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| **AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND****AIR CONDITIONING ENGINEERS, INC.**1791Tullie Circle, NE / Atlanta, GA30329(404) 636-8400 |
| TC/TG/TRG MINUTES COVER SHEET(Minutes of all TC/TG/TRG Meetings are to be distributed to all persons listed below within 60 days following the meeting.) |
| TC/TG/TRG NO.: | **4.10** | TC/TG/TRG TITLE: | **INDOOR ENVIRONMENTAL MODELING** |
| DATE OF MEETING: | January 16th, 2021 | LOCATION: | Chicago, IL (Virtual TC Meeting) |
| DATE ISSUED: | January 17th, 2021 | RECORDED BY: | Leon Wang |
| VOTING MEMBERS | TERM | PRESENT | officers | TERM |
| On | Off | On | Off |
| Van Gilder, Jim | 18 | 22 | ✓ | Chair | Zuo, Wangda | 19 | 21 |
| Koupriyanov, Mikhail  | 18 | 22 | ✓ | Vice Chair | Lo, James | 19 | 21 |
| Zhai, John  | 20 | 24 | ✓ | Secretary | Wang, Leon | 19 | 21 |
| Heidanndegad, Mohammad | 20 | 24 | ✓ | Programs | VanGilder, Jim  | 19 | 21 |
| Wang, Leon  | 17 | 21 | ✓ | Research | Lin, Charlie | 17 | N/A |
| Hosni, Mo | 20 | 24 | X | Handbook | Rim, Donhyun | 18 | N/A |
| Zuo, Wangda | 17 | 21 | ✓ | Membership | Phyfe, Duncan | 18 | N/A |
| Phyfe, Duncan | 18 | 22 | ✓ | Web Page | Dols, William Stuart | 19 | N/A |
| Dols, Stuart | 17 | 21 | ✓ | Honors and Awards | Lin, Chao-Hsin | 16 | N/A |
| Chen, QingYan | 17 | 21 | ✓ | ALI | Zhai, John | 04 | N/A |
| Yang, Xudong (INT) | 17 | 21 | X |  |  |  |  |
| Cook, Malcom (INT) | 20 | 24 | X |  |  |  |  |
| Lin, Chao-Hsin | 18 | 22 | ✓ |  |  |  |  |

**Attendance List: See Appendix B**

|  |  |  |
| --- | --- | --- |
| **Society Liaisons, etc.** |  | PRESENT |
| Jamie Bennett | TAC Section Head | ✓ |
| Natascha Milesi-Ferretti | RAC Research Liaison | ✓ |
| Meredith, David | Prof. Devt. Committee |  |
| James Aswegan | Standards Liaison |  |
| Hosni, Mo | Program Liaison |  |
| Jay Kohler | TAC Chairman |  |
| Ferguson, Kimball | Special Publications Liaison |  |
| Ramspeck, Claire | Staff Liaison (Standards) |  |
| Gulledge, Charles E. | TEGA Liaison |  |
| Vaughn, Michael | Staff Liaison (Research) |  |
| GERARDO ALFONSO | Handbook Liaison (Fundamental) |  |
| Brian Krafthefer | Handbook Liaison (Applications) | ✓ |

**Call to order by Chairman:** (Wangda Zuo) at 10:00 am.

**Welcome by Chair**

**Self-Introductions of attendees**

**Roll call** (Duncan Phyfe) – voting members

|  |  |  |  |
| --- | --- | --- | --- |
| Cook, Malcolm (int.) | X | Xudong, Yang (int.) | X |
| Koupriyanov, Mikhail  | ✓ | Van Gilder, Jim  | ✓ |
| Hosni, Mo | X | Phyfe, Duncan | ✓ |
| Dols, Stuart  | ✓ | Wang, Leon  | ✓ |
| Zuo, Wangda | ✓ | Heidarinejad, Mohammad | ✓ |
| Chen, Yan | ✓ | Lin, Chao-Hsin | ✓ |
| Zhai, John | ✓ |  |  |

**Attendance**

* **10 of 11** non-international voting members were present
* **0 of 2** international voting members were present
* **Quorum achieved**
* Non-voting officers present: James Lo (vice-chair)

**Minutes from Austin meeting**

* Discussion on TC’s new scope (Jamie Bennett):

“TC 4.10 is concerned with developing methods and procedures for predicting indoor environmental conditions, including airflow, air quality, and the thermal environment.”

* Call vote for the TC’s new scope
	+ **Vote: (10-0-0)**
	+ **New scope approved**
* New scope updated on TC 4.10 website (Stuart)
* Call Approval of Austin minutes
	+ **Vote: (10-0-0)**
	+ **Minutes approved**

**ASHRAE Staffs**

* RAC Research Liaison (Natascha Milesi-Ferretti)
	+ Due to COVID-19, ASHRAE research funds are lower, while still around 1.6 million for research; Project discussions will be in March of 2021; Currently, no signs of RTAR, PTAR numbers reduced; New projects are recommended to follow the ASHRAE strategic plan. Normal RAC announcements will be available on Feb. 8, 2021.
* ASHRAE Handbook Liaison (Applications) (Brian Krafthefer)
	+ Donghyun will need to forward the Chicago handbook committee meeting minutes to Brian. The new fundamental chapter was sent in June 2020. The application handbook was due in July 2022 and will be published in 2023.
	+ Recommending publications could help with revenues: e.g., updating ASHRAE design guidelines. Books. etc. Could use PTAR to support the publication efforts.
* TAC Section Head (Jamie Bennett)
	+ FG (Functional Group): encourage FG to work more efficiently. Both the section head (Jamie) and the committee (TC chair - Wangda) will work on a version. The two versions will be validated for submission to ASHRAE. Similar to activity form to keep track of a TC’s performance and evaluation.

**Announcements and reports (Wangda Zuo)**

* Chair’s Breakfast –Virtual Meeting

**Membership** (Duncan Phyfe)

* New Officers (Starting from June 30th 2021)
	+ N/A
* Voting Members
	+ VM Rolling OFF on July 31, 2021: Wangda Zuo, Qingyan Chen, Leon Wang, Stuart Dols, Xudong Yang1
	+ VM Rolling ON on August 1, 2021: James Lo, Charlie Lin, Donghyun Rim, Yang-Seon Kim
	+ Needs an international voting member (TBD).
	+ In future in-person meetings, it is possible to use remote sessions (Wangda)

**Standards/Guidelines**

No new ones. GPC 33 was updated in 2020.

**Research** (Charlie Lin)

* RP-1675
	+ May need another no-cost extension (09/30/2021): a six-month extension.
	+ **TC vote for approval of the extension**: **Vote: (10-0-0)**
	+ PMS chair (Jim) will contact the section liaison for the extension
* WS 1744
	+ May need experimental work based on the comments; Concern over the scope of the project. Data for validations. May add a PTAR regarding validation data.
* WS 1827
	+ Sent to ETF first (Jamie). Title changed. Duncan Phyfe and Mike will contribute too.
* RTAR 1828 – No news.
* RTAR 1908 – No news. Shichao will be contacted.
* New RTAR (Leon and Donghyun) - Constructing Surrogate and Reduced Order Models for Stratified Flows
	+ Leon and Donghyun suggested dropping this idea. Charlie suggested keeping it as a placeholder.
* New Ideas
	+ **Leon**: the previous new idea of COVID-19-related fast track RTAR was dropped because of existing literature studies. However, Jamie may combine this COVID-19 idea with WS 1827.
	+ **John**: ASHRAE may not cover all they know scientifically about COVID-19, so we may have a chance to suggest the ideas, although the ASHRAE funding level may be low at the moment.
	+ **Duncan**: ASHRAE scientific committee: the community does not have a certain database: displacement ventilation VS fully-mixed ventilation rooms, given no information about the location of infectors; Duncan will recommend the idea of a fast track of a study from the scientific committee. This may be applied to aircraft environments too.
* The following notes were recorded by Charlie in the Research Subcommittee meeting:

The research subcommittee met on Friday (01/15) at 11:00 am-12:00 pm. There were \_15\_ attendees in the meeting. Revolving submission deadlines: March 15, May 15th, August 15th, and December 15th.

**Current Status of TC 4.10 RTARs, WSs, and Projects.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Projects** | **PMS** | **Title** | **Status** |
| 1675-RP | Jim VanGilder, Mark Seymour, John Groenewold, (Greg), Wangda Zuo | Guidance for CFD Modeling of Data Centers | * Testing data are collected for all tasks
* CFD data analysis ongoing
* Final report in progress
 |
| **Bidding** | **PMS** | **Title** | **Status** |
|  |  |  | No project for bidding this time |
| **WSs** | **Author(s)** | **Title** | **Status** |
| 1744 | Malcolm Cook, James Lo, **Duncan Phyfe,** Mike Koupriyanov | Guidelines for Accurate CFD Modeling of Natural Ventilation | * Re-submitted 03/13/2020
* RAC feedback 06/02/2020
* To be revisited (Duncan)
* Possibility for PTAR
 |
| 1827 | James Bennet,Mike Koupriyanov,Duncan Phyfe | Particle Inhalation Modeling of Aircraft Cabins as Sparse Non-uniform Spaces Phase I | * WS revised per RAC comments
* Contacted TC 9.3; responded 06/22/2020. No news after that.
* To be submitted to ETF, with change in title
 |
| **RTAR** | **Author(s)** | **Title** | **Status** |
| 1828 | Chao-Hsin Lin, Charlie LinChun Chen  | Flow Characteristics of Installed Flex Ducts | * RTAR submitted to RAC 05/15/2017,
* to be revised without TC 5.2
 |
| 1908 | Shichao Liu, Hui Zhang,Leon Wang, Jim Van GilderMohammad Heidarinejad, | A Simplified CFD Modeling Method to Assess Thermal Environment and Air Quality in Buildings with Ceiling Fans | * Submitted 05/15/2020
* Co-sponsor: TC 2.1
* RAC accepted with comments 07/10/2020
 |
| New | Leon Wang,Donghyun Rim, Anthony Fontanini | Constructing Surrogate and Reduced Order Models for Stratified Flows | * RTAR drafted 06/25/2017
* Revision to be done based on discussions before next meeting
* To be sent to TC 4.10 members
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Updates on Request for Support on RTAR/WS

Co-Sponsor WS-1874 “Climate Design Conditions for Roof Top HVAC Equipment” (TC 4.2, Joe Huang). RTAR approved by RAC. John Zhai from TC 4.10 was involved in discussions. Shichao Liu on PES.

Co-Sponsor RTAR-1868 “Feasibility of Predicting Indoor Formaldehyde, VOC, and CO2 Concentration using Simplified Inputs to Air Quality Models in New Office Buildings” (SSPC 62.1, Author: Lisa Ng, Atila, Gourish, Meng). Similar to RP-1596. TC 2.8 is also involved. Xudong Yang is interested. Less than $200k.

Co-sponsor WS 1748 “Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations (Phase 2)” (led by TC 4.7, Authors: Tony Fontanini, Joe Huang). The WS has received comments from RAC for revision/re-submission. WS to be shared by Tony and voted on by TC 4.10.

**New Ideas:**

* COVID-19 related. Social distancing. Ventilation rate. BCs. Mask. Quick RTAR/WS. With TC 2.1. (Leon. Ray, James, Duncan, Mohammad, Malcolm, Donghyun, Yang-Seon Kim, Reza). Combine it with the 1827-WS (aircraft). Buildings: ventilation types/conditions ~ infection risk with CFD (Duncan Phillips) for ETF.
* **Ventilation effectiveness by SSPC 62.1, looking for co-sponsor with TC 4.10, possible RTAR in the next couple of weeks (Malcolm).**
* Data-driven model for the indoor environment (James Lo). RTAR to be developed before Austin meeting.
* Radiation model in CFD, possible co-sponsorship from TC 6.5. (Mike Koupriyanov, Reza Ghias). RTAR to be developed.
* CFD modeling of chemical reaction in building. With experimental data. (Donghyun, Atila, Shamia). RTAR to be developed.
* **Benchmark cases for CFD (Mike, James, Duncan, Jim). ASHRAE certified cases. Existing and new cases.**
* Open source CFD (Jim, Mike, Chao). Benchmark cases. Cost analysis and quantification. To be worked on after completion of handbook.
* Quantification of multiple GPUs computing for indoor airflows. Embedded devices. (Jim, Wangda, Leon, Himanshu). RTAR before next society meeting.
* Occupational exposure prediction using FFD for real time control intervention. (Jamie, Jim).

**Handbook (Donghyun Rim)**

Friday (01/15/2021), 10:00 AM – 11:00 AM (Eastern Time), Virtual Meeting

* Fundamental revision (waiting for Liason)
* Add examples of particle transport (Application Handbook asking for contributors)

**Program (Jim VanGilder)**

Thursday (01/14/2021), 11:00 AM – 12:00 PM (Eastern Time), Virtual Meeting

* Seminar 23 – Live session Q&A
* Phoenix, Summer 2021 --- Deadline submission: Feb. 22, 2021

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| **Chicago (Virtual), Winter 2021** |
| **Session Type** | **Session Title** | **Session Chair** | **Speakers** |
| Seminar | Seminar 77 - Smart Indoor Environmental Models for Data Centers TC9.9 co-sponsorship | Wangda Zuo | Mark SeymourJim VanGilderDustin Demetriou |
| Seminar | Seminar 88 - Whole Greater Than the Sum: Coupling Building Simulation Techniques | Mike Koupriyanov | Leon WangMark SeymourWangda ZuoJim VanGilderReza Ghias  |
| Seminar | Seminar 23 - Indoor Environment Modeling for Pandemic ResiliencyWednesday, February 10, 6:00 PM - 7:50 PM | James Lo | Yan ChenDietrich WattsDuncan PhillipsDuncan Phyfe |
| Seminar | Seminar 70 - Modeling of Surfaces Mass Transfer in Indoor Environment | Wangda Zuo | Atila NovoselacDuncan Phyfe |

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| **Phoenix, Summer 2021** |
| **Session Type** | **Session Title** | **Session Chair** | **Speakers** |
| Seminar | Work Smarter Not Harder: 3D CFD Not Required!Track 5 | Mohamed Heidarinejad | Duncan Phyfe: 2D train stationDuncan Phillips: Building FNMJames Lo: Sub-zonal models Leon Wang: CONTAM Modeling |
| Seminar | Data-Driven CFDTrack 3 or 5 | Duncan Phyfe | Chao Ding: Compact model/urban microclimateWangda Zuo: AI+FFDHimanshu SharmaDuncan Phillips: External FlowLeon Wang: Indoor FFD w/ LES |
| Seminar | Recent Advances in CFD for Indoor EnvironmentsTrack 1 or 3, TC9.9 co-sponsorship | Yang-Seon Kim | Jim VanGilder: Data CentersMark Seymour: Data CentersDustin Demetriou: Data Centers (Acoustics) |
| Seminar | Comparison of RANS and LESTrack 3, Connection to Modeling-Natural-Convection research project?  | Wangda Zuo | Duncan Phillips: indoor or outdoorMalcolm CookShichao Liu |
| Seminar | Mixing vs. Displacement Ventilation for Virus TransmissionTrack 5 | Wangda Zuo | Duncan PhillipsDuncan PhyfeYan ChenMike Koupriyanov |

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| **Las Vegas, Winter 2022** |
| **Session Type** | **Session Title** | **Session Chair** | **Speakers** |
| Seminar | International Showcase of Airflow Modeling (Different climates, codes, requirements) | Wangda Zuo | Steven Thomasen???Duncan PhillipsDuncan PhyfeLeon Wang: QatarMark Seymour: Data Center |
| Seminar | War Stories: When Everything Went Wrong (Challenging problems, lessons learned)Something from Data-Center-Modeling research project? | Mike Koupriyanov  | Duncan Phillips: Steady state wasn’t!Jim VanGilderDuncan PhyfeCharlie Lin: Data centers (RP-1675) |
| Seminar | GPU, parallelization, CFD algorithms, results quality, IOT/embedded deviceMaybe put in with Advances in CFD | Himanshu Sharma | Jim VanGilder: DC applicationWangda Zuo: Hardware focusLeon Wang: Limits?John Zhai???Mark Seymour: How fast is needed? |
| Seminar | Aircraft Cabins | Duncan Phyfe | Jamie Bennett |
| Seminar | Aircraft assembly, maintenance, and painting | Duncan Phillips | Jamie Bennett |
| Seminar | Fans, Jets, and Diffusers Oh My!– Airflow Boundary ConditionsMove to Las Vegas | Jim VanGilder | Shichao Liu???Leon Wang: (Vegas) Ceiling fans, floor fansMark Seymour: Data Center (MRF-prefers Vegas)Duncan Phyfe (prefers Vegas)Duncan PhillipsCharlie: ECM fan modelingFrancesco (if virtual)??? |

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| **Unscheduled Ideas/Brainstorming**  |
| **Session Type** | **Session Title** | **Session Chair** | **Speakers** |
|  |  |  |  |

# Notes

* We should be reporting Forums, Debates, Seminars, Paper Sessions, TC Research Results, and Other Papers on our TC Activity form – either for sessions organized by the TC or submitted individually by a member.
* As a committee, we should be pro-actively suggesting tracks: <https://www.ashrae.org/conferences/conference-resources/papers-and-programs>

# Deadlines

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| --- | --- | --- | --- | --- | --- |
| Conference | Type | Program Submissions | Extended Abstract | Conference Paper Abstract/Technical Paper | Conference Paper |
| Phoenix2021 | Summer | Feb 22 2021 | Feb 15 2021 | Aug 2020 | Dec 2020 |
| Las Vegas2022 | Winter | Aug 2021 | Aug 2021 | Apr 2021 | Jul 2021 |
| Toronto2022 | Summer | Feb 2022 | Feb 2022 | Aug 2021 | Dec 2021 |

# Phoenix 2021 - Tracks

Track 1: Fundamentals and Applications

Track 2: HVAC&R Systems and Equipment

Track 3: Research Summit

Track 4: Professional Development

Track 5: Design, Control and Operation of Critical Environments

Track 6: HVAC&R for Indoor Plants and Animals

Track 7: Future Proofing: Renewable, Regenerative, Resilient

Track 8: Hot, Hot, Hot

Definitions

* Seminar: 1-4 presentations, 60 or 90 min (5 presentations acceptable for 90 min slot)
* Forum: 1 moderator, 60 min, no presentations
* Workshop: 1 chair, 1-2 presentations, 60 min, 30 min reserved for discussion
* Conference paper: ≤8 pages total, all formatting by author
* Technical paper: ≤30 double-spaced pages of text, ≤12 figures, formatted by ASHRAE
* Panel Session: 1 moderator, 60-90 minutes, 3-6 participants, no individual presentations
* Extended abstract: ≤3 pages total (published), single-round review (2), presentation

**Web site activity (**Stuart Dols**):**

* TC 4.10 new scope updated.

**Report of relevant activities in other TCs (N/A)**

TC1.2 *Instruments and Measurements*

 TC2.1 *Physiology and Human Environment*

 TC2.3 *Gaseous Air Contaminants/Removal Equipment*

 TC2.4 *Particulate Air Contaminants/Removal Equipment*

 TC4.3 *Ventilation Requirements and Infiltration* – Duncan Phillips

 TC5.3 *Room Air Distribution –* Mike Koupriyanov

 TC5.6 *Control of Fire and Smoke* – Dahai Qi

* + CFD chapter added to new ASHRAE book

 TC5.8 *Industrial Ventilation –* Jamie Bennett

 TC9.2 *Industrial Air-Conditioning and Ventilation –* Jamie Bennett

 TC9.9 *Mission Critical Facilities* – Jim VanGilder

**Honors and Awards (**Chao-Hsin**)**

Ideas about CFD modeling awards – ANSYS CFD awards.

Jensen Zhang was awarded **ASHRAE** Research **Award** (Co-nominated by TC 4.10)

**New Business**

N/A

**Agenda Suggestions for Next Meeting**

N/A

**Call to adjourn by chair:** (Wangda Zuo) at 12:05 pm Vote 10-0-0.

**APPENDIX A: DESCRIPTION OF TC’S SCOPE (NEW)**

TC 4.10 is concerned with developing methods and procedures for predicting indoor environmental conditions, including airflow, air quality, and the thermal environment.

**Appendix B:** Attendance list (based on the online form)

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| --- | --- | --- |
| muh182@iit.edu | Mohammad Heidarinejad | Illinois Institute of Technology |
| leon.wang@concordia.ca | Liangzhu (Leon) Wang | Concordia University |
| william.dols@nist.gov | W. Stuart Dols | NIST |
| yang-seon.kim@wichita.edu | Yang-Seon Kim | Wichita State University |
| lincx@fiu.edu | Cheng-Xian (Charlie) Lin | Florida International University |
| xuha3556@colorado.edu | Xu Han | Harvard University |
| John.zhai@colorado.edu | John Zhai | University of Colorado at Boulder |
| steven.emmerich@nist.gov | Steven Emmerich | NIST |
| dcchris86@gmail.com | Chao Ding | Lawrence Berkeley National Lab |
| duncan.phillips@rwdi.com | Duncan Phillips | RWDI |
| sammeleika@yahoo.com | Sam Meleika | National Renewable Energy Laboratory |
| MikeK@priceindustries.com | Mikhail Koupriyanov | Price Industries Limited |
| mark.seymour@futurefacilities.com | Mark Seymour | Future Facilities |
| prateek.shrestha@colorado.edu | Prateek Shrestha | Oak Ridge National Laboratory  |
| dwdemetr@us.ibm.com | Dustin Demetriou | IBM |
| Wangda.Zuo@colorado.ede | Wangda Zuo | University of Colorado Boulder |
| chao-hsin.lin@boeing.com | Chao-Hsin Lin | Boeing |