

**AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND
 AIR CONDITIONING ENGINEERS, INC.**

1791Tullie Circle, NE / Atlanta, GA30329
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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:	February 3, 2020		LOCATION:	Orlando, FL			
DATE ISSUED:	February 3, 2020		RECORDED BY:	James Lo for 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
Bennet, Jamie	16	20	✓	Secretary	Wang, Leon	19	21
Lin, Charlie	16	20	✓	Programs	VanGilder, Jim	19	21
Leon Wang	17	21	X	Research	Lin, Charlie	17	N/A
Rim, Donghyun	16	20	✓	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	X	Honors and Awards	Lin, Chao-Hsin	16	N/A
Chen, QingYan	17	21	✓	ALI	Zhai, John	04	N/A
Xudong Yang	17	21	X				
Zhang, Tim	16	20	X				
Chao-Hsin Lin	18	22	✓				

Attendance List: See Appendix B

Technical Committee 4.10 – Indoor Environmental Modeling
 These minutes are a **DRAFT** until voted upon by the committee.

Society Liaisons, etc.		PRESENT
Jamie Bennett	TAC Section Head	✓
Xudong Yang	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)	✓
Harris Sheinman	Handbook Liaison (Applications)	

Call to order by Chairman: (Wangda Zuo) at 2:15 p.m.

Welcome by Chair

Self-Introductions of attendees

Roll call (Mike Koupriyanov) – voting members

Zhang, Tim (int.)	X	Xudong, Yang (int.)	X
Koupriyanov, Mikhail	✓	Van Gilder, Jim	✓
Bennet, Jamie	✓	Phyfe, Duncan	✓
Stuart Dols	X	Leon Wang	X
Wangda Zuo	✓	Rim, Donghyun	✓
Yan Chen	✓	Lin, Charlie	✓

Attendance

- **8 of 12** non-international voting members were present
- **0 of 2** international voting members were present
- **Quorum achieved** without counting the Chair
- Non-voting officers present: James Lo (vice chair)

Minutes from Kansas City meeting

- Call Approval of Houston minutes
 - **Vote: (8-0-0)**
 - **Minutes approved**

ASHRAE Staff

- ASHRAE standard committee is looking for experts in reviewing standards in different areas, especially international members.
- Minutes especially research minutes should be forwarded to RL4@ASHRAE.net

Section Head (Jamie Bennett):

- Continuing TC re-org. effort, some TCs have already combined
- Need to re-examine statement of purpose for TC each year
- Indoor Environmental Quality is one of the strategic initiative areas
- All presentations (include presented in TCs) have to adhere ASHRAE rules and template
- Potential TC collaboration Area (instead of scheduled TC meeting rooms) for smaller TCs (10 or less members)

Membership (Duncan Phyfe)

- New Officers (Starting from Summer 2019)
 - N/A
- Voting Members
 - Rolled off VM in July 2020: Jamie Bennett, Donghyun Rim, Charlie Lin and Tim Zhang (Int)
 - Rolled on VM in July 2020: John Zhai, Mohammad Heidandegad, Mo Hosni, Malcolm Cook (INT)

- o New CM: Chao Ding, Jeff Franklin, Yang-Seon Kim, Sammy Meleika

Standards/Guidelines ()

N/A

Research (Charlie Lin)

The research subcommittee met on Sunday (02/02) at 5:00-6:00 pm. There were 19 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 Wangda Zuo John Groenewold	Guidance for CFD Modeling of Data Centers	<ul style="list-style-type: none"> Data center lab is setup, and testing data for three cases were collected CFD models were improved and simulations are ongoing NCE to be requested
Bidding	PMS	Title	Status
			No project for bidding this time
WSs	Author(s)	Title	Status
1744	Malcolm Cook, James Lo, Duncan Phye, Mike Koupriyanov, Jordan Clark	Guidelines for Accurate CFD Modeling of Natural Ventilation	<ul style="list-style-type: none"> Comments received from RAC 10/28/2016 WS revised To be voted and submitted for the next window
1827	James Bennet, Ray Horstman	Particle Inhalation Modeling of Aircraft Cabins as Sparse Non-uniform Spaces Phase I	<ul style="list-style-type: none"> WS revised per RAC comments Working on co-sponsorship Need champion (TC meeting, James Bennet)
RTAR	Author(s)	Title	Status
1828	James Bennett, Chao-Hsin Lin, Charlie Lin Chun Chen	Flow Characteristics of Installed Flex Ducts	<ul style="list-style-type: none"> RTAR submitted to RAC 05/15/2017, to be revised without TC 5.2 James to take the lead
New	Leon Wang, Donghyun Rim, Anthony Fontanini	Constructing Surrogate and Reduced Order Models for Stratified Flows	<ul style="list-style-type: none"> RTAR drafted 06/25/2017 Revision to be done based on discussions before next meeting To be sent to TC 4.10 members
New	Shichao Liu, Leon Wang, Mohammad Heidarinejad, Jim Van Gilder	Assessing thermal comfort and indoor air quality with ceiling fans integrated with mechanical mixing ventilation systems	<ul style="list-style-type: none"> RTAR drafted 01/08/2019 RTAR revised per discussions To be discussed and voted by email
(New)	Ray Horstman	Compensating for Sky Temperature Using Indoor Environmental Modeling of Environmental Test Chambers	<ul style="list-style-type: none"> Was not submitted to RAC per Liaison suggestions Revised version received with a new title and clarified scope. More discussions are needed.

Comments on WS-1744 “Guidelines for Accurate CFD Modeling of Natural Ventilation”

- Experimental work removed with reduced budget.

Comments on RTAR “Constructing Surrogate and Reduced Order Models for Stratified Flows”

- To be further revised.
- Leon and Donghyun will be co-authors.

Comments on RTAR “Assessing thermal comfort and indoor air quality with ceiling fans integrated with mechanical mixing ventilation systems”

- Add experimental validation
- Check related research conducted by other TCs

Comments on RTAR “Compensating for Sky Temperature Using Indoor Environmental Modeling of Environmental Test Chambers”

- Title to be revised to reflect the CFD work
- Clarify the benefits of environmental chamber
- How to mimic very cold outdoor environment using CFD-calibrated indoor environment chamber
- Possible cost sharing?
- How thermal radiation is taken into account in the validation cases?
- Expand the applicable examples to be more aligned to TC4.10's mission.

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 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 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:

- Data-driven model for 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.
- Ventilation effectiveness by SSPC 62.1, looking for co-sponsor with TC 4.10, possible RTAR in the next couple of weeks (Malcolm).
- CFD modeling of chemical reaction in building. With experimental data. (Donghyun, Atila, Shamia). RTAR to be developed.
- Benchmark cases for CFD (Jim, Mike, James, Duncan). Topic being discussed.
- Open source CFD (Jim, Mike). To be worked on after completion of handbook.
- Occupational exposure prediction using FFD for real time control intervention. New idea raised during general meeting (Jamie).
- Cost Analysis of CFD (Chao).

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- Quantification of multiple GPUs computing for indoor airflows (Jim, Wangda, Leon). RTAR before next society meeting.

Handbook (Donghyun Rim)

The Handbook subcommittee met on Sunday (02/02) at 4:00-5:00 pm. There were 15 attendees in the meeting.

ASHRAE Fundamentals Chapter 13 – Indoor Airflow Modeling

- Plan to update the chapter for 2021 Fundamentals
- Will make a clear, brief, and succinct Fundamental chapter that we won't make any major revisions for a while.
- The revision should be submitted by May 17 to be considered for publication.
- The most recent version document has been uploaded in Basecamp
- Plan to have couple online meetings to revise the chapter.

ASHRAE Applications Chapter 59– Indoor Airflow Modeling

- Can revise the chapter (online version only)
- The most recent document was shared in Basecamp for review.

Program (Jim VanGilder)

The Program Subcommittee met on Sunday (02/02) from 3:00-4:00pm.

Orlando, Winter 2020			
Session Type	Session Title	Session Chair	Speakers
Seminar	Aircraft Cabins Sunday 1:30 PM - 3:00 PM	Leon Wang	Yan Chen Jamie Bennett Tim Zhang Chun Chen Mo Hosni
Seminar	Ventilation Effectiveness Metrics Part 1: Humans Tuesday 8:00 AM - 9:30 AM	Malcolm Cook	Benjamin Simpson Mike Koupriyanov Duncan Phillips Kishor Khankari
Seminar	Ventilation Effectiveness Metrics Part 2: Equipment Wednesday 8:00 AM - 9:30 AM	Malcolm Cook	Mark Seymour Jim VanGilder Mike Koupriyanov

			Sammy Meleika
Seminar	Leveraging Models to Make Controls Smart Wednesday 11:00 AM - 12:30 PM	Duncan Phyfe	Charalampos Angelopoulos Mark Seymour Wangda Zuo Jim VanGilder Leon Wang

Austin, Summer 2020			
(Research Summit Track for all?)			
Session Type	Session Title	Session Chair	Speakers
Seminar	Modeling Chilled Beams (co-sponsor with 5.3 – Mike K. Snappier/goal-oriented title? Less airflow, energy efficiency, optimizing, occupant comfort, air quality)	Duncan Phyfe	Mike Koupriyanov: active John Zhai: validation data active (not CFD) Yan Chen: passive
Seminar	Impact of the Urban Microclimate on Buildings and the Indoor Environment (Related Seminar on Tuesday in Orlando: Seminar 52- building energy usage)	Shichao Liu	Leon Wang Mohamed Heidarinejad Duncan Phillips: micro-scale urban heat island Chao Ding: cross-ventilation
Seminar	Work Smarter Not Harder, Part 1: 3D CFD Not Required! (Was: Old School/Judgement/Right Tool for Job)	Mohamed Heidarinejad	Duncan Phyfe: 2D train station Duncan Phillips: tall building FNM James Lo: sub-zonal models (local age of air, buildings)
Seminar	Work Smarter Not Harder, Part 2: Compact Models	Wangda Zuo	Mark Seymour: When are compact models needed for data centers?

	(Was: Leveraging Compact Models) (TC9.9 co-sponsorship)		<p>Jim VanGilder: data center rack model</p> <p>Dustin Demetriou: compact IT</p> <p>Jeff Franklin: industrial environment</p>
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Future Conferences			
(Note: Energy Conservation Track)			
Session Type	Session Title	Session Chair	Speakers
Seminar	Coupling of CFD, FNM, Multi-Zone, etc. (New title: what is goal? Chicago)	Mike K.	<p>Leon: FFD w/ weather model</p> <p>Mark Seymour: CFD/FNM</p> <p>Wangda Zuo: FFD/MZ/HVAC control</p> <p>Jim VanGilder: FNM+PFM or FNM+CFD</p>
Seminar	Data-Driven CFD (Chicago)	Duncan Phyfe	<p>Chao Ding: compact model (also urban microclimate)</p> <p>Wangda Zuo: AI+FFD</p> <p>James Lo: Indoor cross-ventilation</p>
Seminar	Modeling Surfaces in Indoor Environments (Chicago)	Wangda Zuo	<p>Gang Tan</p> <p>Donghyun Rim: Human/Building</p> <p>Duncan Phyfe: Condensation?</p> <p>Atila Novoselac</p> <p>Gang Tan: TEC, phase change</p>

Seminar	Recent Advances in CFD for Indoor Environment <i>(Chicago)</i>	Yang-Seon Kim	Jim VanGilder Leon Wang: City (Large Scale) FFD w/ LES Mark Seymour Dustin Demetriou: Multiphysics
Seminar	International Showcase of Airflow Modeling <i>(Chicago)</i>	????	Steven Thomasen Duncan Phillips
Seminar	War Stories: When Everything Went Wrong (Challenging problems, lessons learned)	Mike Koupriyanov	Duncan Phillips: Steady state wasn't! Jim VanGilder Jeff Franklin Duncan Phyfe
Seminar	Comparison of RANS and LES		Duncan Phillips Jeff Franklin Yan Chen
Seminar	Ceiling Fans or other fans	Jim VanGilder	Shichao Liu Leon
Seminar	GPU, parallelization, CFD algorithms, results quality	????	Jim VanGilder Wangda Zuo Leon Wang John Zhai

Deadlines

Conference	Type	Seminar/Forum/Workshop/Debate/ Panel Session/Extended Abstract	Conference Paper Abstract/Technical Paper	Conference Paper
Austin 2020	Summer	Feb 10, 2020	Aug 12, 2019	Dec 2, 2019
Chicago 2021	Winter	Aug 2020	Mar 2020	Jul 2020
Phoenix 2021	Summer	Feb 2021	Aug 2020	Dec 2020

Web site activity (Stuart Dols):

- N/A

Report of relevant activities in other TCs

- TC1.2 *Instruments and Measurements* - Arsen Melikov
- TC2.1 *Physiology and Human Environment* – Arsen Melikov, Ray Horstman
- TC2.3 *Gaseous Air Contaminants/Removal Equipment*
- TC2.4 *Particulate Air Contaminants/Removal Equipment*
- TC2.6 *Sound and Vibration Control*
- TC4.3 *Ventilation Requirements and Infiltration* – Leon Wang
- TC4.7 *Load Calculation and Energy Modeling*
- TC5.3 *Room Air Distribution* - John Zhai
- TC5.6 *Control of Fire and Smoke* – Kai Kang
- TC9.2 *Industrial Air Conditioning and Ventilation*–Duncan Phyfe
 - TC 5.8 in merged into TC 9.2
- TC9.3 *Transportation* - Ray Horstman
- TC9.6 *Healthcare Facilities* – James Mcneil
- TC9.9 *Mission Critical Facilities* – Jim VanGilder
- Standard 55 *Thermal Environmental Conditions for Human Occupancy*
- Standard 62.1 *Ventilation for Acceptable Indoor Air Quality* – James Lo
 - Guideline 42 (IAQ) will be updated 2020

Honors and Awards (Chao-Hsin)

Nominate Jensen for research award

New Business

How do we retain Provisional members to CM and increase involvement in ASHRAE

Agenda Suggestions for Next Meeting

N/A

Call to adjourn by chair: (Wangda Zuo) at 4:15 p.m. Vote 8-0-0.

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APPENDIX A: DESCRIPTION OF TC'S SCOPE (FROM WEBSITE)

TC 4.10 is concerned with developing, evaluating and recommending procedures for predicting indoor environmental conditions including thermal, acoustical, illumination, and air quality for new or existing buildings.

Appendix B: Attendance list

Yan	Chen	Purdue U Chinese University of Hong Kong	yanchen@purdue.edu
Chun	Chen		chunchen@mae.cuhk.edu.hk
Malcolm	Cook	Loughborough University	malcolm.cook@lboro.ac.uk
Dustin	Demetriou	IBM	dwdemetr@us.ibm.com
Watts	Dietrich	CDC/NIOSH	img5@cdc.gov
Chao	Ding	LBNL University of Colorado Boulder	chaoding@lbl.gov
Cary	Faulkner		cary.faulkner@colorado.edu
Jeff	Franklin	Airflow Sciences Corporation	jfranklin@airflowsciences.com
Mohammad	Heidarinejad	Illinois Institute of Technology	muh182@iit.edu
Danlin	Hou	Concordia University	danlin.hou@mail.concordia.ca
Joe	Huang	White Box Technologies	yjhuang@whiteboxtechnologies.com
Alekhya	Kaianathbhatta	Price Industries	AlekhyaK@priceindustries.com
Yang-Seon	Kim	Wichita State University	yang-seon.kim@wichita.edu
Mike	Koupriyanov	Price Industries	MikeK@priceindustries.com
Cheng-xian (Charlie)	Lin	FIU	lincx@fiu.edu
Chao-Hsin	Lin	Boeing	chao-hsin.lin@boeing.com
Shichao	Liu	WPI	sliu8@wpi.edu
James	Lo	Drexel University	james.lo@drexel.edu
Ulrike	Passe	Iowa State University	upasse@iastate.edu
Duncan	Phillips	RWDI	duncan.phillips@rwdi.com
Duncan	Phyfe	Alden	dphyfe@aldenlab.com
Donghyun	Rim	Penn State	drim@psu.edu
Mark	Seymour	Future Facilities	mark.seymour@futurefacilities.com
Jim	VanGlider	Schneider Electric	jim.vanglider@se.com
Leon	Wang	Concordia University University of Colorado Boulder	leon.wang@concordia.ca
John	Zhai		john.zhai@colorado.edu
Wangda	Zuo	University of Colorado Boulder	wangda.zuo@colorado.edu