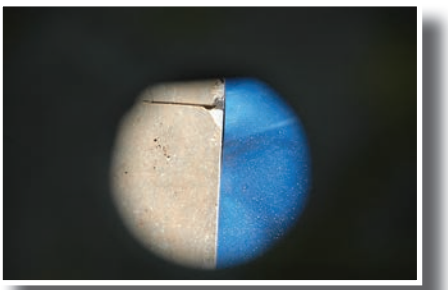
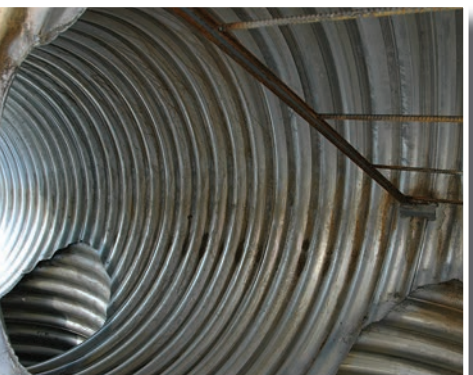
Your Guide to the

ASHRAE Annual Conference

JUNE 27 – JULY 1, 2015

ATLANTA





- Complete technical program
- Social events schedule
- All education courses
- Maps of meeting areas

Your Guide to the ASHRAE Annual Conference

June 27 – July 1, 2015

ASHRAE EVENTS APP

Update your ASHRAE App for the Annual Conference to access the full meeting agenda with venue floor plans, social events, and tips for your time in Atlanta. The event app also features exclusive registrant-only features like the BRAND NEW capability to view Virtual Conference presentations from your mobile device, a customizable personal schedule, an interactive attendee list, and digital speaker evaluations. The app is made possible through support from the following sponsor:

Get the free mobile app at: www.ashrae.org/app

PERSONAL PROGRAM—PLAN YOUR OWN MEETING SCHEDULE!

FRIDAY, JUNE 26	SATURDAY, JUNE 27	SUNDAY, JUNE 28
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
	7:00 pm–9:00 pm **Welcome Party** College Football Hall of Fame	3:00 pm–7:00 pm

NOTES:

PLAN YOUR OWN MEETING SCHEDULE!—PERSONAL PROGRAM

MONDAY, JUNE 29	TUESDAY, JUNE 30	WEDNESDAY, JULY 1
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** Atlanta Hilton Grand Ballroom A/B, 2nd floor	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–10:00 pm **Members' Night Out** Atlanta Hilton Grand Ballroom A/B, 2nd floor	

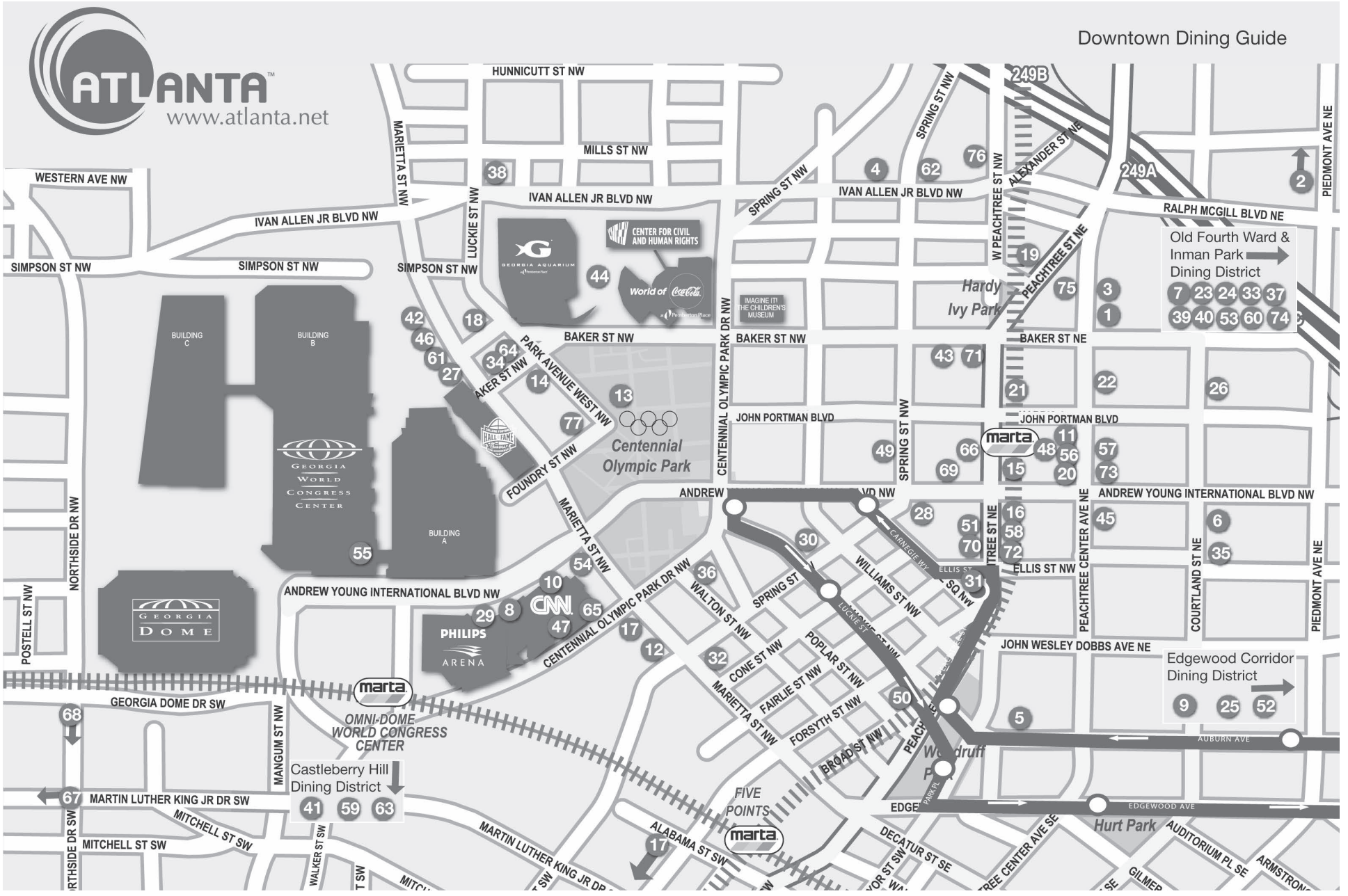
Downtown Atlanta Dining Guide

Restaurants	Number on Map	Phone Number
Asian		
Pacific Rim Bistro $$	1	404.893.0018
Poor Calvin's $$	2	404.254.4051
American/New American		
Big Kahuna $	3	404.644.0909
BLT Steak (W Hotel Downtown) $$$	4	404.577.7601
Carnegie's Restaurant $	5	404.588.0332
Collage (Sheraton Hotel) $	6	404.659.6500
Copenhill Café (The Carter Center) $	7	404.420.5136
Dantanna's $$	8	404.522.8873
Drafting Table, The $	9	404.343.2821
Fandangles Restaurant & Martini Bar (Sheraton) $$	6	404.659.6500
Fresh To Order $	10	404.390.1200
Gibney's $	11	404.688.0928
Glenn's Kitchen (The Glenn Hotel) $$	12	404.469.0700
Googie Burger $	13	404.223.5664
Great American Cookies - Centennial Olympic Park	14	404.458.2759
Hard Rock Café $	15	404.688.7625
Hooters $	16	404.522.9464
Hudson Grille $	17	404.221.0102
Johnny Rockets $	18	404.525.7117
Max Lager's American Grill & Brewery $	19	404.525.4400
Metro Café Diner $	20	404.577.1420
Polaris (Hyatt Regency Atlanta) $$	21	404.640.6425
Pulse (Marriott Marquis) $	22	404.521.0000
Rathbun's $$$	23	404.524.8280
Serpas True Food $$	24	404.688.0040
Shed at Glenwood $	25	404.835.4363
Southern Elements (Hilton Hotel) $$	26	404.659.2000
STATS $$	27	404.885.1472
Sun Dial (Westin Peachtree) $$$	28	404.589.7506
Taco Mac (Philips Arena) $	29	404.835.1192
Ted's Montana Grill $$	30	404.521.9796
The Terrace (Ellis Hotel) $$	31	404.523.5155
Thrive Restaurant $$	32	404.389.1000
TWO. urban licks $$	33	404.522.4622
Bar/Lounge		
GAME X $$	34	404.525.0728
Harlem Nights $$	35	678.927.9267
High Velocity (Marriott Marquis) $	22	404.586.6017
Livingroom (W Downtown) $$	4	404.582.5800
Lobby Bar (Westin Peachtree) $	28	404.659.1400
Park Bark $$	36	404.524.0444
Point of View (Hilton Atlanta) $	26	404.659.2000
Porter Beer Bar, The $	37	404.223.0393
SkyLounge (Glenn Hotel) $$	12	404.521.2250
Suite Food Lounge $$	38	404.577.1021
Twenty-Two Storys (Hyatt Regency) $$	21	404.577.1234
Brew Pub		
Wrecking Bar BrewPub $$	39	404.221.2600
Barbecue		
Fox Bros. Bar-B-Q $	40	404.577.4030
Smoke Ring $	41	404.228.6377
Twin Smokers Bar-B-Q $$	42	404.698.4707
Caribbean		
Trader Vic's (Hilton Atlanta) $$	26	404.221.6339
Coffee Shop/Desserts/Wine Bar		
Market Café (AmericasMart) $	43	404.220.2268
Marketplace (Hilton Hotel) $	26	404.659.2000
Pemberton Café $	44	404.525.6253
The Market (Hyatt Regency) $	22	404.577.1234

Restaurants	Number on Map	Phone Number
Dinner Theatre		
Agatha's- A Taste of Mystery $$$	45	404.584.2255
European		
Der Biergarten $$	46	404.521.2337
Food Courts		
CNN Center $	47	404.827.2491
Peachtree Center $	48	404.654.1265
Indian		
Haveli Indian Cuisine $	49	404.522.4545
NaanStop $	50	404.522.6226
Irish Pub		
Meehan's Public House $$	51	404.214.9821
Italian & Northern Italian		
Noni's Bar and Deli $	52	404.343.1808
Sotto Sotto $$	53	404.523.6678
International		
Nikolai's Roof (Hilton Hotel) $$$	26	404.221.6362
Prime Meridian (Omni Hotel) $$	54	404.818.4450
Terraces Restaurant & Lounge (GWCC) $$	55	404.223.4539
Japanese		
Benihana Restaurant $$	56	404.522.9627
Mediterranean		
Truva $$	57	404.577.8788
Mexican		
Alma Cocina $$	58	404.815.4700
No Mas! Hacienda & Cantina $$	59	404.574.5678
Pizza		
Fritti Restaurant $$	60	404.880.9559
Max's $	61	404.974.2941
Mellow Mushroom $	62	404.577.1001
Spin, The Spinning Pie Pizza Lounge $	63	404.880.0703
Seafood		
Legal Sea Foods $$	64	678.500.3700
McCormick & Schmick's $$	65	404.521.1236
Ray's in the City $$	66	404.524.9224
Soul Food		
Busy Bee Café $	67	404.525.9212
Southern/New Southern		
Paschal's Restaurant $$	68	404.525.2023
Pittypat's Porch $$	69	404.525.8228
Sway (Hyatt Regency) $$	21	404.577.1234
Sweet Georgia's Juke Joint $$	70	404.209.0907
White Oak Kitchen & Cocktails $$	71	404.524.7200
Steakhouse		
Atlanta Grill (Ritz-Carlton) $$$	72	404.221.6550
Cuts Steakhouse $$	73	404.525.3399
Kevin Rathbun Steak $$$	74	404.524.5600
Morton's Steakhouse $$$	75	404.577.4366
Room at Twelve Hotel $$$	76	404.418.1250
Ruth's Chris Steak House $$$	77	404.223.6500
Sear (Marriott Marquis) $$$	22	404.586.6134

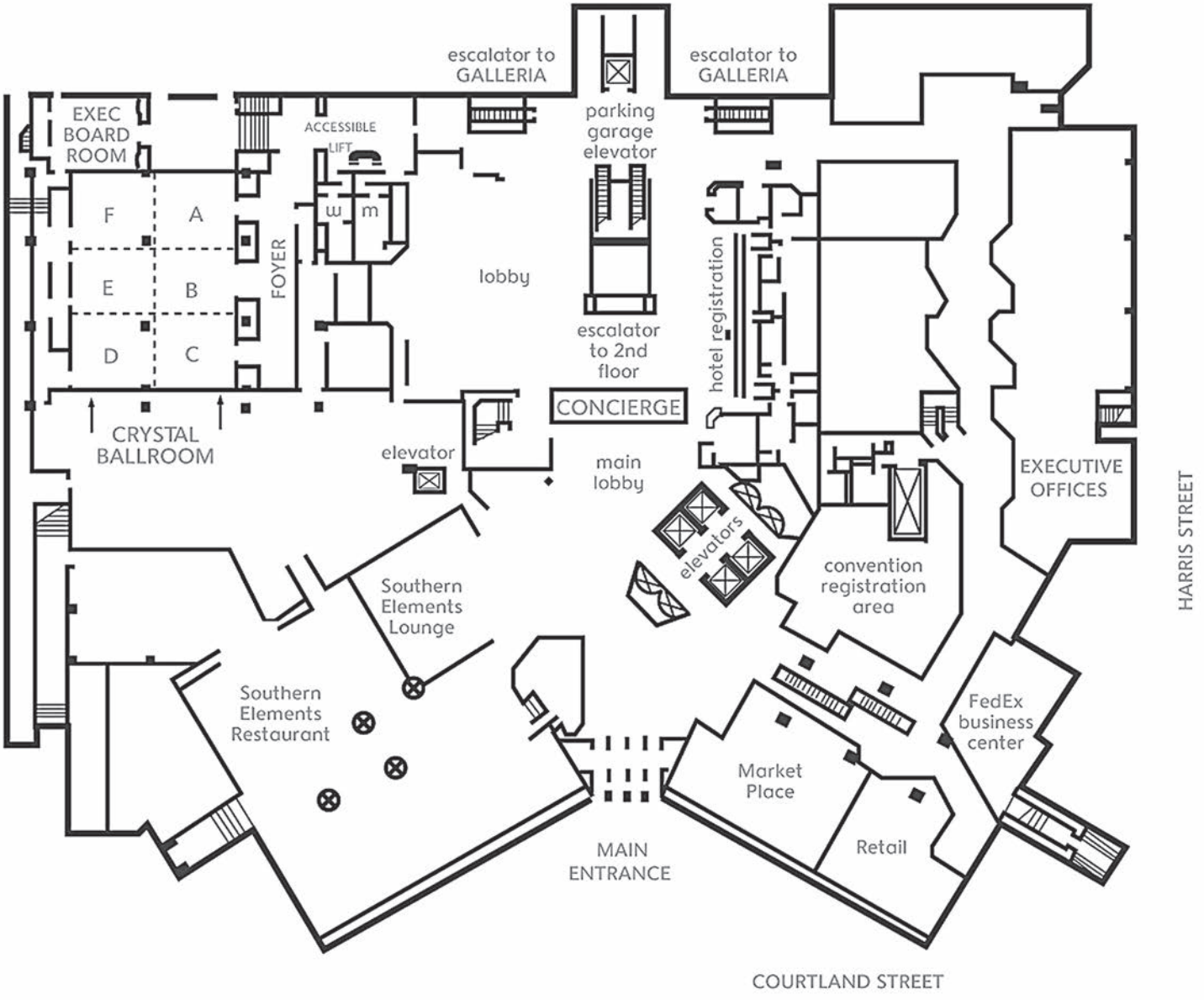
Average Entrée Price Legend

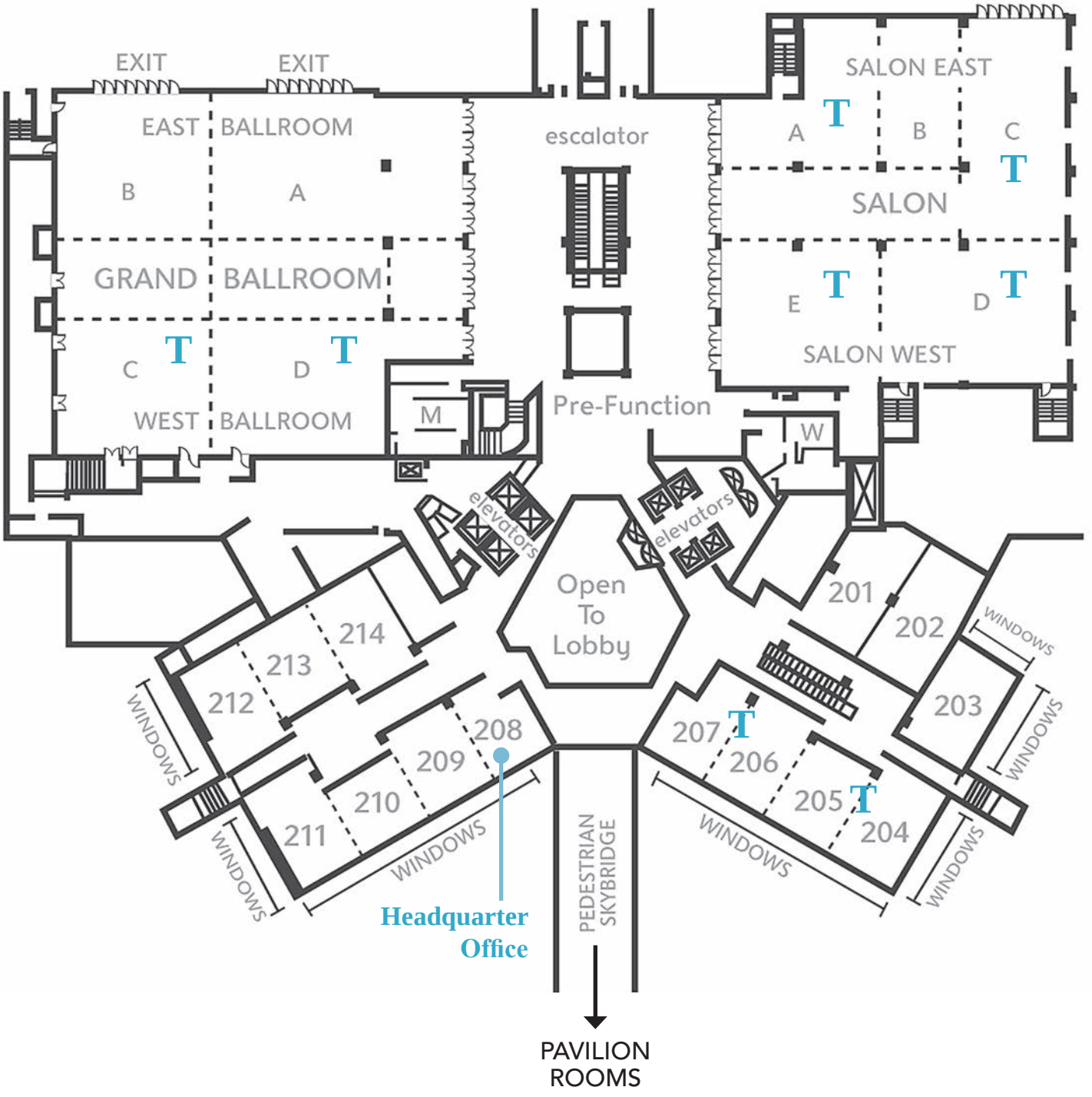
Casual Dining ($): Up to $15, Midpoint ($$): $15-$35, Fine Dining ($$$): $35+


ATLANTA
www.atlanta.net
Downtown Dining Guide
HUNNICUTT ST NW
MILLS ST NW
WESTERN AVE NW
IVAN ALLEN JR BLVD NW
SIMPSON ST NW
MARIETTA ST NW
LUCKIE ST NW
SPRING ST NW
ALEXANDER ST NE
249B
249A
PIEDMONT AVE NE
RALPH MCGILL BLVD NE
W PEACHTREE ST NW
PEACHTREE ST NE
Old Fourth Ward & Inman Park Dining District
BAKER ST NW
BAKER ST NE
CENTENNIAL OLYMPIC PARK DR NW
PARK AVENUE WEST NW
FOUNDRY ST NW
JOHN PORTMAN BLVD
Hardy Ivy Park
Centennial Olympic Park
CENTER FOR CIVIL AND HUMAN RIGHTS
GEORGIA AQUARIUM
World of Coca-Cola
IMAGINE IT! THE CHILDREN'S MUSEUM
BUILDING C
BUILDING B
BUILDING A
GEORGIA WORLD CONGRESS CENTER
GEORGIA DOME
PHILIPS ARENA
CNN
marta
ANDREW YOUNG INTERNATIONAL BLVD NW
NORTHSIDE DR NW
POSTELL ST NW
GEORGIA DOME DR SW
OMNI-DOME WORLD CONGRESS CENTER
MANGUM ST NW
Castleberry Hill Dining District
MARTIN LUTHER KING JR DR SW
MITCHELL ST SW
WALKER ST SW
ALABAMA ST SW
FIVE POINTS
DECATUR ST SE
MARTIN LUTHER KING JR DR
WALTON ST NW
SPRING ST
WILLIAMS ST NW
CONE ST NW
POPLAR ST NW
FAIRLIE ST NW
FORSYTH ST NW
BROAD ST NW
MARIETTA ST NW
CARNEGIE WY NW
ELLIS ST NW
PEACHTREE CENTER AVE NE
COURTLAND ST NE
JOHN WESLEY DOBBS AVE NE
Edgewood Corridor Dining District
AUBURN AVE
EDGEWOOD AVE
Hurt Park
AUDITORIUM PL SE
ARMSTRONG
GILMER
PEACHTREE CENTER AVE SE

HILTON ATLANTA

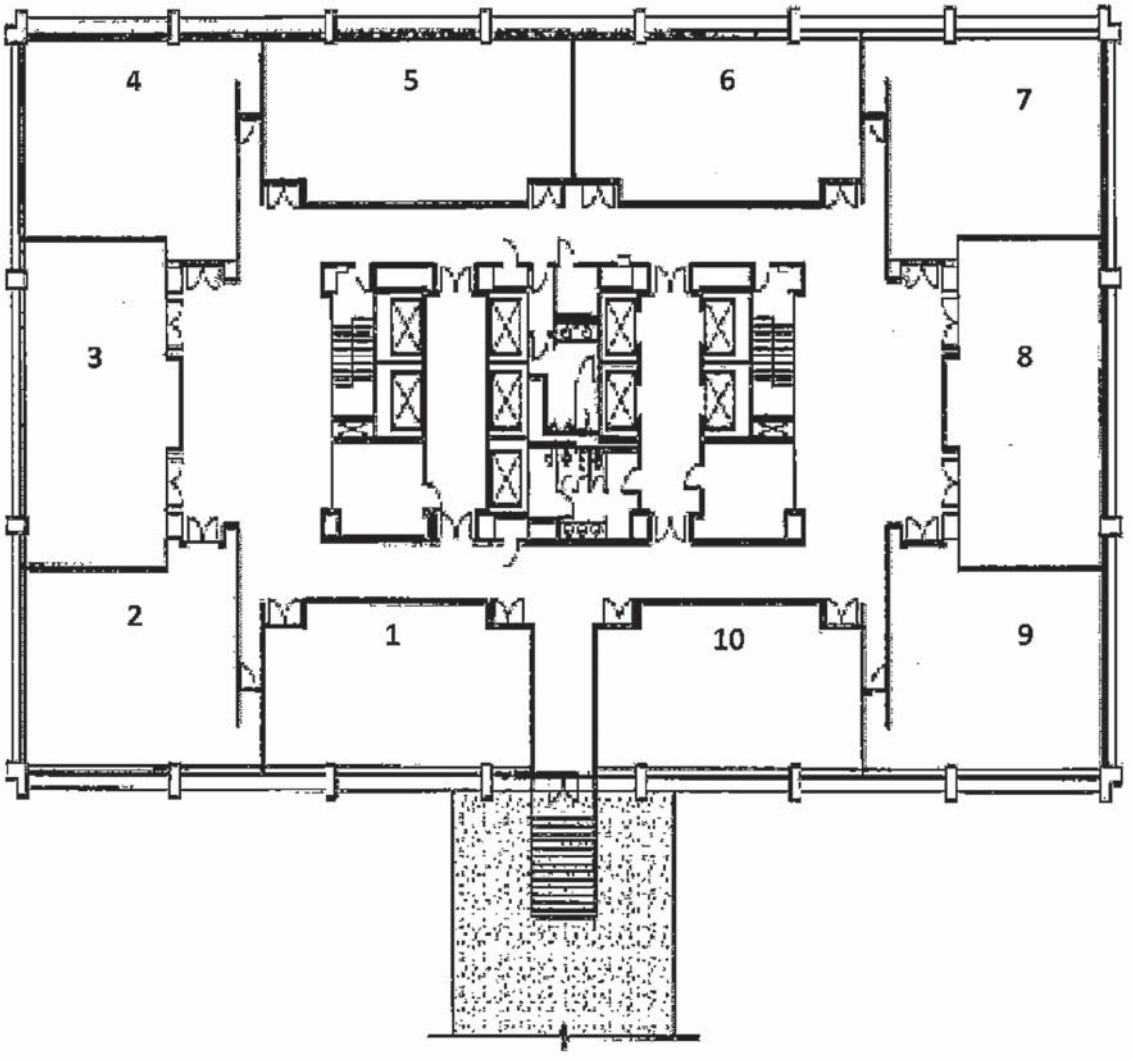
FIRST FLOOR



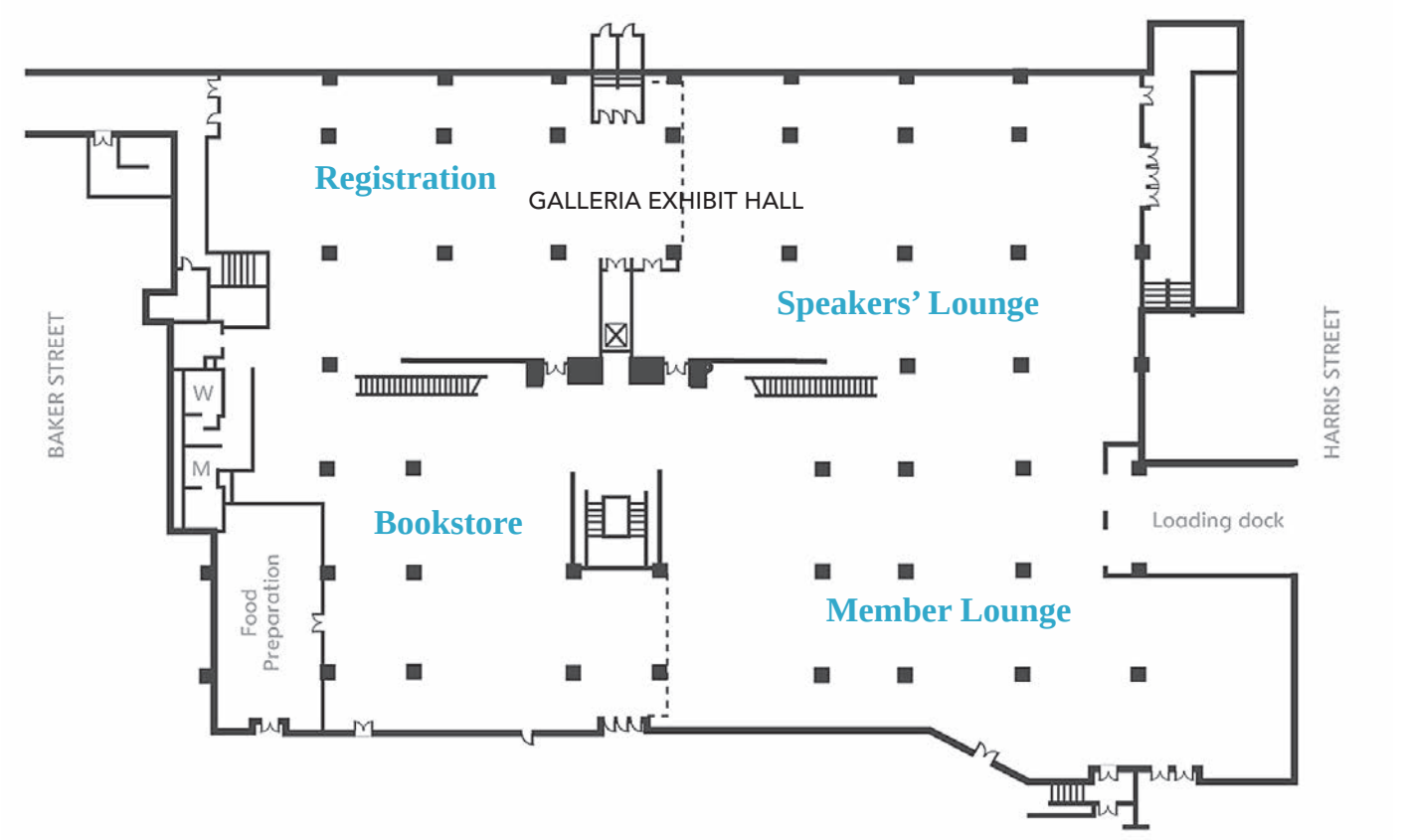


T = Technical Sessions

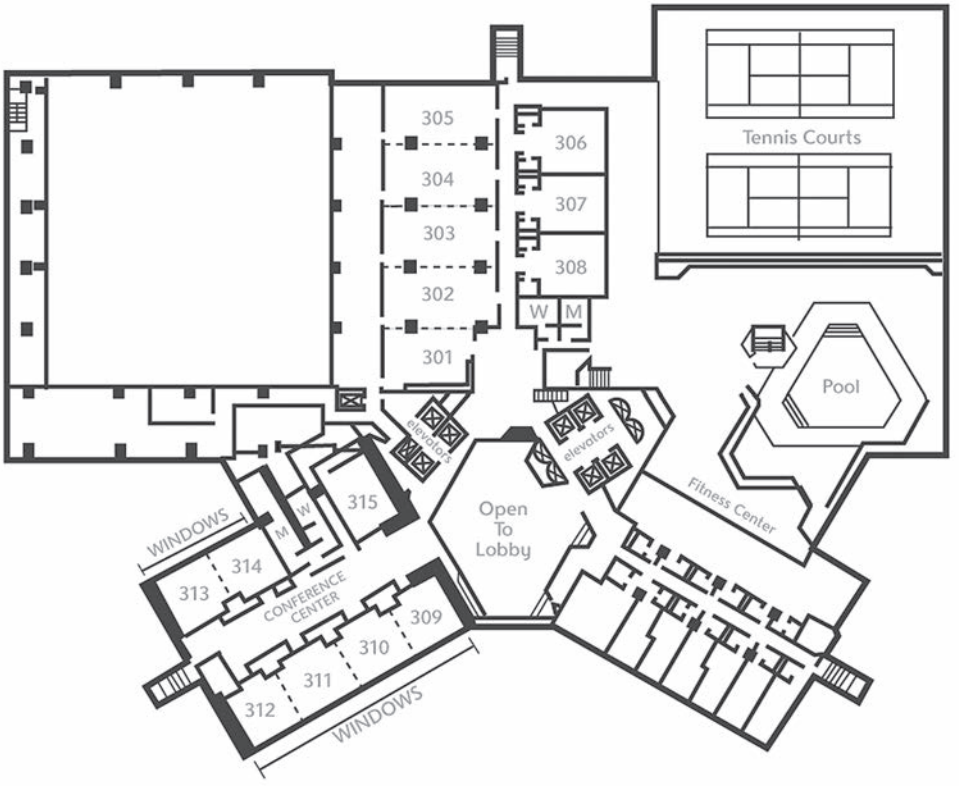
Floor 2. You must cross the pedestrian skybridge to get to the Pavilion Space.



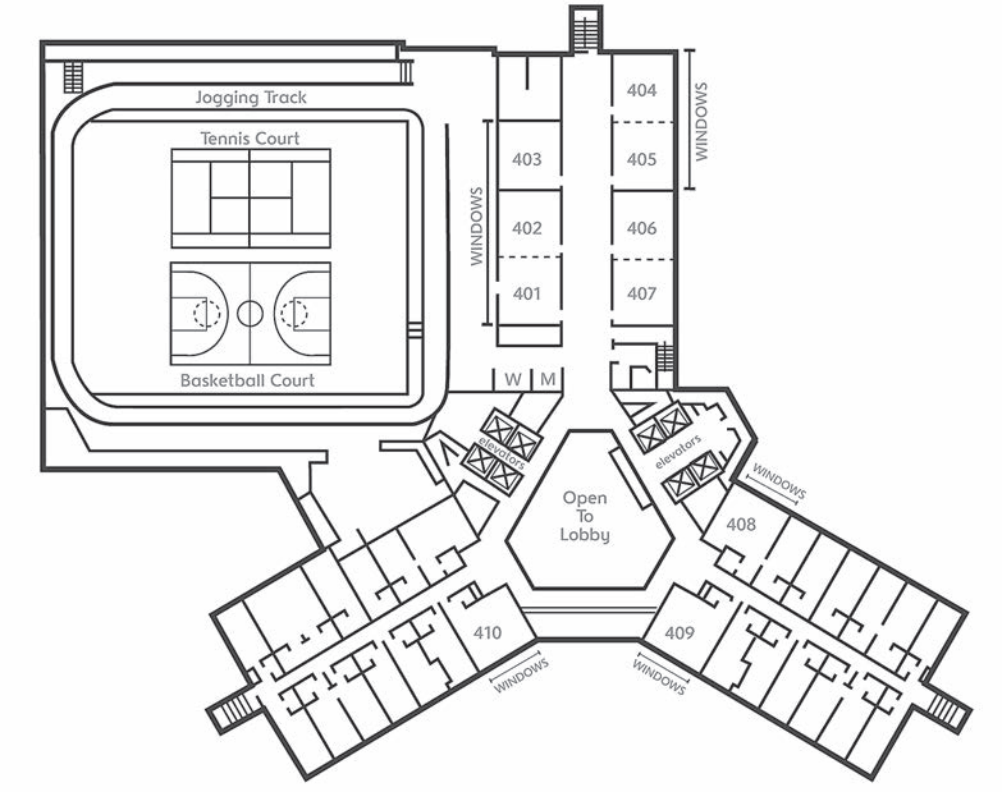
HILTON ATLANTA
LOWER LEVEL



HILTON ATLANTA
THIRD FLOOR



HILTON ATLANTA
FOURTH FLOOR



CONFERENCE SPONSORS

ASHRAE thanks the following sponsor for their support of the 2015 Atlanta Conference

CHAPTER AND SOCIETY OFFICIALS

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

ATLANTA CHAPTER OFFICERS

President, Brian Justice
President-Elect, John Pruitt
Secretary, Ignatius Nicholas Kassanis
Treasurer, Richard Dustin

ATLANTA HOST COMMITTEE

General Chair, Pam Immekus
Honorary Chair Posthumously, James Lang
Co-Chair, Peggy Fritz
Sessions, Ben Coe
Entertainment, Tom & Weesie Kisgen, Bruce Longino, Wayne Schweitzer
Hospitality, Mike Eckert
Tours, Henry Slack, Caroline Calloway, Harris Sheinman
Information/Publicity, Dominic Radosta

ASHRAE Officers

Thomas H. Phoenix, P.E., President
T. David Underwood, P.Eng., President-Elect
Timothy G. Wentz, Treasurer
Darryl K. Boyce, P.Eng., Vice President
Charles E. Gulledge III, Vice President
Bjarne W. Olesen, Ph.D., Vice President
James K. Vallort, Vice President
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Andrea Zarour
Dennis Alejandro, Consultant
Michael J. McDermott, Consultant

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. Session and speaker evaluations are available through the event app. In addition, 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 in the technical paper sessions. Questions are given to the authors for reply and published in ASHRAE Transactions.

HOTEL ADDRESS, TELEPHONE

Hilton Atlanta
255 Courtland Street, NE
Atlanta, GA 30303
(404) 659-2000

INTERNET ACCESS

Internet access and computers for e-mail are 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.

Internet is also available complimentary in your sleeping room in the Hilton. Access code is: **ASHRAE2**

Wireless internet will be available in all meeting rooms at the Hilton. ASHRAE will be working with the internet provider to manage the bandwidth so that member expectations of accessibility and speed are fulfilled. We would like to request that everyone limit their usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming video, etc.

Follow the instructions below to create your personal Internet account. Access Code: **ASHRAE2015**
Valid for: June 25 – July 1, 2015

How to connect in Hilton Atlanta Meeting Rooms:

1. Plug-in the Ethernet cable or turn on and enable your Wireless LAN (Wi-Fi) adapter on your computer/device.
2. If you are using a wired connection, verify you have a link light on your adapter.
3. If you are using a wireless connection, search and select the wireless network (SSID) for “Hilton-Meeting” location. Your wireless adapter should show “Connected”.
4. Launch your Internet browser, go to a public Internet page (i.e. www.google.com) and you should be redirected to the guest login page.
5. Enter the “Access Code” provided above in the appropriate field on the login page.
6. Accept the Terms (if applicable) and click the Connect Now button to login.
7. You should be redirected to your home page and are now connected to the Internet.
8. If you experience any problems connecting, dial 61 from a house phone and ask for PSAV Event Technology

CONFERENCE APP

Update your ASHRAE App for the Annual Conference to access the full meeting agenda with venue floor plans, social events, and tips for your time in Atlanta. The event app also features exclusive registrant-only features like the BRAND NEW capability to view Virtual Conference presentations from your mobile device, a customizable personal schedule, an interactive attendee list, and digital speaker evaluations.

MEMBERSHIP BALLOT

Eligible Members will have the opportunity to cast online ballots for Society officers in the conference registration area (Hilton, Galleria Exhibit Hall, Lower Level). Polls will be open during registration hours on Friday, June 26 through Sunday, June 28 at 5:00 p.m. EDT. New Officers and Directors will be installed at the President’s Luncheon on Monday, June 29.

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 in technical program sessions.

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 Atlanta 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.

PHOTO RELEASE

Photographs will be taken at the ASHRAE Annual 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

Business-casual attire is appropriate for meetings and social events. The Welcome Party is casual. Everyone is encouraged to wear your favorite college jersey. Members’ Night Out is also casual.

LOST AND FOUND

Items found during the conference should be turned into the staff in the ASHRAE headquarters room, 208/209 of the Hilton or ASHRAE registration in the Galleria Exhibit Hall. If you have misplaced something during the conference please check these two locations as well as security with the hotel.

TECHNICAL PROGRAM PDHs

All of the sessions presented in the technical program are approved for professional development hours (PDHs). PDHs recognized by most U.S. states, AIA LUs and LEED®AP credits are available. In order to report your attendance at the session, please sign the PDH sign-in sheets that are in each room and include your license number for Florida. See program listing for specific information. Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session. ASHRAE Certified Professionals may earn Professional Development Hours (PDHs) to meet recertification requirements by attending Tech Program sessions in a content area related to their certification. Send questions to certification@ashrae.org.

Badges are required for attendance at any of the technical sessions. Scanners will be used to capture the information located on your badge. Upon conclusion of the conference you will be able to get a complete record of all the sessions you attended.

CONFERENCE PAPERS

Abstracts of all sessions are included in this program. During the conference, papers presented at the technical paper and conference paper sessions can be purchased in the ASHRAE Bookstore as individual preprints or on the 2015 ASHRAE Annual Conference Papers (online). After the conference, papers will be posted in the online ASHRAE Bookstore. Papers are not available for seminars or forums. Technical paper session papers will be published with discussion in ASHRAE Transactions. Prior meeting papers can be purchased in the online Bookstore at www.ASHRAE.org or searched online in Abstract Center. The Abstract Center is 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 Atlanta 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 will receive an email notification when sessions are available for viewing. The email will include a link to the Atlanta Virtual Conference. If you do not have your password, go to www.ashrae.org/Atlantaonline 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 from all technical paper sessions, conference paper sessions, seminars and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.

Ability to post questions or answers for selected sessions through Wednesday, July 8. Presentations available online through January 2017.

A full slate of technical programs will be posted beginning Monday, June 29, of the sessions that were presented the previous day, with additional content posted through Thursday, July 2.

Access to the Atlanta Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration, Hilton Galleria Exhibit Hall. $249 ASHRAE member; $445 non member or register online.

MEMBERS' NIGHT OUT RESERVED SEATING

Hilton, Grand Ballroom A/B, second floor

Members' Night Out will be in the Atlanta Hilton on Tuesday, June 30. If you have purchased a ticket for this event, you will receive an exchange coupon. Take this coupon to the Reserved Seating desk, located in the ASHRAE registration and exchange it for a reserved seat ticket by 2:00 p.m., Monday, June 29. Each table seats ten. A seating chart is available to help in deciding table preference. Seats are available on a first come, first served basis. When reserving your seat, please advise us of any special dietary requirements at that time to ensure that we are able to accommodate your requests during the evening. Attire is casual.

Detailed information on the entertainment for Members' Night Out is located in this program.

MEDICAL EMERGENCY

Medical emergencies should be directed to the hotel operator.

Closest Hospital:
Emory University Hospital
550 Peachtree St, Atlanta 30308
(404) 686-4411
Distance from Hotel: 0.6 miles
Approximate Travel Time: 12 Minutes

AWARDS PRESENTATION

Saturday, June 27, 3:15-5:30 p.m.
Plenary Session, Grand Ballroom A/B

LINCOLN BOUILLON AWARD

"Given in recognition of outstanding work in increasing the membership of the Society."

Gregory A. Schnable, Rocklin, CA
Sacramento Valley Chapter

CHAPTER PROGRAM STAR AWARD

"Given in recognition of excellence in chapter program endeavors."

William P. Lee, P.E., Honolulu, HI
Hawaii Chapter

WILLIAM J. COLLINS, JR. RP AWARD

"Given in recognition of the chapter RP Chair who excels in raising funds for ASHRAE's RP Campaign."

Robert C. Kunkel, P.E., Tucson, AZ
Tucson Chapter

RALPH G. NEVINS PHYSIOLOGY AND HUMAN ENVIRONMENT AWARD

"Given to a promising investigator for significant accomplishment in the study of physiology and human response to the environment."

Zhecho Dimitrov Bolashikov, Ph.D., Kongens Lyngby, Denmark
Sub-Region B

HOMER ADDAMS AWARD

"Given in recognition of a graduate student who has been engaged in an ASHRAE research project."

Limin Zhou, Ph.D., Pittsburgh, PA
Pittsburgh Chapter

ENVIRONMENTAL HEALTH AWARD

"Given in recognition of excellence in volunteer service focused on environmental health issues"

John D. Spengler, Ph.D., Boston, MA
Boston Chapter

GOVERNMENT ACTIVITIES AWARD

"Given in recognition to an individual for outstanding effort and achievement in state, provincial, and local government activities in connection with technical issues important to the Society."

Ross D. Montgomery, P.E., Parrish, FL
Florida West Coast Chapter

Robert Craddock, Regina, SK, Canada
Regina Chapter

STUDENT ACTIVITIES ACHIEVEMENT AWARD

"Given to a Chapter Student Activities Chairman for service related to the goals and growth of student activities at all levels."

Adam Parker, Charlotte, NC
Southern Piedmont Chapter

2014 TECHNICAL PAPER AWARD

"Given in recognition of the best paper presented at a Technical Paper Session at a Society Conference in 2014"

Limin Zhou, Ph.D., Pittsburgh, PA; **David W. Herrin, P.E., Ph.D.,** Lexington, KY; **Tianxiang Li,** Lexington, KY for authoring *"A Design Approach for Preventing and Solving Combustion Oscillation Problems"*

Tami M. Brandl, Ph.D., Clay Center, NE; **Morgan D. Hayes**, Urbana, IL; **Hongwei Xin,** Ames, IA; **John A. Nienaber, P.E., Ph.D.,** Clay Center, NE; **Hong Li**, Newark, DE; **Roger A. Eigenberg**, Clay Center, NE; **John P. Stinn, Ph.D.,** Ames, IA; **Timothy A. Shepherd**, Ames, IA for authoring *"Heat and Moisture Production of Modern Swine"*

Scott Bucking, Ph.D., Ottawa, ON, Canada; **Andreas Athienitis, Eng., Ph.D.,** Montreal, QC, Canada; **Radu Zmeureanu, Eng., Ph.D.,** Montreal, QC, Canada for authoring *"Multi-Objective Optimal Design of a Near Net Zero Energy Solar House"*

Yang Zou, Ph.D., Urbana, IL; **Hanfei Tuo**, Urbana, IL; **Pega S. Hrnjak, Ph.D. ,** Urbana, IL for authoring *"R410A Maldistribution Impact on the Performance of Microchannel Evaporator"*

POSTER PRESENTATION AWARD

"Given in recognition of the best Poster Presentation at each Winter and Annual Conference in 2014."

Limin Zhou, Ph.D., Pittsburgh, PA; **David W. Herrin*, P.E., Ph.D.,** Lexington, KY**; Tianxiang Li,** Lexington, KY., for authoring *"A Design Approach for Preventing and Solving Combustion Oscillation Problems"*

Presenter:* ***David W. Herrin, P.E., Ph.D.*

WILLIS H. CARRIER AWARD

"Given in recognition of the best paper presented at a Society Conference in 2014 by a member thirty-two years of age or less."

Morgan D. Hayes, Urbana, IL for co-authoring *"Heat and Moisture Production of Modern Swine"*

ASHRAE JOURNAL PAPER AWARD

"Given in recognition of the best article published in the ASHRAE Journal in 2014."

Paul Lindahl, Overland Park, KS
Kansas City Chapter

CROSBY FIELD AWARD

"Given in recognition of the highest rated paper presented at a Technical Session or Symposium in 2014."

Didier Thevenard, Ph.D., P.Eng., Kitchener, ON, Canada, and **Mark W. Shephard,** East Gwillimbury, ON, Canada for authoring *"Temperature Trends for Locations Listed in the Tables of Climatic Design Conditions in the 2013 ASHRAE Handbook - Fundamentals"*

DISTINGUISHED FIFTY-YEAR MEMBER AWARD

"Given in recognition of fifty years of membership and performing outstanding service for the Society."

Arthur G. Bendelius, P.E., Big Canoe, GA
Robert S. Burdick, P.E., Tucson, AZ
Paul N. Deltz, P.E., New Braunfels, TX
James H. Lang (presented posthumously)
Vincent D. Lee-Thorp, Great Falls, VA
Evans J. Lizardos, Mineola, NY
Ronald P. Vallort, P.E., Ponte Vedra Beach, FL

DISTINGUISHED SERVICE AWARD

"Given in recognition of faithful and distinguished service on behalf of the Society."

Devin A. Abellon, P.E., Phoenix, AZ
Raymond J. Albrecht, P.E., Westerlo, NY
Gary L. Berlin, Manheim, PA
Jeff Boldt, Madison, WI
J. Steven Brown, Washington, DC
Fabio Clavijo, P.E., Bogota, Colombia
Douglas Cochrane, P.Eng., Mississauga, ON, Canada
Alan P. Cohen, Des Plaines, IL
Charles W. Coward, P.E., Moorestown, NJ
Robert Craddock, Regina, SK, Canada
W. Stuart Dols, Gaithersburg, MD
H. Jay Enck, Duluth, GA
John Michael Filler, Jr., P.E., Pueblo, CO
William J. Fisk, P.E., Berkeley, CA
Paul W. Francisco, Champaign, IL
Thomas Arthur Gilbertson, P.E., Moraga, CA
Melvin G. Glass, P.E., El Paso, TX
Norman Grusnick, P.Eng., Surrey, BC, Canada
Lixing Gu, Ph.D., P.E., Merritt Island, FL
Susanna Hanson, La Crosse, WI
Philip Haves, Ph.D., Berkeley, CA
Jennifer A. Isenbeck, P.E., Tampa, FL
T. Randall Jones, Mount Pleasant, SC
Debra H. Kennoy, King of Prussia, PA
Kishor Khankari, Ph.D., Ann Arbor, MI
Thomas H. Kuehn, Ph.D., P.E., Minneapolis, MN
Josephine Lau, Ph.D., Omaha, NE
Cesar Luis DL. Lim, Paranaque City, Philippines
Chao-Hsin Lin, Ph.D., P.E., Redmond, WA
Itzhak Maor, Ph.D., P.E., Cherry Hill, NJ
Janice K. Means, P.E., Bloomfield Hills, MI
Paul W. Meisel, P.E., Dublin, OH
Harry M. Milliken III, Lewiston, ME
Stephen W. Nicholas, North Andover, MA
Paul T. Ninomura, P.E., Issaquah, WA
Darin W. Nutter, Ph.D., P.E., Fayetteville, AR
W. Vance Payne II, Ph.D., Gaithersburg, MD
Kenneth C. Peet, Louisville, KY
Ashish Rakheja, Uttar Pradesh, India
Brian L. Reynolds, La Crosse, WI
John M. Talbott, P.E., Baltimore, MD
Adrienne Thomle, Reno, NV
Paolo Tronville, Ph.D., Torino, Italy
Edward Tsui, Wan Chai, Hong Kong
Filza H. Walters, Livonia, MI
Richard Decker Watson, Old Saybrook, CT
William A. Webb, P.E., Brooksville, FL
David P. Wilson, Ph.D., East Amherst, NY
Douglas F. Zentz, Big Rapids, MI

EXCEPTIONAL SERVICE AWARD

"Given in recognition of faithful service with exemplary effort on behalf of the Society, in excess of that required for the Distinguished Service Award."

Donald L. Brandt, Phoenix, AZ
Steven Emmerich, Gaithersburg, MD
Paul W. Francisco, Champaign, IL
Charles E. Gulledge III, P.E., Greensboro, NC
John Hogan, P.E., Seattle, WA
Ira G. Poston, Burlington, NC
Mick Schwedler, P.E., La Crosse, WI
M. Ginger Scoggins, P.E., Cary, NC
Vincent Tse, R.P.E., C.Eng., Kowloon Bay, Hong Kong
Timothy G. Wentz, P.E., Lincoln, NE
Thomas Werkema, Louisville, TN

ANDREW T. BOGGS SERVICE AWARD

"Given to a past Exceptional Service Award recipient in recognition of continuing, unselfish, dedicated and distinguished work on behalf of the Society."

Bill Harrison, Little Rock, AR

LOUISE AND BILL HOLLADAY DISTINGUISHED FELLOW AWARD

"Given to a Fellow of the Society in recognition of continuing preeminence in engineering or research work."

Raymond Cohen, Ph.D., P.E.
Valparaiso, IN

ROOMS/HOURS

FINDING YOUR ASSIGNED MEETING ROOM

To assist you in finding your meeting room at the Annual Conference, please refer to the floor plans located in this program. Meeting space is located in the Atlanta Hilton.

CONFERENCE REGISTRATION

Hilton, Galleria Exhibit Hall, Lower Level

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

Friday, June 26 . . . . . 10:00 a.m. – 5:00 p.m.
Saturday, June 27 . . . . . 7:15 a.m. – 6:00 p.m.
Sunday, June 28 . . . . . 7:00 a.m. – 5:00 p.m.
Monday, June 29 . . . . . 7:30 a.m. – 5:00 p.m.
Tuesday, June 30 . . . . . 7:30 a.m. – 4:30 p.m.
Wednesday, July 1 . . . . . 7:30 a.m. – 10:15 a.m.

ASHRAE BOOKSTORE

Hilton, Galleria Exhibit Hall, Lower Level

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, June 26 . . . . . 10:00 a.m. – 5:00 p.m.
Saturday, June 27 . . . . . 7:15 p.m. – 6:00 p.m.
Sunday, June 28 . . . . . 7:00 a.m. – 5:00 p.m.
Monday, June 29 . . . . . 7:30 a.m. – 5:00 p.m.
Tuesday, June 30 . . . . . 7:30 a.m. – 4:30 p.m.
Wednesday, July 1 . . . . . 7:30 a.m. – 1:00 p.m.

ASHRAE's eLearning system, from the ASHRAE Learning Institute, will be demonstrated at the bookstore. Take a hands-on demonstration and learn more about new ways to earn PDHs/CEUs, on demand, online.

SPEAKER'S LOUNGE

Hilton, Galleria Exhibit Hall, Lower Level

The Speaker's Lounge will be open during the following hours:

Saturday, June 27 . . . . . 1:00 p.m. – 3:00 p.m.
Sunday, June 28 . . . . . 7:00 a.m. – 5:00 p.m.
Monday, June 29 . . . . . 7:00 a.m. – 12:15 p.m.
and 1:30 – 5:30 p.m.
Tuesday, June 30 . . . . . 7:00 a.m. – 5:00 p.m.
Wednesday, July 1 . . . . . 7:00 a.m. – 1:00 p.m.

PRESS ROOM

Hilton, Galleria Exhibit Hall, Lower Level

The Press Room will be open as follows:

Saturday, June 27 . . . . . 9:00 a.m. – 2:30 p.m.
Sunday, June 28 . . . . . 7:30 a.m. – 5:00 p.m.
Monday, June 29 . . . . . 7:30 a.m. – 11 a.m.
and 2:00 p.m. – 4:00 p.m.
Tuesday, June 30 . . . . . 7:30 a.m. – 4:00 p.m.

MEMBERSHIP DESK

Hilton, Galleria Exhibit Hall, Lower Level

The 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.

HEADQUARTER OFFICE

Hilton, Room 208/209, 2nd floor

The ASHRAE Headquarter office offers members complimentary copying, services of a typist and access to printers for laptop computers.

Friday, June 26 . . . . . Noon – 5:00 p.m.
Saturday, June 27 . . . . . 8:00 a.m. – 5:00 p.m.
Sunday, June 28 . . . . . 8:00 a.m. – 5:00 p.m.
Monday, June 29 . . . . . 8:00 a.m. – 5:00 p.m.
Tuesday, June 30 . . . . . 8:00 a.m. – 5:00 p.m.
Wednesday, July 1 . . . . . 8:00 a.m. – 1:00 p.m.

YEA ACTIVITY

Young Engineers in ASHRAE (YEA) Hospitality Suite
Nikolai's Roof – top floor of the Hilton

Attention young professional members age 35 and younger! You are invited to visit the YEA Hospitality Suite on Sunday, June 28, from 4:00 p.m. – 6:00 p.m. The suite offers social and networking opportunities and light refreshments will be served.

LEADERSHIP U

At each ASHRAE conference, the Leadership U program gives four future ASHRAE leaders the opportunity to shadow an ASHRAE Board member, providing a high level conference experience and unique networking opportunity. This program is operated by the Young Engineers in ASHRAE (YEA) Committee and more information can be found at www.ashrae.org/yea. The Leadership U participants for the 2015 ASHRAE Annual Conference are:

Lindsey King, Central Pennsylvania Chapter, Region III
Christine Reinders, Boston Chapter, Region I
Mitesh Kumar, Singapore Chapter, Region XIII
Kimberly Pierson, Charleston Chapter, Region IV

ASHRAE LOUNGE

Hilton, Galleria Exhibit Hall, Lower Level

The ASHRAE Lounge offers an opportunity to network with friends or stop for a cup of coffee between technical sessions. Coffee will be offered throughout the day and anyone who is registered for the conference is welcome in the lounge.

The lounge will be open to all registered attendees during the following hours:

Saturday, June 27 . . . . . 7:30 a.m. – 3:00 p.m.
Sunday, June 28 . . . . . 7:30 a.m. – 4:00 p.m.
Monday, June 29 . . . . . 7:30 a.m. – 4:00 p.m.
Tuesday, June 30 . . . . . 7:30 a.m. – 4:00 p.m.
Wednesday, July 1 . . . . . 7:30 a.m. – 1:00 p.m.

ATLANTA HOST COMMITTEE DESK

Hilton, Galleria Exhibit Hall, Lower Level

The Host Committee will have an information desk located near 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 Atlanta. The information desk will be open:

Friday, June 26 . . . . . 1:00 – 3:00 p.m.
Saturday, June 27 . . . . . 8:00 a.m. – 3:00 p.m.
Sunday, June 28 . . . . . 8:00 a.m. – 3:00 p.m.
Monday, June 29 . . . . . 9:00 a.m. – Noon

ORLANDO 2016 WINTER CONFERENCE INFORMATION

Hilton, Galleria Exhibit Hall, Lower Level

Information on the upcoming Winter Conference scheduled for January 23–27, 2016 at the Orlando Hilton will be available in the registration area. AHR Expo dates are January 25–27, 2016 and will be held at the Orange County Convention Center.

FUTURE ASHRAE CONFERENCES

2015

Sept. 30 – Oct. 2: **ASHRAE Energy Modeling Conference –** Atlanta, GA

Oct. 20 – 22: **AHR Expo Mexico –** Guadalajara, Mexico

2016

Jan. 23 – 27: **ASHRAE Winter Conference –** Orlando, FL

March 14 – 16: **6th International Conference on Energy and Research Development –** Kuwait

June 25 – 29: **ASHRAE Annual Conference –** St. Louis, MO

Aug/Sept: **ASHRAE Energy Modeling Conference**

Sept. 12 – 14: **ASHRAE IAQ 2016 Conference co-organized by AIVC –** Alexandria, VA

Sept. 22 – 23: **2nd International Conference on Efficient Building Design –** Beirut, Lebanon

Experience an ASHRAE conference first-hand!

www.ashrae.org/events

FUTURE ASHRAE MEETINGS

Winter	Date	Annual
Orlando January 23–27	2016	St. Louis June 25–29
Las Vegas January 28–February 1	2017	Long Beach June 24–28
Chicago January 20–24	2018	

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
Chicago	2012	San Antonio
Dallas	2013	Denver
New York	2014	Seattle
Chicago	2015	Atlanta

SCHEDULE

Location of Meetings

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

Conference schedule

FRIDAY, June 26

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 53–68.

10:00 am–5:00 pm **Registration,** Atlanta Hilton, Galleria, Lower Level

10:00 am–5:00 pm **ASHRAE Bookstore**, Atlanta Hilton, Galleria, Lower Level

SATURDAY, June 27

7:30 am–3:00 pm **ASHRAE Member Lounge,** Atlanta Hilton, Galleria, Lower Level

7:15 am–6:00 pm **Registration,** Atlanta Hilton, Galleria, Lower Level

7:15 am-6:00pm **ASHRAE Bookstore,** Atlanta Hilton, Galleria, Lower Level

9:00 am–2:30 pm **Press Room,** Atlanta Hilton, Galleria, Lower Level

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 53–68.

1:00 pm–3:00 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

Special Event

3:15 pm–5:00 pm **Meeting of the Members**

Plenary Session, Hilton, Grand Ballroom A/B, 2nd floor

Opening and Welcoming Remarks by ASHRAE President **Thomas H. Phoenix**

Welcome by Director and Chair, Region IV, **Ginger Scoggins**

Secretary's Report by Executive Vice President **Jeff H. Littleton**

Awards Presentation
See page 14 for details.

Special Event

7:00 pm–9:00 pm **Welcome Party**
College Football Hall of Fame

***Note:** $60 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. Shuttle service to the Hall of Fame will begin at 6:30 pm. Buses will be staged on the John Portman Blvd. street side of the hotel.

See page 23 for details.

SUNDAY, June 28

7:00 am–5:00 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

7:00 am–5:00 pm **Registration,** Atlanta Hilton, Galleria, Lower Level

7:00 am–5:00 pm **ASHRAE Bookstore**, Atlanta Hilton, Galleria, Lower Level

7:30 am–4:00 pm **ASHRAE Member Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–5:00 pm **Press Room,** Atlanta Hilton, Galleria, Lower Level

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 28–51.

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 53–68.

9:00 am-1:00 pm **Tour:** City Tour, CNN

12:15 pm-4:15 pm **Tour:** Historic Roswell

See descriptions on page 20.

Tours depart from John Portman Blvd. street side of the Hilton. If you exit the hotel from the lobby turn left. Tours will assemble in the lobby.

4:00 pm–6:00 pm **Young Engineers in ASHRAE (YEA) Networking Event,** Hilton, Nikolai's Roof located on the top floor of the hotel

***Attention members age 35 and younger—** You are invited to participate in the YEA Networking Event, offering social and networking opportunities.*

MONDAY, June 29

7:00 am–12:15 pm and 1:30 pm–5:30 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–5:00 pm **Registration,** Atlanta Hilton, Galleria, Lower Level

7:30 am–5:00 pm **ASHRAE Bookstore,** Atlanta Hilton, Galleria, Lower Level

7:30 am–4:00 pm **ASHRAE Member Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–11:00 am **Press Room,** Atlanta Hilton, Galleria, Lower Level

8:00 am– 5:30 pm **Technical Sessions**
See Technical Program on pages 28–51.

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 53–68.

Special Event

12:15 pm–2:00 pm **President's Luncheon**
(doors open at noon)
Grand Ballroom A/B, Hilton, 2nd floor

President-Elect **T. David Underwood**, presents his 2015-2016 presidential theme. Certificates of Appreciation will be presented to retiring Board members and the 2015–2016 Officers and new Board members will be installed. Spouses and guests are cordially invited to attend.

Note: *Ticket required and may be purchased at the ASHRAE Registration desk for $50.*

1:30 pm–5:30 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

2:00 pm–5:00 pm **Technical Tours:** Southface, Ponce City Market

2:00 pm–5:00 pm **Technical Tours:** Fox Theater

2:30 pm–5:30pm **Tour:** Buckhead the Beautiful

See descriptions on pages 20–21.

Tours depart from John Portman Blvd. street side of the Hilton. If you exit the hotel from the lobby turn left. Tours will assemble in the lobby.

2:00 pm–4:00 pm **Press Room,** Atlanta Hilton, Galleria, Lower Level

Regional Dinners
Sign up in ASHRAE registration area.

TUESDAY, June 30

7:00 am–5:00 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–4:30 pm **Registration,** Atlanta Hilton, Galleria, Lower Level

7:30 am–4:30 pm **ASHRAE Bookstore,** Atlanta Hilton, Galleria, Lower Level

7:30 am–4:00 pm **ASHRAE Member Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–4:00 pm **Press Room,** Atlanta Hilton, Galleria, Lower Level

8:00 am–4:45 pm **Technical Sessions**
See Technical Program on pages 28–51.

8:00 am–5:00 pm **Committee Meetings**
See listing on pages 53–68.

9:00 am–12:30 pm **Tour**: Atlanta Botanical Garden
See description on page 20.

Noon–1:30 pm **Life Members' Luncheon**
Hilton, Room 301, 3rd floor
Note: *Ticket required and may be purchased at the ASHRAE registration desk for $30.*

1:30 pm–3:30 pm **Technical Tour:** ASHRAE Headquarters

2:00 pm–5:00 pm **Technical Tour:** Georgia Institute of Technology

2:00 pm–5:30 pm **Tour**: World of Coca Cola

3:30 pm–5:30 pm **Technical Tour:** ASHRAE Headquarters
Tours depart from John Portman Blvd. side of the Hilton. If you exit the hotel from the lobby turn left. Tours will assemble in the lobby.

See descriptions on pages 20–22.

Special Event

6:15 –7:00 pm **Reception,** Atlanta Hilton**,** Grand Ballroom Foyer

7:15 –10:30 pm **Members' Night Out,** Grand Ballroom A/B, 2nd floor
Dinner and Entertainment

Note: *Ticket required and may be purchased at the ASHRAE registration desk for $60.*

See page 23 for details.

WEDNESDAY, July 1

7:00 am–1:00 pm **Speakers' Lounge,** Atlanta Hilton, Galleria, Lower Level

7:30 am–10:15 am **Registration,** Atlanta Hilton, Galleria, Lower Level

7:30 am–1:00 pm **ASHRAE Bookstore,** Atlanta Hilton, Galleria, Lower Level

7:30 am–1:00 pm **ASHRAE Member Lounge,** Atlanta Hilton, Galleria, Lower Level

8:00 am–12:30 pm **Technical Sessions**
See Technical Program on pages 28–51.

8:00 am–1:00 pm **Committee Meetings**
See listing on pages 53–68.

SPOUSE/GUEST GUIDE

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 Atlanta 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 Hilton, Galleria, Lower Level.

Location: Hilton, Galleria, Lower Level

Hours

Saturday, June 27 . . . . . 7:30 a.m. – 3:00 p.m.
Sunday, June 28 . . . . . 7:30 a.m. – 4:00 p.m.
Monday, June 29 . . . . . 7:30 a.m. – 4:00 p.m.
Tuesday, June 30. . . . . 7:30 a.m. – 4:00 p.m.
Wednesday, July 1 . . . . . 7:30 a.m. – 1:00 p.m.

GENERAL TOURS

Stand-by tour tickets will be distributed at ASHRAE registration 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 be prepared to pay by credit card at the bus. Tour tickets may be purchased at the ASHRAE registration desk, Hilton Galleria Exhibit Hall, Lower Level.

All tours depart from the John Portland Blvd. side of the Hilton. If exiting the hotel from the main lobby turn left.

City Tour, CNN

Sunday, June 28 • 9 a.m.-1 p.m.
Cost: $60

Discover why billions of people worldwide depend on CNN for news. Start by making a little news of your own during a behind-the-scenes tour of the worldwide headquarters for CNN, Headline News and CNN International. Journey into the heart of CNN Worldwide while getting an in depth look at global news in the making. Inside CNN Atlanta consists of a 55-minute guided walking tour offering guests behind-the-scenes views of the studios of CNN.

Along the way, attendees see downtown's soaring skyscrapers, midtown's Fox Theatre, the High Museum of Art and "The Dump," where Margaret Mitchell wrote Gone with the Wind. Drive by the shopping and entertainment district—Atlantic Station, the Georgia Tech campus and many Olympic venues. Guests will also see the Georgia Aquarium, World of Coca-Cola and Centennial Olympic Park.

Then, enjoy a driving tour of Sweet Auburn Avenue, the first, and for a long time the most thriving black business district in the south and important landmark of the Civil Rights Movement. At the end of this exciting day, guests will understand what Atlanta is all about!

Historic Roswell

Sunday, June 28 • 12:15-4:15 p.m.
Cost: $65

Attendees visit two fascinating historical homes in Roswell. First stop is Barrington Hall, recognized by Atlanta Magazine as one of Metro Atlanta's Most Beautiful Homes. It is known nationally as one of the most outstanding examples of Greek Revival style architecture.

The second home is Bulloch Hall. This 1853 home is a great example of temple form architecture and it is filled with interesting presidential history.

After having toured these homes and their lovely grounds, attendee have some free time to meander through Historic Roswell—a most charming and unique shopping and dining district. This quaint setting includes an eclectic combination of antique shops, crafts, art galleries and boutiques for your guests to explore to their hearts content. Attendees may enjoy lunch on their own at one of the many local restaurants. The historic homes are Americans with Disability Act accessible on the first floor only.

Buckhead the Beautiful

Monday, June 29 • 2:30-5:30 p.m.
Cost: $55

The tour begins with a drive through the exclusive West Paces Ferry area of Atlanta, also known as the "Beverly Hills of the South." It is home to some of America's most famous residents. Attendees also enjoy driving by the Governor's Mansion, the official home of Governor Nathan Deal. Next, explore Atlanta's colorful past in further detail at the fascinating Atlanta History Center. After exploring the many exhibits, guests may stroll through the Tullie Smith House and Farm. A plantation house built in the 1840s by the Robert Smith family.

The final stop will be a tour of the elegant Swan House Mansion. This famous home is one of the many Atlanta filming locations of "The Hunger Games: Catching Fire." No location looks more splendid on screen than the Swan House, built for prominent Atlantans Emily and Edward Inman in 1928. The Philip T. Shutze designed masterpiece served as the site for spectacular party scenes showcasing the exterior of the house. During the tour of the home, attendees can spot details such as the iconic swans in the dining room in scenes featuring the nefarious President Snow (Donald Sutherland) and scheming Plutarch Heavensbee (Philip Seymour Hoffman). The Atlanta History Museum is Americans with Disability Act accessible, but not the Tullie Smith House.

Atlanta Botanical Garden

Tuesday, June 30 • 9 a.m.-12:30 p.m.
Cost: $60

The Atlanta Botanical Garden is composed of 15-acres of formal gardens including specialty gardens such as Herb, Japanese, Rose, Woodland Shade, Orchid and more. Their 16,000 square feet Fuqua Conservatory contains indoor exhibits of rare and endangered plants from tropical rainforests and deserts. Adjoining this building, the Orchid Center is home to the largest collection of orchids on permanent display in the United States.

World of Coca Cola

Tuesday, June 30 • 2-5:30 p.m.
Cost: $55

The tour begins with a city tour on the way to the Coca-Cola Museum, with details shared about the city of Atlanta.

Once at the World of Coca-Cola, attendees can see, hear and taste the magnificent story of the world's most popular soft drink at the New World of Coca-Cola. It's a truly unique experience that encompasses the rich history and progress of the refreshing beverage created in Atlanta in 1886.

Tour the entire World of Coca-Cola facility. Visit the Pop Culture Gallery with one of a kind artwork by such luminaries as Andy Warhol and Norman Rockwell or create your very own piece of pop art! Delight in the 4-D Theatre and see the actual Bottle Works in progress. Stand in the presence of the actual secret formula of the world's most favorite beverage. Enjoy the ultimate tasting experience as you taste all the Coca-Cola flavors from around the globe and take a souvenir bottle home with you!

TECHNICAL TOURS

Stand-by tour tickets will be distributed at ASHRAE registration 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 be prepared to pay by credit card at the bus. Tour tickets may be purchased at the ASHRAE registration desk, Hilton Galleria Exhibit Hall, Lower Level.

All tours depart from the John Portland Blvd. side of the Hilton. If exiting the hotel from the main lobby turn left.

Fox Theatre

Monday, June 29 • 2 p.m.-5 p.m.
Cost: $30

If you've ever wondered what hidden treasures and stories lie behind the glowing marquee of the Fox Theatre in Atlanta, now is your chance to discover it all.

Attendees enjoy a guided tour showcasing the must-see details of the Fox and its remarkable history. Entering through the same entrance as patrons did in 1929, visitors tour locations throughout the building – from the orchestra pit and Mighty Mo', the largest working Moller theatre organ in the world to the Men's Lounge featuring the original furniture chosen by the wife of movie-mogul William Fox. They will also learn the incredible story of how Atlanta citizens rose up to save a landmark from the wrecking ball while walking the very same halls as Elvis, The Rolling Stones and Madonna.

One simple fact that makes the Fox Theatre so unique is that it was commissioned and built by the Shriners with the intention to build their own Mosque in Atlanta. Every room reflects inspiration from ancient Egypt and the Middle East – from the authentic hieroglyphics on the ceiling in the Egyptian ballroom to the auditorium designed to look like an open courtyard of a Middle Eastern palace. Despite its intricate detail from floor to ceiling, the building only took 18 months to complete from start to finish.

The air-conditioning system for the facility is as unique and historical as the theatre. The Fox Theatre was one of the first buildings in Atlanta to have air conditioning.

The original air conditioning system was an ammonia refrigeration and air washer system, which began service in 1929 when the Fox Theatre opened. That system was updated in 1946 with the provision of a 300-ton centrifugal water chiller to provide chilled water to the air wash system. The new chiller was the most up-to-date technology at that time. The 1946 chiller remains serviceable today as a back-up source of chilled water for a new water chiller installed in 2010, which is now the main source of chilled water. The air wash system has been retired in place and a chilled water coil has been added to the built-up air handling system. Outside air capability was added to this system to facilitate a positive building pressure and eliminate the issues previously experienced with negative building pressure. This system is designed to operate at a very low fan RPM to minimize the possibility for noise transmission into the theatre. The 7-foot diameter fan sheave was also replaced in 2010; the new sheave was delivered to the site in two pieces to accommodate movement into the mechanical equipment room.

Southface Eco Office and Ponce City Market

Monday, June 29 • 2-5 p.m.
Cost: $30

Southface Eco Office:
Located in downtown Atlanta, the award-winning Southface Eco Office officially opened in August 2009. A visionary project, it brought together more than 200 organizations, many of which are competitors, to collaborate on its design and construction, and to contribute products, services and capital. The vision for the Eco Office was to create a model of environmentally responsible construction while demonstrating that green commercial buildings create healthy, productive workplaces that are also operationally cost effective. To this end, the Eco Office consumes 84 percent less water and 53.3 percent less energy than comparably sized buildings, fulfilling its mission and, we believe, making it one of the most sustainable small commercial buildings in the world.

Ponce City Market Tour:
Ponce City Market is pursuing a LEED Core & Shell Silver certification in the two-million-square-foot, 1920s-era, adaptive reuse space in an urban and transit-friendly location. From 1926 to 1979 it was a Sears, Roebuck and Co. retail store, warehouse and regional office. Managers are installing water-efficient fixtures and landscaping, reclaiming rain water and other building-generated water, and using the latest in LED lighting and efficient HVAC systems in the base building.

Some highlights:
Material re-use is equivalent to saving 1,198,050,000 MBTUs total energy from the existing building (instead of constructing the same amount of new space). HVAC is variable-speed, water-source heat pumps. Tenant energy use is sub-metered. Windows are original steel-frame windows, fully restored. Targeted energy savings above minimum code is 10 to 15 percent – an impressive feat in a 90-year-old building. Site irrigation will come from recaptured rainwater and reclaimed water reducing site water use by 50 percent.

Walking tours of Ponce City Market involve traversing unpredictable construction conditions, including uneven surfaces and stairs. Visitors should dress comfortably in closed-toe shoes (no heels allowed). Hard hats are provided, and attendees are asked to sign a liability waiver before touring. Children under the age of 18 are not permitted on tours.

Georgia Institute of Technology

Tuesday, June 30 • 2-5 p.m.
Cost: $30

The Georgia Institute of Technology is known for its commitment to addressing global challenges in sustainable energy, disease diagnosis and treatment, national defense and security, and other areas.

Georgia Tech has a long history with district energy. The Holland steam plant started steam production in 1917 with four coal-fired boilers. Today the plant provides steam to 4.8 million sq ft of space using three natural gas-fired boilers that can run on propane as a backup fuel. The plant also has a 34 MW, 110,000 lb/hr electric boiler. The newer 10,000 ton chilled-water system currently serves 61 buildings on campus.

The G. Wayne Clough Undergraduate Learning Commons is a 220,000 square foot LEED Platinum facility. The building serves the undergraduate community housing state of the art classrooms, presentation studios, labs and study space. Its sustainable features include a 1.4million gallon cistern, green roof garden, demand controlled ventilation, heat recovery systems, chilled beam demonstration, radiant floor, daylight harvesting, photovoltaic panels and solar thermal domestic hot water.

ASHRAE Headquarters

Tuesday, June 30 • 1:30-3:30 p.m. and 3:30-5:30 p.m.
Cost: $30

To "walk the talk" and demonstrate the Society's commitment to sustainability, ASHRAE renovated its existing headquarters building in Atlanta. When the project was completed in June 2008, ASHRAE had succeeded in creating a healthy, productive facility that will serve as a sustainable showcase for years to come.

After the renovation and occupancy, the building has received an A- (Very Good) As Designed rating and an A- (Very Good) As Operated rating from ASHRAE's Building Energy Quotient (bEQ) program.

The building received an ENERGY STAR rating from the U.S. Environmental Protection Agency in 2012 with a score of 95. The current site energy use intensity (EUI) is 35.8 kBtu/Sqft (411 MJ/m2). The EUI is a 60 percent reduction from the pre-renovation value of 81.9 kBtu/Sqft (941 MJ/m2) when the building had an ENERGY STAR rating of 36.

ASHRAE also was awarded Platinum Certification under the New Construction Version 2.2 rating system from USGBC's LEED program. ASHRAE earned 54 points of an attempted 55, with 69 points possible.

In addition, ASHRAE was awarded the highest rating of four Green Globes from the Green Building Initiative under their Continual Improvement of Existing Buildings (CIEB) assessment and certification program. Only 3 percent of projects assessed by GBI achieve four Globes certification.

Sustainable measures include reduced annual energy usage through use of a dedicated outdoor air supply (DOAS) system with energy recovery and humidity control for building ventilation; a ground-source heat pump system (GSHP) serving the second floor; and variable refrigerant flow systems with heat recovery serving the first floor. A 52.3 percent reduction in water consumption was achieved by using low-flow fixtures and waterless urinals in the building and by eliminating an outdoor irrigation system and chiller. The overall energy savings were achieved even though outside air delivered to each space was increased by 30 percent beyond minimum rates specified in ASHRAE's Standard 62.1.

KEYNOTE SPEAKER – GENE KRANZ

Saturday, June 27
3:15 – 5:30, Grand Ballroom A/B, 2nd floor

Legendary NASA Flight Control Director Who Led the Effort to Save Apollo 13, Gene Kranz is the keynote speaker at the opening Plenary Session, held Saturday, June 27. Registration is not required to attend the Session, which also features the Honors and Awards program.

As the leader of the "Tiger Team" of flight directors who brought the Apollo 13 spaceship safely back to Earth on April 17, 1970, Kranz demonstrated extraordinary courage and heroism.

Commissioned into the US Air Force in 1954, Kranz flew high-performance jet fighter aircraft and was a flight test engineer on early jet bomber development. In 1960, Kranz joined the NASA Space Task Group at Langley, Virginia, as a flight controller on Project Mercury. He served as flight director for the 33 missions of Projects Gemini, Apollo, and Skylab, and led the flight control team during the first lunar landing.

Kranz retired from NASA in 1994 after 37 years of federal service, and is currently a consultant and speaker. The hit film Apollo 13 chronicles Kranz's struggle to devise the plan that would safely bring the ship and its crew of three astronauts home after its oxygen system failed. Actor Ed Harris portrays Kranz in the film, which was directed by Ron Howard.

Kranz was a co-recipient of the Presidential Medal of Freedom awarded by President Nixon for the Apollo 13 mission, and was designated a Distinguished Member of the Senior Executive Service by President Reagan.

Since his retirement from NASA, Kranz has served as a flight engineer on a B-17 "Flying Fortress," constructed an aerobatic biplane, and published a New York Times best-selling memoir about his experiences in the space program. His book, Failure is Not an Option: Mission Control from Mercury to Apollo 13 and Beyond, was selected by The History Channel as the basis for a documentary on Mission Control.

WELCOME PARTY

Saturday, June 27
7 – 9 p.m. ***(Note new time!)***

College Football Hall of Fame

Attendees are encouraged to wear their high school, college or pro football jerseys or t-shirts, to share their team pride and enjoy a tailgate party.

The College Football Hall of Fame in Atlanta represents today's game and media world while respectfully giving a nod to the past. The National Football Foundation's decision in 2009 to move the Hall of Fame into the deep South symbolizes how the sport has changed demographically and through television.

The Playing Field
A 45-yard field spanning 15,000 square feet. Plenty of room to stretch out and enjoy the opening reception with your fellow attendees.

Shuttle service will begin at 6:30 p.m. from the John Portman Blvd. side of the Hilton. Turn left out of the main lobby. Doors will not open until 7:00 p.m. The Football Hall of Fame is open on Saturday to the general public until 6:00 p.m. so the later start allows them to prepare for our party. Last shuttle will depart from the Hall of Fame at 9:30 p.m. The Football Hall of Fame is 1.2 miles from the Hilton by bus, 6 minute ride. Walking distance is .8 miles and 16 minutes. To walk take John Portman Blvd. (turn left out of the Hilton lobby and right onto John Portman).

Tailgate Menu:
Hamburger, Cheeseburger sliders
Pimento Cheese sliders
BBQ Pulled Pork sliders
Grilled Chicken Satay
Potato Salad
Vegetable crudite
Chips
Cookies
Two drink tickets

Cost: $60

PRESIDENT'S LUNCHEON

Monday, June 29
Atlanta Hilton, Grand Ballroom A/B, 2nd floor
12:15 – 2 p.m. (Doors open at 12 p.m.)

2015–16 ASHRAE President David Underwood, P.Eng., Fellow ASHRAE, Life Member, CPMP, presents his presidential theme, Making Connections. The theme focuses on the first goal in ASHRAE's strategic plan, which calls for connecting as a way to foster vibrant, informed and engaged ASHRAE and industry communities. Underwood's theme focuses not only on the connections of ASHRAE membership but extends to connecting with industry, communities, governments and globally.

Certificates of appreciation to retiring Board members are presented, and the 2015–16 officers and Board of Directors will be installed.

Attire: Business casual
Cost: $50

MEMBERS NIGHT OUT

Tuesday, June 30
Atlanta Hilton, Grand Ballroom A/B, 2nd floor
6:15 – 10 p.m.
Cash bar reception begins at 6:15 p.m. in the foyer of the Grand Ballroom.

It's a beach party! Come and enjoy some great beach music that will have you swinging in your seat. Spend a relaxing evening with good friends and some good music.

The featured musicians are friends of President Tom Phoenix – the Band of Oz. The group was formed in 1967 as a part-time band playing fraternity parties and high school proms all over the South. In 1977 the band went on the road full time. Since that time the band has made an exceptional name for itself throughout the Southeast by playing the top clubs and corporate parties, and getting excellent reviews along the way. For several years the group has been a guest on most of the major beach concerts in the Carolinas, Virginia, and Georgia.

The Band of Oz is one of the most successful groups in the Southeast, and continues to get the very best reviews from the top people in the entertainment business. The band now features a full horn section which makes a dynamic eight-member group.

Attire: Casual
Cost: $60

Full-Day Seminars & Half-Day Courses for In-Depth Instruction

ASHRAE Learning Institute (ALI) provides high-quality courses presented by industry-recognized experts. Choose from two full-day seminars and seven half-day short courses to help you stay current on the latest HVAC technology. Each training session 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.

Register at **http://www.ashrae.org/atlantacourses** or onsite at the ASHRAE registration booth at the Atlanta Hilton.

Please refer to the map in this program to assist in finding the rooms for the ALI courses.

FULL-DAY PROFESSIONAL DEVELOPMENT SEMINARS

Registration fees: $485 per course; $395 for ASHRAE members
Completion of each seminar earns 6 PDHs/AIA LUs or .6 CEUs.
(check with your state for their continuing education credit requirements)

SATURDAY, JUNE 27, 2015

Commercial Building Energy Audits (code 60)

8:00 am – 3:00 pm, Atlanta Hilton, Room: 302

This seminar discusses how to perform commercial building energy audits. Best practices and other information relevant for building owners, managers and government entities are covered. The seminar includes a summary of materials essential for performing ASHRAE Level 1, 2 and 3 audits, timesaving tips for every auditor, how to hire an auditor, what to ask for in a comprehensive audit report, and how to build a successful energy efficiency retrofit team.

Instructor: Jim Kelsey, P.E., Member ASHRAE, BEAP, LEED® AP

Operations and Maintenance of High-Performance Buildings (code 61)

8:00 am – 3:00 pm, Atlanta Hilton, Room: 303

A high-performance building "consistently delivers a highly productive environment without wasting resources" (ASHRAE Guideline 32: Sustainable High-Performance Operations and Maintenance). Operating and maintaining high-performance buildings often requires different actions than a typical commercial or institutional building. After defining what a high-performance building is, this course will provide practical insights about operations and maintenance practices for both typical and high-performance buildings. This seminar includes an interactive group project to reinforce concepts such as how to identify and define energy and maintenance management metrics, and how to make the business case for changes to an existing building and its systems.

Instructor: Laurie Gilmer, P.E., Member ASHRAE, LEED® AP

HALF-DAY SHORT COURSES

Registration fees: $159 per course; $119 for ASHRAE members
Completion of each course earns 3 PDHs/AIA LUs or .3 CEUs.
(check with your state for their continuing education credit requirements)

SATURDAY, JUNE 27, 2015

Understanding Standard 189.1-2014 for High-Performance Buildings (code 62)

12:00 pm – 3:00 pm, Atlanta Hilton, Room: 304

Based on Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, this course provides the minimum requirements for the design, construction, and plans for operation of high-performance, green buildings. The course discusses new buildings and their systems, new portions of buildings and their systems, and new systems and equipment in existing buildings. Water use efficiency, indoor environmental quality, energy efficiency, site sustainability, and a building's impact on the atmosphere are covered. Goals of establishing mandatory criteria in all topical areas, providing simple compliance options, and the complement of green building rating programs for Standard 189.1 are covered. Upon completion of this course, participants will understand the basic requirements of Standard 189.1, the background that led to the development of these requirements, and how to apply the requirements in the Standard to new commercial buildings and major renovation projects.

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

SUNDAY, JUNE 28, 2015

Laboratory Design: The Basics and Beyond (code 63)

3:30 pm – 6:30 pm, Atlanta Hilton, Room: Salon D

A comprehensive overview of HVAC design for laboratories is examined in this course. The course focuses on the essential elements of the design process that are unique to laboratory HVAC systems. Topics include: planning steps; determining exhaust/supply requirements; load calculation; pressure mapping; evaluating system options; layout of ducts and rooms; sizing primary air systems; designing exhaust stacks; sustainability in laboratories and control strategies. Example problems and case studies will also be presented.

Instructor: John Varley, P.E., Member ASHRAE, HBDP, LEED® AP

Troubleshooting Humidity Control Problems (code 64)

3:30 pm – 6:30 pm, Atlanta Hilton, Room: Salon C

This course puts attendees on the fast track to understanding the effects of successful humidity control. It includes an in-depth discussion of moisture load calculations and how humidity control can be added to HVAC designs for seven different types of commercial buildings. The course also covers the effects of different humidity levels on thermal comfort, corrosion, mold growth and airborne microorganisms - information that helps the building owner and designer define the optimal humidity control level for each application.

Instructor: Lew Harriman, Fellow ASHRAE

MONDAY, JUNE 29, 2015

Design of Commercial Ground Source Heat Pumps (code 65)

2:30 pm – 5:30 pm, Atlanta Hilton, Room: Salon C

This course describes the best design practices of ground source heat pump systems to achieve maximum customer benefit. The course examines the economic analysis of ground source vs. more traditional systems and what is necessary to design an effective and efficient ground source system. The course covers energy analysis, equipment selection, drilling technologies, testing requirements, hydronic system design and system controls. Participants will learn all that is necessary for the design and installation of a successful ground source heat pump system.

Instructor: Kirk Mescher, P.E., Member ASHRAE, LEED® AP

Complying with Standard 90.1-2013: HVAC/ Mechanical (code 66)

2:30 pm – 5:30 pm, Atlanta Hilton, Room: Salon D

In 2007, ASHRAE determined that the 2010 version of Standard 90.1 would show a 30% reduction in energy use when compared to the 2004 edition. In 2013, ASHRAE asked for an additional 20% reduction, setting a target for a Standard 50% below that required for a 2004 compliant building. Design professionals, code officials and building owners must keep up with the new, more stringent requirements to comply with this quickly evolving Standard. This course describes the new and updated Mandatory and Prescriptive requirements, along with insights on how to comply during building design and construction.

Instructor: McHenry Wallace, P.E., Member ASHRAE, LEED® AP

TUESDAY, JUNE 30, 2015

Commissioning Process & Standard 202 (code 67)

8:00 am – 11:00 am, Atlanta Hilton, Room: Pavilion 8

ASHRAE Standard 202, the recently published code-language representation of ASHRAE's long-established commissioning process requirements, is the focus of this course. The course objective is to provide an understanding of the commissioning process as described by Standard 202, to explain how and why the Standard 202 commissioning process differs from the Guideline 0 commissioning process, and to explore how compliance with the standard is likely to evolve.

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

Designing High-Performance Healthcare HVAC Systems (code 68)

12:00 pm – 3:00 pm, Atlanta Hilton, Room: Pavilion 8

This advanced course provides an in-depth discussion of system design, controls sequences and psychrometrics to meet the aggressive performance, maintenance, reliability, energy and sustainability goals of high-performance healthcare HVAC systems. The course covers the relationship of infection control and HVAC design, detailed definitions of the key elements of high performance in healthcare, control sequences and setpoints, and energy conservation strategies and relationship to temperature/ relative humidity requirements.

Instructor: Daniel Koenigshofer, P.E., Member ASHRAE, HFDP

notes

WHAT IS A TECHNICAL COMMITTEE?

The technical expertise of ASHRAE is concentrated in its **Technical Committees (TCs), Task Groups (TGs), Technical Resource Groups (TRGs) and Multidisciplinary Task Group (MTGs)**. These groups are responsible in various degrees for:

- preparing the text of ASHRAE Handbook chapters
- originating, coordinating, and supervising Society-sponsored research projects
- presenting programs at ASHRAE meetings
- reviewing technical papers
- evaluating the need for standards
- and advising the Society on all aspects of the technology it embraces

ASHRAE TCs consist of people who have a recognized proficiency in a specific field of interest. TGs, similar to TCs, are formed when a subject of current interest is not covered in the scope of an existing TC or when the subject encompasses the scope of more than one TC. A TG is usually the first step towards becoming a TC when the TG's scope is not covered under a TC. TRGs are similar to TCs except that their responsibilities are limited to preparing, reviewing, or revising technical material. They do not have responsibility for programs, research, or standards. MTGs are different from TCs, TGs, and TRGs. A MTG is formed when the Society has determined a need for limited activity in a broad field of interest that encompasses the expertise of TCs from two or more sections and/or from non-TC groups such as Standing Standard Project Committees (SSPCs) or outside organizations. The functions of a MTG may include Handbook, Program, Publications, Research and Standards to various degrees, but the customary function of the MTG will be to coordinate those activities within the TCs and other groups, and organizations represented on the MTG.

APPLYING FOR MEMBERSHIP ON A TECHNICAL COMMITTEE

ASHRAE welcomes new members to its technical committees.

To be considered for technical committee membership, you must:

- Notify ASHRAE staff at TCStaff@ashrae.net of your interest in a particular TC, TG, TRG, or MTG.
- "Manage Your Membership" link from the ASHRAE Web site

Please note:
If you do not have an ASHRAE ID, are or not applying for ASHRAE membership, and are applying for a position that requires an ASHRAE bio to be on file, please go to www.ashrae.org and click on the Log In tab at the top of the page. Next click on need a login? to request an ID and PIN. You may also use that link if you already have an ASHRAE ID as a non-member, but you do not have a record of what that number is.

You will immediately be assigned as a Provisional Corresponding Member. The acceptance of provisional corresponding membership implies participation in committee activities through correspondence or in-person involvement. Provisional corresponding members serve 2 year terms. Although provisional corresponding members are not voting members, at the end of your term and based on participation in the committee, you may be considered for future voting membership.

Notification of acceptance to a TC is emailed upon your appointment.

ATTENDING TECHNICAL COMMITTEE MEETINGS

During the Annual and Winter Conference

The ASHRAE Technical Committees, Task Groups and Technical Resource Groups 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 chair at the request of a member. You are encouraged to attend any of these meetings in which you have a technical interest. TC chairs are reminded prior to each meeting to make a special effort to welcome visitors (potential members), particularly international members, to TC meetings – A TC can never have too many willing and able volunteers.

ASHRAE ANNUAL CONFERENCE TECHNICAL PROGRAM

Atlanta – June 2015

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. 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.

Technical sessions are in the Atlanta Hilton.

All sessions listed as starting at the same time are concurrent.

ASHRAE'S CONFERENCES AND EXPOSITIONS COMMITTEE WELCOMES YOU TO THE 2015 ANNUAL CONFERENCE

Five 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 July 6, 2015, 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 an online papers collection 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 an online papers collection are available for purchase in the ASHRAE Bookstore.

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. For a permanent record of the seminar presentations, the Seminar DVD will be available. Orders can be taken in the ASHRAE Bookstore.

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.

Workshops. Workshops enable technical committees and other ASHRAE committees to provide a series of short presentations on a topic requiring specific expertise. These short presentations are provided with an increased emphasis on audience participation and training in a specific set of skills. PowerPoint presentations with audio descriptions are posted online in the Virtual Conference.

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 Atlanta 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 will receive an email notification when sessions are available for viewing. The email will include a link to the Atlanta Virtual Conference. If you do not have your password, go to www.ashrae.org/Atlantaonline 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 from all technical paper sessions, conference paper sessions, seminars and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.

Ability to post questions or answers for selected sessions through Wednesday, July 8. Presentations available online through January 2017.

A full slate of technical programs will be posted beginning Monday, June 29, of the sessions that were presented the previous day, with additional content posted through Thursday, July 2.

Access to the Atlanta Virtual Conference is free with your paid conference registration. To register only for the Virtual Conference, go to ASHRAE Registration, Hilton Galleria Exhibit Hall. $249 ASHRAE member; $445 non member or register online.

2015 ASHRAE Annual Conference—Papers (online)

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

$79 (includes five FREE hard copies of preprint papers)

Available at the Conference Bookstore

Conference Seminars DVD

63 Seminars (PowerPoint files synced with speakers' audio)

$119 (ships September 2015)

Conference Preprints (individual papers, in print)

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

$6 each

Available at the Conference Bookstore

ASHRAE Transactions (Print Volume)

Technical Paper Session papers with discussion questions and answers for papers in bound, library-quality form

$79 (ships October 2015)

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

Submitted for approval for GBCI LEED AP CE Credits

Packages

1. 2015 ASHRAE Annual Conference – Papers (online) and Seminars DVD

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

$149 – *Purchase in the Conference Bookstore*

2. 2015 ASHRAE Annual Conference – Papers (online) and *ASHRAE Transactions*

(See description at left.)

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

$124 – *Purchase in the Conference Bookstore*

3. Complete Annual Conference Content Package (2015 ASHRAE Annual Conference – Papers (online), Seminars DVD, and *ASHRAE Transactions*)

$174 – *Purchase in the Conference Bookstore*

All prices are special conference-only prices.

Sunday, June 28

8:00 AM-9:00 AM

TECHNICAL PAPER SESSION 1 (BASIC)

Building Modeling Criteria

Track: Modeling throughout the Building Life Cycle

Room: 204/205

Chair: Joy Altwies, University of Wisconsin-Madison, Madison, WI

Climate change has many effects, and one of them requires that the representative weather files used to determine code criteria require updates. This session provides reports on updated weather files and the update process for many U.S., Canadian and international sites. It also presents a new model for identifying outlier data collected by smart meters so that more robust baseline models of building operation can be developed.

1. 2014 Update to Climatic Data for Energy Standards Criteria Development: Part 1, CDD and HDD Baseline Values (AT-15-001)
***John Hogan, P.E., Member**, Consultant, Seattle, WA*

2. 2014 Update to Climatic Data for Energy Standards Criteria Development: Part 2, Representative Weather Files (AT-15-002)
***John Hogan, P.E., Member**, Consultant, Seattle, WA*

3. A New Clustering Method to Identify Outliers and Diurnal Schedules from Building Energy Interval Data (AT-15-003)
***Saurabh Jalori, Affiliate**[1] and T. Agami Reddy, Ph.D., P.E., Member*[2], *(1)Atelier Ten, New York, NY, (2)The Design School/The School of Sustainable Engineering and the Built Environment, Tempe, AZ*

8:00 AM-9:00 AM

CONFERENCE PAPER SESSION 1 (ADVANCED)

Advanced Energy Design Guides and Beyond

Track: Moving Advanced Energy Design Guidance to the Mainstream

Room: Salon C

Chair: Paul A. Torcellini, Ph.D., Member, NREL, Golden, CO

This session provides attendees with the history of the AEDGs, as well as methods of achieving net zero energy buildings in commercial and residential applications. By implementing combined heat-power, solar and photovoltaic systems, engineers learn how to meet net zero goals.

1. Energy Cost Minimization for Net Zero and Positive Energy Buildings with Biomass-Fueled CHP (AT-15-C001)
***Masahiko Murai**, Hiroaki Otake, Masaaki Saito, Hiraku Asakura, Takao Nosaka and Nobutaka Nishimura, Toshiba Corporation, Tokyo, Japan*

2. The Path to Achieving Net Zero Energy Homes: Energy Choices, Consumer Costs and the Environment (AT-15-C002)
***Larry Brand, Member**[1], Martha Brook, P.E., Member*[2] *and Neil P. Leslie, P.E., Member*[1], *(1)Gas Technology Institute, Des Plaines, IL, (2)California Energy Commission, Sacramento, CA*

3. Through the Past Decade: How Advanced Energy Design Guides Have Influenced the Design Industry (AT-15-C003)
***Bing Liu, P.E., Member**[1], Rahul A. Athalye, Associate Member*[2] *and Jian Zhang, Ph.D., Member*[1], *(1)Pacific Northwest National Laboratory, Richland, WA, (2)PNNL, Richland, WA*

8:00 AM-9:00 AM

CONFERENCE PAPER SESSION 2 (INTERMEDIATE)

Analysis for Improved Efficiency of Chilled Water Systems

Track: HVAC&R Fundamentals and Applications
Room: Grand Ballroom C
Chair: Charles E. Henck, Whitman, Requardt & Associates LLP, Baltimore, MD

Despite many advances in chilled water systems, we continue to see improvements in systems and operational methods. This session uses model results to recommend improved control strategies for a chilled water plant, provides an exergy analysis of a chilled water supply and distribution system and examines a proposed multifunctional heat pump system to effectively utilize waste heat and heat capacity in gray water for heating or cooling of residential buildings.

1. Data Analysis and Modeling of an All-Variable Speed Chiller Plant (AT-15-C004)
Liping Wang, Ph.D., P.E., Member[1], *Mary Ann Piette*[2], *Steve Greenberg*[2], *Alan Meier*[2] *and John Fiegel*[3], *(1)University of Wyoming, Laramie, WY, (2)Lawrence Berkeley National Laboratory, Berkeley, CA, (3)Johnson Controls, Inc., Miltpitas, CA*

2. Exergy Analysis of Chilled Water Circuit under Different Variable-Flow Control Methods and Supply Water Temperatures (AT-15-C005)
Hang Yin, Ph.D.[1], *Ryozo Ooka, Ph.D., Affiliate*[1] *and Masanori Shukuya, Ph.D.*[2], *(1)University of Tokyo, Tokyo, Japan, (2)Tokyo City University, Tokyo, Japan*

3. Effects of Condenser Heat Recovery of a Multi-Functional Heat Pump System in Cooling Mode (AT-15-C006)
Xiaoyu Liu, Ph.D., Student Member[1], *Haorong Li*[1], *Siu-kit Lau, Ph.D., Member*[2] *and Hui Shen, Student Member*[3], *(1)University of Nebraska–Lincoln, Omaha, NE, (2)Armstrong (China) Investment Co., Ltd., Shanghai, China, (3)Purdue University, West Lafayette, IN*

8:00 AM-9:00 AM

SEMINAR 1 (INTERMEDIATE)

Fume Hood Design for the 21st Century: Proceedings from a Cross-Disciplinary Workshop

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 09.10 Laboratory Systems
Chair: Carol Donovan, Associate Member, Sebesta, Woburn, MA

Fume Hood Summits were held at UCLA in November of 2013 and again in Massachusetts in October of 2014. The purpose of the summit was to update consensus statements generated in 1998 that discuss the design, operation and testing of laboratory fume hood systems. Fume hoods and laboratory ventilation have changed significantly over the past two decades with increased emphasis on lab safety and energy efficiency. This seminar provides overviews of each summit and describes specific issues and consensus statements regarding design and operation of laboratory ventilation systems. The outcome of these changes impacts relevant stakeholders and their decisions.

1. Fume Hood Design for the 21st Century: Proceedings from a Cross-Disciplinary Workshop
James Coogan, P.E., Member*, Siemens Industry, Inc., Buffalo Grove, IL*

2. A Current Consensus on Safety and Performance of Chemical Fume Hood Systems
Thomas Smith, Member*, Exposure Control Technologies, Inc., Cary, NC*

8:00 AM-9:00 AM

SEMINAR 2 (BASIC)

Portable Combustion Analyzers: Accurate? Are Standards Needed?

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Grand Ballroom D
Sponsor: 06.10 Fuels and Combustion, 06.03 Central Forced Air Heating and Cooling Systems
Chair: George Kusterer, Associate Member, Bock Water Heaters (Ret.), Madison, WI

Portable combustion analyzers (PCAs) are used to measure the efficiency, reliability and safety of fuel-burning equipment, such as boilers. Their popularity has grown as combustion systems become more complex, energy audits more common and IAQ a greater concern. How accurate are these instruments, particularly for high efficiency appliances? This seminar reviews how the PCAs work, their built-in assumptions and what the data reported means. Practical guidelines for PCA use are presented, including calibration methods, sampling techniques and interpretation of readings. Finally, this seminar describes how PCAs are used in Europe, where performance standards have been established.

1. Portable Combustion Analyzers: How They Work, What They Measure and What It Means
Thomas Butcher, Ph.D., Fellow ASHRAE*, Brookhaven National Laboratory, Upton, NY*

2. Getting the Most from Portable Combustion Analyzers
Marko Bruinsma, Member*, Testo, Inc., Sparta, NJ*

3. Use of Portable Combustion Analyzers Across the Pond
Jonathan Kane*, Kane International, Welyn Garden City, United Kingdom*

8:00 AM-9:00 AM

SEMINAR 3 (BASIC)

Designing HVAC Systems: Engineering Keys to Legionella Control and Prevention

Track: Laboratories
Room: Salon D
Sponsor: 03.06 Water Treatment, 08.06 Cooling Towers and Evaporative Condensers
Chair: Frank Morrison, Member, Baltimore Aircoil Company, Baltimore, MD

Legionella is a waterborne pathogen that accounts for numerous deaths each year. Legionella species are among the pathogens that are a concern for facilities in potable and cooling water systems. While many guidelines exist to assist with preventing Legionellosis, incorporating these recommendations into building specifications at the design stage is not always straightforward and is often overlooked. This seminar provides an overview of Legionella (the bacteria and the disease) and provides guidance to engineers on how to specify system design using existing guidelines and codes.

1. Legionellosis and Legionella Species
Janet Stout, Ph.D., Member*, Special Pathogens Laboratory, Pittsburgh, PA*

2. Engineering HVAC Systems for the Prevention of Legionellosis
Jeff Boldt, P.E., HBDP, Member*, KJWW Engineering Consultants, Madison, WI*

8:00 AM-9:00 AM

WORKSHOP 1 (INTERMEDIATE)

Do We Need a Performance Rating System for Gas Phase Filters?

Track: Indoor Air Quality
Room: 206/207
Sponsor: 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment
Chair: Ashish Mathur, Ph.D., Member, UltraViolet Devices, Inc., Valencia, CA

Activated carbon and filters thereof are used in HVAC applications for effective removal of gaseous contaminants, VOCs and odors. These filters are offered by several manufacturers in various filter configurations and varying performance levels. Performance of carbon filters is based on two criteria: removal efficiency and working capacity, which can be evaluated using ASHRAE test Standard 145.2 against one challenge contaminant. However, real-life applications involve a mixture of gases and VOCs, making it difficult for design engineers and end users to decide which carbon filter to choose. Unlike particulate filters, there is no rating system which can guide the end user to choose the best carbon filter for their application. This workshop discusses current practices and test methods in evaluating carbon filters and elicits audience participation to discuss the feasibility of a uniform rating or classification system for carbon filters.

1. Key Performance Criteria for Carbon Filters and Method of Testing
***Kathleen Owen, Member**, RTI International, Research Triangle Park, NC*

2. Gas Phase Filters: The Good, the Bad, the Ugly and How to Tell the Difference
***Paula Levasseur, Member**, Cameron Great Lakes, Portland, OR*

8:00 AM-9:00 AM

WORKSHOP 2 (BASIC)

Psychrometrics: Effort, Accuracy and Applicability

Track: HVAC&R Fundamentals and Applications
Room: Salon E
Sponsor: 01.01 Thermodynamics and Psychrometrics, SPC 213P Method of Calculating Moist Air Thermodyn
Chair: James Schaefer, Jacobs Engineering, Houston, TX

This workshop addresses ASHRAE members' emerging concerns about choosing the appropriate psychrometric calculation method in various situations. People usually choose a method based on their ease of access, like using mobile apps in the field and using computer functions in the office. But few of them check their accuracy, calculation speed, applicability, etc. before use, and are confused by significantly different results for the same problem. This workshop starts the discussion by asking the audience's preferences in practical scenarios. A panel then discusses their features and the criteria to choose them, and gives feedback on the audiences' choice.

1. Review of Psychrometric Chart and Table
***Omar Abdelaziz, Ph.D., Member**, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Different Computational Methods of Psychrometric Properties
***Vikrant Aute, Ph.D., Member**, University of Maryland, College Park, MD*

9:00 AM-9:30 AM

NETWORKING COFFEE BREAK

(Grand Ballroom Foyer, 2nd floor)

Grab some coffee and network with your fellow ASHRAE conference attendees after the opening sessions. This is a great chance to discuss the program and form connections to make the most of your time in Atlanta.

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 2 (BASIC)

Health-Care Systems

Track: HVAC&R Fundamentals and Applications
Room: 206/207
Chair: Joy Altwies, University of Wisconsin-Madison, Madison, WI

Health-care buildings are typically quite energy intensive due to 24/7 operation and ventilation requirements. This session examines changes that have occurred in health-care ventilation requirements over the last 150 years, looks at the use of laminar airflow screens in operating rooms to reduce bacterial contamination and provides measured results for how plug loads vary in different parts of medical office buildings.

1. A History of the Changing Concepts on Health-Care Ventilation (AT-15-004)
***Dan Koenigshofer, P.E., HFDP, Member**[1] and Travis R. English, P.E., Member[2], (1)Dewberry, Chapel Hill, NC, (2)Kaiser Permanente, Oakland, CA*

2. Plug and Process Loads in Medical Office Buildings (AT-15-005)
***Arash Guity, P.E., Member**[1], Ross Ruecker[2] and Jun Timbang[3], (1)M+NLB, San Francisco, CA, (2)Mazzetti, San Francisco, CA, (3)Kaiser Permanente, Oakland, CA*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 3 (BASIC)

Occupants and Thermal Comfort

Track: High Performance Buildings
Room: Grand Ballroom C
Chair: Jaya Mukhopadhyay, Texas A&M University, College Station, TX

Modeling buildings to achieve both thermal comfort and energy savings is often at variance with occupant behavior. This session looks at advanced modeling to better account for occupant needs and behaviors in a range of "energy efficient" buildings to better ensure the desired operational efficiencies are achieved while still optimizing occupant needs and functions.

1. Thermal Comfort and IAQ of Dutch Energy Efficient Buildings with Thermal Activated Building Systems (AT-15-C007)
***Wim Zeiler**, Eindhoven University of Technology, Eindhoven, Netherlands*

2. Occupant Behavior: Impact on Building Energy Performance (AT-15-C008)
***Volkan Doda** and Shreshth Nagpal, HBDP and BEMP, Member, Atelier Ten, New York, NY*

3. In-Use Energy Management in an Acute Hospital in the UK: Patient-Centric Norms of Energy Performance (AT-15-C009)
***Matthew Bacon, Ph.D.**, Conclude Consultancy Limited, Surrey, United Kingdom*

9:45 AM-10:45 AM

SEMINAR 4 (BASIC)

Energy Performance of Active Chilled Beam Installations

Track: High Performance Buildings
Room: Salon E
Sponsor: 05.03 Room Air Distribution
Chair: Thomas Rice, Member, SEMCO LLC, Columbia, MO

Chilled beams have been evaluated and designed into projects in the United States. With newer technologies, there is an initial fear of the unknown. This fear has created a two-fold problem for building owners who want to benefit from the technology: over-design by engineers and over-price by contractors. These two items have slowed chilled beam use in the United States, as first cost and energy savings directly impact return on investment. This seminar brings light to projects that have had a comparable first cost to traditional systems, with low energy use and a fantastic return on investment.

1. Successful Application of Chilled Beams in a High School Environment
***Paul Christy**, Clark County Public Schools, Winchester, KY*

2. Successful Application of Chilled Beams in a University Science Building
***Stephen Hamstra, P.E., HBDP, Member**, Greensleeves Energy Solutions, Findlay, OH*

9:45 AM-10:45 AM

SEMINAR 5 (INTERMEDIATE)

The Building Envelope and Its Impacts on Occupant Comfort

Track: HVAC&R Fundamentals and Applications
Room: Salon D
Sponsor: 04.04 Building Materials and Building Envelope Performance
Chair: Sean O'Brien, P.E., Member, Simpson Gumpertz & Heger, Inc., New York, NY

The building envelope can have significant impacts on occupant comfort, with improper design leading to issues such as excessive heat gain, noise or cold temperatures. ASHRAE Standard 55 provides clear guidance on the conditions required for comfort, but unfortunately many designers do not fully understand how to use the data from that standard to design an effective enclosure that controls heat and airflow to promote occupant comfort. This session reviews the basics of how building envelopes can impact occupant comfort and provides design guidance for avoiding problems.

1. Applying ASHRAE Standard 55 to Building Envelope Design
***Sean O'Brien, P.E., Member**, Simpson Gumpertz & Heger, Inc., New York, NY*

2. The Building Enclosure and Its Impact on Occupant Comfort
***Peter Adams, P.Eng., Member**, Morrison Hershfield Limited, Toronto, ON, Canada*

9:45 AM-10:45 AM

FORUM 1 (INTERMEDIATE)

Lab Safety and Energy Management: Understanding the Risk

Track: Laboratories
Room: Grand Ballroom D
Sponsor: 09.10 Laboratory Systems
Chair: Adam Bare, P.E., Associate Member, Newcomb & Boyd, Atlanta, GA

This forum entertains discussions on the benefits of stakeholders working together to create safer, more energy efficient and sustainable laboratories. Recent initiatives undertaken by ASHRAE, AIHA and ACS to bridge the gap between safety and ventilation management are reviewed. A common thread to all stakeholders is how best to manage laboratory ventilation without compromising environmental health and safety and meet the occupational needs of the space in terms of temperature, humidity and air quality. Laboratory energy initiatives are reviewed, including risks, benefits, safety compliance and liability reduction. Ventilation optimization is discussed, including roles and responsibilities of stakeholders.

9:45 AM-10:45 AM

WORKSHOP 3 (INTERMEDIATE)

Acoustic Mitigation for Lightweight Roof Assemblies

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon A/B
Sponsor: 02.06 Sound and Vibration Control
Chair: Erik Miller-Klein, P.E., Member, SSA Acoustics, LLP, Seattle, WA

Engage with expert noise and vibration control engineers to learn about how to effectively use and supplement Chapter 48 of 2015 HVAC Applications Handbook. The session includes a detailed case study and mitigation results for rooftop equipment that created major tonal noise annoyances for a commercial building.

1. Using the Vibration Isolation Section of Chapter 48 of 2015 HVAC Applications Handbook
Steve Wise, Member*, Wise Associates, Madison, WI*

2. Case Study: Noise and Vibration Control for HVAC Units Containing Pure Tones
Jerry Lilly, P.E., Member*, JGL Acoustics, Issaquah, WA*

9:45 AM-10:45 AM

WORKSHOP 4 (ADVANCED)

Solar Decathlon Global Network: Database and Modeling Engine Research, Development and Validation

Track: Research Summit
Room: 204/205
Sponsor: 06.07 Solar Energy Utilization
Chair: Marija Todorovic, Ph.D., P.E., Fellow ASHRAE, vea-invi.ltd, Belgrade, Serbia

The workshop addresses synergetic measurement/monitoring/BPS and weather data for the validation of BPS and modeling predictive smart grid control of zero CO2 emission and Energy Plus buildings and neighborhoods (World Network Uni-Lab-EnEff-HVAC-RES-Industry). Workshop presentations aim to approach a definition of "Network as Living Lab Research for BPS software validation and improvement" in synergy with worldwide meteorological data collection and TMY evaluation, prepare relevant data for a building's total (including integrated solar and other RRES) performance monitoring and in addition present weather extremes and global warming evidence by measurements and monitoring. The session aims to increase understanding of global climate changes, sustainable buildings/HVAC and renewable energy supply systems and equipment, and more.

1. International Sustainable Campus Network Universities as Pilots for a Solar Energy Future
Siir Kilkis, DSc, Member*, The Scientific and Technological Research Council of Turkey, Ankara, Turkey*

2. Optimization of Grid-Connected Zero Energy Houses via Synergetic Monitoring versus BPS-Based on Modeling Predictive Smart Grid Control Evaluation
Edwin Rodriguez-Ubinas*, Universidad Politécnica de Madrid, Madrid, Spain*

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 3 (INTERMEDIATE)

Energy Analysis in Buildings

Track: Modeling throughout the Building Life Cycle
Room: Salon E
Chair: Ann Peratt, Associate Member, PKMR Engineers, Overland Park, KS

Energy analysis is a critical element in identifying the potential for improved energy efficiency in buildings, both from retrofitting improved equipment and improving building operation. This session gives results from the use of energy modeling to improve the number of buildings undergoing deep retrofits, for improving the efficiency of clean rooms and for baselining the performance of a university campus.

1. Energy Analysis of Cleanrooms in an Academic Research Building (AT-15-006)
Jared M Levy*, Michael M. Ohadi and Kyosung Choo, Ph.D., University of Maryland, College Park, MD*

2. Energy Audit and Base Case Simulation of Ryerson University Buildings (AT-15-007)
Hessam Taherian[1]*, Alan S. Fung, Ph.D., P.E., Member*[2]*, Mirza R Hossain*[2]*, Md. Ziaur Rahman*[2] *and Mohamed MM Selim*[1]*, (1)University of Alabama at Birmingham, Birmingham, AL, (2)Ryerson University, Toronto, ON, Canada*

3. Design Criteria and Thermal Performance of a Building Integrated Ventilated Concrete Slab (AT-15-008)
Navid Ekrami, Student Member[1]*, Raghad S. Kamel, Student Member*[1] *and Alan S. Fung, Ph.D., P.E., Member*[2]*, (1)Ryerson University, Toronto, ON, Canada, (2)University of Alabama at Birmingham, Birmingham, AL*

4. Business and Technical Concepts for Deep Energy Retrofit of Public Buildings (AT-15-009)
Alexander Zhivov, Ph.D., Member[1]*, Rüdiger Lohse, Ph.D.*[2]*, John A. Shonder, Member*[3]*, Cyrus Nasseri*[4]*, Heimo Staller*[5]*, Ove C. Moerck, Ph.D.*[6] *and Marko Nokkala*[7]*, (1)Engineer Research & Development Center, Champaign, IL, (2)Leiter Contracting, Baden-Württemberg, Germany, (3)Oak Ridge National Laboratory, Oak Ridge, TN, (4)US Department of Energy, Washington, DC, (5)AEE INTEC, Gleisdorf, Austria, (6)Cenergia Energy Consultants, Copenhagen, Denmark, (7)VTT Technical Research Centre of Finland, Espoo, Finland*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 4 (INTERMEDIATE)

Comprehensive Modeling in Buildings

Track: Modeling throughout the Building Life Cycle
Room: Salon C
Chair: Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

Accurate modeling for all functions of a building and its systems are essential in order to design, construct and operate buildings optimally. This session looks at modeling programs used for both new construction and retrofits and how review of performance data can be used to improve future modeling programs.

1. Calibrated Building Energy Simulation in Practice: Issues, Approaches and Case Study Example (AT-15-C010)
Steven Snyder, Associate Member *and Itzhak Maor, Ph.D., P.E., Member, Johnson Controls, Inc., Philadelphia, PA*

2. Energy Modeling for Jails and Detention Facilities (AT-15-C011)
Ok-Youn Yu, Ph.D., P.E.*, Jeff Tiller, P.E., Member, Jeff Holcomb, Ph.D. and Eli Roxby, Appalachian State University, Boone, NC*

3. Insulating History: Hygrothermal Assessment of Insulation Retrofits in Historic Heavy Masonry Buildings (AT-15-C012)
Calina Ferraro, P.E., Associate Member[1]*, Joseph Little*[2] *and Beñat Arregi*[2]*, (1)Randall Lamb Associates, Inc., La Mesa, CA, (2)Building Life Consultancy, Dublin, Ireland*

4. Increasing Flexibility in Energy Code Compliance: Performance Packages (AT-15-C013)
Reid Hart, P.E., Member *and Michael Rosenberg, Pacific Northwest National Laboratory, Richland, WA*

11:00 AM-12:30 PM

SEMINAR 6 (INTERMEDIATE)

BAS Data Analysis in Campuses

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Grand Ballroom C
Sponsor: 01.04 Control Theory and Application, 07.03 Operation and Maintenance Management
Chair: Marcelo Acosta, P.E., Member, Armstrong Fluid Technology, Toronto, ON, Canada

Building automation systems (BAS) in campuses produce vast amounts of data that far exceed the capabilities of their operations teams for detailed analysis. The first speaker explores how detailed diagnostics, improvements recommendations and work order prioritization can still be efficiently produced via selective multilevel analysis (SMA), combining automated and human resources. The second speaker presents the results of ASHRAE research project RP1633, focused on how to present BAS data meaningfully to different users.

1. Beyond Graphs and Statistics: Extracting Meaning from BAS Big Data
***Tunji Asiwaju, Member**, Armstrong Fluid Technology, Toronto, ON, Canada*

2. From Data to Info: Useful and Insightful BAS User Interfaces Are Possible
***Nicholas Gayeski, Ph.D.**, KGS Buildings, LLC, Cambridge, MA*

11:00 AM-12:30 PM

SEMINAR 7 (INTERMEDIATE)

Chiller Sequencing Challenges

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon A/B
Sponsor: 08.02 Centrifugal Machines
Chair: Jay Eldridge, Member, Daikin Applied, Minneapolis, MN

This session addresses unique challenges and issues associated with sequencing chilled water system equipment in systems that have multiple chillers, water-side economizers, multiple types of chillers and multiple chiller plants. The focus is on strategies to provide stable control while improving plant efficiency.

1. Optimized Control Sequences for Chilled Water Plants with Variable Speed Chillers
***Steve Taylor, P.E., Fellow ASHRAE**, Taylor Engineering, LLC, Alameda, CA*

2. Sequencing Chillers with Free Cooling
***Susanna Hanson, Member**, Trane, Inc., LaCrosse, WI*

3. Sequencing Multiple Chiller Plants
***Andrew Price, P.E., Member**, Affiliated Engineers, Inc., Madison, WI*

11:00 AM-12:30 PM

SEMINAR 8 (BASIC)

Indoor Environmental Quality: A Global and Holistic Perspective, Part 1

Track: Indoor Air Quality
Room: 206/207
Sponsor: Environmental Health Committee, Presidential AdHoc, Indoor Environmental Quality, 02.01 Physiology and Human Environment
Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

The newly established Indoor Environmental Quality-Global Alliance (IEQ-GA) will provide guidance on the definition of acceptable indoor environmental quality, with an emphasis on thermal conditions and indoor air pollution, to ensure that the knowledge gathered from indoor environmental quality (IEQ) research is promulgated to, and implemented by, IEQ practitioners and regulatory bodies worldwide. The IEQ is influenced by several parameters, like thermal comfort, indoor air quality (ventilation), lighting and acoustics. The seminar presents a holistic approach to indoor environmental quality and gives information on different societies' activities to improve the indoor environment.

1. The Value Chain of Indoor Environmental Quality
***Bjarne W. Olesen, Ph.D.**, Technical University of Denmark, Kongens Lyngby, Denmark*

2. The Cost of Poor Indoor Environmental Quality
***William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE**, Pennsylvania State University, University Park, PA*

3. European Activities in Relation to Indoor Environmental Quality
***Jaap Hogeling, Fellow ASHRAE**, REHVA, Brussels, Belgium*

4. EPA's Role in Improving the Indoor Environmental Quality
***David Rowson**, US Environmental Protection Agency, Washington, DC*

11:00 AM-12:30 PM

SEMINAR 9 (INTERMEDIATE)

International Perspectives on Residential Energy Efficiency

Track: HVAC&R Systems and Equipment
Room: 204/205
Sponsor: Residential Markets Ad Hoc Committee, 02.08 Building Environmental Impacts and Sustainability
Chair: Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

As a global technical society, ASHRAE's interests extend well beyond North America. This is especially true in the residential market, where ASHRAE has the opportunity both to influence and to learn from the international design community. This seminar discusses the application of ASHRAE residential standards and best practices in other regions of the world. It also summarizes various ways different countries are managing their unique challenges in residential construction and existing structures that may provide innovative options for North American designs. European, South American and Middle Eastern residential design practices and challenges are reviewed.

1. European Residential Building Typologies and Energy Efficiency Measures
***Constantinos A. Balaras, Ph.D., Fellow ASHRAE**, Institute for Environmental Research & Sustainable Development, NOA, Athens, Greece*

2. How Will Brazil Meet Residential Energy Needs in a Drought?
***Oswaldo de Siqueira Bueno, BEAP**, Oswaldo Bueno Engenharia e Representações Limitada, São Paulo, Brazil*

3. Application of ASHRAE Standard 90.2 for Middle East Regions
***Walid M. Chakroun, Ph.D., Fellow ASHRAE**, Kuwait University, Kuwait, Kuwait*

11:00 AM-12:30 PM

SEMINAR 10 (INTERMEDIATE)

New Weather Data for Design Calculations and Energy Simulations

Track: Modeling throughout the Building Life Cycle
Room: Salon D
Sponsor: 04.02 Climatic Information, 04.01 Load Calculation Data and Procedures
Chair: Norman J. Bourassa, Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA

Recent developments in climate analysis at ASHRAE and others have greatly increased the breadth as well as accuracy of climatic data needed for HVAC design calculations and building energy simulations. This seminar introduces these developments, including: ASHRAE's 2013 Handbook of Fundamentals containing design conditions for 6,443 locations; the National Climatic Data Center providing weather data and services for tens of thousands of stations worldwide; satellite-derived solar radiation providing accurate and uninterrupted solar data for any place in the world, which NREL is combining with reanalysis data to produce the next generation of gridded TMYs for more than a million U.S. locations.

1. What's New in ASHRAE Climatic Design Information: 2013 Fundamentals and Standard 169-2013
***Drury Crawley, Ph.D., BEMP, Fellow ASHRAE**, Bentley Systems, Inc., Washington, DC*

2. NOAA's National Centers for Environmental Information: New Products and Services
***Anthony Arguez, Ph.D.**, National Oceanic and Atmospheric Administration, Asheville, NC*

3. Developing the Next Generation of Gridded TMYs
***Aron Habte**, NREL, Golden, CO*

4. Utilizing Web-Based Weather Data Sources for Building Energy Calculations
***Yu Joe Huang, BEMP, Member**, White Box Technologies, Moraga, CA*

11:00 AM-12:30 PM

SEMINAR 11 (INTERMEDIATE)

Upgrading Ventilation in Existing Laboratories

Track: Laboratories
Room: Grand Ballroom D
Sponsor: 09.10 Laboratory Systems
Chair: James Coogan, P.E., Member, Siemens Industry, Inc., Buffalo Grove, IL

Operating laboratories present opportunities to improve performance in several directions at once. The opportunities arise from events and trends occurring during the life of the building, including: change in use or priorities; worn, degraded or neglected equipment; increased attention to ventilation requirements; and new generation of equipment and controls. The significance of each of these factors varies from building to building. If equipment is in disrepair, or out of adjustment, fixing that is the first goal. Ventilation engineers and safety professionals together reassess the quantity and quality of the ventilation at containment devices and in rooms. Often improvements in exposure control come at lower flow rates. The resulting energy savings pay for the project that enhances ventilation.

1. New Life for Old Lab Ventilation Systems
***Paul Fuson, Member**, Siemens Industry, Inc., Buffalo Grove, IL*

2. Upgrade Traditional Chemical Fume Hoods to Improve Containment Performance and Reduce Energy Consumption
***Thomas Smith, Member**, Exposure Control Technologies, Inc., Cary, NC*

3. Lessons Learned from 12 Years of Laboratory Conversions to VAV and Control Retrofits
***Gwelen Paliaga, Member**, Taylor Engineering, LLC, Alameda, CA*

1:30 PM-3:00 PM

TECHNICAL PAPER SESSION 4 (BASIC)

Air Quality and Refrigeration System Performance

Track: Research Summit
Room: 206/207
Chair: Samir Traboulsi, P.Eng., Member, Thermotrade/Ranec, Beirut, Lebanon

Many factors impact air quality and refrigeration system performance. This session reports experimental work on exhaust emissions testing, use of tape for sealing plywood joints and the performance on non-HFC supermarket refrigeration systems with modeling of chronic CO exposure.

1. Environmental Degradation Effect on Air-Tightness of Pressure-Sensitive Adhesive Exterior Housing Tapes on Plywood (AT-15-010)
***Megan A. Kreiger**, Jedediah B. Alvey, Axy Pagan-Vazquez and Dahtzen Chu, US Army Corps of Engineers, Champaign, IL*

2. Evaluating Chronic Carbon Monoxide Exposures: An Engineering Fundamentals Approach (AT-15-011)
***Juan Ramirez**, Michael Prisco and Atif Yardimci, Exponent, Warrenville, IL*

3. Energy Consumption and Performance Comparisons of Supermarket Refrigeration Systems (AT-15-012)
***Orkan Kurtulus**[1], Eckhard Groll, Dr.Ing., Fellow ASHRAE[1], William Travis Horton[1] and J. R. Poland[2], (1)Purdue University, West Lafayette, IN, (2)Hill PHOENIX, Covington, GA*

1:30 PM-3:00 PM

CONFERENCE PAPER SESSION 5 (INTERMEDIATE)

Cooling Equipment Analysis

Track: HVAC&R Systems and Equipment
Room: Salon D
Chair: Michael Patton, Member, Griswold Water Systems, New Smyrna Beach, FL

Cooling equipment design and operation has a major impact on the energy use of most commercial buildings and many housing units. This session provides new analysis approaches for design of variable-speed air-source heat pumps, an improved model for the performance of passive chilled beams in the presence of ventilation airflows and a new approach to modeling variable-speed vapor-compression machines when optimal supervisory control is required. It also evaluates a novel air-conditioning and power system that combines liquid desiccant technology and fuel cells.

1. Development of a MATLAB-Based Integrated Model for Optimal Design and Operation of Heat Pumps (AT-15-C014)
***Nabil Nassif, Ph.D., P.E., Member**, North Carolina A&T State University, Greensboro, NC*

2. Characterizing the in-Situ Performance of Passive Chilled Beams (AT-15-C015)
***Janghyun Kim, Student Member**, James Braun, Ph.D., Fellow ASHRAE and Athanasios (Thanos) Tzempelikos, Ph.D., Member, Purdue University, West Lafayette, IN*

3. Development of BeCool(TM), Combined Power and Air Conditioning System (AT-15-C016)
***Daniel Betts, Ph.D.** and Matt Graham, Be Power Tech, LLC, Parkland, FL*

4. Computationally Efficient Heat Pump Model to Accommodate Complex Load-Side Conditions or Configurations (AT-15-C017)
***Muhammad Tauha Ali** and P.R. Armstrong, Ph.D., Member, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates*

1:30 PM-3:00 PM

SEMINAR 12 (INTERMEDIATE)

Biocontainment Facility Design, Commissioning and Certification Strategies

Track: Laboratories
Room: Grand Ballroom C
Sponsor: 09.10 Laboratory Systems
Chair: Robert Weidner, Gannett Fleming, Inc., Camp Hill, PA

Biocontainment facilities involved detailed design, commissioning and regular testing. This session addresses opportunities to simplify designs and develop thorough commissioning and annual recertification procedures. Attendees learn about the details of biocontainment design and how this will impact the commissioning and recertification processes.

1. Design Strategies for Elimination of Air Flow Reversal in Bsl-3 Facilities
***Chris Kiley, P.E., Member**, Merrick & Company, Atlanta, GA*

2. Commissioning Strategies for Effective Functional Testing and Integrated System Testing of Bsl-3 Facilities
***Dan Cook**, Cornerstone Commissioning, Inc., Exeter, NH*

3. Commissioning and Beyond: Annual Certification and Commissioning of Biocontainment Facilities
***Scott Rusk**, Kansas State University, Manhattan, KS*

4. Biocontainment Ventilation: Complex or Simple Design
***John Keene, Ph.D.**, Global Biohazard Technologies, Midlothian, VA*

1:30 PM-3:00 PM

SEMINAR 13 (INTERMEDIATE)

How Dry Am I?: Locating, Quantifying and Reducing Microbial Growth Risk in Buildings

Track: Indoor Air Quality
Room: Salon C
Sponsor: 01.12 Moisture Management in Buildings
Chair: Steve Cornick, National Research Council Canada, Ottawa, ON, Canada

Persistent dampness from rainwater intrusion, plumbing leaks and condensation reduces indoor air quality and increases health risks. In recent years new instruments and novel techniques have been deployed to help quantify the risks of mold and bacterial growth, and to locate potential problem areas with more speed and certainty. This seminar describes several such tools and techniques, including case histories of research to understand microbial ecology in buildings and to reduce microbial growth risk and energy consumption.

1. Thermal Cameras, Moisture Meters and Their Deep, Dark Secrets
***Lew Harriman, Fellow ASHRAE**, Mason Grant, Portsmouth, NH*

2. Quantifying Microbial Growth Potential Using Surface Water Activity (aW) Measurements
***Brady Carter, Ph.D.**, Decagon Devices, Pullman, WA*

3. Field Measurements of Microbial Communities and Equilibrium Relative Humidity (AKA Surface Water Activity) on Office Surfaces in Three North American Climates
***Jeffrey Siegel, Ph.D.**, University of Toronto, Toronto, ON, Canada*

1:30 PM-3:00 PM
SEMINAR 14 (INTERMEDIATE)

Real-Time Fault Detection and Diagnosis for Enhanced Building Operations

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon A/B
Sponsor: 07.05 Smart Building Systems
Chair: Li Song, Ph.D., P.E., Member, University of Oklahoma, Norman, OK

About 20%–30% of the energy consumed in commercial buildings is typically wasted because of poor or inefficient building operations. Identifying the root causes of energy waste in buildings can be challenging, largely because energy flows are generally invisible. This seminar includes interesting recent research and case studies on real-time fault diagnostics and performance monitoring systems at both the system level, such as roof-top units/heat pumps and air-handling units and whole building level.

1. Model-Based Real-Time Whole Building Energy Performance Monitoring and Diagnosis, Part 1: Real Time Energy Simulation
***Xiufeng Pang, Ph.D., P.E., Member**, Lawrence Berkeley National Laboratory, Berkeley, CA*

2. Model-Based Real-Time Whole Building Energy Performance Monitoring and Diagnosis, Part 2: Fault Detection and Diagnosis
***Zheng O'Neill, Ph.D., P.E., Member**, University of Alabama, Tuscaloosa, AL*

3. Proactive Afdd for Rtus and Ahus Using Transactional Networks
***Srinivas Katipamula**, Pacific Northwest National Laboratory, Richland, WA*

4. Using a Hybrid Method to Construct a Computational Efficient Cooling Coil MODEL for Real-Time Single-Duct Variable Air Volume System Fault Detection and Diagnosis
***Li Song, Ph.D., P.E., Member**, University of Oklahoma, Norman, OK*

1:30 PM-3:00 PM
SEMINAR 15 (BASIC)

Rules of Engagement: Ethics and Young Professionals

Track: HVAC&R Fundamentals and Applications
Room: 204/205
Sponsor: 01.07 Business, Management & General Legal Education
Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

Today's engineering professional can find her or himself in a wide array of project delivery execution strategies. There's Design-Build, DBOM, DBOT, P3, ESCO and performance-based methodologies, as well as OEM Product Design. Couple these and other variations with increasing market pressure to deliver projects faster and cheaper, and it is easier than ever to get into potentially dicey ethical circumstances that were never discussed in formal engineering education. This workshop looks at the world of engineering practice and some of the ethical considerations and quandaries that go beyond or wrap around the scenarios covered in academia.

1. Engineering Ethics 101
***Kristin Schaefer, P.E., Member**, Schaefer Engineering, Katy, TX*

2. My Perspective, Part 1
***Steven F. Bruning, P.E.**, Newcomb & Boyd, Atlanta, GA*

3. My Perspective, Part 2
***Thomas Lawrence, Ph.D., P.E.**, University of Georgia, Atlanta, GA*

1:30 PM-3:00 PM
SEMINAR 16 (INTERMEDIATE)

There Is Gold in the Heartland at the Federal Courthouse in Cedar Rapids, Iowa

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Grand Ballroom D
Sponsor: 09.01 Large Building Air-Conditioning Systems, 07.09 Building Commissioning
Chair: Alonzo Blalock, P.E., Member, Jacobs Engineering, Fort Worth, TX

This seminar presents the description of 11 years of multidiscipline teamwork to produce a major building with complex systems and operation at below-targeted energy conditions. The building is a multistory facility for Federal Courts and related office functions. The overall process was led by GSA of Region 6. The scope for the project incorporates enhanced requirements for project performance. Final building occupancy was in late 2012 and energy use data is reviewed along with information on contribution from the roof-mounted PV system as part of the presentations. The HVAC system utilizes a water-side-based integrated economizer.

1. An Overview of the Development and Construction of the New U.S. Courthouse in Cedar Rapids, Iowa
***James Snedegar**, GSA Region 6, Kansas City, MO*

2. Selecting Systems to Produce Gold Level Performance
***Lincoln Pearce, P.E., BEAP, Member**, KJWW Engineering Consultants, Des Moines, IA*

3. Commissioning for the Gold in All the Systems
***Alonzo Blalock, P.E., Member**, Jacobs Engineering, Fort Worth, TX*

4. The Cedar Rapids Courthouse Actual Energy Performance Has Exceeded All Expectations
***John Nelson, P.E.**, GSA Region 6, Kansas City, MO*

1:30 PM-3:00 PM
SEMINAR 17 (BASIC)

What's New with Guideline 13? Specifying Building Automation Systems

Track: HVAC&R Systems and Equipment
Room: Salon E
Sponsor: 01.04 Control Theory and Application, SGPC 13
Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA

ASHRAE Guideline 13-2014, Specifying Building Automation Systems, included a significant revision providing guidance on specifying BAS requirements for performance monitoring. In addition, Addenda a to the 2014 revision provides up-to-date guidance related to advanced control integration of non-HVAC systems into HVAC systems, multitier system architectures within BAS systems, IT system integration, legacy systems, interoperability, open protocols and integration responsibility concepts. This seminar presents the new guideline content, as well as the workplan for the standing guideline committee moving forward.

1. What Does My BAS Need to Know about IT?
***Grant Wichenko, P.Eng., Member**, Appin Associates, Winnipeg, MB, Canada*

2. Why Does "Integration" Seem like Such a Dirty Word?
***Ron Bernstein**, LonMark International, Encinitas, CA*

3. What's Next for Guideline 13?
***Dave Kahn, P.E., BEAP, BEMP and HBDP, Member**, RMH Group, Lakewood, CO*

3:15 PM-4:45 PM

SEMINAR 18 (BASIC)

Bringing Some Reality to the Virtual World of BIM

Track: Modeling throughout the Building Life Cycle
Room: Grand Ballroom C
Sponsor: 01.05 Computer Applications, CIBSE ASHRAE Liaison, MTG.BIM Building Information Modeling
Chair: Tim Dwyer, Fellow ASHRAE, University College London, London, United Kingdom

This seminar explores the practical challenges, and demonstrates solutions, for bringing real-world products and procedures into the virtual world of building information modeling (BIM). It considers how components that make up buildings and their systems are represented in common software; explores how manufacturers can dispense with much of their traditional printed information for a simple universal digital form that carries information right through from design to operation; sees how the building operation can be enhanced through proper application of BIM standards; and reaches into the (very near) future as BIM increasingly enables improved efficiency, collaboration and build assurance.

1. What Does BIM Have to Do with Family Planning?
***Dennis Knight, P.E., BEMP, Member**, Whole Building Systems, LLC, Charleston, SC*

2. Standardizing Manufacturer Product Data for BIM Applications
***Jose Fandos**, Andekan, LLC, Oakland, CA*

3. How to Bimify Your Asset Management Program
***Robert Hitchcock, Ph.D., Member**, Hitchcock Consulting, Kelsey, CA*

4. The Future of Smart Building Design
***Steve Butler**, Autodesk, Inc., San Francisco, CA*

Monday, June 29

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 5 (BASIC)

Understanding Systems Through Modeling

Track: Modeling throughout the Building Life Cycle
Room: Salon E
Chair: Dimitris Charalambopoulos, D A Charalampopoulos & Assoc., Athens, Greece

Modeling of systems is used for a variety of purposes. This session reports on research that has developed guidelines for automating the creation of thermal models from BIM, development of a new framework for inverse modeling of buildings and a modeling study of several different heating and cooling systems on a K-8 school building.

1. A Unified Inverse Modeling Framework for Whole Building Energy Interval Data: Daily, Hourly Baseline Modeling and Short-Term Load Forecasting (AT-15-013)
***Saurabh Jalori, Affiliate**[1] and T. Agami Reddy, Ph.D., P.E., Member*[2], *(1)Atelier Ten, New York, NY, (2)Arizona State University, Tempe, AZ*

2. An Economic Analysis of Conventional and Heat Pump Heating and Cooling Systems in the DOE Prototypical Elementary School Building in Various Climatic Zones (AT-15-014)
***William A Ryan, Ph.D., P.E.**[1] and Marek Czachorski*[2], *(1)University of Illinois at Chicago, Chicago, IL, (2)MC Scientific, Downers Grove, IL*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 6 (BASIC)

IAQ and Thermal Comfort around the World

Track: Indoor Air Quality
Room: 206/207
Chair: Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC

The first component of this session compares the IAQ requirement of ASHRAE Standard 170-2013 (Ventilation for Health-care Facilities) with German Standard DIN1946-4 2008/12 (HVAC Systems in Health-care Buildings and Rooms) and the requirements of Standard 62.1-2013 (Ventilation for Acceptable Indoor Air Quality). The second component looks at IAQ and lessons learned in educational facilities in the Netherlands, and mixed use/office buildings in China.

1. Highly Sustainable Dutch Schools: What about IAQ and Perceived Thermal Comfort? (AT-15-C018)
***Wim Zeiler**, Eindhoven University of Technology, Eindhoven, Netherlands*

2. Comparison of Indoor Air Quality Standards in Health-Care Settings (AT-15-C019)
***Travis R. English, P.E., Member**[1] and Abdel Darwich, P.E., Member*[2], *(1)Kaiser Permanente, Oakland, CA, (2)Guttmann & Blaevoet, Sacramento, CA*

3. Improving Indoor Air Quality: Lessons from Two Chinese Case Studies (AT-15-C020)
***Stephen Ray, Ph.D., Associate Member** and Luke Leung, P.E., Member, Skidmore, Owings & Merrill LLP, Chicago, IL*

4. Benchmarking the US Health-Care Ventilation Standard with the German Health-Care Ventilation Standard (AT-15-C021)
***Fred J. Betz, Ph.D.**[1], Richard Moeller, P.E., HFDP, Member*[2] *and Wolfgang Krause*[3], *(1)Affiliated Engineers, Inc., Madison, WI, (2) Mazzetti, Irvine, CA, (3)GTB Ingenieure, Berlin, Germany*

8:00 AM-9:30 AM

SEMINAR 19 (INTERMEDIATE)

Apply ANSI/ASHRAE Standard 62.1 Addendum k for Laboratory Hoods

Track: Laboratories
Room: Grand Ballroom D
Sponsor: 05.05 Air-to-Air Energy Recovery, SSPC 62.1, 09.10 Laboratory Systems
Chair: Helen Davis, P.E., Member, AHRI, Arlington, VA

The 2015 Addenda Supplement to ANSI/ASHRAE Standard 62.1-2013, Ventilation for Acceptable Indoor Air Quality, includes Addendum k. This addendum modifies the standard such that laboratory exhaust is assigned a default of Air Class 4 but explicitly allows a responsible Environment Health & Safety (EH&S) professional to determine that a lower air class is appropriate for particular systems. If they assign a lower air class, then the use of heat wheel energy recovery would be allowed. The history of this addendum, case studies and best practices are presented.

1. Laboratory Ventilation Overview
***Hoy Bohanon, P.E., BEAP, Member**, Hoy Bohanon Engineering, PLLC, Clemmons, NC*

2. Applying Total Energy Recovery in Laboratory Environments: Lessons Learned over 20+ Years
***John Fischer, Member**, SEMCO LLC, Columbia, MO*

3. High Efficiency Heat Recovery for Laboratories vs IAQ
***Roland Charneux, P.Eng., HFDP, Fellow ASHRAE**, Pageau Morel et Associés Inc., Montreal, QC, Canada*

8:00 AM-9:30 AM

SEMINAR 20 (BASIC)

Centrifugal Compressor Design: Back to Basics

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 08.02 Centrifugal Machines
Chair: Frederick W Betz, Life Member, PEDCO E&A Services, Cincinnati, OH

Centrifugal compressors are broadly employed in water chiller applications in the HVAC industry. These compressors share much with the world of turbomachines in other industries, but due to ever-increasing performance standards, the needs of the HVAC commercial applications have driven centrifugal compressor technology to higher performing and in many cases more reliable levels than their industrial counterparts. This session provides HVAC professionals more technical insight into the inner workings of centrifugal compressors, design practices used by turbomachinery engineers in developing state-of-the-art equipment and why they are used over positive displacement machines.

1. Centrifugal Compressor Aerodynamic Design Basics
***Rick Heiden, Member**, Trane, Inc., LaCrosse, WI*

2. Centrifugal Compressor Mechanical Design Basics
***Jeb W Schreiber, Member**, Johnson Controls, Inc., York, PA*

3. Can Centrifugal Compressors Meet Efficiency Requirements: What's Next?
***Julian DeBullet, Fellow Life Member**, deBullet Consulting, Front Royal, VA*

8:00 AM-9:30 AM

SEMINAR 21 (INTERMEDIATE)

International Standard for Radiant Heating and Cooling Panel Systems

Track: High Performance Buildings
Room: Salon C
Sponsor: 06.05 Radiant Heating and Cooling
Chair: Kwang Woo Kim, Ph.D., Member, Seoul National University, Seoul, South Korea

Currently, 'ISO 18566 Building Environment Design — Design, test methods and control of radiant heating and cooling panel systems' is under development as a successive work of previously developed 'ISO 11855 Building Environment Design — Design, Dimensioning, Installation and Control of the Embedded Radiant Heating and Cooling Systems.' This new international standard, ISO 18566 will specify the design, test conditions and methods for the determination of the cooling and heating capacity and control of the radiant heating and cooling panel with open air gap to ensure the maximum performance which was intended in the design stage when the system is actually being operated in a building.

1. Professor
***Kwang Woo Kim, Ph.D., Member**, Seoul National University, Seoul, South Korea*

2. Professor
***Joachim Seifert, Dr.Ing.**, Dresden University of Technology, Dresden, Germany*

3. Professor
***Jae-han Lim, Ph.D., Member**, Ewha Womans University, Seoul, South Korea*

4. Professor
***Bjarne W. Olesen, Ph.D.**, Technical University of Denmark, Kongens Lyngby, Denmark*

8:00 AM-9:30 AM

SEMINAR 22 (BASIC)

$PM_{2.5}$ and Gases' Impact on Environment and Health

Track: Indoor Air Quality
Room: 204/205
Sponsor: 02.04 Particulate Air Contaminants and Particulate Contaminant Removal Equipment, SSPC 62.1, 02.03 Gaseous Air Contaminants and Gas Contaminant Removal Equipment
Chair: Kyung-Ju Choi, Clean and Science, Co, Rolling Meadows, IL

In December of 2012, U.S. EPA strengthened PM2.5 down to 12 ìg/m3 to protect public health. Acid rain contributed by PM2.5 is greatly affecting the environment. In order to improve IAQ, indoor pollutants, including gaseous contaminants, must be reduced. This seminar examines the improvement of indoor air quality from reduction in exposure to contaminants in the PM2.5 size range, including gaseous contaminants generated both indoors and outdoors and the impact of air cleaning and ventilation on these contaminants.

1. Improved IAQ and Reduced Exposure to Human Bioeffluents By Advanced Ventilation
***Arsen Melikov, Ph.D., Fellow ASHRAE**, Technical University of Denmark, Kongens Lyngby, Denmark*

2. Modeling the Impact of Residential HVAC Filtration on Indoor Particles of Outdoor Origin
***Brent Stephens, Ph.D., Associate Member**, Illinois Institute of Technology, Chicago, IL*

3. Indoor PM2.5 Particles Generated By Ultrasonic Humidifier
***John Zhang, Ph.D., Member**, 3M Personal Care Division, St. Paul, MN*

4. Removal of PM2.5 By Residential Air Cleaning Devices
***Thad Ptak, Ph.D., Member**, Columbus Industries, Columbus, OH*

8:00 AM-9:30 AM

SEMINAR 23 (INTERMEDIATE)

Climate Change: ASHRAE Design Day Weather Data

Track: Modeling throughout the Building Life Cycle
Room: Salon D
Sponsor: 04.01 Load Calculation Data and Procedures, 04.02 Climatic Information
Chair: Glenn Friedman, P.E., Fellow ASHRAE, Taylor Engineering, LLC, Alameda, CA

One of the most important initial decisions for modeling is selecting the weather data. There are several international methods for defining weather data used for load calculations and building energy modeling. The traditional ASHRAE method for defining weather data involves selecting the peak weather temperature and using a model for the daily range. Over time weather data availability has increased. This workshop allows the participants to explore the derivations of Cooling Design Day weather data using the ASHRAE model technique and other international techniques and to compare those to actual weather data to explore these differences in the results.

1. A New Method to Generate Hourly Air Conditioning Design-Day Temperature in China
***Da Yan**, Tsinghua University, Beijing, China*

2. Australasian HVAC design conditions are effected by El Niño Southern Oscillation
***Eric Peterson, Ph.D., P.E.**, Victoria University, Melbourne, Australia*

3. Revisiting the Formulation of the ASHRAE Design Day
***Yu Joe Huang, BEMP, Member**, White Box Technologies, Moraga, CA*

4. Weather Data Impact on Load Calculations
***Steve Bruning, P.E., Fellow ASHRAE**, Newcomb & Boyd, Atlanta, GA*

8:00 AM-9:30 AM

SEMINAR 24 (INTERMEDIATE)

What is a Zero Energy Building, and How Can We Get There?

Track: High Performance Buildings
Room: Grand Ballroom C
Sponsor: 02.08 Building Environmental Impacts and Sustainability
Chair: Neil P. Leslie, P.E., Member, Gas Technology Institute, Des Plaines, IL

Zero energy buildings have tremendous potential to transform the way buildings use energy. Large private commercial property owners are interested in developing zero energy buildings to meet corporate goals. In response to regulatory mandates, national government agencies and many state and local governments are beginning to move toward zero energy targets. This seminar discusses North American and European efforts to develop flexible and usable concepts and definitions related to zero energy buildings and near zero energy buildings that can be used for a building, or group of buildings, considering on-site and nearby renewable energy options.

1. (Net) Zero Energy Building Definitions and Boundaries
***Kent Peterson, P.E., BEAP, Presidential Fellow Life Member**, P2S Engineering, Inc., Long Beach, CA*

2. Implementation of Zero Energy Building Definitions
***Paul A. Torcellini, Ph.D., Member**, NREL, Golden, CO*

3. European Strategies to Comply with Zero Energy Building Directives
***Bjarne W. Olesen, Ph.D.**, Technical University of Denmark, Kongens Lyngby, Denmark*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 7 (INTERMEDIATE)

Refrigerant Measurements in Micro-Enhanced Geometries

Track: HVAC&R Systems and Equipment
Room: 206/207
Chair: John Dunlap, Dunlap & Partners, Richmond, VA

Refrigerant performance in a variety of micro-enhanced geometries continues to be investigated to improve system performance. This session examines the impact of refrigerant maldistribution on unwanted

superheat regions in micro-channel heat exchangers and reports measurements on several developmental refrigerants in micro-finned geometries.

1. Comparing Distribution of R32 (Low GWP), R410A, R134a and R245fa in the Vertical Header of a Reversible Microchannel Heat Exchanger: Affecting HX Performance (AT-15-C025)
Yang Zou, Ph.D., Member *and Pega Hrnjak, Creative Thermal Solutions, Urbana, IL*

2. Measuring and Predicting Two-Phase Pressure Drop in the Vertical Header with Protruded Microchannel Tubes (AT-15-C026)
Yang Zou, Ph.D., Member *and Pega Hrnjak, Creative Thermal Solutions, Urbana, IL*

3. Heat Transfer and Pressure Drop of New LGWP Refrigerants and Lubricant Mixtures in a 9.5mm Micro-Finned Tube Evaporator (AT-15-C027)
Lorenzo Cremaschi, Ph.D., Member*, Thiam Wong, Student Member, Jeremy Smith, Student Member and Pratik Deokar, Student Member, Oklahoma State University, Stillwater, OK*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 8 (ADVANCED)

Utility Load Forecasting and Demand Response

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon C
Chair: Jeff S. Haberl, Ph.D., P.E., Fellow ASHRAE, Texas A&M University, College Station, TX

More accurate short-term load forecasts by utilities would significantly reduce energy production costs. This session identifies studies of forecasting models that can accurately predict load forecasts in a wide range of buildings or that use demand response data to provide similar load forecasts. This load forecasting can allow utilities to predict load requirements during all months.

1. Demand Response in Commercial Buildings: A Cold Climate Field Study (AT-15-C022)
Marie-Andrée Leduc, P.Eng.[1]*, Ahmed Daoud, Ph.D.*[2]*, Karine Lavigne*[1] *and Alain Poulin*[2]*, (1)Laboratoire des technologies de l'énergie, Shawinigan, QC, Canada, (2)Hydro Quebec, Shawinigan, QC, Canada*

2. Machine Learning Approach Applied in Electricity Load Forecasting: Within Residential Houses Context (AT-15-C023)
S M Mahbobur Rahman *and Bing Dong, Ph.D., Member, University of Texas at San Antonio, San Antonio, TX*

3. Comparison of On-line Building Energy Forecasting Model Using System Identification Method and Other Methods (AT-15-C024)
Xiwang Li, Student Member *and Jin Wen, Ph.D., Member, Drexel University, Philadelphia, PA*

9:45 AM-10:45 AM

SEMINAR 25 (INTERMEDIATE)

High Performance Laboratories: Managing Water and Equipment Loads

Track: Laboratories
Room: Grand Ballroom D
Sponsor: 09.10 Laboratory Systems
Chair: Jason A. Atkisson, P.E., HBDP, Member, Affiliated Engineers, Inc., Madison, WI

This seminar focuses on often overlooked conservation opportunities in the design and operation of high performance laboratories. In particular, this session discusses water and energy saving opportunities from laboratory equipment and how engineers, owners, and operators can capture the other 50% of energy cost savings.

1. Efficient Laboratory Design and Operation: The Last Decade
Steve Frei, P.E., Member*, Affiliated Engineers, Inc., Madison, WI*

2. Efficient Laboratory Design and Operation: Capturing the Last 50%
Paul Erickson, Member*, Affiliated Engineers, Inc., Madison, WI*

9:45 AM-10:45 AM

SEMINAR 26 (INTERMEDIATE)

Improving IAQ in Energy Efficient Building Ventilation: Practical Experience from Experts

Track: Indoor Air Quality
Room: Salon E
Sponsor: 04.10 Indoor Environmental Modeling
Chair: Wangda Zuo, Ph.D., Member, University of Miami, Coral Gables, FL

Natural ventilation (NV) and displacement ventilation (DV) can improve indoor air quality and reduce energy consumption. However, the DV and NV systems need to be carefully designed to achieve their potential. This seminar invites two experts from industry to present how they use computational fluid dynamics to improve IAQ in NV and DV system design for various projects.

1. Improving IAQ By Using Displacement Ventilation and Natural Ventilation: Experience from Practice
Mikhail Koupriyanov, P.Eng., Associate Member *and Chris Burroughs, Member, Price Industries Limited., Winnipeg, MB, Canada*

2. Use of CFD to Improve the IAQ in a Natural Ventilation Design Involved with Solar Load
Reza Ghias, Ph.D., Member *and Corey Lehman, P.E., Southland Industries, Dulles, VA*

9:45 AM-10:45 AM

SEMINAR 27 (BASIC)

Mobile Applications: HVAC Loads, Energy Audits and Operations

Track: Modeling throughout the Building Life Cycle
Room: Salon D
Sponsor: 04.01 Load Calculation Data and Procedures, 01.05 Computer Applications
Chair: Jeff Stein, P.E., Member, Taylor Engineering, LLC, Alameda, CA

This seminar discusses how mobile devices and the apps that run on those devices are changing the way HVAC technicians, maintenance managers and building energy auditors do their jobs. Because mobile devices are so powerful, building professionals can perform much of their work in the field. Such work includes performing HVAC cooling and heating load calculations, performing building energy audits, maintaining equipment, creating onsite proposals for customers, invoicing and many other work functions. The speakers focus on discussing field-based HVAC load calculations and building energy audits, including the advantages of performing these functions in the field versus office.

1. Performing Field-Based HVAC Load Calcs Using Mobile Devices
Stephen Roth, P.E., Member*, Carmel Software Corporation, San Rafael, CA*

2. Mobile Tools for Scoring Building Energy Use
Richard Szydlowski*, Center for Energy and Environment, Minneapolis, MN*

9:45 AM-10:45 AM

SEMINAR 28 (ADVANCED)

Optimization for Data Center and ITE Integration

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: Grand Ballroom C
Sponsor: 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Robin Steinbrecher, Member, Intel, Dupont, WA

The demand for new features and performance requirements are driving IT equipment power requirements higher than previously projected. To address present and future compute requirements and their resultant power consumption data center infrastructure management usage relative to power, thermal and utilization will become even more important than they have ever been. This seminar provides an update to projections previously published by ASHRAE's TC 9.9 while enabling the data center design community along with data center owners to understand key use cases relative to power, cooling and workloads for DCIM and their potential for data center optimization to address future IT technology.

1. IT Equipment: New Components and Usage Impacting Power Trends
***Robin Steinbrecher, Member**, Intel, Dupont, WA*

2. Real Time Monitoring and Availability of Platform Telemetry for Efficient Data Center Cooling
***Nishi Ahuja**, Intel, Dupont, WA*

9:45 AM-10:45 AM

SEMINAR 29 (INTERMEDIATE)

State-of-the-Art Heat Exchangers: Novel Visualization and Design Concepts

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 01.03 Heat Transfer and Fluid Flow
Chair: Omar Abdelaziz, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

Heat transfer investigations are essential to continually develop advanced heat exchangers and HVAC&R systems. Conventional techniques provide limited insights on the performance of advanced heat exchanger designs and can be limiting in exploring the full potential of new surfaces or channel geometries. This seminar presents two innovative techniques to investigate the heat transfer and pressure drop in advanced heat exchangers. The first presentation illustrates the use of neutron imaging to visualize the two-phase flow in diabetic flow inside microchannel heat exchanger tubes. The second presentation describes development of a cost-effective and compact multipass manifold microchannel heat and mass exchanger for HVAC applications, which is less prone to the fouling and flow instability in two-phase applications and shows visualizations results of the two-phase flow in the presence of an innovative manifold design for microchannel enhanced tubes.

1. Experimental Evaluation of Neutron Imaging As a Void Fraction Measurement Technique
***Patrik Geoghegan**, Oak Ridge National Laboratory, Oak Ridge, TN*

2. Multipass Manifold Microchannel Heat Exchangers for HVAC Applications
***Ratnesh Tiwari**, University of Maryland, College Park, MD*

9:45 AM-10:45 AM

SEMINAR 30 (INTERMEDIATE)

U-Factors, Thermal Bridging and What They Mean for Energy Code Compliance

Track: HVAC&R Fundamentals and Applications
Room: 204/205
Sponsor: 04.04 Building Materials and Building Envelope Performance
Chair: Sean O'Brien, P.E., Member, Simpson Gumpertz & Heger, Inc., New York, NY

The concept of U-factors for building enclosure systems has been around for decades but has become more widely recognized as building energy codes (e.g., ASHRAE 90.1) have become increasingly stringent. Prescriptive requirements for insulation in walls and roofs are often difficult to meet in buildings with complex architectural design. Consequently, the U-factor option for compliance has seen much more use in the last few years. This session discusses the basics of heat transfer in buildings as well as the general concept of the U-factor. Examples of how thermal bridging can impact energy performance and U-factors are presented.

1. Heat Transfer and U-Factor Fundamentals
***Sean O'Brien, P.E., Member**, Simpson Gumpertz & Heger, Inc., New York, NY*

2. Using U-Factors to Meet Energy Code Requirements
***Marcus Bianchi**, NREL, Golden, CO*

9:45 AM-10:45 AM

FORUM TC (INTERMEDIATE)

What Should Be Included In A New Handbook Chapter on Fire Stations, Fire Fighter Academies and EMT Training Academies?

Track: HVAC&R Fundamentals and Applications
Room: 301
Sponsor: 09.08 Large Building Air-Conditioning Applications
Chair: E. Doug Fitts, P.E., Life Member, Fitts HVAC Consulting, LLC, Sunrise Beach, MO

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. There is no reference within the ASHRAE Applications Handbook on fire houses, fire training academies and EMT facilities. TC 9.8 Large Building Air-Conditioning Applications, is the place for a new chapter for these facilities. This forum discusses some or all the issues and materials that should be included in this new chapter.

10:00 AM-12:00 PM

SEMINAR TC (INTERMEDIATE)

Improved Duct System Performance: Leakage Elimination and CFD Modeling

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Pavilion 6
Sponsor: 05.02 Duct Design
Chair: Stephen Idem, PhD, Tennessee Technological University, Cookeville, TNAhmad K. Sleiti, Ph.D., P.E., Member, Embry-Riddle Aeronautical University, Prescott, AZ

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. This seminar examines modern technology used to measure duct leakage in residential homes and commercial buildings, and to seal the ducts from the inside out. The process uses escaping air under pressure to cause polymer particles to adhere first to the edges of a leak, then to each other, until the leak is eliminated. The seminar also presents concepts of Computational Fluid Dynamics (CFD) at an introductory level and includes a brief description of turbulence models and grid generation. Case studies involving the use of CFD techniques to guide duct system design and provide practical solutions to fluid flow problems are presented. Speaker Neal Walsh presents "Aeroseal: Eliminating Leakage in Duct Systems," and speaker Dr. Ahmad Sleiti presents Embry-Riddle University: CFD Duct System Modeling.

11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 9 (INTERMEDIATE)

Fault Diagnosis and Commissioning Existing Buildings

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon D
Chair: Alan Neely, Member, Grumman/Butkus Associates, Evanston, IL

Fault diagnostics and retrocommissioning are two methods of identifying deficiencies in building system operations and ensuring that the proper corrections are made. This session highlights the effectiveness of fault diagnostic systems and turnkey retrocommissioning programs.

1. A Fault Diagnosis Warning System of Refrigeration Systems Based on Fault Direction Space Method for Data Centers (AT-15-C031)
***Zhiguang He** and Zhen Li, Tsinghua University, Beijing, China*

2. Scaling Retrocommissioning to Small Commercial Buildings: Development of a Turnkey Automated Hardware-Software Solution (AT-15-C032)
***Guanjing Lin, Ph.D., Associate Member**[1], Jessica Granderson, Ph.D.[1], Michael R. Brambley, Ph.D., Fellow ASHRAE[2] and Yunzhi (Lucy) Huang, Member[2], (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Pacific Northwest National Laboratory, Richland, WA*

3. Retail Building Thermal Efficiency Improvement through an Enhanced Re-Commissioning Framework (AT-15-C033)
***Salvador Acha, Dr.Ing.** and Chang F. Loh, Imperial College, London, United Kingdom*

11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 10 (BASIC)

Modeling for Residential Buildings

Track: Modeling throughout the Building Life Cycle
Room: Grand Ballroom C
Chair: Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE, Oklahoma State University, Stillwater, OK

Modeling of various energy-consuming activities within residential buildings can provide significant benefits. This session highlights (1) potential savings from a distributed generation vs. central system; (2) the importance of multiyear data collection to optimize hot water heating in multistory, multifamily buildings: (3) and precooling strategies to shift peak-load to off-load periods for cost reduction.

1. Optimization of Distributed Generation System Components for a Residential Building (AT-15-C028)
Omar B. Abu-Hamdeh *and Hessam Taherian, Ph.D., Member, University of Alabama at Birmingham, Birmingham, AL*

2. Variations in Use of Domestic Hot Water between Years: Measurements in 539 Apartments during Six Years (AT-15-C029)
Hans Bagge, Ph.D., Associate Member[1] *and Dennis Johansson, Ph.D., Associate Member*[2]*, (1)Lund University, Building Physics, Lund, Sweden, (2)Lund University, Building Services, Lund, Sweden*

3. Developing and Modeling Potential Precooling Strategies for Residential Buildings in the Phoenix Climate (AT-15-C030)
Reza Arababadi, Student Member *and Kristen Parrish, Ph.D., Arizona State University, Tempe, AZ*

11:00 AM-12:00 PM

CONFERENCE PAPER SESSION 11 (BASIC)

Refrigerant Topics

Track: HVAC&R Systems and Equipment
Room: Grand Ballroom D
Chair: Dunstan Macauley, P.E., Member, WSP, Arlington, VA

These papers cover a variety of topics relating to refrigerants: from the highly technical balance of refrigerants and lubricants and the effects on compressor life to the more subtle study of VRF systems in practical applications. Also covered is a practical evaluation of ASHRAE Standard 15.

1. Evaluation of Wear Resistant Refrigerant Compressor Lubricants (AT-15-C034)
Derek W. Kultgen, Associate Member *and Joseph A. Karnaz, Member, CPI Fluid Engineering/Lubrizol, Midland, MI*

2. A Study of Refrigerant Dispersion in Occupied Spaces under Parametric Variation (AT-15-C035)
Christopher Laughman, Ph.D., Associate Member*, Piyush Grover, Ph.D. and Saleh Nabi, Ph.D., Mitsubishi Electric Research Laboratories, Cambridge, MA*

3. Evaluation of Variable Refrigerant Flow (VRF) System Performance Using Ornl's Flexible Research Platform (FRP): Summer Data Analysis Compared with Baseline RTU System (AT-15-C036)
Piljae Im, Ph.D., Member*, Jeffrey D. Munk and Anthony C. Gehl, Oak Ridge National Laboratory, Oak Ridge, TN*

11:00 AM-12:00 PM

SEMINAR 31 (INTERMEDIATE)

Big Data Analytics for Building Energy Management

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon E
Sponsor: 01.05 Computer Applications, 07.01 Integrated Building Design
Chair: Krishnan Gowri, Ph.D., Member, Autodesk, Inc., San Francisco, CA

The big data revolution is offering new opportunities and challenges for improving the operation of buildings and achieving energy savings using data analytics. Utility billing data, sub-metered data and trend data from building automation systems are some of the sources of data that can be analyzed using innovative methods to identify energy saving opportunities. The objective of this seminar is to introduce state-of-the-art capabilities of software tools and services currently available to ASHRAE members for technology adoption. Three industry experts share their experiences and strategies for data collection, storage, processing, visualization, ownership and security. Potential energy savings realized and equipment diagnostic capabilities of big data analytics are presented.

1. ASHRAE DBOSS (Dynamic Building Operation Systems and Services) Initiative
Art Hallstrom, P.E., BEMP, Fellow ASHRAE*, AD Hall and Associates, Lexington, KY*

2. Data Mining BAS Controls Data for Retrocommissioning
Frank Mayfield*, M2M Systems Integrators, Dallas, TX*

3. Energy Management Using Real-Time Data: Predictive Analytics for Managing Peak Demand
Nathan Gould*, Lucid Design Group, Oakland, CA*

11:00 AM-12:00 PM

SEMINAR 32 (INTERMEDIATE)

Human Building Integration: Thermal Comfort Control for an Individual Setting

Track: Indoor Air Quality
Room: Salon C
Sponsor: 02.01 Physiology and Human Environment
Chair: Joon-Ho Choi, Ph.D., Associate Member, University of Southern California, Los Angeles, CA

With the help of advanced technologies for sensing and controls, there are a lot of opportunities to integrate a building and the occupants for enhancing physiological and environmental benefits. Human-building integration (HBI) would be made possible with the support of innovative and accurate thermal comfort models and algorithms, which incorporate occupants' activities and their physiological conditions. Having a better understanding of the relationship between an occupant's physical status and the ambient thermal condition is very necessary to optimize design and performance of HVAC systems. This seminar addresses the concept of HBI and its potential use in an individual environmental control setting.

1. Identification of Occupants' Activities in Practice
Arsen Melikov, Ph.D., Fellow ASHRAE*, Technical University of Denmark, Kongens Lyngby, Denmark*

2. Human-Building Integration As a Proactive Environmental Control Strategy
Joon-Ho Choi, Ph.D., Associate Member*, University of Southern California, Los Angeles, CA*

11:00 AM-12:00 PM

SEMINAR 33 (INTERMEDIATE)

UFAD Commissioning, Troubleshooting and Design Considerations

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon A/B
Sponsor: 05.03 Room Air Distribution
Chair: Chris Burroughs, Member, Price Industries Limited., Winnipeg, MB, Canada

Presentation content includes the idiosyncrasies associated with UFAD that engineers, contractors and operators need to be aware of so that obstacles to a successfully operating system can be avoided. Underfloor air distribution (UFAD) systems are highly integrated with other services and more closely coupled with the building structure than compared to traditional overhead mixing air systems. This inherent quality of UFAD systems demands an integrated and collaborative approach when working on these types of projects. This seminar addresses issues that arise when designers treat UFAD projects similar to an overhead mixing system during design, construction and balancing. This seminar aims to discuss past experiences and easy steps a design team should take from as early as the design stage to the commissioning, balancing and completion of a project to create optimized UFAD systems in future buildings.

1. Proper Testing and Balancing of UFAD Systems
Donald Hill, P.E., Member*, Accutec Service, Inc., Lee's Summit, MO*

2. UFAD System Forensics and Troubleshooting Challenges
***Jim Megerson, P.E., Member**, Design Mechanical Inc., Kansas City, KS*

3. UFAD Design Approach and Avoiding Potential Issues
***Robert Persechini, Member**, RDK Engineers, Boston, MA*

11:00 AM-12:00 PM

FORUM 2 (INTERMEDIATE)

How Do You Use the Advanced Energy Design Guides?

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: 204/205
Sponsor: ASHRAE AEDG Steering Committee
Chair: Daniel Nall, P.E., BEMP, HBDP, Fellow Life Member, Syska Hennessy Group, New York, NY

The AEDGs, sponsored by ASHRAE/AIA/IES/USGBC, are the most popular special publications ever produced by ASHRAE. They are intended to serve both as a cookbook, that if followed rigorously, should produce a building that meets the targeted energy savings goal, and as a resource to assist designers, both in the high performance design process, and in the implementation of a number of energy conservation technologies. The authors and the Society as a whole would like to know how ASHRAE members use the AEDGs so as to improve future editions. Attendees have an opportunity to answer that question in this session.

11:00 AM-12:00 PM

FORUM 3 (BASIC)

Is the ASHRAE Research Process Efficient?

Track: Research Summit
Room: 206/207
Sponsor: RAC
Chair: Kishor Khankari, Ph.D., Member, AnSight LLC, Ann Arbor, MI

ASHRAE Research involves several steps, from brainstorming a topic at TC level; getting RTAR and Work Statements approved by RAC; selecting a contractor for the research; monitoring research progress; to completing the research and publishing and reporting the outcomes to TCs, Handbook authors and the wider ASHRAE family. Several committees and subcommittees exchange draft proposals and comments, progress reports and final results. Is this efficient? Could it be better? Does it make good use of our volunteers' time? Bring constructive suggestions to make ASHRAE Research more efficient, valuable and beneficial to all. This session requires active participation from the audience.

2:15 PM-3:45 PM

SEMINAR 34 (INTERMEDIATE)

Field Performance Results of VRF, GSHP and GS-VRF Systems: The "Living LAB" Results Are In

NY PDH DVD G

Track: High Performance Buildings
Room: Grand Ballroom C
Sponsor: 06.08 Geothermal Heat Pumps and Energy Recovery Applications
Chair: Michael Kuk, BEAP, CPMP, OPMP, Member, CERx Solutions, LLC, Oswego, IL

This seminar covers three case studies of high performance buildings with extensive system comparative data results. Case 1: ASHRAE HQ in Atlanta. This case includes a living lab comparison of three state-of-the-art building systems: ground source heat pump (GSHP), variable refrigerant flow (VRF) and a dedicated outdoor air (DOAS). Case 2 covers a living laboratory at a K-12 school in Mobile, AL. It includes a side-by-side comparison of three of the highest efficiency small commercial systems on the market: GSHP, VRF and variable ducted unitary. Case 3 covers source variable refrigerant flow (GS-VRF) system installed at the Human Health Building at Oakland University in Rochester, MI.

1. ASHRAE Headquarters System Comparison Results, VRF vs. GSHP
***Jeffrey Spitler, Ph.D., P.E., Fellow ASHRAE**, Oklahoma State University, Stillwater, OK*

2. Advanced Heat Pump Field Research and Demonstration Project at Faith Academy
***Chris Gray, P.E., Member**, Southern Company, Birmingham, AL*

3. Ground Source Variable Refrigerant Flow System at the Human Health Building-Oakland University
***Xiaobing Liu, Ph.D., Member**, Oak Ridge National Laboratory, Oak Ridge, TN*

4:00 PM-5:00 PM

WORKSHOP 5 (INTERMEDIATE)

Energy Rating and Managing Your Commercial Building Using ASHRAE Building Energy Quotient (bEQ)

NY PDH G

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Grand Ballroom C
Sponsor: 07.06 Building Energy Performance, bEQ, TRG7 Tools for Sustainable Building Operations, Maintenance and Cost Analysis
Chair: Ross Montgomery, P.E., BEAP, BEMP, CPMP, HBDP, Fellow ASHRAE, Quality Systems and Technology Inc., Parrish, FL

The theme of this second-edition workshop is to outline the role of bEQ in identifying and improving energy performance and efficiency. It explores and explains energy management tools, such as benchmarking, modeling, audits and measurements that building owners and operators can use to evaluate and improve performance. The session makes members aware of bEQ features and benefits they can use for the benefit of their clients and tenants. It identifies and rewards good engineering design and operation practices. It is a primary point of President Phoenix's theme.

1. Using ASHRAE bEQ as an Energy Management and Benchmarking Tool, Along with Retrocommissioning and Energy Audits to Achieve Maximum Potentials
***Terry Townsend, P.E., Fellow ASHRAE**, Townsend Engineering Inc, Chattanooga, TN*

2. How to Perform and Obtain a bEQ As-Designed and In-Operation Rating: Requirements, Technical Aspects and Resources
***Michael Brandemuehl, Ph.D., Member**, University of Colorado, Boulder, CO*

Tuesday, June 30

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 6 (INTERMEDIATE)

Optimizing Systems

NY PDH G

Track: Research Summit
Room: 204/205
Chair: Dan Pettway, Hobbs & Associates, Norfolk, VA

Optimizing building HVAC systems is increasingly important. This session presents the use of gray-box modeling to improve the performance of multistage DX units, discusses a distributed control approach for predictive optimization of HVAC systems, looks at the use of cascaded control architecture to compensate for non-linear HVAC system characteristics and looks at data mining for improved prediction of residential building heating and cooling loads.

1. An Ensemble Model for Predicting Energy Performance in Residential Buildings Using Data Mining Techniques (AT-15-034)
***S Manimaran**[1], Priyanka Bhatia[2] and J. Alamelu Mangai[2], (1)Emirates Global Aluminium, Dubai, United Arab Emirates, (2)BITS Pilani, Dubai Campus, Dubai, United Arab Emirates*

2. Distributed Predictive Optimization of a Building HVAC System (AT-15-015)
***Bryan Rasmussen** and Matt Elliott, Texas A&M University, College Station, TX*

3. Gray-Box Modeling of Multistage Direct Expansion Units to Enable Control System Optimization (AT-15-016)
***Jie Cai, Student Member** and James Braun, Ph.D., Fellow ASHRAE, Purdue University, West Lafayette, IN*

4. HVAC Nonlinearity Compensation Using Cascaded Control Architectures (AT-15-017)
***Christopher R Price**, Bryan Rasmussen and Shuangshuang Liang, Texas A&M University, College Station, TX*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 12 (BASIC)

Demand Response and Energy Forecasting

Track: Building Operation, Maintenance and Optimization/Commissioning

Room: Salon D

Chair: Juan-Carlos Baltazar, PhD, Texas A&M University, College Station, TX

The use of accurate building/system performance monitoring can be useful in determining the accuracy of design modeling. This information can be used to make changes to building/system operations to improve performance and to validate the accuracy (or deficiencies) in modeling programs. This session also explores how the lack of country-specific climate zones can lead to poor modeling and design, leading to less-than-desired energy performance.

1. Modeling and Validation of a DX Heat Pump System Using Artificial Neural Network (AT-15-C038)
Jordan Gooden, Student Member *and Nabil Nassif, Ph.D., P.E., Member, North Carolina A&T State University, Greensboro, NC*

2. Analysis and Results of a Monitoring Campaign in an Elderly Nursing Home in Italy (AT-15-C039)
Piercarlo Romagnoni, Ph.D., Member[1]*, Fred S. Bauman, P.E., Member*[2]*, Fabio Peron, Ph.D.*[1]*, Massimiliano Scarpa, Ph.D.*[1]*, Ugo Mazzali, Ph.D.*[1]*, Gianluca Turchetto*[3] *and Giovanni Curculacos, Member*[3]*, (1)University IUAV of Venice, Venezia, Italy, (2)University of California, Berkeley, Berkeley, CA, (3)TFE Ingegneria, Pianiga (Venice), Italy*

3. Case Study of a Distributed GSHP System in a High School (AT-15-C040)
Xiaobing Liu, Ph.D., Member[1]*, Mini Malhotra, Ph.D., Associate Member*[1] *and Hugh Henderson, P.E.*[2]*, (1)Oak Ridge National Laboratory, Oak Ridge, TN, (2)CDH Energy Corp., Cazenovia, NY*

8:00 AM-9:30 AM

Best Paper Award Presented by ASHRAE's Science and Technology for the Built Environment journal

The Best Paper Award for the best paper published in 2014 in ASHRAE's *Science and Technology for the Built Environment* journal will be presented at the beginning of Seminar 35. The journal publishes papers of archival research quality, with the award recognizing the best of the best. The Best Paper Award is presented to authors: **David Yashar, Piotr Domanski** and **Hong Cho**.

SEMINAR 35 (INTERMEDIATE)

Comfort and Health

Track: Indoor Air Quality

Room: 206/207

Sponsor: Publishing and Education Council

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

This session offers presentations based on a select group of recently published papers from the ASHRAE journal *Science and Technology in the Built Environment*, regarding new research in indoor air quality in high performing buildings and personalized exhaust systems for airborne infection control.

1. A Time-Based Analysis of the Personalized Exhaust System for Airborne Infection Control in Health-Care Settings
Junjing Yang, Ph.D.[1]*, Chandra Sekhar, Ph.D., Fellow ASHRAE*[1]*, Kok Wai Cheong, Ph.D.*[1] *and Benny Raphael*[2]*, (1)National University of Singapore, Singapore, Singapore, (2)ITT Madras, Chennai, India*

2. Indoor Air Quality in 24 California Residences Designed As High Performance Homes
Iain Walker, Ph.D., Fellow ASHRAE[1]*, Brennan Less, Student Member*[2]*, Nasim Mullen, Ph.D.*[3] *and Brett Singer, Ph.D., Member*[1]*, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA, (3)Gap, Inc., San Francisco, CA*

3. Indoor Air Quality in High-Performing Building Case Studies: Got Data?
Steven Emmerich, Member[1]*, Andrew Persily, Ph.D., Member*[1] *and Kevin Teichman, Ph.D., Member*[2]*, (1)National Institute of Standards and Technology, Gaithersburg, MD, (2)Environmental Protection Agency, Washington, DC*

8:00 AM-9:30 AM

SEMINAR 36 (BASIC)

If You Build It, Will They Come? The Next Design-Build Guide

Track: HVAC&R Fundamentals and Applications

Room: Salon C

Sponsor: 01.07 Business, Management & General Legal Education, 07.02 HVAC&R Contractors and Design Build Firms

Chair: E. Mitchell Swann, P.E., Member, MDC Systems, Paoli, PA

TC 1.7 issued the Survival Guide for Design-Build in 2004. It was ahead of its time. Design-Build has been around for as long as building has been around, but recently Design-Build delivery has spread like wildfire! The problem with wildfires is that you sometimes can get caught up in the heat of the moment and burned before you know it. This rapid spread has prompted TC 1.7 and 7.2 to update the Guide for today's brave new world. Come get an overview of the current guide; highlights of hot issues for the next edition and air your questions and concerns EARLY!

1. The Design-Build Survival Guide: What's in It for You?
E. Mitchell Swann, P.E., Member*, MDC Systems, Paoli, PA*

2. The Legal Mysteries of Design-Build
Paul E. Sperry*, Carlock, Copeland & Stair LLP, Charleston, SC*

3. Design Build and the GSA
Marcella Stokes, Member*, US General Services Administration, Region 4, Atlanta, PA*

8:00 AM-9:30 AM

SEMINAR 37 (INTERMEDIATE)

Lower GWP Alternatives for R-404A in Commercial and Transport Refrigeration

Track: Refrigeration

Room: Grand Ballroom C

Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage, TC 10.06, TC 03.01 and MTG LowGWP

Chair: Brian Fricke, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

When commercial and transport refrigeration systems began shifting away from HCFC refrigerants to HFC refrigerants, R-404A became the refrigerant of choice and the industry standard HFC. However, with an extremely high GWP, there is now an industry-wide demand for R-404A replacement refrigerants, driven by recent and proposed changes in regulations, such as the EU F-Gas Regulations and EPA SNAP. Beyond suitable replacement refrigerants, there is a need to understand how these new refrigerants will behave in existing systems and what changes will be required in design practice, construction and commissioning for all systems. This seminar presents experimental results for new lower GWP refrigerant alternatives and discusses how characteristics such as temperature glide and mild flammability may be managed.

1. Challenges in Retrofitting R-404A with Lower GWP Refrigerants
Sarah Kim*, Arkema, Inc., King of Prussia, PA*

2. Evaluation of Low-GWP Replacements for R-404A in Refrigeration Systems
Gustavo Pottker, Member*, Honeywell - Buffalo Research Laboratory, Buffalo, NY*

3. Retrofit Testing of Low GWP Alternatives for Commercial and Transport Refrigeration
Barbara Minor, Member*, DuPont, Wilmington, DE*

4. Lower GWP Options for R-404A in Transport Refrigeration Applications
Chris Repice, Member*, Carrier Transicold, East Syracuse, NY*

8:00 AM-9:30 AM

SEMINAR 38 (INTERMEDIATE)

Modeling, Simulation and Application of Occupant Behavior in Buildings

Track: Research Summit
Room: Salon A/B
Sponsor: 07.05 Smart Building Systems, 01.05 Computer Applications
Chair: Bing Dong, Ph.D., Member, University of Texas at San Antonio, San Antonio, TX

People spend more than 90% of time in buildings, and as a result, occupancy behavior becomes a leading factor that affects building energy consumption, but it is quite often oversimplified. Occupancy behavior has strong interactions with building systems. The occupants' expectation of comfort or satisfaction in the built environment drives the occupant to perform various controls, such as adjusting the thermostat in spaces, opening windows for ventilation, turning on lights, pulling down the window blinds and consuming domestic hot water. Occupancy behavior also strongly couples with building performance. Various occupancy behaviors have different impacts on building performance (e.g. indoor temperature, humidity level, etc.) and energy end use. The building performance will also have economic, physiological and psychological impacts on occupancy expectations. Hence, having a better understanding, description and model of occupant behavior in buildings can improve the accuracy of building simulations and guide the design and operation of buildings. This seminar aims to highlight current state-of-art research on occupant behavior by Lawrence Berkeley National Laboratory under the U.S.-China Clean Energy Research Center for Building Energy Efficiency, by Rutgers University under the Energy Efficient Buildings Hub, by Pacific Northwest National Laboratory Tsinghua University. This forum is part of IEA EBC Annex 66 activities.

1. Apply Occupant Behavior Simulation into Building Energy Performance Evaluation
***Da Yan**, Tsinghua University, Beijing, China*

2. Occupancy-Based Control of Variable-Air-Volume Systems
***Michael R. Brambley, Ph.D., Fellow ASHRAE**, Pacific Northwest National Laboratory, Richland, WA*

3. Prospective Modeling of Occupant Behavior during Design
***Clinton Andrews, P.E.**, Rutgers University, New Brunswick, NJ*

4. Simulation of Occupancy in Buildings
***Tianzhen Hong, Ph.D., P.E., Member**, Lawrence Berkeley National Laboratory, Berkeley, CA*

8:00 AM-9:30 AM

SEMINAR 39 (INTERMEDIATE)

Panel Discussion: 10 Years of Advanced Energy Design Guides from Practitioners' Perspectives

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: Salon E
Sponsor: 07.06 Building Energy Performance, Advanced Energy Design Guide Steering Committee
Chair: Mick Schwedler, P.E., Member, Trane, Inc., La Crosse, WI

The first Advanced Energy Design Guide (AEDG) was published in 2004. Supported by the U.S. DOE, more than 550,000 copies are in circulation, LEED® has a path which uses them and practitioners employ them to reduce building energy use. Panel members from the AEDG partner organizations—American Institute of Architects (AIA), Illuminating Engineering Society (IES), US Green Building Council (USGBC) and ASHRAE—discuss the use of the AEDGs by architects, engineers, lighting designers and the sustainable community. In addition, this workshop requests audience input about using the AEDGs on their projects, as well as encourages their questions.

1. Engineers' Use of AEDGs
***Bjarne W. Olesen, Ph.D.**, Technical University of Denmark, Kongens Lyngby, Denmark*

2. Lighting Designers' Use of AEDGs
***Michael Lane, Member**, Puget Sound Energy, Seattle, WA*

3. Architects' Use of AEDGs
***Daniel Nall, P.E., BEMP and HBDP, Fellow Life Member**, Syska Hennessy Group, New York, NY*

4. Sustainable Community's Use of AEDGs
***Brendan Owens, P.E., Member**, U.S. Green Building Council, Washington, DC*

8:00 AM-9:30 AM

SEMINAR 40 (ADVANCED)

Energy Efficient Labs: Case Studies

Track: Laboratories
Room: Grand Ballroom D
Sponsor: 09.10 Laboratory Systems
Chair: Adam Bare, P.E., Associate Member, Newcomb & Boyd, Atlanta, GA

Laboratory buildings use much more energy than most other building types. Due to their complex nature, labs are also more expensive to maintain and operate. Laboratory safety is the highest priority. Sustainable design often leads to more complicated systems, especially in a laboratory environment. Those systems are often quite expensive and are more difficult to maintain. However, the typical laboratory project goals of delivering a facility that is safe, energy efficient, maintainable and affordable are not necessarily mutually exclusive. This seminar showcases some projects that employed innovative methods to tackle these types of issues, with surprising outcomes.

1. A Case Study in Retrofitting and Upgrading Lab Exhaust Systems from Constant Air Volume (CAV) to Variable Air Volume (VAV)
***David Rausch, Associate Member**, Phoenix Controls, Acton, MA*

2. Beyond LEED Platinum: A Case Study for a High Performance Laboratory Building
***Todd Mowinski II, P.E., Associate Member**, Newcomb & Boyd, Atlanta, GA*

3. Finding the Low Hanging Fruit of Energy Savings in Existing Laboratories
***Chris Germann**, Thermal Recovery Systems, Inc., Tucker, GA*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 7 (INTERMEDIATE)

Analytical Research

Track: Research Summit
Room: Grand Ballroom C
Chair: Kevin Gallen, P.E., Member, Gallen Engineering, Yardley, PA

Powerful analytical techniques are leading to many advances. This session introduces results of CFD modeling to investigate better smoke control strategies and use of hollow fiber membranes to strip CO2 and H2S from water. It also proposes a new index to better reflect the seasonal performance of water chillers.

1. Use of Vertical Shafts as Routes of Smoke Extraction and Safe Egress during High-Rise Fires (AT-15-018)
***William Black, Ph.D., P.E., Member**, Georgia Institute of Technology, Atlanta, GA*

2. Modeling Smoke Movement in Shafts during High-Rise Fires by a Multizone Airflow and Energy Network Program (AT-15-019)
***Guanchao (Jeremy) Zhao** and Liangzhu (Leon) Wang, Ph.D., P.E., Member, Concordia University, Montreal, QC, Canada*

3. SePLV: A New Index for Evaluating Water Chiller Seasonal Performance (AT-15-020)
***Baolong Wang**, Wenxing Shi, Chengbin Wu, Minghong Yang and Xianting Li, Tsinghua University, Beijing, China*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 13 (BASIC)

Air-Side Performance

Track: HVAC&R Fundamentals and Applications
Room: Salon E
Chair: Dimitris Charalambopoulos, D A Charalampopoulos & Assoc., Athens, Greece

Thorough understanding air flows in spaces is necessary to ensure comfort. This session presents research on the influence of the air disturbance caused by cooking behavior on exhaust hood capture, presents a model that is capable of predicting the influence of any damper on the flow in all the terminals in a distribution system and presents initial findings from an ASHRAE Research Project that is extending diffuser selection guide information to cover heating characteristics as well as cooling characteristics.

1. Influence of Air Disturbance Caused By Cooking Behavior on Capture Efficiency of Exhaust Hood in Japanese Commercial Kitchens (AT-15-C041)
Toshiya Iwamatsu, Ph.D., Associate Member *and Wataru Urabe, Central Research Institute of Electric Power Industry, Tokyo, Japan*

2. Effect of Duct Pressure on Airflow Control Dynamics (AT-15-C042)
James Coogan, P.E., Member*, Siemens Industry, Inc., Buffalo Grove, IL*

3. Diffuser Selection for All-Air Heating Systems: Effective Draft Temperature Development (AT-15-C043)
Shichao Liu, Student Member *and Atila Novoselac, Ph.D., Member, University of Texas, Austin, TX*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 14 (BASIC)

Heat Transfer Research

Track: Research Summit
Room: Grand Ballroom D
Chair: Thomas H. Kuehn, PhD, Fellow ASHRAE, University of Minnesota, Minneapolis, MN

Heat transfer is one of the most mature fields in the HVAC industry, but exciting ways to both increase and decrease heat transfer are still being identified. This session takes a look at the potential for air-bearing heat exchangers to further improve the efficiency of household refrigerators and freezers, looks at a new model to improve heat pump water heater condenser design and provides new measurements of the influence of moisture on the thermal conductivity of various insulating materials.

1. Novel Frost Handling Techniques Using Air Bearing Heat Exchangers for Household Refrigerators (AT-15-C044)
Omar Abdelaziz, Ph.D., Member*, Ayyoub Mehdizadeh Momen, Ph.D. and C. Keith Rice, Ph.D., Oak Ridge National Laboratory, Oak Ridge, TN*

2. Investigation of Hygrothermal Effects on the Thermal Conductivity Characteristics of Insulation Materials (AT-15-C045)
Jordan A. Whetsell[1], Junfeng Liang, Ph.D.[1], ***Mrinal C. Saha, Ph.D.****[1], M. Cengiz Altan, Ph.D.[1] and Chien Pan, Ph.D.[2], (1)University of Oklahoma, Norman, OK, (2)ConocoPhillips, Houston, TX*

3. Development and Validation of a Heat Pump Water Heater Model with Wraparound Condenser (AT-15-C046)
Dennis M. Nasuta, Associate Member*, Optimized Thermal Systems, Inc, College Park, MD*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 15 (BASIC)

Outdoor Air and Energy Recovery for Energy Efficiency

Track: High Performance Buildings
Room: Salon C
Chair: Sheila Hayter, PE, NREL, Golden, CA

Dedicated Outside Air Systems (DOAS), economizers and exhaust energy recovery are strategies utilized to reduce energy use. This session explores strategies of design, controls and operations to maximize their effectiveness. This session also discusses the results of ASHRE RP-1 596, which compares simulations to actual ventilation and occupancy data in retail stores when seeking to maintain IAQ while still achieving energy savings.

1. Dedicated Outdoor Air Systems with DUAL Energy Recovery Applied with Distributed Sensible Cooling Equipment (AT-15-C047)
Ronnie Moffitt, P.E., Member*, Trane, Inc., Lexington, KY*

2. Outside Air, Economizers and Exhaust Air Energy Recovery (AT-15-C048)
Paul Pieper, P.Eng., Member*, Venmar CES, St-Leonard-d'Aston, QC, Canada*

3. Energy Savings by Modifying Ventilation Rates in Retail Stores (AT-15-C049)
Zuhaira M A Alhafi, Ph.D., Student Member*, Pennsylvania State University, State College, PA*

9:45 AM-10:45 AM

SEMINAR 41 (INTERMEDIATE)

Energy Efficiency Monitoring and Assessment in Industrial Facilities

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon A/B
Sponsor: 07.05 Smart Building Systems
Chair: Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

The U.S.-DOE sponsors 24 Industrial Assessment Centers (IAC) at 32 participating universities across the country. These centers conduct the energy audit for small- and medium-sized manufacturers to identify site-specific opportunities to improve productivity, reduce waste and save energy through immediate changes in manufacturing processes and equipment, and energy systems. This seminar covers an overview of IACs and a typical industrial energy efficiency monitoring and assessment process. Case studies for estimating fuel usage savings from an inverse-simulation are presented. The complexities of energy use monitoring, including weather normalization, production intensity disaggregation and high frequency sampling techniques, are covered, and preliminary results from production data are presented as well.

1. Industrial Assessment Centers: A Project to Teach Students Energy and Resource Auditing and Help Manufacturing Companies
Donald Colliver, Ph.D., P.E., Presidential Member*, University of Kentucky, Lexington, AL*

2. Principles of Energy Efficient HVAC for Manufacturing Facilities
J. Kelly Kissock, Ph.D., P.E., Member*, University of Dayton, Dayton, OH*

3. Industrial Energy Management: Beyond Monthly Bills
John Gardner, CPMP*, Boise State University, Boise, ID*

9:45 AM-10:45 AM

SEMINAR 42 (INTERMEDIATE)

Ground Source Heat Pumps and Solar Together: Highest Energy Efficiencies Become Possible

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: Salon D
Sponsor: 06.07 Solar Energy Utilization, 06.08 Geothermal Heat Pumps and Energy Recovery Applications
Chair: Khalid Nagidi, BEAP, Member, Energy Management Consulting Group, Wantagh, NY

Advanced net-positive energy building designs require renewable energy generation, usually solar and/or geothermal heat pumps. Integrating solar thermal technology with ground source heat pumps is a natural match, and if used correctly, can increase the effectiveness and reduce the cost of both systems. The 25–65% of solar thermal energy often wasted can be utilized for integrated systems. With PV to power the heat pumps, net-positive energy on an annual basis is achievable. A two-year case study is discussed. The control sequences and integration techniques developed and proven for the GSHP and solar combined systems are described.

1. Hybrid GSHP and Solar Thermal Systems for Sustainable Design
Cary Smith, Member*, Sound Geothermal Corp., Sandy, UT*

2. Integrating a GSHP with Solar Thermal Radiant Floor Heating, a Case Study of a Net Positive Solar Home
Gaylen Atkinson, Member*, Atkinson Electronics, Salt Lake City, UT*

9:45 AM-10:45 AM

SEMINAR 43 (BASIC)

Improved Indoor Air Quality and Reduced Maintenance Utilizing Chilled Beam Systems

Track: Indoor Air Quality
Room: 206/207
Sponsor: 05.03 Room Air Distribution
Chair: Thomas Rice, Member, SEMCO LLC, Columbia, MO

The application of chilled beam systems exists to provide two basic needs of any building: improved indoor air quality and energy savings. What the building management realizes after implementation is that not only are the occupants gaining a significantly better environment, but also the facility managers have considerably less maintenance to ensure sustained occupant comfort. This seminar reviews the impact to the primary air system that delivers air to chilled beam systems and what is required to maintain the chilled beam system. It also covers the areas of impact on ASHRAE Standard 55 and ASHRAE Standard 62.1.

1. Chilled Beam Impact on Primary Air Systems to Improve Indoor Air Quality
***Thomas Rice, Member**, SEMCO LLC, Columbia, MO*

2. Reduced Maintenance with Sustained Comfort Using Chilled Beams
***Chris Lowell, Member**, Halton Company, Scottsville, KY*

9:45 AM-10:45 AM

SEMINAR 44 (INTERMEDIATE)

Safety and Ventilation

Track: HVAC&R Systems and Equipment
Room: 204/205
Sponsor: Publishing and Education Council
Chair: Reinhard Radermacher, Ph.D., Fellow ASHRAE, University of Maryland, College Park, MD

This session offers presentations based on a select group of recently published papers from the ASHRAE journal, *Science and Technology in the Built Environment*, regarding new research in safety and ventilation burning speed of refrigerants, and demand-controlled ventilation for multiple-zone HVAC systems.

1. Developing Alternative Approaches to Predicting the Laminar Burning Speed of Refrigerants Using the Minimum Ignition Energy, 1584-TRP
***Askari Omid**[1], Mohammad Janbozorgi[2], Robinson Greig[1], Ali Moghaddas[1] and Hameed Metghalchi[1], (1)Northeastern University, Boston, MA, (2)University of Southern California, Los Angeles, CA*

2. Demand Controlled Ventilation for Multiple Zone HVAC Systems, Part 1: CO2-Based Dynamic Reset (RP 1547)
***Josephine Lau, Ph.D., Associate Member**[1] and Xingbin Lin, Ph.D., Associate Member[2], (1)University of Nebraska–Lincoln, Omaha, NE, (2)Nexant Inc., Wheaton, IL*

11:00 AM-12:30 PM

TECHNICAL PAPER SESSION 8 (INTERMEDIATE)

Residential Systems Evaluation

Track: HVAC&R Fundamentals and Applications
Room: 206/207
Chair: Pradeep Bansal, Ph.D., Fellow ASHRAE, Oak Ridge National Laboratory, Oak Ridge, TN

The reside/ntial sector uses more energy than the commercial sector but receives much less attention from engineers. This session examines three important topics related to residential energy use. Hot water accounts for about 1/5 of residential use, and a new study proposes a new method for estimating hot water energy use in individual residences. The impact of attic ventilation is re-examined in hot and humid climates, and the impact of flow measurement devices on the actual flow in residential returns is investigated.

1. Estimating Daily Domestic Hot Water Use in North American Homes (At-15-021)
***Danny S. Parker**[1], Philip Fairey, Member[1], and James D. Lutz, P.E., Member[2], (1)Florida Solar Energy Center, Cocoa, FL, (2)Retired, Oakland, CA*

2. Evaluation of Air Flow Measurement Methods for Residential HVAC Returns (AT-15-022)
***Iain Walker, Ph.D., Fellow ASHRAE** and John Christopher Stratton, Lawrence Berkeley National Laboratory, Berkeley, CA*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 16 (BASIC)

HVAC System Topics

Track: HVAC&R Systems and Equipment
Room: Grand Ballroom D
Chair: Henry A. Becker, Member, H-O-H Water Technology, Inc., Palatine, IL

HVAC system efficiency is critical to the comfort and energy efficiency of a facility, and this session looks at several topics important to system comfort and efficiency. It includes a look at the energy and comfort impacts of upgrading a 40-year-old system and provides data useful for fault detection in dual-duct systems. There is increasing interest in systems that separate dehumidification from sensible cooling and the design of a liquid desiccant system suitable for residential dehumidification, while factors that influence the amount of recirculated air entering air cooled condensers is examined in another study.

1. Assessment of Existing Station Ventilation System and Development of Potential Replacements (AT-15-C050)
***Andrew J. Rhodes, Member** and Alex Lofting, Arup North America Ltd., San Francisco, CA*

2. Experimental Study of Laboratory-Controlled Faults in Dual-Duct Variable Air Volume System (AT-15-C051)
***Ran Liu, Ph.D., Associate Member**[1], Xiaohui (Joe) Zhou, Ph.D., P.E., Member[2], Robert Milbrandt, P.E., Member[3] and Scott Lochhead, P.E.[1], (1)Iowa Energy Center, Ankeny, IA, (2)Iowa Energy Center, Ames, IA, (3)Iowa State University, Ames, IA*

3. Energy Efficient Dehumidification by Solar Driven Liquid Desiccant Systems for Residential Application (AT-15-C052)
***Ryan P Everly**, Esdras Murillo and Ulrike Passe, Iowa State University, Ames, IA*

4. Analysis of Airflow Patterns and Air Temperature Distribution Surrounding Air Cooled Chillers (AT-15-C053)
***Kishor Khankari, Ph.D., Member**, AnSight LLC, Ann Arbor, MI*

11:00 AM-12:30 PM

SEMINAR 45 (INTERMEDIATE)

Designing for Variable Refrigerant Flow Systems with ASHRAE Standard 15 in Mind

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 08.07 Variable Refrigerant Flow
Chair: Paul Doppel, Member, Mitsubishi Electric, Suwanee, GA

The theme of the session is to provide engineers with a real-world look at designing variable refrigerant flow (VRF) systems in various building applications with an understanding of how ASHRAE Standard 15 applies. There are several places in ASHRAE 15 that the designer should be aware of when designing with VRF systems. This session merges awareness of the standard with application in the building.

1. VRF Piping that Makes Sense
***John Molnar, Dr.Ing., P.Eng., Member**, Armstrong Fluid Technology, Toronto, ON, Canada*

2. Follow the Refrigerant
***Brian Bogdan, Member**, LG Electronics USA, Inc., Roswell, GA*

3. Risk Management and VRF
***Douglas Tucker, Member**, Mitsubishi Electric, Suwanee, GA*

4. Connecting the Spaces
***Paul Doppel, Member**, Mitsubishi Electric, Suwanee, GA*

11:00 AM-12:30 PM

SEMINAR 46 (ADVANCED)

Energy Efficiency and Renewable Energy Sources for Cold Chain Energy Supply

Track: Refrigeration
Room: Salon D
Sponsor: 02.08 Building Environmental Impacts and Sustainability, AASA
Chair: Ashish Rakheja, P.E., Member, AECOM, New Delhi, India

Energy use in building is responsible for more than 30% of the global CO2 emissions and has a significant role in climate change mitigation, given the large potential savings in both new and existing buildings. This is true for the developed as well as developing countries. With the changing economies and lifestyles there is a good potential for growth in the Cold Chain sector, especially in the developing countries. The construction and operation of cold chain projects have been undertaken by the developing countries and their substantial scope to incorporate energy efficiency and renewable energy in these cold chain buildings. This effort presents a major challenge to the planners, designers and operators of these projects; however, it will result in ensuring the reduction of an environmental footprint of these spaces. In this seminar, global experts present on the role of energy efficiency and renewable energy sources for cold chain energy supply.

1. Prospects of a Net Zero Energy Food Production Facility
***Douglas Reindl, Ph.D., P.E., Member**, University of Wisconsin-Madison, Madison, WI*

2. Ammonia Industrial Refrigeration
***Cesar Luis Lim, Member**, Archen Technologies Inc., NCR, Philippines*

3. Sustainable Supermarket Design
***Roberto Aguilo**, Estudio Aguilo, Buenos Aries, Argentina*

4. Toward Green Cold Chain Projects
***Arvind Surange, P.E., Fellow ASHRAE**, ACR Project Consultants PVT Ltd., Pune, India*

11:00 AM-12:30 PM

SEMINAR 47 (INTERMEDIATE)

Minimizing Energy Consumption in Laboratory HVAC Systems: From Supply to Stack

Track: Laboratories
Room: Salon C
Sponsor: 09.10 Laboratory Systems, 04.03 Ventilation Requirements and Infiltration
Chair: Brad Cochran, P.E., Member, CPP, Inc., Fort Collins, CO

Laboratories historically use 10 to 100 times the amount of energy per ft² as a typical office building. Approximately 60% of this energy consumption is associated with the HVAC system. This seminar presents various methods to reduce the energy consumption of the HVAC system on both the supply and exhaust, while maintaining a safe environment both within the laboratory and the surrounding area.

1. Slashing Lab and Vivarium Energy Use with Demand Control Ventilation
***Gordon Sharp, Member**, Aircuity, Inc., Newton, MA*

2. Going the Extra Mile to Reduce Laboratory Exhaust Energy
***Glenn Friedman, P.E., Fellow ASHRAE**, Taylor Engineering, LLC, Alameda, CA*

3. VAV Laboratory Exhaust Techniques
***John J. Carter, Member**, CPP, Inc., Fort Collins, CO*

4. Powered Plenum Bypass: Reduce Laboratory Exhaust Fan Energy and Maintain Safety
***Martin Stangl, Member**, RWDI Consulting Engineers, Guelph, ON, Canada*

11:00 AM-12:30 PM

SEMINAR 48 (ADVANCED)

Model Predictive Control: Application to Chilled Water Plants and Radiant Slab Cooling

Track: Research Summit
Room: 204/205
Sponsor: 04.07 Energy Calculations
Chair: Philip Haves, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

Model predictive control (MPC) can improve the performance of HVAC systems, particularly those with thermal storage. The seminar illustrates the use of MPC to control a campus chilled water plant with a large thermal storage tank and to control a radiant slab cooling system. MPC can also provide a useful framework for controlling conventional chiller water plant when weather and loads change in a predictable way. The presentations provide an overview of the methods used and how they can be applied to real systems. Real and simulated results that compare the benefits of MPC to conventional control are presented.

1. Modelica-Based Model Predictive Control of a Chilled Water Plant
***Wangda Zuo, Ph.D., Member**, University of Miami, Coral Gables, FL*

2. Model Predictive Control of Radiant Slab Systems
***Frank Chuang**, University of California, Berkeley, Berkeley, CA*

3. Research to Practice: Lessons from Chilled Water Storage and Dynamic Facade MPC Implementations
***Philip Haves, Ph.D., Fellow ASHRAE[1]**, Brian Coffey, Ph.D.[2], (1) Lawrence Berkeley National Laboratory, Berkeley, CA, (2) University College London, London, United Kingdom*

11:00 AM-12:30 PM

SEMINAR 49 (INTERMEDIATE)

Moisture in Buildings and Envelopes: Simulation, Modeling and Design

Track: Modeling throughout the Building Life Cycle
Room: Grand Ballroom C
Sponsor: 04.10 Indoor Environmental Modeling, 04.04 Building Materials and Building Envelope Performance
Chair: Jonathan Sullivan, Associate Member, Burns Engineering, Philadelphia, PA

Moisture in the built environment presents challenges for designers, which, when not properly addressed, can have substantial impact on occupant comfort, indoor air quality and longevity of building materials. However, there is a toolbox for designers to assess the complex heat and mass transfer process through the building and its envelope and understand the building material parameters that affect this process. Ultimately, this seminar lays the framework for how excess moisture can be detrimental to the built environment and describes the various tools designers can utilize to analyze their designs.

1. Interior Moisture Problems in Airtight Buildings
***Sean O'Brien, P.E., Member**, Simpson Gumpertz & Heger, Inc., New York, NY*

2. Modeling Moisture Transport through the Envelope and Its Impact on the Interior Environment
***Florian Antretter, Associate Member**, Fraunhofer IBP, Holzkirchen, Germany*

3. How CFD Can Aid Designers in Analyzing Moisture Transfer in the Building Envelope
***Reza Ghias, Ph.D., Member**, Southland Industries, Dulles, VA*

4. Modeling Moisture Transmission and Condensation Risk in Indoor Environments
***Mikhail Koupriyanov, P.Eng., Associate Member**, Price Industries Limited., Winnipeg, MB, Canada*

11:00 AM-12:30 PM

SEMINAR 50 (BASIC)

The Report of My Death Was an Exaggeration

Track: Building Operation, Maintenance and Optimization/Commissioning

Room: Salon E

Sponsor: 07.03 Operation and Maintenance Management

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

All mechanical equipment dies, but sometimes equipment is retired too soon. Boilers, in particular, tend to be replaced prematurely. Often it is thought to be less costly to replace a nonworking boiler than to troubleshoot and repair it. However, experience has shown that an apparently inoperable boiler can be often revived, at a reasonable cost, and, if operated and maintained properly thereafter, can provide years of reliable service. In this seminar, we discuss reasons why steam boilers fail; which failure modes are reversible; and how to properly commission, as well as operate and maintain, your steam boiler for longevity.

1. Reviving Your Apparently Dead Steamboiler
***Mina Agarabi, P.E., CPMP, Member**, Agarabi Engineering PLLC, New York, NY*

2. Operating and Maintaining Your Boiler for Longevity
***MacDonald Smith, Member**, Raypak, Oxnard, CA*

3. Case Studies: Boilers Have It Tough in New York City
***Tom Sahagian**, Enterprise Community Partners, New York, NY*

1:00 PM-2:20 PM

SEMINAR TC (ADVANCED)

Building Integrated Solar, HVAC&R Systems For Zero CO_2 Emission And Energy Plus Buildings, Healthy Settlements And Sustainable Economy Development

Track: Research Summit

Room: 302

Sponsor: 06.07 Solar Energy Utilization

Chair: Marija Todorovic, Ph.D., P.E., Fellow ASHRAE, vea-invi.ltd, Belgrade, Serbia

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. Inspired by science behind and beyond the Solar Decathlon, a university competition in energy-efficient solar houses, this seminar presents new technologies and research strategies in energy plus buildings, as well as the most recent sustainable approach for the cities' needs, seeking more density buildings solutions, developing Smart Grids as integration of buildings at district level, developing a new and more powerful monitoring system, taking into account weather extremes including catastrophic events and building's resilience relevant features, including houses components, effectiveness and efficiency of implementing harmonious integration of building structure and its thermal mass passive/active solar with HVAC and other technical systems. **Simona Michalickova, Otília Lulkovicova and Theocharis Tsoutsos present Comparison Ideal Absorption Cycle with Solar Energy Supply and Use of Working Substances H20/LiBr and NH3/H20. Nina Hormazabal presents CasaFENIX for Emergency Post-Natural Impact Extreme. Ongun Kazanci and Bjarne W. Olesen present Utilization of Solar Energy in Energy-Plus Houses.**

1:30 PM-3:00 PM

SEMINAR 51 (INTERMEDIATE)

Fellows Debate: Attorneys Will Love BIM

Track: Modeling throughout the Building Life Cycle

Room: Grand Ballroom C

Sponsor: Conferences and Expositions Committee, College of Fellows, 01.07 Business, Management & General Legal Education

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

The complex procurement method including design, construction and operation of buildings holds the potential for conflicts between a project's technical program and commercial objectives of the players. BIM is recognized and supported as perhaps the best solution to many of these problems. But is it? Is it the answer to known failures in the procurement process or is it an oversimplified method of creating a mathematical computerized model of expectations and hopes? Will the correct use of BIM deliver the owner's expectation of building performance at completion, or will it be a fertile ground for litigation based on failure?

1. Team A Speaker 1
***Don Beaty, P.E., Fellow ASHRAE**, DLB Associates, Eatontown, NJ*

2. Team A Speaker 2
***James K. Bidgood Jr.**, Smith, Currie & Hancock LLP, Atlanta, GA*

3. Team A Speaker 3
***Dennis Knight, P.E., BEMP, Member**, Whole Building Systems, LLC, Charleston, SC*

4. Team B Speaker 1
***Richard Rooley, FREng, OPMP, Presidential Fellow Life Member**, Rooley Consultants, Bucks, United Kingdom*

5. Team B Speaker 2
***E. Mitchell Swann, P.E., Member,** MDC Systems, Paoli, PA*

6. Team B Speaker 3
***David Branson, P.E., Member,** Compliance Services Group, Lubbock, TX*

3:15 PM-4:45 PM

SEMINAR 52 (BASIC)

Indoor Environmental Quality: A Global and Holistic Perspective, Part 2

Track: Indoor Air Quality

Room: Grand Ballroom C

Sponsor: Environmental Health Committee, Presidential AdHoc, Indoor Environmental Quality, 02.01 Physiology and Human Environment

Chair: William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Pennsylvania State University, University Park, PA

The newly established Indoor Environmental Quality-Global Alliance (IEQ-GA) provides guidance on the definition of acceptable indoor environmental quality, with an emphasis on thermal conditions and indoor air pollution, to ensure that the knowledge gathered from indoor environmental quality (IEQ) research is promulgated to, and implemented by, IEQ practitioners and regulatory bodies worldwide. The IEQ is influenced by several parameters like thermal comfort, indoor air quality (ventilation), lighting and acoustics. The seminar presents a holistic approach to indoor environmental quality and gives information on different societies' activities to improve the indoor environment.

1. The Influence of Indoor Lighting on Comfort and Health
***Rita Harrold, Member**, Illuminating Engineering Society, New York, NY*

2. The Role of Ventilation in Indoor Environmental Quality
***Max Sherman, Fellow ASHRAE**, Residential Building Systems Group, Lawrence Berkeley National Laboratory, Berkeley, CA*

3. What Every IAQ/IEQ Practitioner Needs to Know: The IAQA/AIHA Body of Knowledge Project
***Mary Ann Latko, Member**, American Industrial Hygiene Association, Washington DC, DC*

4. Post Occupancy Investigations of Indoor Environmental Quality
***Donald Weekes, Member**, Indoor Air Quality Association, Ottawa, ON, Canada*

5:00 PM-6:00 PM

SEMINAR TC (INTERMEDIATE)

Smoke Spread in Rail Cars and Recent Subway Fire Event Ventilation Issues

Track: HVAC&R Systems and Equipment

Room: Pavilion 4

Sponsor: 05.09 Enclosed Vehicular Facilities, 05.06 Control of Fire and Smoke

Chair: Igor Maevski, Ph.D., P.E., Member, Jacobs Engineering, New York, NY

OPEN SESSION: no badge required; no PDHs awarded; presented during the TC's meeting. One person was killed and several were injured as the result of smoke in the recent WMATA L'Enfant Plaza fire event.

The seminar discusses some lessons learned from smoke ventilation. Smoke development inside a train car is a topic that has not been studied extensively due to the complexity of the problem and the need for a real train car that can be used for tests as well as appropriate fire research facilities to conduct these tests in a controlled environment. Studies on a full-scale train were performed in Carleton University. Presentations discuss the experimental data on fire development and smoke movement for the intercity train car fire. The results of this analysis about flame spread speed and window breaking effects are discussed and a comparison is made with the heat release rate.

1. Fire Development and Smoke Movement during a Full-Scale Train-Car Fire
George Hadjisophocleous, Ph.D., Member*, Carleton University, Ottawa, ON, Canada*

2. Discussion on the Recent Wmata Fire Event
David G. Newman, P.E., Member*, Hatch Mott MacDonald, Westwood, MA*

Wednesday, July 1

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 9 (BASIC)

Operation of HVAC Systems

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: 204/205
Chair: Alan Neely, Member, Grumman/Butkus Associates, Evanston, IL

Many approaches have been developed to improve the operational efficiency of HVAC systems over the last couple decades. The development of fault detection software has been an important part of this operational evolution. This session describes two new fault detection devices and also discusses a simple algorithm to identify and eliminate hunting behavior in HVAC systems.

1. Development of a Fault Detection and Diagnostic Tool for Use in Industrial Energy Audits (AT-15-023)
Priyam Parikh *and Bryan Rasmussen, Texas A&M University, College Station, TX*

2. Identification and Elimination of Hunting Behavior in HVAC Systems (AT-15-024)
Rohit Hari Chintala*, Christopher R Price, Shuangshuang Liang and Bryan Rasmussen, Texas A&M University, College Station, TX*

8:00 AM-9:30 AM

TECHNICAL PAPER SESSION 10 (INTERMEDIATE)

Terminal Unit Performance

Track: HVAC&R Systems and Equipment
Room: 206/207
Chair: Monte G. Troutman, PE, Member, B.C. Engineering, Inc., Evansville, IN

Fan-powered terminal units are important components that can have a significant effect on the performance and energy efficiency of a distribution system. Each of the three papers in this session provides important new information to enable better simulation of fan-powered terminal units in common hourly simulation programs.

1. A Simplified Model of the Fan/Motor Performance of Fan Powered Terminal Units that Utilize Electronically Commutated Motors (AT-15-025)
Dennis O'Neal, Fellow ASHRAE*, Carl L Reid and Douglas D Ingram, Baylor University, Waco, TX*

2. Development of Models to Simulate the Part Load Performance of Oversized ECM Fan-Powered Terminal Units (AT-15-026)
Dennis O'Neal, Fellow ASHRAE*, Baylor University, Waco, TX*

3. In-Situ Fan Differential Pressure Rise for a Series VAV Fan Powered Terminal Unit with SCR Control (AT-15-027)
John Bryant, Ph.D., P.E., Member*[1] and Stephen J. Bryant[2], (1)Texas A&M University, College Station, TX, (2)Dynamic Systems, Inc., College Station, TX*

4. Modeling Fan-Powered Terminal Unit Fan/Motor Combinations Controlled by Silicon-Controlled Rectifiers (AT-15-028)
Dennis O'Neal, Fellow ASHRAE*, Douglas D Ingram and Carl L Reid, Baylor University, Waco, TX*

8:00 AM-9:30 AM

CONFERENCE PAPER SESSION 17 (INTERMEDIATE)

New Refrigerants and Analytics for Refrigeration

Track: Refrigeration
Room: Grand Ballroom C
Chair: Jennifer E. Leach, P.E., Member, Cummins-Wagner Co, Inc., Annapolis Junction, MD

Some of the greatest advancements in our industry continue to be in refrigerants, particularly with regard to global warming potential. These presentations cover regulatory actions, modeling of household refrigerators, how to achieve safety through management and how to save energy through refrigerant selection.

1. Assessment of Next Generation Refrigerant R-452A to Replace R-404A for Transport Refrigeration Products (AT-15-C054)
Steve Kujak, Member*[1], Jeff Berge[2], Julie Majurin, Associate Member[1], Michal Kolda[3] and Dermott Crombie[4], (1)Ingersoll Rand, La Crosse, WI, (2)Ingersoll Rand, Minneapolis, MN, (3)Ingersoll Rand, Prague, Czech Republic, (4)Ingersoll Rand, Galway, Ireland*

2. Managing Refrigerants with New Mobile Technology to Optimize Economic and Environmental Outcomes (AT-15-C055)
Jeff Cohen*, EOS Climate, San Francisco, CA*

3. A Transient Refrigerator Model Validated Using R600a as a Low-GWP Alternative (AT-15-C056)
Adam Rhoads, Associate Member*[1], Anderson Bortoletto[2], Cara Martin[1] and Reinhard Radermacher, Ph.D., Fellow ASHRAE[3], (1)Optimized Thermal Systems, Inc., College Park, MD, (2)Sub-Zero, Madison, WI, (3)University of Maryland, College Park, MD*

4. Using a Big Data Analytics Approach to Unlock the Value of Retail Refrigeration Case Parametric Data (AT-15-C057)
Niall Brady, P.Eng.*[1], Paulito Palmes, Ph.D.[1] and John Walsh, P.Eng.[2], (1)IBM Research, Dublin, Ireland, (2)IEEE, Dublin, Ireland*

8:00 AM-9:30 AM

SEMINAR 53 (INTERMEDIATE)

Calibrating Operational CFD Models for Real Data Centers

Track: Modeling throughout the Building Life Cycle
Room: Salon A/B
Sponsor: 04.10 Indoor Environmental Modeling, 09.09 Mission Critical Facilities, Technology Spaces and Electronic Equipment
Chair: Nick Gangemi, Member, ASHRAE TC9.9, Rochester, NY

CFD is routinely used for data center design and operation. However, while it is comparatively easy to use CFD successfully for design, when input data is only approximate and there are no measured values for comparison, it is much more difficult to successfully utilize CFD for managing ongoing changes in and optimizing the performance of a real data center. The key to success, and the subject of this seminar, is the creation of a calibrated model, accurate by virtue of its fidelity to and ability to model the physics of the real facility rather than by arbitrary tweaks or assumptions.

1. Importance of Tile Momentum Correction in CFD Simulation of Data Center Temperature Field
H. Ezzat Khalifa, Ph.D., Fellow ASHRAE*, Syracuse University, Syracuse, NY*

2. Developing a Calibrated CFD Model of a 7,400 Ft^2 Raised-Floor Data Center
James VanGilder, P.E., Member*, Schneider Electric, Billerica, MA*

3. Critical CFD Decisions to be Able to Calibrate a Model for Effective Operational Data Center Cooling Performance Management
Mark Seymour, Member*, Future Facilities Ltd, London, United Kingdom*

8:00 AM-9:30 AM

SEMINAR 54 (INTERMEDIATE)

Design of Energy Efficient Hydronic Heating Systems

Track: HVAC&R Systems and Equipment
Room: Grand Ballroom D

Sponsor: 06.01 Hydronic and Steam Equipment and Systems, 06.05 Radiant Heating and Cooling
Chair: David Lee, P.Eng., Member, Armstrong Fluid Technology, Toronto, ON, Canada

The latest evolution of boiler and hot water circulator technology has dramatically improved the energy efficiency of these individual products. But simply installing high efficiency condensing water boilers or ECM circulators in a building does not guarantee lower energy consumption or lower operating costs. This seminar covers some of the design strategies, legislative requirements and equipment selection methodology needed for designing a hydronic heating system that will not only provide enough hot water but will also optimize energy performance. A case study of these best practices applied toward an installation with radiant heating is also be presented.

1. How to Maximize Energy Efficiency with Hybrid Boiler Systems
***Thomas Neill**, Mestek, Westfield, MA*

2. The Role of the Circulator and Its Effect on Hydronic System Efficiency
***Andy Januszewski**, Armstrong Fluid Technology, Toronto, ON, Canada*

3. Start with Efficiency and Work Backwards: Low Temperature Space Heating for a Multipurpose Industrial Facility
***Robert Bean, Member**, Indoor Climate Consultants Inc., Calgary, AB, Canada*

8:00 AM-9:30 AM

SEMINAR 55 (INTERMEDIATE)

Green Building Acoustics: Making Green Sound Good

Track: High Performance Buildings
Room: Salon E

Sponsor: 02.06 Sound and Vibration Control
Chair: Erik Miller-Klein, P.E., Member, SSA Acoustics, LLP, Seattle, WA

Many green buildings built to date unfortunately suffer from poor acoustic environments, but updated standards for high performance buildings and methods for monitoring indoor environmental quality can lead to better consideration of green building acoustics. This session reviews these recent advances, as well as discusses how elements of high performance design can work synergistically with acoustics to achieve good acoustical environments.

1. Global Developments in Green Building IEQ-Acoustic Comfort
***Kenneth P. Roy, Ph.D., Member**, Armstrong World Industries, Lancaster, PA*

2. Best Practice for Evaluating and Improving the Acoustic Performance of Commercial Buildings
***Curt Eichelberger, P.E., Member**, Johnson Controls, Inc., York, PA*

3. Synergies Between High Performance Buildings and Good Acoustics
***Ralph T. Muehleisen, Ph.D., P.E., Member**, Argonne National Laboratory, Lemont, IL*

8:00 AM-9:30 AM

SEMINAR 56 (BASIC)

Innovation for Food Retail: The 50% Advanced Energy Design Guide for Grocery Stores

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: Salon C

Sponsor: 02.08 Building Environmental Impacts and Sustainability, 10.07 Commercial Food and Beverage Cooling Display and Storage
Chair: Andrew Parker, NREL, Golden, CO

The next in the successful series of advanced energy design guides is targeted toward the grocery store sector. The guide shows practical ways for grocery stores to achieve 50% energy savings over Standard 90.1-2004 and exceeds the requirements of 90.1-2013. The guide, while intended for grocery stores, includes specialty sections for refrigeration and food service found not only in grocery stores but in convenience stores and food service establishments. Speakers highlight the guide, providing practical how-to tips to achieve the 50% savings level. The guide also helps those who build or design retail stores that may include refrigeration.

1. The Big Picture: Guide Overview and Analysis
***Paul Torcellini, Ph.D., P.E., Member**, NREL, Golden, CO*

2. Envelope: Walls, Windows, Infiltration, and Special Uses
***Merle McBride, Ph.D., P.E., Life Member**, Owens Corning, Center of Science and Technology, Granville, OH*

3. Lighting: Effectively Connecting the Customer with Food
***Michael Lane, Member**, Puget Sound Energy, Seattle, WA*

4. Refrigeration and HVAC: Saving the Biggest for Last
***Caleb Nelson, P.E., Associate Member**, CTA, Inc., Missoula, MT*

8:00 AM-9:30 AM

SEMINAR 57 (INTERMEDIATE)

Commercial Kitchen Ventilation Commissioning

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon D

Sponsor: 05.10 Kitchen Ventilation, 07.09 Building Commissioning
Chair: Francis Kohout, P.E., CPMP, Member, McDonald's Corp., Oak Brook, IL

Proper commissioning of a commercial kitchen ventilation (CKV) system is necessary to ensure its safe and efficient operation. It is also becoming a common requirement for compliance with local codes and sustainability certifications. This seminar presents critical elements to be considered as part of the commissioning process, from the owners' project requirements through owner acceptance.

1. An Overview of the Commercial Kitchen Ventilation Commissioning Process
***Ben Skelton, P.E., BEMP, Member**, Cyclone Energy Group, Chicago, IL*

2. Exhaust Hoods: From Selection to Air Balance to Operation
***Russell Robison, Member**, Gaylord Industries, Tualatin, OR*

3. Demand Control Kitchen Ventilation (DCKV): How It's Done from Design to Technical Commissioning
***Vernon Smith, P.E., Member**, Smith Energy Engineers, LLC, Berthoud, CO*

4. Demand Control Kitchen Ventilation (DCKV) Case Studies
***Michael Morgan, Associate Member**, Captive Aire Systems, Inc., Allentown, PA*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 11 (INTERMEDIATE)

Analysis by Modeling

Track: HVAC&R Fundamentals and Applications
Room: 204/205
Chair: Helen R. Cerra, Member, ChemTreat, Inc., Glen Allen, VA

Detailed models are becoming increasingly important as computational power grows. This session looks at the use of models for the design of backward centrifugal fans, modeling of airflow and temperature distributions in unconditioned attics and, and it surveys existing models for modeling the radiative sky cooling from roofs to the sky.

1. Survey of Sky Effective Temperature Models Applicable to Building Envelope Radiant Heat Transfer (AT-15-029)
***Salem Algarni** and Darin W. Nutter, Ph.D., Fellow ASHRAE, University of Arkansas, Fayetteville, AR*

2. Develop a Radiant System Module for the Simulation and Analysis of Spaces and Systems (1383-RP) (AT-15-030)
***Charles S. Barnaby, BEMP**[1] and Curtis O. Pedersen, Ph.D., Fellow ASHRAE[2], (1)Wrightsoft Corp., Lexington, MA, (2)University of Illinois at Urbana–Champaign, Champaign, IL*

3. Investigation of Attic Space Airflow and Temperature Distribution, Using a Computational Fluid Dynamics Program (AT-15-031)
***Ahmed Cherif Megri** and Abd Alnasser Almate A. Ali, North Carolina A&T State University, Greensboro, NC*

9:45 AM-10:45 AM

TECHNICAL PAPER SESSION 12 (BASIC)

Water and Energy

Track: Research Summit
Room: 206/207
Chair: Samir Traboulsi, P.Eng., Member, Thermotrade/Ranec, Beirut, Lebanon

The 'energy-water nexus' is receiving considerable attention, and this session offers a different energy-water nexus. It includes three papers on energy use in buildings that each involve water. Two use water for cooling in ways that are not yet common, and the third uses a water-pumping system to measure the impact of harmonic distortion on the energy use of a motor-pump-VFD system.

1. Experimental Investigation of Energy Performance of a Variable Frequency Drive on a Drive-Motor-Pump System (AT-15-032)
Gang Wang, Ph.D., Member*, Esber Andiroglu and James Sprinkle, University of Miami, Coral Gables, FL*

2. Feasibility Study of Deep Lake Water Cooling System in Ryerson University (AT-15-033)
Hessam Taherian*[1], Alan S. Fung, Ph.D., P.E., Member[1], Md. Ziaur Rahman[2] and Mohamed MM Selim[1], (1)University of Alabama at Birmingham, Birmingham, AL, (2)Ryerson University, Toronto, ON, Canada*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 18 (BASIC)

Personal Heating, Cooling and Ventilation

Track: HVAC&R Systems and Equipment
Room: Grand Ballroom D
Chair: Monte G. Troutman, PE, Member, B.C. Engineering, Inc., Evansville, IN

Personal heating and cooling systems can be used as a way to achieve energy savings and thermal comfort. This session presents studies evaluating personal heating and cooling systems and their appropriateness for use in commercial buildings.

1. Numerical Simulation for Thermal Comfort Using Conditioned Air through Mixing and Personalized Ventilation Systems in Field Environmental Chamber (FEC) (AT-15-C058)
Essam E. Khalil, Ph.D., Fellow ASHRAE*, Esmail ElBially, Ph.D., Omar Huzzain, Dr.Ing. and Hossam ElMaghraby, P.E., Cairo University, Cairo, Egypt*

2. Climate Chamber Tests for Measuring Performance Characteristics of a Personal Cooling System (AT-15-C059)
Wim Zeiler, *Jacob C.G. Verhaart, Michal Vesely and Rongling Li, Ph.D., Eindhoven University of Technology, Eindhoven, Netherlands*

3. Performance of Personalized Heating (AT-15-C060)
Wim Zeiler, *Michal Vesely and Jacob C.G. Verhaart, Eindhoven University of Technology, Eindhoven, Netherlands*

9:45 AM-10:45 AM

CONFERENCE PAPER SESSION 19 (BASIC)

Residential Research and Building Occupants

Track: Research Summit
Room: Salon C
Chair: Suzanne LeViseur, PE, Haddad Engineering, Inc.

The residential sector is a major energy user. This session reports research that has investigated different factors that influence residential energy efficiency and comfort. One paper takes a look at the complex interactions between thermal and visual comfort and energy use that need to be considered to optimize the use of shading devices. Data mining is used to develop a new day ahead load forecasting model for individual houses, and the increasingly important role of the occupant and occupancy levels in high performance housing is examined.

1. Measured Occupancy Levels in Apartments and the Consequential Simulated Energy Benefit from Demand Controlled Ventilation (AT-15-C061)
Dennis Johansson, Ph.D., Associate Member*[1] and Hans Bagge, Ph.D., Associate Member[2], (1)Lund University, Building Services, Lund, Sweden, (2)Lund University, Building Physics, Lund, Sweden*

2. Impact of Solar Optical Properties of Roller Shades on Energy, Daylighting and Comfort (AT-15-C062)
Ying-Chieh Chan, Student Member*[1], Athanasios Tzempelikos, Associate Member[1] and Brent Protzman[2], (1)Purdue University, West Lafayette, IN, (2)Lutron Electronics Co., Inc., Coopersburg, PA*

3. A Hybrid Model for Electrical Load Forecasting- a New Approach Integrating Data-Mining with Physics-Based Models (AT-15-C063)
Zhaoxuan Li, Ph.D., Student Member *and Bing Dong, Ph.D., Member, University of Texas at San Antonio, San Antonio, TX*

9:45 AM-10:45 AM

SEMINAR 58 (ADVANCED)

Energy Targets for Commercial Buildings, An Update on 1651-RP

Track: Research Summit
Room: Grand Ballroom C
Sponsor: MTG.ET Energy Targets
Chair: Don Brandt, Member, Trane, Inc. (Retired), Phoenix, AZ

The session provides an update on progress in 1651-RP, developing maximum technically achievable energy targets for a variety of commercial building types and climate zones. Preliminary analysis results from the simple and complex energy efficiency measures (EEMs) using the reference building modes in all climate zones throughout the United States, which is discussed.

1. Update on 1651-RP Development of Maximum Technically Achievable Energy Targets for Commercial Buildings (Ultra-Low-Energy Use Buildings)
Jason Glazer, P.E., Member*, GARD Analytics, Inc., Arlington Heights, IL*

2. Reference Buildings for Simulation: 16 Buildings in 17 Climate Zones
Drury Crawley, Ph.D., BEMP, Fellow ASHRAE*, Bentley Systems, Inc., Washington, DC*

9:45 AM-10:45 AM

SEMINAR 59 (INTERMEDIATE)

Method of Testing the Performance of Cool Storage Systems: Standard 150

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 06.09 Thermal Storage
Chair: Geoffrey C. Bares, Associate Member, CB&I, Plainfield, IL

ASHRAE Standard 150 was created in order to provide a uniform test method for evaluating the performance of cool thermal energy storage systems. This session focuses on how to properly implement ASHRAE Standard 150 to determine the available capacity, efficiency and ability of the thermal energy storage device to meet the cooling load. It also includes a case study that utilized ASHRAE Standard 150 to commission the thermal storage system.

1. ASHRAE Standard 150: An Overview
John Nix*, FPL, Miami, FL*

2. Case Study: Major Theme Park Commissions Its TES System
Lucas B. Hyman, P.E., Member*, Goss Engineering, Inc., Corona, CA*

9:45 AM-10:45 AM

SEMINAR 60 (BASIC)

Steam Tips for the Engineer, Contractor, Commissioning Authority and Building Operator

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon D
Sponsor: 07.07 Testing and Balancing
Chair: Justin Garner, Member, Engineered Air Balance Co, Inc., Houston, TX

Working with steam is becoming a lost skill in our industry. Some engineers and owners choose not to install a steam system because they are afraid of the unknown. The tips discussed in this seminar provide useful information regarding the parts of a building steam system and what is needed to verify operation and performance.

1. Steam Tips: For Engineers, Contractors, Cx Personnel and Building Operators
***Thomas Schlachter, P.E., Member**, Engineered Air Balance Co, Inc., Dallas, TX*

9:45 AM-10:45 AM

FORUM 4 (ADVANCED)

Best Practices in Sustainable Design around the Globe

Track: High Performance Buildings
Room: Salon E
Sponsor: 02.08 Building Environmental Impacts and Sustainability, AASA
Chair: Ashish Rakheja, P.E., Member, AECOM, New Delhi, India

Buildings are responsible for more than 30% of the global CO2 emissions and play a significant role in climate change mitigation, given the large potential savings in both new and existing spaces. For new buildings, sustainable design practices can play a central role in achieving these potential savings. Such sustainable design practices responsive to respective climate zones can contribute significantly towards achieving net-zero or net-positive energy targets for buildings. AASA member speakers from different countries discuss best practices in sustainable design. The main outcome of this forum is to identify these sustainable design practices for all climatic zones. The discussion includes innovative design practices, their advantages, applications and experiences that have been able to push the sustainability envelope in respective climate zones.

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 20 (INTERMEDIATE)

Important Factors for a High Performance Building

Track: High Performance Buildings
Room: Salon E
Chair: Suzanne LeViseur, PE, Haddad Engineering, Inc.

Measuring actual performance of buildings (residential, command, institutional and industrial) to determine the effectiveness of energy efficient design strategies can surface shortcomings in the design, construction and operation of high performing buildings. This session highlights how such performance studies can result in the advancement of high performing building design and optimization of performance.

1. Simple Ways to Make Your Buildings Be High Performing (AT-15-C068)
***Stephen W. Duda, P.E., BEAP, HBDP and HFDP, Fellow ASHRAE**, Ross & Baruzzini, Inc., St. Louis, MO*

2. Impact of Envelope Airtightness on Small Commercial Building Performance (AT-15-C069)
***Marshall L. Sweet, Ph.D.**, Mike Barcik, Member and Sydney G. Roberts, Ph.D., Southface Energy Institute, Atlanta, GA*

3. Horizontal Temperature Distribution in a Plus-Energy House: Cooling Season Measurements (AT-15-C070)
***Ongun B. Kazanci, Student Member** and Bjarne W. Olesen, Ph.D., Technical University of Denmark, Kongens Lyngby, Denmark*

11:00 AM-12:30 PM

CONFERENCE PAPER SESSION 21 (BASIC)

Ventilation and IAQ

Track: Indoor Air Quality
Room: 206/207
Chair: Chuck Curlin, P.E., Member, Shultz Engineering Group, Charlotte, NC

Thermal comfort and IAQ are often ventilation-dependent. This session provides design and operational guidance to improve IAQ in spite of often less-than-ideal ventilation circumstances in a wide range of buildings.

1. Numerical Investigation for Airflow and Thermal Comfort in an Air-Conditioned Open Football Stadium (AT-15-C064)
***Essam E. Khalil, Ph.D., Fellow ASHRAE**, Esmail ElBially, Ph.D., Gamal Elharriry, Dr.Ing. and Mohamed Sobhi, P.E., Cairo University, Cairo, Egypt*

2. A VAV System HEAT Recovery Economizer to Furnish Free Humidification and Exceed Standard 62.1 Ventilation Requirements in Winter (AT-15-C065)
***Mike Scofield, P.E., Fellow Life Member**[1] and Vijayanand Periannan, Member[2], (1)CONSERVATION MECHANICAL SYSTEMS, Sebastopol, CA, (2)Munters Corporation, Buena Vista, VA*

3. Evaluation of Ozone Removal Performance of Ultraviolet Photocatalytic Oxidation Air Cleaning Systems (AT-15-C066)
***Chang-Seo Lee, Ph.D., Associate Member**[1], Lexuan Zhong, Ph.D., Student Member[1], Fariborz Haghighat, Ph.D., P.E., Fellow ASHRAE[1], Carolyn Coulthrust[1] and Ali Bahloul, Ph.D.[2], (1)Concordia University, Montreal, QC, Canada, (2)IRSST(Institut de recherche Robert-Sauve en sante et en securite du travail), West Montreal, QC, Canada*

4. Using a CO2 Feedback System in a Naturally Ventilated Space to Control Ventilation (AT-15-C067)
***Salman Ilyas, Member**[1], Ashley Emery, Fellow ASHRAE[2] and Dean Heerwagen, Life Member[2], (1)Arup, Los Angeles, CA, (2)University of Washington, Seattle, WA*

11:00 AM-12:30 PM

SEMINAR 61 (INTERMEDIATE)

Assessing the Effectiveness and Value of Using Fault Detection and Diagnostics Tools

Track: Building Operation, Maintenance and Optimization/Commissioning
Room: Salon D
Sponsor: 07.05 Smart Building Systems, TC 1.5 - Computer Applications, 07.03 Operation and Maintenance Management
Chair: David P. Yuill, Ph.D., P.E., Member, University of Nebraska, Omaha, NE

Fault detection and diagnostics (FDD) tools aid building operation and maintenance personnel by alerting them to the presence of faults that can cause degradation in equipment life, capacity and energy efficiency, and by diagnosing the fault type. These faults might otherwise go unnoticed, so there is significant potential to provide value to owners and operators of HVAC equipment. For this reason FDD is increasingly being adopted and included in codes and standards. This seminar objectively examines the performance of FDD and the actual value that FDD can provide when consideration of the FDD tools' effectiveness and practical application are included.

1. FDD for AHUs: A Value Proposition for Building Operators?
***Adam Regnier, Student Member**, Drexel University, Philadelphia, PA*

2. If It Ain't Broke…: Identifying the Value That an RTU FDD Tool Brings
***Kristin Heinemeier, Ph.D., Member**, Western Cooling Efficiency Center UC Davis, Davis, CA*

3. A Standard Method to Evaluate the Performance of FDD for RTU and Split Systems
***David P. Yuill, Ph.D., P.E., Member**, University of Nebraska, Omaha, NE*

4. A Figure of Merit to Quantify the Total Value of Using an FDD Tool
***David P. Yuill, Ph.D., P.E., Member**, University of Nebraska, Omaha, NE*

11:00 AM-12:30 PM

SEMINAR 62 (INTERMEDIATE)

Natural Ventilation: Balancing Health and Energy in Health-Care Facilities

Track: Indoor Air Quality
Room: Salon C
Sponsor: Environmental Health Committee, 09.06 Health-Care Facilities
Chair: Erica Stewart, Member, Kaiser Permanente, Oakland, CA

Health-care associated infections (HAIs) account for an estimated 100,000 deaths a year in the U.S. alone. While Europe, Asia and Africa have employed natural ventilation in health-care facilities for many years, this approach has been largely discouraged in North America. This seminar provides a summary of the infection data collected to date; describes the different natural ventilation strategies employed in different

parts of the world; compares the standards and guidelines that underpin building codes; and illustrates actual design solutions with case studies that have been built in the Caribbean, Africa and Asia.

1. Natural Ventilation: A Sustainable Solution to Infection Control in Health-Care Settings in Resource-Poor Contexts
***Hal Levin, AIA, Fellow ASHRAE**, Building Ecology Research Group, Santa Cruz, CA*

2. Design Strategies for Natural Ventilation for Infection Control
***Yuguo Li, Ph.D., Fellow ASHRAE**, Hong Kong University, Hong Kong, China*

3. Applications and Considerations of Natural Ventilation in Resource-Limited Settings
***Arash Guity, P.E., Member**, M+NLB, San Francisco, CA*

4. Barriers to Natural Ventilation in Health-Care Facilities
***Travis English, P.E., Member**, Kaiser Permanente, Oakland, CA*

11:00 AM-12:30 PM

SEMINAR 63 (INTERMEDIATE)

Retrofit or Not? Life-Cycle Strategy for Systems with R-22 and High-GWP Refrigerants

DVD

Track: Refrigeration
Room: Grand Ballroom C
Sponsor: Refrigeration Committee, TC3.1, TC8.01, 10.07 Commercial Food and Beverage Cooling Display and Storage
Chair: Georgi S. Kazachki, Ph.D., Fellow ASHRAE, Dayton Phoenix Group, Inc., Dayton, OH

The approaching deadline for discontinuing R-22 production creates anxiety among end-users of refrigeration and air-conditioning equipment about relevant actions they need to take. The presentations on R-22 alternatives do not emphasize that no regulation mandates R-22 replacement in existing units. This seminar introduces the most recent information on R-22 and other high-GWP alternatives and clarifies that as long as the refrigerant in the system or unit doesn't leak, it can be there for the life of the equipment and that the decision on refrigerant retrofit or a new system has to be based on a life-cycle cost analysis.

1. Volatility and the Hidden Business Risk
***Jason Robbins, P.E., Member**, Walgreens, Inc., Deerfield, IL*

2. R22 and R404A Servicing Options: Service, Retrofit, or Replace
***Brett Van Horn, Ph.D., Member**, ARKEMA, King of Prussia, PA*

3. Retrofit or Not? Decision Making for R-22 Systems
***Robert W. Yost, Member**, National Refrigerants, Rosenhayen, NJ*

4. Evaluations of R22 Replacements for Refrigeration and Air Conditioning
***Ankit Sethi, Associate Member**, Honeywell International, Buffalo, NY*

11:00 AM-12:30 PM

SEMINAR 64 (INTERMEDIATE)

Solar PV 101 for Designers

Track: Moving Advanced Energy Design Guidance to the Mainstream
Room: 204/205
NY PDH DVD G
Sponsor: 06.07 Solar Energy Utilization
Chair: Constantinos A. Balaras, Ph.D., Fellow ASHRAE, National Observatory of Athens, Athens, Greece

Photovoltaics (PV) convert light from the sun directly into electricity for a wide variety of applications, have few or no moving parts, are modular to match power requirements on any scale, are reliable and long lived. This session for design professionals is an introduction to PV concepts, terminology, basic design, sizing, stringing and estimating the annual energy production, typical mounting or racking options, identifying cost, incentives and financing options, and reviewing current trends in the PV marketplace with several case studies.

1. Solar PV Site Assessment
***Khalid Nagidi, BEAP, Member**, Energy Management Consulting Group, Wantagh, NY*

2. PV System: Design and Installation Guidelines
***James Leidel, Ph.D.**, Emergent Clean Energy Technologies LLC, |Rochester, MI*

3. PV System Commissioning
***Svein Morner, Ph.D., P.E., CPMP**, Sustainable Engineering Group LLC, Middleton, WI*

11:00 AM-12:30 PM

SEMINAR 65 (INTERMEDIATE)

ASHRAE RP-1455 and GPC-36: Standardized Best of Class Sequences for HVAC Systems

NY PDH DVD G

Track: HVAC&R Systems and Equipment
Room: Salon A/B
Sponsor: 01.04 Control Theory and Application, GPC 36
Chair: Barry B. Bridges, P.E., CPMP, Life Member, Sebesta, Saint Paul, MN

High performance buildings require high performance controls. This program presents the results of ASHRAE RP-1455, to develop and test "best of class" HVAC system control sequences for air systems, and an overview of ASHRAE GPC-36, a guideline to publish and maintain the best of class sequences and their corresponding functional performance tests. The goal is to define standardized high performance, optimized control sequences which meet or exceed the requirements of ASHRAE Standards 62.1, 90.1 and 55.1 and can be implemented by all of the major control manufacturers. This seminar is presented by members of the RP-1455 team and ASHRAE GPC-36 committee.

1. GPC-36 and RP-1455: Best of Class Control Sequences for HVAC Systems
***Mark Hydeman, P.E., Fellow ASHRAE**, Taylor Engineering, LLC, Alameda, CA*

2. Advanced Control Confirmation a Sequence Operation Works in a Controller
***Brian Russell, P.E., Associate Member**, Facility Dynamics Engineering, Ashland, VA*

3. Advanced Control Field Results of Actual Implementation and Analysis
***Xiaohui (Joe) Zhou, Ph.D., P.E., Member**, Iowa Energy Center, Ames, IA*

11:00 AM-12:30 PM

SEMINAR 66 (INTERMEDIATE)

Different Methods for Energy Consumption Reduction in Walk-In Coolers

NY PDH DVD G

Track: Refrigeration
Room: Grand Ballroom D
Sponsor: 10.07 Commercial Food and Beverage Cooling Display and Storage
Chair: Mayzar Amin, Ph.D., Student Member, Miami University, Middletown, OH

The refrigeration systems in food stores and supermarkets continuously operate to maintain proper food storage temperatures. During the operation, the evaporator coils require periodic defrost, which poses adverse impact on food safety. This study attempts to explore methods of minimizing the number of times these units go through the defrost cycle. The research focuses on using coils with hydrophobic material properties to repel moisture and a demand-defrost controller for walk-in freezers that activates the defrost cycle only when frost forms on coils and not at usual prescribed periods.

1. Manager
***Ramin Faramarzi, P.E., Member**, Southern California Edison, Irwindale, CA*

2. Engineer
***Sean Gouw, Associate Member**, Southern California Edison, Irwindale, CA*

3. Research Engineer II
***Denis Livchak**, PG&E Food Services Technology Center, San Ramon, CA*

STANDING COMMITTEE CHAIRS

As the 2014–15 Society year draws to a close here at the 2015 Annual Conference, I want to thank you for serving as a standing committee chair. Your assistance over the past year has been invaluable.

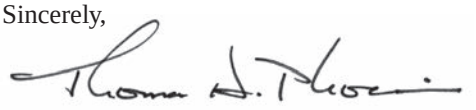
I've had the pleasure of being actively involved with our Society for 30 years. People, passion and performance are three things that make ASHRAE the outstanding organization that it is. Thanks to our volunteers, such as yourselves, ASHRAE is building a worldwide best practices network of innovative people and successful technologies to serve the built environment community.

Our membership also has great passion – I see that in how much time and dedication you have given during the last year to help guide the Society in policy and procedure to move us into the future.

Our people plus their passion ensures performance – whether that's improving the performance of our great Society or improving the performance of building stock around the world.

As the president of High Point University near my hometown of Greensboro, North Carolina, has said, "Passion ignites energy. Energy ignites a purpose. Having a purpose leads to success. But, nothing happens unless there is passion." Thank you for the hard work and dedication. I hope you continue to share your passion.

Sincerely,



Thomas H. Phoenix, P.E., ASHRAE Fellow, BEMP, BEAP
2014–15 ASHRAE President

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Eric W. Adams, Chair
Technical Activities Committee

Megan Tosh, Chair
Young Engineers in ASHRAE Committee

SOCIETY COMMITTEE MEETINGS

All committee meetings are in the Atlanta Hilton. Numbers in parenthesis indicate the floor location of the meeting room. Subcommittees are indented.

Advocacy
Friday (6/26) 3:00 pm – 5:30 pm 204 (2)

AEDG Steering Committee
Monday (6/29) 2:15 pm – 5:00 pm 310 (3)

ASHRAE Foundatcmion
Monday (6/29) 8:00 am – 10:30 am 301 (3)

ASHRAE Foundation Executive Subcommittee
Saturday (6/27) 1:00 pm – 3:00 pm 410 (4)

Associate Society Alliance
Monday (6/29) 4:15 pm – 6:00 pm Crystal Ballroom CD (1)

Audit Committee
Friday (6/26) 1:30 pm – 3:00 pm 207 (2)

Board of Directors
Sunday (6/28) 1:00 pm – 5:30 pm Grand Ballroom A/B (2)
Wednesday (7/1) 2:00 pm – 6:00 pm Grand Ballroom A/B (2)

Building Energy Quotient
Sunday (6/28) 8:30 am – 11:30 am 201 (2)

Building Energy Quotient Marketing Subcommittee
Saturday (6/27) 1:30 pm – 2:30 pm 314 (3)

Building Energy Quotient Methodology Subcommittee
Saturday (6/27) 12:30 pm – 1:30 pm 314 (3)

Certification
Saturday (6/27) 8:00 am – 12:00 pm 312 (3)

Chapter Technology Transfer
Saturday (6/27) 8:00 am – 12:00 pm 202 (2)
Friday (6/26) 8:00 am – 12:00 pm 304 (3)

Chapter Technology Transfer Executive
Friday (6/26) 5:00 pm – 6:00 pm 307 (3)

Chapter Technology Transfer Member Services
Friday (6/26) 1:30 pm – 5:00 pm 304 (3)

Chapter Technology Transfer Operations
Friday (6/26) 1:30 pm – 5:00 pm 307 (3)

Chapter Technology Transfer New Member Orientation
Saturday (6/27) 12:30 pm – 2:00 pm 202 (2)

CLIMA 2016 Advisory Committee
Saturday (6/27) 12:30 pm – 1:30 pm 407 (4)

College of Fellows
Sunday (6/28) 10:00 am – 12:00 pm 203 (2)

College of Fellows Board/Advisory
Sunday (6/28) 9:00 am – 10:00 am 203 (2)

Conferences and Expositions Committee
Saturday (6/27) 8:00 am – 12:00 pm 201 (2)

Conferences and Expositions Executive
Friday (6/26) 1:00 pm – 3:00 pm 202 (2)

Conferences and Expositions Annual and Winter Meetings
Friday (6/26) 3:00 pm – 6:00 pm 202 (2)

Conference and Expositions New Member Training
Saturday (6/27) 1:00 pm – 3:00 pm 201 (2)

CT/CRC Ad Hoc
Monday (6/29) 8:00 am – 10:00 am Pavilion 5 (2)

Developing Economies Ad Hoc
Monday (6/29) 8:00 am – 12:00 pm Executive Boardroom (1)

Development Committee
Monday (6/29) 10:30 am – 11:45 am 301 (3)

Effective Use of Volunteer Time Ad Hoc
Monday (6/29) 10:00 am – 12:00 pm 404 (4)

Electronic Communications
Saturday (6/27) 11:00 am – 3:00 pm 402 (4)

Electronic Communications Subcommittees
Saturday (6/27) 8:00 am – 11:00 am 402 (4)

Environmental Health
Monday (6/29) 2:15 pm – 6:15 pm 212 (2)

Environmental Health Executive
Monday (6/29) 7:00 am – 8:00 am 212 (2)

Environmental Health Research/Handbook
Monday (6/29) 8:00 am – 10:00 am 212 (2)

Environmental Health Policy/Program
Monday (6/29) 10:00 am – 12:00 pm 212 (2)

Executive
Saturday (6/27) 8:30 am – 1:00 pm 210 (2)
Wednesday (7/1) 7:30 am – 9:00 am 212 (2)

Finance
Friday (6/26) 8:00 am – 1:00 pm 203 (2)

Finance Investment Subcommittee
Thursday (6/25) 5:00 pm – 7:00 pm 207 (2)

Finance Planning Subcommittee
Thursday (6/25) 5:00 pm – 7:00 pm 206 (2)

Grassroots Government Activities
Friday (6/26) 9:00 am – 10:30 am 204 (2)
Friday (6/26) 2:15 pm – 2:45 pm 204 (2)
Saturday (6/27) 8:00 am – 1:00 pm Pavilion 4 (2)

Grassroots Government Activities Executive
Friday (6/26) 8:00 am – 8:45 am 204 (2)
Saturday (6/27) 1:15 pm – 1:45 pm Pavilion 4 (2)

Grassroots Government Activities Member Svcs.
Friday (6/26) 10:45 am – 11:45 am 204 (2)

Grassroots Government Activities Operations
Friday (6/26) 10:45 am – 11:45 am 206 (2)

Grassroots Government Activities International Task Force
Friday (6/26) 1:00 pm – 2:00 pm 204 (2)

Handbook
Sunday (6/28) 10:30 am – 1:00 pm Pavilion 8 (2)

Handbook Executive
Saturday (6/27) 1:00 pm – 2:00 pm 305 (3)

Handbook Strategic Planning
Saturday (6/27) 2:00 pm – 3:00 pm 305 (3)

Handbook Electronic Media
Sunday (6/28) 8:00 am – 9:00 am 308 (3)

Handbook Functional
Sunday (6/28) 8:00 am – 9:00 am 312 (3)

Handbook International
Sunday (6/28) 8:00 am – 9:00 am 313 (3)

Handbook Training
Sunday (6/28) 8:00 am – 9:00 am Pavilion 8 (2)

Handbook 2016 HVAC Systems & Equipment
Sunday (6/28) 9:00 am – 10:00 am 313 (3)

Handbook 2017 Fundamentals
Sunday (6/28) 9:00 am – 10:00 am 312 (3)

Handbook 2018 Refrigeration
Sunday (6/28) 9:00 am – 10:00 am 308 (3)

Handbook Volume Subcommittees
Sunday (6/28) 10:00 am – 10:30 am Pavilion 8 (2)

Historical
Sunday (6/28) 8:30 am – 12:00 pm 306 (3)

Honors & Awards
Sunday (6/28) 1:30 pm – 5:00 pm 203 (2)
Monday (6/29) 2:15 pm – 5:30 pm 309 (3)

Honors & Awards Orientation
Sunday (6/28) 12:30 pm – 1:30 pm 203 (2)

IAQA Board of Directors
Tuesday (6/30) 8:00 am – 5:00 pm 203 (2)
Wednesday (7/1) 8:00 am – 12:00 pm 210 (2)

IAQ Position Document Committee
Tuesday (6/30) 9:30 am – 11:00 am 313 (3)

IEQ Global Alliance Ad Hoc
Tuesday (6/30) 12:30 pm – 2:45 pm 310 (3)

Journal Advertising Sales
Sunday (6/28) 7:00 am – 8:00 am 309 (3)

Life Members' Executive Board
Tuesday (6/30) 9:00 am – 11:00 am 311 (3)

Members Council
Tuesday (6/30) 8:00 am – 12:00 pm Crystal Ballroom BE(1)

Member Council Region Operations
Saturday (6/27) 8:00 am – 12:00 pm 310 (3)

Members Council Planning
Sunday (6/28) 8:00 am – 12:00 pm 406 (4)

Member Council Orientation
Tuesday (6/30) 2:00 pm – 4:00 pm Crystal Ballroom BE (1)

Membership Promotion
Saturday (6/27) 8:00 am – 3:00 pm Pavilion 8 (2)

Membership Promotion Subcommittees
Friday (6/26) 9:00 am – 2:00 pm 212 (2)

Nominating
Sunday (6/28) 8:00 am – 12:00 pm Crystal Ballroom CD(1)

PEAC
Tuesday (6/30) 12:00 pm – 2:00 pm 213 (2)

Planning
Friday (6/26) 1:00 pm – 4:00 pm 211 (2)

Professional Development
Monday (6/29) 8:00 am – 12:00 pm 213 (2)

Publications Committee
Sunday (6/28) 8:00 am – 12:00 pm 401 (4)

Publications Planning Subcommittee
Saturday (6/27) 10:00 am – 12:00 pm 305 (3)

Publishing and Education Council
Tuesday (6/30) 8:00 am – 12:00 pm Crystal Ballroom AF (1)

Publishing and Education E-Learning
Saturday (6/27) 1:30 pm – 3:00 pm 407 (4)

Publishing and Education HVAC&R Research Journal Subcommittee
Monday (6/29) 11:00 am – 12:00 pm 408 (4)

Publishing and Education Fiscal Planning
Monday (6/29) 2:00 pm – 3:30 pm Pavilion 10 (2)

Publishing and Education Functional Planning
Monday (6/29) 3:30 pm – 5:00 pm Pavilion 10 (2)

Publishing and Education Council Orientation
Tuesday (6/30) 2:00 pm – 4:00 pm Crystal Ballroom AF (1)

Refrigeration
Sunday (6/28) 8:00 am – 12:00 pm 301 (3)

Refrigeration Executive
Sunday (6/28) 7:00 am – 8:00 am 301 (3)

Refrigeration PMS for 1634-RP
Monday (6/29) 4:30 pm – 6:30 pm 408 (4)

Region Members Council Representative/ Regional Vice Chair Training
Friday (6/26) 3:00 pm – 5:00 pm Crystal Ballroom AF (1)

Region-at-Large Planning
Monday (6/29) 2:15 pm – 4:15 pm Pavilion 8 (2)

Research Administration
Friday (6/26) 3:00 pm – 7:00 pm 302 (3)
Saturday (6/27) 8:00 am – 3:00 pm Pavilion 7 (2)
Wednesday (7/1) 7:00 am – 10:00 am 203 (2)

Research Administration Excom
Friday (6/26) 1:00 pm – 2:30 pm 302 (3)

Research Promotion
Friday (6/26) 12:00 pm – 5:30 pm 301 (3)
Saturday (6/27) 7:30 am – 1:00 pm 203 (2)

Research Promotion Executive Subcommittee
Friday (6/26) 9:00 am – 11:00 am 301 (3)

Research Subcommittee Chairs
Monday (6/29) 6:30 am – 8:00 am Grand Ballroom A/B (2)

Residential Presidential Ad Hoc
Sunday (6/28) 8:30 am – 11:30 am 213 (2)

Scholarship Trustees
Tuesday (6/30) 8:00 am – 11:00 am 213 (2)

Society Rules
Tuesday (6/30) 4:00 pm – 5:30 pm 302 (3)

Standards
Wednesday (7/1) 7:30 am – 9:30 am Grand Ballroom A/B (2)
Saturday (6/27) 8:00 am – 12:00 pm Salons AB (2)

Standards Executive
Friday (6/26) 8:00 am – 12:00 pm 303 (3)

Standards Training Ad Hoc
Friday (6/26) 12:00 pm – 1:00 pm 303 (3)

Standards ILS/ISAS
Friday (6/26) 1:00 pm – 4:00 pm 305 (3)

Standards PC Chair Breakfast
Sunday (6/28) 7:00 am – 9:00 am Grand Ballroom A/B (2)

Standards PPIS
Friday (6/26) 2:00 pm – 6:00 pm 306 (3)
Tuesday (6/30) 11:00 am – 1:00 pm 403 (4)

Standards SPLS
Friday (6/26) 2:00 pm – 6:00 pm 303 (3)
Tuesday (6/30) 1:30 pm – 4:00 pm 403 (4)

Standards SRS
Tuesday (6/30) 5:00 pm – 6:00 pm 403 (4)

Student Activities
Saturday (6/27) 8:00 am – 3:00 pm Pavilion 2 (2)

Student Activities Central Training Subcommittee
Friday (6/26) 8:00 am – 10:00 am 214 (2)

Student Activities Executive
Friday (6/26) 10:00 am – 12:00 pm 214 (2)

Student Activities K-12
Friday (6/26) 12:00 pm – 2:00 pm 214 (2)

Student Activities ABET/Post High
Friday (6/26) 2:00 pm – 4:00 pm 214 (2)

Student Activities Design Competition
Friday (6/26) 4:00 pm – 6:00 pm 214 (2)

Student Activities Grants
Friday (6/26) 4:00 pm – 6:00 pm 213 (2)

Student Activities New Member Training
Saturday (6/27) 7:00 am – 8:00 am Pavilion 2 (2)

Student Activities Centralized Training
Sunday (6/28) 8:00 am – 5:00 pm Macon (Sheraton) (2)

Technical Activities
Saturday (6/27) 8:00 am – 3:00 pm Pavilion 5 (2)
Wednesday (7/1) 7:00 am – 10:00 am 211 (2)

TAC/Standing Committee Executive Interface
Saturday (6/27) 7:00 am – 8:00 am Pavilion 5 (2)

TC Program Subcommittee Training
Tuesday (6/30) 11:15 am – 12:00 pm 315 (3)

Technology Council
Wednesday (7/1) 9:00 am – 12:00 pm 201 (2)

Technology Council Operations/Planning
Tuesday (6/30) 7:30 am – 9:00 am Pavilion 9 (2)

Technology Council Special Projects
Tuesday (6/30) 9:00 am – 10:30 am Pavilion 9 (2)

Technology Council Document Review
Tuesday (6/30) 10:30 am – 12:00 pm Pavilion 9 (2)

Technology Council Planning
Tuesday (6/30) 2:00 pm – 4:00 pm Pavilion 9 (2)

Young Engineers in ASHRAE
Saturday (6/27) 8:00 am – 3:00 pm 213 (2)

CHRONOLOGICAL

Thursday, June 25

Finance Investment Subcommittee
Thursday 5:00 pm–7:00 pm 207 (2)
Finance Planning Subcommittee
Thursday 5:00 pm–7:00 pm 206 (2)

Friday, June 26

Grassroots Government Activities Executive
Friday 8:00 am–8:45 am 204 (2)
Student Activities Central Training Subcommittee
Friday 8:00 am–10:00 am 214 (2)
Chapter Technology Transfer
Friday 8:00 am–12:00 pm 304 (3)
Standards Executive
Friday 8:00 am–12:00 pm 303 (3)
Finance
Friday 8:00 am–1:00 pm 203 (2)
Grassroots Government Activities
Friday 9:00 am–10:30 am 204 (2)
Research Promotion Executive Subcommittee
Friday 9:00 am–11:00 am 301 (3)
Membership Promotion Subcommittees
Friday 9:00 am–2:00 pm 212 (2)
Student Activities Executive
Friday 10:00 am–12:00 pm 214 (2)
Grassroots Government Activities Member Svcs.
Friday 10:45 am–11:45 am 204 (2)
Grassroots Government Activities Operations
Friday 10:45 am–11:45 am 206 (2)
Standards Training Ad Hoc
Friday 12:00 pm–1:00 pm 303 (3)
Student Activities K-12
Friday 12:00 pm–2:00 pm 214 (2)
Research Promotion
Friday 12:00 pm–5:30 pm 301 (3)
Grassroots Government Activities International Task Force
Friday 1:00 pm–2:00 pm 204 (2)
Research Administration Excom
Friday 1:00 pm–2:30 pm 302 (3)
Conferences and Expositions Executive
Friday 1:00 pm–3:00 pm 202 (2)
Planning
Friday 1:00 pm–4:00 pm 211 (2)
Standards ILS/ISAS
Friday 1:00 pm–4:00 pm 305 (3)
Audit Committee
Friday 1:30 pm–3:00 pm 207 (2)
Chapter Technology Transfer Member Services
Friday 1:30 pm–5:00 pm 304 (3)
Chapter Technology Transfer Operations
Friday 1:30 pm–5:00 pm 307 (3)
Student Activities ABET/Post High
Friday 2:00 pm–4:00 pm 214 (2)
Standards PPIS
Friday 2:00 pm–6:00 pm 306 (3)
Standards SPLS
Friday 2:00 pm–6:00 pm 303 (3)
Grassroots Government Activities
Friday 2:15 pm–2:45 pm 204 (2)
Region Members Council Representative/ Regional Vice Chair Training
Friday 3:00 pm–5:00 pm Crystal Ballroom A/F (1)
Advocacy
Friday 3:00 pm–5:30 pm 204 (2)
Conferences and Expositions Annual and Winter Meetings
Friday 3:00 pm–6:00 pm 202 (2)
Research Administration
Friday 3:00 pm–7:00 pm 302 (3)
Student Activities Design Competition
Friday 4:00 pm–6:00 pm 214 (2)
Student Activities Grants
Friday 4:00 pm–6:00 pm 213 (2)
Chapter Technology Transfer Executive
Friday 5:00 pm–6:00 pm 307 (3)

Saturday, June 27

Student Activities New Member Training
Saturday 7:00 am–8:00 am Pavilion 2 (2)
TAC/Standing Committee Executive Interface
Saturday 7:00 am–8:00 am Pavilion 5 (2)
Research Promotion
Saturday 7:30 am–1:00 pm 203 (2)
Electronic Communications Subcommittees
Saturday 8:00 am–11:00 am 402 (4)
Certification
Saturday 8:00 am–12:00 pm 312 (3)
Chapter Technology Transfer
Saturday 8:00 am–12:00 pm 202 (2)
Conferences and Expositions Committee
Saturday 8:00 am–12:00 pm 201 (2)
Member Council Region Operations
Saturday 8:00 am–12:00 pm 310 (3)
Standards
Saturday 8:00 am–12:00 pm Salons A/B (2)
Grassroots Government Activities
Saturday 8:00 am–1:00 pm Pavilion 4 (2)
Membership Promotion
Saturday 8:00 am–3:00 pm Pavilion 8 (2)
Research Administration
Saturday 8:00 am–3:00 pm Pavilion 7 (2)
Student Activities
Saturday 8:00 am–3:00 pm Pavilion 2 (2)
Technical Activities
Saturday 8:00 am–3:00 pm Pavilion 5 (2)
Young Engineers in ASHRAE
Saturday 8:00 am–3:00 pm 213 (2)
Executive
Saturday 8:30 am–1:00 pm 210 (2)
Publications Planning Subcommittee
Saturday 10:00 am–12:00 pm 305 (3)
Electronic Communications
Saturday 11:00 am–3:00 pm 402 (4)
Building Energy Quotient Methodology Subcommittee
Saturday 12:30 pm–1:30 pm 314 (3)

CLIMA 2016 Advisory Committee
Saturday 12:30 pm–1:30 pm 407 (4)
Chapter Technology Transfer New Member Orientation
Saturday 12:30 pm–2:00 pm 202 (2)
Handbook Executive
Saturday 1:00 pm–2:00 pm 305 (3)
ASHRAE Foundation Executive Subcommittee
Saturday 1:00 pm–3:00 pm 410 (4)
Conference and Expositions New Member Training
Saturday 1:00 pm–3:00 pm 201 (2)
Grassroots Government Activities Executive
Saturday 1:15 pm–1:45 pm Pavilion 4 (2)
Building Energy Quotient Marketing Subcommittee
Saturday 1:30 pm–2:30 pm 314 (3)
Publishing and Education E-Learning
Saturday 1:30 pm–3:00 pm 407 (4)
Handbook Strategic Planning
Saturday 2:00 pm–3:00 pm 305 (3)

Sunday, June 28

Journal Advertising Sales
Sunday 7:00 am–8:00 am 309 (3)
Refrigeration Executive
Sunday 7:00 am–8:00 am 301 (3)
Standards PC Chair Breakfast
Sunday 7:00 am–9:00 am Grand Ballroom A/B (2)
Handbook Electronic Media
Sunday 8:00 am–9:00 am 308 (3)
Handbook Functional
Sunday 8:00 am–9:00 am 312 (3)
Handbook International
Sunday 8:00 am–9:00 am 313 (3)
Handbook Training
Sunday 8:00 am–9:00 am Pavilion 8 (2)
Members Council Planning
Sunday 8:00 am–12:00 pm 406 (4)
Nominating
Sunday 8:00 am–12:00 pm Crystal Ballroom C/D (1)
Publications Committee
Sunday 8:00 am–12:00 pm 401 (4)
Refrigeration
Sunday 8:00 am–12:00 pm 301 (3)
Student Activities Centralized Training
Sunday 8:00 am–5:00 pm Macon (Sheraton) (2)
Building Energy Quotient
Sunday 8:30 am–11:30 am 201 (2)
Residential Presidential Ad Hoc
Sunday 8:30 am–11:30 am 213 (2)
Historical
Sunday 8:30 am–12:00 pm 306 (3)
College of Fellows Board/Advisory
Sunday 9:00 am–10:00 am 203 (2)
Handbook 2016 HVAC Systems & Equipment
Sunday 9:00 am–10:00 am 313 (3)
Handbook 2017 Fundamentals
Sunday 9:00 am–10:00 am 312 (3)
Handbook 2018 Refrigeration
Sunday 9:00 am–10:00 am 308 (3)
Handbook Volume Subcommittees
Sunday 10:00 am–10:30 am Pavilion 8 (2)
College of Fellows
Sunday 10:00 am–12:00 pm 203 (2)
Handbook
Sunday 10:30 am–1:00 pm Pavilion 8 (2)
Honors & Awards Orientation
Sunday 12:30 pm–1:30 pm 203 (2)
Board of Directors
Sunday 1:00 pm–5:30 pm Grand Ballroom A/B (2)
Honors & Awards
Sunday 1:30 pm–5:00 pm 203 (2)

Monday, June 29

Research Subcommittee Chairs
Monday 6:30 am–8:00 am Grand Ballroom A/B (2)
Environmental Health Executive
Monday 7:00 am–8:00 am 212 (2)
CT/CRC Ad Hoc
Monday 8:00 am–10:00 am Pavilion 5 (2)
Environmental Health Research/Handbook
Monday 8:00 am–10:00 am 212 (2)
ASHRAE Foundation
Monday 8:00 am–10:30 am 301 (3)
Developing Economies Ad Hoc
Monday 8:00 am–12:00 pm Executive Boardroom (1)
Professional Development
Monday 8:00 am–12:00 pm 213 (2)
Effective Use of Volunteer Time Ad Hoc
Monday 10:00 am–12:00 pm 404 (4)
Environmental Health Policy/Program
Monday 10:00 am–12:00 pm 212 (2)
Development Committee
Monday 10:30 am–11:45 am 301 (3)
Publishing and Education HVAC&R Research Journal Subcommittee
Monday 11:00 am–12:00 pm 408 (4)
Publishing and Education Fiscal Planning
Monday 2:00 pm–3:30 pm Pavilion 10 (2)
Region-at-Large Planning
Monday 2:15 pm–4:15 pm Pavilion 8 (2)
AEDG Steering Committee
Monday 2:15 pm–5:00 pm 310 (3)
Honors & Awards
Monday 2:15 pm–5:30 pm 309 (3)
Environmental Health
Monday 2:15 pm–6:15 pm 212 (2)
Publishing and Education Functional Planning
Monday 3:30 pm–5:00 pm Pavilion 10 (2)
Associate Society Alliance
Monday 4:15 pm–6:00 pm Crystal Ballroom C/D (1)
Refrigeration PMS for 1634-RP
Monday 4:30 pm–6:30 pm 408 (4)

Tuesday, June 30

Technology Council Operations/Planning
Tuesday 7:30 am–9:00 am Pavilion 9 (2)
Scholarship Trustees
Tuesday 8:00 am–11:00 am 213 (2)

Members Council
Tuesday 8:00 am–12:00 pm Crystal Ballroom B/E (1)

Publishing and Education Council
Tuesday 8:00 am–12:00 pm Crystal Ballroom A/F (1)

IAQA Board of Directors
Tuesday 8:00 am–5:00 pm 203 (2)

Technology Council Special Projects
Tuesday 9:00 am–10:30 am Pavilion 9 (2)

Life Members' Executive Board
Tuesday 9:00 am–11:00 am 311 (3)

IAQ Position Document Committee
Tuesday 9:30 am–11:30 am 313 (3)

Technology Council Document Review
Tuesday 10:30 am–12:00 pm Pavilion 9 (2)

Standards PPIS
Tuesday 11:00 am–1:00 pm 403 (4)

TC Program Subcommittee Training
Tuesday 11:15 am–12:00 pm 315 (3

PEAC
Tuesday 12:00 pm–2:00 pm 213 (2)

IEQ Global Alliance Ad Hoc
Tuesday 12:30 pm–2:45 pm 310 (3)

Standards SPLS
Tuesday 1:30 pm–4:00 pm 403 (4)

Member Council Orientation
Tuesday 2:00 pm–4:00 p Crystal Ballroom B/E (1)

Publishing and Education Council Orientation
Tuesday 2:00 pm–4:00 pm Crystal Ballroom A/F (1)

Technology Council Planning
Tuesday 2:00 pm–4:00 pm Pavilion 9 (2)

Society Rules
Tuesday 4:00 pm–5:30 pm 302 (3)

Standards SRS
Tuesday 5:00 pm–6:00 pm 403 (4)

Wednesday, July 1

Research Administration
Wednesday 7:00 am–10:00 am 203 (2)

Technical Activities
Wednesday 7:00 am–10:00 am 211 (2)

Executive
Wednesday 7:30 am–9:00 am 212 (2)

Standards
Wednesday 7:30 am–9:30 am Grand Ballroom A/B (2)

IAQA Board of Directors
Wednesday 8:00 am–12:00 pm 210 (2)

Technology Council
Wednesday 9:00 am–12:00 pm 201 (2)

Board of Directors
Wednesday 2:00 pm–6:00 pm Grand Ballroom A/B (2)

Thursday, July 2

Executive Committee
Thursday 7:30 am–11:00 am 212 (2)

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. **Committee listed in color have been confirmed.**

Description of abbreviations

GPC = Guideline Project Committee
RP = Research Project
SPC = Standard Project Committee
SSPC = Standing Standard Project Committee
TC = Technical Committee
TG = Task Group
TRG = Technical Resource Group

All meetings are scheduled in Atlanta Hilton. The number in parenthesis beside the room assignment is the floor location.

TC/TG Chair's Breakfast Section 1
Sunday (6/28), 6:30 am–8:00am, 201 (2)

TC/TG Chair's Breakfast Section 2
Sunday (6/28), 6:30 am–8:00 am, 214 (2)

TC/TG Chair's Breakfast Section 3
Sunday (6/28), 6:30 am–8:00 am, 405 (4)

TC/TG Chair's Breakfast Section 4
Sunday (6/28), 6:30 am–8:00 am, 311 (3)

TC/TG Chair's Breakfast Section 5
Sunday (6/28), 6:30 am–8:00 am, 303 (3)

TC/TG Chair's Breakfast Section 6
Sunday (6/28), 6:30 am–8:00 am, 402 (4)

TC/TG Chair's Breakfast Section 7
Sunday (6/28), 6:30 am–8:00 am, 307 (3)

TC/TG Chair's Breakfast Section 8
Sunday (6/28), 6:30 am–8:00 am, 404 (4)

TC/TG Chair's Breakfast Section 9
Sunday (6/28), 6:30 am–8:00 am, 203 (2)

TC/TG Chair's Breakfast Section 10
Sunday (6/28), 6:30 am–8:00 am, 211 (2)

TC/TG Chair's Training Workshop
Sunday (6/28), 9:45 am–10:45 am, Salon C (2)

TC Program Subcommittee Training
Tuesday (6/30), 11:15 am–12:00 pm 315 (3)

Research Subcommittee Breakfast
Monday (6/29), 6:30 am–8:00 am, Grand Ballroom A/B (2)

TC 1.1 Thermodynamics & Psychrmetrics
Monday (6/29), 2:15 pm–4:15 pm, 313 (3)
Sponsoring: Workshop 2: Psychrometrics: Effort, Accuracy and Applicability

TC 1.2 Instruments & Measurements
Tuesday (6/30), 1:00 pm–3:30 pm, 307 (3)

TC 1.3 Heat Transfer & Fluid Flow
Tuesday (6/30), 1:00 pm–3:30 pm, 303 (3)
Sponsoring: Seminar 29: State-of-the-Art Heat Exchangers: Novel Visualization and Design Concepts

TC 1.3/8.5 Research
Sunday (6/28), 3:00 pm–7:00 pm, Salon E (2)

TC 1.4 Control Theory & Application
Tuesday (6/30), 1:00 pm – 3:30 pm, 304 (3)
Sponsoring: Seminar 6: BAS Data Analysis in Campuses,
Seminar 17: What's New with Guideline 13? Specifying Building Automation Systems,
Seminar 65: ASHRAE RP-1455 and GPC-36: Standardized Best of Class Sequences for HVAC Systems

TC 1.4 YEA
Sunday (6/28), 2:30 pm–3:00 pm, Executive Boardroom (1)

TC 1.4 Control Components and Applications
Sunday (6/28), 3:00 pm–4:00 pm, Executive Boardroom (1)

TC 1.4 Programs
Sunday (6/28), 4:00 pm–5:30 pm, Executive Boardroom (1)

TC 1.4 Education
Sunday (6/28), 5:30 pm–6:30 pm, Executive Boardroom (1)

TC 1.4 Research
Monday (6/29), 2:15 pm–4:15 pm, 402 (4)

TC 1.4 Handbook
Monday (6/29), 4:15 pm–6:30 pm, 402 (4)

TC 1.4 Executive
Tuesday (6/30), 7:00 am–8:00 am, 311 (3)

TC 1.5 Computer Applications
Monday (6/29), 6:30 pm – 9:00 pm, 304 (3)
Sponsoring: Seminar 18: Bringing Some Reality to the Virtual World of BIM,
Seminar 31: Big Data Analytics for Building Energy Management

TC 1.5 DBOSS
Sunday (6/28), 3:00 pm–4:00 pm, 304 (3)

TC 1.5 Cyber Security
Sunday (6/28), 4:00 pm–5:00 pm, 304 (3)

TC 1.5 Emerging Applications
Sunday (6/28), 5:00 pm–6:00 pm, 304 (3)

TC 1.5 Program
Sunday (6/28), 6:00 pm–7:00 pm, 304 (3)

TC 1.5 Research
Sunday (6/28), 7:00 pm–8:00 pm, 304 (3)

TC 1.5 Handbook
Monday (6/29), 6:00 pm–6:30 pm, 309 (3)

TC 1.6 Terminology
Monday (6/29), 4:15 pm–6:30 pm, Executive Boardroom (1)

TC 1.6 Handbook, Terminology and STD-134
Monday (6/29). 8:00 am–12:00 pm, 405 (4)

TC 1.7 Business, Management & General Legal Education
Monday (6/29), 10:15 am–12:00 pm, 305 (3)
Sponsoring: Seminar 15: Rules of Engagement: Ethics and Young Professionals,
Seminar 36: If You Build It, Will The Come? The Next Design-Build Guide

TC 1.8 Mechanical Systems Insulation
Monday (6/29), 4:15 pm–6:30 pm, 405 (4)

TC 1.8 Research, Handbook, Programs
Sunday (6/28), 8:00 am–10:30 am, 407 (4)

TC 1.9 Electricaystems
Tuesday (6/30), 3:30 pm–6:00 pm, 408 (4)

TC 1.10 Cogeneration Systems
Tuesday (6/30), 3:30 pm–5:00 pm, 305 (3)

TC 1.10 Handbook, CTIC, Program, Research,Membership
Tuesday (6/30), 12:00 pm–3:00 pm, 305 (3)

TC 1.11 Electric Motors and Motor Control
Tuesday (6/30), 1:00 pm–3:30 pm, 313 (3)

TC 1.12 Moisture Management in Buildings
Saturday (6/27), 1:00 pm–3:00 pm, 301 (3)

Sponsoring: Seminar 13: How Dry Am I?: Locating, Quantifying and Reducing Microbial Growth Risk in Buildings

TC 1.12 Research/Program/Standards
Saturday (6/27), 8:00 am–12:00 pm, 301 (3)

TC 2.1 Physiology & Human Environment
Tuesday (6/30), 1:00 pm–3:30 pm, 312 (3)

Sponsoring: Seminar 32: Human Building Integration: Thermal Comfort Control for an Individual Setting

TC 2.1 Research
Sunday (6/28), 1:00 pm–3:00 pm, 305 (3)

TC 2.1 Programs
Sunday (6/28), 3:00 pm–4:00 pm, 305 (3)

TC 2.1 Handbook
Sunday (6/28), 4:00 pm–5:00 pm, 305 (3)

TC 2.2 Plant and Animal Environment
Monday (6/29), 4:15 pm–6:30 pm, 308 (3)

TC 2.3 Gaseous Air Contaminants /Removal Equip.
Tuesday (6/30), 1:00 pm–3:30 pm, Salon E (2)

Sponsoring: Workshop 1: Do We Need a Performance Rating System for Gas Phase Filters?

TC 2.3 Research
Sunday (6/28), 5:00 pm–7:00 pm, Pavilion 8 (2)

TC 2.3 Publications
Monday (6/29), 3:00 pm–4:00 pm, 401 (4)

TC 2.3 Handbook
Monday (6/29), 4:15 pm–6:00 pm, 401 (4)

TC 2.3 Standards
Monday (6/29), 6:00 pm–8:00 pm, 303 (3)

TC 2.3 Planning
Tuesday (6/30), 6:30 am–8:00 am, 303 (3)

TC 2.3 Program
Tuesday (6/30), 12:00 pm–12:45 pm, 210 (2)

TC 2.4 Particulate Air Contaminants /Removal Equip.
Tuesday (6/30), 3:30 pm–6:00 pm, Salon E (2)

Sponsoring: Seminar 22: PM2.5 and Gases' Impact on Environment and Health

TC 2.4 Handbook
Saturday (6/27), 1:00 pm–2:30 pm, 306 (3)

TC 2.4 PMS RP 1691
Sunday (6/28), 2:00 pm–3:00 pm, Pavilion 8 (2)

TC 2.4 Research
Sunday (6/28), 3:00 pm–5:00 pm, Pavilion 8 (2)

TC 2.4 Standards
Monday (6/29), 4:15 pm–6:00 pm, 303 (3)

TC 2.4 Planning
Tuesday (6/30), 8:00 am–10:00 am, 303 (3)

TC 2.4 Program
Tuesday (6/30), 10:00 am–11:00 am, 303 (3)

TC 2.5 Global Climate Change
Tuesday (6/30), 1:30 pm–3:30 pm, 306 (3)

TC 2.5 Climate Change Chapter
Sunday (6/28), 5:00 pm–7:00 pm, 402 (4)

TC 2.6 Sound & Vibration Control
Monday (6/29), 2:15 pm–4:15 pm, Salon E (2)

Sponsoring: Workshop 3: Acoustic Mitigation for Lightweight Roof Assemblies,
Seminar 55: Green Building Acoustics: Making Green Sound Good

TC 2.6 Vibration Isolation
Sunday (6/28), 8:30 am–9:30 am, 303 (3)

TC 2.6 Programs
Sunday (6/28), 11:00 am–12:00 pm, 303 (3)

TC 2.6 Publications
Sunday (6/28), 1:00 pm–2:00 pm, 303 (3)

TC 2.6 RP 1408
Sunday (6/28), 2:00 pm–3:00 pm, 303 (3)

TC 2.6 Hot Topic 1
Sunday (6/28), 3:00 pm–4:00 pm, 303 (3)

TC 2.6 Hot Topic 2
Sunday (6/28), 4:00 pm–5:00 pm, 303 (3)

TC 2.6 Excom
Sunday (6/28), 5:00 pm–6:00 pm, 303 (3)

TC 2.6 RP 1529
Monday (6/29), 9:00 am–10:00 am, 302 (3)

TC 2.6 Research
Monday (6/29), 10:00 am–11:00 am, 302 (3)

TC 2.6 Criteria
Monday (6/29), 11:00 am–12:00 pm, 302 (3)

TC 2.7 Seismic and Wind Restraint Design
Tuesday (6/30), 3:30 pm–6:00 pm, 202 (2)

TC 2.7 Research/Program/Publications
Tuesday (6/30), 1:00 pm–3:30 pm, 202 (2)

TC 2.8 Building Environmental Impacts and Sustainability
Sunday (6/28), 5:00 pm–7:00 pm, Salons AB (2)

Sponsoring: Seminar 24: What is a Zero Energy Building, and How Can We Get There?, Seminar 46: Energy Efficiency and Renewable Energy Sources for Cold Chain Energy Supply, Seminar 56: Innovation for Food Retail: The 50% Advanced Energy Design Guide for Grocery Stores, Forum 4: Best Practices in Sustainable Design around the Globe.

TC 2.8 International
Sunday (6/28), 11:30 am–12:00 pm, 315 (3)

TC 2.8 Green Guide
Sunday (6/28), 12:00 pm–12:45 pm, 315 (3)

TC 2.8 Water-Energy Nexus
Sunday (6/28), 12:45 pm–1:15 pm, 315 (3)

TC 2.8 Research
Sunday (6/28), 1:15 pm–2:30 pm. 315 (3)

TC 2.8 Handbook
Sunday (6/28), 2:30 pm–3:30 pm, 315 (3)

TC 2.8 Programs
Sunday (6/28), 3:30 pm–4:00 pm, 315 (3)

TC 2.8 Existing Buildings
Sunday (6/28), 4:00 pm–4:30 pm, 315 (3)

TC 2.9 Ultraviolet Air and Surface Treatment
Monday (6/29), 10:00 am–12:00 pm, 303 (3)

TC 2.9 Standards
Saturday (6/27), 12:00 pm–1:00 pm, 315 (3)

TC 2.9 Programs
Sunday (6/28), 8:00 am–10:00 am, Executive Boardroom (1)

TC 2.9 Handbook
Sunday (6/28), 10:00 am–12:00 pm, Executive Boardroom (1)

TC 2.9 Research
Monday (6/29), 8:00 am–10:00 am, 303 (3)

TC 3.1 Refrigerants & Secondary Coolants
Monday (6/29), 4:15 pm–6:30 pm, 211 (2)

TC 3.1 Research and Program
Monday (6/29), 11:00 am–12:00 pm, 214 (2)

TC 3.1 Handbook
Monday (6/29), 3:00 pm–4:00 pm, 211 (2)

TC 3.2 Refrigerant System Chemistry
Monday (6/29), 2:15 pm–4:15 pm, 302 (3)

TC 3.2 Handbook
Sunday (6/28), 3:00 pm–4:00 pm, 407 (4)

TC 3.2 Research
Sunday (6/28), 4:00 pm–5:00 pm, 407 (4)

TC 3.3 Refrigerant Contaminant Control
Tuesday (6/30), 3:30 pm–6:00 pm, Salon D (2)

TC 3.3 Research
Sunday (6/28), 5:00 pm–5:30 pm, 407 (4)

TC 3.4 Lubrication
Tuesday (6/30), 1:00 pm–3:30 pm, Salon D (2)

TC 3.4 Research
Sunday (6/28), 5:30 pm–6:00 pm, 407 (4)

TC 3.6 Water Treatment
Tuesday (6/30), 1:00 pm–3:30 pm, 401 (4)

Sponsoring: Seminar 3: Designing HVAC Systems: Engineering Keys to Legionella Control and Prevention

TC 3.6 Handbook/Program/Research
Sunday (6/28), 3:00 pm–5:00 pm, 401 (4)

TC 3.8 Refrigerant Containment
Monday (6/29), 4:15 pm–6:30 pm, 206/207 (2)

TC 4.1 Load Calculation Data and Procedures
Monday (6/29), 2:15 pm–4:15 pm, 406 (4)

Sponsoring: Seminar 23: Climate Change: ASHRAE Design Day Weather Data,
Seminar 27: Mobile Applications: HVAC Loads, Energy Audits and Operations

TC 4.1 RP-1681 PMS
Sunday (6/28), 2:00 pm–3:00 pm, Pavilion 1(2)

TC 4.1 Handbook
Sunday (6/28), 3:00 pm–4:00 pm, Pavilion 1 (2)

TC 4.1 Research
Sunday (6/28), 4:00 pm–5:00 pm, Pavilion 1 (2)

TC 4.1 Programs
Sunday (6/28), 5:00 pm–6:00 pm, Pavilion 1 (2)

TC 4.1 Standards
Sunday (6/28), 6:00 pm–7:00 pm, Pavilion 1 (2)

TC 4.2 Climatic Information
Tuesday (6/30), 1:00 pm–3:30 pm, 402 (4)

Sponsoring: Seminar 10: New Weather Data for Design Calculations and Energy Simulations

TC 4.2 1699-RP PMS
Sunday (6/28), 1:00 pm–2:30 pm, 308 (3)

TC 4.2 Program
Sunday (6/28), 2:30 pm–3:30 pm, 308 (3)

TC 4.2 1561-RP PES
Sunday (6/28), 3:30 pm–5:00 pm, 308 (3)

TC 4.2 Research
Monday (6/29), 4:15 pm–6:30 pm, 213 (2)

TC 4.3 Ventilation Requirements & Infiltration
Monday (6/29), 4:15 pm–6:30 pm, 314 (3)

TC 4.4 Bldg. Materials and Bldg. Envelope Performance
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 3 (2)

Sponsoring: Seminar 5: The Building Envelope and Its Impacts on Occupant Comfort,
Seminar 30: U-Factors, Thermal Bridging and What They Mean for Energy Code Compliance

TC 4.4 Research
Sunday (6/28), 1:00 pm–4:00 pm, 307 (3)

TC 4.4 Handbook
Sunday (6/28), 4:00 pm–4:30 pm, 307 (3)

TC 4.4 Program
Sunday (6/28), 4:30 pm–5:00 pm, 307 (3)

TC 4.4 Standards
Sunday (6/28), 5:00 pm–5:30 pm, 307 (3)

TC 4.5 Fenestration
Tuesday (6/30), 2:00 pm–4:00 pm, Pavilion 7 (2)

TC 4.5 Calculational Methods
Tuesday (6/30), 1:00 pm–2:00 pm, Pavilion 7 (2)

TC 4.5 Research
Monday (6/29), 2:15 pm–3:15 pm, 314 (3)

TC 4.5 Program
Monday (6/29), 3:15 pm–4:15 pm, 314 (3)

TC 4.5 Handbook
Sunday (6/28), 4:15 pm–6:30 pm, 409 (4)

TC 4.7 Energy Calculations
Tuesday (6/30), 6:00 pm–8:30 pm, Salon C (2)

Sponsoring: Seminar 48: Model Predictive Control: Application to Chilled Water Plants and Radiant Slab Cooling

TC 4.7 1588-RP PMS
Sunday (6/28), 6:45 pm–8:15 pm, 404 (4)

TC 4.7 Simulation and Component Models
Monday (6/29), 6:00 pm–7:30 pm, Crystal Ballroom CD (1)

TC 4.7 Data-Driven Models
Monday (6/29), 7:30 pm–9:00 pm, Crystal Ballroom CD (1)

TC 4.7 Applications
Tuesday (6/30), 3:30 pm–5:00 pm, Salon C (2)

TC 4.7 Handbook
Tuesday (6/30), 5:00 pm–6:00 pm, Salon C (2)

TC 4.10 Indoor Environmental Modeling
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 9 (2)

Sponsoring: Seminar 26: Improving IAQ in Energy Efficient Building Ventilation: Practical Experience from Experts,
Seminar 49: Moisture in Buildings and Envelopes: Simulation, Modeling and Design,

Seminar 53: Calibrating Operational CFD Models for Real Data Centers

TC 4.10 Handbook
Sunday (6/28), 2:00 pm–4:00 pm, 404 (4)

TC 4.10 Program
Sunday (6/28), 4:00 pm–5:00 pm, 404 (4)

TC 4.10 Research
Sunday (6/28), 5:00 pm–6:00 pm, 404 (4)

TC 5.1 Fans
Monday (6/29), 4:15 pm–6:30 pm, Pavilion 9 (2)

TC 5.1 Handbook
Sunday (6/28), 2:00 pm–3:00 pm, 406 (4)

TC 5.1 Research
Sunday (6/28), 3:00 pm–4:00 pm, 406 (4)

TC 5.1 Program
Sunday (6/28), 4:00 pm–5:00 pm, 406 (4)

TC 5.2 Duct Design
Tuesday (6/30), 3:30 pm–6:00 pm, 304 (3)

TC 5.2 Subcommittees
Sunday (6/28), 12:30 pm–3:00 pm, Pavilion 3 (2)

TC 5.2 Duct Design Guide
Monday (6/29), 8:00 am–10:00 am, Pavilion 6 (2)

TC 5.2 Eliminating Leakage in Duct Systems
Monday (6/29), 10:00 am–11:00 am, Pavilion 6 (2)

TC 5.2 CFD Duct System Modeling
Monday (6/29), 11:00 am–12:00 pm, Pavilion 6 (2)

TC 5.3 Room Air Distribution
Tuesday (6/30), 1:00 pm–3:30 pm, Grand Ballroom D (2)

Sponsoring: Seminar 4: Energy Performance of Active Chilled Beam Installations, Seminar 33: UFAD Commissioning, Troubleshooting and Design Considerations, Seminar 43: Improved Indoor Air Quality and Reduced Maintenance Utilizing Chilled Beam Systems

TC 5.3 Handbook
Friday (6/26), 12:00 pm–5:00 pm, Pavilion 5 (2)

TC 5.3 Handbook
Saturday (6/27), 8:00 am–3:00 pm, 212 (2)

TC 5.3 Fan Coils
Sunday (6/28), 8:00 am–9:00 am, Pavilion 6 (2)

TC 5.3 Chilled Beams
Sunday (6/28), 9:00 am–10:00 am, Pavilion 6 (2)

TC 5.3 Air Curtains
Sunday (6/28), 10:00 am–10:45 am, Pavilion 6 (2)

TC 5.3 Underfloor Air Distribution
Sunday (6/28), 10:45 am–12:15 pm, Pavilion 6 (2)

TC 5.3 Research/Handbook/Program
Sunday (6/28), 1:00 pm–3:00 pm, Pavilion 6 (2)

TC 5.4 Industrial Process Air Cleaning
Monday (6/29), 2:15 pm–4:15 pm, 408 (4)

TC 5.5 Air-to-Air Energy Recovery
Tuesday (6/30), 3:30 pm–6:00 pm, 213 (2)

Sponsoring: Seminar 19: Apply ANSI/ASHRAE Standard 62.1 Addendum k for Laboratory Hoods

TC 5.5 Handbook, Program, Research
Monday (6/29), 4:15 pm–6:30 pm, 403 (4)

TC 5.6 Control of Fire & Smoke
Monday (6/29), 4:15 pm–6:30 pm, Salon E (2)

TC 5.6 Program
Sunday (6/28), 3:00 pm–4:00 pm, 403 (4)

TC 5.6 Research
Sunday (6/28), 4:00 pm–5:30 pm, 403 (4)

TC 5.6 Handbook
Sunday (6/28), 5:30 pm–7:00 pm, 403 (4)

TC 5.7 Evaporative Cooling
Monday (6/29), 4:15 pm–6:30 pm, Pavilion 4 (2)

TC 5.7 Programs, Research, Handbook
Sunday (6/28), 3:00 pm–5:00 pm, 314 (3)

TC 5.8 Industrial Ventilation Systems
Monday (6/29), 4:15 pm–6:30 pm, 307 (3)

TC 5.8 Ventilation of Hazardous Spaces
Tuesday (6/30), 3:30 pm–6:00 pm, 306 (3)

TC 5.9 Enclosed Vehicular Facilities
Tuesday (6/30), 3:30 pm–6:00 pm, Pavilion 4 (2)

TC Seminar on 6/30 at 5:00 pm: Smoke Spread in Rail Cars and Recent Subway Fire Event Ventilation Issues

TC 5.9 Program, Handbook, Research
Tuesday (6/30), 1:00 pm–3:30 pm, Pavilion 4 (2)

TC 5.10 Kitchen Ventilation
Monday (6/29), 5:15 pm–6:15 pm, 404 (4)

Sponsoring: Seminar 57: Commercial Kitchen Ventilation Commissioning

TC 5.10 Handbook
Monday (6/29), 2:15 pm–3:15 pm, 404 (4)

TC 5.10 Program
Monday (6/29), 3:15 pm–4:15 pm, 404 (4)

TC 5.10 Research
Monday (6/29), 4:15 pm–5:15 pm, 404 (4)

TC 5.11 Humidifying Equipment
Monday (6/29), 2:15 pm–4:15 pm, 210 (2)

TC 5.11 Research
Sunday (6/28), 3:00 pm–5:00 pm, 309 (3)

TC 5.11 PMS 1630
Monday (6/29), 8:30 am–11:00 am, 410 (4)

TC 6.1 Hydronic & Steam Htg. Equip & Sys
Tuesday (6/30), 1:00 pm–3:30 pm, Salon C (2)

Sponsoring: Seminar 54: Design of Energy Efficient Hydronic Heating Systems

TC 6.1 Handbook
Sunday (6/28), 5:00 pm–6:00 pm, 311 (3)

TC 6.1 Chilled Water Plant
Sunday (6/28), 6:00 pm–7:00 pm, 311 (3)

TC 6.1 Program
Monday (6/29), 2:15 pm–3:15 pm, 405 (4)

TC 6.1 Research
Monday (6/29), 3:15 pm–4:15 pm, 405 (4)

TC 6.2 District Energy
Sunday (6/28), 3:00 pm–5:00 pm, 301 (3)

TC 6.2 Programs, Research, Handbook
Sunday (6/28), 1:00 pm – 3:00 pm, 301 (3)

TC 6.3 Central Forced Air Htg. & Cooling Sys
Tuesday (6/30), 1:00 pm–3:30 pm, 311 (3)

TC 6.5 Radiant Heating and Cooling
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 4 (2)

Sponsoring: Seminar 21: International Standard for Radiant Heating and Cooling Panel Systems

TC 6.5 Research, Spec Pubs, Journal, Program, Handbook
Sunday (6/28), 3:00 pm–5:00 pm, Pavilion 4 (2)

TC 6.6 Service Water Heating Systems
Monday (6/29), 4:15 pm–6:30 pm, 305 (3)

TC 6.6 Research/Program
Monday (6/29), 2:15 pm–4:15 pm, 305 (3)

TC 6.7 Solar Energy Utilization
Tuesday (6/30), 1:00 pm–3:30 pm, 302 (3)

Sponsoring: Workshop 4: Solar Decathlon Global Network: Database and Modeling Engine Research, Development and Validation, Seminar 42: Ground Source Heat Pumps and Solar Together: Highest Energy Efficiencies Become Possible, TC Seminar on 6/30 at 1 pm: Building Integrated Solar, HVAC&R Systems For Zero CO2 Emission And Energy Plus Buildings, Healthy Settlements And Sustainable Economy Development, Seminar 64:Solar PV 101 for Designers

TC 6.7 Research
Monday (6/29), 4:15 pm–5:00 pm, 313 (3)

TC 6.7 Standards
Monday (6/29), 5:00 pm–5:45 pm, 313 (3)

TC 6.7 Program
Monday (6/29), 5:45 pm–6:30 pm, 313 (3)

TC 6.7 Handbook
Monday (6/29), 6:30 pm–8:30 pm, 313 (3)

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications
Tuesday (6/30), 3:30 pm–6:00 pm, 303 (3)

Sponsoring: Seminar 34: Field Performance Results of VRF, GSHP and GS-VRF Systems: The "Living LAB" Results Are In

TC 6.8 Handbook/Research/Programs
Sunday (6/28), 5:00 pm–7:00 pm, 308 (3)

TC 6.9 Thermal Storage
Monday (6/29), 4:30 pm–6:00 pm, 203 (2)

TC 6.9 Standards
Monday (6/29), 2:15 pm–2:40 pm, 203 (2)

TC 6.9 Program
Monday (6/29), 2:40 pm–3:10 pm, 203 (2)

TC 6.9 Handbook
Monday (6/29), 3:10 pm–3:30 pm, 203 (2)

TC 6.9 LRP /Website
Monday (6/29), 3:30 pm–3:50 pm, 203 (2)

TC 6.9 Research
Monday (6/29), 3:50 pm–4:10 pm, 203 (2)

TC 6.10 Fuels & Combustion
Tuesday (6/30), 3:30 pm–6:00 pm, 214 (2)

Sponsoring: Seminar 2: Portable Combustion Analyzers: Accurate? Are Standards Needed?

TC 6.10 Handbook
Monday (6/29), 2:15 pm–4:15 pm, 410 (4)

TC 7.1 Integrated Building Design
Monday (6/29), 8:15 am–10:30 am, 210 (2)

TC 7.1 Research
Sunday (6/28), 5:00 pm–6:00 pm, 305 (3)

TC 7.1 Programs
Sunday (6/28), 6:00 pm–7:00 pm, 305 (3)

TC 7.2 HVAC Construction and Design Build Technology
Sunday (6/28), 10:00 am–12:00 pm, 310 (3)

TC 7.3 Operations & Maintenance Management
Tuesday (6/30), 1:00 pm–3:30 pm, 309 (3)

Seminar 50: The Report of My Death Was an Exaggeration

TC 7.3 Standards/Program
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 1 (2)

TC 7.3 Research/Handbook/Education
Monday (6/29), 4:15 pm–6:30 pm, Pavilion 1 (2)

TC 7.4 Exergy Analysis for Sustainable Buildings
Sunday (6/28), 8:00 am–10:00 am, 310 (3)

TC 7.5 Smart Building Systems
Tuesday (6/30), 3:30 pm–6:00 pm, 201 (2)

Sponsoring: Seminar 14: Real-Time Fault Detection and Diagnosis for Enhanced Building Operations, Seminar 38: Modeling, Simulation and Application of Occupant Behavior in Buildings, Seminar 41: Energy Efficiency Monitoring and Assessment in Industrial Facilities, Seminar 61: Assessing the Effectiveness and Value of Using Fault Detection and Diagnostics Tools

TC 7.5 PMS RP-1615
Sunday (6/28), 2:00 pm–3:00 pm, Pavilion 2 (2)

TC 7.5 Fault Detection & Diagnosis
Sunday (6/28), 3:00 pm–3:45 pm, Pavilion 2 (2)

TC 7.5 Enabling Technologies
Sunday (6/28), 3:45 pm–4:30 pm, Pavilion 2 (2)

TC 7.5 Smart Grid
Sunday (6/28), 4:30 pm–5:15 pm, Pavilion 2 (2)

TC 7.5 Handbook
Sunday (6/28), 5:15 pm–6:00 pm, Pavilion 2 (2)

TC 7.5 Buildings Operations Dynamics
Monday (6/29), 4:30 pm–5:15 pm, Pavilion 2 (2)

TC 7.5 Research
Monday (6/29), 5:15 pm–6:15 pm, Pavilion 2 (2)

TC 7.6 Building Energy Performance
Tuesday (6/30), 1:00 pm–3:30 pm, Salon AB (2)

Sponsoring: Workshop 5: Energy Rating and Managing Your Commercial Building Using ASHRAE Building Energy Quotient (bEQ), Seminar 39: Panel Discussion: 10 Years of Advanced Energy Design Guides from Practitioners' Perspectives

TC 7.6 Research
Sunday (6/28), 1:00 pm–2:00 pm, 405 (4)

TC 7.6 Commercial Building Energy Audit
Sunday (6/28), 2:00 pm–3:00 pm, 405 (4)

TC 7.6 Handbook
Sunday (6/28), 3:00 pm–4:00 pm, 405 (4)

TC 7.6 Federal Buildings
Saturday (6/27), 9:00 am–3:00 pm, Pavilion 6 (2)

TC 7.6 Federal Buildings
Sunday (6/28), 9:00 am–12:00 pm, Pavilion 4 (2)

TC 7.6 Monitoring and Energy Performance
Monday (6/29), 2:15 pm–4:15 pm, 312 (3)

TC 7.6 Energy Management
Monday (6/29), 4:15 pm–5:15 pm, 312 (3)

TC 7.6 Standards
Monday (6/29), 5:15 pm–6:15 pm, 312 (3)

TC 7.6 Executive
Monday (6/29), 6:15 pm–7:00 pm, 312 (3)

TC 7.7 Testing & Balancing
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 2 (2)
Sponsoring: Seminar 60: Steam Tips for the Engineer, Contractor, Commissioning Authority and Building Operator

TC 7.7 Program/Handbook
Saturday (6/27), 12:00 pm–3:00 pm, 311 (3)

TC 7.8 Owning & Operating Costs
Monday (6/29), 2:15 pm–4:15 pm, Pavilion 6 (2)

TC 7.8 Program, Handbook, Research
Sunday (6/28), 3:00 pm–5:00 pm, 410 (4)

TC 7.9 Building Commissioning
Sunday (6/28), 1:00 pm–5:00 pm, 202 (2)

TC 7.9 Handbook, Research, Program
Saturday (6/27), 8:00 am–12:00 pm, 410 (4)

TC 8.1 Positive Displacement Compressors
Tuesday (6/30), 3:30 pm–6:00 pm, 307 (3)

TC 8.2 Centrifugal Machines
Monday (6/29), 2:15 pm–4:15 pm, 307 (3)
Sponsoring: Seminar 7: Chiller Sequencing Challenges, Seminar 20: Centrifugal Compressor Design: Back to Basics

TC 8.2 Research and Program
Sunday (6/28), 5:00 pm–7:00 pm, 313 (3)

TC 8.2 Handbook
Sunday (6/28), 7:00 pm–8:00 pm, 313 (3)

TC 8.3 Absorption and Heat Operated Machines
Monday (6/29), 3:30 pm–6:00 pm, 407 (4)

TC 8.3 Research/Handbook
Monday (6/29), 2:15 pm–3:30 pm, 407 (4)

TC 8.4 Air-to-Refrigerant Heat Transfer Equip
Tuesday (6/30), 3:30 pm–6:00 pm, 308 (3)

TC 8.4 Research/Standards
Monday (6/29), 6:30 pm–9:30 pm, Pavilion 5 (2)

TC 8.5 Liquid to Refrigerant Heat Transfer
Monday (6/29), 4:15 pm–6:30 pm, Pavilion 3 (2)

TC 8.5/1.3 Research
Sunday (6/28), 3:00 pm–7:00 pm, Salon E (2)

TC 8.6 Cooling Towers and Evaporative Condensers
Monday (6/29), 2:15 pm–4:15 pm, 213 (2)

TC 8.6 Handbook/Program/Research/Standards
Monday (6/29), 8:30 am–10:00 am, 402 (4)

TC 8.7 Variable Refrigerant Flow
Monday (6/29), 4:15 pm–6:30 pm, 201 (2)
Sponsoring: Seminar 45: Designing for Variable Refrigerant Flow Systems with ASHRAE Standard 15 in Mind

TC 8.8 Refrigerant System Controls & Accessories
Tuesday (6/30), 1:00 pm–3:30 pm, 214 (2)

TC 8.8 Research, Program, Handbook
Tuesday (6/30), 3:30 pm–4:30 pm, 312 (3)

TC 8.9 Residential Refrigerators and Food Freezers
Monday (6/29), 2:15 pm–4:15 pm, Executive Boardroom (1)

TC 8.10 Mechanical Dehumidifiers & Heat Pipes
Tuesday (6/30), 3:30 pm–6:00 pm, 410 (4)

TC 8.10 Program/Handbook/Research/Standards
Tuesday (6/30), 1:00 pm–3:30 pm, 410 (4)

TC 8.11 Unitary and Room Air Conditioners & Heat Pumps
Monday (6/29), 4:15 pm–6:30 pm, Pavilion 8 (2)

TC 8.11 Handbook/Program/Research
Sunday (6/28), 3:00 pm–5:00 pm, Pavilion 10 (2)

TC 8.12 Desiccant Dehumidification Equipment and Components
Monday (6/29), 2:15 pm–4:15 pm, 201 (2)

TC 9.1 Large Building Air-Conditioning Systems
Tuesday (6/30), 1:00 pm–3:30 pm, 212 (2)
Sponsoring: Seminar 16: There Is Gold in the Heartland at the Federal Courthouse in Cedar Rapids, Iowa

TC 9.1 Research/Program/Handbook
Tuesday (6/30), 12:00 pm–1:00 pm, 212 (2)

TC 9.2 Industrial Air Conditioning
Tuesday (6/30), 1:00 pm–3:30 pm, 308 (3)

TC 9.2 Nuclear
Monday (6/29), 2:15 pm–3:45 pm, 403 (4)

TC 9.2 Program/Handbook/Research
Sunday (6/28), 4:00 pm–6:00 pm, 312 (3)

TC 9.3 Transportation Air Conditioning
Monday (6/29), 2:15 pm–6:30 pm, Pavilion 7 (2)

T C 9.4 Justice Facilities
Sunday (6/28), 8:00 am–10:00 am, 403 (4)

TC 9.6 Health Care Facilities
Sunday (6/28), 5:00 pm–7:00 pm, Grand Ballroom C (2)

TC 9.6 Water
Sunday (6/28), 9:00 am–10:00 am, Pavilion 5 (2)

TC 9.6 Infectious Diseases
Sunday (6/28), 10:00 am–12:00 pm, Pavilion 5 (2)

TC 9.6 Research
Sunday (6/28), 1:00 pm–2:00 pm, Pavilion 5 (2)

TC 9.6 Handbook
Sunday (6/28), 2:00 pm–3:00 pm, Pavilion 5 (2)

TC 9.6 Energy
Sunday (6/28), 3:00 pm–4:00 pm, Pavilion 5 (2)

TC 9.6 Program
Sunday (6/28), 4:00 pm–5:00 pm, Pavilion 5 (2)

TC 9.7 Educational Facilities
Sunday (6/28), 1:00 pm–3:00 pm, Pavilion 4 (2)

TC 9.8 Large Building Air-Conditioning Applications
Monday (6/29), 2:15 pm–4:15 pm, 301 (3)

TC 9.8 Handbook/Research/Program
Monday (6/29), 9:00 am–12:00 pm, Pavilion 2 (2)
Sponsoring: TC Forum on 6/29 at 9:45 am: What Should Be Included In A New Handbook Chapter on Fire Stations, Fire Fighter Academies and EMT Training Academies?

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
Monday (6/29), 2:15 pm–6:30 pm, Grand Ballroom D (2)
Sponsoring: Seminar 28: Optimization for Data Center and ITE Integration

TC 9.9 Program/ Handbook/ Research
Sunday (6/28), 5:00 pm–9:00 pm, Grand Ballroom D (2)

TC 9.10 Laboratory Systems
Tuesday (6/30), 3:30 pm–6:00 pm, Grand Ballroom D (2)
Sponsoring: Seminar 1: Fume Hood Design for the 21st Century:

Proceedings from a Cross-Disciplinary Workshop, Forum 1: Lab Safety and Energy Management: Understanding the Risk, Seminar 11: Upgrading Ventilation in Existing Laboratories, Seminar 12: Biocontainment Facility Design, Commissioning and Certification Strategies, Seminar 25: High Performance Laboratories: Managing Water and Equipment Loads, Seminar 40: Energy Efficient Labs: Case Studies, Seminar 47: Minimizing Energy Consumption in Laboratory HVAC Systems: From Supply to Stack

TC 9.10 Standards
Sunday (6/28), 3:00 pm–3:45 pm, Pavilion 3 (2)

TC 9.10 Research
Sunday (6/28), 3:45 pm–4:30 pm, Pavilion 3 (2)

TC 9.10 Program
Sunday (6/28), 4:30 pm–5:15 pm, Pavilion 3 (2)

TC 9.10 Lab Classification
Sunday (6/28), 5:15 pm–6:00 pm, Pavilion 3 (2)

TC 9.10 Labs Energy Efficiency
Sunday (6/28), 6:00 pm–7:00 pm, Pavilion 3 (2)

TC 9.10 Design Guide
Tuesday (6/30), 1:00 pm–2:30 pm, Pavilion 10 (2)

TC 9.10 Handbook
Tuesday (6/30), 2:30 pm–3:30 pm, Pavilion 10 (2)

TC 9.11 Clean Spaces
Monday (6/29), 2:15 pm–4:00 pm, Salon AB (2)

TC 9.11 Cleanroom Energy Efficiency
Monday (6/29), 4:00 pm–5:00 pm, Salon AB (2)

TC 9.11 Handbook
Monday (6/29), 5:00 pm–5:30 pm, Salon AB (2)

TC 9.11 Design Guide
Monday (6/29), 5:30 pm–6:00 pm, Salon AB (2)

TC 9.12 Tall Buildings
Tuesday (6/30), 3:30 pm–6:00 pm, 313 (3)

TC 10.1 Custom Engineered Refrig Systems
Monday (6/29), 2:15 pm–4:15 pm, 315 (3)

TC 10.1 Cryogenic Refrigerants
Sunday (6/28), 3:00 pm–5:00 pm, Pavilion 6 (2)

TC 10.1 Research, Program, Handbook
Sunday (6/28), 5:00 pm–7:00 pm, Pavilion 6 (2)

TC 10.2 Automatic Ice Making Plants/Skating Rinks
Monday (6/29), 4:30 pm–6:30 pm, 304 (3)

TC 10.3 Refrigerant Piping, Controls and Accessories
Tuesday (6/30), 1:00 pm–3:30 pm, 406 (4)

TC 10.3 PMS RP-1569
Tuesday (6/30), 8:00 am–10:00 am, 314 (3)

TC 10.5 Refrigeration Distrib and Storage Facilities
Tuesday (6/30), 3:30 pm–6:00 pm, 401 (4)

TC 10.6 Transport Refrigeration
Monday (6/29), 4:45 pm–7:00 pm, 409 (4)

TC 10.7 Commercial Food and Beverage Refrigeration Equipment
Monday (6/29), 2:15 pm–4:15 pm, 303 (3)
Sponsoring: Seminar 37: Lower GWP Alternatives for R-404A in Commercial and Transport Refrigeration, Seminar 66: Different Methods for Energy Consumption Reduction in Walk-In Coolers

TC 10.7 Program
Sunday (6/28), 5:15 pm–6:00 pm, 203 (2)

TC 10.7 Research
Sunday (6/28), 6:00 pm–6:45 pm, 203 (2)

TC 10.7 Handbook
Sunday (6/28), 6:45 pm–7:30 pm, 203 (2)

TC 10.8 Refrigeration Load Calculations
Sunday (6/28), 3:00 pm–5:00 pm, 313 (3)

Task Groups (TG), Technical Resource Groups (TRG) and Multidisciplinary Task Groups (MTG)

TG1.Optimization
Sunday (6/28), 1:00 pm–3:00 pm, 309 (3)

TG2.HVAC Security
Tuesday (6/30), 9:00 am–12:00 pm, 306 (3)

TRG4.IAQP
Sunday (6/28), 10:30 am–12:30 pm, 210 (2)

MTG Building Information Modeling
Saturday (6/27), 1:00 pm–3:00 pm, 406 (4)

MTG Energy Targets Multidisciplinary Task Group
Tuesday (6/30), 12:00 pm–2:30 pm, Pavilion 1 (2)
Sponsoring: Seminar 58: Energy Targets for Commercial Buildings, An Update on 1651-RP

MTG Low GWP Refrigerants
Wednesday (7/1), 10:00 am–11:00 am, 212 (2)

SPC Chair Training Breakfast
Sunday (6/28), 7:00 am–9:00 am, Grand Ballroom AB (2)

SSPC 15 Safety Standards for Refrigeration Systems
Saturday (6/27), 1:00 pm–3:00 pm, 404 (4)

SSPC 15 Safety Standards for Refrigeration Systems
Sunday (6/28), 8:00 am–12:00 pm, 302 (3)
Sunday (6/28), 1:00 pm–5:00 pm, 302 (3)

SPC 16/58 MOT/Rating Room Air Conditioners and PTAC/PTHP
Tuesday (6/30), 8:00 am–12:00 pm, 404 (4)

SPC 20 MOT/Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
Sunday (6/28), 12:00 pm–2:00 pm, 407 (4)

SPC 23.1 MOT/for Performance Rating Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant
Monday (6/29), 2:15 pm–4:15 pm, 409 (4)

SPC 25 MOT/Forced Convection and Natural Convection Air Coolers for Refrigeration
Monday (6/29), 8:00 pm–10:00 pm, 306 (3)

SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship
Tuesday (6/30), 1:00 pm–5:00 pm, 407 (4)

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes
Sunday (6/28h), 5:00 pm–7:00 pm, 309 (3)

SPC 29 MOT/Automatic Ice Makers
Monday (6/29), 4:15 pm–7:15 pm, Pavilion 6 (2)

SPC 30 MOT Liquid Chilling Packages
Monday (6/29), 8:00 am–11:00 am, 314 (3)

SPC 32.1 MOT for Rating Vending Machines for Sealed Beverages
Sunday (6/28), 10:30 am–1:00 pm, 305 (3)

SPC 32.2 MOT for Rating Pre-Mix and Post-Mix Beverage Dispensing Equipment
Tuesday (6/30), 8:30 am–11:30 am, 305 (3)

SPC 33 MOT/ Forced Circulation Air Cooling and Air Heating Coils
Tuesday (6/30), 8:00 am–12:00 pm, Executive Boardroom (1)

SSPC 34 Designation & Safety Class. of Refrig.
Monday (6/29), 6:30 pm–10:00 pm, 211 (2)

SSPC 34 Designation Nomenclature
Saturday (6/27), 7:00 am–10:00 am, Pavilion 3 (2)

SSPC 34 Flammability
Saturday (6/27), 10:00 am–3:00 pm, Pavilion 3 (2)

SSPC 34 Toxicity
Sunday (6/28), 6:30 pm–10:00 pm, Pavilion 2 (2)

SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment
Wednesday (7/1), 8:00 am–10:00 am, 213 (2)

SSPC 41 Standard Methods for Measurement
Sunday (6/28), 1:00 pm–4:00 pm, 212 (2)

SSPC 41.2 Laboratory Airflow-Standard Method for Laboratory Airflow Measurement
Monday (6/29), 8:00 am–12:00 pm, Pavilion 1 (2)

SSPC 41.9 Standard Methods Refrigerant Mass Flow Measurement Using Calorimeters
Sunday (6/28), 10:00 am–12:00 pm, 410 (4)
Tuesday (6/30), 10:00 am–12:00 pm, 409 (4)

SPC 51 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
Sunday (6/28), 12:30 pm–3:00 pm, 403 (4)

SSPC 52.2 MOT/Part Size Eff. Proc. for Testing Air Cleaning Devices
Saturday (6/27), 8:00 am–12:00 pm, Salon E (2)

SSPC 55 Thermal Env. Cond. for Human Occupancy
Saturday (6/27), 8:00 am–3:00 pm, 214 (2)
Sunday (6/28), 9:00 am–12:00 pm, 314 (3)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality
Saturday (6/27), 9:00 am–3:00 pm, Salon C (2)

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality
Sunday (6/28) 1:00 pm–7:00 pm,Crystal Ballroom ABEF (1)

SSPC 62.1 Administration Subcommittee
Friday (6/26), 1:00 pm–5:00 pm, Pavilion 9 (2)

SSPC 62.1 Education Subcommittee
Friday (6/26), 1:00 pm–5:00 pm, Pavilion 7 (2)

SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings
Friday (6/26), 1:00 pm–5:00 pm, Pavilion 8 (2)

SSPC 62.2 Ventilation and Acceptable IAQ in Low-Rise Residential Buildings
Saturday (6/27), 12:00 pm–3:00 pm, Pavilion 9 (2)

SSPC 62.2 Technical Ad Hoc
Friday (6/26), 9:00 am–12:00 pm, Pavilion 8 (2)

SSPC 62.2 Envelope Subcommittee
Saturday (6/27), 8:30 am–11:00 am, 404 (4)

SSPC 62.2 IAQ Subcommittee
Saturday (6/27), 8:30 am–11:00 am, Pavilion 9 (2)

SSPC 62.2 System Subcommittee
Saturday (6/27), 8:30 am–11:00 am, 403 (4)

SPC 63.1 MOT/Liquid-Line Refrigerant Driers
Sunday (6/28), 6:00 pm–10:00 pm, 410 (4)

SPC 63.2 MOT/Filtration Capacity of Liquid Line Filter Driers
Sunday (6/28), 2:00 pm–3:00 pm, 410 (4)

SPC 70 MOT/for Rating the Performance of Air Outlets and Air Inlets
Monday (6/29), 8:00 am–12:00 pm, 307 (3)

SPC 72 MOT/Commercial Refrigerators and Freezers
Sunday (6/28), 1:00 pm–5:00 pm, 402 (4)

SPC 79 Room Fan Coil Standard Committee
Saturday (6/27), 8:00 am–12:00 pm, 309 (3)

SSPC 90.1 Energy Eff. Design of New Bldg.
Saturday (6/27), 8:00 am–12:00 pm, Crystal Ballroom ABEF (1)
Sunday (6/28), 9:00 am–12:00 pm, Crystal Ballroom ABEF (1)
Monday (6/29), 8:00 am–12:00 pm, Crystal Ballroom ABEF (1)

SSPC 90.1 Format & Compliance Subcommittee
Friday (6/26), 5:00 pm–10:00 pm, 207 (2)
Saturday (6/27), 1:00 pm–5:00 pm, 313 (3)
Sunday (6/28), 4:00 pm–7:00 pm, 211 (2)

SSPC 90.1 Mechanical Subcommittee
Friday (6/26), 9:00 am–10:00 pm, Crystal Ballroom BE (1)
Saturday (6/27),1:00 pm–7:00 pm,Crystal Ballroom ABEF (1)
Sunday (6/28), 1:00 pm–8:00 pm, Crystal Ballroom CD (1)

SSPC 90.1 Lighting Subcommittee
Friday (6/26), 9:00 am–10:00 pm, Pavilion 2 (2)
Saturday (6/27), 1:00 pm–7:00 pm, 312 (3)
Sunday (6/28), 1:00 pm–8:00 pm, 210 (2)

SSPC 90.1 ECB Subcommittee
Friday (6/26), 5:00 pm–10:00 pm, 211 (2)
Saturday (6/27), 1:00 pm–5:00 pm, 307 (3)
Sunday (6/28), 1:00 pm–4:00 pm, 211 (2)

SSPC 90.1 Envelope Subcommittee
Friday (6/26), 9:00 am–10:00 pm, 201 (2)
Saturday (6/27), 1:00 pm–8:00 pm, 211 (2)
Sunday (6/28), 1:00 pm–8:00 pm, 201 (2)

SSPC 90.2 Energy Eff. Design of New Low Rise Res. Bldg.
Monday (6/29), 2:15 pm–6:15 pm, Crystal Ballroom ABEF (1)
Tuesday (6/30),1:00 pm–5:00 pm, Pavilion 5 (2)

SSPC 90.2 Envelope
Monday (6/29), 6:30 pm–9:15 pm, Crystal Ballroom ABEF (1)
Tuesday (6/30), 8:00 am–12:00 pm, 309 (3)

SSPC 90.2 Lighting
Monday (6/29), 6:30 pm–9:15 pm, 314 (3)
Tuesday (6/30), 8:00 am–12:00 pm, 408 (4)

SSPC 90.2 Mechanical
Monday (6/29), 6:30 pm–9:15 pm, 311 (3)
Tuesday (6/30), 8:00 am–12:00 pm, 307 (3)

SPC 90.4 Energy Standard for Data Centers and Telecommunications Buildings
Saturday (6/27), 9:00 am–1:00 pm, 211 (2)
Monday (6/29), 7:30 am–11:30 am, 203 (2)

SPC 94.2 MOT/Thermal Storage Devices with Electrical Input and Thermal Output based on Thermal Performance
Monday (6/29), 8:00 am–11:00 am, 311 (3)

SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems
Tuesday (6/30), 9:30 am–11:00 am, 310 (3)

SPC 99 Refrigerant Oil Description
Tuesday (6/30), 8:30 am–9:30 am, 310 (3)

SSPC 100 Energy Efficiency in Existing Buildings
Sunday (6/28), 4:00 pm–6:00 pm, 212 (2)
Tuesday (6/30), 8:00 am– 2:00 pm, 214 (2)

SSPC 100 Energy Efficiency in Existing Buildings- WG3
Sunday (6/28), 8:00 am–10:00 am, 408 (4)

SSPC 100 Energy Efficiency in Existing Buildings - WG1
Monday (6/29), 10:00 am–12:00 pm, Pavilion 10 (2)

SSPC 100 Energy Efficiency in Existing Buildings - WG5
Sunday (6/28), 12:00 pm–2:00 pm, 408 (4)

SSPC 100 Energy Efficiency in Existing Buildings - WG2
Monday (6/29), 6:30 pm–8:30 pm, 301 (3)

SPC 103/MOT Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers
Sunday (6/28), 6:30 pm–9:30 pm, 405 (4)

SPC 110 MOT/Performance of Laboratory Fume Hoods
Tuesday (6/30), 8:00 am–12:00 pm, 312 (3)

SPC 111 Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation and Air-Conditioning Systems (12)
Friday (6/26), 8:00 am–12:00 pm, 207 (2)

SPC 116 MOT/for Rating Seasonal Efficiency of Unitary Air-Conditioners and Heat Pumps
Wednesday (7/1), 10:00 am–12:00 pm, 213 (2)

SPC 118.1 MOT/Commercial Water Heaters
Sunday (6/28), 9:00 am–11:00 am, Pavilion 3 (2)

SPC 118.2R MOT/Rating Residential Water Heaters
Tuesday (6/30), 1:00 pm–5:00 pm, 404 (4)

SPC 124 MOT/Rating Combinations Space-Heating an Water Heating Appliances
Wednesday (7/1), 8:00 am–12:00 pm, 214 (2)

SPC 127 MOT/for Rating Computer and Data Processing Room Unitary Air Conditioners
Saturday (6/27), 11:00 am–3:00 pm, 308 (3)

SPC 130 MOT/for Rating Ducted Air Terminal Units
Sunday (6/28), 2:00 pm–6:00 pm, 306 (3)

SSPC 135 BACnet
Thursday (6/25), 9:00 am–4:00 pm, 206 (2)

SSPC 135 BACnet
Friday (6/26), 8:00 am–5:00 pm, Pavilion 3 (2)

SSPC 135 BACnet
Friday (6/26), 8:00 am–5:00 pm, Pavilion 4 (2)

SSPC 135 BACnet
Saturday (6/27), 8:00 am–3:00 pm, Crystal Ballroom CD (1)

SSPC 135 BACnet
Sunday (6/28), 8:00 am–5:00 pm, Pavilion 7 (2)

SSPC 135 BACnet
Sunday (6/28), 8:00 am–5:00 pm, Pavilion 9 (2)

SSPC 135 BACnet
Monday (6/29), 8:00 am–12:00 pm, Crystal Ballroom CD (1)

SSPC 140 Standard MOT for Evaluation of Bldg. Energy Analysis Computer Program
Monday (6/29), 2:15 pm–6:15 pm, 306 (3)

SSPC 145 Test Methods for Assessing Performance of Gas Phase Air Clean. Equip.
Sunday (6/28), 12:00 pm–3:00 pm, 314 (3)

SPC 147 Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment
Tuesday (6/30), 8:00 am–12:00 pm, Pavilion 10 (2)

SPC 150 MOT/Performance of Cool Storage Systems
Sunday (6/28), 5:30 pm–7:00 pm, 408 (4)

SSPC 154 Ventilation for Commercial Cooking Operations
Sunday (6/28), 8:00 am–12:00 pm, Pavilion 1 (2)

SPC 155P MOT/Rating Commercial Space Heating Boiler Systems
Sunday (6/28), 1:00 pm–5:00 pm, 311 (3)

SPC 158.1 MOT Capacity of Refrigerant Solenoid Valves
Sunday (6/28), 5:00 pm–7:00 pm, 309 (3)

SPC 158.2 MOT Capacity of Refrigerant Pressure Regulators
Sunday (6/28), 5:00 pm–7:00 pm, 309 (3)

SSPC 160 Criteria for Moisture Control Design Analysis
Tuesday (6/30), 8:00 am–12:00 pm, 212 (2)

SPC 161P Air Quality Within Commercial Aircraft
Monday (6/29), 9:00 am–12:00 pm, 308 (3)

SPC 164 MOT for Humidifiers
Monday (6/29), 9:00 am–11:00 am, 408 (4)

SSPC 169 Climatic Data for Building Design Standards
Monday (6/29), 10:00 am–12:00 pm, 406 (4)

SSPC 170 Clinical
Monday (6/29), 4:15 pm–6:15 pm, 301 (3)

SSPC 170 Task Group for Natural Ventilation
Tuesday (6/30), 1:15 pm–3:15 pm, 201 (2)

SSPC 170 Ventilation of Healthcare Facilities
Tuesday (6/30), 8:00 am–1:00 pm, 201 (2)

SPC 171 MOT/ of Seismic Restraint Devices for HVAC&R Equipment (7/5)
Tuesday (6/30), 8:00 am–12:00 pm, 401 (4)

SPC 172 MOT/Insoluble Materials in Synthetic Lubricants and HFC Refrigerant Systems
Monday (6/29), 10:00 am–12:00 pm, 310 (3)

SPC 175 Metal Pressure Vessel Testing
Monday (6/29), 4:15 pm–6:15 pm, 315 (3)

SPC 177P MOT/Fractionation Measurement of Refrigerant Blends
Monday (6/29), 8:00 am–10:00 am, 312 (3)

SPC 180 Standard Practice for Inspection and Maintenance of Commercial-Building HVAC Systems
Friday (6/26), 2:00 pm–6:00 pm, 308 (3)

SPC 182 MOT Absorption Water-Chilling and Water-Heating Packages
Monday (6/29), 11:00 am–12:00 pm, 210 (2)

SPC 184 MOT/Field Test of Liquid Package Chillers
Tuesday (6/30), 8:00 am–12:00 pm, 402 (4)

SPC 185 MOT/UVC Lights for Use in Air Handling Units or Air Ducts to Inactivate Airborne Microorganisms
Saturday (6/27), 12:00 pm–1:00 pm, 315 (3)

SPC 188 Legionellosis: Risk Management for Building Water Systems
Tuesday (6/30), 8:00 am–12:00 pm, 202 (2)
Tuesday (6/30), 3:45 pm–5:30 pm, Salon AB (2)
Wednesday (7/1), 8:00 am–12:00 pm, 202 (2)
Wednesday (7/1), 1:00 pm–2:30 pm, 202 (2)

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings
Tuesday (6/30), 7:30 am–9:30 am, Crystal Ballroom CD (1)
Wednesday (7/1), 8:00 am–12:00 pm, 303/304 (3)

SSPC 189.1 Working Group 6 (Water Use)
Tuesday (6/30), 9:30 am–11:30 am, Crystal Ballroom CD (1)

SSPC 189.1 Working Group 7 (Energy Efficiency)
Tuesday (6/30), 9:30 am–12:30 pm, 211 (2)

SSPC 189.1 Working Group 5 (Site Sustainability)
Tuesday (6/30), 12:00 pm–2:00 pm, Crystal Ballroom CD (1)

SSPC 189.1 Working Group 7.5
Tuesday (6/30), 1:00 pm–4:00 pm, 211 (2)

SSPC 189.1 Working Group 9 (Materials and Resources)
Tuesday (6/30), 2:30 pm–4:30 pm, Crystal Ballroom CD (1)

SSPC 189.1 Working Group 8 (IEQ)
Tuesday (6/30), 4:00 pm – 7:00 pm, 211 (2)

SSPC 189.1 Working Group 10
Tuesday (6/30), 5:00 pm–7:00 pm, Crystal Ballroom CD (1)

SPC 189.3 Design, Construction and Operation of High-Performance Green Healthcare Facilities
Monday (6/29), 8:00 am–12:00 pm, 202 (2)

SPC 189.3 Design, Construction and Operation of High-Performance Green Healthcare Facilities
Monday (6/29), 2:15 pm–3:30 pm, 202 (2)

SPC 191 Water Conservation
Sunday (6/28), 9:00 am–11:00 am, 214 (2)

SPC 196P MOT/ Measuring Refrigerant Leak Rates
Sunday (6/28), 6:00 pm–10:00 pm, 310 (3)

SPC 197 MOT/Attenuation Characteristics of Vibration Isolators (8/4)
Monday (6/29), 4:30 pm–6:00 pm, 410 (4)

SPC 199 MOT/Rating the performance of Industrial Pulse Cleaned Dust Collectors
Friday (6/26), 1:00 pm–5:00 pm, Pavilion 1 (2)
Sunday (6/28), 8:00 am–12:00 pm, 202 (2)

SPC 200 MOT/Chilled Beams
Monday (6/29), 8:00 am–12:00 pm, 201 (2)

SPC 201P: Facility Smart Grid Information Model
Monday (6/29), 2:15 pm–6:15 pm, 214 (2)
Tuesday (6/30), 8:00 am–12:00 pm, 308 (3)

SPC 201P Task Groups
Sunday (6/28), 1:00 pm–5:00 pm, 310 (3)

SPC 201P Task Groups
Monday (6/29), 8:00 am–12:00 pm, 309 (3)

SPC 202 Commissioning Process for Buildings & Systems
Monday (6/29), 8:00 am–12:00 pm, Pavilion 7 (2)

SPC 204P MOT/Rating Micro Combined Heat and Power Devices
Monday (6/29), 6:30 pm–9:30 pm, Executive Boardroom (1)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Working Group
Sunday (6/28), 9:00 am–12:00 pm, 402 (4)

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment
Tuesday (6/30), 8:00 am–11:00 am, 304 (3)

SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics Applied Commercial Air-Cooled Packaged Systems
Monday (6/29), 8:00 am–10:00 am, Pavilion 4 (2)

SPC 207 Airflow Working Group
Monday (6/29), 10:00 am–12:00 pm, Pavilion 4 (2)

SPC 207 Economizer Working Group
Monday (6/29), 4:30 pm–6:30 pm, 210 (2)

SPC 207 Refrigerant Working Group
Monday (6/29), 6:30 pm–8:30 pm, 210 (2)

SPC 208 Control Valve Test
Friday (6/26), 1:00 pm–4:00 pm, Pavilion 10 (2)

SPC 209 Energy Simulation Aided Design
Monday (6/29), 2:15 pm–6:15 pm, Pavilion 5 (2)

SPC 209 Construction/Operations Subcommittee
Sunday (6/28), 6:00 pm–10:00 pm, 307 (3)

SPC 209 Design Development/Construction Documents
Sunday (6/28), 6:00 pm–10:00 pm, 401 (4)

SPC 209 Predesign Subcommittee
Sunday (6/28), 6:00 pm–10:00 pm, 314 (3)

SPC 209 Conceptual design/Schematic design
Monday (6/29), 8:00 am–12:00 pm, 401 (4)

SPC 209 Resources Subcommittee
Monday (6/29), 8:00 am–12:00 pm, 403 (4)

SPC 210 MOT/for Rating Commercial Walk-in Refrigerators and Freezers
Monday (6/29), 8:00 am–12:00 pm, Pavilion 8 (2)

SPC 211 Commercial Building Energy Audits
Monday (6/29), 8:00 am–12:00 pm, Pavilion 9 (2)

SPC 212 MOT/for Determining Energy Performance and Water-Use Efficiency of Add-On Evaporative Pre-Coolers for Unitary Air Conditioning Equipment
Tuesday (6/30), 8:00 am–12:00 pm, 407 (4)

SPC 213P Method of Calculating Moist Air Thermodynamics
Tuesday (6/30), 8:00 am–10:00 am, 406 (4)

SPC 214 P Standard for Measuring and Expressing Building Energy Performance in a Rating Program
Monday (6/29), 2:15 pm–6:15 pm, 311 (3)

SPC 215 MOT to Determine Leakage Airflows and Fractional Leakage of Operating Air-Handling Systems
Monday (6/29), 2:15 pm–4:15 pm, 308 (3)

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans
Monday (6/29), 8:00 am–11:00 am, 315 (3)

SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities
Tuesday (6/30), 8:00 am–12:00 pm, 410 (4)

SPC 218P – MOT for Lubricant and Refrigerant Miscibility Determination
Monday (6/29), 8:00 am–10:00 am, 310 (3)

GPC 1.2 Commissioning Process for Existing HVAC&R Systems
Friday (6/26), 8:00 am–3:00 pm, Pavilion 6 (2)

GPC 1.3 Building Operation and Maintenance Training for the HVAC&R Commissioning Process
Tuesday (6/30), 1:00 pm–5:00 pm, 409 (4)

GPC 11 Field Testing of HVAC Controls Components
Saturday (6/27), 9:00 am–12:00 pm, 409 (4)

GPC 22 Instrumentation for Central Chilled Water Plants
Wednesday (7/1), 8:00 am–10:00 am, 313 (3)

GPC 23 Guideline for the Design/Application of HVAC Equip. for Rail Passenger Vehicles
Monday (6/29), 8:00 am–12:00 pm, 313 (3)

GPC 27P Procedures for Measurement of Gases in Indoor Environments
Sunday (6/28), 3:00 pm–5:00 pm, 408 (4)

GPC 34P Energy Guideline for Historical Buildings and Structures
Tuesday (6/30), 7:00 am–9:00 am, 403 (4)

GPC 35 Method for Determining the Energy Consumption Caused By Air-Cleaning and Filtration Devices
Monday (6/29), 8:00 am–12:00 pm, Pavilion 3 (2)

GPC 36 High Performance Sequences of Operation for HVAC Systems
Monday (6/29), 8:00 am–12:00 pm, 304 (3)

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens
Saturday (6/27), 1:00 pm–3:00 pm, 315 (3)

SGPC 0-General Commissioning Process
Saturday (6/27), 8:00 am–3:00 pm, 401 (4)

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments
Sunday (6/28), 9:00 am–12:00 pm, 307 (3)

SGPC 13 Guideline for Specifying Direct Digital Control Systems
Saturday (6/27), 8:00 am–12:00 pm, 314 (3)

SGPC 20 Documenting HVAC&R Work Processes and Data Exchange Requirements
Monday (6/29), 10:15 am–12:00 pm, Pavilion 5 (2)

US TAG to ISO/TC 142
Saturday (6/27), 2:30 pm–3:15 pm, Salon E (2)

US TAG to ISO/TC 163
Tuesday (6/30), 3:00 pm–4:30 pm, Pavilion 6 (2)

US Tag to ISO/TC 205
Tuesday (6/30), 1:00 pm–2:30 pm, Pavilion 6 (2)

JWG US Tag to ISO/TC 205 & US TAG to ISO/TC 163
Tuesday (6/30), 2:30 pm–3:00 pm, Pavilion 6 (2)

US TAG to ISO/TC 86
Monday (6/29), 8:00 am–10:00 am, Pavilion 10 (2)

ISO 817 MA
Tuesday (6/30), 8:00 am–12:00 pm, Pavilion 5 (2)

ISO 817 MA-Toxicity
Monday (6/29), 8:00 am–10:00 am, 407 (4)

ISO 817 MA-Flammability
Monday (6/29), 8:00 am–9:00 am, 409 (4)

ISO 817 MA-Design and Nomenclature
Monday (6/29), 9:00 am–10:00 am, 409 (4)

China National Refrigeration Safety Standard (GB 9237) Working Group
Tuesday (6/30), 10:00 am–12:00 pm, 405 (4)

USNC/IIR
Tuesday (6/30), 2:00 pm–4:00 pm, 210 (2)

USNT/IEA
Tuesday (6/30), 4:00 pm–6:00 pm, 210 (2)

Thermal Performance of the Exterior Envelopes of Whole Buildings
Sunday (6/28), 6:00 pm–12:00 am, 302 (3)

Thermal Performance of the Exterior Envelopes of Whole Buildings
Monday (6/29), 9:00 am–12:00 pm, 211 (2)

gbXML
Tuesday (6/30), 12:00 pm– 1:00 pm, 311 (3)

Description of abbreviations
GPC = Guideline Project Committee
RP = Research Project
SPC = Standard Project Committee
SSPC = Standing Standard Project Committee
TC = Technical Committee
TG = Task Group
TRG = Technical Resource Group

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