion, increasing asset life and maintaining efficient heat transfer. Three methods for effective treatment of water for large, sensible heat, thermal storage systems will provide a state of the art look at water treatment.

1. Applications of Low Temperature Fluid (LTF) in Thermally-Stratified Thermal Energy Storage (TES) (CH-12-C063)

John S. Andrepont, Life Member, The Cool Solutions Company, Lisle, IL

2. The Challenges of Treating Large Thermal Storage and District Cooling Systems (CH-12-C064)

Robert S. Walicki, Ph.D., Danny Blagojevich and Philip Yu, Nalco Company, Naperville, IL

3. Control of Corrosion, Microbiology and Deposition in Large Thermal Chilled Water Storage Systems (CH-12-C065)

Henry A. Becker, Member and Jon J. Cohen, H-O-H Water Technology, Inc, Palatine, IL

Seminar 35 (Advanced)

Advancements and Trends in Low Global Warming Impact Technologies

Track: Refrigeration



Room: Empire

Sponsor: Refrigeration Committee, TC3.1, TC10.7, 08.01 Positive Displacement Compressors

Chair: Georgi S. Kazachki, Ph.D., Fellow ASHRAE, DRS Technologies, Florence, KY

The global warming impact of refrigeration, air-conditioning and heat pump (RAC&HP) technologies became the next urgent concern after addressing stratospheric ozone depletion from the chlorine-containing refrigerants. In addition to the direct impact of the leaked refrigerant, RAC&HP technologies contribute to global warming indirectly through the energy required for their operation. This seminar presents the most recent achievements in research and development of Low Global Warming Impact Technologies providing a balanced approach through the use of natural and low GWP refrigerants as well as through cycle, system and component design optimization for refrigerant charge reduction, leak elimination, and efficiency enhancements.

1. Understanding Direct and Indirect GWP Impact of Refrigeration Systems

Douglas T. Reindl, Ph.D., P.E., Fellow, Engineering Professional Development, University of Wisconsin-Madison, Madison, WI

2. Performance Enhancement Options for CO2 Cycle

Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

3. Latest Developments in Low Global Warming Refrigerants for Commercial Supermarket Refrigeration

Samuel F. Yana Motta, Ph.D., Member, Honeywell, Buffalo, NY

4. Advances in Reducing the Flammability of Low GWP Refrigerants

Brett Van Horn, Ph.D., Member, ARKEMA Inc., King of Prussia, PA

Seminar 36 (Intermediate)

Cutting-Edge Japanese Technologies, Part 2: 2011 SHASE Annual Award and Development of CFD on the Basis of BIM

Track: Energy Efficiency –

New Technologies and Applications



Room: Crystal

Chair: Masaya Okumiya, Ph.D., Member, Nagoya University, Aichi, Japan

The purpose of this session is to explain the latest Japanese HVAC and modeling technologies. Some of these technologies were awarded the SHASE Annual Award in 2011. The first of these technologies is a desiccant cooling system that can realize a non-condensing environment using a non-condensing air-conditioning system. The second is an innovative energy- and resource-saving air-cleaning system that was developed by separating the heat treatment and air-cleaning functions and by using the minimum elements required for clean rooms. Finally, we introduce the development of CFD parts for HVAC elements on the basis of BIM, and explain the usable features and format of the CFD for HVAC design engineers.

1. Next-Generation Non-Condensing Air-Conditioning System: Desiccant Air-Conditioning System Combined with CO2 Heat Pump

Makoto Koganei, Ph.D., Member, Yamaguchi University, Yamaguchi, Japan

2. Development of Energy- and Resource-Saving Air-Cleaning System (Task and Ambient Air-Cleaning System)

Hisashi Hasebe, Ph.D., Shimizu Corporation, Tokyo, Japan

3. Modularizing HVAC Elements for CFD Software

Masashi Imano, Ph.D., The University of Tokyo, Tokyo, Japan

Seminar 37 (Basic)

Issues Update: U.S. State Building Energy Codes Legislation and Regulations

Track: Energy Efficiency – New Technologies and Applications

Room: Wabash

Sponsor: Advocacy Committee

Chair: Tom E. Watson, P.E., Fellow ASHRAE, McQuay International, Staunton, VA

States are one of the most active areas of building codes legislation and regulations in the United States. They often look to each other for direction, and the actions of a few key states can impact several others, and possibly the entire nation. Legislation has been introduced in several states that would use ASHRAE standards to help accomplish policymakers' energy efficiency and other goals. This session updates members on the current status and chances of passage of building codes legislation in key states, providing insight into the intersection between what is politically acceptable and what is helpful, in a technical sense, to the building industry.

1. Key Building Energy Codes Legislative and Regulatory Issues in the Northwest

Charlie Grist, Northwest Power and Conservation Council, Portland, OR

2. Key Building Energy Codes Legislative and Regulatory Issues in the Midwest

Isaac Elneceve, Midwest Energy Efficiency Alliance, Chicago, IL

3. Key Building Energy Codes Legislative and Regulatory Issues in the Southwest

Jim Meyers, Southwest Energy Efficiency Project, Boulder, CO

4. Key Building Energy Codes Legislative and Regulatory Issues in the Northeast

Carolyn Sarno, Northeast Energy Efficiency Partnerships, Lexington, MA



ASHRAE Poster Session and "Research Cavalcade"



Room: Red Lacquer

Chair: Sarah E. Maston, P.E., Member, Advanced Building Performance, Hudson, MA

New: Selected oral presentations of Technical Paper Posters. Join your research colleagues for dialogue on a wide-range of topics presented by poster and orally. Each presenter will have five minutes to give an overview of their paper. Q&A will follow after the session. One-on-one in-depth discussions will take place during the poster session. Come to this new addition to the poster session and contribute to the research discussion!

The Research Cavalcade begins at 11:15 am.

The order of presentations is:

A Virtual Chilled Water Flow Meter Development at Air-Handling Unit Level (CH-12-024)

Li Song Ph.D., P.E. Member, University of Oklahoma, Norman, OK

Evaluation of ASHRAE Dilution Models to Estimate Dilution from Rooftop Exhausts (CH-12-026)

Amit Gupta, Ph.D., Member, Engineering Consultants and Planners, Roorkee, India

Feasibility of Foundation Heat Exchangers in Ground Source Heat Pump Systems in the United States (CH-12-027)

James R. Cullin, Student Member, Lu Xing, Edwin Lee, Jeffrey Spitzer, Ph.D., P.E. and Daniel Fisher, Fellow S-B-A, Oklahoma State University, Stillwater, OK

Measurements of Pipe Insulation Thermal Conductivity at Below Ambient Temperatures Part 1: Experimental Methodology and Dry Tests (RP-1356) (CH-12-030)

Lorenzo Cremaschi, Ph.D., Associate Member, **Shanshan Cai**, Kasey Worthington and Afshin Ghajar, Oklahoma State University, Stillwater, OK

1. A Model for Predicting Wireless Signal Transmission Performance of ZigBee-Based Sensor Networks in Residential Houses (CH-12-022)

Lingying Zhao, Ph.D., Member¹, Peter Ling¹, Jia Liu¹ and Hui Li², (1)The Ohio State University, Columbus, OH, (2)Sky Climber LLC, Delaware, OH

The goal of this study was to establish a path loss model for predicting wireless signal transmission in residential house to guide configuration of reliable wireless network application in multi-zone HVAC system control. Our study focused on ZigBee, a wireless networking protocol tailored for low cost and power consumption sensor networks. Factors affecting wireless data transmission in residential indoor environment include space separations (e.g., walls, floors, and furniture) and interference from other wireless devices. Effects of these factors on the path loss of wireless channels were quantified through an empirical signal attenuation model based on received signal strength indicator (RSSI) value. The model was validated by comparing the predicted path loss to the measured loss. The results showed that the mean and the standard deviation of the prediction errors were 7.7 ± 7.1 dB, which is comparable to previous literature research results. Our performance analysis showed that the over-prediction of our path loss model is bounded by 11.8%. The path loss model can be used as a means to determine the sensor locations for reliable networks and to improve the design of wireless transceivers.

2. A Proposed Method of Test for Spoilage of Fruits and Vegetables (CH-12-023)

Kristopher R. Lineberry, Student Member¹, Michael Pate, Ph.D., P.E., Member² and Byron Brehm-Stecher, Ph.D.¹, (1)Iowa State University, Department of Mechanical Engineering, Ames, IA, (2)Texas A&M University, College Station, TX

This document is intended to provide all procedures and background needed for testing produce spoilage from an environmental chamber. Instructions start with the procurement of the produce and sample preparation prior to placement within the environmental chamber, data collection procedures used throughout the experiments are specified and a checklist for visually identifying physical attributes of "spoilage" is developed. Procedures for counting of microorganisms and data collection are explained step-by-step.

3. A Virtual Chilled Water Flow Meter Development at Air-Handling Unit Level (CH-12-024)

Li Song, Ph.D., P.E., Member¹, Atul Swamy, Student Member¹ and Gang Wang, Ph.D., P.E., Member², (1)University of Oklahoma, Norman, OK, (2)Texas A & M University, Kingsville, TX

In this paper, a virtual Air handling unit (AHU) level water flow meter is developed by using a control valve as a measurement device. The flow through the valve is indirectly calculated using two measurable inputs (differential pressure measurements and valve opening positions) and three constants (inherent valve characteristics, valve coefficient and the valve authority). Thus, the non-intrusive virtual flow meter introduced in this paper provides a solution to one of the measurement barriers and challenges: a low cost, reliable energy metering system at the AHU level. Due to the fact that the virtual flow measurement is achieved by an indirect calculation based on multiple inputs, possibility of measurement errors is significantly increased comparing with a direct flow measurement. In this paper, we first introduce mathematical models of the virtual flow meter. This study has proven that theoretically it is feasible to use the control valve as the measurement device at the AHU level to provide satisfactory results. More studies will be carried out on experimental tests in next phase study.

4. Energy Savings Potential of Variable Condenser Water Flow Systems (CH-12-025)

Zhiqin Zhang, Ph.D. and Jingjing Liu, Student Member, Nexant, Inc., San Francisco, CA

Most chilled water systems are designed and operated with constant condenser water flow rates. Recently, there is a trend to apply the VSDs to all the components to achieve higher operation performance when specially tailored operating strategies are incorporated. This paper studied the energy savings potential of varying condenser water flow rate by simulating an example condenser water loop. The simulation results show that, if pump water flow and fan airflow are throttled by valves or dampers, the system could consume more energy when reducing the condenser water flow. Compared to the operating with a constant optimal CW flow, the savings of applying variable optimal CW flow are neglectable. This method can be applied to actual systems to find the optimal condenser water operating strategies.

5. Evaluation of ASHRAE Dilution Models to Estimate Dilution from Rooftop Exhausts (CH-12-026)

Amit Gupta, Ph.D., Member, Engineering Consultants and Planners, Roorkee, India

Re-entrainment of building exhausts may lead to poor indoor air quality, potential health hazards, worker complaints and lower productivity. To minimize re-entrainment, the American Society of Heating, Refrigerating, and

Air Conditioning Engineers (ASHRAE) recommends minimum dilution models Dr and Ds to estimate worst-case dilutions at fresh-air intakes. The Dr and Ds models predicts plume center-line (worst-case) dilution at roof level, assuming that the plume has a Gaussian concentration profile in both the vertical and lateral directions. The Dr model considers effect of plume rise, however, the Ds model assumes negligible plume rise and is primarily recommended for wall vents and capped stacks. This paper evaluates the ASHRAE (2003, 2007) dilution models using data from wind tunnel and field experiments carried out with typical low-rise and high-rise buildings.

6. Feasibility of Foundation Heat Exchangers in Ground Source Heat Pump Systems in the United States (CH-12-027)

James R. Cullin, Student Member, Lu Xing, Edwin Lee, Jeffrey Spitzer, Ph.D., P.E. and Daniel Fisher, Fellow S-B-A, Oklahoma State University, Stillwater, OK

Foundation heat exchangers (FHXs) used in residential ground source heat pump systems represent a potential cost savings due to their lesser first cost over other types of heat exchangers. By simulating a foundation heat exchanger system for two low-energy house constructions in seventeen United States locations, a preliminary map detailing the feasibility of FHX systems in the United States has been developed, with most of the country showing at least marginal feasibility for the technology. The FHX simulation process uses decoupled models of house and basement; the coupling between the two zones creates a difference of around 1.0°C (1.8°F) in the simulated maximum or minimum heat pump entering fluid temperature. Additionally, the operation of an FHX in the soil around a house was found to have a negligible impact on soil freezing near the house foundation. The FHX simulation needs a fully-coupled house/basement model, as well as the capacity to handle snow cover, to be even more robust.

7. Least Cost Upgrade Solutions to Achieve Improved Energy Efficiency Standards for Residential New Housing in Canada (CH-12-028)

Alan S. Fung, Ph.D., P.E., Member, Aya Dembo, Student Member and Farhan Khaddad, Ryerson University MIE, Toronto, ON, Canada

This paper presents the methodology developed to identify the most cost-effective (or least cost) specifications in residential new housing constructions to achieve improved energy efficiency standards including the “EnerGuide 80”, which is a requirement of the 2012 Ontario Building Code (OBC) and beyond, ultimately reaching the net zero energy (NZE) level. The proposed methodology considers the initial capital cost, and the life cycle cost implications of achieving such standards while maintaining an adequate level of thermal comfort. The results showed that, based on the life cycle cost analysis of 30 years, the most cost-effective combination of upgrades includes improved thermal resistance in the building envelope components (ceiling, both above and below-grade walls, floors, and basement slab), and installation of the most efficient heating, ventilating, and air-conditioning (HVAC) system, resulting in 25% reduction in the estimated annual space and domestic hot water (DHW) energy consumption, while achieving the EnerGuide Rating of 82, thereby meeting the requirements of the 2012 OBC. With the installation of a photovoltaic (PV) system, the estimated profit of up to \$70,038 could be achieved through Ontario’s micro Feed-in Tariff (FIT) program.

8. Literature Review of the Effect of Temperature and Humidity on Viruses (CH-12-029)

Farhad Memarzadeh, Ph.D., P.E., National Institutes of Health, Bethesda, MD

An extensive literature review of over 120 papers was conducted on the effect of humidity and temperature on the transmission of infectious viruses. This review targets infectious viruses known to be transmitted via the airborne route and by direct and indirect contact. Evidence is cited from both direct and indirect study results examining environmental conditions that affect infectious disease aerosol transmission in enclosed environments. These results will have a major influence on the choice of infection control measures in indoor environments as well as an associated cost for equipment and renovations to the ventilation system or room design.

9. Measurements of Pipe Insulation Thermal Conductivity at Below Ambient Temperatures Part 1: Experimental Methodology and Dry Tests (RP-1356) (CH-12-030)

Lorenzo Cremaschi, Ph.D., Associate Member, Shanshan Cai, Kasey Worthington and Afshin Ghajar, Oklahoma State University, Stillwater, OK

Mechanical pipe insulation systems are installed around cold cylindrical surfaces, such as chilled pipes, which often work at below ambient temperatures in several industrial and commercial building applications. The thermal performance of pipe insulation systems is affected by local ambient conditions

and might vary gradually with time. In this paper, a novel experimental apparatus to measure the thermal conductivity of mechanical pipe insulation systems at below ambient temperatures is presented. The new apparatus was validated with two pipe insulation systems, cellular glass and Polyisocyanurate (PIR), used to benchmark our measurements against data available in the public domain. The thermal conductivity of additional three pipe insulation materials, that is, fiberglass, flexible elastomeric and phenolic, was also measured at several insulation temperatures at below ambient and in dry non-condensing ambient conditions. Correlations of the pipe insulation thermal conductivity were developed based on insulation specimen average temperature and wall thicknesses. Corresponding uncertainties of the measurements and the edge effects of the longitudinal butt joints are also critically analyzed in this paper.

10. Method for Estimating Energy Savings Potential of Chilled Water Plant Retro-Commissioning (CH-12-031)

Zhiqin Zhang, Ph.D.¹ and W. Dan Turner, Ph.D., P.E.², (1)Nexant, Inc., San Francisco, CA, (2)Energy Systems Laboratory, College Station, TX

Chilled water plant is a major contributor of total energy consumption for a facility. Various energy efficiency measures have been proposed to improve plant performance in retro-commissioning projects. This paper introduces a method to estimate the savings potential of some popular measures by building a forward simulating model for a chilled water plant without storage. This model is based on a wire-to-water efficiency concept to simulate the plant power for producing cooling. The wire-to-water efficiency of each type of equipment is calculated with selected models or equations. The fluctuation of the chilled water loop supply and return temperature difference is also considered to reflect its impacts on the chiller loading and pumping power. By finding the optimal reset schedule of some controlled variables, the utility billing cost of a chiller plant can be minimized. The variables to be optimized are cooling tower approach temperature, chiller chilled water leaving temperature, and chiller condenser water flow rate. This is a non-linear programming problem and can be solved with the generalized reduced gradient nonlinear solver. The application of this method is illustrated with an example chilled water system.

11. Passive Houses: What May Happen When Energy Efficiency Becomes the Only Paradigm (CH-12-032)

Hugo Hens, Ph.D., Fellow ASHRAE, K.U.Leuven, Leuven, Belgium

In the paper the case of a passive house is discussed that was declared inhabitable less than 2 years after the inhabitants, a family of five, moved in. The enclosure consisted of a timber-framed façade finished with a brick veneer and, a pitched tiled roof, both with U-value 0.13 W/(m².K)/0.023 Btu/(ft².h.°F), argon-filled, low-e triple glazed timber windows with average U-value 0.74 W/(m².K) (0.13 Btu/(ft².h.°F)) and a floor on grade, annual mean U-value 0.16 W/(m².K) (0.028 Btu/(ft².h.°F)). A balanced ventilation system with heat recovery supplied the fresh air, while a heating coil in the supply duct after the recovery unit cared for heating. Supply air first passed through a ground tube before entering the recovery unit. Air-tightness should have been such that n50 did not pass 0.6 h-1. Very soon, the inhabitants complained about degrading health. On site measurements showed the inside air was quite polluted, while relative humidity was remarkably high. A closer look revealed stagnant water in the ground tube, a too low fresh air supply, an inadequate design of the ventilation, heating and domestic hot water system and an OSB air barrier at the inside of the enclosure that turned quite humid at the rain-side during summer and acted as effective UF-source that way.

Tuesday, January 24

1:30 PM-3:00 PM

Seminar 38 (Intermediate)

Advancing the “I” in BIM

Track: Integrated Design

Room: Crystal

Sponsor: 7.02 HVAC&R Contractors and Design Build Firms,

07.01 Integrated Building Design

Chair: George Austin, Engineering, David Shultz Associates,

Charlotte, NC



Holding great promise for lowering costs and improving building performance, seemingly everybody in the AEC community wants a piece of Building Information Modeling. Unfortunately many in the HVAC&R industry have regarded early attempts at BIM as nothing more than glorified coordination drawings. This seminar is aimed at learning how some leading owners,

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contractors, and academic institutions are overcoming early challenges to exploit the “I” in BIM, leading to better cost efficiencies and maintenance practices. What will it take to reap the intended value of BIM? After brief background presentations, four industry leaders share their knowledge through a forum discussion.

1. BIM Challenges and Opportunities for the Mechanical Contractor

Joseph E. Burns, Burns Mechanical, Horsham, PA

2. Reducing the Time and Cost of Construction with BIM:

The Last 100 Feet

Andy Stapleton, Mortenson Construction, Elk Grove Village, IL

3. BIM Developments for Energy Efficient Buildings

John Messner, Ph.D., Member, The Pennsylvania State University, State College, PA

4. The Owner’s Perspective: BIM after Construction

Birgitta Foster, buildingSMART Alliance, Albuquerque, NM

Seminar 39 (Intermediate)

Comparison of Laboratory and Field Performance Testing and Ratings of Fans

Track: HVAC&R Systems and Equipment



Room: Water Tower

Sponsor: 05.01 Fans, 05.09 Enclosed Vehicular Facilities

Chair: Asesh Raychaudhuri, P.E., Member, US Dept. of Veterans Affairs, Washington, DC

Manufacturers adopt AMCA standard methods in the laboratories for performance testing and generate fan curves. In-situ fan performance and system curve in almost all situations do not match laboratory results. Of course, there are different reasons for these differences. One reason is the use of different techniques and tools used to measure the performance in the laboratory and field. Also, the accuracy of the available field methods are not well-established and standardized. This seminar discusses the different methods and tools available and used together with their comparisons.

1. Instruments and Techniques Used for Performance Testing

Chuck Coward, P.E., Fellow ASHRAE, Waddell Engineering Co, Moorestown, NJ

2. Laboratory Performance Testing and Rating of Fans

Radha K. Ganesh, Ph.D., P.E., Member, Twin City Fan Companies, Plymouth, MN

3. Fan Airflow and Pressure: Can We Measure In-Situ Performance?

Craig P. Wray, P.E., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

Tuesday, January 24

3:15 PM-4:45 PM

Seminar 40 (Advanced)

Advanced Control and Diagnostic Techniques for Efficient Operation of High Performance Buildings

Track: High Performance Buildings



Room: Water Tower

Sponsor: 07.05 Smart Building Systems

Chair: T. Agami Reddy, Ph.D., P.E., Member, Drexel University, Philadelphia, PA

There is considerable interest in the building energy community of ways to design low energy and even net-zero energy buildings. In conjunction with this focus, there needs to be an equal amount of emphasis placed on ways to operate such buildings so that the full advantages of all the new elements and control features being proposed are being fully realized. Many of these features involve dynamic control of building elements. This seminar covers promising and emerging techniques by three distinguished speakers on active daylighting control, on mixed mode cooling strategies, and embedded supervisory control strategies for building systems.

1. Active Control of Daylighting Systems and Solar Gains in High Performance Buildings

Andreas K. Athienitis, Ph.D., P.E., Member, Concordia University, Montréal, QC, Canada

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2. MPC-Benchmarked Operating Strategies for Mixed-Mode Commercial Buildings

Peter May-Ostendorp, Student Member, University of Colorado, Boulder, CO

3. Strategies and Algorithms to Enable Intelligent Buildings

James E. Braun, Ph.D., Purdue University, West Lafayette, IN

Seminar 41 (Basic)

Loads on the Move: Mobile Apps

Track: HVAC&R Fundamentals and Applications



Room: Crystal

Sponsor: 04.01 Load Calculation Data and Procedures, 01.05

Computer Applications

Chair: Glenn Friedman, P.E., Member, Taylor Engineering, Alameda, CA

In the world of technology, mobile applications, for load calculations and energy analysis, are becoming a reality. Come find out the pros and cons of HVAC mobile applications. There are four presentations on mobile applications technologies followed by a moderated roundtable on different sides of the mobile app benefits and shortcomings.

1. Mobile + Cloud: The Next Generation of Engineering Applications

Charles S. Barnaby, Member, Wrightsoft Corp., Lexington, MA

2. Non-Traditional Load Calculation Technology

Stephen Roth, P.E., Member, Carmel Software Corp, San Rafael, CA

3. Mobile Applications for Building Energy Audits

Oliver Davis, Associate Member, s/b Concept 3D, Inc., Boulder, CO

4. Mobile Applications: A Word of Caution

Larry Sun, Member, Tsuchiyama, Kaino Sun & Carter, Irvine, CA

Tuesday, January 24

5:30 PM-6:30 PM

Forum (Intermediate)

Design Issues for Heat Recovery Heat Pumps – What’s Missing

Track: HVAC&R Systems and Equipment

Room: Adams

Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications

Chair: Frank Pucciano, Member, Sabot 6, Atlanta, GA

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC’s meeting. Heat recovery heat pumps have been used in a number of commercial, industrial and institutional applications. The fundamental technology is simple – find a low temperature heat source and boost its useful temperature with a heat recovery heat pump to heat water, product or air. The difficulty is integrating the correct heat exchangers at the ideal location with the appropriate control scheme. Unfortunately, the Montreal Protocol and the attention to air conditioning and refrigeration refrigerant replacements put heat recovery heat pumps on the back burner since they could no longer heat fluids to as high as 180 °F. New refrigerants, new chiller technologies and a renewed interest by manufacturers have re-stimulated the interest in Heat Recovery Heat Pumps. The basic integration designs are the same, but better controls and better technology present the need for increased understanding. This Forum is intended to explore the needs of ASHRAE membership for the best practices for integrating the new and improved technologies.

Wednesday, January 25

8:00 AM-9:30 AM

Technical Paper Session 8 (Intermediate)

Effects of Various Factors on Heat Exchanger Performance

Track: HVAC&R Systems and Equipment



Room: Water Tower

Sponsor: 08.04 Air-to-Refrigerant Heat Transfer Equipment, 08.05

Liquid-to-Refrigerant Heat Exchangers

Chair: Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

The purpose of this technical session is to inform design engineers of how the performance of air and water to refrigerant heat exchangers are affected by factors such as condensation temperature, water quality, frost growth, and air-side particulate fouling.

1. Effect of Condensation Temperature and Water Quality on Fouling of Brazed-Plate Heat Exchangers (RP-1345) (CH-12-033)

Lorenzo Cremaschi, Ph.D., Associate Member, Atharva Barve and XiaXiao Wu, Student Member, Oklahoma State University, Stillwater, OK

2. Measurements of Frost Growth on Louvered Folded Fins of Micro-channel Heat Exchangers Part 1: Experimental Methodology (RP-1589) (CH-12-034)

Lorenzo Cremaschi, Ph.D., Associate Member, Tommy Hong, Ehsan Moallem and Daniel Fisher, Fellow S-B-A, Oklahoma State University, Stillwater, OK

3. Experimental Evaluation of Air Side Particulate Fouling Performance of Heat Exchangers (CH-12-035)

Yigang Sun¹, Zhang Yuanhu², Ford Steve³, Barker Douglas³ and Mark Johnson, Associate Member⁴, (1)University of Illinois at Urbana-Champaign, Urbana, IL, (2)University of Illinois at Urbana-Champaign, Urbana, IL, (3)University of Illinois at Urbana-Champaign, Urbana, IL, (4)Modine Mfg., Racine, WI, USA, Racine, WI

Conference Paper Session 24 (Intermediate)

The Role of Energy Efficiency and Renewable Energy

Track: Energy Efficiency – New Technologies and Applications



Room: Salons 4/5

Sponsor: 06.07 Solar Energy Utilization, ASHRAE Associate Alliance Society

Chair: Marija S. Todorovic, Ph.D., University Of Belgrade, Belgrade, Serbia

Sustainable energy use in high performance buildings based on the inextricable linkage of energy efficiency and renewable (solar and other RES) implementation – optimized by the BPS and co-simulation via integrated building design, is to be covered. Session goal is to answer the question “Is buildings sector (urban and rural) strategic energy planning worldwide appropriate or should it be more “offensive” concerning the current RES technologies (thermal and electrical) and RES technical potential status, demonstration and commercialization, as well as successful decades of RES systems reliable operation, particularly in buildings sectors. Special attention will be drawn to the high IEQ-HVAC (high indoor environment-HVAC) buildings and their further “greening to approach NZEB” dependence on the further commercialization and implementation of RES technologies and RES integrated approach (from modeling through end designs and construction to the operational optimization via BEMS). Not less important are complex energy systems of the combined RES based central and/or municipal utilities energy generation and buildings distributed pure RES or hybrid (fossil and RES based) co-generation. Solar and other RES natural and technical potentials, locally available, are mainly in all world regions well determined and consequently many Governments Strategic Energy Plans are predicting important target - percentage growth of RES utilization in building sector and total.

1. Renewable Energy Utilization in Chinese Buildings: Technology Development and Demonstration Projects (CH-12-C066)

Xudong Yang, Ph.D., P.E., Member, Ming Shan and Ming Yang, Tsinghua University, Beijing, China

2. Renewable Energy Policy Initiatives in UAE and Pakistan (CH-12-C067)

Farooq Mehboob, P.E., Member, S.Mehboob & Company, Karachi, Pakistan

Conference Paper Session 25 (Advanced)

Heat Exchangers: Benefits and Models

Track: HVAC&R Systems and Equipment



Room: Crystal

Chair: Mark Hydeman, P.E., Fellow, Taylor Engineering, LLC, Alameda, CA

This session features papers on applications and tools for ground-coupled heat pumps and hydrothermal energy conversion. The four papers cover the following topics: an overview of hydrothermal energy conversion with case studies; two papers on modeling techniques for ground couple heat pump

fields; and a field test methodology to evaluate the ground thermal properties for ground-couple heat field design.

1. Hydrothermal Energy: Sustainable Benefits for Island and Coastal Communities (CH-12-C068)

Tadeusz Jagustyn, Member, Cotherm of America Corporation, Fort Lauderdale, FL

2. A Load-Aggregation Method to Calculate Extraction Temperatures of Borehole Heat Exchangers (CH-12-C069)

Saqib Javed, P.E., Student Member and Johan Claesson, Ph.D., Chalmers University of Technology, Gothenburg, Sweden

3. A Method to Evaluate Thermal Response Tests on Groundwater-filled Boreholes (CH-12-C070)

Saqib Javed, P.E., Student Member, Helena Nakos and Johan Claesson, Ph.D., Chalmers University of Technology, Gothenburg, Sweden

4. Thermal Network Model for Variable Flow Ground Heat Exchanger Systems (CH-12-C071)

Wei Ruan, Student Member and William T. Horton, Purdue University, West Lafayette, IN

Conference Paper Session 26 (Advanced)

Natural Ventilation Impacts and Applications in Large Buildings

Track: HVAC&R Fundamentals and Applications



Room: Monroe

Chair: Larry Sun, Member; Tsuchiyama, Kaino Sun & Carter; Irvine, CA

Natural ventilation is being considered for a wider range of large buildings. The selection of natural, hybrid or mechanical ventilation strategies involves an understanding of the effect of different climates, acceptable comfort conditions, energy, capital and maintenance costs. In addition within large, naturally ventilated buildings, there are often specific areas of the building which are mechanically conditioned. The interaction of these spaces with the naturally ventilated space can have significant effects. This session discusses these impacts, as well as other design considerations and tools for informed design of a large naturally-ventilated building.

1. Ventilation Effectiveness of a Building Cluster (CH-12-C072)

KC Tsui, Member¹, Yuguo Li, Ph.D., Fellow ASHRAE², Srinivas Katipamula, Ph.D., P.E., Fellow ASHRAE³ and Srinivas Katipamula, Ph.D., P.E., Fellow ASHRAE³, (1)University of Hong Kong, Hong Kong, Hong Kong, (2)Hong Kong University, Hong Kong, China, (3)Pacific Northwest National Laboratory, Richland, WA

2. Design of Practical Hybrid Ventilation Building in Central Tokyo (CH-12-C073)

Maria Alejandra Menchaca Brandan, Student Member, Stephen Ray, Student Member and Leon Glicksman, Ph.D., Fellow ASHRAE, Massachusetts Institute of Technology, Cambridge, MA

3. Ventilation Approaches for Shopping Malls: An Examination of Natural and Hybrid Strategies (CH-12-C074)

David P. D. Hamlyn, Ph.D.¹, John Daniel Cash, P.E., Affiliate¹, Shaun D. Fitzgerald, Ph.D.¹, Gwilym Still² and Philip Armitage², (1)Breathing Buildings Ltd., Cambridge, United Kingdom, (2)Max Fordham LLP, Cambridge, United Kingdom

Seminar 42 (Intermediate)

Case Studies: New Equipment and Applications to Improve Energy Efficiency

Track: Energy Efficiency – New Technologies and Applications



Room: Adams

Sponsor: 09.01 Large Building Air-Conditioning Systems

Chair: Kelley P. Cramm, P.E., Member, Henderson Engineers, Lenexa, KS

Energy efficiency opportunities abound for new and older buildings. Major improvements can be made by upgrading equipment, applying equipment in innovative ways, and using energy modeling and metering. This showcases three unusual approaches to improving performance in buildings.

1. Geothermal Upgraded to Heat Recovery Chiller and Variable Refrigerant Flow

John L. Kuempel, P.E., Member, DeBra-Kuempel, Cincinnati, OH

2. Chilled Water Modeling and Energy Metering for an Existing Chilled Water System Saves Energy

Howard J. McKew, P.E., Member, RDK Engineers, Andover, MA

3. Ground Source Central Plant Successes and Lessons Learned

Mick Schwedler, P.E., Member, Trane, La Crosse, WI

Seminar 43 (Intermediate)

Industrial Refrigeration Worst Practices

Track: Refrigeration

Room: Empire

Sponsor: 10.01 Custom Engineered Refrigeration Systems

Chair: Wayne Borrowman, P.Eng., Member, CIMCO Refrigeration, Delta, BC, Canada

Most ASHRAE seminars try to teach participants about the latest, greatest, best and the brightest methods for designing built environments. But what about the other end of the spectrum - the worst? There is just as much to learn from the implementation of bad ideas, the application of poor practices and the operation of facilities without proper procedures. And nowhere does this become more evident than in industrial refrigeration applications. This seminar highlights fairly common designs, maintenance practices and operational SNAFU's throughout the industrial refrigeration world that often lead to more problems. The presenters provide methods to correct the design or operation to alleviate the resulting problems.

1. Infiltration Nightmares: Keeping the Moisture Out of the Freezer

Donald J Cleland, Ph.D., Fellow ASHRAE, Massey University, Palmerston North, New Zealand

2. Refrigeration System Screw-Ups: The Only Thing Worse Than Poor Design Is Poor Implementation

Douglas T. Reindl, Ph.D., P.E., Fellow, University of Wisconsin-Madison, Madison, WI

3. Mechanical Integrity Mayhem: How to Destroy Piping in One Year or Less

Daniel Dettmers, Member, IRC, U.W. Madison, Madison, WI

Seminar 44 (Advanced)

Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 1

Track: Energy Modeling Applications

Room: Red Lacquer

Sponsor: 04.07 Energy Calculations

Chair: Wangda Zuo, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA

Integrated performance simulation of buildings and heating, ventilation and air-conditioning (HVAC) systems can help in reducing energy consumption and increasing occupant comfort. As part one of the two seminars in integrated building simulation, this seminar first discusses why, when and how we can use integrated multi-domain simulation for innovative building design and operation. The concepts and principles are then demonstrated by using two applications, including integrated simulation of energy and airflow for natural ventilation, as well as coupled simulation of building physics and energy system.

1. Why and When Do We Need Integrated Simulations for Buildings?

Jan Hensen, Ph.D., Fellow ASHRAE, Eindhoven University of Technology, Eindhoven, Netherlands

2. Assessment of Natural and Hybrid Ventilation Models in Whole-Building Energy Simulations

John Zhai, Ph.D., Member, University of Colorado, Boulder, CO

3. The Design of An ESP-r and TANSYS Co-Simulator

Ian Beausoleil-Morrison, Ph.D, Member, Carleton University, Ottawa, Ontario, Canada

Seminar 45 (Basic)

Trying Hard to Play Nice: Assessing Industry Barriers to the Use of IPD

Track: Integrated Design

Room: Wabash

Sponsor: 07.01 Integrated Building Design

Chair: Gregory Dobbs, Ph.D., Member, Pennsylvania State University, Philadelphia, PA

IPD (Integrated Project Delivery) with "BIM" and "green" are key aspects of the design and construction "hot list". IPD execution promises to streamline project delivery and optimize outcomes but IPD hinges on a collaborative process both in philosophy and in practice. The industry is often much more adversarial. Special legal issues encountered on publically-funded projects and when doing retrofits will be included. The program identifies principal barriers and how to overcome them so that the marketplace can realize the value of IPD.

1. Cat Herding 101: IPD and You!

E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

2. Making a Green City in a Garden

Erin Lavin Cabonargi, Public Building Commission of Chicago, Chicago, IL

3. Removing Barriers and Encouraging Solutions in Optimizing Integrated Project Delivery Methods for Retrofit Projects

Franca Trubiano, Ph.D., University of Pennsylvania, Philadelphia, PA

Wednesday, January 25

9:45 AM-10:45 AM

Technical Paper Session 9 (Advanced)

Pressure Loss Measurements in Air Duct Junctions

Track: HVAC&R Fundamentals and Applications

Room: Salons 4/5

Sponsor: 05.02 Duct Design

Chair: Herman Behls, Member, Behls & Associates, Arlington Heights, IL

The first paper in this session reports results from RP-1488. The purpose of that study was to obtain experimental loss coefficient data for various diverging flow flat oval tees and laterals. The results for branch loss coefficient data for tee and lateral fittings were shown to fit a power law correlation developed previously. The main loss coefficient data could not be correlated by power law. The average value for the main loss coefficient for straight-body tees was found to be -0.167. Likewise the main loss coefficient for straight-body laterals was found to be -0.216. This session also presents a method of correlating main and branch loss coefficients for saddle tap tees operated in the diverging and converging flow modes. The goal of that test program was to determine if the saddle tap tee is an efficient air moving junction, and if so to include the resulting loss coefficient data in the ASHRAE Duct Fitting Database (DFDB).

1. Laboratory Testing of Saddle Tap Tees to Determine Loss Coefficients (CH-12-036)

Ananth Nalla and Stephen A. Idem, Member, Tennessee Technological University, Cookeville, TN

2. Measurements of Flat Oval Diverging Flow Fitting Loss Coefficients (RP-1488)(CH-12-037)

Daniel Gibbs, Associate Member¹ and Stephen A. Idem, Member², (1)Barge Waggoner Sumner & Cannon, Inc., Nashville, TN, (2)Tennessee Technological University, Cookeville, TN

Conference Paper Session 27 (Advanced)

Correct Sizing of HVAC Equipment and Systems for Standard 62.1

Track: HVAC&R Systems and Equipment

Room: Adams

Sponsor: 03.06 Water Treatment, STD 62.1, 08.06 Cooling Towers and Evaporative Condensers

Chair: Scott Mayes, LAKOS, Olathe, KS

This session addresses the correct sizing of HVAC equipment and systems and overall building energy consumption for compliance with Std. 62.1. Discussions include the use of a standard way to deal with Zmax so that significant amounts of energy and money can be saved. On the water side, a case study comparing the energy savings of full flow, side stream, and basin sweeping is compared and the energy savings potential reported.

1. Energy Conservation through Filtration and Hydronic Free Cooling (CH-12-C075)

George Oranski, P.E., Member¹ and **Scott Mayes²**, (1)Energy Systems Group, Newburgh, IN, (2)LAKOS, Olathe, KS

2. Optimizing Efficiency: Minimizing the Combined Energy Use of Fans and Ventilation Air Conditioning (CH-12-C076)

Jui-Chen R. Chang, P.E., Member, **Chris Wilson, Member** and **Omar Hawit, P.E., Member**, Westlake Reed Leskosky, Washington, DC

Conference Paper Session 28 (Intermediate)

Carbon Fiber Air Filters:

U-Bend and L-Bend Anchor Forces



Track: HVAC&R Fundamentals and Applications

Room: Crystal

Chair: Liping Liu, Ph.D., Lawrence Tech University, Southfield, MI

This session contains presentations about two typical elements for HVAC applications. It is widely known that an ionizer operated upstream of a ventilation air filter can significantly enhance the filtration efficiency. Based on an experimental investigation, the first paper presents how different fiber materials and filter classes will influence this efficiency enhancement. The second paper aims to address the anchor forces in L-bend and U-bend piping due to thermal expansion. Anchor force results are calculated following different methodologies (ASHRAE, Kellogg, Grinnell-Spielvogel, and simple cantilever methods). The large discrepancy among the results is explained and recommendations are made for ASHRAE Handbook edits and future research.

1. Influence of Filter Fiber Material on Removal of Ultrafine and Sub-micron Particles Using Carbon Fiber Ionizer-Assisted Intermediate Air Filters (CH-12-C077)

Bingbing Shi, M.D. and **Ekberg Lars, Ph.D.**, Chalmers University of Technology, Göteborg, Sweden

2. Comparison of Simplified Computational Methods of Flexibility Analysis to Determine Thermally Developed U-Bend and L-Bend Anchor Forces (CH-12-C078)

Sean Robinson¹ and **D. Scott Fisher, P.E. Member²**, (1) University of Illinois, Champaign, IL, (2) State Farm Co., Bloomington, IL

Seminar 46 (Advanced)

Case Study: Swedish Issaquah, Taking Hospital Energy Efficiency to the Next Level through an Integrated Project Delivery Approach

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers

Room: Red Lacquer

Chair: Norm Brown, P.E., Member, CDi Engineers, Lynnwood, WA

Establishing an aggressive, achievable building EUI mandated an innovative mechanical design approach that resulted in an energy saving of 40%. This project integrated the cooling, heating and domestic water systems utilizing a heat recovery chiller. The team's presentation covers an overview of systems selection, design concepts, modeling results, construction and commissioning lessons learned and the importance of training to correctly operate a non-traditional system. There is a deep dive into the IPD processes which were integral to the project's success.

Case Study: Swedish Issaquah- Taking Hospital Energy Efficiency to the Next Level through an Integrated Project Delivery Approach

Norm Brown, P.E., Member¹ and **David Malone, P.E.²**, (1)CDi Engineers, Lynnwood, WA, (2)University Mechanical, Mukilteo, WA

Seminar 47 (Basic)

Now That's Cool: Navigating in the Digital Marketing World

Track: Professional Skills



Room: Water Tower

Chair: Trudy Ferguson, Member, Holaday-Parks, Inc., Seattle, WA

Networking and marketing isn't like it used to be. Gone are the days of marketing your HVAC company by sending out a postcard. Customer connections are all about relationships and are happening on golf courses, charity events, and places like LinkedIn, Facebook, and Twitter. Trudy Ferguson, a marketing professional for over 20 years, brings her expertise in marketing a Mechanical Contracting firm into focus and shows you how to switch gears and navigate this new terrain.

Seminar 48 (Intermediate)

Smart Buildings: Implementing Predictive Energy Optimization Technology to Drive Efficiency and Savings

Track: High Performance Buildings



Room: Monroe

Chair: Mike Zimmerman, BuildingIQ, Palo Alto, CA

Commercial buildings consume 20% of U.S. energy. Building operators are looking to save energy and reduce their utilities expense with less capital and resources. Many existing energy management systems do not have the capabilities to incorporate predictive modeling-based optimization strategies that address real-time and forecasted weather data, real-time and future energy supply pricing/constraints, and the occupant comfort the current environment demands. This session explores the next generation of intelligent building energy management, showcasing how predictive energy optimization technology can manage energy consumption in buildings and save 10-30% energy with little or no capital and no impact on occupant comfort.

Seminar 49 (Advanced)

Impact of Extreme Ambients on Performance of Unitary Air Conditioners and Heat Pumps

Track: HVAC&R Systems and Equipment



Room: Empire

Sponsor: 08.11 Unitary and Room Air Conditioners and Heat Pumps

Chair: Mark Spatz, P.E., Member, Honeywell Inc., Buffalo, NY

Typically air conditioner and heat pump performance is well characterized for average temperature conditions but not that well understood for either low temperatures applications for heat pumps or very high temperatures. This session will focus on both lab and field experience with this equipment operating at extreme conditions.

1. Performance Enhancement by Using Vapor Injection Cycle for Extreme Operating Conditions

Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD

2. Cold Weather Heat Pumps Really Can Work!

Russell K. Johnson, Member, Johnson Research LLC, Pueblo West, CO

3. Heat Pump Energy Performance in Northern Climates

Robert "Dutch" Uselton, P.E., Fellow ASHRAE, Lennox Industries Inc., Carrollton, TX

Forum 5 (Intermediate)

Survivor 2.0: The ASHRAE Design-Build Survival Guide – Where Should ASHRAE Be Headed with an Update to the Guide?

Track: Integrated Design

Room: Wabash

Sponsor: 01.07 Business, Management & General Legal Education, TC 7.2 Design Build HVAC

Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

In 2004, ASHRAE published the Survival Guide for Design-Build Execution under the auspices of TC 1.7. Since then, the Design-Build execution strategy has grown from \$50 billion in contracts to over \$200 billion; IPD &

BIM are now on the scene and they're all green! We'll look to update the Guide with input from engineers, contractors and owners. This forum introduces the Guide to the unfortunate few who've not had the pleasure and help us craft the next version. TC 1.7 and TC 7.2 continue to move "one step beyond" in providing sound guidance to our membership!

Wednesday, January 25

11:00 AM-12:30 PM

Conference Paper Session 29 (Advanced)

HVAC Controls and Heat Pump Electric Resistance Heat

Track: *Energy Efficiency – New Technologies and Applications*



Room: Salons 4/5

Chair: Gary C. Debes, Member, Coward Environmental Systems, Coatesville, PA

This session will focus on Heat Pump operation in low-ambient conditions as well as improved controls to accommodate the increase in ventilation air in this era of energy conservation. The operation of Heat Pump systems in low ambient outdoor conditions regularly requires heavy reliance on the electric resistance heat installed in the system. This paper will cover alternate system design to alleviate this resistance heat demand. ASHRAE Standard 62.1 requires elevated outdoor air levels, these control strategies will show energy conservation measures available that will satisfy these requirements.

1. Low Outdoor Temperature Heat Pump Applications to Reduce Electric Resistance Heat (CH-12-C079)

John Bush, Associate Member¹, Ronald Domitrovic, Ph.D., Associate Member¹ and Ammi Amarnath², (1)Electric Power Research Institute, Knoxville, TN, (2)Electric Power Research Institute, Palo Alto, CA

2. Advanced Unitary HVAC Control Sequence (CH-12-C080)

Reid Hart, P.E., Member, PECEI, Portland, OR

Conference Paper Session 30 (Advanced)

Vehicle Design Fire for Tunnel Ventilation

Track: *HVAC&R Fundamentals and Applications*



Room: Water Tower

Sponsor: 05.09 Enclosed Vehicular Facilities

Chair: Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY

Design fires are an essential part in designing tunnels and tunnel fire life safety systems. Fire characteristics are used to establish the sizing of ventilation and other mechanical equipment in tunnels and the scenarios to consider when developing emergency response plans. They are also used, indirectly, when considering the impact of fires on the structure. As such, design fires form the base input for emergency ventilation, evacuation, and structural design analyses. A design fire is generally defined in terms of heat release rate, and species output as functions of time. This session summarizes efforts to develop a set of design fire scenarios for both road and railway tunnels.

1. Design Fires for the Design of Road Tunnels (CH-12-C081)

Ahmed Kashef, Ph.D., P.E., Member¹, Joao Viegas, Ph.D.², Antoine Mos, Ph.D.³ and Norris Harvey, Ph.D., P.E.⁴, (1)National Research Council Canada, Ottawa, ON, Canada, Ottawa, ON, Canada, (2)Laboratório Nacional de Engenharia Civil, Lisboa, Portugal, (3)Centre d'Etudes des Tunnels (CETU), Bron, France, (4)Parsons Brinckerhoff Americas, Inc., New York, NY

2. NYCT R-142 Train Design Fire Scenario Characteristics (CH-12-C082)

J. Greg Sanchez, Member, MTA-New York City Transit, New York, NY

3. A New Approach to Determining Passenger Rail Vehicle Design Fires (CH-12-C083)

Jeffrey Tubbs, P.E., Member¹, Jarrod Alston, P.E.¹, Kurt Schebel², Nicholas Dembsy, Ph.D., P.E.³, Brian Meacham, Ph.D., P.E.³ and Mathew Johann, P.E.⁴, (1)Arup, Cambridge, MA, (2)Arup, New York, NY, (3)Worcester Polytechnic Institute, Worcester, MA, (4)Arup, Cambridge, MA

Conference Paper Session 31 (Advanced)

Advances in Refrigerants and Refrigeration Systems

Track: *Refrigeration*



Room: Empire

Sponsor: Refrigeration Committee, 08.09 Residential Refrigerators and Food Freezers

Chair: Pradeep Bansal, Ph.D., Fellow ASHRAE, The University of Auckland, Auckland, New Zealand

This session presents three papers that cover the advances in refrigerants and refrigeration systems. The first paper presents the results of a simulation model to predict the performance of several drop-in low global warming potential (GWP) alternative refrigerants (LGARs) in the household refrigerator to that of HFC-134a. The second paper presents results of an experimental and thermodynamic analysis on the low GWP R-404A alternatives for commercial refrigeration, while the third paper presents experimental results of refrigerant R-134a in a transparent vertical T-junction type separator with outlets at the top and bottom for flash gas bypass air conditioning system.

1. Modeling of Household Refrigerator Performance with LGARs (CH-12-C084)

Daniel Leighton, Student Member, Yunho Hwang, Ph.D., Member and Reinhard Radermacher, Ph.D., Fellow, University of Maryland, College Park, MD

2. Low GWP R-404A Alternatives for Commercial Refrigeration (CH-12-C085)

Barbara Minor, Member and Ward Wells, DuPont, Wilmington, DE

3. Experimental Study of Refrigerant Two Phase Separation in Compact Vertical T-Junction (CH-12-C086)

Hanfei Tuo, Ph.D., Student Member and Predrag Hrnjak, Ph.D., Fellow Member, University of Illinois at Urbana Champaign, Urbana, IL

Seminar 50 (Advanced)

DOAS Parallel Systems, Configuration and Control

Track: *Energy Efficiency – New Technologies and Applications*

Room: Crystal



Sponsor: 05.05 Air-to-Air Energy Recovery

Chair: Michael S. Sherber, P.E., Member, The Firma Group, Avon, CT

Energy recovery is often used with a dedicated outdoor air system (DOAS). This energy recovered can be utilized for two purposes. Energy recovery from the exhaust air can be used to trim the ventilation heating/cooling/dehumidification load. Exhaust air can also be used to change the sensible heat ratio of the cooling provided to better dehumidify the air.

1. Dedicated Outdoor Air Systems (DOAS) Automatic Control Considerations

Stanley Mumma, Ph.D., P.E., Fellow Life Member, Pennsylvania State University, University Park, PA

2. Dedicated Outdoor Air Systems: Dual Parallel Recovery Systems

Ronnie Moffitt, P.E., Member, Trane, Inc., Lexington, KY

3. Dedicated Outdoor Air System Configurations

Paul Pieper, P.E., Member, Venmar CES, St-Leonard-d'Aston, QC, Canada

Seminar 51 (Intermediate)

Indoor Air Quality in Green Building Programs:

Are They Really Serious About It?

Track: *High Performance Buildings*



Room: Monroe

Sponsor: Environmental Health Committee, SSPC 62.1

Chair: Hal Levin, Fellow ASHRAE, Building Ecology Research Group, Santa Cruz, CA

For the last several years, green buildings have been taking the building community by storm. Green buildings are intended to save energy, improve indoor air quality, and limit a range of environmental impacts, and there has been much debate about how successful they are in achieving these noble goals. In particular, how green buildings address indoor air quality is sometimes

viewed with skepticism, in part based on concerns that energy efficiency is driving the green train. Everyone agrees that buildings need to change, both inside the building and out, and a balanced, thoughtful and honest approach is needed to get the job done.

1. How Green Building Programs Deal with IAQ

Andrew K. Persily, Ph.D., National Institute of Standards and Technology, Gaithersburg, MD

2. Getting IAQ into the Design and Construction Process

Hoy R. Bohanon, P.E., Member, Working Buildings, Winston-Salem, NC

3. Why Green Building Rating Systems Are Almost Always Wrong about IAQ

Hal Levin, Fellow ASHRAE, Building Ecology Research Group, Santa Cruz, CA

Seminar 52 (Intermediate)

Integrated Design and Commissioning on the Same Building: Collaboration or Collision?

Track: Integrated Design

Room: Wabash

Sponsor: 07.09 Building Commissioning, 07.01 Integrated Building Design

Chair: David Shipley, P.Eng., Member, ICF Marbek, Ottawa, ON, Canada

Integrated building design (IBD) and building commissioning are both strategies for improving a new building's ability to meet the needs of the owner and occupants. IBD involves getting all the participants in the design process together to work out common issues. Commissioning that (appropriately) starts early in the design process drives participants to coordinate a commissioning plan and design activities. How do the two interact? This seminar includes presentations from an IBD professional that included commissioning in a project and presentations from commissioning authorities who were involved in projects that included IBD.

1. Commissioning in an Integrated Building Design Process: Case Study of an Industrial Research Facility

Stephen Pope, Member, Natural Resources Canada, Ottawa, ON, Canada

2. The Commissioning Process and Integrated Building Design Process

Bradley Brooks, Ph.D., Member, PECEI, Portland, OR

3. IBD of a Multi-Phased Commercial Office Remodel: A Case Study with the CxA as Commissioning Advocate

Barry B. Bridges, P.E., Member, Sebesta Blomberg, Roseville, MN

Seminar 53 (Advanced)

Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 2

Track: Energy Modeling Applications

Room: Red Lacquer

Sponsor: 04.07 Energy Calculations

Chair: Jerone Matthew Gagliano, P.E., Member, Performance Systems Development, Ithaca, NY

As part two of the integrated multi-domain building simulation seminars, this seminar introduces the development of common platforms for co-simulation for multiple computer programs and hardware. The platforms include Building Control Virtual Test Bed and Functional Mock-up Interface. It discusses the concepts and advantages of using a common platform in integrated building simulation. Examples of using these platforms for innovative low energy building design and operations are also demonstrated.

1. Building Virtual Control Test Bed: An Open Source Platform for Co-Simulation and Real-Time Simulation

Michael Wetter, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Functional Mockup Interface: An Open-Source Standard for Co-Simulation and Model Exchange

Wangda Zuo, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA

3. Building Energy Performance Simulation Based on Dynamic Occupancy Models

Yao-Jung Wen, Ph.D., Philips Research North America, Briarcliff Manor, NY

4. Coupling Heterogeneous Computational Codes for Human-centred Indoor Thermal Performance Analysis

Christophe Von Treeck¹ and Sebastian Stratbucker², (1)Fraunhofer Institute for Building Physics, Germany, München, Germany, (2)Fraunhofer Institute for Building Physics, Fraunhoferstraße, Germany

Seminar 54 (Intermediate)

Optimizing Cleanrooms for High Performance, Energy Reduction and Sustainability

Track: Specialized Applications –

Healthcare, Laboratories, and Data Centers



Room: Adams

Sponsor: 09.11 Clean Spaces, 09.10 Laboratory Systems

Chair: Peter B. Gardner, P.E., Member, Torcon, Inc., Red Bank, NJ

Cleanroom facilities consume 5-50 times more energy than commercial spaces in the same sizes to achieve specified air cleanliness. Recent design and research developments focus more on achieving high performance while reducing energy consumption and improving sustainability. The seminar starts with a presentation addressing general cleanroom design criteria, such as cleanliness, particle, temperature, humidity, pressure, filter type and exhaust/make-up air in relationship with energy use. The second presentation reveals the findings from recent ASHRAE project which utilized real-time particle sensors to trace particle migration between rooms of different cleanliness classes and pressures to identify the minimum pressure differentials under various scenarios and conditions. The last topic covers case studies in energy reductions by using particle monitoring to reduce airflow, by recapturing lost pressure air, and by switching from ducted to fan-powered systems, etc.

1. Cleanroom Design Criteria in Relationship with Energy Use

Hemant S. Kavathekar, P.E., Member¹ and Peter Lambert, Member², (1)3M Co., St. Paul, MN, (2)Torcon, Inc, Red Bank, NJ

2. Case Studies: Energy Reduction Practices in Cleanrooms

Charles R. Lampert, Member, Advantage Point Group, St. Paul, MN

3. An Overview of International Cleanroom Standards and Their Impact on Performance and Energy Usage

Farooq Mehboob, P.E., Member, S.Mehboob & Company, Karachi, Pakistan

4. New Research Findings on Cleanroom Pressure Control Criteria

Wei Sun, P.E., Member, Engsysco Inc., Ann Arbor, MI

notes

SOCIETY COMMITTEE MEETINGS

(Subcommittees are indented)

All Society Standing Committee Meetings are scheduled in the Palmer House Hilton. All meeting rooms are subject to change. The numbers in parenthesis following the room name provide the floor location within the hotel.

ALPHABETICAL LISTING

Advocacy,

Sun., 1/22, 6:30 a.m. – 8:30 a.m., Indiana (3)

Codes & Standards,

Sat., 1/21, 2:00 p.m. – 3:00 p.m., LaSalle 5 (7)

AEDG Steering Committee,

Mon., 1/23, 2:15 p.m. – 5:00 p.m., Indiana (3),

ASHRAE/AHRI Joint Expo,

Sun., 1/22, 9:00 a.m. – 11:00 a.m., Grant Park(6)

ASHRAE Foundation,

Mon., 1/23, 8:00 – 10:00 a.m., Madison (3)

Executive Subcommittee,

Sat., 1/21, 1:30 – 3:00 p.m., Kimball (3)

ASHRAE Research Canada,

Sun., 1/22, 7:00 – 8:30 a.m., Dearborn 2 (7)

Associate Society Alliance,

Sun., 1/22, 1:30 p.m. – 4:30 p.m., Salons 6/7 (3)

Mon., 1/23, 4:15 – 6:00 p.m., Honore (Lobby)

Board of Directors,

Sun., 1/22, 1:30 p.m. – 5:30 p.m., Grand Ballroom (4)

Wed., 1/25, 2:00 – 6:00 p.m., State Ballroom (4)

Building Energy Quotient Committee

Sun., 1/22, 8:30 a.m. – 11:30 a.m., LaSalle 3 (7)

Building Safety and Security Position Document,

Sun., 1/22, 3:00 p.m. – 5:00 p.m., Clark 10 (7)

CBEA Codes,

Tues., 1/24, 3:00 p.m. – 5:00 p.m., Price (5)

Certification,

Sat., 1/21, 8:00 a.m. – Noon, Indiana (3)

Chapter Technology Transfer,

Fri., 1/20, 8:00 a.m. – Noon, Honore (Lobby)

Sat., 1/21, 8:00 a.m. – Noon, Price (5)

Member Services,

Fri., 1/20, 1:30 p.m. – 5:00 p.m., Montrose 4 (7)

Operations,

Fri., 1:30 p.m. – 5:00 p.m., Montrose 5 (7)

Executive,

Fri., 5:00 p.m. – 6:00 p.m., Montrose 4 (7)

CIBSE/ASHRAE Liaison,

Wed., 1/25, 9:30 a.m. – Noon, Cresthill (3)

CLIMA,

Sat., 1/21, 12:30 – 1:30 p.m., LaSalle 4 (7)

College of Fellows Board/Advisory,

Sun., 1/22, 8:00 – 10:00 a.m., Dearborn 1 (7)

College of Fellows,

Sun., 1/22, 10:00 a.m. – Noon, Dearborn 1 (7)

Conferences and Expositions Committee,

Sat., 1/21, 8:00 a.m. – 12:00 p.m., Salon 1 (3)

Executive,

Fri., 1/20, 1:00 p.m. – 3:00 p.m., Salons 6/7 (3)

TAC/CEC Executive,

Sat., 1/21, 7:00 a.m. – 8:00 a.m., Salons 8/9 (3)

Annual and Winter Meetings,

Fri., 1/20, 3:00 p.m. – 6:00 p.m., Salons 6/7 (3)

Electronic Communications,

Sat., 1/21, 11:00 a.m. – 3:00 p.m., Salon 10 (3)

Environmental Health,

Mon., 1/23, 2:15 p.m. – 6:15 p.m., Wilson (3)

Executive,

Mon., 1/23, 7:00 a.m. – 8:00 a.m., Wilson (3)

Education/Research,

Mon., 1/23, 8:00 a.m. – 10:00 a.m., Wilson (3)

Handbook/Program,

Mon., 1/23, 10:00 a.m. – Noon, Wilson (3)

Executive,

Sat., 1/21, 8:30 a.m. – 1:00 p.m., Cresthill (3)

Wed., 1/25, 7:30 a.m. – 9:00 a.m., Cresthill (3)

Thurs., 1/26, 7:30 a.m. – 11:00 a.m., Cresthill (3)

Finance,

Fri., 1/20, 8:00 a.m. – 1:00 p.m., Kimball (3)

Investment Subcommittee,

Thursday, 1/19, 7:00 p.m. – 9:00 p.m., Logan (3)

Planning Subcommittee,

Thursday, 1/19, 7:00 p.m. – 9:00 p.m., Kimball (3)

Handbook,

Sun., 1/22, 10:30 a.m. – 1:00 p.m., Hancock (6)

Electronic Media

Sun., 8:00 a.m. – 9:00 a.m., Sandburg 2 (7)

Functional

Sun., 8:00 a.m. – 9:00 a.m., Sandburg 3 (7)

Publicity

Sun., 8:00 a.m. – 9:00 a.m., Sandburg 4 (7)

Practical Applications

Sun., 8:00 a.m. – 9:00 a.m., Sandburg 5 (7)

Program

Sun., 8:00 a.m. – 9:00 a.m., Sandburg 7 (7)

Handbook 2015 HVAC Applications TCs/

Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 2 (7)

Handbook 2013 Fundamentals TCs/

Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 3 (7)

Handbook 2014 Refrigeration TCs/

Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 4 (7)

Volume Subcommittees,

Sun., 1/22, 10:00 a.m. – 10:30 a.m., Hancock (6)

SPO/Excom,

Sat., 1/21, Noon – 3:00 p.m., Clark 9 (7)

Handbook Training for TC Handbook Chairs,

Sun., 1/22, 8:00 – 9:00 a.m., Salons 6/7 (3)

Historical,

Sun., 1/22, 8:30 a.m. – Noon, Logan (3)

Honors & Awards,

Sun., 1/22, 1:00 – 5:00 p.m., Kimball (3)

Mon., 1/23, 2:15 p.m. – 5:30 p.m., Montrose 5 (7)

IAQ 2013 Steering Committee,

Mon., 1/23., 7:00 p.m. – 9:00 p.m., Wilson (3)

Life Members' Executive Board,

Tues., 1/24, 7:30 a.m. – 9:30 a.m., Indiana (3)

Members Council,

Mon., 1/23, 8:00 a.m. – Noon, Honore (Lobby)

Tues., 1/24, 8:00 a.m. – Noon, Honore (Lobby)

Membership Promotion,

Sat., 1/21, 8:00 a.m. – 3:00 p.m., Salon 12 (3)

Nominating,

Sun., 1/22, 7:30a – 3:00 p.m., Honore (Lobby)

PEAC,

Tues., 1/24, Noon – 2:00 p.m., Logan (3)

Planning,

Fri., 1/20, 1:00 p.m. – 6:00 p.m., Salon 12 (3)

Professional Development,

Mon., 1/23, 8:00 a.m. – Noon, Marshfield (3)

Publications Committee,

Sun., 1/22, 8:00 a.m. – Noon, Marshfield (3)

Planning Subcommittee,

Sat., 1/21, 10:00 a.m. – Noon, Clark 9 (7)

Publishing and Education Council,

Tues., 1/24, 8:00a – Noon, Grant Park(6)

E-Learning

Sat., 1/21, 1:30 pm. – 3:00 p.m., LaSalle 4 (7)

Research Journal,

Mon., 1/23, 11:00 a.m. – Noon, Clark 10 (7)

Fiscal,

Mon., 1/23, 2:00 p.m. – 3:30 p.m., Clark 7 (7)

Functional,

Mon., 1/23, 3:30 p.m. – 5:00 p.m., Clark 7 (7)

Refrigeration,

Sun., 1/22, 8:00 a.m. – Noon, Price (5)

Refrigerants PD Ad Hoc,

Tues., 1/24, 3:30 p.m. – 4:45 p.m., Cresthill (3)

Region-at-Large Planning,

Mon., 1/23, 2:15 p.m. – 4:15 p.m., Kimball (3)

Research Administration,

Sat., 1/21, 8:00 a.m. – 3:00 p.m., Salons 4/5 (3)

Wed., 1/25, 7:00 a.m. – 11:00 a.m., Hancock (6)

Research Subcommittee Chairs,

Mon., 1/23, 6:30 a.m. – 9:00 a.m., Grand Ballroom (4)

Research Promotion,

Sat., 1/21, 7:30 a.m. – 1:00 p.m. , LaSalle 1 (7)

Executive Subcommittee,

Fri., 1/20, 2:00 p.m. – 6:00 p.m., Montrose 3 (7)

Scholarship Trustees,

Tues., 1/24, 8:00 a.m. – Noon, Salon 10 (3)

Society Rules,

Tues., 1/24, 2:00 p.m. – 5:00 p.m., Harvard (3)

Standards,

Sat., 1/21, 8:00 a.m. – 1:00 p.m., Crystal (3)

Wed., 1/25, 7:30 – 9:30 a.m., State Ballroom (4)

Executive,

Fri., 1/20, 8:00 a.m. – 11:00 a.m., Logan (3)

TCLS,

Fri., 1/20, 11:00 a.m. – Noon, Logan (3)

Tues., 1/24, 5:00 p.m. – 5:30 p.m., Sandburg 3 (7)

PPIS,

Fri., 1/20, 2:00 p.m. – 6:00 p.m., Logan (3)

Tues., 1/24, 11:00 a.m. – 1:00 p.m., Sandburg 3 (7)

ILS/ISAS

Fri., 1/20, 1:00 p.m. – 4:00 p.m., Montrose 1 (7)

SPLS,

Fri., 1/20, 2:00 p.m. – 5:00 p.m., Grant Park (6)

Tues., 1/24, 1:30 p.m. – 3:30 p.m., Sandburg 3 (7)

SRS,

Tues., 1/24, 5:30 p.m. – 6:00 p.m., Sandburg 3 (7)

Code Interaction,

Sun., 1/22, 7:00 p.m. – 10:00 p.m., Burnham 2 (7)

PC Chair Breakfast,

Sun., 1/22, 7:00 – 9:00 a.m., Grand Ballroom (4)

Student Activities,

Sat., 1/21, 8:00 a.m. – 3:00 p.m., Marshfield (3)

Executive,

Fri., 1/20, 10:00 a.m. – Noon, Madison (3)

K-12/STEM,

Fri., Noon – 2:00 p.m., Madison

Post High/ABET,

Fri., 2:00 p.m. – 4:00 p.m., Madison

Design Competition,

Fri., 4:00 p.m. – 6:00 p.m., Madison

Grants,

Fri., 4:00 – 6:00 p.m., Harvard (3)

Student Program,

Welcome and Orientation

Sat., 1/21, 2:00 p.m. – 3:00 p.m., Red Lacquer (4)

Program,

Sun., 1/22, 9:00 a.m. – 2:00 p.m., Red Lacquer (4)

Student/Yea Mixer

Sat., 1/21, 5:00 p.m. – 6:30 p.m., Chicago (5)

Student Congress,

Mon., 1/23, 10:00 a.m. – Noon, Clark 5 (7)

Technical Activities,

Sat., 1/21, 8:00 a.m. – 3:00 p.m., Salons 8/9 (3)

Wed., 1/25, 7:00 a.m. – 10:00 a.m., Grant Park (6)

TAC/CEC Executive,

Sat., 1/21, 7:00 a.m. – 8:00 a.m., Salons 8/9 (3)

TC/TG Chair's Training Workshop,

Sun., 1/22, 9:45 – 10:45 a.m., Crystal (3)

TAC: TC/TG Section Meetings

Sun., 6:30 a.m. – 8:00 a.m.

Section 1, Salon 2 (3)

Section 2, Burnham 1 (7)

Section 3, Clark 1 (7)

Section 4, Montrose 5 (7)

Section 5, Clark 5 (7)

Section 6, Burnham 2 (7)

Section 7, LaSalle 1 (7)

Section 8, LaSalle 2 (7)

Section 9, LaSalle 3, (7)

Section 10, Wilson (3)

Technology Council,

Tues., 1/24, 8:00 a.m. – Noon, Price (5)

Wed., 1/25, 9:00a.m. – 11:00 a.m., Salons 6/7 (3)

Special Projects,

Mon., 1/23, 7:30 a.m. – 9:30 a.m., Montrose 3 (7)

Document Review Subcommittee,

Mon., 1/23, 8:00 a.m. – 9:00 a.m., Indiana (3)

Planning,

Mon., 1/23, 9:00 a.m. – 11:00 a.m., Montrose 4 (7)

Operations,

Mon., 1/23, 10:30 a.m. – Noon, Montrose 3 (7)

YEA ,

Sun., 1/22, 7:00 a.m. – Noon, Clark 3 (7)

CHRONOLOGICAL LISTING

FRIDAY, JANUARY 20

Standards Executive,

Fri., 8:00 a.m. – 11:00 a.m., Logan (3)

Chapter Technology Transfer,

Fri., 8:00 a.m. – Noon, Honore (Lobby)

Finance,

Fri., 8:00 a.m. – 1:00 p.m., Kimball (3)

Student Activities Executive,

Fri., 10:00 a.m. – Noon, Madison (3)

Standards TCLS,

Fri., 11:00 a.m. – Noon, Logan (3)

Student Activities K – 12/STEM,

Fri., Noon – 2:00 p.m., Madison

CEC Executive,

Fri., 1:00 p.m. – 3:00 p.m., Salons 6/7 (3)

Standards ILS/ISAS

Fri., 1:00 p.m. – 4:00 p.m., Montrose 1 (7)

Planning,

Fri., 1:00 p.m. – 6:00 p.m., Salon 12 (3)

CTT Member Services,

Fri., 1:30 p.m. – 5:00 p.m., Montrose 4 (7)

CTT Operations,

Fri., 1:30 p.m. – 5:00 p.m., Montrose 5 (7)

Student Activities Post High/ABET,

Fri., 2:00 p.m. – 4:00 p.m., Madison

Standards SPLS,

Fri., 2:00 p.m. – 5:00 p.m., Grant Park (6)

Research Promotion Executive Subcommittee,

Fri., 2:00 p.m. – 6:00 p.m., Montrose 3 (7)

Standards PPIS,

Fri., 2:00 p.m. – 6:00 p.m., Logan (3)

CEC Annual and Winter Meetings,

Fri., 3:00 p.m. – 6:00 p.m., Salons 6/7 (3)

Student Activities Design Competition,
Fri., 4:00 p.m. – 6:00 p.m., Madison

Student Activities Grants,
Fri., 4:00 – 6:00 p.m., Harvard (3)

CTT Executive,
Fri., 5:00 p.m. – 6:00 p.m., Montrose 4 (7)

SATURDAY, JANUARY 21

TAC/CEC Executive,
Sat., 7:00 a.m. – 8:00 a.m., Salons 8/9 (3)

Research Promotion,

Sat., 7:30 a.m. – 1:00 p.m., LaSalle 1 (7)

Certification,

Sat., 8:00 a.m. – Noon, Indiana (3)

Chapter Technology Transfer,

Sat., 8:00 a.m. – Noon, Price (5)

Conferences and Expositions Committee,

Sat., 8:00 a.m. – 12:00 p.m., Salon 1 (3)

Standards,

Sat., 8:00 a.m. – 1:00 p.m., Crystal (3)

Membership Promotion,

Sat., 8:00 a.m. – 3:00 p.m., Salon 12 (3)

Research Administration,

Sat., 8:00 a.m. – 3:00 p.m., Salons 4/5 (3)

Student Activities,

Sat., 8:00 a.m. – 3:00 p.m., Marshfield (3)

Technical Activities,

Sat., 8:00 a.m. – 3:00 p.m., Salons 8/9 (3)

Executive,

Sat., 8:30 a.m. – 1:00 p.m., Cresthill (3)

Publications Planning Subcommittee,
Sat., 10:00 a.m. – Noon, Clark 9 (7)

Electronic Communications,

Sat., 11:00 a.m. – 3:00 p.m., Salon 10 (3)

Handbook SPO/Excom,
Sat., Noon – 3:00 p.m., Clark 9 (7)

CLIMA,

Sat., 12:30 – 1:30 p.m., LaSalle 4 (7)

ASHRAE Foundation Executive,
Sat., 1:30 – 3:00 p.m., Kimball (3)

Publishing and Education Council E-Learning
Sat., 1:30 pm. – 3:00 p.m., LaSalle 4 (7)

Advocacy Codes & Standards,
Sat., 2:00 p.m. – 3:00 p.m., LaSalle 5 (7)

Student Welcome and Orientation
Sat., 2:00 p.m. – 3:00 p.m., Red Lacquer (4)

Student/Yea Mixer
Sat., 5:00 p.m. – 6:30 p.m., Chicago (5)

SUNDAY, JANUARY 22

TAC: TC/TG Section Meetings

Sun., 6:30 a.m. – 8:00 a.m.

- Section 1, Salon 2 (3)
- Section 2, Burnham 1 (7)
- Section 3, Clark 1 (7)
- Section 4, Montrose 5 (7)
- Section 5, Clark 5 (7)
- Section 6, Burnham 2 (7)
- Section 7, LaSalle 1 (7)
- Section 8, LaSalle 2 (7)
- Section 9, LaSalle 3, (7)
- Section 10, Wilson (3)

Advocacy,

Sun., 6:30 a.m. – 8:30 a.m., Indiana (3)

ASHRAE Research Canada,

Sun., 7:00 – 8:30 a.m., Dearborn 2 (7)

Standards PC Chair Breakfast,
Sun., 7:00 – 9:00 a.m., Grand Ballroom (4)

YEA,

Sun., 7:00 a.m. – Noon, Clark 3 (7)

Nominating,

Sun., 7:30a – 3:00 p.m., Honore (Lobby)

Handbook Electronic Media

Sun., 8:00 a.m. – 9:00a.m., Sandburg 2 (7)

Handbook Functional
Sun., 8:00 a.m. – 9:00 a.m., Sandburg 3 (7)

Handbook Publicity
Sun., 8:00 a.m. – 9:00 a.m., Sandburg 4 (7)

Handbook Practical Applications
Sun., 8:00 a.m. – 9:00 a.m., Sandburg 5 (7)

Handbook Program
Sun., 8:00 a.m. – 9:00 a.m., Sandburg 7 (7)

Handbook Training for TC Handbook Chairs,
Sun., 8:00 – 9:00 a.m., Salons 6/7 (3)

College of Fellows Board/Advisory,

Sun., 8:00 – 10:00 a.m., Dearborn 1 (7)

Publications Committee,

Sun., 8:00 a.m. – Noon, Marshfield (3)

Refrigeration,

Sun., 8:00 a.m. – Noon, Price (5)

Building Energy Quotient Committee

Sun., 8:30 a.m. – 11:30 a.m., LaSalle 3 (7)

Historical,

Sun., 8:30 a.m. – Noon, Logan (3)

Handbook 2015 HVAC Applications TCs/
Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 2 (7)

Handbook 2013 Fundamentals TCs/
Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 3 (7)

Handbook 2014 Refrigeration TCs/
Volume Subcommittee

Sun., 9:00 a.m. – 10:00 a.m., Sandburg 4 (7)

ASHRAE/AHRI Joint Expo,

Sun., 9:00 a.m. – 11:00 a.m., Grant Park(6)

Student Program,

Sun., 9:00 a.m. – 2:00 p.m., Red Lacquer (4)

TC/TG Chair's Training Workshop,

Sun., 9:45 – 10:45 a.m., Crystal (3)

Handbook Volume Subcommittees,
Sun., 10:00 a.m. – 10:30 a.m., Hancock (6)

College of Fellows,

Sun., 10:00 a.m. – Noon, Dearborn 1 (7)

Handbook,

Sun., 10:30 a.m. – 1:00 p.m., Hancock (6)

Honors & Awards,

Sun., 1:00 – 5:00 p.m., Kimball (3)

Associate Society Alliance,

Sun., 1:30 p.m. – 4:30 p.m., Salons 6/7 (3)

Board of Directors,

Sun., 1:30 p.m. – 5:30 p.m., Grand Ballroom (4)

Building Safety and Security Position Document,

Sun., 3:00 p.m. – 5:00 p.m., Clark 10 (7)

Standards Code Interaction,
Sun., 7:00 p.m. – 10:00 p.m., Burnham 2 (7)

MONDAY, JANUARY 23

Research Subcommittee Chairs,
Mon., 6:30 a.m. – 9:00 a.m., Grand Ballroom (4)

Environmental Health Executive,
Mon., 7:00 a.m. – 8:00 a.m., Wilson (3)

Technology Council Special Projects,
Mon., 7:30 a.m. – 9:30 a.m., Montrose 3 (7)

Technology Council Document Review Subcommittee,
Mon., 8:00 a.m. – 9:00 a.m., Indiana (3)

ASHRAE Foundation,

Mon., 8:00 – 10:00 a.m., Madison (3)

Environmental Health Education/Research,
Mon., 8:00 a.m. – 10:00 a.m., Wilson (3)

Members Council,

Mon., 8:00 a.m. – Noon, Honore (Lobby)

Professional Development,

Mon., 8:00 a.m. – Noon, Marshfield (3)

Technology Council Planning,
Mon., 9:00 a.m. – 11:00 a.m., Montrose 4 (7)

Environmental Health Handbook/Program,
Mon., 10:00 a.m. – Noon, Wilson (3)

Student Congress,

Mon., 10:00 a.m. – Noon, Clark 5 (7)

Technology Council Operations,
Mon., 10:30 a.m. – Noon, Montrose 3 (7)

Publishing and Education Council Research Journal,
Mon., 11:00 a.m. – Noon, Clark 10 (7)

Publishing and Education Council Fiscal,
Mon., 2:00 p.m. – 3:30 p.m., Clark 7 (7)

Region-at-Large Planning,

Mon., 2:15 p.m. – 4:15 p.m., Kimball (3)

AEDG Steering Committee,
Mon., 2:15 p.m. – 5:00 p.m., Indiana (3),

Environmental Health,

Mon., 2:15 p.m. – 6:15 p.m., Wilson (3)

Honors & Awards,

Mon., 2:15 p.m. – 5:30 p.m., Montrose 5 (7)

Publishing and Education Council Functional,
Mon., 3:30 p.m. – 5:00 p.m., Clark 7 (7)

Associate Society Alliance,

Mon., 4:15 – 6:00 p.m., Honore (Lobby)

IAQ 2013 Steering Committee,

Mon., 1/23., 7:00 p.m. – 9:00 p.m., Wilson (3)

TUESDAY, JANUARY 24

Life Members' Executive Board,

Tues., 7:30 a.m. – 9:30 a.m., Indiana (3)

Members Council,

Tues., 8:00 a.m. – Noon, Honore (Lobby)

Publishing and Education Council,

Tues., 8:00a – Noon, Grant Park(6)

Scholarship Trustees,

Tues., 8:00 a.m. – Noon, Salon 10 (3)

Technology Council,

Tues., 8:00 a.m. – Noon, Price (5)

Standards PPIS,
Tues, 1/24, 11:00 a.m. – 1:00 p.m., Sandburg 3 (7)

PEAC,

Tues., Noon – 2:00 p.m., Logan (3)

Standards SPLS,
Tues., 1:30 p.m. – 3:30 p.m., Sandburg 3 (7)

Society Rules,

Tues., 2:00 p.m. – 5:00 p.m., Harvard (3)

CBEA Codes,

Tues., 3:00 p.m. – 5:00 p.m., Price (5)

Refrigerants PD Ad Hoc,

Tues., 3:30 p.m. – 4:45 p.m., Cresthill (3)

Standards TCLS,
Tues., 5:00 p.m. – 5:30 p.m., Sandburg 3 (7)

Standards SRS,
Tues., 5:30 p.m. – 6:00 p.m., Sandburg 3 (7)

WEDNESDAY, JANUARY 25

Technical Activities,

Wed., 7:00 a.m. – 10:00 a.m., Grant Park (6)

Research Administration,

Wed., 7:00 a.m. – 11:00 a.m., Hancock (6)

Executive,

Wed., 7:30 a.m. – 9:00 a.m., Cresthill (3)

Standards,

Wed., 7:30 – 9:30 a.m., State Ballroom (4)

Technology Council,

Wed., 9:00a.m. – 11:00 a.m., Salons 6/7 (3)

CIBSE/ASHRAE Liaison,

Wed., 9:30 a.m. – Noon, Cresthill (3)

Board of Directors,

Wed., 2:00 – 6:00 p.m., State Ballroom (4)

THURSDAY, JANUARY 26

Executive,

Thurs., 7:30 a.m. – 11:00 a.m., Cresthill (3)

notes

TC/TG/SPC MEETINGS

The ASHRAE Technical Committees, Task Groups and Technical Resource Groups listed below usually meet at each Society Winter and Annual Conference. Attendance at these meetings is open to all society members, to all registered guests at scheduled Society Conferences, and to those invited by the chairman at the request of a member. You are encouraged to attend any of these meetings in which you have a technical interest.

Finding the Assigned Meeting Room Codes for meeting locations:

The number in parentheses following the room name is the floor location of the meeting room.

NOTE: If the meetings listed below are not printed in color they have not been confirmed.

Format of Listings

Committee Number and Title

Day Time Location

Session(s) the committee is sponsoring

TCs

TC/TG Chair's Breakfast

Sunday 6:30 – 8:00 a.m.
 Section 1, (29), Salon 2 (3)
 Section 2, (21), Burnham 1 (7)
 Section 3, (15), Clark 1 (7)
 Section 4, (17), Montrose 5 (7)
 Section 5, (29), Clark 5 (7)
 Section 6, (25), Burnham 2 (7)
 Section 7, (23), LaSalle 1 (7)
 Section 8, (23), LaSalle 2 (7)
 Section 9, (25), LaSalle 3, (7)
 Section 10, (25), Wilson (3)

TC/TG Chair's Training Workshop

Sunday 9:45 – 10:45a Crystal (3)

Research Subcommittee Breakfast

Monday 6:30 – 8:00a Grand Ballroom (4)

TC Program Subcommittee Training

Tuesday 11:15 – Noon Speaker's Lounge, 4th floor exhibit hall

TC 1.1 Thermodynamics & Psychrometrics (10/15)

Monday 2:15 – 4:15p LaSalle 4 (7)

Sponsoring: Seminar 31: Magneto-Caloric Refrigeration: Are You Attracted to Cool Ideas?

TC 1.2 Instruments & Measurements (15)

Tuesday 1:00 – 3:30p Dearborn 3 (7)

TC 1.2 Standards/Handbook (5/5)

Monday 4:15 – 6:30p Montrose 2 (7)

TC 1.3 Heat Transfer & Fluid Flow (25/15)

Tuesday 1:00 – 3:30p Grant Park (6)

Sponsoring: Forum: Low GWP Refrigerants: Current Status and Future Path

TC 1.3 Handbook LaSalle 4 (7)

Sunday 1:00 – 3:00p

TC 8.5/1.3 Research (20/30) (screen)

Sunday 3:00 – 7:00p Salon 4/5/8/9 (3)

TC 1.4 Control Theory & Application (40) (Screen)

Tuesday 1:00 – 3:30p Spire (6)

TC 1.4 RP-1597 (8) (Screen)

Sunday 8:00 – 9:00a Clark 10 (7)

TC 1.4 Control Components and Applications /Green Buildings (20/5)(Screen)

Sunday 3:00 – 4:45p Hancock (6)

TC 1.4 Program (30) (screen)

Sunday 4:45 – 5:30p Hancock

TC 1.4 Reference Applications (20/10)(Screen)

Sunday 5:30 – 6:30p Hancock

TC 1.4 Research (20/10)(Screen)

Monday 2:15 – 4:15p Salon 10 (3)

TC 1.4 Handbook (15)

Monday 4:15 – 6:15p Salon 10 (3)

TC 1.4 Executive (15)

Tuesday 7:00 – 8:00a Sandburg 3 (7)

TC 1.5 Computer Applications (20/5)(Screen)

Monday 6:30 – 9:00p Spire (6)

TC 1.5 Emerging Applications (6/10)

Sunday 5:00 – 6:00p Clark 10 (7)

TC 1.5 Research (15)

Sunday 6:00 – 7:00p Clark 10

TC 1.5 Program (15)

Sunday 7:00 – 8:00p Clark 10

TC 1.5 T&P (5)

Sunday 8:00 – 8:30p Clark 10

TC 1.5 PMS 1468

Sunday 10:15a – Noon Indiana (3)

TC 1.5 Handbook (15)

Monday 6:00 – 6:30p Spire (6)

TC 1.6 Terminology (10/8) (Screen/E)

Monday 4:15 – 6:30p Medinah (6)

TC 1.6 Evaluation for wiki Terms (6/4) (Screen)

Monday 8:00a – Noon Burnham 5 (7)

TC 1.7 Business, Management & General Legal Education (20/5)

Monday 10:15a – Noon Price (5)

Sponsoring: Forum 3: Protecting Your Design Against Changing Requirements and

Forum 5: Survivor 2.0: The ASHRAE Design-Build Survival Guide – Where Should ASHRAE Be Headed with an Update to the Guide?

TC 1.8 Mechanical Systems Insulation (20)

Monday 4:15 – 6:30p Clark 3 (7)

TC 1.8 Research (10)

Sunday 8:00 – 9:30a Montrose 1 (7)

TC 1.8 Handbook (10)

Sunday 9:30 – 10:30 Montrose 1

TC 1.8 Program

Sunday 10:30 – 11:00a Montrose 1

TC 1.9 Electrical Systems (8/4)

Tuesday 3:30 – 6:00p Clark 10 (7)

TC 1.10 Cogeneration Systems (20/10)

Tuesday 3:00 – 5:00p Salon 2 (3)

TC 1.10 Program/Research/Handbook (15/10)

Tuesday 1:00 – 3:00p Salon 2

TC 1.10 CTIC (10/5)
Monday 4:15 – 6:30p LaSalle 4 (7)

TC 1.11 Electric Motors and Motor Control (20)
Tuesday 1:00 – 3:30p Clark 10 (7)

TC 1.12 Moisture Management in Buildings (15/25) (screen/E)
Saturday 1:00 – 3:00p Clark 5 (7)

TC 1.12 Programs/Handbook/Research (10)
Saturday 8:00a – Noon Clark 5 (7)

TC 2.1 Physiology & Human Environment (12/18) (Screen)
Tuesday 1:00 – 3:30p Clark 3 (7)
Sponsoring: Seminar 14: Why Are We Overcooling Buildings in Summer?

TC 2.1 Research (13/7)(Screen/E)
Sunday 1:00 – 3:00p Marshfield (3)

TC 2.1 Programs (5/5)
Sunday 3:00 – 4:00p Marshfield

TC 2.1 Handbook
Sunday 4:00 – 5:00p Marshfield

TC 2.1 1504–TRP
Tuesday 8:00 – 9:00a Clark 3 (7)

TC 2.1 1515 TRP
Tuesday 9:00 – 10:00a Clark 3

TC 2.2 Plant and Animal Environment (10/5)
Monday 4:15 – 6:30p Kimball (3)

TC 2.3 Gaseous Air Contaminants /Removal Equip. (18/30)
Tuesday 1:00 – 3:30p Hancock (6)

TC 2.3 RP 1557 (5/15)
Sunday 11:00 – 12:00 Madison (3)

TC 2.3 Research (20/20) (Screen/Flipchart)
Sunday 5:00 – 7:00p Wabash (3)

TC 2.3 Handbook (10/10)(Flipchart/screen)
Monday 4:15 – 6:00p Montrose 3 (7)

TC 2.3 Standards (15/10) (Screen)
Monday 6:00 – 8:00p Salon 2 (3)

TC 2.3 Planning (15) (Flipchart)
Tuesday 6:30 – 8:00a Burnham 5 (7)

TC 2.3 Program (20/20)(Flipchart/Screen)
Tuesday 12 – 12:45p Hancock

TC 2.4 Particulate Air Contaminants /Removal Equip. (18/30)
Tuesday 3:30 – 6:00p Hancock (6)
Sponsoring: Forum 2: Stop Wasting Energy! Optimization of Air Pre-filter and Final Filter for Commercial and Industrial HVAC Systems and Seminar 26: YEA for Air Cleaning!

TC 2.4 Handbook (10/10)(flipchart)
Saturday 1:00 – 2:30p Spire (6)

TC 2.4 PMS 1360-RP (30)(Screen)
Sunday 11:00 – Noon Salon 2 (3)

TC 2.4 Research (20/20) (Flipchart/Screen)
Sunday 3:00 – 5:00p Wabash (3)

TC 2.4 Planning (20/10)(Screen/flipchart)
Monday 8:00 – 10:00a Spire (6)

TC 2.4 Program (20/10) (flipchart)
Monday 10:00 – 11:00a Spire (6)

TC 2.4 Standards (20/10) (screen)
Monday 4:15 – 6:00p Salon 2 (3)

TC 2.5 Global Climate Change (20/10)
Tuesday 1:30 – 3:30p Kimball (3)

TC 2.6 Sound & Vibration Control (18/30) (Screen)
Monday 2:15 – 4:15p Price (5)
Sponsoring: Seminar 25: Vibration Induced Noise and Mechanical Equipment Vibration Isolation, Balance and Predictive Maintenance

TC 2.6 Hot Topic: BIM Acoustics
Sunday 1:30 – 2:00p Montrose 4 (7)

TC 2.6 Criteria (20) (Screen)
Sunday 2:00 – 3:00p Montrose 4

TC 2.6 Programs (25)
Sunday 3:00 – 4:00p Montrose 4

TC 2.6 Standards (20)
Sunday 4:00 – 5:00p Montrose 4

TC 2.6 Excom (10)
Sunday 5:00 – 6:00p Montrose 4

TC 2.6 Vibration Isolation (20) (Screen)
Monday 8:00 – 9:00a Dearborn 2 (7)

TC 2.6 Publications (15/15)
Monday 9:00 – 10:00a Dearborn 2

TC 2.6 RP 1408 PMS (Lined Duct) (15) (Screen)
Monday 10:00 – 11:00a Dearborn 2

TC 2.6 Research (25) (Screen)
Monday 11:00 – Noon Dearborn 2

TC 2.7 Seismic and Wind Restraint Design (24/6)(Screen)
Tuesday 3:30 – 6:00p Burnham 2 (7)
Sponsoring: Forum 1: How to Specify Seismic Certification

TC 2.7 Research, Programs, Publication, Wind, Commissioning (20) (Screen)
Tuesday 1:00 – 3:30p Burnham 2

TC 2.8 Building Environmental Impacts and Sustainability (75) (Screen)
Sunday 5:00 – 7:00p Adams (6)
Sponsoring: Seminar 19: The Role of Fossil Fuels in Future Sustainable Buildings

TC 2.8 International (15/15) (Screen)
Sunday 12:00 – 12:45p Grant Park(6)

TC 2.8 Green Guide (25)
Sunday 12:45 – 1:30p Grant Park

TC 2.8 Research
Sunday 1:30 – 3:00p Grant Park

TC 2.8 Handbook (25)
Sunday 3:00 – 4:00p Grant Park

TC 2.8 Program (25)
Sunday 4:00 – 4:30p Grant Park

TC 2.8 Existing Buildings
Sunday 4:30 – 4:50p Grant Park

TC 2.9 Ultraviolet Air and Surface Treatment (30) (Screen/Flipchart)
Monday 10:00a – Noon Dearborn 1 (7)

TC 2.9 Program, Handbook, Standards (30) (Screen/Flipchart)
Sunday 8:00 – 1:30p Salon 12 (3)

TC 2.9 Research (Flipchart)
Monday 8:00 – 10:00a Dearborn 1

TC 3.1 Refrigerants & Secondary Coolants (20/10)(Screen/E)
Monday 4:15 – 6:30p LaSalle 3 (7)

**TC 3.1 Research (10/10) (screen/E)**

Monday 11:00a – Noon LaSalle 3

TC 3.1 Program and Handbook (6/4)

Monday 2:15 – 3:45p LaSalle 3

TC 3.2 Refrigerant System Chemistry (12/40)(Screen/E)

Monday 2:15 – 4:15p Monroe (6)

TC 3.2 Research (10/8)

Sunday 4:00 – 5:00p Montrose 3 (7)

TC 3.3 Refrigerant Contaminant Control (50)

Tuesday 3:30 – 6:00p Wabash (3)

TC 3.3 Research (10/8)

Sunday 5:00 – 5:30p Montrose 3 (7)

TC 3.4 Lubrication (60)

Tuesday 1:30 – 3:30p Wabash (3)

TC 3.4 Research (10/8)

Sunday 5:30 – 6:00 Montrose 3 (7)

TC 3.6 Water Treatment (18/10)

Tuesday 1:00 – 3:30p Dearborn 1 (7)

Sponsoring: AHR Expo Session 1: Selection, Operation & Maintenance and Water Treatment for Multi-Metal Boilers and Conference Paper Session 27: Correct Sizing of HVAC Equipment and Systems for Standard 62.1

TC 3.6 Handbook/Program/Research (12/4)

Sunday 3:00 – 5:00p Sandburg 2 (7)

TC 3.8 Refrigerant Containment (9/5)

Monday 4:15 – 6:30p Sandburg 2 (7)

TC 4.1 Load Calculation Data and Procedures (20/10)

Monday 2:15 – 4:15p Salon 12 (3)

Sponsoring: Seminar 41: Loads on the Move: Mobile Apps

TC 4.1 Handbook

Sunday 3:00 – 4:00p Sandburg 6 (7)

TC 4.1 Research (10/5)

Sunday 4:00 – 5:00p Sandburg 6

TC 4.1 Programs & Standards (10/5)

Sunday 5:00 – 7:00p Sandburg 6

TC 4.2 Climatic Information (20/10) (Screen/Flip)

Tuesday 1:00 – 3:30p Burnham 1 (7)

TC 4.2 1654-URP (20) (Screen/flip)

Sunday 9:30 – 10:00a Sandburg 6 (7)

TC 4.2 1413-RP (20)(Screen/flip)

Sunday 10:00 – 11:30a Sandburg 6

TC 4.2 1613-TRP PES/Handbook (20) (Screen/Flip)

Sunday 12 – 1:30p Sandburg 6

TC 4.2 Program (20) (Screen/flip)

Sunday 1:30 – 2:30a Sandburg 6

SSPC 169 (10/8) (Screen/flip)

Monday 10:00a – Noon Burnham 2 (7)

TC 4.2 Research (20) (Screen/flip)

Monday 4:15 – 6:00p Sandburg 6 (7)

TC 4.3 Ventilation Requirements & Infiltration (14/20)

Monday 4:15 – 6:30p Clark 5 (7)

TC 4.3 1596 RP (SP98) PMS (10) (Screen/E)

Sunday 7:00 – 9:00p Clark 1 (7)

TC 4.3 PMS for RP-1478 (12)

Tuesday 8:00 – 10:00a Sandburg 6 (7)

TC 4.4 Bldg. Materials and Bldg. Envelope Performance (30/10) (Screen)

Monday 2:15 – 4:15p Spire (6)

TC 4.4 Research (30/10) (Screen)

Sunday 1:00 – 2:00p Salon 2 (3)

TC 4.4 Handbook (30/10)

Sunday 2:00 – 4:30p Salon 2

TC 4.4 Program (20/5)

Sunday 4:30 – 5:00p Salon 2

TC 4.4 Standards (20/5)

Sunday 5:00 – 5:30p Salon 2

TC 4.5 Fenestration (10/10)

Monday 2:15 – 4:15p Montrose 4 (7)

TC 4.5 Computational Methods

Sunday 1:00 – 3:00p Montrose 1 (7)

TC 4.5 Research & Long Range Planning (8/4)

Sunday 3:15 – 4:00p Montrose 1

TC 4.5 Program (8/4)

Sunday 4:00 – 5:00p Montrose 1

TC 4.5 Handbook (8/4)

Sunday 5:00 – 6:30p Montrose 1

TC 4.5 1415-RP PMS

Monday 9:00 – 10:00a Clark 3 (7)

TC 4.7 Energy Calculations (75) (screen)

Tuesday 6:00 – 8:30p Wabash (3)

Sponsoring: Seminar 18: Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling,

Seminar 28: Improving Energy Modeling Consistency, Seminar 44: Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 1, and Seminar 52: Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 2

TC 4.7 RP 1468 PMSC (Screen)

Sunday 10:00a – Noon Burnham 1 (7)

TC 4.7 RP 1404 PMSC (Screen)

Sunday 1:00 – 3:00p Burnham 1

TC 4.7 RP 1416 PMSC (screen)

Monday 8:00 – 10:00a Burnham 1 (7)

TC 4.7 Simulation and Component Models (20/20) (Screen)

Monday 6:00 – 7:30p Salon 6/7 (3)

TC 4.7 Data-Driven Models (25)

Monday 7:30 – 9:00p Salon 6/7

TC 4.7 Applications (40) (Screen)

Tuesday 3:30 – 5:00p Salon 4 (3)

TC 4.7 Handbook

Tuesday 5:00 – 6:00p Salon 4

TC 4.10 Indoor Environmental Modeling (40)

Monday 2:15 – 4:15p Clark 5 (7)

TC 4.10 RP 1458 PMS (15) (Screen)

Sunday 1:30 – 2:30p Dearborn 2 (7)

TC 4.10 RP 1512 PMS (15) (Screen)

Sunday 2:30 – 3:30p Dearborn 2 (7)

TC 4.10 Program (20)

Sunday 3:30 – 4:30p Dearborn 2 (7)

TC 4.10 Handbook (20)

Sunday 4:30 – 5:00p Dearborn 2 (7)

TC 4.10 Research (30)

Sunday 5:30 – 6:30p Dearborn 2 (7)



TC 5.1 Fans (25) (Screen)**Monday 4:15 – 6:30p Price (5)***Sponsoring: Seminar 39: Comparison of Laboratory and Field Performance Testing and Ratings of Fans***TC 5.1 Research, Handbook, Program (12/5)****Sunday 3:00 – 5:00p Montrose 6 (7)****TC 5.2 Duct Design (12/20)****Tuesday 3:30 – 6:00p Buckingham (5)***Sponsoring: Seminar 16: Air-Handling System Leakage: Benefits and Costs of Field Tests and Technical Paper Session 9: Pressure Loss Measurements in Air Duct Junctions***TC 5.2 Duct Leakage (10)****Sunday 12:30 – 1:00p Cresthill (3)****TC 5.2 Duct Fitting Database (10)****Sunday 1:00 – 1:30p Cresthill (3)****TC 5.2 Research (10)****Sunday 1:30 – 2:30p Cresthill (3)****TC 5.2 Handbook (20)****Sunday 2:30 – 3:00p Cresthill (3)****TC 5.2 Standards (20)****Sunday 3:00 – 3:30p Cresthill (3)****TC 5.2 Programs (20)****Sunday 3:30 – 4:00p Cresthill (3)****TC 5.2 CFD Shootout Project (10)****Sunday 4:00 – 5:00p Cresthill (3)****TC 5.2 1180 Design Guide for Duct Design (20)****Monday 10:00a – Noon Buckingham (5)****TC 5.3 Room Air Distribution (30/30) (Screen/E)****Tuesday 1:00 – 3:30p Monroe (6)***Sponsoring: Seminar 32: Thermal Displacement Ventilation Applications for High Performance Buildings, Part 1 and Technical Paper Session 7: Effect of Typical Inlet Conditions on Air Outlet Performance***TC 5.3 Handbook (20/20)(screen/E)****Friday 8:00 – 5:00p LaSalle 1 (7)****TC 5.3 Handbook (20/20) (screen/E)****Saturday 8:00 – 3:00p Hancock (6)****TC 5.3 Fan Coils (30/20) (Screen/E)****Sunday 8:30 – 9:30a Salon 1 (3)****TC 5.3 Chilled Beams (30)****Sunday 9:30 – 10:30a Salon 1****TC 5.3 Research Projects (30/20)****Sunday 10:30 – Noon Salon 1****TC 5.3 Research/ Handbook/Program (30/20)****Sunday Noon – 2:00p Salon 1****TC 5.4 Industrial Process Air Cleaning (30)****Monday 2:15 – 4:15p LaSalle 1 (7)****TC 5.5 Air-to-Air Energy Recovery (22/4)****Tuesday 3:30 – 6:00p Madison (3)***Sponsoring: Seminar 49: DOAS Parallel Systems, Configuration and Control***TC 5.5 Handbook, Program, Research (12)****Monday 4:15 – 6:30p Sandburg 4 (7)****TC 5.6 Control of Fire & Smoke (23/30)(Screen)****Monday 4:15 – 6:30p Hancock (6)****TC 5.6 Program (12/4)(Screen)****Sunday 3:00 – 4:00p Madison (3)****TC 5.6 Research****Sunday 4:00 – 5:30p Madison (3)****TC 5.6 Handbook****Sunday 5:30 – 7:00p Madison (3)****TC 5.6 Guideline 5 Subcommittee****Monday 2:15 – 4:15p Hancock****TC 5.7 Evaporative Cooling (30)****Monday 4:15 – 6:30p Dearborn 1 (7)****TC 5.7 Program, Handbook, Research (7/4)****Sunday 3:00 – 5:00p Burnham 5 (7)****TC 5.8 Industrial Ventilation Systems (20/5)****Monday 4:15 – 6:30p Dearborn 2 (7)****TC 5.8 Ventilation of Hazardous Spaces (5/5)****Sunday 7:00 – 9:00p Montrose 3 (7)****TC 5.9 Enclosed Vehicular Facilities (30/10)****Tuesday 3:30 – 6:00p Empire (L)***Sponsoring: Conference Paper Session 12: Design, Application and Commissioning Issues Related to Emergency Smoke Management Fans for Tunnel Applications and Conference Paper Session 30: Vehicle Design Fire for Tunnel Ventilation***TC 5.9 Program, Handbook, Research (25/10)****Tuesday 1:00 – 3:30p Empire****TC 5.10 Kitchen Ventilation (30/15) (screen/E)****Sunday 3:00 – 4:30p Spire (6)****TC 5.10 Research****Sunday 8:00 – 9:00a Spire****TC 5.10 Handbook****Sunday 9:00 – 10:00a Spire****TC 5.10 Program****Sunday 10:00 – 11:00a Spire****TC 5.10 Codes & Standards****Sunday 1:00 – 2:00p Spire****TC 5.10 PMS 1469 Thermal Comfort in Kitchens****Monday 10:30 – Noon Burnham 1 (7)****TC 5.11 Humidifying Equipment (10/3)****Monday 2:15 – 4:15p Clark 9 (7)***Sponsoring: Seminar 30: Humidification: Why Is It Necessary and How to Do It Safely***TC 5.11 Handbook/Program (9/5)****Sunday 10:00 – Noon Sandburg 7 (7)****TC 6.1 Hydronic & Steam Htg. Equip & Sys (35/15)****Tuesday 1:00 – 3:30p Adams (6)***Sponsoring: Conference Paper Session 10: Modeling to Improve DHW and Hydronic Systems***TC 6.1 Program (10/10)****Monday 2:15 – 3:15p Clark 3 (7)****TC 6.1 Research (10/10)****Monday 3:15 – 4:15p Clark 3****TC 6.1 Handbook****Sunday 5:00 – 6:00p LaSalle 1 (7)****TC 6.1 Chilled Water Plant (10/10)****Sunday 6:00 – 7:00p LaSalle 1****TC 6.2 District Energy (20/10) (Screen)****Sunday 3:00 – 5:00p LaSalle 3 (7)**

TC 6.2 Programs, Research, Handbook, Planning, (14)

Sunday 2:00 – 3:00p LaSalle 3

TC 6.3 Central Forced Air Htg. & Cooling Sys (30)

Tuesday 1:00 – 3:30p Clark 5 (7)

TC 6.3 Research (10/5)(Screen)

Monday 2:15 – 4:15p Clark 10 (7)

TC 6.3 Program (10/10)

Monday 4:15 – 6:30p Clark 10

TC 6.5 Radiant Heating and Cooling (17/10)

Monday 2:15 – 4:15p Medinah (6)

TC 6.5 RP 1383 (4/20) (Screen)

Sunday 2:00 – 3:00p Medinah

TC 6.5 Research, Spec Pubs, Journal, Program, Handbook (6/8)

Sunday 3:00 – 5:00p Med inah

TC 6.6 Service Water Heating Systems (18/15)

Monday 4:15 – 6:30p Monroe (6)

Sponsoring: Technical Paper Session 5: Laboratory Testing of Heat Pump Water Heaters

TC 6.6 Research/Handbook/Program (18/15)

Monday 2:15 – 4:15p Burnham 2 (7)

TC 6.7 Solar Energy Utilization (20/10)

Tuesday 1:00 – 3:30p Clark 7 (7)

Sponsoring: Conference Paper Session 3: How Regulations and Policies are Promoting Sustainable Energy Use and High-Performance Buildings Around the World, Conference Paper Session 24: The Role of Energy Efficiency and Renewable Energy, and Seminar 1: 2011 Solar Decathlon: Lessons for Net Zero Residential Structures

TC 6.7 Program (5/5)

Monday 4:15 – 5:30p Clark 1 (7)

TC 6.7 Research (5/5)

Monday 5:30 – 6:30p Clark 1

TC 6.7 Handbook (5/5)

Monday 6:30 – 8:30p Clark 1

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25)

Tuesday 3:30 – 6:30p Adams (6)

Sponsoring: Forum: Design Issues for Heat Recovery Heat Pumps - What's Missing and Seminar 15: Chicago Smackdown: Air Source vs. Ground Source or Best Practices for Air Source vs. Ground Source Heat Pump Systems

TC 6.8 Research/Handbook/Program (15/15)

Sunday 5:00 – 7:00p Marshfield (3)

TC 6.9 Thermal Storage (25/5)

Monday 2:15 – 4:15p Grant Park (6)

Sponsoring: Conference Paper Session 23: Modern Treatment of Water and Ice Based TES Systems

TC 6.9 Standards (20)

Sunday 1:00 – 1:30p Logan (3)

TC 6.9 Program

Sunday 1:30 – 2:30p Logan (3)

TC 6.9 Research

Sunday 2:30 – 3:30p Logan (3)

TC 6.9 Handbook,

Sunday 3:30 – 4:30p Logan (3)

TC 6.9 LRP

Sunday 4:30 – 5:00p Logan (3)

TC 6.10 Fuels & Combustion (30)

Tuesday 3:30 – 6:00p Clark 5 (7)

TC 6.10 Handbook (4/4)

Monday 2:15 – 4:15p Sandburg 4 (7)

TC 7.1 Integrated Building Design (25/10)

Monday 8:15 – 10:30a Burnham 4 (7)

Sponsoring: Conference Paper Session 4: ID: Goals, Obstacles and Lessons Learned, Conference Paper Session 16: Integrated Design Energy Retrofits, Seminar 9: Streamlining BIM through Open Information Exchanges, Part 1, Seminar 12: Streamlining BIM through Open Information Exchanges, Part 2, and Seminar 45: Trying Hard to Play Nice: Assessing Industry Barriers to the Use of IPD

TC 7.1 Subcommittees (15)

Sunday 5:00 – 7:00p Clark 9 (7)

TC 7.2 HVAC Construction and Design Build Technology (15) (Screen)

Sunday 10:00a – Noon Montrose 5 (7)

Sponsoring: Seminar 38: Advancing the "I" in BIM

TC 7.3 Operations & Maintenance Management (25/7)

Tuesday 1:00 – 3:30p Salon 1 (3)

Sponsoring: Seminar 5: What Is the Right Degree of Automation in Building Operations: A Debate and Discussion, Seminar 7: Has Your TRAINing Left the Station?, Seminar 13: Sustainability in Commercial Buildings: Integration Measures for Bridging the Gaps in Performance from Design to Operations, and Seminar 27: Approaching Net-Zero and Maintaining Your Course: O&M Tools to Maintain Building Performance

TC 7.3 Standards/Program (7/3)

Monday 2:15 – 4:15p Ashland (3)

TC 7.3 Research/Handbook (7/3)

Monday 4:15 – 6:30p Ashland (3)

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)

Sunday 8:15 – 10:15a Montrose 4 (7)

Sponsoring: Seminar 11: Exergy Analysis for Sustainable Buildings

TC 7.5 Smart Building Systems (16/24)(Screen)

Tuesday 3:30 – 6:00p Wilson (3)

Sponsoring: Seminar 40: Advanced Control and Diagnostic Techniques for Efficient Operation of High Performance Buildings

TC 7.5 Fault Detection &Diagnosis (40)

Sunday 3:00 – 3:45 p Honore (1)

TC 7.5 Wireless Applications (40)

Sunday 3:45 – 4:30p Honore

TC 7.5 Smart Grid

Sunday 4:30 – 5:15p Honore

TC 7.5 Handbook

Sunday 5:15 – 6:00p Honore

TC 7.5 Buildings Operations Dynamics

Monday 4:00 – 5:30p Salon 12 (3)

TC 7.5 Research

Monday 5:30 – 6:30p Salon 12

TC 7.6 Building Energy Performance (30)

Tuesday 1:00 – 3:30p Wilson (3)

TC 7.6 Research (12)

Sunday 12:00 – 2:00p Sandburg 3 (7)

TC 7.6 Commercial Building Energy Audit

Sunday 2:00 – 3:00p Sandburg 3

TC 7.6 Handbook (12)
Sunday 3:00 – 4:00p Sandburg 3

TC 7.6 Monitoring & Energy Performance
Monday 2:15 – 4:15p Montrose 6 (7)

TC 7.6 Energy Management (20)
Monday 4:15 – 5:15p Montrose 6

TC 7.6 Standards (12)
Monday 5:15 – 6:30p Montrose 6

TC 7.6 Executive (12)
Monday 6:30 – 7:00p Montrose 6

TC 7.7 Testing & Balancing (20/30)
Monday 2:15 – 4:15p Wabash (3)

TC 7.7 Program/Handbook (5/5)
Saturday 1:00 – 3:00p Clark 2

TC 7.8 Owning & Operating Costs (25)
Monday 2:15 – 4:15p Burnham 1 (7)

TC 7.8 Program, Handbook, Research (5/5)
Sunday 3:00 – 5:00p Sandburg 7 (7)

TC 7.9 Building Commissioning (75)
Sunday 3:00 – 5:00 Monroe (6)
Sponsoring: Seminar 21: Maximizing the Benefits of Commissioning: Incorporating Design Reviews and the Building Envelope into the Commissioning Scope and Seminar 51: Integrated Design and Commissioning on the Same Building: Collaboration or Collision?

TC 7.9 Research (20)
Saturday 9:00 – 10:30a Wilson (3)

TC 7.9 Program
Saturday 10:30 – Noon Wilson (3)

TC 8.1 Positive Displacement Compressors (12/14)
Tuesday 3:30 – 6:00p Logan (3)

TC 8.1 Research (6/2)
Monday 2:15 – 4:15p Clark 8 (7)

TC 8.2 Centrifugal Machines (20/8)
Monday 2:15 – 4:15p Dearborn 2 (7)
Sponsoring: Conference Paper Session 15: Considerations for Chiller Life Cycle Evaluations Including Comparisons to ARI 550/590 IPLV and Seminar 20: Back to Basics: Selection of Proper Chiller Technology

Handbook (6)
Sunday 5:00 – 6:00p Salon 10 (3)

Research (6)
Sunday 7:00 – 8:00p Salon 10

TC 8.3 Absorption and Heat Operated Machines (30)
Monday 3:30 – 6:00p LaSalle 2 (7)

TC 8.3 Research/Handbook (6/6)
Monday 2:00 – 3:30p LaSalle 2

TC 8.4 Air-to-Refrigerant Heat Transfer Equip (20/10)
Tuesday 3:30 – 6:00p Grant Park (6)
Sponsoring: Technical Paper Session 8: Effects of Various Factors on Heat Exchanger Performance

TC 8.4 Research (15/15) (Screen)
Monday 6:30 – 7:30p LaSalle 2 (7)

TC 8.5 Liquid to Refrigerant Heat Transfer (25/10)
Monday 4:15 – 6:30p Burnham 1 (7)

TC 8.5/1.3 Research (20/15) (screen)
Sunday 3:00 – 7:00p Salons 4/5/8/9 (3)

TC 8.6 Cooling Towers and Evaporative Condensers (20)
Monday 2:15 – 4:15p Logan (3)

TC 8.6 Handbook/Program/Research (10)
Monday 9:00 – 11:00a Clark 7 (7)

TC 8.7 Variable Refrigerant Flow (20/30)
Monday 4:15 – 6:30 Grant Park (6)
Sponsoring: Seminar 4: Water-Cooled VRF Systems: An Introduction

TC 8.8 Refrigerant System Controls & Accessories (10/10)
Tuesday 1:00 – 3:30p Clark 1 (7)
Sponsoring: Seminar 29: HVAC&R Research Journal: Controls

TC 8.8 Program, Research, Handbook (10/5)
Monday 2:15 – 4:15p Wrigley (6)

TC 8.9 Residential Refrigerators and Food Freezers (6/10)
Monday 2:15 – 4:15p Madison (3)

TC 8.10 Mechanical Dehumidifiers & Heat Pipes (12/4)
Tuesday 3:30 – 6:00p Sandburg 5 (7)

TC 8.10 Research/Handbook/Program (8/8)
Tuesday 2:00 – 3:30p Sandburg 5

TC 8.11 Unitary and Room Air Conditioners & Heat Pumps (20/30)
Monday 4:15 – 6:30p Wabash (3)

TC 8.11 Handbook/Program/Research (10/5)
Sunday 3:00 – 5:00p LaSalle 5 (7)

TC 8.12 Desiccant Dehumidification Equipment and Components (30)
Monday 2:15 – 4:15p Dearborn 1 (7)

TC 9.1 Large Building Air-Conditioning Systems (23/5)
Tuesday 1:00 – 3:30p Buckingham (5)
Sponsoring: Seminar 42: Case Studies: New Equipment and Applications to Improve Energy Efficiency

TC 9.1 Research/Program/Handbook/Standards (23/5)
Tuesday 12:00 – 1:00p Buckingham (5)

TC 9.2 Industrial Air Conditioning (25/10)
Tuesday 1:00 – 3:30p Salons 4/5/8/9

TC 9.2 Program, Research, Handbook (12)
Sunday 5:00 – 7:00p Millenium (6)

TC 9.2 Nuclear (15/5)
Monday 2:15 – 4:15p Dearborn 3 (7)

TC 9.3 Transportation Air Conditioning (25/20)
Monday 3:30 – 6:00p Salons 6/7 (3)

TC 9.3 Handbook (4/4)
Sunday 9:00 – 10:00a Burnham4 (7)

TC 9.3 Aviation (20/10) (screen)
Sunday 10:00 – Noon Burnham 4

TC 9.3 Automotive (6/4) (screen)
Sunday 5:00 – 7:00p Sandburg 3 (7)

TC 9.3 Research (25/25) (Screen)
Monday 2:15 – 3:30p Salons 6/7

TC 9.4 Applied Heat Pump/Heat Recovery Systems (13/25)
Merged with TC 6.8

TC 9.5 Residential and Small Bldg. Applications (20/10)
Tuesday 3:30 – 6:00p LaSalle 1 (7)

TC 9.6 Health Care Facilities (30/30) (Screen)
Sunday 5:00 – 7:00p Monroe (6)

TC 9.6 SP 91.2 (20) (screen)
Sunday 8:15a – Noon Montrose 3 (7)

**TC 9.6 Research (15) (Screen)**

Sunday 12:30 – 2:00p Montrose 3

TC 9.6 Handbook (10)

Sunday 1:00 – 2:00 p Clark 9 (7)

TC 9.6 Infectious Diseases (20)

Sunday 2:00 – 3:00p Clark 9

TC 9.6 Energy (20) (Screen)

Sunday 2:00 – 3:00p Montrose 3

TC 9.6 Program (10) (screen)

Sunday 3:00 – 4:00p Montrose 3

TC 9.7 Educational Facilities (13/10)

Sunday 1:00 – 3:00p Montrose 5 (7)

TC 9.8 Large Building Air-Conditioning Applications (30)

Monday 2:15 – 4:15p Salon 1 (3)

TC 9.8 Handbook/ Research/ Program (10/4)

Monday 10:00a – Noon Wrigley (6)

TC 9.9 Mission Critical Facilities (25/50)(screen)

Monday 2:15 – 9:30p Empire (L)

Sponsoring: Seminar 3: Liquid Cooling Technologies to Enable High Density and Improve Energy Efficiency of Information Technology Data Center Facilities and Seminar 23: Design Best Practices from the Server to the Data Center, What the Operator Should Know

TC 9.9 Program/ Handbook/ Research (25/10)(screen)

Sunday 5:00 – 7:00p Spire (6)

TC 9.10 Laboratory Systems (75)(Screen)

Tuesday 3:30 – 6:00p Monroe (6)

TC 9.10 Standards, Research (10/5)

Sunday 3:00 – 5:00p Montrose 5 (7)

TC 9.10 Program (10)

Sunday 5:00 – 6:00p Montrose 5

TC 9.10 Handbook, Design Guide (15)

Tuesday 1:00 – 3:30p Montrose 5 (7)

TC 9.11 Clean Spaces (30/45)(Screen/E)

Monday 2:15 – 4:00p Adams (6)

Sponsoring: Seminar 53: Optimizing Cleanrooms for High Performance, Energy Reduction and Sustainability

TC 9.11 RP-1431 PMS (5/10) (Screen)**TC 9.11 RP-1344 PMS****TC 9.11 RP-1604 PMS**

Sunday 3:00 – 5:00p Millennium (6)

TC 9.11 Handbook (10/12)(Screen)

Monday 4:00 – 4:30p Adams

TC 9.11 Design Guide (10)

Monday 4:30 – 5:30p Adams

TC 9.11 Short Course (10)

Monday 5:30 – 6:00p Adams

TC 9.12 Tall Buildings (12/5)

Tuesday 3:30 – 6:00p Dearborn 3 (7)

TC 10.1 Custom Engineered Refrig Systems (30)

Monday 2:15 – 4:15p Buckingham (5)

Sponsoring: Seminar 43: Industrial Refrigeration Worst Practices

TC 10.1 Research/Handbook, Standards/ Program (15/5)

Sunday 5:00 – 7:00p Sandburg 4 (7)

TC 10.1 Cryogenics Refrigerants Subcommittee (10)

Sunday 3:00 – 5:00p LaSalle 4 (7)

TC 10.2 Automatic Ice Making Plants/Skating Rinks (15)

Monday 4:15 – 6:30p Burnham 5 (7)

TC 10.3 Refrigerant Piping, Controls and Accessories (30)

Tuesday 1:00 – 3:30p Indiana (3)

TC 10.5 Refrigeration Distrib and Storage Facilities (15/10)

Tuesday 3:30 – 6:00p Dearborn 1 (7)

TC 10.6 Transport Refrigeration (8/10)

Monday 4:45 – 7:00p Sandburg 8 (7)

10.6 Handbook (6/2)

Monday 2:15 – 4:15p Sandburg 8

TC 10.7 Commercial Food, Beverage Display & Storage (25/25)

Monday 2:15 – 4:15p State Ballroom (4)

TC 10.7 1467-RP PMS (4/4)(screen)

Sunday 7:00 – 8:00a Madison (3)

TC 10.7 Program (5/10)

Sunday 5:15 – 6:00p LaSalle 2 (7)

TC 10.7 Research (5/10)

Sunday 6:00 – 6:45p LaSalle 2

TC 10.7 Handbook (5/10)

Sunday 6:45 – 7:30p LaSalle 2

TC 10.8 Refrigeration Load Calculations (10/10)

Sunday 3:00 – 5:00p Salon 10 (3)

TC 10.9 Refrigeration Applications for Foods & Beverages (15/10)

Monday 4:15 – 6:30p Buckingham (5)

TGs/TRGs**TG1.Optimization (15) (Screen)**

Sponsoring: Forum: What Should be Included in the Handbook Chapter on Optimization?

Sunday 1:00 – 3:00p Price (5)

TG2.HVAC Security (20/6)

Tuesday 9:00 – 12N Burnham 1 (7)

TRG4 Sustainable Building Guidance & Metrics (17/10)

Saturday 1:00 – 300p Price (5)

TRG4.IAQP (10/10)

Monday 2:15 – 4:15 Marshfield (3)

TRG7-Under Floor Air Distribution (Screen/E) (40)

Wednesday 8:00 – Noon Price (5)

TG9.JF Justice Facilities (20/5)

Sunday 8:00 – 10:00a Kimball (3)

MTG Building Performance Metrics (19/10)(Screen)

Sunday 1:00 – 4:00p Dearborn 1 (7)

MTG Energy Efficiency Classification of General**Ventilation Air-Cleaning Devices (15/5) (Screen)**

Tuesday 8:00 – 10:00a Wilson (3)

MTG Building Information Modeling (15/15)

Saturday 1:00 – 3:00p LaSalle 1 (7)

MTG Energy Targets Multidisciplinary Task Group,

Saturday 1:00 – 3:00p Indiana (3)



STANDARDS—GPCs/SPCs

SPC Chair Training Breakfast

Sunday 7:00 – 9:00a Grand Ballroom (4)

SSPC 15 Safety Standards for Refrigeration Systems (22/25)(screen)

Sunday 1:00 – 5:00p Buckingham (5)

SSPC 15 Ad Hoc 2L Classification Working Group (11/20)(Screen)

Sunday 9:00a – 11:00a Buckingham

SSPC 15 ISO 5149 Ad Hoc (11/20)

Sunday 11:00a – Noon Buckingham

SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/PTHP (5/3)

Tuesday 8:00 – Noon Montrose 2 (7)

SPC 17 MOT/Capacity of TEV's (6/4)

Sunday 5:00 – 7:00p Kimball (3)

SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (5/10) (Screen)

Sunday 12:00 – 2:00p Montrose 6 (7)

SPC 22 MOT Water-cooled Refrigerant Condensers (6/10)(Screen)

Sunday 10:00a – Noon Sandburg 5 (7)

SPC 23.2 MOT/Rating Positive Displacement Compressors that Operate at Supercritical Temperatures of the Refrigerant (7/4) (Screen)

Monday 10:00a – Noon Sandburg 6 (7)

SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration (7/4)(screen)

Monday 7:45 – 9:15p Sandburg 6 (7)

SPC 29 MOT/Automatic Ice Makers (20)

Monday 4:15 – 6:30 Montrose 4 (7)

SPC 30 MOT Liquid Chilling Packages (6/2)

Sunday 6:00 – 7:00 p Burnham 5 (7)

SPC 33 MOT/Forced Circulation Air Cooling and Air Heating Coils

Monday 7:30 – 8:15p LaSalle 2 (7)

SSPC 34 Designation & Safety Class. Of Refrig. (25/25)(Screen/E)

Monday 6:30 – 10:00p Wabash (3)

SSPC 34 Designation Nomenclature (10/10) (screen/E)

Saturday 7:00 – 10:00a Buckingham (5)

SSPC 34 Flammability (15/20)(screen/E)

Saturday 10:00 – 3:00p Buckingham

SSPC 34 Toxicity (10/20) (screen/E)

Sunday 6:30 – 10:00p Wilson (3)

SPC 40 MOT/Rating Heat Operated Unitary Air-Conditioning and Heat-Pump Equipment

Monday 10:00 – Noon Sandburg 4 (7)

SSPC 41 Standard Methods for Measurement (15/10)

Sunday 1:00 – 4:00p Dearborn 3 (7)

41.1 Temperature- Standard Method for Temperature Measurement (10/5)

Monday 8:00 – 10:00a Montrose 1 (7)

41.2 Laboratory Airflow-Standard Method for Laboratory Airflow Measurement (10/5)

Monday 8:00 – Noon Montrose 5 (7)

41.3 Pressure-Standard Method for Pressure Measurement (10/5)

Sunday 4:00 – 6:00p Dearborn 3 (7)

41.4 Lubricant Content-Standard Method for Measurement of Proportion of Lubricant in Liquid Refrigerant (10/5)

Monday 10:00 – Noon Montrose 1 (7)

41.6 Humidity-Standard Methods for Measurement of Moist Air Properties (10/5)

Sunday 10:00a – Noon Clark 1 (7)

41.7 Standard Methods for Gas Flow Measurement (10/5)

Tuesday 8:00 – 10:00a Montrose 3 (7)

41.8 Standard Methods for Liquid Flow Measurement (10/5)

Tuesday 10:00 – Noon Montrose 3

41.10 Calorimeter Test Methods for Volatile Refrigerants Mass Flow Measurements Using Flowmeters (10/5)

Monday 2:15 – 4:15 Montrose 1 (7)

41.11 Power-Standard Methods for Power Measurement (10/5)

Monday 8:00a – 10:00a Montrose 2 (7)

SSPC 52.2P MOT/Part Size Eff. Proc. for Testing Air Cleaning Devices (17/20) (Screen)

Saturday 8:00 – Noon Spire (6)

SSPC 55 Thermal Env Cond. for Human Occupancy (19/6)(screen)

Saturday 8:00a – 3:00p Salon 2 (3)

Sunday 9:00a – 12p LaSalle 2 (7)

SSPC 62.1 Ventilation and Acceptable IAQ in Commercial, Institutional and High-Rise Residential Buildings (30/30) (E/Screen)

Saturday 1:30 – 3:00p Water Tower (6)

Sunday 1:00 – 7:00p State Ballroom (4)

SSPC 62.1 Education (15/15) (screen)

Friday 1:00 – 5:00p LaSalle 3 (7)

Saturday 8:00a – 12:30p Water Tower (6)

SSPC 62.1 Administration (15/15)(screen)

Friday 1:00 – 5:00p LaSalle 2 (7)

Saturday 8:00a – 12:30p LaSalle 3 (7)

SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings (28/13)(Screen/Electric)

Friday 1:00 – 2:30p Honore (L)

Saturday 8:30 – 3:00p Salon 6/7 (3)

SSPC 62.2 IAQ Subcommittee (12)

Friday 2:30 – 5:00p Kimball (3)

SSPC 62.2 System Subcommittee (12)

Friday 2:30 – 5:00p Marshfield (3)

SSPC 62.2 Envelope Subcommittee (20)

Friday 2:30 – 5:00p Honore (L)

Standard 136 subcommittee

Friday 9:00 – Noon Salon 12 (3)

SPC 72 MOT/Commercial Refrigerators and Freezers (12/12)

Sunday 1:00 – 5:00p LaSalle 2 (7)

SPC 79 MOT/for Rating Fan-Coil Conditioners (20/20) (Screen/E)

Saturday 8:00a – Noon Burnham 4 (7)

SPC 84-2008 MOT/Air-to-Air Heat/Energy Exchangers (9/4)

Tuesday 8:00 – 12:00p Clark 10 (7)

SPC 86 MOT/the Floc Point of Refrigeration Grade Oils (5/5)

Tuesday 8:00 – 10:00a LaSalle 5 (7)

SSPC 90.1 Energy Eff. Design of New Bldg. (Screen/E) (50/60)

Saturday 8:00a – 12p Honore (L)

Sunday 9:00a – 12p State Ballroom (4)

Monday 8:00a – 12p State Ballroom

Format & Compliance Subcommittee (4/6)(E)

Friday 5:00 – 10:00p Sandburg 5 (7)

Saturday 1:00 – 5:00p Burnham 3 (7)
Sunday 4:00 – 7:00p Sandburg 5 (7)

Mechanical Subcommittee (25/25)(screen/E)

Friday 9:00a – 10p Salon 2 (3)
Saturday 1:00 – 7:00p Dearborn 1 (7)
Sunday 1:00 – 8:00p Burnham 4 (7)

Lighting Subcommittee (12/10)(screen/E)

Friday 9:00a – 10p Burnham 1 (7)
Saturday 1:00 – 7:00p Burnham 1 (7)
Sunday 1:00 – 8:00p Clark 3 (7)

ECB Subcommittee (8/10) (E)

Friday 5:00 – 10:00p Sandburg 2 (7)
Saturday 1:00 – 5:00p Burnham 2 (7)
Sunday 1:00 – 4:00p Sandburg 5 (7)

Envelope Subcommittee (screen/E)(15/30)

Friday 9:00a – 10:00p Salon 1 (3)
Saturday 1:00 – 7:00p Burnham 4 (7)
Sunday 1:00 – 7:00p Clark 5 (7)

SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg. (21/25) (screen/E)

Monday 2:15 – 6:15p Burnham 4 (7)
Tuesday 1:00 – 5:00p Burnham 4 (7)

SSPC 90.2 Lighting (4/4) (Screen/E)

Monday 6:15 – 9:15p Burnham 5 (7)
Tuesday 8:00 – Noon Burnham 3

SSPC 90.2 Mechanical (6/6)(Screen/E)

Monday 6:15 – 9:15p Burnham 2 (7)
Tuesday 8:00 – Noon Burnham 2

SSPC 90.2 Envelope (11/15) (Screen/E)

Monday 6:15 – 9:15 Burnham 4 (7)
Tuesday 8:00 – Noon Burnham 4

SSPC 100 Energy Efficiency in Existing Buildings (13/15)(Screen)

Tuesday 8:00 – 12:30p Dearborn 1 (7)

SPC 105 Standard Methods of Measuring and Expressing Building Energy Performance (8/8) (Screen)

Sunday 9:00a – 1:00p Wilson (3)

SPC 110 Fume Hood Testing (10)

Saturday 8:00a – Noon Sandburg 3 (7)

SPC 118.1 MOT/Commercial Water Heaters (6/6)

Sunday 9:00 – 11:00a LaSalle 5 (7)

SPC 118.2R MOT/Rating Residential Water Heaters (19/15)

Tuesday 1:00 – 5:00p LaSalle 2 (7)

SPC 120 MOT/to Determine Flow Resistance of HVAC Ducts and Fittings (10)

Sunday 12:00 – 12:30 Burnham 3 (7)

SPC 124 MOT/Rating Combination Space-Heating and Water Heating Appliances (20)

Wednesday 8:00 – Noon Buckingham (5)

SPC 126 MOT/HVAC Air Ducts (10)

Sunday 12:00 – 12:30 Burnham 3 (7)

SPC 127 MOT/Rating Computer and Data Processing Room Unitary Air-Conditioners (9/6)(Screen/E)

Tuesday 1:00 – 5:00p LaSalle 5 (7)

SPC 129 Measuring Air Change Effectiveness (15/10)(Screen)

Sunday 5:00 – 7:00p Dearborn 1 (7)

SPC 130 MOT/for Rating Ducted Air Terminal Units (20/15) (E/Screen)

Sunday 2:00 – 6:00p Clark 2 (7)

SSPC 134 Graphic Symbols (10/6)

Saturday 1:00 – 2:00p Wilson (3)

SSPC 135 BACnet (45/15)

Saturday 8:00 – 3:00p Wabash (3)
Monday 8:00a – Noon Salon 6/7 (3)

SSPC 135 (25)

Thursday (1/19) 8:00a – 5:00p Wabash (3)

SSPC 135 Working Group (25)

Friday 8:00a – 5:00p Burnham 2 (7)

SSPC 135 Working Group (25)

Friday 8:00a – 5:00p Burnham 4 (7)

SSPC 135 BACnet Working Group (25)

Sunday 8:30a – 5:00p Burnham 2 (7)

SSPC 135 BACnet (25)

Sunday 8:00a – 5:00p Clark 7 (7)

SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program (15/5) (screen)

Monday 2:15 – 6:15p LaSalle 5 (7)

SSPC 145P Test Methods for Assessing Performance of Gas Phase Air Clean. Equip. (15/15)(Screen/ E)

Sunday Noon – 3:00p LaSalle 1 (7)

SPC 147 Minimizing the Release of Refrigerants (12/12)(screen/ flipchart)

Sunday 6:00 – 10:00p Grant Park (6)

SPC 150 MOT/Performance of Cool Storage Systems (6/2)

Sunday 5:30 – 6:30p LaSalle 4 (7)

SPC 151 MOT/Shipboard Balancing (6/4)

Saturday 1:00 – 3:00p Clark 1 (7)

SPC 154 Ventilation for Commercial Cooking Operations (10/10) (Screen)

Monday 2:15 – 5:15p Millenium (6)

SPC 155P MOT/Rating Commercial Space Heating Boiler Systems (9/9)

Sunday 12:30 – 2:30p Millenium (6)

SPC 158.1 MOT/Capacity of Refrigerant Solenoid Valves (6/2)

Sunday 5:00 – 7:00p Harvard (3)

SSPC 160 Criteria for Moisture Control Design Analysis (11/10) (Screen)

Tuesday 8:00a – Noon Sandburg 4 (7)

SPC 161P Air Quality Within Commercial Aircraft (25/10)(Screen)

Sunday 1:00 – 5:00p Wilson (3)

Monday 8:00a – Noon Hancock (6)

SPC 164.1 MOT/ for Residential Central-System Humidifiers (12/3) (screen)

Monday 8:00 – 10:00a LaSalle 5 (7)

SPC 164.3 MOT/Commercial and Industrial Humidifiers (8/4)

Monday 10:00 – Noon LaSalle 5

SSPC 169 Weather Data for Building Design Standards (screen/flip) (12/8)

Monday 10a – Noon Burnham 2 (7)

SSPC 170 Ventilation of Healthcare Facilities (21/15) (screen)

Tuesday 8:00 – 12:45p Clark 5 (7)

SSPC 170 Clinical Subcommittee (12/20) (Screen)

Monday 4:15 – 6:15p Salon 1 (3)

SPC 172P MOT/Insoluble Materials in Synthetic Lubricants And HFC Refrigerant Systems (8/2)

Monday 8:00 – Noon Dearborn 3 (7)

SPC 173 MOT/Determine the Performance of Halocarbon Refrigerant Leak Detectors (5/2)

Monday 6:30 – 9:30p Sandburg 2 (7)

SPC 175 Metal Pressure Vessel Testing (5/5)

Monday 4:15 – 6:15p Sandburg 3 (7)

SPC 177P MOT/Fractionation Measurement of Refrigerant Blends (6/10)(Screen)

Monday 8:00 – 10:00a Sandburg 8 (7)

SPC 179P MOT/Life Testing Positive Displaced Compressors (10/10)

Sunday 1:00 – 5:00p Sandburg 4 (7)

SSPC 180 Standard Practice for Inspection & Maintenance of HVAC Systems (15/9) (Screen)

Friday 1:00a – 4:00p Salon 10 (3)

SPC 181 MOT/Liquid-to-Liquid Heat Exchangers (7/10)(Screen)

Monday 2:15 – 4:00p Sandburg 6 (7)

SPC 184 MOT/Field Testing Chillers (13/9) (screen)

Tuesday 8:00 – Noon LaSalle 2 (7)

SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms (15/15)(Flipchart/screen)

Saturday 8:00a – 3:00p Clark 3 (7)

SPC 188 Minimizing the Risk of Legionellosis Associated with Building Water Systems (35/10) (screen)

Tuesday 9:00 – Noon Spire (6)

Tuesday 3:30 – 6:00p Spire

SPC 189.1 ASHRAE/USGBC/IESNA Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (40/40) (E/screen)

Wednesday 8:00a – Noon Honore (L)

Working Group 6 (Water Use)(30/20)(E/Screen)

Tuesday 8:00 – 10:00a Salons 6/7 (3)

Working Group 8 (IEQ) (20/20) (E/Screen)

Tuesday 8:00 – 11:00a Salon 12 (3)

Working Group 10 (Plans and Operation) (30/20) (E/Screen)

Tuesday 10:00a – Noon Salons 6/7

Working Group 7 (Energy Efficiency)(20/20) (E/Screen)

Tuesday 12:00 – 3:00p Salon 12

Working Group 9 (Materials and Resources) (10/10)

Tuesday 2:00 – 4:00p Salons 6/7

Working Group 5 (Site Sustainability)(10/10)(E/Screen)

Tuesday 4:00 – 6:00p Salons 6/7

Working Group 75 (Energy Performance) (20/20)

Tuesday 3:00 – 6:00p Salon 12

SPC 189.2 Design, Construction and Operation of High-Performance Green Healthcare Facilities (25/10)(screen)

Monday 8a – Noon Salon 2 (3)

Monday 2:00 – 3:00p Salon 2

SPC 190 MOT/Rating Indoor Pool Dehumidifiers for Moisture Removal Capacity and Moisture Removal Efficiency (6/6)

Tuesday 1:00 – 2:00p Sandburg 5 (7)

SPC 191 Water Conservation (15/10) (screen)

Sunday 9:00 – Noon Clark 5 (7)

SPC 194 MOT/Direct-Expansion Ground Source Heat Pumps (6/10) (Screen)

Sunday 1:00 – 4:00p Clark 1 (7)

SPC 195P MOT/for Airflow Controls (10/5)

Tuesday 8:00 – Noon Montrose 5 (7)

SPC 196P MOT/ Measuring Refrigerant Leak Rates (12/5)

Sunday 6:00 – 10:00p Sandburg 2 (7)

SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (6/6) (screen)

Monday 4:15 – 6:30p Madison (3)

SPC 198 MOT/Rating DX Dedicated Outdoor-Air Systems (6/6)

Tuesday Noon – 1:00 p Sandburg 5 (7)

SPC 199 MOT/Rating the Performance of Industrial Pulse Cleaned Dust Collectors (10)

Friday 8:00a – 5:00p Sandburg 3 (7)

SPC 200 MOT/Chilled Beams (20/20)(screen/E)

Monday 8:00 – Noon Salon 1 (3)

SPC 201P: Facility Smart Grid Information Model (42/15) (screen)

Monday 2:15 – 6:30p Salons 4/5/8/9/ (3)

Tuesday 8:00a – Noon State Ballroom (4)

SPC 202 The Commissioning Process for Buildings & Systems (25/10) (Screen)

Monday 8:00 – Noon LaSalle 2 (7)

SSPC 203 MOT/Determining Heat Gain of Office Equipment Used in Buildings (10/3) (screen)

Saturday 1:00 – 3:00 Sandburg 4

SPC 204P MOT/Rating Micro Combined Heat and Power Devices (12/12)

Tuesday 1:00 – 3:00p LaSalle 1 (7)

Wednesday 8:00a – 12N Salon 10 (3)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (18/12)(Screen/E)

Tuesday 8:00 – 10:00a Salon 2 (3)

SPC 206 MOT/for Rating of Multi-Purpose Residential Heat Pumps for Space Conditioning, Water Heating and Dehumidification (14/6)

Monday 2:15 – 5:00 p Sandburg 5 (7)

SPC 207P-Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems (20/10) (Screen)

Monday 8:00a – Noon LaSalle 1 (7)

SGPC 0-General Commissioning Process (10/5)

Saturday 8:00 – 12:00p Burnham 2 (7)

GPC 1.2 Commissioning Process for Existing HVAC&R Systems (25/5) (Screen)

Friday 8:00a – 5:00p Wilson (3)

Saturday 8:00a – Noon Clark 7 (7)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process (8/6)

Tuesday 1:00 – 5:00p Clark 2 (7)

GPC 1.4 Systems Manual Preparation for the Commissioning Process (8/10) (Screen)

Saturday 1:00 – 3:00p LaSalle 3 (7)

GPC 1.5 Commissioning Smoke Control Systems (11/10) (screen/E)

Monday 2:15 – 4:15 Hancock (6)

SGPC – 10 Achieving Acceptable Indoor Environment (12/12) (Screen)

Sunday 9:00 – Noon Dearborn 3 (7)

SGPC 13 Guideline for Specifying Direct Digital Control Systems (15) (Screen/E)

Saturday 8:00 – Noon LaSalle 5 (7)

GPC 14 Measuring Energy Demand and Water (8/12)(Screen)

Sunday 6:30 – 9:00p LaSalle 3 (7)

SGPC 20 Documenting HVAC&R Work Processes and Data Exchange Requirements (10)

Monday 10:15a – 12:15p Kimball (3)

GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles (10/5) (screen)

Monday 8:00 – Noon Sandburg 5 (7)

Tuesday 8:00 – Noon Montrose 4 (7)

Tuesday 1:00 – 5:00p Montrose 4

GPC 25 MOM/Solar-Optical Properties of Materials (5/5)

Sunday 8:00 – 9:00p LaSalle 4 (7)

GPC 27P Procedures for Measurement of Gases in Indoor Environments (5/5) (flipchart)

Sunday 3:00 – 5:00p Wrigley (6)

GPC 32 Sustainable, High Performance Operations & Maintenance (10/10)

Sunday 1:00 – 3:00p Indiana (3)

GPC 33P Guideline for Documenting Airflow and Contaminant Transport Modeling Studies (9/6)

Tuesday 11:00 – Noon Sandburg 6 (7)

OTHER

Thermal Performance of the Exterior Envelopes of Whole Buildings

Monday 9:00 a.m. – Noon Salon 12 (3)

USNC/IIR (20/10)

Tuesday 2:00 – 4:00p Dearborn 2 (7)

USNT/IEA (20/10)

Tuesday 4:00 – 6:00p Dearborn 2

gbXML

Sunday 5:00 – 6:00p Cresthill (3)

ISO/TC 86/SC 1/WG 1 (15) (Screen)

Wednesday (1/25) 9:00a – 5:00p Dearborn 1 (7)

Thursday (1/26) 9:00a – 5:00p Dearborn 1

Friday (1/27) 9:00a – 1:00p Dearborn 1

ISO/TC 142/WG 2 (30)

Monday 4:15 – 6:30p LaSalle 1 (7)

ISO/TC142/WG11 (8)

Tuesday 10:00 – 11:30a Marshfield (3)

US TAG to ISO/TC 142 (30/10) (Screen)

Saturday 2:30 – 3:15p Spire (6)

US TAG to ISO/TC 205 (20) (Screen)

Tuesday Noon – 2:00p Cresthill (3)

Policy for Scheduling TC/TG/SPC Meetings

TC and TG meetings will be automatically scheduled on the same day and time based upon the previous meeting schedule. Any changes to the time slot must be made in writing. All TC/TG subcommittees must be scheduled for each meeting. All SPC meetings must be confirmed prior to scheduling

Audiovisual equipment and electric for laptops must be ordered for each meeting and only advance orders will be guaranteed. LCD projectors are not available.

NOTE: The parenthesis beside each committee represent the number of people expected to attend the meeting and any audiovisual equipment ordered. We encourage you to order audiovisual equipment in advance, as we are unable to guarantee that equipment will be available on-site. Every effort is made to accommodate room size versus number of committee members. If you have not supplied the Conferences Department with the number of members on your committee or subcommittee, we have no basis for room assignments.

notes

ASHRAE STAFF

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Jamond Madison
Wayne Madkins
Lily Cheng

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Claire Neme

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Jan Young, Assistant Manager
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Mark Ames
Mark Wills

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Mark Owen, Handbook Editor
Heather Kennedy
Nancy Thysell

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Roxanne Jackson
Buyi Kalala
Kristi Baer
Amy Lin
Tom Cahill

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Fred Turner, Editor, ASHRAE Journal
Sarah Foster
Rebecca Matyasovski
Christopher Weems
Jeri Eader
Charlotte Tubbs
Chad Bedwell

Mailroom

Lamont Jackson

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Kim Fulcher

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Rhiannon Loomis,
Assistant Mgr., Membership
Jackie Roessler,
Assistant Mgr. Customer Service
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Andrean Crossman
Tracee Dowdell

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Beverly Fulks

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Technology

Claire Ramspeck, Director
Denise Latham
Lilas Pratt, Manager Special Projects
Bert Etheredge,
Asst. Mgr., Special Projects

SPEAKERS LIST

A

Abdelaziz, Omar, *Conference Paper Session 2*
Anderson, Thomas, *Seminar 21*
Andolsun, Simge, *Conference Paper Session 9*
Andrepoint, John S., *Conference Paper Session 23*
Arena, Lois B., *Conference Paper Session 17*
Athienitis, Andreas K., *Seminar 40*
Austin, George, *Seminar 10 and Seminar 38*
Aute, Vikrant, *Seminar 34*

B

Baker, Robert G., *Seminar 27*
Balbach, Chris, *Seminar 18*
Baltazar, Juan-Carlos, *Conference Paper Session 6*
Bansal, Pradeep, *Conference Paper Session 31*
Barnaby, Charles S., *Seminar 18 and Seminar 41*
Baumann, Oliver, *Conference Paper Session 7*
Bavan, Jeya, *Conference Paper Session 22*
Beausoleil-Morrison, Ian, *Seminar 44*
Becker, Henry A., *Conference Paper Session 23*
Behls, Herman, *Technical Paper Session 9*
Berlin, L. Gary, *Seminar 30*
Betz, Fred W., *Seminar 20*
Bobker, Michael F., *Seminar 5 and Seminar 27*
Bogen, Chris, *Seminar 12*
Bohanon, Hoy R., *Seminar 51*
Bolin, Robert, *Seminar 33*
Borrowman, Wayne, *Seminar 43*
Brambley, Michael R., *Conference Paper Session 14 and Seminar 5*
Brandt, Don, *Forum 4*
Braun, James E., *Seminar 40*
Brenner, Jacob, *Seminar 29*
Bridges, Barry B., *Seminar 52*
Britt, Monroe, *Forum 2*
Brooks, Bradley, *Seminar 52*
Brown, Norm, *Seminar 46*
Bryant, John, *Technical Paper Session 6*
Burns, Joseph E., *Seminar 38*
Bush, John, *Conference Paper Session 29*

C

Cabonargi, Erin Lavin, *Technical Plenary and Seminar 45*
Carlson, James A., *Forum 1*
Castelvecchi, John P., *Conference Paper Session 7*
Chang, Cheng, *Conference Paper Session 14*
Charneux, Roland, *Conference Paper Session 19*
Chen, Hui, *Conference Paper Session 10*
Claesson, Johan, *Conference Paper Session 25*
Cleland, Donald J., *Seminar 43*
Cohen, Jon J., *AHR Expo Session 1 and Conference Paper Session 23*
Coley, Steven E., *Seminar 1*
Colino, Mark P., *Conference Paper Session 12*
Coogan, Jim, *Conference Paper Session 21*
Coward, Chuck, *Seminar 39*
Cramm, Kelley P., *Seminar 42*
Cremaschi, Lorenzo, *Poster Session, Seminar 34, and Technical Paper Session 8*
Cullin, James R., *Poster Session*

D

Danks, Richard A., *Seminar 27*
Dave, Shreya, *Conference Paper Session 18*
Davies, Hywel, *Conference Paper Session 22*

Davis, Oliver, *Seminar 41*
Day, Tony, *Conference Paper Session 22*
Dean, Bill, *Technical Paper Session 1*
Debes, Gary C., *Conference Paper Session 29*
Delgoshaei, Payam, *Conference Paper Session 2*
Deru, Michael, *Technical Paper Session 3*
Dettmers, Daniel, *Seminar 43*
Dobbs, Gregory, *Conference Paper Session 16 and Seminar 45*
Duda, Stephen W., *Conference Paper Session 15*
Dukhan, Nihad, *Conference Paper Session 13*
Dwyer, Tim, *Conference Paper Session 22*
Dwyer, Annette, *Seminar 30*
Dzelzitis, Egils, *Seminar 2*

E

East, Bill, *Seminar 9*
Egan, Aileen Marie, *Conference Paper Session 9*
Eicker, Ursula, *Conference Paper Session 3*
Eldridge, David S., *Conference Paper Session 5*
Ellis, David, *Seminar 19*
Elneceve, Isaac, *Seminar 37*
Engelbrecht, Kurt, *Seminar 31*
Evans, Boyd, *Seminar 31*

F

Fahim, Zara, *Conference Paper Session 6*
Fallon, Kristine, *Seminar 12*
Faris, Gus, *Technical Paper Session 6*
Ferguson, Trudy, *Seminar 47*
Feucht, Alissa Nicole, *Conference Paper Session 7*
Feuser, Michael, *Conference Paper Session 12*
Field, Brandon S., *Conference Paper Session 14*
Fish, Amanda J., *Conference Paper Session 4*
Ford, Andy, *Conference Paper Session 22*
Foster, Birgitta, *Seminar 38*
Franconi, Ellen, *Seminar 28*
Freihaut, James, *Conference Paper Session 16*
Friedman, Glenn, *Seminar 41*
Fung, Alan S., *Poster Session*

G

Gagliano, Jerone Matthew, *Seminar 53*
Ganesh, Radha K., *Seminar 39*
Gangemi, Nick, *Conference Paper Session 1*
Garde, Francois, *Conference Paper Session 4*
Gardner, Peter B., *Conference Paper Session 8 and Seminar 54*
Ghia, Urmila, *Conference Paper Session 21*
Gibbs, Daniel, *Technical Paper Session 9*
Glanville, Paul, *Technical Paper Session 5*
Gray, Chris, *Seminar 15*
Grimsrud, David T., *Technical Paper Session 4*
Grist, Charlie, *Seminar 37*
Gupta, Amit, *Poster Session*

H

Hallenbeck, Michael D., *Conference Paper Session 13*
Hameyie, Eunice, *Conference Paper Session 11*
Hamlyn, David P. D., *Conference Paper Session 26*
Hart, Reid, *Conference Paper Session 29*
Hasebe, Hisashi, *Seminar 36*
Hawit, Omar, *Conference Paper Session 27*
Heckler, David, *Seminar 4*
Heiden, Rick M., *Conference Paper Session 15*
Hens, Hugo, *Poster Session*
Hensen, Jan, *Seminar 44*

Higgins, Jared A., *Conference Paper Session 10*
Hiller, Carl, *Technical Paper Session 5*
Hitchcock, Robert J., *Seminar 12*
Huang, Joe, *Seminar 28*
Hudon, Kate, *Technical Paper Session 1*
Hwang, Yunho, *Conference Paper Session 17, Seminar 35, Seminar 49, and Technical Paper Session 8*
Hydeman, Mark, *Seminar 18 and Conference Paper Session 25*

I

Idem, Stephen A., *Seminar 16*
Imano, Masashi, *Seminar 36*
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