

ASHRAE ANNUAL CONFERENCE

June 22–26, 2019 | Kansas City, MO

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ASHRAE 365 App

ASHRAE has a free app to use at the conference. Download ASHRAE 365 for conference notifications, venue floor plans, Kansas City-area information and the option to connect with other attendees. You can also customize your schedule, participate in live audience polls and complete speaker evaluations. After the conference, ASHRAE 365 will be available year-round to provide you with the latest information and resources from ASHRAE.



Download ASHRAE 365 for free on the App Store or Google Play. For additional information, go to ashrae.org/365

SCHEDULE AT A GLANCE

For a full schedule of all meetings, events and sessions, download the **ASHRAE 365** app and select the **2019 Annual Conference**. You can build your custom schedule on your smart phone or tablet. Use the "Schedule" feature to view the full conference schedule. Filter by session/event type, track, level, day or room name.

Friday, June 21

TIME	EVENT NAME	LOCATION
8:00 am–5:00 pm	Committee Meetings	Marriott and KCCC
10:00 am–5:00 pm	Registration and Bookstore	2103AB, KCCC
12:00 pm–5:00 pm	Headquarters Room	Andy Kirk, Marriott West

Saturday, June 22

TIME	EVENT NAME	LOCATION
7:15 am–6:00 pm	Registration and Bookstore Lanyards sponsored by 	2103AB, KCCC
7:30 am–3:00 pm	ASHRAE Member Lounge	12th St. Meeting Room, Marriott West
7:30 am–3:00 pm	Companion Lounge	Barney Allis Lobby, Marriott East
8:00 am–5:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am–5:00 pm	Committee Meetings	Marriott and KCCC
8:00 am–3:00 pm	ALI Professional Development Seminars <i>ticket required</i>	2205 and 2206, KCCC
9:00 am–1:00 pm	Certification Exam <i>pre-registration required</i>	2202, KCCC
1:00 pm–3:00 pm	Speakers' Lounge	2102A, KCCC
3:15 pm–5:00 pm	Meeting of the Members, Plenary Session sponsored by 	Imperial Ballroom, Marriott East
6:30 pm–8:30 pm	Welcome Party <i>ticket required</i>	WWI Museum and Memorial

Sunday, June 23

TIME	EVENT NAME	LOCATION
7:00 am–5:00 pm	Speakers' Lounge	2102A, KCCC
7:00 am–5:00 pm	Registration and Bookstore	2103AB, KCCC
7:30 am–4:00 pm	ASHRAE Member Lounge	12th St. Meeting Room, Marriott West
7:30 am–4:00 pm	Companion Lounge	Barney Allis Lobby, Marriott East
8:00 am–4:45 pm	Technical Sessions	KCCC
8:00 am–5:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am–5:00 pm	Committee Meetings	Marriott and KCCC
9:00 am–9:30 am	Networking Coffee Break sponsored by bsi.	2100 Lobby, KCCC
1:00 pm–5:00 pm	General Tour: Museums at 18th & Vine <i>ticket required</i>	Departs from Marriott, West Tower on Central Ave.
1:30 pm–5:30 pm	Board of Directors meeting	Imperial, Marriott East
3:30 pm–6:30 pm	ALI Short Courses <i>ticket required</i>	2205 and 2206, KCCC
4:00 pm–6:00 pm	Young Engineers in ASHRAE (YEA) Hospitality Reception	Barney Allis Lobby, Marriott East

Monday, June 24

TIME	EVENT NAME	LOCATION
6:30 am-7:30 am	Fun Run/Walk	Barney Allis Plaza, across the street from all ASHRAE hotels
7:00 am-12:15pm	Speakers' Lounge	2102A, KCCC
7:00 am-5:00 pm	Registration and Bookstore	2103AB, KCCC
7:30 am-4:00 pm	ASHRAE Member Lounge	12th St. Meeting Room, Marriott West
7:30 am-4:00 pm	Companion Lounge	Barney Allis Lobby, Marriott East
8:00 am-12:00 pm	Technical Sessions	KCCC
8:00 am-5:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am-5:00 pm	Committee Meetings	Marriott and KCCC
9:30 am-9:45 am	Networking Coffee Break <i>sponsored by SPX</i>	2100 Lobby, KCCC
9:30 am-11:00 am	Meet and Greet	Rendezvous, Marriott East
12:15 pm-2:00 pm	President's Luncheon <i>ticket required</i>	Imperial, Marriott East
1:30 pm-5:00 pm	Speakers' Lounge	2102A, KCCC
2:15 pm-3:45 pm	Technical Session: College of Fellows Debate	2101, KCCC
2:15 pm – 5:30 pm	Hybrid Tour: Kauffman Center for the Performing Arts <i>ticket required</i>	Departs from Marriott West, Central Ave.
2:15 pm – 5:30 pm	General Tour: WWI Museum <i>ticket required</i>	Departs from Marriott West, Central Ave.
2:30 pm-5:30 pm	ALI Short Courses <i>ticket required</i>	2202, 2205 and 2206, KCCC
2:30 pm – 5:30pm	Tech Tour: KC Star Press <i>ticket required</i>	Departs from Marriott West, Central Ave.
4:00 pm-6:00 pm	Women in ASHRAE Happy Hour <i>ticket required</i>	Big John's Deck, 928 Wyandotte St.
After 5:00 p.m.	Regional Dinners <i>Sign up in advance</i>	Info posted at Registration 2103AB, KCCC

notes

Tuesday, June 25

TIME	EVENT NAME	LOCATION
7:00 am-5:00 pm	Speakers' Lounge	2102A, KCCC
7:30 am-4:30 pm	Registration and Bookstore	2103AB, KCCC
7:30 am-4:00 pm	ASHRAE Member Lounge	12th St. Meeting Room, Marriott West
7:30 am-4:00 pm	Companion Lounge	Barney Allis Lobby, Marriott East
8:00 am-11:00 am	ALI Short Courses <i>ticket required</i>	2205 and 2206, KCCC
8:00 am-5:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am-4:45 pm	Technical Sessions	KCCC
8:00 am-5:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am-5:00 pm	Committee Meetings	Marriott and KCCC
12:00 pm-1:30 pm	Life Members' Lunch <i>ticket required</i>	Tea Room, Marriott East
12:00 pm-3:00 pm	ALI Short Course <i>ticket required</i>	2205, KCCC
2:00 pm-5:30 pm	Certification Exam <i>pre-registration required</i>	2206, KCCC
2:00 pm-5:00 pm	General Tour: Steamboat Arabia Tour <i>ticket required</i>	Departs from Marriott West, Central Ave.
2:30 pm-6:00 pm	Hybrid Tour: Boulevard Brewing Company <i>ticket required</i>	Departs from Marriott West, Central Ave.
6:15 pm-7:15 pm	Reception	Colonial, Marriott East
7:15 pm-10:00 pm	Members' Night Out <i>ticket required</i>	Imperial, Marriott East

Wednesday, June 26

TIME	EVENT NAME	LOCATION
7:00 am-1:00 pm	Speakers' Lounge	2102A, KCCC
7:30 am-11:00 am	Registration	2103AB, KCCC
7:30 am-1:00 pm	Bookstore	2103AB, KCCC
7:30 am-1:00 pm	ASHRAE Member Lounge	12th St. Meeting Room, Marriott West
7:30 am-1:00 pm	Companion Lounge	Barney Allis Lobby, Marriott East
8:00 am-12:30 pm	Technical Sessions	KCCC
8:00 am-1:00 pm	Headquarters Room	Andy Kirk, Marriott West
8:00 am-2:00 pm	Committee Meetings	Marriott and KCCC
2:00 pm-6:00 pm	Board of Directors Meeting	Imperial, Marriott East

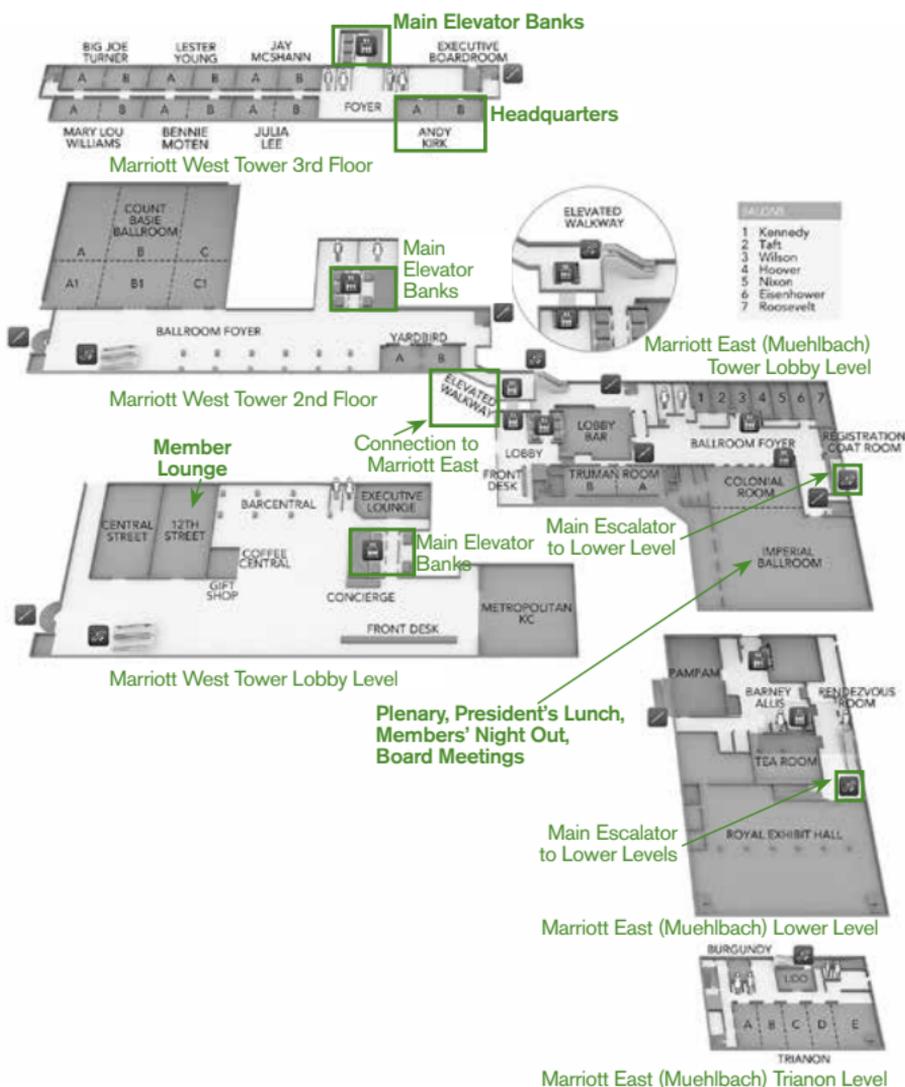
VENUE FLOOR PLANS

Marriott West and East (Muehlebach) Towers

200 W 12th St, Kansas City, MO 64105

The Marriott is divided into two towers – the West Tower and the East (formally known as the Muehlebach) Tower. Both towers have guest rooms and meeting space and are connected via skybridge. The skybridge is accessible on the 2nd floor of the West Tower. Take the skybridge outside of the Yard Bird rooms to the East Tower (Muehlebach). Once in the East Tower, take the escalator or the elevator down to the lobby level for access to the meeting rooms on the lobby level and the East Tower's front desk.

The entrance to the West Tower of the Marriott is on W. 12th St. Turn right out of the lobby to walk toward the Convention Center. The street level entrance to the Marriott East Tower (Muehlebach) is on Wyandotte St. along with the entrance to the Holiday Inn Aladdin and the Crowne Plaza. From the Marriott East Tower, Holiday Inn and Crowne Plaza, cross through the Barney Allis Plaza to access the Convention Center.

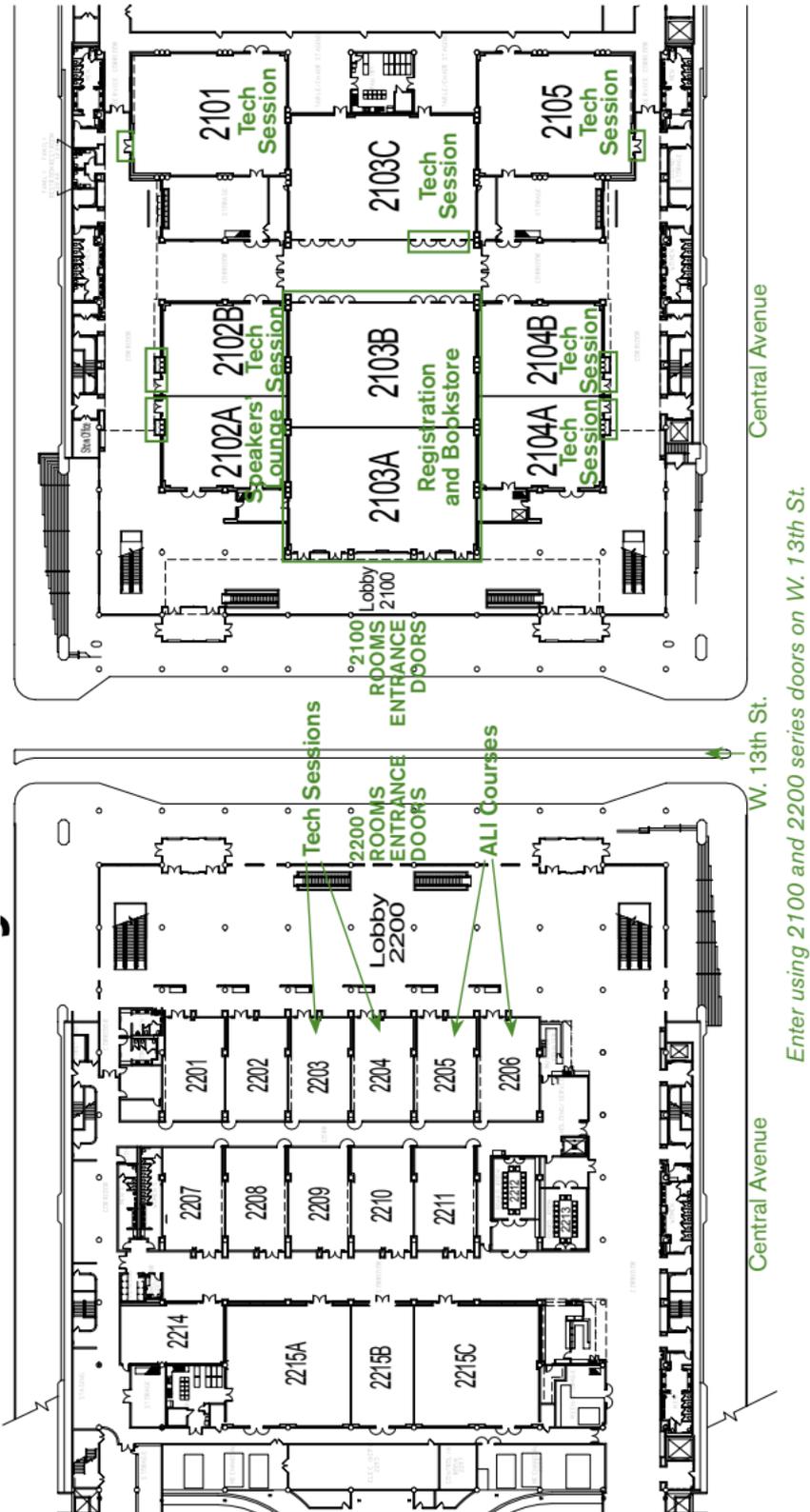


Kansas City Convention Center

301 W 13th St, Kansas City, MO 64105

The Kansas City Convention Center can be accessed where Central Avenue meets W. 13th Street. Doors to the 2100 and 2200 rooms will be open following this schedule:

Saturday	Sunday		Monday	Tuesday		Wednesday
	2100s	2200s		2100s	2200s	
6:30 a.m.	5:00 a.m.	6:00 a.m.	6:30 a.m.	6:30 a.m.	6:00 a.m.	6:30 a.m.



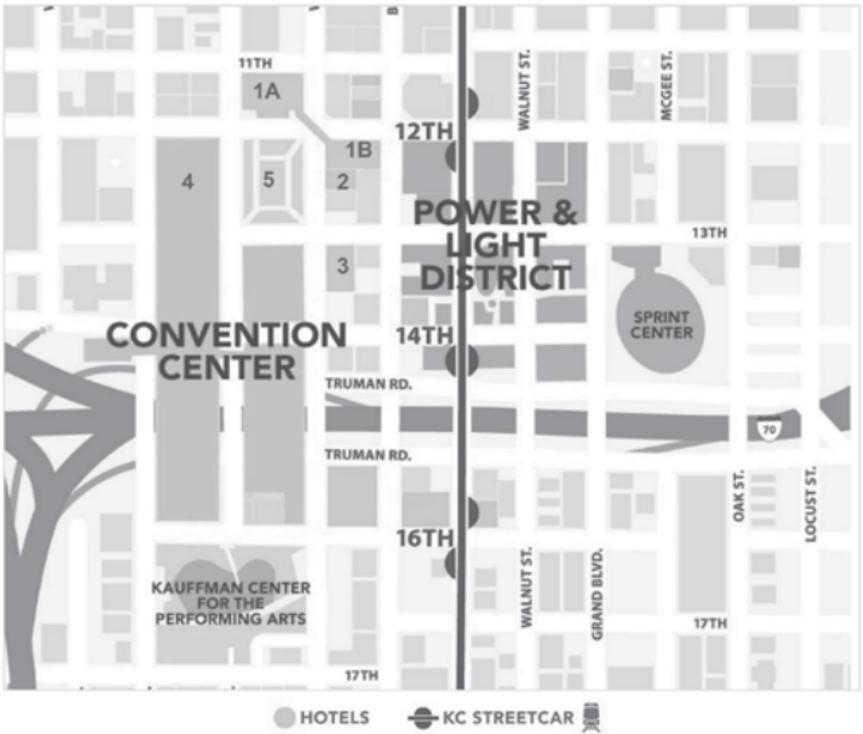
Central Avenue

W. 13th St.

Enter using 2100 and 2200 series doors on W. 13th St.

Central Avenue

City Map



HOTELS/KCCC

- 1A. Marriott Downtown – West Tower
- 1B. Marriott Downtown – East Tower (Muehlebach)
- 2. Aladdin
- 3. Crowe Plaza
- 4. KCCC – 2100 and 2200 rooms
- 5. Barney Allis Plaza

Thank You to our Sponsors

Keynote Sponsor



Sunday Networking Coffee Break

bsi.

Monday Networking Coffee Break



Sponsor of Lanyards



CHAPTER AND SOCIETY OFFICIALS

Thank You to our Volunteers

KANSAS CITY HOST COMMITTEE

General Chair: Blake Ellis
Vice Chair: Kelley Cramm
Sessions: Ann Peratt
Entertainment: Misty Givens
Hospitality and Information: Stuart Braden
Tours: Jim Berger
Sustainability Project: Ben MacKenzie

KANSAS CITY CHAPTER OFFICERS

President: Dieter Myers
President-Elect: Jarrod Foster
Vice President: Susan Nagel
Secretary: Amy Stadler
Treasurer: Ann Peratt

ASHRAE OFFICERS

President: Sheila Hayter
President-Elect: Darryl Boyce
Treasurer: Chuck Gulledge
Vice President: Julia Keen
Vice President: Mick Schwedler
Vice President: Dennis Knight
Vice President: Farooq Mehboob

CONFERENCES AND EXPOSITIONS COMMITTEE

Chair: Kevin Marple	Ryan MacGillivray
Vice Chair: Michael Collarin	Corey Metzger
Conference Chair:	Maggie Moninksi
Carrie Anne Monplaisir	Leticia De Oliveira Neves
Devin Abellon	Kimberly Pierson
Vikrant Aute	Sonya Pouncy
Robert Cox	Ashish Rakheja
Gary Debes	Christine Reinders-Caron
Melanie Derby	Lee Riback
Joseph Firrantello	Raul Simonetti
Ashu Gupta	Marianna Vallejo
Richard Hermans	Daniel Rogers,
Stephen Idem	BOD Ex-Officio
Rupesh Iyengar	Darryl Boyce,
Nivedita Jadhav	Coordinating Officer
Bing Liu	

GENERAL INFORMATION

Internet Access

Wireless internet will be available in all meeting rooms at the Marriott and the KCCC. Due to the number of users, please limit usage to functions that do not use excessive bandwidth such as Facebook, YouTube, streaming videos, etc.

MARRIOTT MEETING ROOMS

Network: PSAV Meetings

SSID: ASHRAE

Password: kansascity19

KANSAS CITY CONVENTION CENTER

SSID: ASHRAE

Password: kansascity19

Conference Policies

RECORDINGS

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, video and audio recording of this program is not allowed without ASHRAE's prior written consent.

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 Marriott or KCCC.

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.

Technical Program Information

BADGE SCANNING AND SESSION EVALUATIONS

Badges must be worn for admission to the technical program. Your badge will be scanned as you enter a Technical Session so that ASHRAE may provide you with a summary of all sessions attended which will be emailed to you after the conference. Question/comment cards are distributed to Technical Paper session attendees. Completed cards can be returned to a monitor. Questions/comments can also be provided online via ashrae.org/QCOnline. Questions are given to the authors for reply and published with Technical Papers in ASHRAE Transactions. Please access the ASHRAE 365 app to complete the technical program speaker and session evaluations. Paper evaluation forms are distributed for Forum sessions only. Please return the completed Forum evaluation forms to the monitors.

PROFESSIONAL DEVELOPMENT HOURS (PDHs)

All of the sessions presented in the technical program are approved for professional development hours (PDHs), including State of Florida PDHs.

In addition, some sessions have been submitted for approval for the State of New York PDHs and AIA Learning Units. Those programs are indicated with a  symbol. Others have been submitted for LEED AP credits and are indicated with a  symbol. Certain sessions may be acceptable for ASHRAE certification renewal. Send questions to certification@ashrae.org.

Sign-in sheets are available in the session room for State of Florida and AIA licensees. Sessions are approved for 1, 1.5 or 2 PDHs depending on the length of the session.

CONFERENCE PAPERS

During the Annual and Winter Conferences, papers presented in the technical and conference paper sessions are available as a collection via subscription to the Technology Portal online, and the final papers are published in ASHRAE Transactions. All papers published between the years 1980–1997 may be searched online in the Abstract Archive Center. Access to the Abstract Archives is a member benefit. For ordering information, contact ASHRAE Customer Service at 1-800-527-4723 or cservice@ashrae.org.

VIRTUAL CONFERENCE

Don't miss the state-of-the-art concepts and latest design techniques presented in the Society's technical program available through the virtual conference. The Kansas City Virtual Conference allows you to view presentations and to interact with an online audience through a discussion board. All registered conference attendees will receive an email notification when sessions are available for viewing. To access the Kansas City Virtual Conference go to www.ashrae.org/kansascityvirtual.

Virtual Conference registration includes:

- Synced audio and PowerPoint presentations from all, conference paper sessions, seminars, technical paper sessions and workshops.
- Ability to post comments and rate presentations.
- Print presentation slides in notes format.

Presentations are available online for 18 months with the ability to post questions or answers for selected sessions through Monday, July 15.

A full slate of technical programs will be posted daily beginning Monday, June 24 through Thursday, June 27, of the sessions that were presented the previous day.

Access to the Kansas City Virtual Conference is free with your conference registration. To register for the Virtual Conference only, register online at www.ashrae.org/kansascity.

\$249 ASHRAE member; \$445 non-member

In Case of an Emergency

Plan ahead—when you reach your destination, check the location of exits. Walk to the nearest exit; learn the route, obstacles, etc.

MARRIOTT KANSAS CITY DOWNTOWN

Dial 7777 from any hotel phone to contact security or call 911 directly from your personal phone. When 911 is called please also notify the hotel to assist when emergency services arrive on property. If speaking to 911 dispatch, the two Marriott Tower addresses are as follows:

Marriott West Tower	Marriott East Tower
200 W. 12th St.	1213 Wyandotte St.

The hotel has an emergency response team 24 hours a day. In the event of an emergency, 911 may be called from all phones within the hotel.

The Kansas City Downtown Marriott Security Department, as well as a small number of other employees, are trained in CPR and First Aid.

In the event of an evacuation, the hotel will use the PA system to inform guests in affected areas to evacuate the hotel and inform them of an evacuation location. Additional hotel management will be walking the property to help direct hotel guests in the event of an emergency.

KANSAS CITY CONVENTION CENTER

In the event of an emergency, an alarm will sound and KCCC staff will provide instructions for attendees.

For non-life-threatening emergencies, please call the **KCCC Security team at 816-513-5111**. Security will dispatch law enforcement or emergency services if needed. Know your location and be ready to explain to security and/or emergency services of your exact location within the center.

Please use the black phones throughout the convention center for emergencies that call Security or 911.

EMERGENCY NUMBERS AND ADDRESSES

Hospital	Truman Medical Ctr	816-556-3000	2301 Holmes St (1.1 mi)
Police	Kansas City PD	816-234-5111	1125 Locust St (0.5 mi)
Fire	KCFD Station 8	816-513-4600	1517 Locust St (0.8 mi)
Pharmacy	CVS	816-842-2514	10th & Main (0.3 mi)
Urgent Care	Sprint Center Urgent Care	816-268-4295	1403 Grand Blvd. (0.6 mi)

SAFETY TIPS

Street Safety. The streets of any city at any time can be unsafe. When you leave your hotel to go out during the day or the evening, make sure you take off your badge. Wearing a badge is an advertisement that you are a visitor to the city and that you are probably unfamiliar with your location.

Walk “smart” when you leave the convention site—know your destination and the best way to reach it. Walk along lighted sidewalks at night and don't walk alone. Trust your instincts—if you're uncomfortable with a situation, get out of it.

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

Helpful Information

MEALS

Meals are not included in your conference registration; however, we know that sometimes you have limited time to grab a quick meal between meetings and technical sessions. Here are few grab-and-go options at the Marriott:

CoffeeCentral

Daily 6:00 a.m.–10:00 p.m.

Serves coffee and pastries and is in the West Tower lobby near the bar and 12th Street meeting room.

MetropolitanKC

Breakfast (buffet and menu) 6:00–11:00 a.m., Mon.–Fri.

Lunch (buffet and menu) 11:00 a.m.–2:00 p.m., Mon.–Fri.

Dinner 5:00–10:00 p.m., 7 days a week

Located in the West Tower lobby near the front desk.

BarCentral

Coffee Service 6:00 a.m.–10:00 p.m. daily

Food 11:00 a.m.–12:00 a.m. daily

Drinks 11:00 a.m.–12:00 a.m. Sunday–Thursday;

11:00 a.m.–1:30 a.m. Friday - Saturday

Fresh Bites

24 Hours Daily

In-Room Dining Reimagined – regular in-room dining experience plus the option to pick up if you are on-the-go.

Dial 4615 from your hotel room, visit FreshBitesKansasCity.com or download the Kansas City Marriott Downtown app to place your order.

THINGS TO DO IN KANSAS CITY

Stop by the Host Committee desk in the lobby of the 2100 building at the KCCC outside of registration and bookstore or the Hospitality Desk at the Member Lounge in the 12th St. Meeting Room in the lobby of the Marriott West Tower. The Kansas City host committee will provide “Things to Do” recommendations as well as local restaurants.

You can also visit www.visitkc.com/ashrae for:

- The KC BBQ Experience + a list of restaurants by district
- 33 Free Things to Do in Kansas City
- Local Events
- About Kansas City
- Visitors Help
- Maps and Info on Getting Around the Convention Center Area

FAMILY SERVICES

Visit KC, the Kansas City Convention and Visitors Bureau, recommends the following companies for child care services while in Kansas City:

A1 Tiny Tots Nannying and Sitter Services

www.a1tinytots.com

816-591-9330

SeekingSitters of Kansas City

www.seekingsitterskansascity.com

918-749-3588

ASHRAE makes no representation as to the quality or suitability of the child care options available. ASHRAE has done no investigation or inquiry into these options and accordingly assumes no liability for these services. All participants considering these facilities should perform their own investigation into the quality, suitability or desirability of these child care facilities.

MOTHERS' ROOM

ASHRAE is pleased to offer a private room to nursing mothers in both locations. Please visit the Registration Desk in 2103AB, KCCC to inquire about access.

Marriott	KCCC
Imperial Office, Lobby, East Tower	Show Office 2201, 2200s Building

LOST AND FOUND

Items found during the conference should be turned into the staff at the following locations:

	Marriott	KCCC
ASHRAE Lost and Found	Staff Headquarters, Andy Kirk, 3rd floor, West Tower	Registration 2103AB
Venue Lost and Found	Contact the Marriott's Security and Loss Prevention team	Contact Security at 816-513-5111 or at the Kitchen Dock entrance on 14th street between Broadway and Central.

LeadershipU

At each ASHRAE conference, the LeadershipU 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 LeadershipU participants for the 2019 ASHRAE Annual Conference are:

John Constantinide, Spacecoast Chapter, Region XII

Anuj Gupta, ASHRAE Deccan Chapter, Region-at-Large

Randy Reed, Idaho Chapter, Region IX

Kirsten Burk, National Capital Chapter, Region III

EVENT DETAILS

Saturday, June 22

CERTIFICATION EXAM

2202, KCCC | 9:00 a.m. – 1:00 p.m.

Recognized by over 35 national, state and local government bodies – and with nearly 3,000 certifications earned – ASHRAE certifications increasingly have become the must-have credential for built-environment professionals. ASHRAE certification exams will be administered to candidates in these key, built-environment fields: Commissioning, Energy Auditing, Energy Modeling, Healthcare Facility Design, High-Performance Building Design and Building Operations.

Pre-application required.



MEETING OF THE MEMBERS – PLENARY SESSION

Imperial Ballroom, Marriott-East | 3:15 – 5:00 p.m.

Kick off the ASHRAE Annual Conference with the opening Plenary session. ASHRAE award winners are recognized and updates on the Society will be presented. The plenary session is open, no badge or registration is required to attend.

Doors open at 3:00 p.m.

Opening and Welcome Remarks	ASHRAE President, Sheila Hayter
Welcome to Region IX	Director and Regional Chair, Trent Hunt
Secretary's Report	Executive Vice President, Jeff Littleton
Awards Presentation	See list of award winners on pages 22–27
Keynote Address	Mike Massimino



Mike Massimino, a former NASA astronaut and the first person to tweet from space, is a Professor of Mechanical Engineering at Columbia University and the Senior Advisor for Space Programs at the Intrepid Sea, Air, and Space Museum. He received his Bachelor of Science from Columbia and Masters of Science in both Mechanical Engineering and in

Technology and Policy, as well as his PhD in Mechanical Engineering from the Massachusetts Institute of Technology.

Keynote Address sponsored by:



WELCOME PARTY

National WWI Museum | 6:30 – 8:30 p.m. | \$65

Enjoy catching up with old friends and making new ones at the 2019 ASHRAE Annual Conference Welcome Party. The Welcome Party will take place at the National WWI Museum and Memorial. The Museum and Memorial was “built by Kansas Citizens and embraced by the nation” in 1921. The Museum and Memorial exhibits will be open for the duration of the Welcome Party. Food and drinks will be available in specified areas of the museum. Visit theworldwar.org for more information on exhibits and collections.

Continuous shuttle service is provided starting at 6:00 p.m. Shuttles depart on the corner of W. 12th St. and Central St. Turn right out of the main entrance of the Marriott West Tower.

Menu

Appetizers with a Kansas City Flare: Smokey Pork Bayonets, Sliced Smoked Beef Brisket with Petite Buns and BBQ Sauce for Mini Sandwiches, Chicken Jalapeno Bacon Wrapped Brochettes, Jumbo Buffalo Wings, Cheesy Mac and Cheese Au Gratin, Potato Salad, Domestic and Imported Cheese Board, Grilled Vegetable Crudit  and Apple Cobbler Streusel.

Your ticket includes (2) drink tickets.

Sunday, June 23

NETWORKING COFFEE BREAK

KCCC, 2100s Lobby | 9:00 a.m.

Join your fellow conference-goers over a cup of joe between the first and second Technical Program sessions.

Sponsored by: **bsi.**

YOUNG ENGINEERS IN ASHAE (YEA)

HOSPITALITY RECEPTION

Barney Allis Historical Lobby, Lower Lobby, Marriott East | 4:00 – 6:00 p.m.

Attention members age 35 and younger—
you are invited to visit the YEA Hospitality Reception, offering social and networking opportunities Light refreshments will be available.

Monday, June 24

FUN RUN/WALK

Barney Allis Plaza | 6:30 am

This fun run is organized **by attendees for attendees!** Meet at the Barney Allis Plaza located across the street from all ASHRAE partner hotels for a casual run/walk with some of your closest ASHRAE friends before the Technical Program starts at 8:00 a.m. Multiple course distance options will be offered from 1 to 5 miles. All paces are welcome. The courses will be marked in chalk and/or flour and maps will be available the morning of the event.

NETWORKING COFFEE BREAK

KCCC, 2100s Lobby | 9:30 a.m.

Caffeinate with colleagues and peers before the second block of Technical Program sessions begin at 9:45 a.m.

Sponsored by:  **SPX**[®]
COOLING TECHNOLOGIES

PRESIDENT'S LUNCH

Imperial Ballroom, Marriott-East | 12:15 – 2:00 P.M. | \$55

2019-20 ASHRAE President Darryl K. Boyce, P.Eng., presents his presidential theme, Building for People and Performance. Achieving Operational Excellence.

Certificates of appreciation to retiring Board members are presented, and the 2019-20 officers and Board of Directors installed.

WOMEN IN ASHRAE HAPPY HOUR

John's Big Deck, 928 Wyandotte St. | 4:00 – 6:00 p.m. | \$30

Join women from around the world to share ideas and learn how to be active at the chapter, region, and/or Society level. Current ASHRAE members will share insight and experiences. This event requires pre-registration. To get to John's Big Deck, turn left out of the Marriott-West lobby and then turn left on Wyandotte St. Big John's Deck will be down two blocks and on the left.

Two drink tickets and light apps are included with your ticket purchase.

Tuesday, June 25

LIFE MEMBERS' LUNCHEON

Tea Room, Lower Lobby, Marriott East | 12:00 – 1:30 p.m. | \$35

Enjoy lunch, share ideas about the future of technology and swap memories of the Society while dining with other Life Members. This member grade is for members who have completed 30 years of continuous membership and are at least 65 years of age.

CERTIFICATION EXAM

2206, KCCC | 2:00 – 5:30 p.m.

ASHRAE certification exams will be administered to candidates in these key, built-environment fields: Commissioning, Energy Auditing, Energy Modeling, Healthcare Facility Design, High-Performance Building Design and Building Operations.

Pre-application required.



MEMBERS' NIGHT OUT

Imperial Ballroom, Lobby, Marriott East | Reception and Cash Bar 6:15 p.m. | Dinner and Entertainment 7:15 p.m. | \$65

Let the games begin! Have you ever thought you could do better than the game show contestants you see on TV? Now is your chance to prove it! After enjoying dinner with friends, you can participate in an evening of game show style games with the opportunity to take home a prize! Attire is casual and comfortable.

notes

COMPANION GUIDE

Lounges

ASHRAE MEMBER LOUNGE

12th Street Meeting Room, Lobby, Marriott West

The ASHRAE Member Lounge is open daily for all individuals who are registered for the conference. Light refreshments are available in the morning each day and beverages are available all afternoon.

COMPANION LOUNGE

Barney Allis Historical Lobby, Lower Lobby, Marriott East

The Companion Lounge is open daily with light refreshments available in the morning and beverages available all day. The lounge is open to all registered companions and is a great place to meet others.

MEMBER AND COMPANION LOUNGE HOURS

Saturday, June 22	7:30 a.m. – 3:00 p.m.
Sunday, June 23	7:30 a.m. – 4:00 p.m.
Monday, June 24	7:30 a.m. – 4:00 p.m.
Tuesday, June 25	7:30 a.m. – 4:00 p.m.
Wednesday, June 26	7:30 a.m. – 1:00 p.m.

Meet and Greet

Rendezvous, Lower Lobby, Marriott East

Monday, June 24 | 9:30 – 11:00 a.m.

The Meet and Greet, open to all registered companions and guests, gives companions an opportunity to meet with old friends and greet new ones.

Join Bethanie Schemel from KC Barbecue Tours in a historic speakeasy setting for a presentation of Kansas City history and how the mob made barbecue such a staple in the Kansas City culture. Bethanie will also discuss the presidential history of Kansas City and specifically within the famous Muehlebach Hotel which is known today as the Kansas City Marriott Downtown East Tower.

Bethanie Schemel and her husband, Karl, own and operate KC Double Decker Tours and KC Barbecue Tours. Bethanie started research on the history of Kansas City and specifically Kansas City Barbecue for the opening of KC Barbecue Tours and KC Double Decker Tours a few years ago. Bethanie knows the “who, what, where, why and when” and verbally paints a picture to tell the story of Kansas City and its barbecue roots.

Light refreshments will be served.

TIPS FOR FIRST TIME ATTENDEES

ASHRAE conferences provide opportunities for you to learn about the latest technology in the HVAC&R industry, express your opinion about controversial issues, explore new applications for fundamental ideas, to meet the people behind those ideas and to help shape the Society that serves your profession.

If this is your first time attending, you may have questions about what is available to registered attendees. Here are a few tips to help you navigate the conference.

Technical Program

The technical program for the ASHRAE Conference includes technical paper sessions, conference paper sessions, seminars, debates, panels, workshops and forums. Check the program book or ASHRAE 365 app to see what you want to attend. You can jump between sessions if you want to hear one specific presentation in each session. Volunteers will be at the door checking and scanning badges.

See page 39 for descriptions of the different types of sessions available within the Technical Program.

All registered attendees receive access to the Virtual Conference, PowerPoint presentations with audio descriptions.

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 to be awarded. 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.

Advancing the Industry: Committee Meetings

The technical expertise of ASHRAE is concentrated in its technical committees, task groups and technical resource groups, which are responsible for preparing the ASHRAE Handbook volumes, initiating and supervising Society research projects, presenting programs at ASHRAE conferences, reviewing technical papers and evaluating the need for standards.

To be a member of a technical committee (TC), you must be active in the field addressed by the committee. You do not have to be an ASHRAE member to participate in a technical committee, nor do you have to be a member of a technical committee to attend committee meetings.

Standards project committees (SPCs) are appointed specifically by the Standards Committee to develop and revise standards to reflect technical advances in the areas that they cover. To qualify for membership in a committee, you must be knowledgeable in the discipline of the proposed standard.

A schedule of all meetings is included in the conference program on pages 88–116 and the ASHRAE 365 app. Attendance at TC and SPC meetings is open to any interested party.

Support Services

The ASHRAE Bookstore and membership booth are set up on site to offer conference participants the latest information about the industry and to answer questions concerning ASHRAE membership.

ASHRAE publications, including conference papers, are available for sale in the ASHRAE Bookstore. Located in the registration area the bookstore features a display of books devoted entirely to the HVAC&R industry. Publications from ASHRAE's publications catalog, as well as a variety of new publications and books from allied organizations are on display. ASHRAE publications may be purchased individually on site, or you may wish to order several books and have them shipped to you at a later date or use the online bookstore at **www.ashrae.org/bookstore**.

The membership booth is located in the registration area. Membership applications are available, as well as brochures about the HVAC&R industry and information on student membership. Registrants paying the non-member registration fee receive their first year of membership free. To obtain membership an application form must be submitted with the meeting registration form or within 60 days following the meeting. A staff member will be present during registration hours to assist you.

Networking: Get Involved

ASHRAE conferences and meetings provide an international setting for attendees to gather and exchange ideas, to explore possibilities in the industry and to examine its problems. Opportunities to get involved range from presenting a conference paper to participating in a seminar or attending committee meetings. By reviewing your program and planning ahead, you can ensure that the conference will be a success instead of a series of missed opportunities. Attend events to get to know other members and attendees. Event details are on pages 15–18.

SOCIETY AWARDS

PLENARY SESSION AWARDS PRESENTATION

Imperial Ballroom, Marriott-East | 3:15 – 5:00 p.m.

At the Plenary session, the Honors and Awards Program recognizes dedicated ASHRAE members who voluntarily give freely of their time and expertise to “advance the arts and sciences of HVAC&R to serve humanity and promote a sustainable world.”

Pass-Through Awards

LINCOLN BOUILLION AWARD

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

Carlos E. Arguijo, P.E., El Paso, Texas, *El Paso Chapter*

CHAPTER PROGRAMS STAR AWARD

Given in recognition of excellence in chapter program endeavors.

Joe Chow, BEAP, Hong Kong, China, *Hong Kong Chapter*

WILLIAM J. COLLINS AWARD

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

Daniel Redmond, P.Eng., Ottawa, Ontario, Canada, *Ottawa Valley Chapter*

LOU FLAGG HISTORICAL AWARD

Given in recognition of a Chapter Gold Ribbon Award winner for compiling information on outstanding historical projects or persons related to HVAC&R.

Randy C. Schrecengost, P.E., BEAP, Austin, Texas, *Austin Chapter*

GOVERNMENT AFFAIRS 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.

Meghan K. McNulty, P.E., Atlanta, GA, *Atlanta Chapter*

DONALD BAHNFLETH ENVIRONMENTAL HEALTH AWARD

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

William P. Bahnfleth, Ph.D., P.E., Presidential Fellow Life Member ASHRAE, University Park, Pennsylvania

HOMER ADDAMS AWARD

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

Omer Sarfraz, Stillwater, Oklahoma

ASHRAE JOURNAL PAPER AWARD

Given in recognition of the best article published in the ASHRAE Journal in 2018.

Daniel Koenigshofer, P.E., HFDP, and **John W. Roberts, P.E., HFDP, Life Member ASHRAE,** Raleigh, North Carolina

STANDARDS ACHIEVEMENT AWARD

Given in recognition for excellence in volunteer service for developing ASHRAE standards/guidelines.

Richard L. Hall, P.E., Life Member, ASHRAE
Worthington, Ohio

RALPH G. NEVINS PHYSIOLOGY & HUMAN ENVIRONMENT AWARD

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

Bin Cao, Ph.D., Beijing, China

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.

Michel D. Hayek, Zouk-Mosbeh, Lebanon

YOUTH OUTREACH AWARD

Given in recognition for the outstanding effort of a member who actively engages a youth audience in their country, region, or local community through science, technology, engineering and mathematics activities.

Cynthia Cecilia Carrillo Mendez, P.E., Menlo Park, California

SCIENCE AND TECHNOLOGY FOR THE BUILT ENVIRONMENT BEST PAPER AWARD

Given in recognition of the best referred paper published in the volume year of the Science and Technology for the Built Environment, the ASHRAE Research Journal.

Burak Gunay, Ph.D., Ottawa, Ontario, Canada

Weiming Shen, Ottawa, Ontario, Canada

Chunsheng Yang, Ottawa, Ontario, Canada

Paper Awards

CROSBY FIELD AWARD

Given in recognition of the highest rated paper presented at a Technical Session or Symposium in 2018.

Amy Van Asselt, Ph.D., Easton, Pennsylvania

Douglas T. Reindl, Ph.D., P.E., Fellow ASHRAE,
Madison, Wisconsin

Gregory F. Nellis, Madison, Wisconsin

ASHRAE TECHNICAL PAPER AWARD

Given in recognition of the best paper presented at a Technical Paper Session at a Society Conference in 2018.

Peng Yin, Ph.D., Lafayette, Louisiana, receives an award for the following:

“Modeling Variable-Airflow Series Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

“Annual Energy Performance Evaluation of Series and Parallel Fixed-Airflow Fan-Powered Terminal Units.”

“Modeling Variable-Airflow Parallel Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

Carl Lewis Reid, Austin, Texas, receives an award for

“Modeling Variable-Airflow Series Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

Dennis L. O’Neal, Ph.D., P.E., Waco Texas, receives an award for the following:

“Modeling Variable-Airflow Series Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

“Annual Energy Performance Evaluation of Series and Parallel Fixed-Airflow Fan-Powered Terminal Units.”

“Modeling Variable-Airflow Parallel Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

Di Lu, College Station, Texas, receives an award for

“Annual Energy Performance Evaluation of Series and Parallel Fixed-Airflow Fan-Powered Terminal Units.”

Shima Sadat Shahahmadi, Oklahoma City, Oklahoma, and **Li Song**, Norman, Oklahoma, receive an award for

“Valve Flowmeter Enhancement through Computing Valve Dynamic Behaviors.”

WILLIS H. CARRIER AWARD

Given in recognition of the best paper presented at a Society Conference in 2017 by a member thirty-two years of age or less.

Carl Lewis Reid, Austin, Texas and **Peng Yin, Ph.D.**, Lafayette, Louisiana, receive the award for

“Modeling Variable-Airflow Series Fan-Powered Terminal Units with a Mass and Energy Balance Approach.”

Distinguished Service Award

Gerado Alfonso, Eng., Bogotá, Columbia

Charlene Warres Bayer, Ph.D., Fellow Life Member ASHRAE, Marietta, Georgia

Niels Bidstrup, Ph.D., Bjerringbro, Denmark

Alonzo A.B. Blalock, P.E., Fort Worth, Texas

Nohad I. Boudani, P.Eng., Beirut, Lebanon

Clive Broadbent, P.Eng., Fellow Life Member ASHRAE, Canberra, Australia

Robert B. Burkhead, Louisville, Kentucky

Dimitris A. Charalampopoulos, BEAP, Paleon Phaliron, Greece

Rupal A. Choksi, Arlington, Virginia

Jon J. Cohen, Glen Allen, Virginia

James G. Crawford, Fellow Life Member ASHRAE, Tyler, Texas

Lorenzo Cremaschi, Ph.D., Auburn, Alabama

Den Low Han Guan, P.E., Kuala Lumpur, Malaysia

Pam Duffy, P.E., Dallas, Texas.

Philip W. Fairey, Cocoa, Florida

Gus Faris, Life Member ASHRAE, Houston, Texas

Bruce L. Flaniken, P.E., Fellow Life Member ASHRAE, Houston, Texas

Brian Hafendorfer, P.E., Lexington, Kentucky

William M. Healy, Ph.D., Gaithersburg, Maryland

Mark A. Hertel, P.E., Life Member ASHRAE, Fontana, California

Jaap Hogeling, Fellow Life Member ASHRAE, Rotterdam, Netherlands

Jonathan Humble, West Hartford, Connecticut

Ronald Judkoff, Life Member ASHRAE, Golden, Colorado

Esher Kweller, P.E., Life Member ASHRAE, Washington, District of Columbia

Walter W. Law, Jr., P.E., Knoxville, Tennessee

Marilyn A. Listvan, Ph.D., Edina, Minnesota

R. Christopher Mathis, Asheville, North Carolina

Dustan Meredith, P.E., Lexington, Kentucky

Richie Mittal, New Delhi, India

John S. Molnar, P.Eng., Burlington, Ontario, Canada

Matthew J. Nelson, P.E., Cleveland, Ohio.

Zheng O'Neill, Ph.D., P.E., Tuscaloosa, Alabama.

Kathleen Owen, Fellow ASHRAE, Cary, North Carolina

Gary Phetteplace, Ph.D., P.E., Fellow Life Member ASHRAE, Lyme, New Hampshire

Donald Prather, Arlington, Virginia

Keith Reihl, P.E., HBDP, Cypress, Texas

Rachel L. Romero, P.E., Golden, Colorado

Heather Schopplein, P.E., El Cajon, California

Robert E. Simmons, P.E., Houston, Texas

Eric Sturm, La Crosse, Wisconsin

Wei Sun, P.E., Fellow ASHRAE, Ann Arbor, Michigan

Jonathan I. Symko, Life Member ASHRAE, Sugar Land, Texas

Marija S. Todorovic, Ph.D., P.E., Fellow ASHRAE, Belgrade, Serbia

Richard E. Vehlow, P.E., Albany, New York

John L. Wright, Ph.D., P.Eng., Waterloo, Ontario, Canada

Keith A. Yelton, Life Member ASHRAE, Gresham, Oregon

Forrest S. Yount, Charlotte, North Carolina

Richard A. Zbin, HFDP, Life Member ASHRAE, Silver Spring, Maryland

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.

M. Kent Anderson, Life Member ASHRAE, Traverse City, Michigan

Walid Chakroun, Ph.D., P.E., Fellow ASHRAE, Kuwait City, Kuwait

Kelley Cramm, P.E., Lenexa, Kansas

David Scott Fisher, Bloomington, Illinois

Arthur L. Giesler, Niles, Illinois

William Klock, P.E., Austin, Texas

Lawrence C. Markel, Fellow Life Member ASHRAE, Oak Ridge, Tennessee

R. Christopher Mathis, Asheville, North Carolina

John H. Nix, II, Gainesville, Florida

Jeffrey D. Spittle, Ph.D., P.E., Stillwater, Oklahoma

Wei Sun, P.E., Fellow ASHRAE, Ann Arbor, Michigan

Edward Ka Cheung Tsui, Wanchai, Hong Kong

William F. Walter, Syracuse, New York

Richard D. Watson, Westbrook, Connecticut

David P. Yuill, Ph.D., P.E., Omaha, Nebraska

Distinguished 50-Year Member Award

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

Ainul Abedin, P.E., Fellow Life Member ASHRAE,
Karachi, Pakistan

Paul Ross Conrad, P.Eng., Life Member ASHRAE,
Halifax, Nova Scotia, Canada

Charles C. Copeland, P.E., Fellow Life Member ASHRAE,
New York, New York

Daniel J. Driscoll, P.E., Fellow Life Member ASHRAE,
New Hyde Park, New York

Walter T. Grondzik, P.E., Fellow Life Member ASHRAE,
Muncie, Indiana

Hng Hung Chenh, Fellow Life Member ASHRAE,
Singapore

Richard D. Miller, P.E., Fellow Life Member ASHRAE,
Henderson, Nevada

Yasunobu Nishi, Dr.Eng., Fellow Life Member ASHRAE,
Sapporo, Japan

Avraham Shitzer, Ph.D., Fellow Life Member ASHRAE,
Haifa, Israel

Edward F. Sowell, Ph.D., Fellow Life Member ASHRAE,
Placentia, California

Alan Thompson, C.Eng., Fellow ASHRAE, Auckland,
New Zealand

Samuel G. Toub, P.E., Fellow Life Member ASHRAE,
Dallas, Texas

Cedric S. Trueman, P.Eng., Life Member ASHRAE,
Victoria, British Columbia, Canada

Alfred W. Woody, P.E., Fellow Life Member ASHRAE,
Norton Shores, Michigan

Robert A. Zagar, P.E., Life Member ASHRAE, St. Louis,
Missouri

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.

Ross D. Montgomery, P.E., Fellow ASHRAE, CPMP, BEAP, HBDP, Tampa, Florida

Louise & Bill Holladay Distinguished Fellow Award

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

Predrag Pega Hrnjak, Fellow Life Member ASHRAE,
Urbana, Illinois

ASHRAE CONFERENCES: PAST AND FUTURE

Upcoming Topical Conferences

2019 ASHRAE Building Performance Analysis Conference
Sept. 25–27 | Denver, CO | www.ashrae.org/BuildPerform2019

Seventh International Conference on Energy Research and Development, co-organized by Kuwait University and ASHRAE
Nov. 19–21 | Kuwait | www.ashrae.org/kuwait

2019 Buildings XIV International Conference
Dec. 9–12 | Clearwater Beach, FL | www.ashrae.org/BuildingsXIV

2020 Indoor Environmental Quality Performance Approaches – Transitioning from IAQ to IEQ
Sept. 14–16 | Athens, Greece | www.ashrae.org/IAQ2020

Upcoming Winter and Annual Conferences

Year	Winter	Annual
2020	Orlando, FL, Feb. 1–4	Austin, TX, June 27–July 1
2021	Chicago, IL, Jan. 23–27	Phoenix, AZ, June 26–30
2022	Las Vegas, NV, Jan. 29–Feb. 2	Toronto, ON, June 25–29

Past Winter and Annual Conferences

Year	Winter	Annual	Year	Winter	Annual
1980	Los Angeles	Denver	2001	Atlanta	Cincinnati
1981	Chicago	Cincinnati	2002	Atlantic City	Honolulu
1982	Houston	Toronto	2003	Chicago	Kansas City
1983	Atlantic City	Washington	2004	Anaheim	Nashville
1984	Atlanta	Kansas City	2005	Orlando	Denver
1985	Chicago	Honolulu	2006	Chicago	Quebec City
1986	San Francisco	Portland	2007	Dallas	Long Beach
1987	New York	Nashville	2008	New York	Salt Lake City
1988	Dallas	Ottawa	2009	Chicago	Louisville
1989	Chicago	Vancouver	2010	Orlando	Albuquerque
1990	Atlanta	St. Louis	2011	Las Vegas	Montreal
1991	New York	Indianapolis	2012	Chicago	San Antonio
1992	Anaheim	Baltimore	2013	Dallas	Denver
1993	Chicago	Denver	2014	New York	Seattle
1994	New Orleans	Orlando	2015	Chicago	Atlanta
1995	Chicago	San Diego	2016	Orlando	St. Louis
1996	Atlanta	San Antonio	2017	Las Vegas	Long Beach
1997	Philadelphia	Boston	2018	Chicago	Houston
1998	San Francisco	Toronto	2019	Atlanta	Kansas City
1999	Chicago	Seattle			
2000	Dallas	Minneapolis			

ROOMS AND HOURS

Registration and ASHRAE Bookstore and Logo Store

2103AB | KCCC

Registration is required for all conference participants. Official badges must be worn at all functions and for admission into the technical sessions. 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 and ASHRAE logo items.

Friday, June 21	10:00 a.m. – 5:00 p.m.
Saturday, June 22	7:15 a.m. – 6:00 p.m.
Sunday, June 23	7:00 a.m. – 5:00 p.m.
Monday, June 24	7:00 a.m. – 5:00 p.m.
Tuesday, June 25	7:30 a.m. – 4:30 p.m.
Wednesday, June 26	7:30 a.m. – 11:00 a.m. <i>*Bookstore closes at 1:00 p.m.</i>

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.

Speakers' Lounge

2102A | KCCC

Saturday, June 22	1:00 p.m. – 3:00 p.m.
Sunday, June 23	7:00 a.m. – 5:00 p.m.
Monday, June 24	7:00 a.m. – 12:15 p.m. 1:30 p.m. – 5:00 p.m.
Tuesday, June 25	7:00 a.m. – 5:00 p.m.
Wednesday, June 26	7:00 a.m. – 1:00 p.m.

Membership Desk

2103AB | KCCC

The membership information desk is available for paying dues, applying for membership, updating membership information. 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.

Headquarters Office

ANDY KIRK | 3RD FLOOR | MARRIOTT WEST

The ASHRAE Headquarter office offers members complimentary copying and access to printers for laptop computers.

Friday, June 21	12:00 p.m. – 5:00 p.m.
Saturday, June 22	8:00 a.m. – 5:00 p.m.
Sunday, June 23	8:00 a.m. – 5:00 p.m.
Monday, June 24	8:00 a.m. – 5:00 p.m.
Tuesday, June 25	8:00 a.m. – 5:00 p.m.
Wednesday, June 26	8:00 a.m. – 1:00 p.m.

Lounges

MEMBER LOUNGE

12th St. Meeting Room | Lobby | Marriott West

COMPANION LOUNGE

Barney Allis Historical Lobby | Lower Lobby | Marriott West

Lounges are open to all registered attendees and registered companions. See page 19 for more information.

Saturday, June 22	7:30 a.m. – 3:00 p.m.
Sunday, June 23	7:30 a.m. – 4:00 p.m.
Monday, June 24	7:30 a.m. – 4:00 p.m.
Tuesday, June 25	7:30 a.m. – 4:00 p.m.
Wednesday, June 26	7:30 a.m. – 1:00 p.m.

Kansas City Host Desk

2103 LOBBY | KCCC

Stop by the Kansas City Host Committee desk to receive information about local Kansas City recommendations and discounts on dining, retail and entertainment. Members of the host committee will also be stationed at the Members Lounge each morning to welcome members and answer local questions.

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 last-minute cancellations. If you have a stand-by ticket, please be prepared to pay by credit card or exact cash at the bus.

Longer descriptions of the tours can be found in the ASHRAE 365 app or at www.ashrae.org/kansascity.

All tours depart on the corner of W. 12th St. and Central Ave. From the Marriott West Tower lobby, turn right to Central Ave. Please arrive at least 10 minutes before the tour is scheduled to depart.

Technical Tour

KC STAR PRESS PAVILION

Monday, June 24 | 2:30 – 5:30 p.m. | \$40

It took two city blocks, three years and \$200 million to make The Kansas City Star's printing facility a reality. By replacing antiquated presses with state-of-the-art, computer-controlled systems, The Star now leads the industry in high-quality newspaper publishing in North America.

The same type of KBA presses in use by The Star also print 100% of all North American currency and 90% of the world's currency. Our sleek modern glass building stands eight stories tall allowing passers-by to view the printing process.

Hybrid Tours

New for the Annual Conference in Kansas City are general, site seeing tours with an ASHRAE twist! Attend the following tours to see these great sites in Kansas City with a representative from the local ASHRAE Host Committee to provide technical, back-of-house information.

KAUFFMAN CENTER FOR PERFORMING ARTS

Monday, June 24 | 2:15 – 5:30 p.m. | \$40

The Kauffman Center for the Performing Arts, a multi-venue center for music, opera, theater and dance designed by Moshe Safdie opened in Kansas City on September 16, 2011. Three of the region's leading performing arts organizations – Kansas City Ballet, Kansas City Symphony and Lyric Opera of Kansas City – are in residence at the Kauffman Center.

The Center was originally to be supplied by downtown chilled water loop and a Variable Primary System. More details related to the building's specifics can be found in the app.

BOULEVARD BREWING COMPANY

Tuesday, June 25 | 2:30 – 6:00 p.m. | \$55

Founded in 1989, Boulevard Brewing Co. has grown to become the largest specialty brewer in the Midwest, with its beers being sold in more than 30 states coast-to-coast.

Boulevard began in 1988 when founder John McDonald started construction of the brewery in a turn-of-the-century brick building on Kansas City's historic Southwest Boulevard. A vintage Bavarian brewhouse was installed with used equipment from a closed brewery in Bavaria, Germany, and the first batches of beer were produced in the fall of 1989.

With capacity reaching an estimated 600,000 barrels from an expansion project completed in 2006, the brewery is now one of the largest craft brewers in the Midwest.

General Tours

MUSEUMS AT 18TH & VINE

Sunday, June 23 | 1:00 – 5:00 p.m. | \$60

The Negro Leagues Baseball Museum

Before Jackie Robinson broke the color barrier in 1947, black baseball players competed in the Negro Leagues, various professional organizations that operated around the country starting around 1920. Those leagues have a ton of history. They produced a number of legendary players who became stars in the Negro Leagues and in Major League Baseball after Robinson opened the door for his peers. The museum tells the complete story. The Negro Leagues Baseball Museum opened in the early '90s and has moved twice to larger facilities. The current 10,000-square foot home features a large baseball diamond with Negro League all-stars at each position.

The American Jazz Museum

Jazz music is just amazing. It puts a smile on your face and pep in your step. KC has an impressive musical history that visitors can experience at the American Jazz Museum, located inside the same building as the Negro Leagues Museum. The museum features listening stations where you can check out your favorite jazz artists and hear songs from performers you may not be familiar with. Louis Armstrong, Duke Ellington, Big Joe Turner, Count Basie, Dizzy Gillespie, Nat King Cole and others are represented with audio clips and old television footage.

NATIONAL WORLD WAR I MUSEUM AND MEMORIAL

Monday, June 24 | 2:15 – 5:30 p.m. | \$65

The National World War I Museum and Memorial is America's leading institution dedicated to remembering, interpreting and understanding the Great War and its enduring impact on the global community. The museum maintains the Liberty Memorial as a beacon of freedom and symbol of the courage, patriotism, sacrifice and honor of all who served in World War I.

In 1920 the museum began collecting objects and documents from all the nations involved in the First World War. Nearly 100 years later is home to one of the largest Great War collections in the world—more than 75,000 items strong.

While it is the official World War I museum of the United States, the museum uses its collection to tell more than just the American story. Exhibitions take a comprehensive look at the entire war.

STEAMBOAT ARABIA

Tuesday, June 25 | 2:00 – 5:00 p.m. | \$70

The Arabia Steamboat Museum is a unique Kansas City attraction: a time capsule of life on the

American frontier in the mid-nineteenth century. It is not your typical museum. Visitors have the one-of-a-kind opportunity to experience everyday objects that made life possible for pioneers in the 1800s. It is the largest single collection of the pre-Civil War artifacts in the world. When the mighty Steamboat Arabia sank on September 5, 1856, she carried 200 tons of mystery cargo. Lost for 132 years, its recovery in 1988 was like finding King Tut's Tomb of the Missouri River. Remarkably preserved clothes, tools, guns, dishware and more. The discovery is truly a modern-day treasure-hunting story at its best.

notes

Full-Day Professional Development Seminars

Registration fees: \$539 (\$435 ASHRAE Member)

Each seminar earns 6 PDHs/AIA LUs. Check with your state for their continuing education credits requirements. Please bring to the course all identification numbers (AIA, NY, NC) to ensure you receive proper credit.

SATURDAY, JUNE 22, 2019

Commissioning Process in New and Existing Buildings (code 60)

8:00 a.m. – 3:00 p.m., 2205, KCCC

This introductory seminar focuses on how the building commissioning process can be applied cost-effectively to new construction and to existing facilities, with a strong emphasis on existing facilities applications. Learn the fundamentals of the commissioning process through each step of a new construction project, from predesign to occupancy and operations. The seminar will also discuss how the application of the commissioning process in existing facilities differs from new construction. Benefits of commissioning and how the process can improve the built environment, reduce environmental impacts through responsible resource utilization, improve the quality of design and construction, and raise the professional reputation of the entire commissioning team will be covered. Take away compelling information and case studies that demonstrates the value of investing in the commissioning process.

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

Effective Energy Management in New and Existing Buildings (code 61)

8:00 a.m. – 3:00 p.m., 2206, KCCC

Buildings use 40% of U.S. energy, of which one-third can be cost effectively saved by using energy management—an orderly process in which managers use resources at their disposal to accomplish clear, energy-saving objectives. Sustained energy management is the quickest, cheapest, cleanest way to expand our world's energy supplies and reduce greenhouse gas emissions. This seminar weaves together energy management principles of the ASHRAE Handbook—HVAC Applications, ENERGY STAR® guidelines, and the new ASHRAE/IES Standard 100-2018, Energy Efficiency in Existing Buildings. Practical experiences of successful energy managers are presented. Numerous case studies are discussed, including a hospital, high-rise building, bank, and convention center. Together, these successful examples

demonstrate how to take advantage of the ENERGY STAR® Portfolio Manager for documented performance tracking and national recognition as an ENERGY STAR®.

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

Half-Day Short Courses

Registration fees: \$214 (\$159 ASHRAE Member)

Each course earns 3 PDHs/AIA LUs. Check with your state for their continuing education credits requirements. Please bring to the course all identification numbers (AIA, NY, NC) to ensure you receive proper credit.

SUNDAY, JUNE 23, 2019

Latest in High-Performance Dedicated Outdoor Air Systems (DOAS) (code 62)

3:30 p.m. – 6:30 p.m., 2205, KCCC

The dedicated outdoor air system (DOAS) has become a very popular means to provide ventilation for buildings, particularly for low-energy, max tech, and zero energy buildings. DOAS and the accompanying room-level heating/cooling units provide many benefits, including low energy use, cost-effective humidity control, redundancy, and control simplicity. This course covers the latest in DOAS application, design, and control, and the instruction is best suited for those seeking basic to intermediate discussions on DOAS, including an overall introduction to the concept.

Instructor: Arthur Hallstrom, P.E., Fellow/Life Member ASHRAE, BEMP



Guideline 36: Best in Class HVAC Control Sequences (code 63)

3:30 p.m. – 6:30 p.m., 2206, KCCC

This course introduces the current version of ASHRAE Guideline 36, which focuses on variable-air-volume (VAV) systems. The discussion will include the research underlying the current sequences and ongoing and planned future research intended to develop additional advanced sequences for other HVAC system types. In this course, attendees will learn about the ASHRAE Guideline 36 sequences and how they improve energy efficiency, thermal comfort, and indoor air quality. Attendees will also learn how to specify sequences for this guideline.

Instructors: Steve Taylor, P.E., Fellow/Life Member ASHRAE

MONDAY, JUNE 24, 2019



IgCC and ASHRAE Standard 189.1 Technical Provisions (code 64)

2:30 p.m. – 5:30 p.m., 2205, KCCC

The IgCC and ASHRAE Standard 189.1 Technical Provisions course covers how ASHRAE/ICC/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings, forms the technical basis for the International Green Construction Code® (IgCC). The code provides the minimum requirements needed to achieve high-performance green buildings and was developed to provide a balance of environmental factors involved with designing, building, and planning for the operation of buildings. This course provides a detailed look at the technical standard and its application as a building code, including a description of key requirements contained in the IgCC and ASHRAE/ICC/USGBC/IES Standard 189.1 on the topics of sites, water, energy, indoor environmental quality, and materials. Consulting engineers, architects, facility managers, contractors, and code officials will learn to distinguish between the two compliance path options (prescriptive and performance) and their associated provisions in the IgCC, as well as how to apply these paths in design. Attendees will also be able to differentiate the code and standard from other green building certification systems.

Instructors: Thomas Lawrence, Ph.D., P.E., Fellow ASHRAE, LEED® AP; and Anthony Floyd, Member ASHRAE, LEED® AP, AIA



Effective Presentation for Positive Results (code 65)

2:30 p.m. – 5:30 p.m., 2206, KCCC

Effectively present your ideas and communicate the depth of your knowledge with this course. Geared towards HVAC&R professionals, Effective Presentation for Positive Results increases the impact of your presentation through logical and sequential steps. Make compelling presentations that result in positive outcomes by planning and delivering organized, logical, and persuasive explanations. Improve your methods and skills when presenting, particularly in front of groups and when lecturing on complex, technical topics. As you learn to communicate with poise and self-confidence, you can better prepare to convey information clearly and flexibly, with an eye towards impressing your audience.

Instructor: Alan Veeck, Life Member ASHRAE

Designing and Operating High-Performing Healthcare HVAC Systems (code 66)

2:30 p.m. – 5:30 p.m., 2202, KCCC

This advanced course discusses the nuances of HVAC system design for healthcare facilities. The course details the relationship of infection control and HVAC design including application of ASHRAE/ASHE Standard 170-2017, Ventilation of Health Care Facilities. The course will go into detail on the interactions of the key elements of high performance in healthcare, infection control, comfort, reliability, safety, maintenance, energy and sustainability. Numerous energy conservation strategies will be considered in the context of achieving all the goals of a high-performing hospital. For example, the hardware and controls for setback of temperature and airflow and the relationship to temperature, relative humidity, air exchange, filtration, and pressurization requirements are discussed.

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

TUESDAY, JUNE 25, 2019



Solar PV and Thermal Systems Analysis and Design (code 67)

8:00 a.m. – 11:00 a.m., 2205, KCCC

This course is designed to introduce the HVAC community (engineers, architects, building owners, facility managers, plus others) to sustainable design principles and provide the knowledge necessary to evaluate and implement cost-effective solar applications for commercial facilities. The purpose is to provide attendees with the knowledge and skills required for the development, evaluation, procurement, and installation of commercial solar projects. The technical focus is on cost-effective photovoltaic and solar water heating applications for commercial facilities. However, a wide variety of solar applications are discussed. The objective is to enable the participants to economically evaluate, procure, and monitor the design and installation of a wide variety of cost-effective solar energy applications.

Instructors: Khalid Nagidi, Member ASHRAE, LEED® AP; and Svein Morner, Ph.D., Member ASHRAE



Laboratory Exhaust Stacks: Safe and Energy-Efficient Design (code 68)

8:00 a.m. – 11:00 a.m., 2206, KCCC

This course provides designers and operators of laboratories with wet lab exhaust systems with the proper methodology to ensure safe systems operation. Laboratory Exhaust Stacks: Safe and Energy-Efficient Design walks students through the entire design process. Energy consumption represents an important component of the course, as laboratories consume significantly more energy than a typical office building, due to laboratory ventilation systems. Training topics include how to properly locate air intakes and exhaust stacks and the various methods for applying variable-air-volume (VAV) control to minimize energy usage while avoiding adversely impacting the air quality. Attendees will calculate an appropriate concentration design criterion for a specific emission source and determine dispersion modeling techniques for particular applications.

Instructor: Brad Cochran, P.E., Member ASHRAE

Variable Refrigerant Flow Systems: Design and Applications (code 69)

12:00 p.m. – 3:00 p.m., 2205, KCCC

Variable refrigerant flow (VRF) systems are now being applied in many building types across North America. This course provides non-manufacturer-specific concepts of how to apply VRF systems to buildings. The course supplements the fundamental technology presented in the 2016 ASHRAE Handbook—HVAC Systems and Equipment, offering consulting engineers who already have a basic knowledge of VRF technology comprehensive system design and application guidance using building-specific scenarios. This course is geared towards mechanical engineers, design/build contractors, consulting engineers, HVAC system designers, and facility engineers.

Instructor: Jocelyn Léger, P.Eng., CEM, Member ASHRAE, LEED® AP

2019 ANNUAL CONFERENCE TECHNICAL PROGRAM

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.

Types of Sessions Presented

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. During Annual Conferences, extended abstracts may be included in these sessions. Preprints and final versions of the papers and extended abstracts are available as a collection via subscription to the Technology Portal online, and the final papers and extended abstracts are published in ASHRAE Transactions.

DEBATES

Debates highlight hot-button issues. Experts, either on teams or as individuals, present different sides of an issue in debate format. Each participant presents evidence for or against a specific statement or question such as ‘Is Sustainability Really Sustainable?’.

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.

PANELS

Panel discussions can feature a broad range of subjects and explore different perspectives on issues in the industry. A panel may feature discussions about integrated project delivery among designers, builders and facility management professionals.

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. Seminars are available as a collection via subscription to the Technology Portal online and include video files synched with audio, audio files and PDF files of the presentations.

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. Comments may be submitted on paper forms available at each session or via ashrae.org/QCOnline. Power point presentations with audio descriptions of the presentations are posted online in the Virtual Conference. Preprints and final versions of the papers are available as a collection via subscription to the Technology portal online and the final papers are published in ASHRAE Transactions.

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.



Conference—Papers subscription in Technology Portal (includes Conference Papers, Technical Papers, and Extended Abstracts) – \$69



Conference—Seminars subscription in Technology Portal – \$109



Preprints of Conference Papers, Technical Papers and Extended Abstracts (individual papers, in print) – \$6 each



ASHRAE Transactions (print volume) – \$45



Submitted for approval 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. 2019 ASHRAE Annual Conference

Conference—Papers subscription and Conference—Seminars subscription, \$154

2. 2019 ASHRAE Annual Conference

Conference—Papers subscription and *ASHRAE Transactions*, \$129

3. Complete Annual Conference Content Package, 2019 ASHRAE Annual Conference

Conference—Papers subscription, Conference—Seminars subscription, and *ASHRAE Transactions*, \$179

All prices are special conference-only prices.

Sunday, June 23

8:00 AM – 9:00 AM

Debate 1 (Intermediate)

Site vs. Source Energy: Which Metric Should Be Used?

Track: Fundamentals and Applications

Room: 2101, KCCC

Sponsor: 7.6 Building Energy Performance

Moderator: Adam Hinge, P.E., Fellow ASHRAE, Sustainable Energy Partnerships, Tarrytown, NY,

1. **Barry Abramson, P.E., Member, Servidyne, LLC, Atlanta, GA,**

2. **Nathaniel Boyd, P.E., Member, University of Central Florida, Orlando, FL**

3. **John Constantinide, Member, Alpha MRC Architects Engineers, Merritt Island, FL**

4. **Keith Emerson, Retired, Denver, CO**

8:00 AM – 9:00 AM

Panel 1 (Basic)

Integrated A/E Firms vs. MEP Consulting Firms Perspective

Track: Professional Development

Room: 2102B, KCCC

Chair: David Swain, P.E., Member, Affiliated Engineers, Chicago, IL

1. **Integrated A/E Firms vs. MEP Consulting Firms Perspective, Part 1**

Patrick Dempsey, P.E., BEAP, BEMP and HBDP, Member, CannonDesign, Chicago, IL

2. **Integrated A/E Firms vs. MEP Consulting Firms Perspective, Part 2**

Jason Borowski, P.E., Member, Century Engineering, Chicago, IL

8:00 AM – 9:00 AM

Conference Paper Session 1 (Advanced)

Innovations in Phase Change and Supercritical Heat Transfer



Track: Research Summit

Room: 2204, KCCC

Chair: Xiaofei Wang, Ph.D., University of Illinois at Urbana-Champaign, Urbana, IL

1. Experimental Investigation of Two-Phase Flow Heat Transfer of R410A and ZnO Nanolubricant Mixture in a Smooth Tube (KC-19-A001)

Pratik S. Deokar, Student Member and Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

2. Heating of Supercritical Carbon Dioxide in Small Channels (KC-19-A002)

Brian Fronk, Ph.D., Associate Member, Saad Jajja and Jessa Sequeira, Oregon State University, Corvallis, OR

3. Permeability and Rate-of-Rise of Additively-Manufactured Wicking Structures (KC-19-A003)

Jordan Morrow, Student Member, Nhicolas Aponte, Ryan Huber, Student Member, Partha P. Chakraborty, G. A. Riley and Melanie Derby, Ph.D., Member, Kansas State University, Manhattan, KS

8:00 AM – 9:00 AM

Conference Paper Session 2 (Intermediate)

Specialty Buildings: Data Centers and Sports Facilities



Track: Modeling Throughout the Building Life Cycle/ Research Summit

Room: 2203, KCCC

Chair: Gurunarayana Ravi, Lennox International, Frisco, TX

1. Development of a New Prototype Energy Model for Data Centers (KC-19-C001)

Tianzhen Hong, Ph.D., Member and Kaiyu Sun, Member, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Improving Data Center and Telecommunication System HVAC Design from Lessons Learned from Retro-Commissioning (KC-19-C002)

Richard Pavlak, P.E., Fellow ASHRAE and Nicholas Pavlak, Member, Heapy Engineering, Dayton, OH

3. Uncertainties on Cooling Energy Based on Computational Indoor Air Modeling in Sports Facilities (KC-19-A004)

Samah Ben Ayed, Ph.D., Associate Member¹, Donghun KIM, Ph.D.², Jeff Borggaard, Ph.D.³ and Eugene Cliff, Ph.D.³, (1)New Mexico State University, Las Cruces, NM, (2)Purdue University, West Lafayette, IN, (3)Virginia Tech, Blacksburg, VA

Tech Program

8:00 AM – 9:00 AM

Seminar 1 (Intermediate)**Commissioning and Re-Commissioning: The Process and the Practice***Track: Commissioning New & Existing Buildings**Room: 2104A, KCCC***Sponsor: 7.9 Building Commissioning, 6.8 Geothermal Heat Pump and Energy Recovery Applications***Chair: William Bradford, P.E., Member, BRPH, Orlando, FL***1. Commissioning Is a Team Effort: A Roadmap to Customer Satisfaction***David Meyers, AIA, Burns & McDonnell, St. Louis, MO***2. Commissioning and Re-Commissioning Complex and Simple Geothermal Heat Pump Systems: Similarities, Differences and Critical Items***Michael Kuk, OPMP, CPMP and BEAP, Member, CERx Solutions LLC, Montgomery, IL*

8:00 AM – 9:00 AM

Seminar 2 (Intermediate)**Net-Zero Hospital Guidebook (ASHRAE/RHEVA)***Track: Fundamentals and Applications**Room: 2105, KCCC***Sponsor: 9.6 Healthcare Facilities***Chair: Travis English, P.E., Member, Kaiser Permanente, Anaheim, CA***1. Towards Net Zero: European Context and the Process of Towards Net Zero***Wim Maassen, HaskoningDHV Nederland B.V., Rotterdam, Netherlands***2. Towards Net Zero: International Bench Marking and the Implications to US Hospitals***Heather Burpee, University of Washington Integrated Design Lab, Seattle, WA***3. Towards Net Zero: Smart Measures for Net Zero***Frank Mills, Member, Frank Mills Consulting, Leyland, United Kingdom*

8:00 AM – 9:00 AM

Seminar 3 (Basic)**Ready, Set, Grow: Establishing Your New Business***Track: Professional Development**Room: 2104B, KCCC**Chair: Pam Duffy, Member, Spark One Solutions, LLC, Dallas, TX***1. Ready: Developing and Defining Your Vision***Madison Schultz, P.E., Member, OK BeCo, Oklahoma City, OK***2. Set: Business and Fiscal Structure (a.k.a The Boring Stuff)***Wendy Kelley, CPA, Kansas City, KS*

3. Grow: Building a (Positive) Reputation for Your New Business
Pam Duffy, Member, Independent Consultant, Dallas, TX

8:00 AM – 9:00 AM

Seminar 4 (Basic)



Using Analytics and Big Data to Optimize Your HVAC Systems

Track: Optimization in HVAC&R

Room: 2103C, KCCC

Sponsor: 6.1 Hydronic and Steam Equipment and Systems, 1.4 Control Theory and Application

Chair: David Lee, P.Eng., Member, Armstrong Fluid Technology, Toronto, ON, Canada

1. The Transformation of HVAC through Information and Analytics

Mark Gallagher, Member, Armstrong Fluid Technologies, Toronto, ON, Canada

2. Analytics and Optimization Strategies for HVAC: From Device to Overall Building Systems

Brent Waluzak, Siemens, Tampa Bay, FL

9:45 AM – 10:45 AM

Conference Paper Session 3 (Intermediate)

Building Energy Modeling in Large Institutions and Schools



Track: Modeling Throughout the Building Life Cycle/ Research Summit

Room: 2203, KCCC

Chair: Wade H. Conlan, P.E., Member, Hanson Professional Services, Maitland, FL

1. First Steps to Maintain a Large Fleet of Building Energy Models (KC-19-C003)

Daniel Villa, P.E., Member¹, Joshua New, Ph.D., Member², Gerald R. Gallegos, P.E.³, Mark Adams², Aaron Garrett, Ph.D.⁴, Thushara Gunda, Ph.D.³ and William Peplinski¹, (1)Sandia National Laboratories, Albuquerque, NM, (2)Tunation, LLC, Knoxville, TN, (3)Sandia National Laboratories, Albuquerque, NM, (4)Jacksonville State University, Jacksonville, AL

2. Simulation-Based Nationwide Fault Impact Analysis for the Secondary School in U.S. (KC-19-C004)

Yanfei Li, Student Member¹ and Zheng O'Neill, Ph.D., P.E., Member², (1)The University of Alabama, Tuscaloosa, AL, (2) University of Alabama, Tuscaloosa, AL

3. IEQ in High-Performance Urban Elementary Schools (KC-19-A005)

Emily Oldham, Associate Member¹ and Hyojin Kim, Ph.D., Member², (1)DLR Group, Washington, DC, (2)Catholic University of America, Washington, DC

9:45 AM – 10:45 AM

Conference Paper Session 4 (Intermediate)**Research on Fundamental HVAC&R Systems***Track: Research Summit*

Room: 2204, KCCC



Chair: Samir Traboulsi, Ph.D., Fellow Life Member,
Thermotrade/Ranec, Beirut, Lebanon

1. Thermodynamic Analysis of a Vortex Tube Integrated Subcritical Vapour Compression Cycle (KC-19-C005)

Akhilesh Arora, Ph.D., Associate Member, Delhi Technological University, Delhi, India

2. Performance of Spiral and Plain Finned-Tube Evaporator Coils for Novel Defrost System in Commercial Freezers (KC-19-A006)

Mostafa Elsharqawy, Ph.D., P.E.¹, Punnoose Abraham¹, Sameh Saad, Ph.D.² and Kazi Ahmed², (1)University of Guelph, Guelph, ON, Canada, (2)Betterfrost Technologies Inc., Toronto, ON, Canada

3. Three-Dimensional Computations for Forced Convection of Air in Offset-Strip Fin Channels: Effects of Fin Offset Length (KC-19-C006)

Dantong Shi, Kuan-Ting Lin, Milind A. Jog, Ph.D. and Raj M. Manglik, Ph.D., Member, University of Cincinnati, Cincinnati, OH

9:45 AM – 10:45 AM

Seminar 5 (Intermediate)

ASHRAE's New Residential Indoor Air Quality Guide: Best Practices for Construction and O&M

Track: Occupant Health & Safety

Room: 2102B, KCCC

Sponsor: Environmental Health Committee

Chair: Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

1. Residential Envelopes and Moisture Control

Lawrence Schoen, P.E., Fellow ASHRAE, Schoen Engineering Inc, Columbia, MD

2. Whole Dwelling Ventilation, Exhaust and Filtration

Amy Musser, P.E., CPMP, BEMP and BEAP, Member, Vandemusser Design, LLC, Asheville, NC

9:45 AM – 10:45 AM

Seminar 6 (Intermediate)**Diet and Exercise for Healthy High Performing Buildings***Track: Commissioning New & Existing Buildings*

Room: 2101, KCCC

Sponsor: 9.10 Laboratory Systems, 7.9 Building Commissioning

Chair: Christine Reinders-Caron, Iowa State University, Ames, IA

1. Making Smart Buildings Brilliant

Kelsey Leslie, P.E., Member, Paladin, Inc., Lexington, KY

2. Exercise Your Building for Healthy Performance

Vanessa Friedberg, P.E., Associate Member, Siemens Building Technologies, Austin, TX

3. Keeping Your Building on a Healthy Diet

Morgan Hilk, Associate Member, Environmental Systems Design Inc, Chicago, IL

9:45 AM – 10:45 AM

Seminar 7 (Advanced)



Learning from Designers of Radiant Buildings

Track: Radiant Heating & Cooling

Room: 2104B, KCCC

Sponsor: 6.5 Radiant Heating and Cooling

Chair: Ongun Kazanci, Ph.D., International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

1. Current Practice for Design and Control of High Thermal Mass Radiant Cooling Systems and Opportunities for Future Improvements

Jonathan Woolley, Center for the Built Environment, University of California, Berkeley, CA

2. Construction and Energy Costs of Radiant Systems in the California Bay Area

Jingjuan (Dove) Feng, Ph.D., P.E., Member, TRC Advanced Energy Services, Oakland, CA

9:45 AM – 10:45 AM

Seminar 8 (Intermediate)



What's New in Laboratory Ventilation? ASHRAE'S New Publication "Classification of Laboratory Ventilation Design Level"

Track: Occupant Health & Safety

Room: 2105, KCCC

Sponsor: 9.10 Laboratory Systems

Chair: Kelley Cramm, P.E., Member, Henderson Engineers, Lenexa, KS

1. Safety Dictates the Lab Ventilation Design Level

Thomas Smith, Member, 3Flow, Cary, NC

2. Using Lab Ventilation Design Level in Day-to-Day Operations

Ellen Sweet, Cornell University, Ithaca, NY

9:45 AM – 10:45 AM

Workshop 1 (Basic)

"Slide Rules" for Engineers: Presentation Design Best Practices for Technical Professionals

Track: Professional Development

Room: 2104A, KCCC

Chair: Mark P. Malkin, P.E., University of Wisconsin-Madison, Madison, WI

1. "Slide Rules" for Engineers: Presentation Design Best Practices for Technical Professionals

Joy Altwies, Ph.D., P.E., Member, University of Wisconsin-Madison, Madison, WI

9:45 AM – 10:45 AM

Workshop 2 (Intermediate)

Unlocking Optimization for HVAC&R

Track: Optimization in HVAC&R

Room: 2103C, KCCC

Sponsor: 1.13 Optimization

Chair: David Yashar, Ph.D., P.E., Member, National Institute of Standards and Technology, Gaithersburg, MD

1. Optimization for Building Equipment

Khaled Saleh, Ph.D., P.E., Member, Daikin, Houston, TX

2. Optimization Building Controls

Christopher Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Cambridge, MA

11:00 AM – 12:30 PM

Conference Paper Session 5 (Intermediate)

HVAC is for People: Thermal Comfort and Adaptive Controls



Track: Research Summit

Room: 2204, KCCC

Chair: Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

1. Personalized Thermal Demand Prediction Algorithm Based on Wrist Temperature and Heart Beat (KC-19-C007)

Linhao Li, Delos Living LLC, New York, NY

2. Ayurvedic Management of Diseases Caused Due to Continuous Usage of Air-Conditioning (KC-19-C008)

Reena Arora, Dr.Eng¹, Akhilesh Arora, Ph.D., Associate Member² and Raghunandan Sharma, M.D.³, (1)Ayurvedic Clinic, Delhi, India, (2)Delhi Technological University, Delhi, India, (3)Ayurplanet Ayurveda, London, United Kingdom

3. A Review of Adaptive Thermal Comfort Implementation in International Thermal Comfort Standards (KC-19-A007)

Ongun Berk Kazanci, Ph.D., Associate Member¹, Daniel Coakley, Ph.D., Member² and Bjarne Olesen, Ph.D., Presidential Member¹, (1)International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark, (2) Mitsubishi Electric R&D Centre Europe BV, Livingston, United Kingdom

4. Air Conditioner Control Strategy Based on Thermal Comfort Improvement Model (KC-19-C009)

Guan-Wen Chen¹, Hung-Wen Lin, Ph.D., Member¹, Deqing Moo² and Yin-Chun Tsai³, (1)Industrial Technology Research Institute, Hsinchu, Taiwan, (2)University of Malaya, Kuala Lumpur, Malaysia, (3)National Tsing Hua University, Hsinchu, Taiwan

11:00 AM – 12:30 PM

Conference Paper Session 6 (Intermediate)

Unitary, Room Air Conditioners and Refrigeration Cycles



Track: Research Summit

Room: 2203, KCCC

Chair: Ahmed Elatar, Ph.D., ORNL, Oak Ridge, TN

1. Study of Heat Exchanger Inlet Air Velocity Distribution for Ducted Tests in a Psychrometric Chamber (ASHRAE RP-1785) (KC-19-C010)

Abraham J. Lee, Student Member, Christian K. Bach, Ph.D. and Craig R. Bradshaw, Ph.D., Member, Oklahoma State University, Stillwater, OK

2. Potency of Cyclic Degradation Coefficient in Characterizing Dynamic Air Conditioner Operation (KC-19-C011)

Rohit Dhumane¹, Jiazhen Ling, Ph.D., Member¹, Vikrant Aute, PhD, Member¹, Reinhard Radermacher, Ph.D., Fellow ASHRAE¹, Allen Kirkwood² and Jack Esformes², (1)University of Maryland, College Park, MD, (2)Carrier Corporation, Indianapolis, IN

3. Improvement of Unitary Equipment and Heat Exchanger Testing Methods (ASHRAE RP 1733/43) (KC-19-C012)

Md Yeam Hossain, Student Member, Christian Bach, Ph.D., Associate Member, Omer San, Ph.D. and Romit Maulik, Oklahoma State University, Stillwater, OK

11:00 AM – 12:30 PM

Seminar 9 (Intermediate)



Automated Fault Detection and Diagnostics Software for Cx, RCx and MBCx

Track: Commissioning New & Existing Buildings

Room: 2101, KCCC

Sponsor: 7.5 Smart Building Systems, 7.9 Building Commissioning

Chair: Xiaohui Zhou, Ph.D., Member, Slipstream, Madison, WI

1. How AFDD Tools Can Support Commissioning Teams

Nicholas Gayeski, Ph.D., KGS Buildings, LLC, Cambridge, MA

2. AFDD for Retro-Commissioning

Adam Regnier, Kinetic Buildings, Philadelphia, PA

3. AFDD for Monitoring-Based Commissioning

Peter Serian, Member, CopperTree Analytics, Surrey, BC, Canada

4. A Commissioning Agent's Perspective on AFDD

Lincoln Harmer, P.E., BEMP, Member, kW Engineering, Salt Lake City, UT

11:00 AM – 12:30 PM

Seminar 10 (Advanced)



Occupant Behavior Analysis and Application Based on Large-Scale Datasets

Track: Research Summit

Room: 2103C, KCCC

Tech Program

Sponsor: MTG.OBB Occupant Behavior in Buildings

Chair: Bing Dong, Associate Member, University of Texas at San Antonio, San Antonio, TX

1. Data Mining for Occupant Behavior from Large Scale Operation Data of VRF Systems

Da Yan, Building Energy Research Center, Tsinghua University, Beijing, China

2. A Preview of Human-Thermostat Interactions from a Manufacturer's Dataset

Jing Yang, Carnegie Mellon University, Philadelphia, PA

3. Derive and Quantify Urban Scale Occupancy Profiles Based on Mobile Position Data

Bing Dong, Ph.D., Associate Member, University of Texas at San Antonio, San Antonio, TX

4. Findings from Consumer-Grade IAQ Measurements in Residential and Commercial Buildings

Clinton Andrews, P.E., Rutgers University, New Brunswick, NJ

11:00 AM – 12:30 PM

Seminar 11 (Intermediate)



Optimization for Next Generation Systems

Track: Optimization in HVAC&R

Room: 2105, KCCC

Sponsor: 1.13 Optimization

Chair: Christopher Laughman, Ph.D., Member, Mitsubishi Electric Research Laboratories, Cambridge, MA

1. Multi-Objective Design Optimization of Air-Cooled Condensers Operating with Low-GWP Refrigerants

Omar Abdelaziz, CLEAT Consulting, Dubai, United Arab Emirates

2. Optimization of Air-to-Refrigerant Evaporator with Low-GWP Refrigerants

Piotr Domanski, Ph.D., Fellow ASHRAE, National Institute of Standards and Technology, Gaithersburg, MD

3. Operation Optimization of Grid-Interactive Efficient Buildings for the Grid with High Penetrations of Renewables

Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

11:00 AM – 12:30 PM

Seminar 12 (Intermediate)



Thermodynamics of Frost Formation

Track: Fundamentals and Applications

Room: 2104B, KCCC

Sponsor: 1.1 Thermodynamics and Psychrometrics

Chair: Ayyoub Mehdizadeh Momen, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

1. How to Prevent Frost and Ice Formation in Industrial Freezers

S.A. Sherif, Ph.D., Fellow ASHRAE, University of Florida, Gainesville, FL

2. Impact of Surface Morphology on the Frost Growth Rate: A Thermodynamic Prospective

Kashif Nawaz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

3. Density of Frost on Super-Hydrophobic and Super-Hydrophilic Surfaces Under Air Forced Convective Operating Conditions

Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

11:00 AM – 12:30 PM

Seminar 13 (Intermediate)



The Role of Gas Filtration on Improving IAQ

Track: Occupant Health & Safety

Room: 2104A, KCCC

Sponsor: 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Chair: Kyung-Ju Choi, Ph.D., Member, Clean & Science, Louisville, KY

1. Potential of Air Cleaning for Improving Indoor Air Quality

Jensen Zhang, Ph.D., Member, Syracuse University, Syracuse, NY

2. The Role of Gas-Phase Air Filtration Improving for Improving IAQ: Case Studies

Christopher Muller, Member, Purafil, Filtration Group, Doraville, GA

3. IAQ: Keep the Oxygen, Lose the Pollutants

Kathleen Owen, Fellow ASHRAE, Owen Air Filtration Consulting, Cary, NC

11:00 AM – 12:30 PM

Seminar 14 (Intermediate)



Understanding the 2018 ENERGY STAR Score Updates

Track: Modeling Throughout the Building Life Cycle

Room: 2102B, KCCC

Sponsor: 7.6 Building Energy Performance

Chair: Amanda Webb, Ph.D., Associate Member, University of Cincinnati, Cincinnati, OH

1. Updating EPA's Energy STAR Metrics with New Market Data

Cindy Jacobs, U.S. Environmental Protection Agency, Washington, DC

2. The New Energy STAR Scores: Evaluating the Impact on Buildings

Barry Abramson, P.E., CPMP and BEAP, Member, Servidyne, LLC, Atlanta, GA

3. Energy Benchmarking and How Technology and Scoring Changes Affect the User Experience

Jesse Fields, City of Kansas City Missouri, Kansas City, MO

4. Building Benchmarking from a Research Perspective

Ketaki Agale, University of Cincinnati, Cincinnati, OH

1:30 PM – 3:00 PM

Technical Paper Session 1 (Intermediate)**Cooling and Thermal Comfort Strategies***Track: Systems & Equipment in the Built Environment**Room: 2203, KCCC**Chair: Jon Cohen, Member, ChemTreat, Inc., Richmond, VA***1. Uncertainty Analysis of a Numerical Performance Model for an Inflatable Fabric Evaporative Cooling Tower (KC-19-001)***Stephen Idem, Ph.D., Member¹, Steven Duong², Robert Craven³ and Steve Garner³, (1)Tennessee Tech University, Cookeville, TN, (2)Nissan Inc., Smyrna, TN, (3)LTA Projects, Cookeville, TN***2. Achieving Health and Comfort in High-Rise Residential Buildings by Using Dynamic-Hybrid Air Permeable Ceiling (KC-19-002)***Mohd Firrdhaus Mohd Sahabuddin, Cristina Gonzalez-Longo and Stirling Howieson, Ph.D., The University of Strathclyde, Glasgow, United Kingdom***3. Fire Hazard Analysis of Energy-Saving High-Volume Low-Speed Fan System in Large Spaces (KC-19-003)***Xiaolei Chen, Ph.D.¹ and Frank Wang, P.E.², (1)California State University, Los Angeles, CA, (2)Jensen Hughes, Anaheim, CA*

1:30 PM – 3:00 PM

Technical Paper Session 2 (Intermediate)**Studies in Loads and Sequences for Optimized Performance***Track: Optimization in HVAC&R**Room: 2204, KCCC**Chair: Jaya Mukhopadhyay, Ph.D., Member, Montana State University, Bozeman, MT***1. Analysis on Applicability and Feasibility of Popularizing Naphthalene Sublimation Technique in Island-Reef Areas (KC-19-004)***Jingchao Xie¹, Yaping Cui¹, Jiaping Liu¹ and Jianping Wang², (1) Beijing University of Technology, Beijing, China, (2)Naval Institute of Engineering Design & Research, Beijing, China***2. Load Forecasting and Equipment Sequencing in a Central Heating and Cooling Plant: A Case Study (KC-19-005)***H. Burak Gunay, Ph.D., Associate Member¹, Araz Ashouri, Ph.D., Associate Member² and Weiming Shen, Ph.D.², (1)Carleton University, Ottawa, ON, Canada, (2)National Research Council Canada, Ottawa, ON, Canada***3. A Preliminary Analysis on the Use of Low-Cost Data Streams for Occupancy Count Estimation (KC-19-006)***H. Burak Gunay, Ph.D., Associate Member¹, Araz Ashouri, Ph.D., Associate Member², Weiming Shen², Guy Newsham, Ph.D.² and William O'Brien, Ph.D., Member¹, (1)Carleton University, Ottawa, ON, Canada, (2)National Research Council Canada, Ottawa, ON, Canada*

4. Development of a Unified Tool for Analysis of Room Loads and Conditions (KC-19-007)

Charles S. Barnaby, BEMP, Life Member¹ and **Peter Simmonds, Ph.D., Fellow ASHRAE²**, (1)Moultonborough, NH, (2)Buildings and Systems Analytics LLC, Emneth, CA, United Kingdom

1:30 PM – 3:00 PM

Seminar 15 (Intermediate)



Indoor Relative Humidity: Evaluating Dry Air and Measures of Health

Track: Research Summit

Room: 2103C, KCCC

Sponsor: 5.11 Humidifying Equipment

Chair: Brian Gilligan, P.E., GSA - Office of Federal High Performance Buildings, Washington, DC

1. Wellbuilt for Wellbeing: IAQ, Stress and Sleep in Four Federal Office Buildings

Brian Gilligan, P.E., GSA - Office of Federal High Performance Buildings, Washington, DC

2. Patients as Bioindicators

Stephanie Taylor, M.D., Member, Harvard Medical School, Infection Control Consultant, Boston, MA

3. Doing Due Diligence in Research and Data Analysis

Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

1:30 PM – 3:00 PM

Seminar 16 (Intermediate)



Multiscale Building Energy Modeling, Part 11

Track: Modeling Throughout the Building Life Cycle

Room: 2102B, KCCC

Sponsor: 4.7 Energy Calculations, 1.5 Computer Applications

Chair: Daniel Macumber, Member, National Renewable Energy Laboratory, Golden, CO

1. Building Energy Model Assimilation and Calibration with Real World Sensor Data

Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

2. Classification and Approach to Multi-Scale Building Energy Modeling

Daniel Villa, P.E., Member, Sandia National Laboratories, Albuquerque, NM

3. City-Scale Building Energy Modeling and Calibration

Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

4. Development and Validation of a National-Scale Building Stock Energy Model

Anthony Fontanini, National Renewable Energy Laboratory, Golden, CO

1:30 PM – 3:00 PM

Seminar 17 (Intermediate)**Next Level Challenges (Renovations, Special Systems and Acoustics)***Track: Commissioning New & Existing Buildings**Room: 2101, KCCC***Sponsor: 7.9 Building Commissioning, 6.6 Service Water Heating Systems, 2.6 Sound and Vibration***Chair: Alonzo Blalock, P.E., Member, Jacobs Engineering, Fort Worth, TX***1. Commissioning a High-Rise Hotel, Hybrid Domestic Water Heating System Prior to Occupancy***Norman Nelson, P.E., BEAP, Life Member, Jacobs Engineering Group, Portland, OR***2. Testing Processes for Multi-Story Building with Replacement of Ahus and Common Relief***Clay Wiedner, Member, Ross & Baruzinni, Inc., St. Louis, MO***3. How to Acoustical Commission & Inspect in Accordance with ASHRAE 189.1***Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA***4. Acoustical Commissioning Around the World***Jason Swan, Member, Sandy Brown Associates, LLP, London, United Kingdom*

1:30 PM – 3:00 PM

Seminar 18 (Basic)**The Technical Engineers Pathway to Career Growth: A Geek's Guide to Success***Track: Professional Development**Room: 2105, KCCC***Sponsor: 1.4 Control Theory and Application***Chair: David Kahn, P.E., Member, City and County of Denver, Denver, CO***1. Subject Matter Expert: What You Need to Know and Where to Find It***Gaylen Atkinson, Life Member, Salt Lake, UT***2. The Delicate Balance of Mentoring: Giving Mentees the Opportunity to Create Themselves***James Delmonaco, P.E., Member, P2S Engineering, San Diego, CA***3. Emotional Quotient and Career Success***Bud Gains, P.E., Life Member, Mtech, Denver, CO*

1:30 PM – 3:00 PM

Seminar 19 (Intermediate)**What's Loss Got to Do with It?: Analysis of Indicator Diagrams of Positive Displacement Compressors***Track: Research Summit**Room: 2104B, KCCC***Sponsor: 8.1 Positive Displacement Compressors, 1.2 Instruments and Measurements, 8.2 Centrifugal Machines**

Chair: Margaret Mathison, Ph.D., Member, Iowa State University, Ames, IA

1. Leveraging Loss Analysis to Explore Novel Attributes and Critical Features for Maximum Efficiency in Spool Compressors
Craig Bradshaw, Ph.D., Member, Oklahoma State University, Stillwater, OK

2. Experimental Analyses of Indicated and Mechanical Losses in Screw Compressors
Davide Ziviani, Ph.D., Member, Purdue University, West Lafayette, IN

3. Experimental Setup and Analysis of Indicated Losses in Scroll Compressors
Kirill Ignatiev, Ph.D., Member, Emerson Climate Technologies, Sidney, OH

1:30 PM – 3:00 PM

Seminar 20 (Intermediate)



Your Ethics Tool Box: Building a Framework for Ethical Decision-Making With Case Studies

Track: Professional Development

Room: 2104A, KCCC

Sponsor: 1.7 Business, Management & General Legal Education

Chair: Michael Bilderbeck, P.E., Fellow ASHRAE, Pickering Firm, Memphis, TN

1. Case Studies 1

Scott Fanning, P.E., Member, Fanning, Fanning & Associates, Inc., Lubbock, TX

2. Case Studies 2

Jennifer Leach, P.E., Member, Patterson-Kelley, East Stroudsburg, PA

3. Case Studies 3

Michael Bilderbeck, P.E., Fellow ASHRAE, Pickering Firm, Memphis, TN

3:15 PM – 4:45 PM

Seminar 21 (Intermediate)



Heat Exchangers Circuit Optimization

Track: Systems & Equipment in the Built Environment

Room: 2101, KCCC

Sponsor: 1.13 Optimization, 8.4 Air-to-Refrigerant Heat Transfer Equipment

Chair: Omar Abdelaziz, CLEAT Consulting, Dubai, United Arab Emirates

1. Dry Cooler Application in a Wind Tunnel

Stanislav Perencivic, Member, Guentner Germany, Fürstenfeldbruck, Germany

2. Heat Exchanger Circuitry Design by Decision Diagrams

Christopher Laughman, Ph.D., Member¹ and Vikrant Aute, PhD, Member², (1) Mitsubishi Electric Research Laboratories, Cambridge, MA, (2) University of Maryland, College Park, MD

3. Tube-Fin Heat Exchanger Circuitry Optimization for Robust Performance Under Airflow Maldistribution

Zhenning Li, Student Member, University of Maryland, College Park, MD

Monday, June 24

8:00 AM – 9:30 AM

Technical Paper Session 3 (Intermediate)

Studies in Particles, Friction and Desiccant Applications in HVAC



Track: Optimization in HVAC&R

Room: 2102B, KCCC

Chair: Jon Cohen, Member, ChemTreat, Inc., Richmond, VA

1. A New Algorithm to Measure the Convergence of PSO with an Application to Hydronic Design in Buildings (KC-19-008)

Ramiro Bravo, Ph.D., Member and Forrest Flocker, University of the Permian Basin, Odessa, TX

2. Performance Evaluation of a Three-Fluid Liquid Desiccant Membrane Air-Conditioning System (KC-19-009)

Mohamed Abdel-Salam, Ph.D.¹, Devin Storle² and Carey Simonson, Ph.D., P.E., Member², (1)Enbridge Gas Distribution Inc., North York, ON, Canada, (2)University of Saskatchewan, Saskatoon, SK, Canada

8:00 AM – 9:30 AM

Conference Paper Session 7 (Intermediate)

Radiating Heating/Cooling, Renewable Energy and Beyond



Track: Research Summit

Room: 2203, KCCC

Chair: Samir Traboulsi, Ph.D., Fellow Life Member, Thermotrade/Ranec, Beirut, Lebanon

1. Integrated Sizing Methodology for a Hybrid Geotabs Building (KC-19-C013)

Eline Himpe, Ph.D., Mohsen Sharifi, Jelle Laverge, Ph.D. and Rana Mahmoud, Gent University, Gent, Belgium

2. Radiant Ceiling Panels: An Analysis of Load Shifting, Energy Use, and Comfort in a Laboratory House Setting (KC-19-C014)

James Haile, P.E. and David Springer, Frontier Energy, Inc., Davis, CA

3. Solar Powered Reefers: An Opportunity (KC-19-A008) (WITHDRAWN)

Chilukuri Maheshwar, CEng, Life Member, Anglo Eastern Maritime Academy, Navi Mumbai, India

4. Investigation of a Solid Oxide Fuel Cell in a Residential Furnace during Rapid Thermal Cycling (KC-19-A009)

Ryan J Milcarek, Ph.D., Member¹, Mengyuan Chu² and Jeongmin Ahn, Ph.D.², (1)Arizona State University, Tempe, AZ, (2)Syracuse University, Syracuse, NY

5. Effect of Climate Change and Extreme Weather Events on the Thermal Conditions of Canadian Multi-Unit Residential Buildings (KC-19-A010)

Hua Ge and Fuad Mutasim Baba, Concordia University, Montreal, QC, Canada

8:00 AM – 9:30 AM

Conference Paper Session 8 (Intermediate)

Urban Building Simulations



Track: Research Summit

Room: 2204, KCCC

Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

1. Impact of Microclimate and Macroclimate on Building Energy Consumption (KC-19-C015)

Carlo Bianchi, Ph.D., Student Member, Jermy Thomas, Student Member and Amanda Smith, Associate Member, University of Utah, Salt Lake City, UT

2. Modeling Urban Microclimates of Extreme Weathers by Integrating City Fast Fluid Dynamics and City Building Energy Model (KC-19-A011)

Liangzhu (Leon) Wang, Ph.D., P.E., Member, Ali Katal and Mohammad Mortezaazadeh, Student Member, Concordia University, Montréal, QC, Canada

3. Dimensionless CFD Analysis of Reynolds Independence and Similarity in Urban and Built Environment Airflows (KC-19-A012)

Liangzhu (Leon) Wang, Ph.D., P.E., Member and Chang Shu, Student Member, Concordia University, Montreal, QC, Canada

4. City-Scale High-Resolution WRF-UCM Urban Weather Predictions Compared to a Dense Network of Ground-Based Weather Station Data for Assessment of Urban Building Energy Consumption (KC-19-C016)

Soham Vanage, Elham Jahani, Student Member, Kristen Cetin, Ph.D., P.E., Associate Member, David Jahn and William Gallus, Ph.D., Iowa State University, Ames, IA

5. The Influence of Role Models on the Sustainability of the Engineering Profession in the UK: A Case Study (KC-19-C017)

Ina Colombo, Ph.D., International Institute of Refrigeration (IIR), Paris, France

8:00 AM – 9:30 AM

Seminar 22 (Intermediate)



Frost Control Strategies for Air-to-Air Energy Recovery

Track: Systems & Equipment in the Built Environment

Room: 2104A, KCCC

Sponsor: 5.5 Air-to-Air Energy Recovery

Chair: Kristin Sullivan, P.E., Member, Ingersoll Rand, La Crosse, WI

1. Frost Formation and Defrost Strategies for Fixed-Plate Heat and Energy Recovery Ventilators

Mo Afshin, P.Eng., Member, CORE Energy Recovery Solutions, Vancouver, BC, Canada

2. Heat Pipe Under Frosting Conditions

Marc Tardif, P.Eng., Member, Innergytech Inc., Drumminville, QC, Canada

3. Frost Prevention Methods on Energy Recovery Wheels

Tom Rice, Member, FlaktGroup SEMCO, Columbia, MO

8:00 AM – 9:30 AM

Seminar 23 (Intermediate)**Secrets of (Controls Implementation) Success***Track: Commissioning New & Existing Buildings**Room: 2105, KCCC***Sponsor: 1.4 Control Theory and Application***Chair: Chariti Young, Member, Automated Logic Corp., Kennesaw, GA***1. Don't Forget the Handlebars When Assembling the Bike: The Importance of Controls-Centric Mechanical Design***Brandon Gill, Taylor Engineering, Alameda, CA***2. Submittal Review for Success: Looking for the Right Stuff***Chris Miller, Associate Member, P2S Inc., Long Beach, CA***3. Begin with the End in Mind: Operator Engagement for Operational Success***Stanley Chandler, Control Service Company, Kansas City, MO*

8:00 AM – 9:30 AM

Seminar 24 (Intermediate)**The Art and Science of Reducing Flow to Improve Safety and Stop Wasting Energy in Labs***Track: Occupant Health & Safety**Room: 2103C, KCCC***Sponsor: 9.10 Laboratory Systems, 5.3 Room Air Distribution***Chair: Carol A, Donovan, Member, NV5, Boston, MA***1. Use of Airflow to Mitigate Risk of Exposure to Hazardous Airborne Materials Generated in Labs***Thomas Smith, Member, 3Flow, Raleigh, NC***2. Use of Computational Fluid Dynamics Analysis to Optimize Laboratory Airflow, Safety and Energy Efficiency***Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI***3. New Technologies to Control Airflow Distribution in Labs to Minimize Flow and Maximize Safety***Philip Sloan, DuctSox Corp, Peosta, IA*

8:00 AM – 9:30 AM

Seminar 25 (Intermediate)**The Climate Aloft: Designing for Tall Buildings***Track: Fundamentals and Applications**Room: 2101, KCCC***Sponsor: 9.12 Tall Buildings, 4.2 Climatic Information***Chair: Luke Leung, P.E., Member, Skidmore, Owings, & Merrill LPP, Chicago, IL***1. Evaluating Environmental Conditions Aloft Using Analytical Tools and Observational Data***Michael Roth, Ph.D., Member, Klimaat, Guelph, ON, Canada*

2. Vertical Temperature Conditions and Their Effect on Heating and Cooling Load Calculations

Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems Analytics LLC, Emneth, CA, United Kingdom

3. Investigating Climatic Design Values at Elevated Heights by High-Resolution Numerical Weather Modeling

Xin Qiu, Ph.D., Member, Novus Environmental Inc., Guelph, ON, Canada

4. Managing Building Microclimate on Observation Decks and Natural Ventilation at the Top of Tall through Mega Tall Buildings

Duncan Phillips, Ph.D., P.E., Associate Member, RWDI, Guelph, ON, Canada

8:00 AM – 9:30 AM

Seminar 26 (Intermediate)



The Process for Zero Energy Office Buildings: The Next ASHRAE Advanced Energy Design Guide

Track: Optimization in HVAC&R

Room: 2104B, KCCC

Sponsor: 2.8 Building Environmental Impacts and Sustainability

Chair: Tom Phoenix, P.E., Presidential Fellow Life Member, CPL (Clark Patterson Lee), Greensboro, NC

1. Overview of the AEDG Series and a Look Towards the Future

Tom Phoenix, P.E., Presidential Fellow Life Member, CPL (Clark Patterson Lee), Greensboro, NC

2. The Process of Creating the Zero Energy Office Guide

Paul Torcellini, Ph.D., P.E., Member, National Renewable Energy Laboratory, Golden, CO

3. Marriage of the Envelope and HVAC Selection and Design

Daniel Nall, P.E., HBDP, CPMP and BEMP, Fellow Life Member, Syska Henessy Group, Princeton, NJ

4. A Deep Dive into HVAC Systems for Zero Energy Buildings

Ronnie Moffitt, P.E., Member, Trane, Inc., Lexington, KY

9:45 AM – 10:45 AM

Technical Paper Session 4 (Basic)

ASHRAE 125th Anniversary: Retrospect on Geothermal Heat Pumps and Refrigerant Properties



Track: Fundamentals and Applications

Room: 2203, KCCC

Sponsor: Historical Committee

Chair: Jeff Haberl, Ph.D., Fellow ASHRAE, Texas A & M University, College Station, TX

1. Geothermal Heat Pumps: Simply Efficient (KC-19-010)

Lisa Meline, P.E., Member¹ and Stephen Kavanaugh, Member², (1) Meline Engineering Corporation, Sacramento, CA, (2) University of Alabama, Tuscaloosa, AL

2. Chronological Variations in ASHRAE Handbook Refrigerant Thermodynamic and Transport Properties from 1981 to 2017 (KC-19-011)

Paul Nagy and Michael Pate, Ph.D., Life Member, Texas A&M University, College Station, TX

9:45 AM – 10:45 AM

Conference Paper Session 9 (Intermediate)

Evaluation of Duct Design and Fan-Coil Units



Track: Research Summit

Room: 2204, KCCC

Chair: Hyojin Kim, Ph.D., Member, Catholic University of America, Washington, DC

1. Effect of Inlet Duct Design on Fan Performance of Indoor Air Handling Unit (ASHRAE 1743-RP) (KC-19-A013)

Md Yeam Hossain, Student Member¹, Christian K. Bach, Ph.D.¹, Ardiyansyah Yatim, Associate Member² and Omer San, Ph.D.¹, (1) Oklahoma State University, Stillwater, OK, (2) University of Indonesia, Depok, Indonesia

2. A Field Evaluation of the Airflow Performance of Fan-Coil Units (KC-19-A014)

Dennis O'Neal, Ph.D., P.E., Fellow ASHRAE¹ and Peng Yin, Ph.D., Associate Member², (1) Baylor University, Waco, TX, (2) University of Louisiana at Lafayette, Lafayette, LA

3. Comparison of Hydronic Fan-Coil Unit Energy Consumption with Modulation and On-Off Controls (ASHRAE RP-1741) (KC-19-A015)

Peng Yin, Ph.D., Associate Member¹, Zahra Sardoueiniasab¹ and Dennis O'Neal, Ph.D., P.E., Fellow ASHRAE², (1) University of Louisiana at Lafayette, Lafayette, LA, (2) Baylor University, Waco, TX

9:45 AM – 10:45 AM

Seminar 27 (Basic)



ASHRAE's 2019 Strategic Plan: Development, Initiatives and Implementation

Track: Professional Development

Room: 2105, KCCC

Sponsor: Planning

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

1. Development of the New ASHRAE Strategic Plan

William McQuade, Member, Johnson Controls, Inc., York, PA

2. ASHRAE 2019 Strategic Plan Initiatives: What and Why

William Bahnfleth, Ph.D., P.E., Presidential Fellow ASHRAE, Penn State, University Park, PA

3. Implementing and Monitoring the New Strategic Plan

M. Dennis Knight, P.E., Fellow ASHRAE, Whole Building Systems, LLC, Mt. Pleasant, SC

9:45 AM – 10:45 AM

Seminar 28 (Intermediate)



Balancing Energy and Effectiveness

Track: Modeling Throughout the Building Life Cycle

Room: 2101, KCCC

Sponsor: 4.10 Indoor Environmental Modeling

Chair: Gang Tan, Ph.D., P.E., Member, University of Wyoming, Laramie, WY

**1. Energy Efficient or Effective Data Center Cooling:
Is It Either/Or?**

Mark Seymour, Member, Future Facilities, London, United Kingdom

**2. Optimization on Thermostat Location in an Office Room Using
a Coupled Simulation of Indoor Airflow and HVAC System**

Wangda Zuo, Ph.D., Member, Colorado University at Boulder, Boulder, CO

9:45 AM – 10:45 AM

Seminar 29 (Advanced)



Controlling High Thermal Mass Radiant Buildings

Track: Radiant Heating & Cooling

Room: 2102B, KCCC

Sponsor: 6.5 Radiant Heating and Cooling

Chair: David Desjardins, Member, Viega LLC, Nashua, NH

**1. Controlling High Thermal Mass Radiant Buildings: Publicly
Available Sequences of Operation**

Paul Raftery, Ph.D., Member, University of California, Berkeley, CA

**2. Controlling High Thermal Mass Radiant Buildings: Implemen-
tation of Publicly Available Sequences of Operation for Radiant
Systems in Two Field Study Sites**

Carlos Duarte, Student Member, University of California, Berkeley, CA

9:45 AM – 10:45 AM

Seminar 30 (Intermediate)



**Evaluating Automated Fault Detection and Diagnostics
Tools for Commissioning New and Existing Buildings**

Track: Commissioning New & Existing Buildings

Room: 2104B, KCCC

**Sponsor: 7.5 Smart Building Systems, 7.9 Building
Commissioning**

Chair: Jin Wen, Ph.D., Member, Drexel University, Philadelphia, PA

**1. Evaluating the Performance Building Fault Detection and
Diagnostics Algorithms and Tools**

Guanjin Lin, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

**2. A Building Simulation Emulator with HVAC Fault Injection
Capability for Testing AFDD Methods and Fault Impact Analysis**

Vrabie Draguna, Ph.D., Member, Pacific Northwest National Laboratory, Richland, WA

3. Fault Tests on an Occupancy Emulated Small Office Building

Piljae Im, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN

9:45 AM – 10:45 AM

Seminar 31 (Basic)**How Much Sound Do Active Chilled Beams Make?**

Track: Systems & Equipment in the Built Environment

Room: 2103C, KCCC

Sponsor: 2.6 Sound and Vibration, 5.3 Room Air Distribution

Chair: Jason Swan, Member, Sandy Brown Associates, LLP, London, United Kingdom

1. Active Chilled Beam Basics

Nick Searle, Member, Titus, Plano, TX

2. New ASHRAE 200 Acoustical Testing Requirements

Karl Peterman, P.E., Member, Vibro-Acoustics, Markham, ON, Canada

3. Chilled Beam Sound Case Study

Erik Miller-Klein, P.E., Member, A3 Acoustics, LLP, Seattle, WA

9:45 AM – 10:45 AM

Seminar 32 (Intermediate)**New ASHRAE Cleanroom Design Guide, Part 1: Fundamentals**

Track: Fundamentals and Applications

Room: 2104A, KCCC

Sponsor: 9.11 Clean Spaces

Chair: Philip Naughton, Member, Applied Materials Inc, Austin, TX

1. Cleanroom Design Guide Introduction

Wei Sun, P.E., Member, Engsysco Inc, Ann Arbor, MI

2. Fundamentals of Contamination Control in Cleanrooms: Transport, Capture and Control

R Vijayakumar, Ph.D., Fellow ASHRAE, Aerfil, Liverpool, NY

3. Cleanroom Design: Air Management and Environmental Control

Philip Naughton, Member, Applied Materials Inc, Austin, TX

11:00 AM – 12:00 PM

Panel 2 (Basic)**Flooding Design: What Do You Need to Know?**

Track: Occupant Health & Safety

Room: 2102B, KCCC

Sponsor: 2.7 Seismic and Wind Resistant Design

Chair: James Carlson, Fellow ASHRAE, Seismic Source International, Omaha, NE

1. Application

James Tauby, Mason Industries, New York, NY

2. Flooding

Robert Simmons, P.E., Member, Petra Seismic Design, Houston, TX

3. Manufacturer

Patrick Marks, P.E., Fellow ASHRAE, Johnson Controls, New Freedom, PA

11:00 AM – 12:00 PM

Conference Paper Session 10 (Intermediate)

Experimental Data and Modeling of Air Distribution Systems



Track: Research Summit

Room: 2204, KCCC

Chair: Gurunarayana Ravi, Lennox International, Frisco, TX

1. Empirical Modeling of Variable Air Variable Water Fan Coil Units in Cooling Mode for Building Energy Calculations (ASHRAE RP-1741) (KC-19-A016)

Peng Yin, Ph.D., Associate Member¹, Tanjebul Alam, Student Member¹ and Dennis O'Neal, Ph.D., P.E., Fellow ASHRAE², (1) University of Louisiana at Lafayette, Lafayette, LA, (2) Baylor University, Waco, TX

2. Air Leakage Analysis and Modeling in Parallel Fan-Powered Terminal Units Using EnergyPlus (KC-19-A017)

Zahra Sardoueiniasab¹, Peng Yin, Ph.D., Associate Member² and Dennis O'Neal, Ph.D., P.E., Fellow ASHRAE³, (1)APTIM, Baton Rouge, LA, (2)University of Louisiana at Lafayette, Lafayette, LA, (3)Baylor University, Waco, TX

3. Automatic Fault Detection and Diagnosis of Air Handling Unit Using an Online Machine Learning Algorithm (KC-19-A018)

Majid Karami and Liping Wang, Ph.D., P.E., Member, University of Wyoming, Laramie, WY

11:00 AM – 12:00 PM

Conference Paper Session 11 (Intermediate)

Sensitivities and Uncertainties in Building Energy Modeling and Performance



Track: Research Summit

Room: 2203, KCCC

Chair: Parag Rastogi, Student Member, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland

1. Sensitivity Analysis of Optimal Energy in Buildings to Environment Parameters (KC-19-A019)

Samah Ben Ayed, Ph.D., Associate Member¹, Jeff Borggaard, Ph.D.² and Eugene Cliff, Ph.D.², (1)New Mexico State University, Las Cruces, NM, (2)Virginia Tech, Blacksburg, VA

2. ASHRAE TRP-1771: Methodology to Evaluate Sensitive Levels of Inputs for US Commercial Building Models (KC-19-A020)

Yunyang Ye¹, Kathryn Hinkelman¹, Wangda Zuo, Ph.D., Member¹ and Gang Wang, P.E., Member², (1)University of Colorado, Boulder, CO, (2)University of Miami, Coral Gables, FL

3. Model-Based Home Envelope Performance Evaluation: A Use Case of Data from Connected Thermostats (KC-19-A021)

Li Song, Ph.D., P.E., Member, Junke Wang, Student Member and Choon Yik Tang, Ph.D., University of Oklahoma, Norman, OK

11:00 AM – 12:00 PM

Seminar 33 (Intermediate)**Existing Building Commissioning: The Nitty Gritty***Track: Commissioning New & Existing Buildings**Room: 2101, KCCC***Sponsor: 7.9 Building Commissioning***Chair: Tracey Whaley, P.E., Member, DLR Group, Denver, CO***1. Existing Building Commissioning: The Nitty Gritty***Tracey Jumper, Member, Jump-Start Building Commissioning LLC, Selma, TX***2. The Value of Commissioning Study***Tom Poeling, P.E., Member, U.S. Engineering Company, Westminster, CO*

11:00 AM – 12:00 PM

Seminar 34 (Intermediate)**Microbial Risks in the Built Environment: “Legionella” Commissioning and Supplemental Disinfection of Building Water Systems***Track: Systems & Equipment in the Built Environment**Room: 2104B, KCCC***Sponsor: 3.6 Water Treatment***Chair: Helen Cerra, Member, ChemTreat, Inc., Glen Allen, VA***1. Decontamination of Building Water Systems in the Age of “Legionella”***Janet Stout, Ph.D., Associate Member, Special Pathogens Laboratory, Pittsburgh, PA***2. Supplemental Disinfection: Evaluation of the Potable Water Supplemental Disinfection Technologies***Joseph Ham, Member, Eldon Water, Inc., Novi, MI*

11:00 AM – 12:00 PM

Seminar 35 (Intermediate)**New ASHRAE Cleanroom Design Guide, Part 2: Applications***Track: Fundamentals and Applications**Room: 2105, KCCC***Sponsor: 9.11 Clean Spaces***Chair: Philip Naughton, Member, Applied Materials Inc, Austin, TX***1. Cleanroom Standards: Cleanroom Testing, Certification and Commissioning***Vincent Sakraida, P.E., BR+A Consulting Engineers, St. Louis, MO***2. Cleanroom Applications in Semiconductors and Microelectronics***Philip Naughton, Member, Applied Materials Inc, Austin, TX***3. Cleanroom Applications in Biotechnology, Pharmaceutical and Food Preparation***Gary Shamshoian, P.E., Member¹ and Vincent Sakraida, P.E.², (1) BEST Technology, Inc., San Jose, CA, (2)BR+A Consulting Engineers, St. Louis, MO*

11:00 AM – 12:00 PM

Seminar 36 (Basic)



Professional Skills Highlights from Distinguished Lecturers

Track: Professional Development

Room: 2103C, KCCC

Chair: Madison Schultz, P.E., Member, OK BeCo,
Oklahoma City, OK

1. How to Use Emotional Intelligence to Become a Better Leader Professionally and Personally

Karine Leblanc, Member, US Air Conditioning Distributors, Los Angeles, CA

2. Time Management for the Perpetually Busy Engineer

Pam Duffy, Member, Spark One Solutions, LLC, Dallas, TX

11:00 AM – 12:00 PM

Seminar 37 (Intermediate)



Radiant Cooling and Heating Using Ground Source Heat Pumps

Track: Radiant Heating & Cooling

Room: 2104A, KCCC

Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: Michael Kuk, Member, CERx Solutions LLC,
Montgomery, IL

1. Radiant Cooling/Heating and Ground Source Heat Pumps: A Great Match!

Stephen Hamstra, P.E., HBDP, Member, Melink Solar & Geo, Cincinnati, OH

2. Radiant Heating and Cooling with a Geothermal Open Loop System: A Case Study

Greg Tinkler, Member, Page, Houston, TX

2:15 PM – 3:45 PM

Debate 2 (Advanced)

College of Fellows Debate: Does Climate Change Pose a Liability Risk to Engineers?

Track: Professional Development

Room: 2101, KCCC

Sponsor: 1.7 Business, Management & General Legal Education, College of Fellows

Moderator: Mitchell Swann, P.E., MDC Systems, Paoli, PA

1. Don Beaty, P.E., Fellow ASHRAE, DLB Associates, Eatontown, NJ,

2. Katherine Hammack, P.E., Fellow ASHRAE, Ernst & Young LLP, Tysons, VA,

3. Beth Tomlinson, P.E., Member, TDKA, St. Paul, MN,

4. Tom Lawrence, Ph.D., Member, University of Georgia College of Engineering, Athens, MI,

5. Dru Crawley, Ph.D., P.E., Fellow ASHRAE, Bentley Systems Inc., Washington, DC

6. Karen Erger, J.D., Lockton Companies, Kansas City, MO

Tuesday, June 25

8:00 AM – 9:30 AM

Conference Paper Session 12 (Intermediate)

Alternative Refrigerants: Low GWP Refrigerants and Ionic Liquids



Track: Research Summit

Room: 2204, KCCC

Chair: Wade H. Conlan, P.E., Member, Hanson Professional Services, Maitland, FL

1. Performance of a Novel R410A Replacement in an Air-Cooled Chiller (KC-19-C018)

Kenneth Schultz, Ph.D., Member, Ingersoll Rand, La Crosse, WI

2. Theoretical and Experimental Studies of Ice Slurries (Green Secondary Refrigerant) Using PG and MEG as Antifreezes (KC-19-A022)

Rajinder Singh, Ph.D., Member, Pusa Institute of Technology, New Delhi, India

3. Solubilities and Diffusivities of HFC and HFO Refrigerants in a Synthetic Polyol Ester Lubricant Oil (KC-19-A023)

Ana Rita C. Morais, Ph.D.¹, Luke B. Simoni, Ph.D.², Aaron M. Scurto, Ph.D.³ and Mark Shiflett, Ph.D., P.E.¹, (1)University of Kansas, Lawrence, KS, (2)The Chemours Company, Wilmington, DE, (3)The University of Kansas, Lawrence, KS

4. Investigating the Thermodynamic and Transport Properties of Hydrofluorocarbon: Ionic Liquid Mixtures with Applications Towards Refrigerant Gas Separations (KC-19-A024)

Mark Shiflett, Ph.D., P.E., David Minnick, Ph.D. and Ana Rita Morais, Ph.D., University of Kansas, Lawrence, KS

5. Thermodynamic and Kinetic Analysis of Ammonia in Ionic Liquids for Absorption Refrigeration (KC-19-A025)

Tugba Turnaoglu and Mark B. Shiflett, Ph.D., P.E., University of Kansas, Lawrence, KS

Tech Program

8:00 AM – 9:30 AM

Conference Paper Session 13 (Intermediate)

Chiller Optimization and VFD Controls



Track: Research Summit

Room: 2102B, KCCC

Chair: Parag Rastogi, Student Member, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland

1. Two-Objective Genetic Algorithm Optimization of Chilled Water Plant Design (KC-19-A026)

Nabil Nassif, Ph.D., P.E., Member¹, Nihal Al Raees, Student Member² and Fouad Al Rifaie², (1)University of Cincinnati, Cincinnati, OH, (2)North Carolina A&T State University, Greensboro, NC

2. Smart Integrated Optimization Technique for Large Chilled Water Systems (KC-19-A027)

Mostafa Tahmasebi, Student Member, Nabil Nassif, Ph.D., P.E., Member and Rand Talib, Ph.D., Student Member, University of Cincinnati, Cincinnati, OH

3. An Approach for Motor Efficiency with Variable Frequency Drives (KC-19-A028)

Gang Wang, P.E., Member¹, Zufen Wang¹, Zhitao Han, Ph.D.² and Li Song, Ph.D., P.E., Member³, (1)University of Miami, Miami, FL, (2)Northeast Forestry University, Harbin, China, (3)University of Oklahoma, Norman, OK

4. The Impacts of Variable Frequency Drives on Drive System Efficiency (KC-19-A029)

Gang Wang, P.E., Member², Zhitao Han, Ph.D.¹, and Zufen Wang² (1)Northeast Forestry University, Harbin, China, (2)University of Miami, Miami, FL

8:00 AM – 9:30 AM

Conference Paper Session 14 (Intermediate)

Improved Ventilation for Healthcare Facilities and Disease Transmission



Track: Occupant Health & Safety

Room: 2203, KCCC

Chair: Kashif Nawaz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

1. Performance of Displacement Ventilation for Hospital Patient Rooms with Varying Cooling Loads (KC-19-C019)

Kishor Khankari, Ph.D., Fellow ASHRAE, AnSight LLC, Ann Arbor, MI

2. Designing Simplified Airborne Infection Isolation Rooms to Reduce Infection Rate in Future Pandemics (KC-19-C020)

Merethe Cecilie Lind, CEng, Affiliate¹, Trond Thorgeir Harsem, P.Eng., Member¹, Bård Venås, Dr.Eng., Affiliate¹, Petri Kalliomäki, CEng, Affiliate², Anders Welde Vikan, CEng, Affiliate¹ and Hannu Koskela, Ph.D., Affiliate², (1)Norconsult AS, Sandvika, Norway, (2)Turku AMK, Turku, Finland

3. Infectious Passenger Isolation System for Aircraft (KC-19-C021)

Byron Jones, Ph.D., P.E., Fellow ASHRAE¹, Ian Darrach¹, James Bennett, Ph.D., Member², Kenneth Mead, Ph.D., P.E., Member³ and Mohammad Hosni, Ph.D., Fellow ASHRAE¹, (1)Kansas State University, Manhattan, KS, (2)National Institute for Occupational Safety and Health, Cincinnati, OH, (3)U.S. Public Health Service National Institute for Occupational Safety and Health, Cincinnati, OH

4. Codes, Standards and OSHA Regulations Impacting Occupant Health and Safety in Buildings (KC-19-C022)

Stephen W. Duda, P.E., HFDP, HBDP and BEAP, Fellow ASHRAE, Ross & Baruzzini, Saint Louis, MO

8:00 AM – 9:30 AM

Seminar 38 (Intermediate)



Building Energy Efficiency at the System Level

Track: Systems & Equipment in the Built Environment

Room: 2104B, KCCC

Sponsor: 7.6 Building Energy Performance, SSPC 90.1

Chair: Harold Jepsen, Associate Member, Legrand, Pleasant Grove, UT

1. Developing System-Level Key Performance Indicators

Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA

2. Benefits of Total System Performance Ratio: An HVAC System-Level Metric

Supriya Goel, Pacific Northwest National Laboratory, Richland, WA

3. Measuring and Standardizing Packages for Systems-Level Energy Savings

Paul Mathew, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

8:00 AM – 9:30 AM

Seminar 39 (Advanced)

**Model-Predictive Control for HVAC System Optimization**

Track: Optimization in HVAC&R

Room: 2103C, KCCC

Sponsor: 7.5 Smart Building Systems, 7.6 Building Energy Performance

Chair: Eric Yang, P.E., Member, Energy Systems Group, Washington, DC

1. Adaptive Model-Based Predictive Control for HVAC

Draguna Vrabie, Ph.D., Member, Pacific Northwest National Laboratory, Richland, WA

2. Field Evaluation of Model-Predictive Optimized Control System in Commercial Buildings

Guanjing Lin, Ph.D., Associate Member, Lawrence Berkeley National Laboratory, Berkeley, CA

3. A Framework for Comparing Model Predictive Control Solutions: Needs and Approach

David Blum, Lawrence Berkeley National Laboratory, Berkeley, CA

8:00 AM - 9:30 AM

Seminar 40 (Intermediate)

**Overcoming Common Misconceptions in Water Treatment**

Track: Optimization in HVAC&R

Room: 2101, KCCC

Sponsor: 3.6 Water Treatment, 8.6 Cooling Towers and Evaporative Condensers

Chair: Jon Cohen, Member, ChemTreat, Naperville, IL

1. Water Conditions and the Potential Effects on Our Piping Systems and Components

Jeff Ramey, United Technologies, Carrier Corporation, Syracuse, NY

2. Steam, Heating and Chilled: Common Misconceptions Overcoming Optimum End User Operation

Joshua Ince, P.Eng., Member, Eldon Water Inc, West Chester, OH

3. Strategies for Optimizing Water Treatment in Cooling Towers

Henry A. Becker, Member, Earthwise Environmental, Wood Dale, IL

4. Cooling Tower Sump-Piping Design and Operational Practices That Affect Water Treatment Efficiency

Gary Harbison, Harbison, Oakland, CA

8:00 AM – 9:30 AM

Seminar 41 (Intermediate)



Radiant Heating and Cooling Systems: Dispelling the Myths with Facts and Research

Track: Radiant Heating & Cooling

Room: 2105, KCCC

Sponsor: 6.5 Radiant Heating and Cooling

Chair: Fred Bauman, P.E., Member, Center for the Built Environment, Berkeley, CA

1. The Myths and Facts of Radiant Heating and Cooling Systems

Bjarne Olesen, Ph.D., Presidential Member, International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

2. Surface Heat Transfer Coefficients of Radiant Systems

Jun Shinoda, Student Member, Technical University of Denmark, Lyngby, Denmark

3. Ceiling Panels with Phase Change Materials as an Alternative to TABS in Renovation Projects

Ongun Berk Kazanci, Ph.D., Associate Member, International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

4. SMART Sensing: Scanning Mean Radiant Temperature Sensor for Characterizing Radiant Environments

Forrest Meggers, Princeton University, Princeton, NJ

8:00 AM – 9:30 AM

Seminar 42 (Intermediate)



Tech Program

Why Did the Heat Cross That Thermal (Dynamic) Bridge?

Track: Modeling Throughout the Building Life Cycle

Room: 2104A, KCCC

Sponsor: 4.4 Building Materials and Building Envelope Performance

Chair: Paulo Tabares, Ph.D., Associate Member, Colorado School of Mines, Golden, CO

1. The Dynamic and Static Behavior of Selected Steel Wall Assemblies

Mehdi Ghobadi, Ph.D., National Research Council Canada, Ottawa, ON, Canada

2. Effect of Dynamic Modeling of Thermal Bridges on the Energy Performance of Residential Buildings for Cold Climates

Hua Ge, Concordia University, Montreal, QC, Canada

3. Dynamic vs. Static Analysis of Thermal Bridges in Walls

Achilles Karagiozis, Ph.D., Member, Owens Corning, Granville, OH

4. Dynamic Modelling of 3-Dimensional Thermal Bridges: Energy and Moisture Impact

Florian Antretter, Member, Fraunhofer-Institut für Bauphysik, Valley, Germany

9:45 AM – 10:45 AM

Seminar 43 (Intermediate)**Advances in Ceiling Fans for Comfort Cooling***Track: Research Summit*

Room: 2104B, KCCC

Sponsor: 2.1 Physiology and Human Environment, Standard 55, Standard 216*Chair: Gwelen Paliaga, P.E., Member, TRC Advanced Energy Services, Oakland, CA***1. What Air Speeds Can I Expect for a Given Fan and Room? Predicting Indoor Air Speeds Based on Full Scale Laboratory Measurements***Paul Raftery, Ph.D., Member, University of California, Berkeley, CA***2. Ceiling Fans in Practice***Jim Bradburn, P.E., Member, HGA Architects and Engineers, Minneapolis, MN***3. The Importance of Air Movement for Comfort When Occupants' Activity Levels Change***Hui Zhang, Ph.D., Member, University of California, Berkeley, CA*

9:45 AM – 10:45 AM

Seminar 44 (Intermediate)**ASHRAE Research Overview for Lower GWP Flammable Refrigerants***Track: Research Summit*

Room: 2103C, KCCC

Sponsor: MTG.LowGWP Lower Global Warming Potential Alternative Refrigerants, 1.1 Thermodynamics and Psychrometrics, 1.3, 8.5, 8.4, 8.11*Chair: Kashif Nawaz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN***1. Flammable Refrigerants Post-Ignition Simulation and Risk Assessment (Overview of RP- 1806)***Phillip Johnson, P.E., Member, McQuay International, Staunton, VA***2. Flammable Refrigerants Post-Ignition Simulation and Risk Assessment (Overview of RP- 1807)***Dutch Uselton, P.E., Fellow ASHRAE, Lennox Industries Inc., Carrollton, TX***3. Servicing and Installing Equipment Using Flammable Refrigerants: Assessment of Field-Made Mechanical Joints (Overview of RP- 1808)***Brian Fricke, Ph.D., Member, Oak Ridge National Laboratory, Oak Ridge, TN*

9:45 AM – 10:45 AM

Seminar 45 (Intermediate)



Building Envelope Cx x4: The Value, Requirements, Case Studies and Research

Track: Commissioning New & Existing Buildings

Room: 2105, KCCC

Sponsor: 7.9 Building Commissioning

Chair: James Vallort, Fellow ASHRAE, Environmental Systems Design, Inc., Denver, CO

1. Building Envelope Commissioning: The Value Proposition

Tim Zelazny, AIA, Environmental Systems Design, Inc., Chicago, IL

2. The Value of Becx Divided By 10: Snapshots in Reality

Fiona Aldous, Member, WJE, Boca Raton, FL

3. Understanding the Value of Building Enclosure Commissioning through a Performance Metric

Simon Pallin, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

9:45 AM – 10:45 AM

Seminar 46 (Intermediate)



Controls and Indoor Air Quality

Track: Research Summit

Room: 2204, KCCC

Sponsor: Publication and Education Council

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

1. Virtual Measurements of the Air Properties in AHUs or Virtual Re-Calibration of Sensors

Radu Zmeureanu, Ph.D., Life Member, Concordia University, Montreal, QC, Canada

2. Machine Learning vs. Hybrid Machine Learning Model for Optimal Operation of a Chiller

Cheol-Soo Park, Ph.D., Seoul National University, Seoul, Korea, Republic of (South)

3. IAQ and Energy Implications of High Efficiency Filters in Residential Buildings: A Review (RP-1649)

Masih Alavy, Student Member, University of Toronto, Toronto, ON, Canada

9:45 AM – 10:45 AM

Seminar 47 (Intermediate)



Modeling Transient Events, Part 2: The Indoor Environment

Track: Modeling Throughout the Building Life Cycle

Room: 2101, KCCC

Sponsor: 4.10 Indoor Environmental Modeling, 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Chair: Duncan Phyfe, Associate Member, Alden Research Laboratory, Holden, MA

1. Improving Prescriptive Design Using Transient CFD Simulations

Michael Carl, RWDI, Guelph, ON, Canada

2. A Compact Cooling-Unit Model for Transient Data Center Simulations

James W. VanGilder, P.E., Member, Schneider Electric, Andover, MA

3. Sub-Scale Modeling of High-Rise Building with Hybrid Ventilation Free Cooling and Phase Change Material Thermal Storage

Liangzhu (Leon) Wang, Ph.D., P.E., Member, Concordia University, Montreal, QC, Canada

9:45 AM – 10:45 AM

Seminar 48 (Basic)



Radiant at Work: Case Studies Featuring Radiant Heating and Cooling in Large-Scale Office Buildings

Track: Radiant Heating & Cooling

Room: 2104A, KCCC

Sponsor: 6.5 Radiant Heating and Cooling

Chair: Devin Abellon, P.E., Member, Uponor, Phoenix, AZ

1. Pearl River Tower: Design and Post-Occupancy Performance of the Radiant Ceiling System

Luke Leung, P.E., Member, Skidmore, Owings, & Merrill LPP, Chicago, IL

2. SFO CAC: The Beauty of Working Together

Noah Zallen, P.E., Member, Integral Group, Oakland, CA

9:45 AM – 10:45 AM

Seminar 49 (Intermediate)



Residential Standards Update: ASHRAE 90.2 and 62.2

Track: Fundamentals and Applications

Room: 2203, KCCC

Chair: Iain Walker, Ph.D., Fellow ASHRAE, Lawrence Berkeley National Laboratory, Berkeley, CA

1. What's New in 62.2

Paul Francisco, Member, University of Illinois at Urbana-Champaign, Champaign, IL

2. The New ASHRAE Standard 90.2-2018 for High Performance Residential Buildings

Theresa Weston, DuPont, Richmond, VA

9:45 AM – 10:45 AM

Workshop 3 (Intermediate)

Targeting What? Best Practices for Setting Performance Goals

Track: Systems & Equipment in the Built Environment

Room: 2102B, KCCC

Chair: Jim Edelson, Associate Member, New Buildings Institute, Portland, OR

1. Performance Goals in ASHRAE's Performance Measurement Protocols and Standard 100

Bruce Hunn, Ph.D., Fellow ASHRAE, ASHRAE, Atlanta, GA

2. A Methodology for Consistent Zero Energy Building Targets
Kevin Carbonnier, Ph.D., New Buildings Institute, Portland, OR

11:00 AM – 12:30 PM

Conference Paper Session 15 (Intermediate)

Building Modeling and Controls



Track: Modeling Throughout the Building Life Cycle/ Research Summit

Room: 2203, KCCC

Chair: Eric Yang, P.E., Member, Energy Systems Group, Washington, DC

1. A Real-Time Platform for Assessment of Chiller-Side Demand Response Strategies (KC-19-C023)

Fan Feng, Student Member¹, Zheng O'Neill¹ and Peng Xu², (1)University of Alabama, Tuscaloosa, AL, (2)Tongji University, Shanghai, China

2. Algorithmically Generated Chiller Performance Curves for Building Energy Simulation (KC-19-A030)

Jeremy Lerond, Affiliate, Pacific Northwest National Laboratory, Seattle, WA

3. Barriers to Energy Controls Delivering Real Savings (KC-19-A031)

Reid Hart, P.E., Member and Michael Rosenberg, Fellow ASHRAE, Pacific Northwest National Laboratory, Richland, WA

4. Modelling Moisture Sources Due to Air Leakage with the Hamt Extension for EnergyPlus (KC-19-C024)

Florian Antretter, Member¹ and Simon Pallin, Ph.D., Associate Member², (1)Fraunhofer-Institut für Bauphysik, Valley, Germany, (2)Oak Ridge National Laboratory, Oak Ridge, TN

5. Enhancing Building Energy Model Calibration with Physics-based Inverse Modeling (KC-19-A032)

Han Li, Associate Member¹, Tianzhen Hong, Ph.D., Member² and Marina Sofos³, (1)Lawrence Berkeley National Laboratory, Berkeley, CA, (2)LBNL, Berkeley, CA, (3)U.S. Department of Energy, Washington, DC

11:00 AM – 12:30 PM

Conference Paper Session 16 (Intermediate)

Indoor Environmental Quality and Chemical Emissions

Track: Research Summit



Room: 2204, KCCC

Chair: Ahmed Elatar, Ph.D., ORNL, Oak Ridge, TN

1. Ventilation Design Considerations for Occupant Health in Aircraft Painting Facilities Under OSHA Requirements (KC-19-C025)

James Bennett, Ph.D., Member, National Institute for Occupational Safety and Health, Cincinnati, OH

2. Development of a Semi-Empirical Model for Predicting the Pressure Drop of Nanofiber Air Filters (KC-19-C026)

Chun Chen, Ph.D., Associate Member, Ye Bian and Li Zhang, Ph.D., The Chinese University of Hong Kong, Hong Kong, China

3. Influence of Source Location and Ventilation Rates on Contaminant Dispersion Pattern in an Aircraft Cabin (KC-19-A033)

James Bennett, Ph.D., Member¹, Veronica Dos Santos Teixeira², Yuanhui Zhang³ and Shamia Hoque, Ph.D., Associate Member⁴, (1)National Institute for Occupational Safety and Health, Cincinnati, OH, (2)The Dow Chemical Company - Charlotte Operations, Fort Mill, SC, (3)University of Illinois at Urbana-Champaign, Urbana, IL, (4)University of South Carolina, Columbia, SC

4. Particle and Chemical Emissions from 3D Printers and Their Potential Health Impacts (KC-19-A034)

Qian Zhang, Ph.D.¹, Aika Davis, Ph.D.¹, Marilyn Black, Ph.D.¹ and Rodney Weber, Ph.D.², (1)Underwriters Laboratories Inc., Marietta, GA, (2)Georgia Institute of Technology, Atlanta, GA

5. A Study of Chemical Exposure from Consumer Products Used in Residential Environments (KC-19-A035)

Aika Davis, Ph.D., Member¹, Debra Harris, Ph.D.² and Marilyn Black, Ph.D.¹, (1)Underwriters Laboratories Inc., Marietta, GA, (2) Baylor University, Waco, TX

11:00 AM – 12:30 PM

Seminar 50 (Basic)



How the Blockchain Will Affect You and Your Work in HVAC&R and Buildings: Don't Get Left Behind, It's Happening Now!

Track: Fundamentals and Applications

Room: 2105, KCCC

Sponsor: 1.5 Computer Applications, MTG.BIM Building Information Modeling

Chair: Tim Dwyer, CEng, Fellow ASHRAE, UCL Institute for Environmental Design and Engineering (IEDE), London, United Kingdom

1. Blockchain Basics

Bruce Billedeaux, Member, Maverick Technologies A Rockwell Automation Company, Portage, MI

2. Why Blockchain Is the Real Deal and Impacts Everyone

Don Beaty, P.E., Fellow ASHRAE, DLB Associates, Eatontown, NJ

3. How Blockchain Technology Can Be Used for HVAC Equipment Maintenance

Stephen Roth, P.E., Member, Carmel Software Corp., San Rafael, CA

4. Blockchains for the Internet of Things: Preventing Forgery and Tampering of Identities

Devu Manikantan Shila, Ph.D., United Technologies Research Center, West Hartford, CT

11:00 AM – 12:30 PM

Seminar 51 (Intermediate)



Low Mass Radiant Systems

Track: Radiant Heating & Cooling

Room: 2101, KCCC

Sponsor: 6.5 Radiant Heating and Cooling, 6.1 Hydronic and Steam Equipment and Systems, SSPC 55, TC7.4

Chair: Robert Bean, P.L.(Eng.), Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

1. The Fundamentals of Low Mass Radiant System Design

Michael O'Rourke, Member, Barcol Air USA, Denver, CO

2. Controls for Low Mass Hydronic Radiant Systems (Radiant Panels)

Peter Simmonds, Ph.D., Fellow ASHRAE, Building and Systems Analytics LLC, Emneth, CA, United Kingdom

3. Application of Low Mass Radiant Systems: Case Study and Lessons Learned

Eric J. Fontaine, Member, vanZelm Engineers, Hartford, CT

4. Cost Effective Application of Low Mass Radiant Systems

Tim McGinn, P.Eng., Member, McGinn Technical Services, Calgary, AB, Canada

11:00 AM – 12:30 PM

Seminar 52 (Intermediate)



Modeling Transient Events, Part 1: External Factors Which Affect the Indoor Environment

Track: Modeling Throughout the Building Life Cycle

Room: 2103C, KCCC

Sponsor: 4.10 Indoor Environmental Modeling, 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

Chair: Duncan Phyfe, Associate Member, Alden Research Laboratory, Holden, MA

1. Modeling Transient Event of Underground Parking Garage

Mohammad Heidarinejad, Illinois Institute of Technology, Chicago, IL

2. CFD Modeling of Natural and Mechanical Ventilation of a Stadium

Duncan Phillips, Ph.D., P.E., Associate Member, RWDI, Guelph, ON, Canada

3. Introducing the Urban-Scale Chlorine Dispersion Experiments and Its Implications on Indoor Health Assessment

Yang-Seon Kim, Wichita State University, Wichita, KS

4. Process of Using Virtual Wind Tunnel for Wind-Building Interaction Investigations

James Lo, Student Member, National Institute of Standards and Technology, Gaithersburg, MD

5. Modeling the Transient Event of Data Center Cooling during the Power Outage

Wangda Zuo, Ph.D., Member, University of Colorado, Boulder, CO

11:00 AM – 12:30 PM

Seminar 53 (Intermediate)

Novel Optimization Techniques for Water Heating Using Sorption Systems

Track: Optimization in HVAC&R

Room: 2104A, KCCC

Sponsor: 8.3 Absorption and Heat Operated Machines

Chair: William Ryan, Ph.D., P.E., Member, University of Illinois at Chicago, Chicago, IL

1. Comparison and Optimization of Absorption Heat Pump vs. Conventional Water Heaters

Chris Keinath, Ph.D., Member, Stone Mountain Technologies, Inc., Johnson City, TN

2. Optimization of a Chemisorption Heat Pump with Buffer Tank for Residential Heating Applications

Zhiyao Yang, Oak Ridge National Laboratory, Oak Ridge, TN

3. Optimization Framework to Maximize Absorption Water Heater Energy Efficiency

Ahmad Abu-Heiba, Oak Ridge National Laboratory, Oak Ridge, TN

11:00 AM – 12:30 PM

Seminar 54 (Advanced)

Optimal Chilled Water Plant Design and Operation: What a “Smart Valve” Can Do for You

Track: Systems & Equipment in the Built Environment

Room: 2104B, KCCC

Sponsor: 7.5 Smart Building Systems, 1.4 Control Theory and Application, 7.9 Building Commissioning

Chair: Scott Hackel, Slipstream, Madison, WI

1. What Is a Smart Valve?

Jon Hildebrand, BELIMO Aircontrols (USA), Inc., Danbury, CT

2. Smart Valves for Full System Optimization

Jeff Creighton, Flow Energy, Woodlinville, WA

3. Practical Applications for Pressure Independent and Smart Control Valves

Steve Taylor, P.E., Fellow ASHRAE, Taylor Engineering, Alameda, CA

11:00 AM – 12:30 PM

Seminar 55 (Intermediate)

System Efficiency

Track: Research Summit

Room: 2102B, KCCC

Sponsor: 5.7 Evaporative Cooling, 7.7 Testing and Balancing, Publication and Education Council

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

1. Load-Based Testing Methodology for Fixed-Speed and Variable-Speed Unitary Air Conditioning Equipment

Andrew Hjortland, Ph.D., Member, Johnson Controls, Norman, OK

2. Oil Retention in Microchannel Heat Exchangers of an R134a Refrigeration System and Effects on Their Energy Performance and System Cop (ASHRAE RP-1564)

Lorenzo Cremaschi, Ph.D., Member, Auburn University, Auburn, AL

3. Detection and Interpretation of Anomalies in Building Energy Use through Inverse Modelling

Burak Gunay, Ph.D., Member, Carleton University, Ottawa, ON, Canada

4. Improving System Efficiency for a Variable-Capacity/ Variable-Blower-Speed Residential Heat Pump System with Multizone Ductwork

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

1:30 PM – 3:00 PM

Seminar 56 (Intermediate)



Radiant Solutions in All Shapes and Sizes

Track: Radiant Heating & Cooling

Room: 2101, KCCC

Sponsor: 6.5 Radiant Heating and Cooling

Chair: Devin Abellon, P.E., Member, Uponor, Phoenix, AZ

1. American University Washington College of Law: Large-Scale Radiant Ceiling Panel Application

Cindy Cogil, P.E., Member, SmithGroup, Chicago, IL

2. Residential Case Study: Radiant vs. Forced Air and Compliance with ASHRAE Standard 55

Robert Bean, P.L.(Eng.), Member, Indoor Climate Consultants Inc., Calgary, AB, Canada

3. Cold Tube Singapore: Outdoor Low Temperature Radiant Cooling Pavilion in the Hot Humid Tropics without Condensation Using IR Transparent Insulated Radiant Panels

Forrest Meggers, Princeton University, Princeton, NJ

4. Research Laboratory Renovation Highlighting Radiant Cooling and Displacement Ventilation Technologies

Michael McDermott, Grumman Butkus Associates, Chicago, IL

3:15 PM – 4:45 PM

Seminar 57 (Intermediate)



Impacts of a Record-Breaking Wet Summer on Building Construction and Operation

Track: Occupant Health & Safety

Room: 2101, KCCC

Sponsor: 1.12 Moisture Management in Buildings, Residential Building Committee

Chair: Ed Light, Member, Building Dynamics, LLC, Ashton, MD

1. Impacts of Extensive Mold Growth in Buildings Where HVAC Systems Have Limited Dehumidification

Ed Light, Member, Building Dynamics, LLC, Ashton, MD

2. Humidity-Related Mold Growth: HVAC Control Options

Rick Meetre, P.E., Building Dynamics, LLC, Ashton, MD

3. Restoration of Rain-Damaged Construction

Paul Haas, Member, Building Dynamics, LLC, West Palm Beach, FL

Wednesday, June 26

8:00 AM – 9:30 AM

Conference Paper Session 17 (Intermediate)

Ground Source Heat Pumps and Novel Geothermal Systems



Track: Radiant Heating & Cooling/Research Summit

Room: 2203, KCCC

Chair: Kashif Nawaz, Ph.D., Associate Member, Oak Ridge National Laboratory, Oak Ridge, TN

1. Long-Term Monitoring and Simulation of a Vertical Closed-Loop Ground Source Heat Pump System Used in the Cold Climate of the U.S. (KC-19-C027)

Rui Miao, Student Member and Yao Yu, Ph.D., BEMP and BEAP, Associate Member, North Dakota State University, Fargo, ND

2. Ground-Source Heat Pump with Parallel Flow Horizontal Ground Loop and Dry Liquid Cooler (KC-19-A036)

Gaoyang Hou, Student Member, Hessam Taherian, Ph.D., Member and Longjun Li, University of Alabama at Birmingham, Birmingham, AL

3. A Desiccant Wheel Application with Condenser Water Cooling and Low Grade Geothermal Energy in Humid Climates (KC-19-A037)

Jiajun Liao, Student Member, Texas A&M University, College Station, TX

4. Design and Construction of Geothermal CO2 Air Conditioner (KC-19-C028)

Paul Kalinowski, Associate Member, Dennis Nasuta, Associate Member and Cara Martin, BEMP, Associate Member, Optimized Thermal Systems, Inc., Beltsville, MD

8:00 AM – 9:30 AM

Conference Paper Session 18 (Intermediate)

Novel Control Research and Strategies



Track: Research Summit

Room: 2204, KCCC

Chair: Davide Ziviani, Ph.D., Member, Purdue University, West Lafayette, IN

1. Real-Time Optimization of Energy Efficiency for Cold Climate Heat Pumps with Extremum Seeking (KC-19-A038)

Yaoyu Li, Ph.D., Member and Wenyi Wang, University of Texas, Dallas, TX

2. Identifying Models of HVAC Systems Using Arimax (KC-19-A039)

Fan Feng, Student Member and Zheng O'Neill, Ph.D., P.E., Member, University of Alabama, Tuscaloosa, AL

3. Machine Learning in a Model Predictive Controller for the Management of the Domestic Hot Water Systems (KC-19-C029)

Louis-Gabriel Maltais, Student Member and Louis Gosselin, Ph.D., P.E., Member, Université Laval, Quebec City, QC, Canada

4. Break-Point Statistical Formulations for Whole Building Heating Hot Water Consumption Modeling (KC-19-A040)

Hongxiang Fu, Student Member, David E. Claridge, Ph.D., P.E., Fellow ASHRAE and Juan-Carlos Baltazar, Ph.D., P.E., BEMP, Member, Texas A&M University, College Station, TX

8:00 AM – 9:30 AM

Seminar 58 (Basic)



Be a Better Human: Top 10 Soft Skills to Take Your Career to the Next Level P

Track: Professional Development

Room: 2101, KCCC

Sponsor: 1.7 Business, Management & General Legal Education

Chair: Rex Scare, P.E., Member, Armstrong International Inc, Three Rivers, MI

1. Be a Better Human: Top 10 Soft Skills to Take Your Career to the Next Level – A

Robin Broder, Henderson Engineers, Lenexa, KS

2. Be a Better Human: Top 10 Soft Skills to Take Your Career to the Next Level – B

Erica Jones, MMC Corp., Overland Park, KS

3. Be a Better Human: Top 10 Soft Skills to Take Your Career to the Next Level – C

Jessica Mangler, P.E., Member, Affiliated Engineers, Inc., Seattle, WA

4. Be a Better Human: Lessons Learned in Mastering Soft Skills

Jennifer Leach, P.E., Member, Patterson-Kelley, East Stroudsburg, PA

8:00 AM – 9:30 AM

Seminar 59 (Intermediate)



Energy Systems Integration and Smart Grid-Ready Buildings: All You Need to Know to Be a Good Grid Citizen

Track: Systems & Equipment in the Built Environment

Room: 2105, KCCC

Sponsor: 6.7 Solar Energy Utilization, 7.5 Smart Building Systems, 2.5, 2.8

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

1. Smart Grid-Ready Buildings: Enabling Tools and Solutions

Glenn Remington, Member, Consumers Energy, Jackson, MI

2. Smart Grid Distribution Intelligence: Towards a Resilient, “Self-Healing” Grid

Andy Haun, Schneider Electric, Andover, MA

3. Integration of Renewable Energy Systems: Opportunities and Challenges

Aaron Bloom, Energy Systems Integration Group, St. Paul, MN

8:00 AM – 9:30 AM

Seminar 60 (Intermediate)**Heat Exchanger Fundamentals and Design Innovations***Track: Fundamentals and Applications**Room: 2103C, KCCC***Sponsor: 8.4 Air-to-Refrigerant Heat Transfer Equipment***Chair: Jun Wang, Ph.D., Member, Sanhua International, Houston, TX***1. Application of Passive Circuitry Arrangement to Improve the Heat Exchange Effectiveness***Davide Ziviani, Ph.D., Member, Purdue University, West Lafayette, IN***2. Quantification of Local Air-Side Heat Transfer through an Absorption-Based Color Change Coatings***Stefan Elbel, Ph.D., Member, Creative Thermal Solutions and University of Illinois at Urbana-Champaign, Urbana, IL***3. Shape-Optimized, Additively Manufactured Air-to-Refrigerant Heat Exchanger Performance for Condenser and Evaporator Applications***Yunho Hwang, Ph.D., Member, University of Maryland, College Park, MD*

8:00 AM – 9:30 AM

Seminar 61 (Intermediate)**PIC Valve Technologies, Applications, and Commissioning***Track: Commissioning New & Existing Buildings**Room: 2104A, KCCC***Sponsor: 7.9 Building Commissioning, 6.1 Hydronic and Steam Equipment and Systems***Chair: Roger Lutz, P.E., Member, Affiliated Engineers, Inc., Madison, WI***1. Flow Metering Style Picvs***Robert Walker, BELIMO Aircontrols (USA), Inc., Danbury, CT***2. Balanced Pressure Globe Style Picvs***Roger Lutz, P.E., HFDP, Member, Affiliated Engineers, Inc., Madison, WI***3. Cartridge Style Picvs***Jerry Martin, Griswold, Madison, WI***4. Pressure Regulator Style Picv***Brent Waluzak, Siemens, Tampa Bay, FL*

8:00 AM – 9:30 AM

Seminar 62 (Basic)**Predictive Analytics for HVAC Engineers: What Is in the Box?***Track: Modeling Throughout the Building Life Cycle**Room: 2102B, KCCC***Sponsor: 1.5 Computer Applications***Chair: Krishnan Gowri, Ph.D., Fellow ASHRAE, BIM2BEM Solutions, Bothell, WA*

1. Urban-Scale Natural Ventilation with Physics-Informed Machine Learning Prediction

Chao Ding, Ph.D., Lawrence Berkeley National Laboratory, Berkeley, CA

2. Integrating BEM with Data and Machine Learning: Challenges and Perspectives

Adrian Chong, Ph.D., National University of Singapore, Singapore, Singapore

3. Great Energy Predictor Shootout II: Revisited

Clayton Miller, Ph.D., National University of Singapore, Singapore, Singapore

8:00 AM – 9:30 AM

Seminar 63 (Intermediate)



Radiant Buildings Post Occupancy: Indoor Environmental Quality, Energy and Operational Performance

Track: Radiant Heating & Cooling

Room: 2104B, KCCC

Sponsor: 6.5 Radiant Heating and Cooling, 2.1 Physiology and Human Environment

Chair: Bjarne Olesen, Ph.D., Presidential Member, International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

1. Comparing Temperature and Acoustic Satisfaction in Sixty Radiant and All-Air Buildings

Fred Bauman, P.E., Fellow ASHRAE, University of California, Berkeley, CA

2. On the Path to Zero Energy: Using Radiant to Reduce Energy Use

Kevin Carbonnier, Ph.D., New Buildings Institute, Portland, OR

3. How Do Radiant Systems Perform in Terms of IEQ and Occupant Productivity and Health?

Ongun Kazanci, Ph.D., International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

4. Occupant Indoor Environmental Satisfaction and Operational Implications in Radiant Buildings

Megan Dawe, Student Member, University of California, Berkeley, CA

9:45 AM – 10:45 AM

Panel 3 (Intermediate)

BIM Blast: Breaking the Curve

Track: Modeling Throughout the Building Life Cycle

Room: 2102B, KCCC

Sponsor: 7.1 Integrated Building Design, SPC-224P

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

1. Application of Building Information Modeling

Dennis Knight, P.E., Fellow ASHRAE, Whole Building Systems, LLC, Mt. Pleasant, SC

2. Integration on a Grand Scale

Van Woods, P.E., Member, US Army Corps of Engineers, Seattle, WA

3. Modeling a Changing Landscape*Craig Dubler, P.E., Member, Penn State University, State College, PA***4. Staying Out of Trouble***Tracy James, J.D., Hamilton Stephens Steele + Martin, PLLC, Charlotte, NC*

9:45 AM – 10:45 AM

Conference Paper Session 19 (Intermediate)**Occupancy Sensors and Schedules***Track: Modeling Throughout the Building Life Cycle/ Research Summit**Room: 2204, KCCC**Chair: Eric Yang, P.E., Member, Energy System Group, Washington, DC***1. Inferring Occupant Counts from Wi-Fi Data through Random Forest (KC-19-A041)***Zhe Wang, Ph.D. and Tianzhen Hong, Ph.D., Member, Lawrence Berkeley National Laboratory, Berkeley, CA***2. Bio-Sensing and Reinforcement Learning Approaches for Occupant-Centric Building Control (KC-19-C030)***Chenlu Zhang, Zhiang Zhang, Student Member and Vivian Loftness, Carnegie Mellon University, Pittsburgh, PA***3. Defining Typical Occupancy Schedules and Behaviors in Residential Buildings Using the American Time Use Survey (KC-19-C031)***Debrudra Mitra, Student Member, Kristen Cetin, Ph.D., P.E., Associate Member, Paul Kremer, Member, Jayde Lovejoy and Yiyi Chu, Iowa State University, Ames, IA*

9:45 AM – 10:45 AM

Conference Paper Session 20 (Basic)**Smart Building Systems: Case Studies***Track: Systems & Equipment in the Built Environment**Room: 2104B, KCCC**Chair: Michael Sherber, P.Eng., Member, PlasmaAir, Stamford, CT***1. Data-Driven Leakage Detection in Air-Handling Units on a University Campus (KC-19-C032)***Megan McHugh and Zoltan Nagy, Ph.D., Associate Member, The University of Texas at Austin, Austin, TX***2. An Interactive Building Control for the Integrative HVAC System Featuring Personalized Cooling in Office Buildings (KC-19-C033)***Siliang Lu, Student Member¹, Erica Cochran Hameen, Ph.D.¹ and Yue Zou, Ph.D., P.E., CPMP, Member², (1)Center for Building Performance and Diagnostics, School of Architecture, Carnegie Mellon University, Pittsburgh, PA, (2)Donghua University, Shanghai, China***3. Using Text Analytics on Operator Logbooks for Performance Benchmarking: A Case Study (KC-19-C034)***Saptak Dutta, Student Member, Burak Gunay, Ph.D., Associate Member and Scott Bucking, Ph.D., Associate Member, Carleton University, Ottawa, ON, Canada*

9:45 AM – 10:45 AM

Conference Paper Session 21 (Intermediate)

Thermal Energy Storage



Track: Research Summit

Room: 2203, KCCC

Chair: Jaya Mukhopadhyay, Ph.D., Member, Montana State University, Bozeman, MT

1. Model Predictive Control of Cool Thermal Energy Storage Under Different Electricity Rate Structures (KC-19-C035)

Amy Van Asselt, Ph.D., Associate Member, Lafayette College, Easton, PA

2. Modeling and Analysis of Compact Evacuated Tube with PCM for a Tank-Less Solar Water Heating System (KC-19-C036)

Mohamed Osman¹, Mohamed Abokersh², Omar Huzayyin, Ph.D., Member³ and Mohamed Elmorsi, Ph.D., Member¹, (1)American University in Cairo, Cairo, Egypt, (2)Public University of Tarragona, Tarragona, Spain, (3)Cairo University, Cairo, Egypt

3. Experimental Test Chamber for Testing Innovative PCM Building Envelope Assemblies in Full Scale Applications (KC-19-A042)

Sajith Wijesuriya, Student Member and Paulo Cesar Tabares Velasco, Ph.D., Associate Member, Colorado School of Mines, Golden, CO

9:45 AM – 10:45 AM

Seminar 64 (Intermediate)



Demystifying Cooling Tower Water Treatment

Track: Systems & Equipment in the Built Environment

Room: 2105, KCCC

Sponsor: 2.8 Building Environmental Impacts and Sustainability, 7.6 Building Energy Performance

Chair: Mike Pascual, P.E., Associate Member, ESD, San Francisco, CA

1. Current Challenges with Cooling Towers

Rafi Karim, P.E., Member, Affiliated Engineers, Inc., Pasadena, CA

2. Alternative Water Treatment Systems

Jesse Dean, National Renewable Energy Laboratory, Golden, CO

3. Chemical Free Water Treatment

Michael Deru, Ph.D., Member, NREL, Golden, CO

9:45 AM – 10:45 AM

Seminar 65 (Basic)



“Legionella:” How To Protect Maintenance Workers

Track: Occupant Health & Safety

Room: 2101, KCCC

Chair: Lan Chi Nguyen Weekes, P.Eng., Member, College La Cite, Ottawa, ON, Canada

1. “Legionella”: How to Prevent and Control Growth through Systems Design

Lan Chi Nguyen Weekes, P.Eng., Member, College La Cite, Ottawa, ON, Canada

Tech Program

2. "Legionella": Education and Protection of Maintenance Workers Donald Weekes, Member, Self, Ottawa, ON, Canada

9:45 AM – 10:45 AM

Seminar 66 (Basic)



YEA Controls FUNDamentals: What to Know about Careers in Controls and the Basics of BAS

Track: Professional Development

Room: 2104A, KCCC

Sponsor: 1.4 Control Theory and Application

Chair: Elise Backstrom, Associate Member, Exyte U.S, Inc., Phoenix, AZ

1. Choose Your Own Adventure: Controls Career Options

Chariti Young, Member, Automated Logic, Kennesaw, GA

2. Are You in Control(s)?

Ron Bernstein, Member, RBCG Consulting, Atlanta, GA

9:45 AM – 10:45 AM

Workshop 4 (Intermediate)

Filter Forecast: The Future of Filtration

Track: Occupant Health & Safety

Room: 2103C, KCCC

Sponsor: 2.4 Particulate Air Contaminants and Particulate Contaminant Removal Equipment

Chair: Kathleen Owen, Fellow ASHRAE, Owen Air Filtration Consulting, Cary, NC

1. How Much Will Clean Air Cost You?

R Vijayakumar, Ph.D., Fellow ASHRAE, Aerfil, Liverpool, NY

2. Measuring Air Filter Efficiency Down to Single-Digit Nanometer Size

Paolo Tronville, Ph.D., Politecnico di Torino, Torino, Italy

11:00 AM – 12:30 PM

Conference Paper Session 22 (Intermediate)

Building Envelope and Fenestration Performance

Track: Research Summit



Room: 2204, KCCC

Chair: Marija Todorovic, P.Eng., Fellow ASHRAE, University of Belgrade, Belgrade, Serbia

1. Best Practices for Full-Scale Testing and Energy Savings, Daylighting and Visual Comfort Evaluation of Dynamic Shading (1710-RP) (KC-19-C037)

Niraj Kunwar, Student Member, Kristen Cetin, Ph.D., P.E., Associate Member and Ulrike Passe, AIA, Associate Member, Iowa State University, Ames, IA

2. Window Enhancements in Prototype Buildings (KC-19-A043)

Chitra Nambiar, Associate Member, Supriya Goel, Michael Rosenberg, Fellow ASHRAE and Jian Zhang, Ph.D., Member, Pacific Northwest National Laboratory, Richland, WA

3. Occupant Window Usage and Cooling Energy Consumption: A Case Study (KC-19-C038)

Jayson Bursill, Student Member, William O'Brien, Ph.D., Member and Ian Beausoleil-Morrison, Carleton University, Ottawa, ON, Canada

4. Unmanned Aerial Vehicles Application in Building Envelope Thermal Energy Assessment in Saudi Arabia (KC-19-C039)

Ayman Youssef, P.E., Member, Ahmed Awfi and Faisal Al Musa, Saudi Aramco, Dhahran, Saudi Arabia

11:00 AM – 12:30 PM

Seminar 67 (Intermediate)



An Alternative View of Radiant Heating and Cooling Systems via Exergy Analysis

Track: Radiant Heating & Cooling

Room: 2203, KCCC

Sponsor: 7.4 Exergy Analysis for Sustainable Buildings (EXER)

Chair: Wangda Zuo, Ph.D., Member, University of Colorado, Boulder, CO

1. What Are the Differences between Air-Based and Radiant Systems in Terms of Exergy?

Ongun Kazanci, Ph.D., International Centre for Indoor Environment and Energy, Technical University of Denmark, Kgs. Lyngby, Denmark

2. Applying Exergy to Radiant Cooling System for the Reduction of Chilled Water Generation

Brian Meneghan, Carrier Corporation, Malta, NY

3. Exergy View of Radiant Heating Panels

Mike Trantham, Member, IMI Flow Design, Dallas, TX

11:00 AM – 12:30 PM

Seminar 68 (Intermediate)



Ground Source Heat Pump System Design

Track: Systems & Equipment in the Built Environment

Room: 2101, KCCC

Sponsor: 6.8 Geothermal Heat Pump and Energy Recovery Applications

Chair: Harrison Skye, Ph.D., Member, National Institute of Standards and Technology, Gaithersburg, MD

1. GSHP Design for Building Retrofits: Three Case Studies

Ed Lohrenz, GEOptimize Inc., Winnipeg, MB, Canada

2. Optimizing Energy Conservation Measures to Reduce Geothermal Heat Exchanger Size

Brendan Hall, P.E., Member, CHA Consulting, Syracuse, NY

3. Hybrid GSHP System Design for Two Buildings in Diverse Climates

Suhasini Pyarasani, Member, Guttman & Blaevoet Engineering, Sacramento, CA

11:00 AM – 12:30 PM

Seminar 69 (Basic)
**Occupant-Centric Building Design and Operation:
State of the Art and Challenges**
Track: Occupant Health & Safety
Room: 2104B, KCCC
Sponsor: MTG.OBB Occupant Behavior in Buildings
Chair: Zoltan Nagy, Ph.D., Associate Member, The University of Texas at Austin, Austin, TX
1. Annex 79 Program: Overview and Goals
Michael Kane, Northeastern University, Boston, MA
2. Definitions and State-of-the-Art of Implemented Occupant-Centric Controls
Zoltan Nagy, Ph.D., Associate Member, The University of Texas at Austin, Austin, TX
3. Understanding the Link between Indoor Environmental Quality, Building Interfaces and Human Behavior
Julia Day, Ph.D., Associate Member, Washington State University, Pullman, WA
4. Case Study Implementation of Occupant-Centric Controls
Burak Gunay, Ph.D., Member, Carleton University, Ottawa, ON, Canada

11:00 AM – 12:30 PM

Seminar 70 (Intermediate)
Poor Performance Guaranteed: Problems with Oversized Air Conditioning Equipment
Track: Systems & Equipment in the Built Environment
Room: 2102B, KCCC
Sponsor: 7.2 HVAC&R Construction & Design Build Technologies, 7.8 Owning and Operating Costs
Chair: Matthew Mullen, P.E., Member, EMCOR Services – New England Mechanical, South Windsor, CT
1. The Unit Has Enough Capacity so Why Is Everyone so Uncomfortable?
Matthew E. Mullen, P.E., BEAP, Member, EMCOR Services – New England Mechanical, South Windsor, CT
2. “We Have Mold on the Flag” and Other Commercial Case Studies
Matthew E. Mullen, P.E., BEAP, Member, EMCOR Services – New England Mechanical, South Windsor, CT
3. Why Is Our House Uncomfortable When the New System Is Bigger than the Old One?
Wes Davis, Affiliate, Air Conditioning Contractors of America, Arlington, VA

11:00 AM – 12:30 PM

Seminar 71 (Advanced)



Refrigerant Flammability Fundamentals

Track: Fundamentals and Applications

Room: 2103C, KCCC

Sponsor: 3.1 Refrigerants and Secondary Coolants

Chair: Barbara Minor, Member, The Chemours Company, Wilmington, DE

1. Burning Velocity Predictive Tools

Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD

2. Evaluation of Experimental Methods for Burning Velocity of Flammable Refrigerants

Gregory Linteris, Ph.D., Associate Member, National Institute of Standards and Technology, Gaithersburg, MD

11:00 AM – 12:30 PM

Seminar 72 (Intermediate)



The Role of Residential Indoor Environments in Allergic Disease

Track: Occupant Health & Safety

Room: 2104A, KCCC

Sponsor: Environmental Health Committee

Chair: Kevin Kennedy, MPH, CIEC, Associate Member, Children's Mercy Kansas City, Kansas City, MO

1. Allergic Disease and Health Effects in Indoor Environments

Jay Portnoy, M.D., Children's Mercy Kansas City, Kansas City, MO

2. Working with Physicians to Solve Indoor Environmental Problems in Homes

Jennifer Lowry, M.D., Children's Mercy Kansas City, Kansas City, MO

3. Assessing Residential Environments: What Should You Do?

Elliott Horner, Ph.D., Member, UL Environment, Marietta, GA

4. Environmental Interventions for Allergic Disease Management: What Works

Kevin Kennedy, MPH, CIEC, Associate Member, Children's Mercy Kansas City, Kansas City, MO

11:00 AM – 12:30 PM

Seminar 73 (Intermediate)



Thermal Stratification for Comfort, Air Quality and Energy Implication

Track: Fundamentals and Applications

Room: 2105, KCCC

Sponsor: 2.1 Physiology and Human Environment

Chair: Shichao Liu, Ph.D., Associate Member, Worcester Polytechnic Institute, Worcester, MA

1. Local Thermal Discomfort Caused by Temperature Stratification

Shichao Liu, Ph.D., Associate Member, Worcester Polytechnic Institute, Worcester, MA

2. Stratification Effect on the Perception and Satisfaction with the Indoor Environmental Quality in Lecture Theatres

Junjing Yang, Ph.D., National University of Singapore, Singapore, Singapore

3. Coupling UFAD and Personalized Ventilation Systems for Enhanced Thermal Comfort, IAQ and Energy Efficiency

Chandra Sekhar, Ph.D., Fellow ASHRAE, National University of Singapore, Singapore, Singapore

4. All-Air Systems with Overhead Supply Diffusers Applied for Space Heating: Design and Operation Challenges

Atila Novoselac, Ph.D., Member, University of Texas at Austin, Austin, TX

notes

COMMITTEE MEETINGS SCHEDULE

In the listing below floor levels and venue names are indicated in parenthesis and subcommittees are indented. Rooms will be set as best as possible as indicated in the parentheses beside the committee, i.e., (20/20) will accommodate at least 20 people at the conference table and at least 20 chairs for the audience. Any audiovisual or electrical ordered will be listed. If AV is not ordered in advance there is no guarantee it will be available onsite.

Meeting Space Floor and Venue Key

The "Schedule" section in the ASHRAE 365 app lets you create your own schedule as well as filter committee meetings by date, time, room and committee type (Standing, Technical, Project).

Society Standing Committees

AEDG Steering Committee (10/10) Electric

Mon. (6/24) 2:15 pm–5:00 pm Big Joe Turner A (3), Marriott-West

Appointments Roadmap (32/0)

Sun. (6/23) 7:00 am–8:00 am Bennie Moten (3), Marriott-West

ASHRAE Foundation (35/15) Electric

Mon. (6/24) 7:30 am–9:30 am Basie C (2), Marriott-West

ASHRAE Foundation Executive Subcommittee (10/5) Electric

Sat. (6/22) 1:30 pm–3:00 pm Jay McShann A (3), Marriott-West

ASHRAE/AIA Liaison Task Group (15/10) Electric

Sat. (6/22) 1:00 pm–3:00 pm Executive Boardroom (3), Marriott-West

Associate Society Alliance (35/35) Screen

Mon. (6/24) 4:15 pm–6:15 pm Basie C (2), Marriott-West

Audit Committee (5/3)

Fri. (6/21) 4:00 pm–5:00 pm Lester Young B (3), Marriott-West

Board of Directors (41/100) Screen/Electric

Sun. (6/23) 1:30 pm–5:30 pm Imperial (L), Marriott-East

Wed. (6/26) 2:00 pm–6:00 pm Imperial (L), Marriott-East

Incoming Board of Directors Training (10/0) Screen/Electric

Fri. (6/21) 8:00 am–4:00 pm Kennedy (L), Marriott-East

Buildings XIV (30/0) Screen

Sun. (6/23) 9:00 am–12:00 pm Basie C1 (2), Marriott-West

Building EQ Committee (15/15) Screen/Electric

Sun. (6/23) 8:30 am–11:30 am Mary Lou Williams A (3), Marriott-West

Building EQ Methodology Subcommittee (8/8) Screen/Electric

Sat. (6/22) 11:00 am–12:45 pm Lester Young A (3), Marriott-West

Building EQ Business Development Subcommittee (8/8) Screen/Electric

Sat. (6/22) 1:15 pm–3:00 pm Lester Young A (3), Marriott-West

Certification (12/12) Screen/Electric

Sat. (6/22) 8:00 am–12:00 pm Kennedy (L), Marriott-East

Chapter Technology Transfer Committee (30/15) Screen/Electric

Fri. (6/21) 8:00 am–12:00 pm Bennie Moten (3), Marriott-West

Sat. (6/22) 8:00 am–12:00 pm Bennie Moten (3), Marriott-West

Chapter Technology Transfer Member Services (15/15) Screen

Fri. (6/21) 1:30 pm–5:00 pm Lester Young A (3), Marriott-West

Chapter Technology Transfer Operations (10/5) Screen

Fri. (6/21) 1:30 pm–5:00 pm Bennie Moten (3), Marriott-West

Chapter Technology Transfer Executive (7/0)

Fri. (6/21) 5:00 pm–6:00 pm Bennie Moten (3), Marriott-West
Chapter Technology Transfer Committee New Member Orientation (10/5)
Screen/Electric

Sat. (6/22) 1:15 pm–2:30 pm Bennie Moten (3), Marriott-West

College of Fellows (25/10) Screen

Sun. (6/23) 10:00 am–12:00 pm Bennie Moten (3), Marriott-West
College of Fellows: Advisory Committee (15/10) Screen

Sun. (6/23) 9:00 am–10:00 am Bennie Moten (3), Marriott-West

Conferences and Expositions Committee (30/5) Screen/Electric

Sat. (6/22) 8:00 am–12:00 pm 2201, KCCC

Conferences and Expositions Executive (30/5)

Fri. (6/21) 1:00 pm–3:30 pm Julia Lee (3), Marriott-West

Conferences and Expositions Annual and Winter (30/5)

Fri. (6/21) 3:45 pm–6:00 pm Julia Lee (3), Marriott-West

Development Committee (25/15) Screen/Electric

Mon. (6/24) 9:45 am–12:00 pm Basie C (2), Marriott-West

**Director and Regional Chairs and Regional Members Council
Representatives (15/30)**

Fri. (6/21) 11:00 am–1:00 pm Roosevelt (L), Marriott-East

Wed. (6/26) 12:00 pm–2:00 pm Julia Lee (3), Marriott-West

Directors-At-Large (15/20)

Wed. (6/26) 12:00 pm–2:00 pm Truman A (L), Marriott-East

Electronic Communications Committee (13/10) Screen

Sat. (6/22) 11:00 am–3:00 pm Big Joe Turner A (3), Marriott-West

Electronic Communications Subcommittees (13/10)

Sat. (6/22) 9:00 am–10:00 am Big Joe Turner A (3), Marriott-West

Environmental Health (20/20) Screen/Electric

Mon. (6/24) 2:15 pm–6:15 pm Lester Young B (3), Marriott-West

Environmental Health Executive (20/20) Screen/Electric

Mon. (6/24) 7:00 am–8:00 am Lester Young B (3), Marriott-West

Environmental Health Handbook/Policy (20/20) Screen/Electric

Mon. (6/24) 8:00 am–10:00 am Lester Young B (3), Marriott-West

Environmental Health Program/Research (20/20) Screen/Electric

Mon. (6/24) 10:00 am–12:00 pm Lester Young B (3), Marriott-West

Executive Committee (13/20) Screen/Electric

Sat. (6/22) 8:30 am–1:00 pm Jay McShann B (3), Marriott-West

Wed. (6/26) 7:30 am–9:00 am Jay McShann B (3), Marriott-West

Thurs. (6/27) 7:30 am–11:00 am Executive Boardroom (3), Marriott-West

Finance Committee (13/20) Electric

Fri. (6/21) 8:00 am–12:00 pm Lester Young B (3), Marriott-West

Finance Investment Subcommittee (4/0)

Thurs. (6/20) 4:00 pm–6:00 pm Julia Lee A (3), Marriott-West

Finance Planning Subcommittee (8/8) Electric

Thurs. (6/20) 4:00 pm–6:00 pm Julia Lee B (3), Marriott-West

Government Affairs Committee (35/30) Screen/Electric

Sat. (6/22) 8:00 am–12:30 pm Roosevelt (L), Marriott-East

GAC: Policy and Programs Subcommittee (15/10) Screen/Electric

Fri. (6/21) 8:00 am–9:00 am Mary Lou Williams (3), Marriott-West

GAC: Member Mobilization Subcommittee (15/10) Screen/Electric

Fri. (6/21) 9:15 am–10:15 am Mary Lou Williams (3), Marriott-West

GAC: Global Affairs Subcommittee (15/10) Screen/Electric

Fri. (6/21) 10:30 am–11:30 am Mary Lou Williams (3), Marriott-West

GAC: Rules Subcommittee (15/10) Screen/Electric

Fri. (6/21) 11:45 am–12:45 pm Mary Lou Williams (3), Marriott-West

GAC: Maps Ad Hoc Subcommittee (15/10) Screen/Electric

Fri. (6/21) 11:45 am–12:45 pm Executive Boardroom (3), Marriott-West

GAC: Training (30/10) Screen/Electric

Fri. (6/21) 2:00 pm–3:00 pm Mary Lou Williams (3), Marriott-West

GAC: Executive Subcommittee (20/15) Screen/Electric

Fri. (6/21) 3:15 pm–4:45 pm Mary Lou Williams (3), Marriott-West

Handbook Committee (30/15) Screen

- Sun. (6/23) 10:30 am–1:00 pm Roosevelt (L), Marriott-East
Handbook Excom (5/5)
- Sat. (6/22) 1:00 pm–2:00 pm Lester Young B (3), Marriott-West
Handbook Strategic Planning (5/5)
- Sat. (6/22) 2:00 pm–3:00 pm Lester Young B (3), Marriott-West
Handbook Electronic Media (5/0)
- Sun. (6/23) 8:00 am–9:00 am Roosevelt (L), Marriott-East
Handbook Functional (5/0)
- Sun. (6/23) 8:00 am–9:00 am Truman B (L), Marriott-East
Handbook Review (5/5)
- Sun. (6/23) 8:00 am–9:00 am Truman A (L), Marriott-East
Handbook Training Workshop (50/0) Screen
- Sun. (6/23) 8:00 am–9:00 am Eisenhower (L), Marriott-East
Handbook 2020 HVAC Systems and Equipment TCs/Volume Subcommittee (25/0)
- Sun. (6/23) 9:00 am–10:00 am Truman A (L), Marriott-East
Handbook 2021 Fundamentals TCs/Volume Subcommittee (25/0)
- Sun. (6/23) 9:00 am–10:00 am Truman B (L), Marriott-East
Handbook 2022 HVAC Applications TCs/Volume Subcommittee (25/0)
- Sun. (6/23) 9:00 am–10:00 am Roosevelt (L), Marriott-East
Handbook Volume Subcommittees (25/0)
- Sun. (6/23) 10:00 am–10:30 am Roosevelt (L), Marriott-East

Historical Committee (20/5) Screen

- Sun. (6/23) 8:30 am–12:00 pm Big Joe Turner B (3), Marriott-West

Honors & Awards (20/0) Screen/Electric

- Sun. (6/23) 1:30 pm–5:00 pm Big Joe Turner B (3), Marriott-West
- Mon. (6/24) 2:15 pm–5:30 pm Big Joe Turner B (3), Marriott-West
Honors & Awards New Member Orientation (5/5) Screen/Electric
- Sun. (6/23) 12:30 pm–1:30 pm Big Joe Turner B (3), Marriott-West

IAQ2020 (20/0) Screen /Electric

- Tues. (6/25) 12:00 pm–2:30 pm Julia Lee A (3), Marriott-West

IEQ-GA (20/0) Screen/Electric

- Tues. (6/25) 3:30 pm–5:00 pm Julia Lee A (3), Marriott-West

Infectious Aerosols Position Document Committee (10/0)**Screen/Electric**

- Mon. (6/24) 6:30 pm–8:30 pm Executive Boardroom (3), Marriott-West

Indoor Air Quality Position Document Committee (10/5)**Screen/Electric**

- Tues. (6/25) 9:00 am–10:30 am Bennie Moten A (3), Marriott-West

Life Member Executive Board Meeting (10/0)

- Tues. (6/25) 9:00 am–11:00 am Hoover (L), Marriott-East

Members Council (37/40) Screen/Electric

- Tues. (6/25) 8:15 am–12:00 pm Basie A (2), Marriott-West
Members Council Region Operations Subcommittee (12/10) Electric
- Sat. (6/22) 8:00 am–12:00 pm Big Joe Turner B (3), Marriott-West
Members Council Planning Subcommittee (12/10) Electric
- Sun. (6/23) 8:00 am–12:00 pm Julia Lee A (3), Marriott-West

Membership Promotion (25/15) Screen/Electric

- Sat. (6/22) 8:00 am–3:00 pm Mary Lou Williams (3), Marriott-West
Membership Promotion Subcommittees (25/10) Screen/Electric
- Fri. (6/21) 8:00 am–2:00 pm Truman B (L), Marriott-East

Nominating (50/25) Screen/Electric

- Sun. (6/23) 9:00 am–12:00 pm Basie A (2), Marriott-West

PEAC (20/20) Screen/Electric

- Tues. (6/25) 12:00 pm–2:00 pm Bennie Moten A (3), Marriott-West

Planning (30/40) Screen/Electric

- Fri. (6/21) 1:00 pm–4:00 pm Colonial (L), Marriott-East

Professional Development (15/20) Screen/Electric

- Mon. (6/24) 8:00 am–12:00 pm Big Joe Turner B (3), Marriott-West

Publications Committee (16/10) Screen

Sun. (6/23) 8:00 am–12:00 pm Lester Young A (3), Marriott-West
Publications Planning Subcommittee (16/5)

Sat. (6/22) 10:00 am–12:00 pm Lester Young B (3), Marriott-West

Publishing and Education Council (35/30) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Basie C (2), Marriott-West

Publishing and Education Council Fiscal (25/10) Screen

Mon. (6/24) 2:00 pm–3:30 pm Truman B (L), Marriott-East

Publishing and Education Council Functional (25/10) Screen

Mon. (6/24) 3:30 pm–5:00 pm Truman B (L), Marriott-East

Publishing and Education Council Orientation (35/30) Screen/Electric

Tues. (6/25) 2:00 pm–4:00 pm Basie C (2), Marriott-West

Refrigeration Committee (20/20) Screen/Electric

Sun. (6/23) 8:00 am–12:00 pm Lester Young B (3), Marriott-West
Refrigeration Excom (20/20) Screen

Sun. (6/23) 7:00 am–8:00 am Lester Young B (3), Marriott-West

Region-at-Large (40/0) Screen

Mon. (6/24) 2:15 pm–4:15 pm Basie A (2), Marriott-West

Research Administration Committee (25/20) Screen/Electric

Sat. (6/22) 8:00 am–3:00 pm Truman B (L), Marriott-East

Wed. (6/26) 7:00 am–11:00 am Bennie Moten (3), Marriott-West

Research Promotion (25/5) Screen/Electric

Sat. (6/22) 7:30 am–1:00 pm Basie A1 (2), Marriott-West

Research Promotion Executive (10/0)

Fri. (6/21) 9:30 am–11:30 am Taft (L), Marriott-East

Research Promotion RVC Training (25/5) Screen

Fri. (6/21) 1:30 pm–5:00 pm Roosevelt (L), Marriott-East

Research Promotion Subcommittee (10/0)

Sat. (6/22) 2:00 pm–3:00 pm Roosevelt (L), Marriott-East

Residential Building Committee (20/20) Screen/Electric

Mon. (6/24) 8:30 am–11:30 pm Bennie Moten (3), Marriott-West

Residential Building Committee: Conferences Subcommittee (8/10)

Sun. (6/23) 8:30 am–9:30 am Big Joe Turner A (3), Marriott-West

Residential Building Committee: Programs Subcommittee (8/10)

Sun. (6/23) 9:30 am–10:30 am Big Joe Turner A (3), Marriott-West

Residential Building Committee: Technical Subcommittee (8/10)

Sun. (6/23) 10:30 am–11:30 am Big Joe Turner A (3), Marriott-West

Residential Building Committee: Publications Subcommittee (8/10)

Sun. (6/23) 1:00 pm–2:00 pm Big Joe Turner A (3), Marriott-West

Residential Building Committee: Stakeholders Subcommittee (8/10)

Sun. (6/23) 2:00 pm–3:00 pm Big Joe Turner A (3), Marriott-West

Resiliency Position Document Committee (10/10) Screen/Electric

Sun. (6/23) 3:00 pm–4:30 pm Mary Lou Williams A (3), Marriott-West

Scholarship Trustees (10/5) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Yard Bird B (2), Marriott-West

Science and Technology for the Built Environment Associate**Editor's Meeting (10/4) Screen/Electric**

Sun. (6/23) 11:30 am–2:00 pm Nixon (L), Marriott-East

Society Rules (12/6) Screen/Electric

Tues. (6/25) 2:00 pm–6:00 pm Yard Bird B (2), Marriott-West

Standards Committee (30/20) Screen/Electric

Sat. (6/22) 8:00 am–1:00 pm Trianon D (T), Marriott-East

Wed. (6/26) 7:30 am–10:00 am Imperial (L), Marriott-East

Standards: Executive Committee (10/10) Screen/Electric

Fri. (6/21) 8:00 am–12:00 pm Lester Young A (3), Marriott-West

StdC Training Adhoc (10/10) Screen/Electric

Fri. (6/21) 12:00 pm–1:00 pm Lester Young A (3), Marriott-West

Standards: ILS/ISAS (10/3) Screen/Electric

Fri. (6/21) 1:00 pm–4:00 pm Lester Young B (3), Marriott-West

Standards: PPIS (8/10) Screen/Electric

Fri. (6/21) 2:00 pm–6:00 pm Big Joe Turner A (3), Marriott-West

Standards: SPLS (20/20) Screen/Electric

Fri. (6/21) 2:00 pm–6:00 pm Jay McShann A (3), Marriott-West

Standards: Code Interaction Subcommittee (CIS) (15/10) Screen/Electric

Sun. (6/23) 6:00 pm–9:30 pm Big Joe Turner B (3), Marriott-West

Standards PPIS (8/10) Screen/Electric

Tues. (6/25) 11:00 am–2:00 pm Lester Young A (3), Marriott-West

Standards SPLS (20/10) Screen/Electric

Tues. (6/25) 2:00 pm–4:00 pm Lester Young A (3), Marriott-West

Standards SRS (8/4) Screen/Electric

Tues. (6/25) 5:00 pm–6:00 pm Lester Young A (3), Marriott-West

Student Activities Committee (25/10) Screen/Electric

Sat. (6/22) 8:00 am–3:00 pm Julia Lee (3), Marriott-West

Student Activities RVC Training (25/10) Screen/Electric

Fri. (6/21) 8:30 am–9:30 am Truman A (L), Marriott-East

Student Activities Executive (25/10) Screen/Electric

Fri. (6/21) 9:30 am–11:30 am Truman A (L), Marriott-East

Student Activities K-12/STEM (25/10) Screen/Electric

Fri. (6/21) 12:00 pm–2:00 pm Truman A (L), Marriott-East

Student Activities ABET (15/10) Screen/Electric

Fri. (6/21) 12:00 pm–2:00 pm Taft (L), Marriott-East

Student Activities Post High (25/10) Screen/Electric

Fri. (6/21) 2:00 pm–4:00 pm Truman A (L), Marriott-East

Student Activities Design Competition (25/10) Screen/Electric

Fri. (6/21) 4:00 pm–6:00 pm Truman A (L), Marriott-East

Student Activities Grants (15/10) Screen/Electric

Fri. (6/21) 4:00 pm–6:00 pm Taft (L), Marriott-East

TC/TG Chair's Training Workshop (3/100)

Sun. (6/23) 9:45 am–10:45 am 2205, KCCC

Technical Activities Committee (25/20) Screen /Electric

Sat. (6/22) 8:00 am–3:00 pm Truman A (L), Marriott-East

Wed. (6/26) 7:00 am–10:00 am Julia Lee (3), Marriott-West

Technology Council (37/20) Screen/Electric

Wed. (6/26) 9:00 am–12:00 pm Mary Lou Williams (3), Marriott-West

Technology Council: Special Projects Subcommittee (8/5) Screen/Electric

Tues. (6/25) 8:00 am–9:00 am Julia Lee A (3), Marriott-West

Technology Council: Operations Subcommittee (20/10) Screen/Electric

Tues. (6/25) 9:00 am–11:00 am Julia Lee A (3), Marriott-West

Technology Council: Document Review Subcommittee (10/10) Screen/Electric

Tues. (6/25) 11:00 am–12:00 pm Julia Lee A (3), Marriott-West

TRAC Meeting (10/0)

Tues. (6/25) 3:00 pm–4:00 pm Executive Boardroom (3), Marriott-West

UNEP ASHRAE Coordination Meeting (12/10) Screen

Sat. (6/22) 5:15 pm–6:15 pm Big Joe Turner A (3), Marriott-West

Young Engineers in ASHRAE Committee (34/15) Electric

Sat. (6/22) 8:00 am–3:00 pm Basie C (2), Marriott-West

YEA Hospitality (125/0)

Sun. (6/23) 4:00 pm–6:00 pm Barney Allis Lobby (LL), Marriott-East

TECHNICAL COMMITTEES

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.

Abbreviations

TC	Technical Committee
TRG	Technical Research Group
MTG	Multidisciplinary Task Group
RP	Research Project

TECHNICAL COMMITTEES (TCs)

TC/TG/MTG Chair's Breakfast (258/0) Screen

Sun. (6/23) 6:30 am–8:00 am 2215BC, KCCC

TC Program Subcommittee Training (30/5) Screen

Tues. (6/25) 11:15 am–12:00 pm 2208, KCCC

Research Subcommittee Chairs (137/0) Screen

Mon. (6/24) 6:30 am–9:00 am Imperial (L), Marriott-East

TC 1.1 Thermodynamics and Psychrometrics (10/15) Screen

Mon. (6/24) 2:15 pm–4:15 pm Executive Boardroom (3), Marriott-West

TC 1.2 Instruments and Measurements (15/40)

Tues. (6/25) 1:00 pm–3:30 pm 2102B, KCCC

TC 1.3 Heat Transfer and Fluid Flow (25/25)

Tues. (6/25) 1:00 pm–3:30 pm 2211, KCCC

TC 1.3/8.5 Research Subcommittee (20/20) Screen/Electric

Sun. (6/23) 3:00 pm–7:00 pm 2207, KCCC

TC 1.4 Control Theory and Application (20/80) Screen

Tues. (6/25) 1:00 pm–3:30 pm 2104A, KCCC

TC 1.4 YEA/Education (15/15) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm Taft (L), Marriott-East

TC 1.4 Control Components and Applications (15/15) Screen

Sun. (6/23) 3:00 pm–4:00 pm Taft (L), Marriott-East

TC 1.4 Programs (15/15) Screen

Sun. (6/23) 4:00 pm–5:30 pm Taft (L), Marriott-East

TC 1.4 Research (20/20) Screen

Mon. (6/24) 2:00 pm–4:00 pm Trianon E (T), Marriott-East

TC 1.4 Handbook (10/5) Screen

Mon. (6/24) 4:00 pm–6:00 pm Trianon E (T), Marriott-East

TC 1.4 Executive (10/5) Screen

Tues. (6/25) 9:00 am–10:00 am 2213, KCCC

TC 1.4 RP-1711 Advanced Sequences of Operation for HVAC Systems – Phase II Central Plants and Hydronic Systems (10/15) Screen

Tues. (6/25) 10:00 am–11:00 am 2213, KCCC

TC 1.5 Computer Applications (25/25) Screen/Electric

Mon. (6/24) 6:30 pm–9:00 pm 2103C, KCCC

TC 1.5 1801-PMS Standardizing and Utilizing ASHRAE Online BIM Data Exchange Protocols

Sun. (6/23) 8:00 am–12:00 pm Kennedy (L), Marriott-East

TC 1.5 RP-1810 Development of Reference Building Information Model (BIM) Test Cases for Improving Usage of Software Interoperability Schemas (10/10) Screen

Sun. (6/23) 12:00 pm–1:00 pm Kennedy (L), Marriott-East

TC 1.5 Cyber Security (15/5)

Sun. (6/23) 4:00 pm–5:00 pm Lester Young B (3), Marriott-West

TC 1.5 Emerging Applications (15/5)

Sun. (6/23) 5:00 pm–6:00 pm Lester Young B (3), Marriott-West

TC 1.5 Program (15/5)

Sun. (6/23) 6:00 pm–7:00 pm Lester Young B (3), Marriott-West

TC 1.5 Research (15/5)

Sun. (6/23) 7:00 pm–8:00 pm Lester Young B (3), Marriott-West

TC 1.5 Handbook (15/5)

Mon. (6/24) 6:00 pm–6:30 pm 2103C, KCCC

TC 1.6 Terminology (10/4) Screen/Electric

Mon. (6/24) 8:00 am–11:00 am 2212, KCCC

TC 1.7 Business, Management and General Legal Education (20/5) Screen/Electric

Mon. (6/24) 10:15 am–12:00 pm 2209, KCCC

TC 1.7 Code of Ethics (8/8) Screen/Electric

Sat. (6/22) 2:00 pm–4:00 pm 2212, KCCC

TC 1.8 Mechanical Systems Insulation (25/10) Screen

Mon. (6/24) 4:15 pm–6:30 pm Bennie Moten (3), Marriott-West

TC 1.8 Handbook–Chapter 23 (10/10) Screen /Electric

Sun. (6/23) 8:00 am–10:30 am 2201, KCCC

TC 1.8 Program (10/10) Screen /Electric

Sun. (6/23) 10:30 am–11:00 am 2201, KCCC

TC 1.8 Research (10/15) Screen /Electric

Sun. (6/23) 11:00 am–12:00 pm 2201, KCCC

TC 1.9 Electrical Systems (8/4) Screen

Tues. (6/25) 3:30 pm–6:00 pm 2213, KCCC

TC 1.10 Combined Heat and Power Systems (20/8) Electric

Tues. (6/25) 2:30 pm–4:00 pm Jay McShann A (3), Marriott-West

TC 1.10 PMS for the Combustion Turbine Inlet Cooling Design Guide (5/10) Electric

Tues. (6/25) 12:30 pm–1:30 pm Jay McShann A (3), Marriott-West

TC1.10 Handbook, Program, Research, Membership (20/5) Electric

Tues. (6/25) 1:30 pm–2:30 pm Jay McShann A (3), Marriott-West

TC 1.11 Electric Motors and Motor Control (13/7) Screen

Tues. (6/25) 1:00 pm–3:30 pm 2213, KCCC

TC 1.12 Moisture Management in Buildings (30/20) Screen/ Electric

Sat. (6/22) 1:00 pm–3:00 pm 2210, KCCC

TC 1.12 Handbook, Research, Program, Standards (15/5) Screen/ Electric

Sat. (6/22) 8:00 am–12:00 pm 2210, KCCC

TC 1.12 PMS RP-1844 (6/0) Screen

Sat. (6/22) 9:00 am–10:30 am 2212, KCCC

TC 1.13 Optimization (20/5)

Sun. (6/23) 1:00 pm–3:00 pm Jay McShann A (3), Marriott-West

TC 2.1 Physiology and Human Environment (25/30) Electric

Tues. (6/25) 1:00 pm–4:00 pm Basie A (2), Marriott-West

TC 2.2 Plant and Animal Environment (10/5) Screen/Electric

Mon. (6/24) 4:15 pm–6:30 pm Eisenhower (L), Marriott-East

TC 2.3 Gaseous Air Contaminants /Removal Equip. (30/30) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2105, KCCC

TC 2.3 Research (20/15) Electric

Sun. (6/23) 5:00 pm–7:00 pm 2211, KCCC

TC 2.3 Standards (7/4) Electric

Mon. (6/24) 2:15 pm–3:00 pm 2211, KCCC

TC 2.3 Handbook (8/3) Electric

Mon. (6/24) 4:30 pm–6:00 pm 2212, KCCC

TC 2.3 Planning (15/3) Electric

Tues. (6/25) 6:30 am–8:00 am 2208, KCCC

TC 2.3 Programs (10/5) Electric

Tues. (6/25) 12:00 pm–12:45 pm 2208, KCCC

TC 2.4 Particulate Air Contaminants / Removal Equipment (18/50) Screen/Electric

Tues. (6/25) 3:30 pm–6:00 pm 2105, KCCC

TC 2.4 Handbook (18/0) Screen/Electric

Sat. (6/22) 12:30 pm–1:30 pm 2213, KCCC

TC 2.4 1649-RP PMS (5/25) Screen/Electric

Sat. (6/22) 1:30 pm–2:30 pm 2213, KCCC

TC 2.4 1784-RP PMS (18/25) Screen/Electric

Sun. (6/23) 9:00 am–10:00 am 2211, KCCC

TC 2.4 1734-RP PMS (18/25) Screen/Electric

Sun. (6/23) 12:30 pm–1:30 pm 2211, KCCC

TC 2.4 1756-RP PMS (18/25) Screen/Electric

Sun. (6/23) 1:45 pm–2:45 pm 2211, KCCC

TC 2.4 Research (18/30) Screen/Electric

Sun. (6/23) 3:00 pm–5:00 pm 2211, KCCC

TC 2.4 Program (18/25) Screen/Electric

Mon. (6/24) 3:15 pm–4:15 pm 2211, KCCC

TC 2.4 Standards (18/25) Screen/Electric

Mon. (6/24) 4:15 pm–5:15 pm 2211, KCCC

TC 2.4 Planning (18/30) Screen/Electric

Tues. (6/25) 8:00 am–10:00 am 2208, KCCC

TC 2.5 Global Climate Change (20/10) Screen

Tues. (6/25) 1:30 pm–3:30 pm Jay McShann B (3), Marriott-West

TC 2.5 Climate Change Chapter (25/25) Electric

Mon. (6/24) 4:00 pm–6:00 pm 2101, KCCC

TC 2.5 Research and Programs (15/10)

Mon. (6/24) 6:00 pm–7:00 pm 2101, KCCC

TC 2.6 Sound and Vibration (20/30) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2210, KCCC

TC 2.6 Vibration Isolation (25/10) Screen/Electric

Sun. (6/23) 8:00 am–9:00 am 2210, KCCC

TC 2.6 Publications (20/10) Screen/Electric

Sun. (6/23) 9:00 am–10:00 am 2210, KCCC

TC 2.6 Research (25/10) Screen/Electric

Sun. (6/23) 10:00 am–11:00 am 2210, KCCC

TC 2.6 Hot Topic: Blocked Impedance (Vibration Isolation),

Structure Impedance, & Source Vibration (30/10) Screen/Electric

Sun. (6/23) 11:00 am–12:00 pm 2210, KCCC

TC 2.6 Standards (20/10) Screen/Electric

Sun. (6/23) 1:00 pm–2:00 pm 2210, KCCC

TC 2.6 Hot Topic: Acoustic Sections from ANSI S12.60 & FGI

Standards in 189.1 (30/10) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm 2210, KCCC

TC 2.6 Programs (15/10) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm 2210, KCCC

TC 2.6 PMS Meeting for RP 1701 Tone Research Project (10/0)
Screen/Electric

Sun. (6/23) 4:00 pm–5:00 pm 2210, KCCC

TC 2.6 Executive Committee (8/0) Screen/Electric

Sun. (6/23) 5:00 pm–6:00 pm 2210, KCCC

TC 2.7 Seismic, Wind and Flood Resistant Design (17/24) Screen

Tues. (6/25) 3:30 pm–6:00 pm 2202, KCCC

TC 2.7 Flood Resistance Design (15/0)

Tues. (6/25) 10:00 am–12:00 pm 2202, KCCC

TC 2.7 Handbook (20/10)

Tues. (6/25) 1:15 pm–1:45 pm 2202, KCCC

TC 2.7 Research (20/10)

Tues. (6/25) 1:45 pm–2:30 pm 2202, KCCC

TC 2.7 Programs (20/10)

Tues. (6/25) 2:30 pm–3:15 pm 2202, KCCC

TC 2.8 Building Environmental Impacts and Sustainability (30/20) Screen/Electric

Sun. (6/23) 5:30 pm–7:00 pm 2214, KCCC

TC 2.8 Green Guide (10/10) Screen/Electric

Sun. (6/23) 11:00 am–11:30 pm 2211, KCCC

TC 2.8 Water–Energy Nexus (10/10) Screen/Electric

Sun. (6/23) 1:00 pm–2:00 pm 2213, KCCC

TC 2.8 Existing and Future Building Challenges (10/10) Screen/
Electric

Sun. (6/23) 2:00 pm–2:30 pm 2213, KCCC

TC 2.8 International (10/10) Screen/Electric

Sun. (6/23) 2:30 pm–3:00 pm 2213, KCCC

TC 2.8 Research (10/10) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm 2213, KCCC

TC 2.8 Programs (10/10) Screen/Electric

Sun. (6/23) 4:00 pm–4:30 pm 2213, KCCC

TC 2.8 Handbook (10/10) Screen/Electric

Sun. (6/23) 4:30 pm–5:00 pm 2213, KCCC

TC 2.9 Ultraviolet Air and Surface Treatment (20/10) Screen

Mon. (6/24) 10:00 am–12:00 pm 2202, KCCC

TC 2.9 Programs (10/10)

Sun. (6/23) 8:00 am–10:00 am 2212, KCCC

TC 2.9 Handbook (10/10)

Sun. (6/23) 10:00 am–12:00 pm 2212, KCCC

TC 2.9 Standards (10/10)

Sun. (6/23) 1:00 pm–3:00 pm 2212, KCCC

TC 2.9 Research (15/10)

Mon. (6/24) 8:00 am–10:00 am 2202, KCCC

TC 2.10 Resilience and Security (20/40) Electric

Tues. (6/25) 11:00 am–12:00 pm 2207, KCCC

TC 2.10 Standards (20/40) Electric

Tues. (6/25) 9:00 am–10:00 am 2207, KCCC

TC 2.10 Handbook (20/40) Electric

Tues. (6/25) 10:00 am–11:00 am 2207, KCCC

TC 3.1 Refrigerants and Secondary Coolants (10/30) Screen/ Electric

Mon. (6/24) 4:15 pm–6:30 pm 2102B, KCCC

TC 3.1 Research (combined with 3.2, 3.3, 3.4, 3.8 Research)
(20/40) Screen/Electric

Sun. (6/23) 4:00 pm–6:00 pm 2104B, KCCC

TC 3.1 Program (Combined with 3.2, 3.3, 3.4 and 3.8 Program)

(15/40) Screen/Electric

Mon. (6/24) 10:30 am–12:00 pm 2215A, KCCC

TC 3.1 Handbook (5/0) Screen/Electric

Tues. (6/25) 10:00 am–11:00 am 2212, KCCC

TC 3.2 Refrigerant System Chemistry (12/40) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2215A, KCCC

TC 3.2 Research (combined with 3.1, 3.3, 3.4, 3.8 Research)

(15/40) Screen/Electric

Sun. (6/23) 3:00 pm–6:00 pm 2104B, KCCC

TC 3.2 Program (Combined with 3.1, 3.3, 3.4 and 3.8 Program)

(15/40) Screen/Electric

Mon. (6/24) 10:30 am–12:00 pm 2215A, KCCC

TC 3.3 Refrigerant Contaminant Control (14/25) Screen

Tues. (6/25) 3:30 pm–6:00 pm 2201, KCCC

TC 3.3 Research (combined with 3.1, 3.2, 3.4, 3.8 Research)

(15/40) Screen/Electric

Sun. (6/23) 3:00 pm–6:00 pm 2104B, KCCC

TC 3.3 Program (Combined with 3.1, 3.2, 3.4 and 3.8 Program)

(15/40) Screen/Electric

Mon. (6/24) 10:30 am–12:00 pm 2215A, KCCC

TC 3.4 Lubrication (20/40) Screen

Tues. (6/25) 1:30 pm–3:30 pm 2215A, KCCC

TC 3.4 Research (combined with 3.1, 3.2, 3.3, 3.8 Research)

(15/40) Screen/Electric

Sun. (6/23) 3:00 pm–6:00 pm 2104B, KCCC

TC 3.4 Program (Combined with 3.1, 3.2, 3.3 and 3.8 Program)

(15/40) Screen/Electric

Mon. (6/24) 10:30 am–12:00 pm 2215A, KCCC

TC 3.6 Water Treatment (18/10) Screen

Tues. (6/25) 1:00 pm–3:30 pm Big Joe Turner B (3), Marriott-West

TC 3.6 Handbook/Program/Research (20/5) Screen /Electric

Sun. (6/23) 3:00 pm–5:00 pm Truman B (L), Marriott-East

TC 3.8 Refrigerant Containment (9/5) Screen

Mon. (6/24) 4:15 pm–6:30 pm 2213, KCCC

TC 3.8 Research (combined with 3.1, 3.2, 3.3, 3.4 Research)

(15/40) Screen/Electric

Sun. (6/23) 3:00 pm–6:00 pm 2104B, KCCC

TC 3.8 Program (Combined with 3.1, 3.2, 3.3 and 3.4 Program)

(15/40) Screen/Electric

Mon. (6/24) 10:30 am–12:00 pm 2215A, KCCC

TC 4.1 Load Calculation Data and Procedures (20/10) Screen

Mon. (6/24) 2:15 pm–4:15 pm Lester Young A (3), Marriott-West

TC 4.1 RP-1729 PMS (8/5) Screen/Electric

Sun. (6/23) 8:00 am–9:00 am 2213, KCCC

TC 4.1 Handbook (15/10) Electric

Sun. (6/23) 3:00 pm–4:00 pm 2102B, KCCC

TC 4.1 Research (15/10) Electric

Sun. (6/23) 4:00 pm–5:00 pm 2102B, KCCC

TC 4.1 Programs (15/10) Electric

Sun. (6/23) 5:00 pm–6:00 pm 2102B, KCCC

TC 4.1 Standards (15/10) Electric

Sun. (6/23) 6:00 pm–7:00 pm 2102B, KCCC

TC 4.2 Climatic Information (20/10) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2201, KCCC

TC 4.2 RP-1847 PMS (8/4) Screen/Electric

Sun. (6/23) 1:00 pm–2:00 pm Lester Young B (3), Marriott-West

TC 4.2 Program (8/2) Electric

Sun. (6/23) 2:00 pm–2:30 pm Lester Young B (3), Marriott-West

TC 4.2 Handbook (8/2) Screen/Electric

Sun. (6/23) 2:30 pm–3:30 pm Lester Young B (3), Marriott-West

TC 4.2 Research (10/5)

Mon. (6/24) 4:15 pm–6:30 pm Nixon (L), Marriott-East

TC 4.3 Ventilation Requirements and Infiltration (10/20)

Mon. (6/24) 4:15 pm–6:30 pm Jay McShann B (3), Marriott-West

TC 4.3 RP-1823 Improved Exhaust-to-Intake Dilution Calculations

PMS Meeting (4/8) Screen

Mon. (6/24) 6:30 pm–7:30 pm Jay McShann B (3), Marriott-West

TC 4.4 Building Materials and Building Envelope Performance (40/10) Screen /Electric

Mon. (6/24) 2:15 pm–4:15 pm Colonial (L), Marriott-East

TC 4.4 PMS 1696-RP (20/10) Screen/Electric

Sun. (6/23) 10:00 am–11:30 am 2215B, KCCC

TC 4.4 PMS 1759-TRP (20/10) Screen/Electric

Sun. (6/23) 11:30 am–1:00 pm 2215B, KCCC

TC 4.4 Program (40/10) Screen/Electric

Sun. (6/23) 1:00 pm–2:30 pm 2215B, KCCC

TC 4.4 Handbook (40/10) Screen/Electric

Sun. (6/23) 2:30 pm–3:30 pm 2215B, KCCC

TC 4.4 Research (40/10) Screen/Electric

Sun. (6/23) 3:30 pm–5:00 pm 2215B, KCCC

TC 4.4 Standards (40/10) Screen/Electric

Sun. (6/23) 5:00 pm–5:30 pm 2215B, KCCC

TC 4.5 Fenestration (10/8)

Tues. (6/25) 2:00 pm–4:00 pm Eisenhower (L), Marriott-East

TC 4.5 Research (10/5) Screen/Electric

Mon. (6/24) 4:30 pm–5:15 pm Lester Young A (3), Marriott-West

TC 4.5 Program (10/5) Screen/Electric

Mon. (6/24) 5:15 pm–6:00 pm Lester Young A (3), Marriott-West

TC 4.5 Calculation Methods (10/5) Screen/Electric

Mon. (6/24) 6:00 pm–7:00 pm Lester Young A (3), Marriott-West

TC 4.5 Handbook (10/5) Screen/Electric

Mon. (6/24) 7:00 pm–8:00 pm Lester Young A (3), Marriott-West

TC 4.7 Energy Calculations (60/20) Electric

Tues. (6/25) 6:00 pm–8:30 pm 2215A, KCCC

TC 4.7 Simulation and Component Models (25/5) Electric

Mon. (6/24) 6:00 pm–7:30 pm 2211, KCCC

TC 4.7 Data-Driven Models (25/5) Electric

Mon. (6/24) 7:30 pm–9:00 pm 2211, KCCC

TC 4.7 Multi-scale Building Energy Modeling (25/5) Electric

Tues. (6/25) 3:30 pm–5:00 pm 2215A, KCCC

TC 4.7 Handbook (15/5) Electric

Tues. (6/25) 5:00 pm–6:00 pm 2215A, KCCC

TC 4.10 Indoor Environmental Modeling (30/15) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm Trianon C (T), Marriott-East

TC 4.10 RP-1675 PMS (5/10) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm Lester Young A (3), Marriott-West

TC 4.10 Program (20/10) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm Lester Young A (3), Marriott-West

TC 4.10 Handbook (20/10) Screen/Electric

Sun. (6/23) 4:00 pm–5:00 pm Lester Young A (3), Marriott-West

TC 4.10 Research (20/10) Screen/Electric

Sun. (6/23) 5:00 pm–6:00 pm Lester Young A (3), Marriott-West

TC 5.1 Fans (20/20) Screen

Mon. (6/24) 4:15 pm–6:30 pm 2215B, KCCC

TC 5.1 Handbook (16/15) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm Julia Lee A (3), Marriott-West

TC 5.1 Research (16/15) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm Julia Lee A (3), Marriott-West

TC 5.1 Program (16/15) Screen/Electric

Sun. (6/23) 4:00 pm–4:30 pm Julia Lee A (3), Marriott-West

TC 5.1 Hot Topics (16/15) Screen/Electric

Sun. (6/23) 4:30 pm–6:00 pm Julia Lee A (3), Marriott-West

TC 5.2 Duct Design (12/20) Screen

Tues. (6/25) 3:30 pm–6:00 pm 2214, KCCC

TC 5.2 Duct Design Guide Subcommittee (25/10) Screen/Electric

Mon. (6/24) 8:00 am–12:00 pm 2215C, KCCC

TC 5.2 Duct Design Guide: Final Chapter Review

Sun. 6/23 2:00 pm–4:00 pm Mary Lou Williams B (3), Marriott-West

TC 5.3 Room Air Distribution (30/30) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2103C, KCCC

TC 5.3 Handbook (20/10) Screen/Electric

Fri. (6/21) 12:00 pm–5:00 pm Big Joe Turner B (3), Marriott-West

TC 5.3 Handbook (20/10) Screen/Electric

Sat. (6/22) 8:00 am–3:00 pm 2208, KCCC

TC 5.3 1741-RP Understanding Fan Coil Components and How They relate to Energy Consumption And Energy Modeling (5/10) Screen/Electric

Sat. (6/22) 12:00 pm–1:30 pm 2212, KCCC

TC 5.3 Research (25/10) Screen/Electric

Sun. (6/23) 8:00 am–10:00 am 2202, KCCC

TC 5.3 Programs (25/10) Screen/Electric

Sun. (6/23) 10:00 am–12:00 pm 2202, KCCC

TC 5.4 Industrial Process Air Cleaning (Air Pollution Control) (11/6)

Mon. (6/24) 2:15 pm–4:15 pm 2212, KCCC

TC 5.5 Air-to-Air Energy Recovery (30/10) Screen

Tues. (6/25) 1:00 pm–3:30 pm 2207, KCCC

TC 5.5 Handbook, Program, Research (8/4) Screen/Electric

Mon. (6/24) 4:15 pm–6:30 pm 2210, KCCC

TC 5.6 Control of Fire and Smoke (23/30) Screen

Mon. (6/24) 4:15 pm–6:30 pm Trianon C (T), Marriott-East

TC 5.6 Program/Research/Handbook (20/10)

Sun. (6/23) 3:00 pm–6:30 pm Jay McShann B (3), Marriott-West

TC 5.7 Evaporative Cooling (20/10)

Mon. (6/24) 4:15 pm–6:30 pm 2215A, KCCC

TC 5.9 Enclosed Vehicular Facilities (30/10) Screen

Tues. (6/25) 3:30 pm–6:00 pm Truman B (L), Marriott-East

TC 5.9 Program, Research, Handbook, Standards (15/7) Screen/Electric

Tues. (6/25) 2:00 pm–3:30 pm Truman B (L), Marriott-East

TC 5.10 Kitchen Ventilation (20/15) Screen

Mon. (6/24) 6:30 pm–7:30 pm Julia Lee B (3), Marriott-West

TC 5.10 PMS 1778 (5/10) Screen /Electric

Sun. (6/23) 3:00 pm–4:00 pm Nixon (L), Marriott-East

TC 5.10 PMS 1614 (5/10) Screen /Electric

Sun. (6/23) 4:00 pm–5:00 pm Nixon (L), Marriott-East

TC 5.10 Handbook (20/10) Screen /Electric

Mon. (6/24) 2:00 pm–3:30 pm Julia Lee B (3), Marriott-West

TC 5.10 Program (20/10) Screen/Electric

Mon. (6/24) 3:30 pm–4:30 pm Julia Lee B (3), Marriott-West

TC 5.10 Research (20/10) Screen/Electric

Mon. (6/24) 4:30 pm–6:30 pm Julia Lee B (3), Marriott-West

TC 5.11 Humidifying Equipment (10/8) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2104A, KCCC

TC 5.11 Research/Handbook (10/8) Screen/Electric

Sun. (6/23) 3:00 pm–5:00 pm 2208, KCCC

TC 6.1 Hydronic and Steam Equipment and Systems (20/25) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2214, KCCC

TC 6.1 Handbook & Chilled Water Plant (20/7) Screen/Electric

Mon. (6/24) 2:15 pm–3:15 pm 2102B, KCCC

TC 6.1 Program & Research (20/7) Screen /Electric

Mon. (6/24) 3:15 pm–4:15 pm 2102B, KCCC

TC 6.2 District Energy (15/50) Screen/Electric

Sun. (6/23) 3:00 pm–5:00 pm 2215C, KCCC

TC 6.2 Programs, Research, Handbook (15/50) Screen/Electric

Sun. (6/23) 1:00 pm–3:00 pm 2215C, KCCC

TC 6.3 Central Forced Air Heating and Cooling Systems (20/12) Screen

Tues. (6/25) 1:00 pm–3:30 pm Lester Young B (3), Marriott-West

TC 6.5 Radiant Heating and Cooling (25/25) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2201, KCCC

TC 6.5 Handbook, Research and Programs (25/25) Screen/Electric

Sun. (6/23) 3:00 pm–6:00 pm Basie A1 (2), Marriott-West

TC 6.6 Service Water Heating Systems (20/30)

Mon. (6/24) 4:15 pm–6:30 pm 2214, KCCC

TC 6.6 Research, Handbook, and Program (20/30)

Mon. (6/24) 2:15 pm–4:15 pm 2214, KCCC

TC 6.7 Solar and Other Renewable Energies (20/55) Screen

Tues. (6/25) 1:00 pm–3:30 pm 2104B, KCCC

TC 6.7 Research, Standards, Programs and Handbook (50/20) Electric

Mon. (6/24) 4:15 pm–8:30 pm Trianon D (T), Marriott-East

TC 6.8 Geothermal Heat Pump and Energy Recovery Applications (16/25) Screen/Electric

Tues. (6/25) 3:30 pm–6:00 pm 2102B, KCCC

TC 6.8 Programs (12/5) Electric

Sun. (6/23) 5:00 pm–6:00 pm Mary Lou Williams A (3), Marriott-West

TC 6.8 Research (16/10) Electric

Mon. (6/24) 4:15 pm–5:45 pm Mary Lou Williams A (3), Marriott-West

TC 6.8 Energy Recovery Applications (12/5) Electric

Tues. (6/25) 8:00 am–9:00 am Mary Lou Williams A (3), Marriott-West

TC 6.9 Thermal Storage (14/25) Screen/Electric

Mon. (6/24) 4:30 pm–6:00 pm 2207, KCCC

TC 6.9 Standards/SPC 150, Programs, Handbook, LRP ad Website, Research (30/20) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2207, KCCC

TC 6.10 Fuels and Combustion (20/10) Screen

Tues. (6/25) 3:30 pm–6:00 pm 2208, KCCC

TC 6.10 Handbook, Research and Program (15/10) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm Basie A1 (2), Marriott-West

TC 7.1 Integrated Building Design (25/10)

Mon. (6/24) 8:15 am–10:30 am 2201, KCCC

TC 7.2 HVAC&R Construction and Design Build Technologies (10/5)

Sun. (6/23) 10:00 am–12:00 pm 2214, KCCC

TC 7.3 Operations and Maintenance Management (25/7) Electric

Tues. (6/25) 1:00 pm–3:30 pm 2210, KCCC

TC 7.3 Education & Training (10/5)

Sun. (6/23) 1:30 pm–3:00 pm Mary Lou Williams A (3), Marriott-West

TC 7.3 Standards (15/10)

Mon. (6/24) 2:15 pm–3:15 pm Hoover (L), Marriott-East

TC 7.3 Program (15/10)

Mon. (6/24) 3:15 pm–4:15 pm Hoover (L), Marriott-East

TC 7.3 Research (15/10)

Mon. (6/24) 4:15 pm–5:15 pm Hoover (L), Marriott-East

TC 7.3 Handbook (15/10)

Mon. (6/24) 5:15 pm–6:30 pm Hoover (L), Marriott-East

TC 7.3 RP-1650 PMS (6/4)

Tues. (6/25) 8:00 am–9:00 am 2212, KCCC

TC 7.4 Exergy Analysis for Sustainable Buildings (14/8)

Sun. (6/23) 8:00 am–10:00 am 2208, KCCC

TC 7.5 Smart Building Systems (20/50) Screen/Electric

Tues. (6/25) 3:30 pm–6:00 pm 2104A, KCCC

TC 7.5 Fault Detection and Diagnosis (20/30) Screen/Electric

Sun. (6/23) 2:30 pm–3:15 pm 2202, KCCC

TC 7.5 Enabling Technologies (20/30) Screen/Electric

Sun. (6/23) 3:15 pm–4:00 pm 2202, KCCC

TC 7.5 Smart Grid (20/30) Screen/Electric

Sun. (6/23) 4:00 pm–4:45 pm 2202, KCCC

TC 7.5 Handbook (10/20) Screen/Electric

Sun. (6/23) 4:45 pm–5:30 pm 2202, KCCC

TC 7.5 Program (10/20) Screen/Electric

Sun. (6/23) 5:30 pm–6:00 pm 2202, KCCC

TC 7.5 Buildings Operations Dynamics (20/30) Screen/Electric

Mon. (6/24) 4:15 pm–5:00 pm 2104A, KCCC

TC 7.5 Research (20/30) Screen/Electric

Mon. (6/24) 5:00 pm–6:00 pm 2104A, KCCC

TC 7.6 Building Energy Performance (25/20) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2209, KCCC

TC 7.6 Federal Buildings (12/3) Screen/Electric

Sat. (6/22) 9:00 am–3:00 pm 2209, KCCC

TC 7.6 Federal Buildings (12/3) Screen/Electric

Sun. (6/23) 9:00 am–12:00 pm 2209, KCCC

TC 7.6 Research (10/5) Screen/Electric

Sun. (6/23) 1:00 pm–2:00 pm 2209, KCCC

TC 7.6 Commercial Building Energy Audit (25/5) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm 2209, KCCC

TC 7.6 Handbook (15/3) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm 2209, KCCC

TC 7.6 Building Data Exchange (12/5) Screen/Electric

Mon. (6/24) 8:00 am–10:00 am 2209, KCCC

- TC 7.6 Monitoring and Energy Performance (12/25) Screen/Electric
 Mon. (6/24) 2:15 pm–4:15 pm 2209, KCCC
- TC 7.6 Energy Management (12/10) Screen/Electric
 Mon. (6/24) 4:15 pm–5:15 pm 2209, KCCC
- TC 7.6 Standards and Programs (10/3) Screen/Electric
 Mon. (6/24) 5:15 pm–6:15 pm 2209, KCCC
- TC 7.6 Executive (10/0) Screen/Electric
 Mon. (6/24) 6:15 pm–7:00 pm 2209, KCCC

TC 7.7 Testing and Balancing (20/30)

- Mon. (6/24) 2:15 pm–4:15 pm 2103C, KCCC
- TC 7.7 Program/Handbook/Research (8/3) Electric
 Sat. (6/22) 8:00 am–10:30 am 2213, KCCC

TC 7.8 Owning and Operating Costs (20/5) Electric

- Mon. (6/24) 2:15 pm–4:15 pm Lido (T), Marriott-East

TC 7.9 Building Commissioning (40/20) Screen/Electric

- Sun. (6/23) 3:00 pm–5:00 pm 2105, KCCC
- TC 7.9 Handbook, Programs, Research (10/10) Electric
 Sat. (6/22) 7:00 am–10:00 am Yard Bird B (2), Marriott-West

TC 8.1 Positive Displacement Compressors (12/22) Screen

- Tues. (6/25) 3:30 pm–6:00 pm 2209, KCCC
- TC 8.1 Research, Program, Handbook (10/5) Electric
 Sun. (6/23) 5:00 pm–6:00 pm Big Joe Turner A (3), TMarriott-West

TC 8.2 Centrifugal Machines (20/8)

- Mon. (6/24) 2:15 pm–4:15 pm Mary Lou Williams A (3), Marriott-West

TC 8.3 Absorption and Heat Operated Machines (20/10) Screen

- Mon. (6/24) 3:30 pm–6:00 pm Yard Bird B (2), Marriott-West
- TC 8.3 Research/Handbook (15/15) Electric
 Mon. (6/24) 2:15 pm–3:30 pm Yard Bird B (2), Marriott-West

TC 8.4 Air-to-Refrigerant Heat Transfer Equipment (20/10) Screen

- Tues. (6/25) 3:30 pm–6:00 pm 2207, KCCC
- TC 8.4 Research, Standards, Handbook (10/15) Screen
 Mon. (6/24) 6:30 pm–8:30 pm 2207, KCCC

TC 8.5 Liquid to Refrigerant Heat Exchangers (47/18) Screen

- Mon. (6/24) 4:15 pm–6:30 pm Colonial (L), Marriott-East
- TC 1.3/8.5 Research Subcommittee (20/20) Screen/Electric
 Sun. (6/23) 3:00 pm–7:00 pm 2207, KCCC
- TC 8.5 Handbook (6/6) Screen/Electric
 Sun. (6/23) 5:00 pm–6:30 pm 2213, KCCC

TC 8.6 Cooling Towers and Evaporative Condensers (20/5)

- Mon. (6/24) 2:15 pm–4:15 pm 2104B, KCCC

TC 8.7 Variable Refrigerant Flow (VRF) (25/50) Screen/Electric

- Mon. (6/24) 4:15 pm–6:30 pm 2104B, KCCC

TC 8.8 Refrigerant System Controls and Accessories (10/10) Screen/Electric

- Tues. (6/25) 1:00 pm–3:30 pm 2212, KCCC

TC 8.9 Residential Refrigerators and Food Freezers (6/10)

- Mon. (6/24) 2:15 pm–4:15 pm 2213, KCCC

TC 8.10 Mechanical Dehumidification and Heat Pipes (30/10)

- Tues. (6/25) 3:30 pm–5:00 pm Trianon E (T), Marriott East
- TC 8.10 Program/Handbook/Research/Standards (30/3) Electric
 Tues. (6/25) 1:00 pm–3:30 pm Trianon E (T), Marriott East

TC 8.11 Unitary and Room Air Conditioners and Heat Pumps (20/40)

Mon. (6/24) 4:15 pm–6:30 pm 2103C, KCCC

TC 8.11 PMS Meeting: RP-1721 Oil Return/Retention in Unitary Split System Gas Lines (6/15) Screen/Electric

Sun. (6/23) 2:00 pm–3:00 pm Basie C1 (2), Marriott-West

TC 8.11 Handbook, Program, Research (15/30) Screen/Electric

Sun. (6/23) 3:00 pm–6:30 pm Basie C1 (2), Marriott-West

TC 8.12 Desiccant Dehumidification Equipment and Components (15/15)

Mon. (6/24) 2:15 pm–4:15 pm Jay McShann B (3), Marriott-West

TC 9.1 Large Building Air-Conditioning Systems (14/10) Electric

Tues. (6/25) 1:30 pm–3:30 pm Hoover (L), Marriott-East

TC 9.1 Handbook, Program, Research (12/2) Electric

Tues. (6/25) 12:00 pm–1:30 pm Hoover (L), Marriott-East

TC 9.2 Industrial Air Conditioning (Combined with TC 5.8 Main) (45/15) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2215B, KCCC

TC 9.2 Nuclear (5/4) Electric

Mon. (6/24) 11:00 am–12:00 pm 2201, KCCC

TC 9.3 Transportation Air Conditioning (30/5) Screen/Electric

Mon. (6/24) 4:15 pm–6:30 pm 2208, KCCC

TC 9.3 Handbook Subcommittee (20/5) Screen/Electric

Mon. (6/24) 9:00 am–10:00 am 2208, KCCC

TC 9.3 Research Subcommittee (15/5) Screen/Electric

Mon. (6/24) 10:00 am–12:00 pm 2208, KCCC

TC 9.3 Rail/Mass Transit Subcommittee (30/5) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm 2208, KCCC

TC 9.4 Justice Facilities (20/5) Electric

Sun. (6/23) 3:00 pm–5:00 pm 2103C, KCCC

TC 9.6 Healthcare Facilities (20/100)

Sun. (6/23) 5:00 pm–7:00 pm 2105, KCCC

TC 9.6 Infectious Diseases (20/60) Electric

Sun. (6/23) 11:00 am–12:30 pm 2215A, KCCC

TC 9.6 Executive Committee (15/0) Screen/Electric

Sun. (6/23) 12:30 pm–1:30 pm 2215A, KCCC

TC 9.6 Research (20/45) Electric

Sun. (6/23) 1:30 pm–2:30 pm 2215A, KCCC

TC 9.6 Handbook (20/45) Electric

Sun. (6/23) 2:30 pm – 3:00 pm 2215A, KCCC

TC 9.6 Energy (20/45) Electric

Sun. (6/23) 3:00 pm– 3:45 pm 2215A, KCCC

TC 9.6 Program (20/45) Electric

Sun. (6/23) 3:45 pm–4:30 pm 2215A, KCCC

TC 9.7 Educational Facilities (15/15) Screen /Electric

Sun. (6/23) 1:00 pm–3:00 pm 2201, KCCC

TC 9.8 Large Building Air-Conditioning Applications (20/10)

Mon. (6/24) 2:15 pm–4:15 pm 2215B, KCCC

TC 9.8 Handbook/Programs/Research (15/5) Electric

Mon. (6/24) 9:00 am–11:00 am 2215B, KCCC

TC 9.8 Indoor Grow Facilities (30/20) Electric

Mon. (6/24) 11:00 am–12:00 pm 2215B, KCCC

TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment (25/75) Screen/Electric

Mon. (6/24) 2:15 pm–7:00 pm 2105, KCCC

TC 9.9 IT Equipment Manufacturers Subcommittee (12/0)

Mon. (6/24) 8:00 am–12:00 pm 2214, KCCC

TC 9.9 Programs, Handbook and Research (25/25) Screen/Electric

Sun. (6/23) 5:00 pm–7:00 pm 2215A, KCCC

TC 9.10 Laboratory Systems (20/40)

Tues. (6/25) 3:30 pm–5:30 pm 2215C, KCCC

TC 9.10 RP-1573 PMS Monitoring (20/10)

Sun. (6/23) 2:00 pm–3:00 pm 2214, KCCC

TC 9.10 Standards (20/10)

Sun. (6/23) 3:00 pm–3:30 pm 2214, KCCC

TC 9.10 Research (20/10)

Sun. (6/23) 3:30 pm–4:15 pm 2214, KCCC

TC 9.10 Program (20/10)

Sun. (6/23) 4:15 pm–5:00 pm 2214, KCCC

TC 9.10 Design Guide (20/10) Screen

Tues. (6/25) 2:30 pm–3:30 pm 2215C, KCCC

TC 9.11 Clean Spaces (30/45) Screen/Electric

Mon. (6/24) 3:00 pm–6:00 pm 2215C, KCCC

TC 9.11 Energy Efficiency (20/20) Screen/Electric

Sun. (6/23) 3:00 pm–4:00 pm 2201, KCCC

TC 9.11 Research (20/20) Screen/Electric

Sun. (6/23) 4:00 pm–5:00 pm 2201, KCCC

TC 9.12 Tall Buildings (12/8)

Sun. (6/23) 12:15 pm–2:00 pm Eisenhower (L), Marriott-East

TC 10.1 Custom Engineered Refrigeration Systems (30/10) Screen

Mon. (6/24) 2:00 pm–4:00 pm Roosevelt (L), Marriott-East

TC 10.2 Automatic Ice Making Plants and Skating Rinks (12/3) Screen/Electric

Mon. (6/24) 4:30 pm–6:30 pm Taft (L), Marriott-East

TC 10.3 Refrigerant Piping, Controls and Accessories (20/10) Screen

Tues. (6/25) 1:00 pm–3:30 pm Yard Bird A (2), Marriott West

TC 10.5 Refrigerated Processing and Storage (15/10)

Tues. (6/25) 3:30 pm–6:00 pm Jay McShann B (3), Marriott-West

TC 10.6 Transport Refrigeration (10/20) Electric

Mon. (6/24) 4:45 pm–7:00 pm 2201, KCCC

TC 10.7 Commercial Food and Beverage Refrigeration Equipment (30/40) Screen

Mon. (6/24) 2:15 pm–4:15 pm Bennie Moten (3), Marriott-West

TC 10.7 Program (10/10) Electric

Sun. (6/23) 5:15 pm–6:00 pm 2209, KCCC

TC 10.7 Research (10/10) Electric

Sun. (6/23) 6:00 pm–6:45 pm 2209, KCCC

TC 10.7 Handbook (10/10) Electric

Sun. (6/23) 6:45 pm–7:15 pm 2209, KCCC

TC 10.8 Refrigeration Load Calculations (10/10)

Sun. (6/23) 3:00 pm–5:00 pm Eisenhower (L), Marriott-East

TECHNICAL RESOURCE GROUPS (TRGs)

TRG4.IAQP – Indoor Air Quality Procedure (12/8) Screen/ Electric

Sun. (6/23) 10:30 am–12:00 pm 2213, KCCC

TRG9 Cold Climate Building Design Guide (20/0) Screen/ Electric

Wed. (6/26) 8:00 am–10:00 am Jay McShann A (3), Marriott-West

MULTIDISCIPLINARY TASK GROUPS (MTGs)

MTG.ACR Air Change Rate–Informal Meeting (25/0)

Mon. (6/24) 9:00 pm–10:00 pm Truman B (L), Marriott-East

MTG.BIM Building Information Modeling (20/0) Screen

Mon. (6/24) 10:15 am–12:00 pm 2213, KCCC

MTG.HWBE Health and Wellness in the Built Environment (20/10) Screen/Electric

Tues. (6/25) 12:00 pm–2:00 pm Julia Lee B (3), Marriott-West

MTG.IAST–Impact of ASHRAE Standards and Technology on Energy Savings/Performance (15/10) Electric

Sat. (6/22) 1:00 pm–2:30 am Taft (L), Marriott-East

MTG.LowGWP–Lower Global Warming Potential Alternative Refrigerants (25/36) Screen

Sun. (6/23) 5:00 pm–6:00 pm 2208, KCCC

Wed. (6/26) 10:00 am–12:00 pm 2202, KCCC

MTG.LowGWP Research Subcommittee (20/20) Screen/Electric

Sun. (6/23) 12:00 pm–2:00 pm 2208, KCCC

MTG.LowGWP Codes and Standards (20/15) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm 2208, KCCC

MTG.OBB–Occupant Behavior in Buildings (30/10) Screen

Mon. (6/24) 8:00 am–10:00 am 2215A, KCCC

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 Groups (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 conferences
- Reviewing papers for conferences
- Developing ASHRAE publications
- Evaluating the need for standards, and
- Advising the Society on all aspects of the technology it embraces

ASHRAE TCs and these other groups are comprised of volunteers who have a recognized proficiency in a specific field of interest. There are some active 100 TCs addressing all aspects of the HVAC&R and buildings industries.

APPLYING FOR MEMBERSHIP ON A TECHNICAL COMMITTEE

ASHRAE welcomes new members to its technical committees. You can join a technical committee by accessing our website at www.ashrae.org/joinatc. You will immediately be assigned as a Provisional Corresponding Member for a two-year term. And able to participate in committee activities. At the end of the term, you may be considered for a position that has voting membership.

ATTENDING TECHNICAL COMMITTEE MEETINGS

TC meetings take place at the Society's Winter and Annual Conferences, and they are open. Attend any meetings in which you have a technical interest. TC chairs welcome new attendees—a TC can never have too many willing and able volunteers.

See the listing of Technical Committee meetings in the Final Program, online or in the app.

Project Committees

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.

Abbreviations

SPC	Standard Project Committee
SSPC	Standing Standard Project Committee
GPC	Guideline Project Committee
SGPC	Standing Guideline Project Committee

STANDARD PROJECT COMMITTEES (SPCs) and STANDING STANDARD PROJECT COMMITTEES (SSPCs)

PC Chairs Training Breakfast (100/0) Screen

Sun. (6/23) 7:30 am–9:00 am Colonial (L), Marriott-East

SSPC 15 Safety Standard for Refrigeration Systems (25/60) Screen /Electric

Sun. (6/23) 1:00 pm–5:00 pm Basie C (2), Marriott-West

SSPC 15 Safety Standards for Refrigeration Systems Rewrite (25/60) Screen/Electric

Sat. (6/22) 1:00 pm–4:00 pm 2215A, KCCC

SSPC 15 Safety Standards for Refrigeration Systems Ad Hoc and Rewrite (25/60) Screen/Electric

Sun. (6/23) 9:00 am–12:00 pm Basie C (2), Marriott-West

SSPC 15 Subcommittee 15.2 Safety Standard for Refrigeration Systems in Residential Applications (20/30) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Truman B (L), Marriott-East

SPC 17 Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (5/3) Electric

Sun. (6/23) 5:00 pm–7:00 pm Kennedy (L), Marriott-East

SPC 23.2 Methods of Test for Rating the Performance of Positive Displacement Compressors that Operate at Supercritical Pressures of the Refrigerants (7/2)

Mon. (6/24) 10:00 am–12:00 pm 2210, KCCC

SPC 24 Methods of Testing for Rating Evaporators Used for Cooling Liquids (6/10) Screen/Electric

Mon. (6/24) 8:00 am–10:00 am Burgundy (T), Marriott-East

SPC 26 Mechanical Refrigeration & Air-Conditioning Installation Aboard Ship (4/2) Screen /Electric

Tues. (6/25) 8:00 am–12:00 pm Big Joe Turner A (3), Marriott-West

SPC 28 MOT Flow Capacity of Refrigerant Capillary Tubes (5/5) Electric

Sun. (6/23) 5:00 pm–7:00 pm Kennedy (L), Marriott-East

SSPC 30 Method of Testing Liquid Chilling Packages (7/7) Screen/Electric

Mon. (6/24) 7:00 am–10:00 am Yard Bird A (2), Marriott-West

SSPC 34 Designation and Safety Classification of Refrigerants (20/50) Screen /Electric

Mon. (6/24) 6:30 pm–10:00 pm 2102B, KCCC

SSPC 34 Designation and Nomenclature Subcommittee (12/35) Screen /Electric

Sat. (6/22) 7:00 am–10:00 am Trianon E (T), Marriott-East

SSPC 34 Flammability Subcommittee (16/35) Screen/Electric

Sat. (6/22) 10:00 am–3:00 pm Trianon E (T), Marriott-East

SSPC 34 Toxicity Subcommittee (10/30) Screen/Electric

Sun. (6/23) 6:30 pm–10:00 pm Bennie Moten (3), Marriott-West

SPC 35-2014 Method of Testing Desiccants for Refrigerant Drying (6/5) Screen/Electric

Tues. (6/25) 10:00 am–11:00 am Wilson (L), Marriott-East

SPC 37 MOT for Rating Electrically Driven Unitary Air-Conditioners and Heat Pump Equipment (22/18) Screen/ Electric

Wed. (6/26) 8:00 am–12:00 pm Truman A (L), Marriott-East

SSPC 41 Standard Methods for Measurement (21/10) Electric

Sun. (6/23) 1:00 pm–3:00 pm Truman B (L), Marriott-East

41.3 Subcommittee, Standard Methods for Pressure Measurement (15/5) Screen/Electric

Sun. (6/23) 10:00 am–12:00 pm Truman B (L), Marriott-East

41.13 Subcommittee (10/10) Screen/Electric

Mon. (6/24) 8:00 am–10:00 am Mary Lou Williams B (3), Marriott-West

41.6 Subcommittee, Standard Methods for Humidity Measurement (15/8) Screen/Electric

Mon. (6/24) 10:00 am–12:00 pm Mary Lou Williams B (3), Marriott-West

41.11 Subcommittee, Standard Methods for Power Measurement (15/5) Screen/Electric

Mon. (6/24) 2:15 pm–4:15 pm Mary Lou Williams B (3), Marriott-West

41.4 Subcommittee, Standard Methods for Proportion of Lubricant in Liquid Refrigerant Measurement (7/4) Screen/Electric

Mon. (6/24) 4:15 pm–6:15 pm Mary Lou Williams B (3), Marriott-West

41.10 Subcommittee, Standard Methods for Refrigerant Mass Flow Measurement Using Flowmeters (15/10) Screen/Electric

Tues. (6/25) 8:00 am–10:00 am Julia Lee B (3), Marriott-West

41.1 Subcommittee, Standard Methods for Temperature Measurement (15/10) Screen/Electric

Tues. (6/25) 10:00 am–12:00 pm Julia Lee B (3), Marriott-West

SSPC 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size (20/35) Screen/Electric

Sat. (6/22) 8:00 am–11:00 am Trianon C (T), Marriott-East

SSPC 55 Thermal Environmental Conditions for Human Occupancy (15/6) Screen/Electric

Sat. (6/22) 8:30 am–3:00 pm Nixon (L), Marriott-East

Sun. (6/23) 9:00 am–12:00 pm Hoover (L), Marriott-East

SSPC 62.1 Ventilation for Acceptable Indoor Air Quality (30/30) Screen/Electric

Sat. (6/22) 8:00 am–12:00 pm Basie A (2), Marriott-West

Sun. (6/23) 1:00 pm–7:00 pm Basie A (2), Marriott-West

SSPC 62.1 IAQ Guideline Subcommittee (15/15) Screen/Electric

Fri. (6/21) 8:00 am–12:00 pm Basie A1 (2), Marriott-West

SSPC 62.1 Administration Subcommittee (15/15) Screen/Electric

Fri. (6/21) 1:00 pm–5:00 pm Basie A (2), Marriott-West

Sat. (6/22) 1:00 pm–3:00 pm Basie A (2), Marriott-West

SSPC 62.1 Research and Education Subcommittee (15/15) Screen/Electric

Fri. (6/21) 1:00 pm–5:00 pm Basie A1 (2), Marriott-West

Sat. (6/22) 1:00 pm–3:00 pm Basie A1 (2), Marriott-West

SSPC 62.1 Buildings, Systems and Equipment (15/15) Screen/Electric

Fri. (6/21) 1:00 pm–5:00 pm Basie C (2), Marriott-West

Sat. (6/22) 1:00 pm–3:00 pm Yard Bird A (2), Marriott-West

SSPC 62.1 Ventilation Subcommittee (15/15) Screen/Electric

Fri. (6/21) 1:00 pm–5:00 pm Basie C1 (2), Marriott-West

Sat. (6/22) 1:00 pm–3:00 pm Basie C1 (2), Marriott-West

SSPC 62.2 Ventilation and Acceptable IAQ in Residential Buildings (40/30) Screen/Electric

Fri. (6/21) 9:00 am–2:30 pm Trianon A (T), Marriott-East

Sat. (6/22) 8:00 am–3:00 pm Colonial (L), Marriott-East

SSPC 62.2 Envelope Subcommittee (20/20) Screen/Electric

Fri. (6/21) 2:30 pm–5:00 pm Trianon A (T), Marriott-East

SSPC 62.2 IAQ Subcommittee (20/20) Screen/Electric

Fri. (6/21) 2:30 pm–5:00 pm Trianon E (T), Marriott-East

SSPC 62.2 System Subcommittee (20/20) Screen/Electric

Fri. (6/21) 2:30 pm–5:00 pm Burgundy (T), Marriott-East

SPC 63.1 Method of Testing Liquid-Line Refrigerant Driers (4/4)

Tues. (6/25) 10:00 am–11:00 am Burgundy (T), Marriott-East

SPC 70 Method of Testing for Rating the Performance of Air Outlets and Air Inlets (11/10) Screen

Mon. (6/24) 8:00 am–10:00 am Mary Lou Williams A (3), Marriott-West

SSPC 72 Method of Testing Open and Closed Commercial Refrigerators and Freezers (24/20) Screen /Electric

Sun. (6/23) 1:00 pm–5:00 pm Roosevelt (L), Marriott-East

SPC 84 Method of Testing Air-to-Air Heat/Energy Exchangers (12/6) Screen/Electric

Mon. (6/24) 2:15 pm–6:15 pm Wilson (L), Marriott-East

SSPC 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings (50/60) Screen/Electric

Sat. (6/22) 8:00 am–12:00 pm Trianon AB (T), Marriott-East

Sun. (6/23) 9:00 am–12:00 pm Trianon AB (T), Marriott-East

Mon. (6/24) 8:00 am–12:00 pm Trianon AB (T), Marriott-East

SSPC 90.1 Envelope Subcommittee (20/30) Screen/Electric

Fri. (6/21) 9:00 am–8:00 pm Trianon D (T), Marriott-East

Sat. (6/22) 1:00 pm–8:00 pm Trianon D (T), Marriott-East

Sun. (6/23) 1:00 pm–8:00 pm Trianon D (T), Marriott-East

SSPC 90.1 Lighting Subcommittee (16/10) Screen/Electric

Fri. (6/21) 9:00 am–10:00 pm Trianon C (T), Marriott-East

Sat. (6/22) 1:00 pm–7:00 pm Trianon C (T), Marriott-East

Sun. (6/23) 1:00 pm–8:00 pm Trianon C (T), Marriott-East

SSPC 90.1 Mechanical Subcommittee (25/25) Screen/Electric

Fri. (6/21) 9:00 am–8:00 pm Trianon B (T), Marriott-East

Sat. (6/22) 1:00 pm–7:00 pm Trianon AB (T), Marriott-East

Sun. (6/23) 1:00 pm–8:00 pm Trianon AB (T), Marriott-East

SSPC 90.1 ECB Subcommittee (12/18) Screen/Electric

Fri. (6/21) 4:00 pm–9:00 pm Lido (T), Marriott-East

Sat. (6/22) 1:00 pm–5:00 pm Lido (T), Marriott-East

Sun. (6/23) 1:00 pm–6:00 pm Lido (T), Marriott-East

SSPC 90.1 Envelope Subcommittee Working Group (15/30) Screen /Electric

Fri. (6/21) 5:00 pm–7:00 pm Trianon A (T), Marriott-East

SSPC 90.1 Format & Compliance Subcommittee (6/6) Screen/Electric

Fri. (6/21) 5:00 pm–10:00 pm Burgundy (T), Marriott-East

Sat. (6/22) 1:00 pm–5:00 pm Burgundy (T), Marriott-East

Sun. (6/23) 4:00 pm–7:00 pm Trianon E (T), Marriott-East

SSPC 90.1 Envelope Subcommittee Working Group (15/30) Screen/Electric

Sat. (6/22) 4:00 pm–6:00 pm Trianon E (T), Marriott-East

SSPC 90.1 Renewable Energy Working Group (10/10)

Sun. (6/23) 3:00 pm–5:00 pm Burgundy (T), Marriott-East

SSPC 90.2 Energy-Efficient Design of Low-Rise Residential Buildings (20/15) Screen/Electric

Mon. (6/24) 2:15 pm–6:15 pm Truman A (L), Marriott-East

Tues. (6/25) 1:00 pm–5:00 pm Truman A (L), Marriott-East

SSPC 90.2 Envelope (10/10) Screen/Electric

Mon. (6/24) 6:30 pm–9:30 pm Truman A (L), Marriott-East

Tues. (6/25) 8:00 am–12:00 pm Truman A (L), Marriott-East

SSPC 90.2 Lighting (3/5) Electric

Mon. (6/24) 6:30 pm–9:30 pm Kennedy (L), Marriott-East

Tues. (6/25) 8:00 am–12:00 pm Kennedy (L), Marriott-East

SSPC 90.2 Mechanical (5/10) Screen/Electric

Mon. (6/24) 6:30 pm–9:30 pm Taft (L), Marriott-East

Tues. (6/25) 8:00 am–12:00 pm Taft (L), Marriott-East

SPC 90.4 Energy Standard for Data Centers (20/10) Screen/Electric

Sat. (6/22) 8:00 am–12:00 pm Lido (T), Marriott-East

Mon. (6/24) 8:00 am–12:00 pm Lido (T), Marriott-East

SPC 97 Sealed Glass Tube Method to Test the Chemical Stability of Materials for Use Within Refrigerant Systems (8/8) Screen/Electric

Tues. (6/25) 9:30 am–12:00 pm Lester Young B (3), Marriott-West

SSPC 100 Energy Efficiency in Existing Buildings (20/10) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Mary Lou Williams B (3), Marriott-West
SSPC 100–Operation and Maintenance (WG3) (5/5) Screen/
Electric

Sun. (6/23) 8:00 am–10:00 am Mary Lou Williams B (3), Marriott-West

SSPC 100 Alternative to EUI (WG5) (16/10) Screen/Electric

Sun. (6/23) 12:00 pm–2:00 pm Mary Lou Williams B (3), Marriott-West

SSPC 100 International Target Table and Climate Zones (WG4)
(5/5) Screen/Electric

Sun. (6/23) 4:00 pm–6:00 pm Mary Lou Williams B (3), Marriott-West

SPC 105 Standard Methods of Determining Expressing and Comparing Building Energy Performance and Greenhouse Gas Emissions (12/25) Screen/Electric

Sun. (6/23) 5:00 pm–9:00 pm Truman B (L), Marriott-East

SPC 110 Method of Testing Performance of Laboratory Fume Hoods (20/10) Screen

Tues. (6/25) 1:30 pm–2:30 pm 2215C, KCCC

SPC 113 Method of Testing for Room Air Diffusion (10/10) Screen

Mon. (6/24) 2:00 pm–3:15 pm Julia Lee A (3), Marriott-West

SPC 118.2 Method of Testing for Rating Residential Water Heaters and Residential-Duty Commercial Water Heaters (20/10) Electric

Tues. (6/25) 1:00 pm–5:00 pm Mary Lou Williams A (3), Marriott-West

SPC 124 MOT/Rating Combinations Space-Heating and Water Heating Appliances (12/15) Electric

Tues. (6/25) 9:00 am–12:00 pm Yard Bird A (2), Marriott-West

**SPC 127 Method of Testing for Rating Air Conditioning Units Serving Data Center (DC) and Other Information Technology Equipment (ITE) Spaces (12/12) Screen/
Electric**

Tues. (6/25) 1:00 pm–5:00 pm Big Joe Turner A (3), Marriott-West

SPC 130–Laboratory Methods of Testing Air Terminal Units (5/20) Screen/Electric

Tues. (6/25) 8:00 am–10:00 am Lester Young A (3), Marriott-West

SSPC 135 BACnet (40/10) Electric and Working Groups (20/5) Electric

Thurs. (6/20) 8:00 am–5:00 pm Yard Bird A (2), Marriott-West

Fri. (6/21) 8:00 am–5:00 pm Yard Bird A (2), Marriott-West

Fri. (6/21) 8:00 am–5:00 pm Yard Bird B (2), Marriott-West

Sat. (6/22) 8:00 am–5:00 pm 2215B, KCCC

Sun. (6/23) 8:00 am–5:00 pm Yard Bird A (2), Marriott-West

Sun. (6/23) 8:00 am–5:00 pm Yard Bird B (2), Marriott-West

Mon. (6/24) 8:00 am–12:00 pm Basie A (2), Marriott-West

SSPC 140 Standard Method of Test for the Evaluation of Building Energy Computer Programs (15/15) Screen/Electric

Mon. (6/24) 2:15 pm–6:15 pm Basie C1 (2), Marriott-West

SSPC 145 Test Method for Assessing the Performance of Gas Phase Air Cleaning Equipment (10/15) Screen/Electric

Sun. (6/23) 12:00 pm–3:00 pm Hoover (L), Marriott-East

SPC 146 Method of Testing and Rating Pool Heaters (7/7) Electric

Tues. (6/25) 10:00 am–12:00 pm Mary Lou Williams A (3), Marriott-West

SSPC 147 Reducing the Release of Halogenated Refrigerants in Refrigeration And Air Conditioning Systems (6/5) Screen/Electric

Mon. (6/24) 8:00 am–12:00 pm Big Joe Turner A (3), Marriott-West

SPC 150-2000: Method of Testing for Performance of Cool Storage Systems (Combined with TC 6.9 Standards) (30/20) Screen/Electric

Mon. (6/24) 2:15 pm–2:40 pm 2207, KCCC

SPC 153 Method of Test for Mass Flow Capacity of Four-Way Refrigerant Reversing Valves (5/2) Electric

Mon. (6/24) 10:00 am–12:00 pm Taft (L), Marriott-East

SSPC 154 Ventilation for Commercial Cooking Operations (14/12) Screen/Electric

Sun. (6/23) 9:00 am–1:00 pm Taft (L), Marriott-East

SPC 155 Method of Testing for Rating Commercial Space Heating Boiler Systems (12/10) Screen/Electric

Sun. (6/23) 1:00 pm–5:00 pm Wilson (L), Marriott-East

SPC 164 Method of Test for Humidifiers (10/8) Screen/Electric

Mon. (6/24) 9:00 am–11:00 am Nixon (L), Marriott-East

SSPC 169 Climatic Data for Building Design Standards (10/2) Screen/Electric

Mon. (6/24) 10:00 am–12:00 pm Wilson (L), Marriott-East

SSPC 170 Ventilation of Health Care Facilities (33/40) Screen/Electric

Mon. (6/24) 4:00 pm–6:15 pm Trianon AB (T), Marriott-East

Tues. (6/25) 8:00 am–12:00 pm Trianon E (T), Marriott-East

SSPC 170 Ventilation of Health Care Facilities, Natural Ventilation Subcommittee (33/40) Screen/Electric

Mon. (6/24) 2:15 pm–4:00 pm Trianon AB (T), Marriott-East

SPC 182 Method of Testing Absorption Water-Chilling and Water-Heating Packages (5/5) Electric

Mon. (6/24) 10:00 am–12:00 pm Executive Boardroom (3), Marriott-West

SSPC 185 Methods of Test to Inactivate Microorganisms in HVAC Systems with UV-C Lights (10/10)

Sat. (6/22) 8:00 am–9:00 am Taft (L), Marriott-East

SSPC 188 Legionellosis: Risk Management for Building Water Systems (45/12) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Trianon D (T), Marriott-East

Tues. (6/25) 3:45 pm–5:30 pm Trianon D (T), Marriott-East

Wed. (6/26) 8:00 am–12:00 pm 2215A, KCCC

SSPC 189.1 ASHRAE/USGBC/IES Standard for the Design of High-Performance Green Buildings except Low-Rise Residential Buildings (45/50) Screen/Electric

Tues. (6/25) 8:00 am–10:00 am Trianon AB (T), Marriott-East

Wed. (6/26) 8:00 am–12:00 pm Basie A (2), Marriott-West

SSPC 189.1 Working Group 6 (Water Use) (20/20) Screen/Electric
 Tues. (6/25) 10:00 am–12:30 pm Trianon C (T), Marriott-East
 SSPC 189.1 Working Group 7 (Energy Efficiency) (30/30)
 Screen/Electric
 Tues. (6/25) 10:00 am–1:00 pm Trianon AB (T), Marriott-East
 SSPC 189.1 Working Group 9 (Materials and Resources) (20/20)
 Screen/Electric
 Tues. (6/25) 1:00 pm–3:00 pm Trianon C (T), Marriott-East
 SSPC 189.1 Working Group 7.5 (30/30) Screen/Electric
 Tues. (6/25) 1:30 pm–4:30 pm Trianon AB (T), Marriott-East
 SSPC 189.1 Working Group 8 (IEQ) (30/30) Screen/Electric
 Tues. (6/25) 2:30 pm–4:30 pm Lido (T), Marriott-East
 SSPC 189.1 Working Group 5 (Site Sustainability) (20/20)
 Screen/Electric
 Tues. (6/25) 4:00 pm–6:00 pm Trianon C (T), Marriott-East
 SSPC 189.1 Working Group 10 (20/20) Screen /Electric
 Tues. (6/25) 5:00 pm–7:00 pm Lido (T), Marriott-East

SSPC 189.3 Design, Construction and Operation of Sustainable, High-Performance Healthcare Facilities (20/20) Screen/Electric

Mon. (6/24) 8:00 am–12:00 pm Roosevelt (L), Marriott-East

SPC 190 Method of Testing for Rating Indoor Pool Dehumidifiers (20/10) Screen

Sun. (6/23) 1:00 pm–2:00 pm Julia Lee B (3), Marriott-West

SPC 191 Standard for the Efficient Use of Water in Building and Mechanical Systems (8/4) Screen/Electric

Sun. (6/23) 9:00 am–12:00 pm Executive Boardroom (3), Marriott-West

SPC 195 Method of Test for Rating Air Terminal Unit Controls (8/4) Electric

Tues. (6/25) 10:00 am–12:00 pm Executive Boardroom (3), Marriott-West

SPC 196 Method of Test for Measuring Refrigerant Leak Rates (7/13) Screen/Electric

Sun. (6/23) 6:00 pm–10:00 pm Wilson (L), Marriott-East

SPC 198 Method of Test for Rating DX-Dedicated Outdoor Air Systems for Moisture Removal Capacity and Moisture Removal Efficiency (16/10) Screen

Sun. (6/23) 12:00 pm–1:00 pm Julia Lee B (3), Marriott-West

SPC 204 Method of Test for Rating Micro Combined Heat and Power Devices

Mon. (6/24) 6:30 pm–9:30 pm Wilson (L), Marriott-East

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment (20/20) Screen /Electric

Tues. (6/25) 8:00 am–12:00 pm Jay McShann A (3), Marriott-West

SPC 205 Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment–Working Groups (20/20) Screen/Electric

Sun. (6/23) 9:00 am–12:00 pm Jay McShann A (3), Marriott-West

SPC 207P Laboratory Method of Test of Fault Detection and Diagnostics for Airside Economizers (15/15) Electric

Mon. (6/24) 8:00 am–10:00 am Jay McShann A (3), Marriott-West

SPC 207P Verification Working Group (10/10) Electric

Mon. (6/24) 4:30 pm–6:30 pm Jay McShann A (3), Marriott-West

SPC 207P Draft Writing Working Group (10/10) Electric
Mon. (6/24) 10:00 am–12:00 pm Jay McShann A (3), Marriott-West

SPC 210P Method of Testing for Rating Commercial Walk-in Refrigerators and Freezers (8/25) Screen/Electric
Mon. (6/24) 8:00 am–12:00 pm Lester Young A (3), Marriott-West

SPC 211 Commercial Building Energy Audits (18/20) Screen/Electric
Mon. (6/24) 8:00 am–12:00 pm Trianon D (T), Marriott-East

SPC 213P Method of Calculating Moist Air Thermodynamic Properties (6/4) Screen/Electric
Tues. (6/25) 8:00 am–12:00 pm Nixon (L), Marriott-East

SPC 216 MOT for Determining Application Data of Overhead Circulator Fans (11/10) Screen/Electric
Mon. (6/24) 2:15 pm–5:15 pm Burgundy (T), Marriott-East

SPC 217 Non-Emergency Ventilation in Enclosed Road, Rail and Mass Transit Facilities (19/6) Screen/Electric
Tues. (6/25) 7:00 pm–12:00 pm Big Joe Turner B (3), Marriott-West

SPC 219 Method of Testing the Ability of Liquid Line Filter Driers or Absorbents to Remove Organic Acid (5/3) Screen
Mon. (6/24) 8:00 am–12:00 pm Kennedy (L), Marriott-East

SPC 220 Method of Testing for Rating Small Commercial Blast Chillers, Blast Chiller-Freezers, and Blast Freezers (12/10)
Mon. (6/24) 4:30 pm–5:30 pm Julia Lee A (3), Marriott-West

SPC 221 Test Method to Field-Measure and Score the Cooling and Heating Performance of an Installed Unitary HVAC System (10/15) Screen/Electric
Mon. (6/24) 2:15 pm–4:15 pm Eisenhower (L), Marriott-East

SPC 224P Standard for the Application of Building Information Modeling (20/0) Screen
Mon. (6/24) 4:15 pm–5:15 pm Lido (T), Marriott-East

SPC 225P Method of Test for Centrifugal Compressors (6/3) Screen/Electric
Tues. (6/25) 7:00 am–10:00 am Eisenhower (L), Marriott-East

SPC 226P, Methods for Performance Testing Positive Displacement Refrigerant Compressor and Compressor Units (10/10) Screen
Mon. (6/24) 10:00 am–12:00 pm 2210, KCCC

SPC 227P Passive Building Design Standard
Mon. (6/24) 10:00 am – 12:00 pm Eisenhower (L), Marriott-East

SPC 228P Standard Method of Evaluating Zero Energy Building Performance (20/15) Screen/Electric
Sat. (6/22) 12:30 pm–3:00 pm Big Joe Turner B (3), Marriott-West

SSPC 300, Commissioning (20/20) Screen/Electric
Mon. (6/24) 8:00 am–12:00 pm Basie A1 (2), Marriott-West
SSPC 300 Standard 230P subcommittee (10/15) Screen/Electric
Fri. (6/21) 1:00 pm–3:00 pm Hoover (L), Marriott-East
SSPC 300 Guideline 0 subcommittee, The Commissioning Process (16/12) Screen/Electric
Sat. (6/22) 10:00 am–11:30 am Yard Bird B (2), Marriott-West

SSPC 300 Guideline 1.1 subcommittee, The HVAC Commissioning Process (16/12) Screen/Electric

Sat. (6/22) 12:00 pm–1:30 pm Yard Bird B (2), Marriott-West

SSPC 300 Standard 202 Subcommittee, Commissioning Process for Buildings and Systems (16/12) Screen/Electric

Sat. (6/22) 1:30 pm–3:00 pm Yard Bird B (2), Marriott-West

SSPC 300 Guideline 1.4 subcommittee, Preparing System Manuals (10/10) Screen/Electric

Sun. (6/23) 10:00 am–12:00 pm Jay McShann B (3), Marriott-West

SSPC 300 Guideline 1.6 subcommittee, Data Center Commissioning (18/12) Screen/Electric

Sun. (6/23) 12:30 pm–2:30 pm Jay McShann B (3), Marriott-West

GUIDELINE PROJECT COMMITTEES (GPCs)

GPC 14 Measurement of Energy, Demand and Water Savings (10/3) Screen/Electric

Sun. (6/23) 6:00 pm–10:00 pm Taft (L), Marriott-East

GPC 22 Instrumentation for Monitoring Central Chilled Water Plants (8/8) Screen

Tues. (6/25) 10:00 am–12:00 pm Eisenhower (L), Marriott-East

GPC 29 Guideline for the Risk Management of Public Health and Safety in Buildings (6/4) Electric

Sun. (6/23) 1:00 pm–3:00 pm Executive Boardroom (3), Marriott-West

GPC 35 Method of Determining the Energy Consumption Caused by Air Filtration Devices (10/40) Screen/Electric

Mon. (6/24) 8:00 am–12:00 pm Trianon C (T), Marriott-East

GPC 37 Upper Room Ultraviolet Germicidal (UV-C) Devices to Control the Transmission of Airborne Pathogens (10/10)

Sat. (6/22) 8:00 am–11:00 am Taft (L), Marriott-East

GPC 41 Design, Installation and Commissioning of Variable Refrigerant Flow Systems (18/7)

Mon. (6/24) 8:00 am–12:00 pm Truman B (L), Marriott-East

STANDING GUIDELINE PROJECT COMMITTEES (SGPCs)

SGPC 10 Interaction Affecting the Achievement of Acceptable Indoor Environments (14/15) Screen

Sun. (6/23) 10:00 am–12:00 pm Wilson (L), Marriott-East

SGPC 13 Specifying Building Automation Systems (10/5) Screen /Electric

Sat. (6/22) 8:00 am–12:00 pm Hoover (L), Marriott-East

SGPC 36 High Performance Sequences of Operation for HVAC Systems (24/20) Screen/Electric

Mon. (6/24) 8:00 am–12:00 pm Truman A (L), Marriott-East

WHAT IS A PROJECT COMMITTEE?

ASHRAE Project Committees (PCs) develop ASHRAE standards and guidelines. ASHRAE PCs consist of people who have a recognized expertise in a specific field of interest. Standards produced by ASHRAE are used as authoritative documents throughout our industry.

APPLYING FOR MEMBERSHIP OF A PROJECT COMMITTEE

ASHRAE welcomes new members to its project committees. With the exception of PC Chairs and Vice Chairs, it is not necessary to be a member of ASHRAE to participate on any of ASHRAE's Standards Project Committee (SPC), Guideline Project Committee (GPC), or Standing Standard/Guideline Project Committees (SSPC, SGPC).

To be considered for project committee membership, you must:

- Submit a PC Application for Membership to ASHRAE staff at Standards.Section@ashrae.org
- Submit a Bias/Conflict of Interest Statement to ASHRAE staff
- Update or complete an ASHRAE Bio online

After you correctly submit all necessary paperwork:

- ASHRAE staff processes the application and provides the membership package to the PC chair
- The PC Chair reviews the membership package and accepts or declines each applicant
- ASHRAE's Standards Project Liaison Subcommittee approves new members

More details on applying for PC membership are available at www.ashrae.org/standards.

ATTENDING PROJECT COMMITTEE MEETINGS

A PC member is expected to attend meetings and pay attention to correspondence. The PC Chair may recommend removal of a PC member for lack of participation such as failing to attend at least half of the scheduled PC meetings in a year.

ASHRAE Project Committees meet at each Society Winter and Annual Conference. Attendance at these meetings is open to everyone. You are encouraged to attend any of these meetings in which you have a technical interest. PC Chairs welcome visitors to PC meetings – a PC can never have too many willing and able volunteers.

See the listing of Standards and Guidelines Committees meetings in the Final Program, online or in the app.

International Standards And Misc. Committees

US TAG to ISO/TC 86 (20/10) Screen/Electric

Mon. (6/24) 8:00 am–10:00 am Jay McShann B (3), Marriott-West

ISO TC86 SC8 WG7: ISO17584 (15/0)

Fri. (6/21) 4:00 pm–6:00 pm Hoover (L), Marriott-East

US TAG to ISO/TC 142 Cleaning Equipment for Air and other Gases (30/30) Screen/Electric

Sat. (6/22) 2:30 pm–3:15 pm Bennie Moten (3), Marriott-West

US Tag to ISO/TC 205 and US Tag to ISO/TC 163 Thermal Performance and Energy in a Building Environment (22/12) Screen/Electric

Tues. (6/25) 1:00 pm–3:30 pm Roosevelt (L), Marriott-East

ISO 817 MA (23/11) Screen/Electric

Tues. (6/25) 8:00 am–12:00 pm Roosevelt (L), Marriott-East

ISO 817 MA-Flammability (15/10) Screen/Electric

Sun. (6/23) 9:00 am–11:00 am Julia Lee B (3), Marriott-West

ISO 817 MA-Toxicity (15/10) Screen/Electric

Mon. (6/24) 8:00 am–9:00 am Hoover (L), Marriott-East

ISO 817 MA-Design and Nomenclature (15/10) Screen/Electric

Mon. (6/24) 9:00 am–10:30 am Hoover (L), Marriott-East

gbXML (10/0)

Mon. (6/24) 2:00 pm–3:00 pm Taft (L), Marriott-East

UL Workshop (30/0)

Sun. (6/23) 9:00 am–10:30 am Basie A1 (2), Marriott-West

USNC/IIR (20/20)

Tues. (6/25) 2:00 pm–4:00 pm Mary Lou Williams B (3), Marriott-West

USNT/IEA (20/10)

Tues. (6/25) 4:00 pm–6:00 pm Mary Lou Williams B (3), Marriott-West