



MINUTES
ASHRAE TC 4.7 ENERGY CALCULATIONS – MAIN MEETING
HILTON ORLANDO LL, ORANGE B
ORLANDO, FL
TUESDAY, FEBRUARY 4, 2020, 6:00 PM – 8:30 PM

MOTIONS:

- Neymark moves to keep the scope as is. Muehleisen seconds. 10-0-0 CNV
- Muehleisen moves to approve agenda from Kansas City. Pruett seconds. 10-0-0 CNV
- Muehleisen moves to approve RP-1661 no cost extension until April 30, 2021. Neymark seconds. 9-0-0 CNV
- Neymark moves to send “Enhancing Whole Building Calibration using Indoor Environment Data” to RAC. Pruett seconds. 9-0-0 CNV
- Muehleisen moves that we officially request an extension for Handbook edits in Austin. Rao seconds. 9-0-0 CNV
- Pruett moves to approve the proposed program for Austin. Rao seconds. 9-0-0 CNV
- Muehleisen moves to adjourn. Everyone seconds.

ACTION ITEMS:

- None recorded

1. Reciting of Code of Ethics Commitment and Introductions (5 minutes) Balbach

Commitment to the ASHRAE Code of Ethics: In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interest.

2. Call of Voting Members (2 min) Kruis

Balbach	X
Cook	X
Crawley	X
Haberl	X*
Judkoff	X*
Kim	X
Kruis	X
Muehleisen	X
New	X
Neymark	X
Pruett	X
Rao	X

*Remote attendance

3. Review TC 4.7 Scope: Balbach

TC 4.7 is concerned with identifying, evaluating, developing, and recommending procedures for calculating energy performance of the built environment.

::MOTION:: Neymark moves to keep the scope as is. Muehleisen seconds. 10-0-0 CNV

3.5 Changes to Agenda

- Changing the order of Subcommittee roster
- Added planned program to below to vote approval

4. **Accept agenda & approve minutes of Kansas City meeting** (8 minutes) Balbach

::MOTION:: Muehleisen moves to approve agenda from Kansas City. Pruetts seconds. 10-0-0 CNV

5. **Announcements/Liaisons** (5 minutes) Balbach

- Jim Bennett (Section 4 Liaison)
- ~~Mike Pouchak~~ David Claridge (Research Liaison)
- Bass Abushakra (Handbook Liaison)

TC can ask for an extension to vote new Chapter in Austin for handbook updates

6. **Chair Remarks** (10 minutes) Balbach

- ASHRAE 2019 - 2024 Strategic Plan (Basecamp)

Survey on Research Strategic Plan was distributed to membership

- Highlights from TC Chairs Breakfast (Updates, FG Re-organization)

No changes at this time for TC 4.7. Executive committee will look at adjusting meeting times for future meetings.

- ASHRAE and IBPSA-USA 2020 Building Performance Analysis Conference & SimBuild, Chicago, IL
- Future ASHRAE conferences - Austin, Chicago, Phoenix, Las Vegas
- Thank you to Jeff Haberl for being Research Chair Tim McDowell to take over for Jeff starting Immediately
- Planned changes after Austin: Ralph Muehleisen to Chair, Neal Kruis to Vice Chair, Alamelu Brooks to Secretary

7. **Membership** (5 minutes) Balbach

- Voting - currently have 11 Voting members (up to 18 is allowed)

- Sagar Rao replaced Anthony Fontanini
- <http://tc0407.ashraetcs.org/membership.php>

11 VM, 1 non-quorum (need 6 VM for quorum)

Balbach and Muehleisen tentative rolling off (tentative because it's supposed to happen automatically but it's ASHRAE so who really knows)

8. Subcommittee Reports

8.1 Simulation and Component Models (10 minutes) Lee

8.2 Data-Driven Modeling (10 minutes) Fontanini

8.3 Multiscale Building Energy Modeling (10 minutes) Judkoff (remote)

8.4 Research (15 minutes) Haberl / Balbach

8.4.1. Research Projects

- Upcoming RTAR's and WS's submission to RAC dates:
 - March 15 – RAC Spring meeting consideration in April
 - May 15 – RAC Annual meeting consideration in June
 - August 15 – RAC Fall meeting consideration in Sept. or Oct.
 - December 15 – RAC Winter meeting consideration in January

- Completed Projects

● [RP-1741 Fan coils for energy use in buildings. \(This is 5.3 we are co sponsors\)](#)

- Awarded Projects

[RP-1816 - Hospital image equipment: recently awarded. Haberl is PMS](#)

RP-1661 - Modelical control strategies for Chillers. Needs no cost extension.

::MOTION:: Muehleisen moves to approve RP-1661 no cost extension until April 30, 2021. Neymark seconds. 9-0-0 CNV

- Approved RTAR

WS-1857 is approved and they are getting cosponsors.

- Approved WS
- Returned WS with Comments
- Rejected RTAR to be Revisited
- WS, RTAR, Requests for Co-sponsorship
- New RTAR

::MOTION:: Neymark moves to send "Enhancing Whole Building Calibration using Indoor Environment Data" to RAC. Pruettt seconds. 9-0-0 CNV

8.5 Handbook (10 minutes)

Pruett

April 2: Author review deadline

May 1: Reviewer deadline

June 21: Official due date for extension

::MOTION:: Muehleisen moves that we officially request an extension for Handbook edits in Austin. Rao seconds. 9-0-0 CNV

8.6 Program (15 minutes)

Kastl

Deadline for Austin: 2/10/20

Points for co-sponsoring and distinguished lecturers

- Chris/Jeff: "Seminar on the Kaggle Competition Winners"
- Paulo: "Development of a Campus Energy Modeling Platform for Sustainable Campus Energy Demonstration"
- Ralph: "Am I Resilient? How Building Energy Models Help Inform Resilient Community Design"

::MOTION:: Pruettt moves to approve the proposed program for Austin. Rao seconds. 9-0-0 CNV

8.7 Historical (5 minutes)

Haberl / Balbach

3 ASHRAE Transaction papers about historical. 2 more papers forthcoming on history of simulation.

8.8 Standards (15 minutes)

Neymark

8.9 Web Site (5 minutes) (<https://tc0407.ashraetcs.org/>)

New

9. Related activities reports (10 minutes)

MTG.OBB Occupant Behavior in Buildings (Abushakra)

MTG has submitted an unsolicited research proposal. Bass wants to get info on why it went as URP and not through the regular route

MTG.BIM Building Information Modeling (Barnaby)

No update

TC 1.5 Emerging Technology Applications

Co-sponsored predictor shootout.

TC 4.1 Load Calculation Data and Procedures (Barnaby)

No Update

TC 4.2 Climatic Information (McDowell/Barnaby/Crawley/Huang)
Sky temperature modeling research may need co-sponsorship

TC 4.5 Fenestration (Rao)

Looking at shading device effects on health

TC 7.5 Smart Building Systems

TC 7.6 Building Energy Performance (Kim)

New working group on energy, water, IAQ

Guideline 14 (Balthazar)

Updating for new draft by the end of 2020.

90.1

10. Awards Nomination (5 min) Balbach

A number of awards submitted from TC 4.7. Contact Jeff on putting together Fellow nominations.

11. New business Balbach

12. Adjourn Balbach

::MOTION:: Muehleisen. Everyone seconds.

RESOURCES

2020 Summer meeting - Austin Texas June 27th - July 1st

[Monday, August 12, 2019 Conference Paper Abstracts, Technical Papers and Paper Session Requests Due](#)

[Friday, August 30, 2019 Conference Paper Abstract Accept/Reject Notifications](#)

Monday, December 2, 2019 Conference Papers Due - Submitted for Review Friday, December 20, 2019 Conference Paper Accept/Revise/Reject Notifications

Wednesday, January 8, 2020 Website Opens for Seminar, Workshop, Panel, Debate, Forum and Extended Abstract Proposals

Monday, January 13, 2020 Revised Conference Papers/Final Technical Papers Due

Monday, February 10, 2020 Program (Seminar, Forum, Workshop, Debate and Panel) and Extended Abstract Paper Due

Tuesday, February 18, 2020 Conference and Technical Paper Final Accept/Reject Notifications

Monday, March 2, 2020 Extended Abstracts Accept/Reject Notifications

Monday, March 16, 2020 Debate, Panel, Seminar, Forum, Workshop Accept/Reject Notifications
Friday, May 1, 2020 Upload of presentation open for review
Monday, June 1, 2020 Presentation submissions due

CONFERENCE TRACKS FOR AUSTIN SUMMER MEETING

Fundamentals and Applications: Fundamentals are the foundation for understanding applications in engineering. Key components of ASHRAE fundamentals include thermodynamics, psychometrics, fluid and mass flow. This track provides opportunities for papers and presentations of varying levels across a large topic base. Concepts, design elements and shared experiences for theoretical and applied concepts of HVAC&R design are included. *Rupesh Iyengar Rupesh_iyengar@yahoo.com*

HVAC&R Systems and Equipment: HVAC&R Systems and Equipment are constantly evolving to address the changing requirements of the built environment. Papers and programs in this track will focus on the development of new systems and equipment, improvements to existing systems and equipment and the proper application and operation of systems and equipment. *Ashu Gupta Ashu.energy@gmail.com*

Research Summit: Active research, and the exchange of those research findings, are critical to the development of our HVAC&R industry and built environment. The 8th annual research summit invites researchers to share those results, including ASHRAE-sponsored research and research of interest to the ASHRAE community. Researchers are invited to present papers, extended abstracts, seminars, forums or participate in panel discussions. The Research Summit includes a partnership with ASHRAE's archival journal, Science and Technology for the Built Environment. *Kristen Cetin kcerin@iastate.edu*

Professional Development: As members of a professional organization, we not only participate for the great value of technical exchange, but also the interpersonal exchange. We recognize that the single greatest strength of our organization is its membership. This track is designed to allow those professionals an opportunity to develop in the areas of presentation skills, leadership, team-building, understanding various business operations, interpersonal skills, etc. In short, the Professional Development Track will cover all aspects of business outside of engineering/technical applications and lends itself to interactive session types such as workshops and forums. **Devin Abellon devin.abellon@yahoo.com**

Grid-Interactive Efficient Built Environment: This new track focuses on the effects of industry trends (grid-enabled buildings, demand response, decarbonization, etc.) on system, building and community design practices. Topics include smart building, grid-enabled equipment and appliance, and HVAC design and operation for load flexibility. Topic can also include energy storage (thermal, battery, building mass, etc.), energy recovery (from condenser water or air), time-of-day practices, utility programs, etc. **Vikrant C Aute vikrant@umd.edu**

Multifamily and Residential Buildings: Multifamily is one of the fast growth building sectors but has been underserved. Multifamily buildings present challenges and opportunities on energy codes requirements, energy efficiency opportunities, ventilation and air tightness balance, and equality to address low-income multifamily buildings. This track covers programs and papers on best practices, utility and above-code incentive programs, field studies, and codes and standards requirements. This track also welcomes programs and papers for single family housing and other residential buildings. *Sonya Pouncy sonyapouncy@gmail.com*

Resilient Buildings and Communities: The cycle of building development, design and construction is moving more rapidly than ever. Key stakeholders in the design and construction process face new challenges of responding to a range of environmental, market and consumer-driven pressures. Increasingly, it is being recognized that "smart" buildings and integrated systems are central to successfully addressing challenges posed by climate change, natural disasters, accidents, disease, and terrorism. Papers and program in this track focus on innovation and exploration related to these challenges and best practices that enable adaptability, resilience and recovery of buildings and communities. **Christine Reinders-Caron christinereinders@gmail.com**

Zero Energy Buildings and Communities: Opportunities and Challenges. To address the climate change challenges and carbon reduction needs, zero energy buildings and communities have proven concept in many cases. However these case studies remain a very minor portion of the building stock. This track provides an opportunity to address the challenges and demonstrate opportunities in a wide range of perspectives. Topics in this track includes integrated design approach, tools and resources to make it easier on zero energy design and operation, innovative and state-of-art technologies and strategies; balance between energy efficiency measures and on-site renewable generation, aggregated scale to achieve zero energy communities and campuses. This track will also cover the topics on policies and regulations, codes and standards and utility programs for adoption and scale up of zero energy buildings and communities. **Raul Simonetti raul.simonetti@carel.com**

Building Myths: It is often difficult to present or publish "negative" results where there was no successful outcome of an experiment or study. This often leads to people conducting similar experiments to discover what others knew but never published. This min-track

is designated to share the lessons learned from these precious experiences. This mini-track will also identify and test unquestioned assumptions related to the built environment and its efficient operation. **Kimberly Pierson** kdpwildcat@gmail.com

2021 Winter Meeting - Chicago, IL January 23rd - January 27th, 2021

Deadlines:

Wednesday, March 18, 2020: Conference Paper Abstracts, Technical Papers and Paper Session Requests Due
Wednesday, April 22, 2020: Conference Paper Abstract Accept/Reject Notifications
Monday, June 15, 2020: Website Opens for Seminar, Workshop, Forum, Debate, and Panel Proposals
Wednesday, July 8, 2020: Final Conference Papers Due - Submitted for Review,, Request for Conference Paper Sessions Due
Monday, July 27, 2020: Conference Paper Accept/Revise/Reject Notifications
Monday, August 10, 2020: Revised Conference Papers/Final Technical Papers Due
Monday, August 24, 2020: Conference and Technical Paper Final Accept/Reject Notifications
Monday, October 5, 2020: Seminar, Workshop, Forum, Debate, and Panel Accept/Reject Notifications

CONFERENCE TRACKS FOR CHICAGO WINTER MEETING

- 1) **HVAC&R Fundamentals and Applications:** Fundamentals are the foundation for understanding applications in engineering. Key components of ASHRAE fundamentals include thermodynamics, psychrometrics, fluid and mass flow. This track provides opportunities for papers and presentations of varying levels across a large topic base. Concepts, design elements and shared experiences for theoretical and applied concepts of HVAC&R design are included.
- 2) **Systems and Equipment:** HVAC&R Systems and Equipment are constantly evolving to address the changing requirements of the built environment. Papers and programs in this track will focus on the development of new systems and equipment, improvements to existing systems and equipment and the proper application and operation of systems and equipment.
- 3) **Refrigeration and Refrigerants:** Refrigeration is a critical element of modern life, from preserving food and medicine to maintaining comfort. With significant changes on the horizon for refrigerant regulations, along with new applications for refrigeration systems being frequently applied, there is more need than ever to understand both the fundamental and advanced concepts and issues related to refrigeration. Papers and programs in this track will focus on refrigerants, refrigerant regulation, refrigeration cycles and refrigeration applications.
- 4) **Environmental Health Through IEQ:** HVAC&R systems play a significant role in maintaining indoor environmental conditions. As people spend increasingly more time in the built environment, health concerns are becoming paramount to design. This track will seek papers and programs on developing, evaluating and predicting optimal indoor environmental conditions, especially as they pertain to environmental health.
- 5) **Building Performance and Commissioning for Operation and Management:** Modern HVAC&R systems are complicated and designed for high efficiencies. In order to optimize their use and provide proper operation, commissioning is recommended. This track provides an opportunity to provide papers and presentations surrounding building operation and commissioning practices as well as case studies in performance and commissioning.
- 6) **Energy Conservation:** Whether it is new construction, renovation, routine maintenance or energy audits there is a major concern over the use of energy in the built environment. Designs are using more techniques to reduce energy with the use of energy wheels and pipes, solar energy, photo voltaic, and more efficient equipment and new concepts that are pushing to be standard design practice. In addition, modeling is being used to generate more life cycle cost decisions for the design and value-engineering decisions beyond standard HVAC practice. This track will highlight case studies and research that expand on the simple to the complex energy savings measures being implemented in today's and tomorrow's designs.
- 7) **International Design:** Design for various environmental elements, geography and culture demand that new and innovative strategies be developed. As an international organization, ASHRAE strives to meet the needs of a global membership. HVAC&R systems vary globally and this track provides an opportunity to share innovative and necessary design elements that can be shared internationally.

8) **Standards, Guidelines and Codes:** ASHRAE is known for its standards and design guidelines – and they are constantly evolving with the intent on improving the built environment and its systems. Designers, Contractors, Architects and Owners must be able to keep up with the continuing changes in the current cycle but to also be prepared for the future changes. In addition, there is a large interaction of ASHRAE with the code authorities and government to incorporate these standards and guidelines. The series of sessions in this track highlight the changes to the standards and guidelines, their projected path and optimum design techniques to meet or exceed the standards.

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Minutes

TC 4.7 Simulation and Component Models Subcommittee

6:00-7:30 pm, Monday, 3 February 2020

6001 Destination Pkwy,
Orlando, FL

6:00	Call to order / introductions / changes to the agenda	Lee
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Announcement: Edwin Lee new S&C chair

6:15	Research Projects	
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- **1741-RP** Understanding Fan Coil Components and How They Relate to Energy Consumption and Energy Modeling (TC 5.3, TC 7.7, requesting TC 4.7 co-sponsor) Kruis

Concluded. Cognizant TC PMS recommended final approval. TC 4.7 got 205 representation of fan coils...they did some energy modeling of fan coils in different climates. Anything needing to go into handbook?

- **1769-RP** Experimental Evaluation of the Efficiency of Belt Drives for Fans (Request for co- sponsorship from TC 5.1 Fans. **Status:** TC voted 3-2-2 in St. Louis to co-sponsor, accepted by RAC, awarded Jun 2018, no TC 4.7 co-sponsorship.

REMOVE FROM AGENDA

- **1661-WS** Development and Validation of Dynamic Models for the Evaluation of Chilled-Water Systems Control Strategies in the ASHRAE Handbook (TC 4.7/ TC 7.5 / TC 1.4) PMS chair or contractor Zuo
 - Previous action item: TC4.7 motion to full TC to approve new
 - PSMC1711-RP (TC 1.4) is related. Jeff Stein is on 1661-RP PMS and likely aware of both efforts.
-

TIM: PMSC not meeting here, had a web call after KC, managed to get them to drop scope to get the project done. We may need a no-cost extension, but needing to check with Wangda about Apr 30 deadline. PMSC hasn't voted on it so we can't vote on a no-cost extension. We'll talk about it.

6:25 **Draft Work Statements/RTARs**

- **1748-WS** Assess and Implement Natural and Hybrid Ventilation Models in Whole-Building Energy Simulations – Phase 2 (TC 4.7 / TC 4.10) **Status according to ASHRAE Fall Research Plan:** not yet approved, must be approved by Oct 1, 2018. Jeff suggests we need to query Mike Vaughn for more detailed RTAR status update.

TONY: Topic has expired. If we want to continue, we can get a new number and re-submit.

- **ACTION: Bass will send RAC comments to Tony, Tim, Chris, and Edwin and Joe. Joe will need to get a new number and resubmit (responding to comments)**

- **1813-RTAR** “Development of an Accuracy Test Method for Residential Attic Duct System Simulations in Whole-Building Energy Simulation Programs”, Rejected by RAC June 2018, still alive? Need to check with Minnie, resubmit? -- No matter what, this needs to be done as a different RTAR.

- **Pre-RTAR** Development of a Reference Building Information Model (BIM) for Daylighting Optimization (TC 1.5 / TC 4.7) No progress on RTAR, but welcome Juan Carlos Baltazar's related experimental findings.

- WS 1784 related: TC4.2 came up with for rooftop units entering air is much higher and affected by the local environment. 4.7 and 4.10 co-sponsored. RTAR approved. Then delayed. Joe converted to a work statement. This committee should look at this and determine whether to recommend anything to main committee? Joe says lit review shows contradicting predictions. Craig Wray took measurements and found no significance.
-

This TC could be interested in tasks 3 and 4 (creating CFD model and create simplified engineering procedure). \$75k for 1 year. During main meeting we should put on record that we could co-sponsor once the WS is complete. And get voting members to read the document and we can do a email vote once it is ready

- Straw poll 8 - 0 - many abstaining
-

7:00

New Research Topics/Research Plan

7:20

- New Research Topics (RTARs and WSs can be submitted 4 times a year—six weeks before Winter and Annual meetings and 1 March/1 August.)
- Improved Sky Temperature Algorithm –

Tim – UCSD completed research in this area, not pursuing this further. 4.2 discussed it, Chip will talk with Tim about it.

- Comparing Attic Models – Huang – Huang will report on this in Orlando This is looking to compare the temp and heat flow into a building as estimated by different software. Tony said CSE-Fraunhafer was funded by DOE to look at different attic models in EnergyPlus.

- **Action Item - Joe to work with Neal to try to get an RTAR and coordinate this with 140 creating new test cases for section 5 that include attics.**

- Follow-on to RP-1588 (Window Modeling) – Huang – discuss. (Simple to detailed window model generator)

Address the future work part of the RP-1588: quantify energy differences between the modeling methods, improve the search method of the solver, Joe wants help in writing. Mahabir will help.

- **Action item: Joe to coordinate with Mahabir of ORNL on writing**

- Toolkit for educational software, resurrecting methods of modeling legacy passive systems. - Haberl
-

Ralph - Propose dropping it

- Evaluation and improvement of chilled water and dx coil models for high latent loads. – Maddox, Haves, Kastl RTAR status?

- **Neal - can ask Doug during 205 meeting**

- Improved interior surface convection algorithms – Haves, Kruis, McDowell, Qi, Liping RTAR status?

- **Ralph will follow up with phil**

- Independent cross-check on models for above code buildings (including delivered savings). – Haberl

Program Ideas

- 7:25
- 2020 Annual (Austin), 2021 Winter (Chicago), 2021 Annual (Phoenix)

1741 topics?

- **Edwin and Brian to follow up with Neal to see if it's time for a 1741 related session.**

Roof temperature myths?

Chip: Explore the issues of why you need different calcs for load and whole building simulation. Chip will try to see about coordinating with someone from 4.1. But this is probably a better fit for MBEM.

New Business

7:30

Adjourn

Next Meeting: Monday, June 29, 2020 Austin, TX



TC4.7 Data-Driven Models Subcommittee Monday; February 3, 2020, 7:30 PM–9:00 PM
Location: Orlando, FL; Hilton Orlando, LL, Orange B

Attendance: Anthony Fontanini, Bass Abushakra, Brian Kastl, Chip Barnaby, Chris Balbach, Clayton Miller, Daniel Villa, Edwin Lee, Erik Kolderup, Hyojin Kim, Jason DeGraw, Joe Huang, Joel Neymark, Qi Li, Ralph Meuhleisen, Scott Judson, Tim McDowell, Zhe Wang, Cary Faulkner, Jessica Stershic, Yingli Lou, Amir Roth, Shengbo Zhang, Alamelu Brooks, Hongxiang Fu, Josh Gibbins, Henry Amistadi, Zhe Yang, Ehsan Kamel, Erika Gupta, Nikitha Rodhakrishnan, Michael Bobker, Mahabir Bhandari.

Agenda:

7:30 Call to order / Introductions / Changes to the agenda

7:40: Upcoming Due Dates (5 minutes)

- Annual Meeting 2020 (Austin, TX – June 27-July 1, 2020)
 - **February 10, 2020** – Seminar, Workshop, Forum, Debate, & Panel Proposals Due

7:45: Research: Work Statements / RTAR's (30 minutes)

- Current Work Statements/RTARS
 - Update on WS 1763 – Development of an Improved Toolkit for Analyzing Building Energy Use from Time Series Data: Update to the Inverse Model Toolkit. (Balbach, Koran, Haberl)
 - (Ralph didn't catch any action items on this)
 - RTAR XXXX - Enhancing Whole-Building Calibrated Simulation Using Indoor Environmental Data (Kim)
 - This is pretty close to ready. Hyojin working with Joel on this. Adding analytic to the empirical. Budget is now \$240k. Above \$150k goes to TAC, Above \$250k goes to tech council. Tony would prefer a single larger project to two smaller ones that take longer to get the RTARs approved. Tim says to let RAC liaison tell us to split. Straw poll 10-0-many abstaining to for full committee to approve with editorial changes.
- Kaggle Competition Update (Miller, Balbach)
 - The competition has completed, winners have been announced
 - Great thanks to Chris, Clayton, Krishnan, and Especially Jeff for paving the way
 - 4370 participants, 3614 teams, 39403 submission from 94 counties. 950 users were their first competition.
 - Open sourcing data or keep private for standard test set?
 - What is a good place for videos related materials?
 - What to do next?

Competition was a success - tentative winners decided. Many solutions have notebooks publicly available on Kaggle sight. Competition committee looking at how to

disseminate the results. Seminar being planned for Austin. Mini-track (possibly) for Chicago. Bass says winners should write paper on their results and the contest organizers should do it if the contestant doesn't want to do it. Ralph: consider hosting some of these things with IBPSA.

Chris suggests seminar for Chicago where people try these methods out on their own data

A mini-track needs at least 12 seminars. We missed the deadline for an official minitrack but we have gentlemen's agreement with CEC to have an unofficial track.

Interested: Zho Wang LBL will want to present in this space. Daniel Villa tentatively. Tony tentatively interested, Qi tentatively interested.

Henry suggests a special publication of technical papers like was done for the previous competition.

There is a question of whether or not to release the lock-box data used for the final competition. If we release the data set no one can continue to try submitting. Tony says the gist of the committee is to keep the lock-box data private.

Looking at a second kaggle competition. Peak load prediction (some time series predictions). Ability to shed loads and time shift. Time series classification. (equipment identification), perhaps on submeter data. mapping points. Anomaly detection.

- Data Driven Smart Cities – Proposed new IEA Annex (Balbach)

ECB Annex 81 Data Driven Smart Cities. Meeting in Berkeley in April hosted by ANL. Includes model predictive control. Zhe will collect and share with DDM.

- New Research Topics

Potential RTAR Topics		
RTAR Title	Champion(s)?	Status/Notes
Determining when a building's behavior have changed, Re-baselining	Bass Balbach Added: Juan-Carlos	Important for EPC projects. Keep on list. Juan Carlos interested to help get going Table it for now
Data-driven clustering methods	C. Balbach K. Haddad	Updates: Fits into/augments the Kaggle. Keep on list. Chris wants to mine the Kaggle before decided
Fully automated inverse models for building energy predictions	C. Miller.	Clayton has a student collecting the Kaggle stuff

	Mike B @CUNY	into a PIP package . Mike @ CUNY building performance says he might have some interested in helping in his lab.
Standard practice of using machine learning models for building energy predictions	Bass and Tony	Bass says this should be an outcome of the Kaggle
Trying to make a machine learning technique informed with more decision based (physics) (like physics informed neural networks).		Discussed by Henry and Tony Flesh out more in future

8:15 Discussion of Program (15 minutes)

- Annual Meeting (Kansas City) Review
 - Related Program Information
 - Seminar 23: Presentation 3: Data Collection and Result Analysis for the Predictor Shootout III
 - Sunday, February 2nd: 3:15 pm – 4:45 pm, Room: Orlando VI

Rough count - 100 people in attendance

- Seminar 61: Outliers Detection Techniques and their Benefits in Data-Driven Modeling
 - Wednesday, February 5th: 8:00 am – 9:30 am, Room: Orange C

Juan Carlos, Agami and Zhe Wang

- Seminar 64: Building Energy Modeling Software Accuracy Testing with ASHRAE Standard 140: Methodology, Overview and Recent Developments
 - Wednesday, February 5th: 9:45 am – 10:45 am, Room: Orange C

Joel, Overview of 140 and airside HVAC new in 2017.

Winter Meeting 2020 (Orlando)	
Track 1:	HVAC&R Fundamentals and Applications
Track 2:	Systems and Equipment
Track 3:	Refrigeration and Refrigerants
Track 4:	Cutting Edge Approaches
Track 5:	High Efficiency Design and Operation
Track 6:	Big Data and Smart Controls
Track 7:	Ventilation, IAQ and Air Distribution Systems
Track 8:	Standards, Guidelines and Codes

Potential Session Topics

Meeting	Session Type	Session Title	Tentative Session Chair(s)	Speakers
	Seminar	Predictor Shootout III: Data-Driven model selection considerations	Jeff (Chris balbach as backup)	Clayton has some speakers
	Seminar	Predictor Shootout III: Data cleaning, lessons learned		
	Seminar	Are you normal? Dealing with non-normal residuals	Ralph will follow up with Liping L. Wang A. Fontanini	Qi Li Tony (will send someone) Ralph (IQR) for small data
		DDM for resilience application	Daniel Villa has some interest	

8:30: Handbook: (15 minutes)

Looking to find volunteers

8:45: New Business (15 minutes)

9:00: Adjourn

Multi-Scale Building Energy Modeling (MBEM) Subcommittee of TC4.7

Minutes

Orlando

Tuesday, 04 Feb 2020

3:30-5:00pm, Hilton Orlando, LL, Orange B

Introductions and Agenda Review (5 minutes)

- Sign-up sheet
- Around Room
- Agenda Mods & Requests
 - o BEQ: How building EQ can work with existing BEMs (Rob Riley, Charles Eley)?

Announcements (5 minutes)

- Call for Austin Program Tracks and schedule (see attachment 1)
- Josh New reports that the roster has been corrected to show Judkoff as subcommittee chair for MBEM (not applications)
- Chris Balbach: Status of ASHRAE TC Reorg.

Program (15 Minutes) (Brian Kastl)

2020 Winter (Orlando) Status

- SSPC-140 Addendum A, (4.7) “Airside HVAC BESTEST” (Joel & Ron), Ralph submitted for Orlando. Was accepted. Seminar 64: 9:45-10:45 Hilton Orlando, LL, Orange C
- Title: Data Visualization to Achieve High Performance Design (Kolderup)?
- MBEM Part 12: Molecules to Models. Submitted by Macumber. Not accepted
 - o [To revisit](#)

2020 Summer (Austin) Proposals

- Ralph submit V&U session for Austin? (LBNL, ORNL, NREL, ANL). Is it ready yet?
- Project Stasio IBPSA Erik Kolderup thinking to submit for Austin?
- Joshua: (idea only – someone should lead) Empirical validation of multiscale buildings
 - o [No takers](#)
- Joshua (idea only – someone else should lead) What data layers contribute what value to a multiscale model.
 - o [Hong, Muehleisen, Fontanini for Chicago?](#)
- Tianzhen thinking of submitting something on “Performance Gap” for Austin?

- o Move to Chicago
- Ralph to submit track on Energy Modeling for Resiliency in Resiliency track.
- Paulo to submit and chair on communities “Sustainable Campuses” ... Student, former student, Wangda
- Data visualization / Project Stasio? (Kolderup)

Tianzhen submitted a HOF section on multiscale for Chapter 19 (TC-4.7).

BEO: (20min) How Building EQ can work with BEMs (20 min)(Rob Riley, Charles Eley)

Ask for volunteers who can apply to test BEO procedure:

- [John Pruitt](#)
- [Qinbo Li \(boboannli@tamu.edu\)](mailto:boboannli@tamu.edu)

Research (30 minutes)

Status: Potential RTARS/Work Statements (15 minutes each max)

WS 1816. Load profiles for hospital imaging equipment. TC-4.7 voted to co-sponsor with TC-9.6 on May 10. Jeff Haberl volunteered for PES for this. This will stay in MBEM and not moved to SCM. Put out for bid, one proposal received. Evaluation of bid was positive. Recommendation put forward to RAC to accept.

ACTION: Follow up to see if Haberl can still participate.

RTAR approved by RAC. WS-1857 started by Neal Krus and Tim McDowell. “Improved simplified methodology for describing and calculating heat conduction through the ground. TC-4.4 will co-sponsor. 90.1 and 4.1 are other potential co-sponsors. ACTION: Neal and Tim to work with Chris for an online/teleconference vote. Info sent out to full TC for comments.

Approved by 4.7. Approved by 4.1. 4.4 mail ballot. 90.1 still needs to discuss.

APPS: WS-1730 “Research to Determine the Mass Flow Rate Correlations for Standard Venting Strategies & Components in Attic Spaces with Sloped Roofs”. Fontanini sent to RAC. Rejected. Response being formulated to RAC comments.

Fontanini needs to get comments from research chair to push it forward.

Check with Jeff Haberl

- MBEM: Optimizing change-over mixed-mode cooling systems for houses, using building simulation (Liping Wang, Jeff Haberl, Kamal Haddad). Liping had to leave before the MBEM meeting. She is considering updating this WS.

Needs to be resubmitted.

- RTAR-xxx, Toolkit for Passive Solar and Whole Building Simulations. Transys, Energy Plus. Make it independent from commercial software; like hvac01, and hvac02 toolkits. How to get to netzero. (Jaya; Montana State University) Jeff says this is under construction but is going slowly.

No status update.

- Jeff H. wants to have more cases for RP 865 – analytical solutions for air side HVAC.

No progress. In roadmap for SSPC 140. Move to SCM.

- Follow-on to RP1588 Window Method. Joe H. There is research need to find the differences between the simple monolithic and the detailed model. This would compare the “Windows” detailed model, the 1588 model, and the simple SHGF approach. These would be run on all the prototype models in all the climate zones to determine national impact. Joe H will start, Neal will help, and this can be a very small and defined RTAR. Joe H. said he would start on this. Jeff Haberl to call Joe H to discuss further.

Move to SCM.

New Research Ideas

Why we have to use different calculations for loads vs. whole building simulation. Chip Barnaby. (moved from SCM)

Future: RP for reviewing BEQ results from 1771. Balbach.

Model calibration for future weather climate change. Villa. RTAR half written. MBEM/DDM?

Updates on related activities (5 minutes)

- IBPSA Project: BIM/GIS and Modelica Framework for building and community energy systems design and operation
 - o MODELICA Libraries, Building and City Models, Dissemination.

New Topics for Discussion (10 min)

- Tianzhen et al writing an MBEM section for TC-4.7 chapter 19 in HOF

Attachment 1: Tracks and Deadlines for Austin (June 27 – July 1, 3030)

ASHRAE Calls for Program Austin Summer 2020

Austin, TX | June 27 -July 1

1. Fundamentals and Applications: Fundamentals are the foundation for understanding applications in engineering. Key components of ASHRAE fundamentals include thermodynamics, psychometrics, fluid and mass flow. This track provides opportunities for papers and presentations of varying levels across a large topic base. Concepts, design elements and shared experiences for theoretical and applied concepts of HVAC&R design are included.

Rupesh Iyengar Rupesh_iyengar@yahoo.com

2. HVAC&R Systems and Equipment: HVAC&R Systems and Equipment are constantly evolving to address the changing requirements of the built environment. Papers and programs in this track will focus on the

development of new systems and equipment, improvements to existing systems and equipment and the proper application and operation of systems and equipment.

Ashu Gupta Ashu.energy@gmail.com

3. **Research Summit:** Active research, and the exchange of those research findings, are critical to the development of our HVAC&R industry and built environment. The 8th annual research summit invites researchers to share those results, including ASHRAE-sponsored research and research of interest to the ASHRAE community. Researchers are invited to present papers, extended abstracts, seminars, forums or participate in panel discussions. The Research Summit includes a partnership with ASHRAE's archival journal, Science and Technology for the Built Environment.

Kristen Cetin kctin@iastate.edu

4. **Professional Development:** As members of a professional organization, we not only participate for the great value of technical exchange, but also the interpersonal exchange. We recognize that the single greatest strength of our organization is its membership. This track is designed to allow those professionals an opportunity to develop in the areas of presentation skills, leadership, team-building, understanding various business operations, interpersonal skills, etc. In short, the Professional Development Track will cover all aspects of business outside of engineering/technical applications and lends itself to interactive session types such as workshops and forums.

Devin Abellon devin.abellon@yahoo.com

5. **Grid-Interactive Efficient Built Environment:** This new track focuses on the effects of industry trends (grid-enabled buildings, demand response, decarbonization, etc.) on system, building and community design practices. Topics include smart building, grid-enabled equipment and appliance, and HVAC design and operation for load flexibility. Topic can also include energy storage (thermal, battery, building mass, etc.), energy recovery (from condenser water or air), time-of-day practices, utility programs, etc.

Vikrant C Aute vikrant@umd.edu

6. **Multifamily and Residential Buildings:** Multifamily is one of the fast growth building sectors but has been underserved. Multifamily buildings present challenges and opportunities on energy codes requirements, energy efficiency opportunities, ventilation and air tightness balance, and equality to address low-income multifamily buildings. This track covers programs and papers on best practices, utility and above-code incentive programs, field studies, and codes and standards requirements. This track also welcomes programs and papers for single family housing and other residential buildings.

Sonya Pouncy sonyapouncy@gmail.com

7. **Resilient Buildings and Communities:** The cycle of building development, design and construction is moving more rapidly than ever. Key stakeholders in the design and construction process face new challenges of responding to a range of environmental, market and consumer-driven pressures. Increasingly, it is being recognized that “smart” buildings and integrated systems are central to successfully addressing challenges posed by climate change, natural disasters, accidents, disease, and terrorism. Papers and program in this track focus on innovation and exploration related to these challenges and best practices that enable adaptability, resilience and recovery of buildings and communities.

Christine Reinders-Caron christinereinders@gmail.com

8. Zero Energy Buildings and Communities: Opportunities and Challenges. To address the climate change challenges and carbon reduction needs, zero energy buildings and communities have proven concept in many cases. However these case studies remain a very minor portion of the building stock. This track provides an opportunity to address the challenges and demonstrate opportunities in a wide range of perspectives. Topics in this track includes integrated design approach, tools and resources to make it easier on zero energy design and operation, innovative and state-of-art technologies and strategies; balance between energy efficiency measures and on-site renewable generation, aggregated scale to achieve zero energy communities and campuses. This track will also cover the topics on policies and regulations, codes and standards and utility programs for adoption and scale up of zero energy buildings and communities.

Raul Simonetti raul.simonetti@carel.com

9. Mini-Track. Building Myths: It is often difficult to present or publish “negative” results where there was no successful outcome of an experiment or study. This often leads to people conducting similar experiments to discover what others knew but never published. This min-track is designated to share the lessons learned from these precious experiences. This mini-track will also identify and test unquestioned assumptions related to the built environment and its efficient operation.

Kimberly Pierson kdpwildcat@gmail.com

Important Dates:

- Monday, August 12, 2019 Conference Paper Abstracts, Technical Papers and Paper Session Requests Due
- Friday, August 30, 2019 Conference Paper Abstract Accept/Reject Notifications
- Monday, December 2, 2019 Conference Papers Due - Submitted for Review (Includes Bio, Learning Objectives and Methods of Assessment)
- Friday, December 20, 2019 Conference Paper Accept/Revise/Reject Notifications
- Monday, January 13, 2020 Website Opens for Seminar, Workshop, Panel, Debate, Forum and Extended Abstract Proposals
- Monday, January 13, 2020 Revised Conference Papers/Final Technical Papers Due
- Monday, February 10, 2020 Program (Seminar, Forum, Workshop, Debate and Panel) and Extended Abstract Paper Due
- Tuesday, February 18, 2020 Conference and Technical Paper Final Accept/Reject Notifications
- Monday, March 2, 2020 Extended Abstracts Accept/Reject Notifications
- Monday, March 16, 2020 Debate, Panel, Seminar, Forum, Workshop Accept/Reject Notifications
- Friday, May 1, 2020 Upload of presentation open for review
- Monday, June 1, 2020 Presentation submissions due

Attachment 2: Paper and Program Type Definitions

Conference Papers are short overview papers (8 pages or less), undergo single blind review and require 2 reviewers per paper.

Technical Papers are full research papers, undergo double-blind review and require 3 reviewers per paper.

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.

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.

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.

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.

SSPC 140 Meeting Summary – 03Feb2020 (submitted to TC4.7 2/04/20)

Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.

For Item 2. Chair Announcements

- **140-2017 is current; integrated airside HVAC cases with 140-2014 test suites.**
 - **IRS rules** re the deduction for energy efficient **commercial buildings** require software used for assessing tax credits be tested as follows for projects placed in service:
 - o On/after Jan 1,2016: test to 140-2014 (except Secs. 5.2.4, 7, 8) **12 progs (31 vers.) qualified; 1 new prog and 4 new versions since last June**
 - o On or before Dec 31, 2015: test to 140-2007, **13 programs qualified.**
- New submittals to ron.judkoff@nrel.gov.
Qualified programs listed at <http://energy.gov/eere/buildings/qualified-software-calculating-commercial-building-tax-deductions> (Last check 24Jan2020).
- **RESNET or DOE list 3** (last check 24Jan2020 tools as either accredited for HERS ratings, “45L” tax credit compliance (DOE). Required tests are NREL’s HERS BESTEST (included since Std 140-2011), along with equipment modeling and other modeling tests developed by RESNET. “45L” submit to DOE (45Lsoftware@ee.doe.gov) **Other submittals to RESNET (<http://www.resnet.us/professional/programs/software>).**
 - **ASHRAE 90.1 and 189.1 reference Standard 140;**
 - 90.1-2016, published Fall 2016, references 140-2014 (except Sections 7, 8)
 - 90.1-2019, published Oct 2019, refs 140-2017 (except Sections 7, 8).
 - **2018 IECC cites 140-2014;** IGCC citation accords with IECC.
 - **ASHRAE 90.2-2018 is published,** references Standard 140, Section 7

Building Thermal Fabric Tests Update (140, Section 5.2)

- Address advances in modeling state of the art since 1995
- Revisions to existing test cases and inclusion of additional excursion (parametric sensitivity) test cases is nearing completion in collaboration with SSPC 140.

Test suite progress:

- 140-2017 Addendum A, building thermal fabric model test update
 - o **Underlying NREL and Argonne project final report to be published by Argonne lab in April (we hope). The technical work is complete.**
 - o **Addendum A on track for PC-approve-for-public-review letter ballot, late Feb**
- Next steps (plan):
 - o Addendum Public Review (Spring/Summer 2020)
 - o Continuous maintenance revision (Autumn 2020).

New Test Suite: Weather Drivers

- **Led by Tim McDowell**
- **Primarily a weather data transcription test, some model tests related to incident solar and humidity calculations**

Prioritization of Possible Test Suites to Develop after Completion of Building Thermal Fabric Tests Update (from Jun 2019):

- After polling the PC members we concluded that four test suites can be given the highest priority by the PC members, these include (in alphabetical order):
 - o Airside HVAC BESTEST Volume 2
 - o Update of HVAC BESTEST cases applying empirically determined performance maps
 - o Weather-Driven Infiltration and Natural Ventilation

- Weather-Drivers

The following test suites also remain under consideration:

Empirical Validation Tests

- New DOE “Validation and Uncertainty” project tests
 - LBNL Flexlab test cases
 - ORNL FRP test cases
- NREL indoor/outdoor apartment module tests
- “ETNA BESTEST” Empirical Validation Test Spec (JNA, Electricite de France, NREL)

Other Analytical Verification and Comparative Tests

- IEA-34/43 Multi-Zone Test Suite
- More Ground-Coupled Heat Transfer Cases
- 2/3-D conduction cases (e.g., window frames and thermal bridges)
- ASHRAE RP-1052 “Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Thermal Fabric
- Domestic Hot Water
- Standard 205 Performance Map Tests

Empirical Validation: Work sponsored by DOE is in progress. Experimental data is being developed along with simulation results for comparison with empirical data. The participating labs are LBNL (Kohler, Haves), ORNL (Im, New), NREL (Judkoff) and ANL (Muehleisen)

- Continuation of original 3 year project
- Uncertainty analysis:
 - ANL’s analysis us being used to differentiate test case quality (ability to simulate)
- A new project in this is NREL’s indoor/outdoor apartment module that allows empirical determination of exterior wall conductance related inputs, which is difficult to determine without the highly controllable environment that is possible by initially running experiments indoors.
- Another new project is ANL/JNA for mining ETNA BESTEST (data collected by Electricite de France [1999-2001] under guidance of J. Neymark & Associates and NREL)

Empirical validation (where program results are compared to empirical data) is much more difficult than comparative testing (comparing software to each other) or analytical verification testing (comparing program results to analytical solution results developed outside of whole building energy sim progs). This is because test specifications are more complex (real experimental facility versus idealized analytical verification or comparative tests for simplicity of input) and inputs must be empirically determined (in addition to the target output results).

Referencing of 140-2017 in 90.1-2019 (from Jun 2019):

- SSPC 90.1 has updated via addendum their reference of 140 for 90.1-2019 to 140-2017; publication of 90.1-2019 expected in November
- 90.1 ECB/140 collaborative working group met Sunday afternoon
 - Primary objective is to develop acceptance criteria for 140 test results.
 - Preliminary work is beginning.

**Std 140 Acceptance Criteria for Programs Applied for 90.1 Energy Cost Budget Analysis
SSPC 140 voted unanimously to endorse continuation of the ECB-140 working group
that will provide proposals to:**

- **Amend Standard 140 to include a normative section with a methodology and all necessary thresholds to assess BEM software using the existing test cases, and**
- **Amend Standard 90.1 Section 11, Appendix C, and Appendix G to include a reference to the new normative section of 140 using simple numeric criteria to determine what software can be used.**

Update of Section 5 to include elements of Section 7 tests is under consideration. This would allow deletion of Section 7 tests which are approaching obsolescence as most residential models are directly applying hourly simulation engines.

Standard 140 Stakeholder Meeting (Muehleisen): Agenda: Working with stakeholders to develop acceptance criteria for use with Standard 140; also possibility of automation of test suites, standardized input (or at least geometry) of tests (flavor of xml), user manual or more examples of using 140. Format is virtual meeting planned in coming months; contact Ralph for info and invite.

References to Standard 140. Standard 140 is referenced by:

- IRS, Standard 90.1
- Standard 189 (High Performance Green Building Design) Appendix D
- Standard 90.2-2018 (new) references Section 7 tests (adapted from HERS BESTEST 1995)
- IECC, IGCC
- The newly developing COMNet (BPI, Energy Foundation et al) User's Manual.
- Implicitly referenced for ASHRAE Building Energy Quotient IF that is based on the COMNet User's Manual;
- RESNET references Section 7 tests.
- Florida Building Commission
- Various international references.

Listing of test suites included in ANSI/ASHRAE Standard 140, Analytical Verification Tests and Comparative Tests (year added to Standard 140 in parenthesis below.)

- NREL/IEA 12/21 "IEA BESTEST", building thermal fabric comparative tests (2001)
- NREL/IEA 22 "HVAC BESTEST Volume 1", working-fluid side analytical verification tests (2004)
- NREL/IEA 22 "HVAC BESTEST Volume 2", working-fluid side comparative (2007)
- NRCan/IEA 22 "Furnace BESTEST", analytical verification and comparative (2007)
- NREL/HERS Council "HERS BESTEST", comparative tests, simplified residential analysis tools (2011)
- NREL/IEA-34/43 "Ground-Coupled Slab-On-Grade In-Depth Tests", analytical verification (2014)
- ASHRAE RP-865 "Air-Side HVAC BESTEST, air-side mechanical equipment analytical verification tests based on ASHRAE 865 RP (2017)

Full SSPC 140 meeting notes are available at <http://sspc140.ashraepcs.org/index.html>.