

**ASHRAE TC 4.3**  
**Ventilation Requirements & Infiltration**  
**Draft Meeting minutes**  
**Winter Conference 2023 Meeting (Hybrid)**

*These draft minutes have not been approved and are not the official, approved record until approved by this committee.*

**Research Subcommittee Meeting:** Monday, February 6, 2023, 4-5 pm EST, Omni Hickory (M3-North) \*or join virtually at <https://events.rdmobile.com/Sessions/Details/1612478>

**Full Committee Meeting:** Monday, February 6, 2023, 5-7 pm EST, Omni Chestnut (M3-North) or join virtually at <https://events.rdmobile.com/Sessions/Details/1612479>

Additions noted with \*\*; revisions noted with \*.

**1. Call to order**

**McNulty**

**2. Review Scope**

*TC 4.3 is concerned with ventilation requirements and the analysis of infiltration, airflow around buildings, exhaust, and the re-entry of exhaust, including their interactions with indoor air quality and energy calculations for buildings and HVAC system design and operation performance and energy consumption. <https://tc0403.ashraetcs.org/>*

**3. ASHRAE Code of Ethics Commitments**

**McNulty**

**Code of Ethics Commitment:** *In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and we shall avoid all real or perceived conflicts of interests. <https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics>*

**Commitment to Care:** *The health and safety of all ASHRAE conference attendees is a top priority. Out of respect for our fellow attendees, we commit to wear masks indoors, monitor our health, seek medical attention if symptoms develop and adhere to all ASHRAE Commitment to Care protocols. We are committed to the well-being of one another.*

**4. Introductions (10')**

**All**

- Determination of a quorum

**Parker**

*VOTING MEMBERS FOR THIS MEETING (Need (4) or ½+1 for a Quorum)*

	Name	Position	Company	Roll Off (June 30)	Present?
1	Meghan McNulty	Chair	Servidyne	2026	Y
2	Isaac Simpson	Vice Chair	DMG North	2024	Y
3	Steven Emmerich	Standards	NIST	2023	Y
4	Iain Walker	Member	Lawrence Berkeley Natl Lab	2024	Y
5	Anthony Abate	Member	Clean Air Group	2025	Y
6	Duncan Philips	Member	RWDI	2025	Y
7	Marianne Touchie	Member	University of Toronto	2025	Y

Non-Voting Officers				
[open]	Programs			
Jason Urso	Membership	Tighe & Bond		Y
Ryan Parker	Secretary/ Co-webmaster	RWDI		Y
Neetha Vasan	Handbook	RWDI		Y
Jordan Clark	Research	Ohio State University		Y
Bryan Morris	Co-Webmaster	Sellen		Y
George Nicholson	Co-Honors & Awards	ADeB Consultants Limited		Y
Hossam Hassaan	Co-Honors & Awards	Delta Construction & Manufacturing Co.		Y

b. Round of introductions

See attendance record, pg 11-20

All

## 5. Agenda additions

All

## 6. Chair's Report (7')

McNulty

- Chair's Goals
  - Interim meetings
    - Planned 1 between each meeting, possibly in April
  - Access to Basecamp\* – the link doesn't work anymore!
    - The option to send a link has been removed.
  - [2022 ASHRAE Position Document recommendations relevant to TC 4.3](#)
    - Recommended to review these for ideas for programs and research.
- Announcements and Highlights from TC Chairs Breakfast Meeting
  - [ASHRAE Simplified Rules of Order](#)
  - Review TC Scope, Continue/Merge/Dissolve
    - All members are welcome to suggest scope changes.
    - Duncan's review of our scope concluded we should remain as once committee.

## 7. Liaison Reports (as they arrive, 1'-2' per liaison or as needed)

Liaisons

- MTG
  - MTG.OTB – Mini Malhotra's update: Contributed to ASHRAE's green guide's new version. Decarbonization updates in particular. RP 1850 – Reviewing occupant data.

- TCs
  - Moh Rafati on TC 5.5
- Other FG – any from other Section 4 TCs?
- Task Force
  - TFBD Retrofit WG\*\*
- RAC
- Section Head (TAC)
  - Pat Marks – Section 4 head. Please do activity forms. Roster updates due before February 15.

#### 8. Approval of minutes from August 2022 Interim Meeting

McNulty

- Motion: Duncan, 2<sup>nd</sup> Marianne. 7:0:0

#### 9. Membership/Roster (5')

McNulty/Urso

- Free conference registration in first 2 years of ASHRAE membership is available
- Use the link below to become a provisional member. This is the only way to join officially. Please keep your email up to date in the ASHRAE portal.

[https://eweb.ashrae.org/eweb/TS\\_ProvisionalSignup.html](https://eweb.ashrae.org/eweb/TS_ProvisionalSignup.html)

#### 10. Subcommittee reports

- Programs (20') Nitin Naik volunteers for chair/McNulty subbed in
  - Notes on getting program submissions accepted:
    - Ensure that the submission is complete. This is the main reason for rejection. Title, Speaker Bio, Session and Presentation Abstracts, Learning Objectives (4), Q&A (10). Make sure the timing is in line with the following; 3 or less speakers – 60 minutes, 4 or 5 speakers – 90 minutes.
  - Speaker Resources
    - <https://ashrae.org/conferences/speaker-resources>
    - Presentation Policy, Commercialism Policy, Presentation Template, Program Submission Template
  - Subcommittee Chair Opening; TC Program Subcommittee Training on Tuesday, February 7 11:15 AM – 12:00 PM EST, Omni CNN Center Atlanta,

Dogwood B (M1-North)

<https://events.rdmobile.com/Sessions/Details/1642811> \*\*

- Current Programs
  - Sunday, February 5<sup>th</sup> 8-9 am EST, [Seminar 5: Smart Residential Ventilation Control for IAQ and Energy Efficiency](#)
  - Tuesday, February 7<sup>th</sup> 8-9:30 am EST, [Seminar 39: How to Evaluate Mechanical Ventilation in Existing Buildings](#), with livestream for virtual attendees
- Future Programs / New Ideas

City	Title	Type	Chair/Speakers
Chicago Jan 2024	Where's My Air Been	Seminar	John Carter/Martin Stangl/Ryan Parker
	ASHRAE Standard 62.2 updates	Seminar	Iain Walker Remove from list - Not enough changes to warrant this in Iain's view.
	Fundamental Physics and Chemistry of Air Quality and Methods for Cleaning	Seminar	Remove – out of scope
Chicago	Burning Questions Around Wildfires and Ventilation/IAQ	Seminar	Isaac Simpson. TC 7.3 co-sponsor. Steve Emmerich volunteers, possibly with seminar on GPC44P Resubmit for Chicago Review notes for speaker suggestions etc from chair breakfast.
Tampa	Evaluating Natural Ventilation	Seminar	Matt Mason (Chair): Justin Berquist, James Lo, Duncan Phillips, Will Lim
	"How To" for 62.1 or 62.2		
Tampa	TC 4.10 – Joint seminar request "Modeling Airflow around buildings and the impact on indoor conditions driving towards increasing building resiliency."		Vote on co-sponsoring this by Feb 27 Neetha is tentative

i. Upcoming Conference Tracks\*\*

## Annual Tampa – June 24-28, 2023

Conference Chair : Bert Phillips, (phillips@unies.mb.ca)

- o HVAC&R Systems and Equipment
  - o Ng Yong Kong – nyk@nyk.com.my
- o Fundamentals and Applications
  - o Brian Fronk – bmf141@psu.edu
- o Research Summit
  - o Davide Ziviani – dziviani@purdue.edu
- o Pathways to Net Zero Energy and Decarbonization
  - o Rafi Karim – rkarim@aeieng.com
- o Future-Proofing the Built Environment
  - o Scott Peach – sp@sp.engineering
- o Building Automation and Control Systems (BACS)
  - o Raul Simonetti – raul.simonetti@carel.com
- o Professional Development and Education
  - o Ahmed Abdel-Salam – ahmed.abdel-salam@usask.ca

## Winter Chicago – January 20-24, 2024

Conference Chair : Suzanne LeViseur, (sleviseur@haddadeng.com)

- o Fundamentals and Applications
  - o Craig Bradshaw – craig.bradshaw@okstate.edu
- o HVAC&R Systems & Equipment
  - o Ng Yong Kong – nyk@nyk.com.my
- o Refrigeration & Refrigerants
  - o Atilla Bivikoglu – abiyik@gazi.edu.tr
- o Decarbonization and Climate Change
  - o Som S Shrestha – shresthass@ornl.gov
- o Hydronic Systems
  - o Joe Chow – joe.ashrae@gmail.com
- o Ventilation, Indoor Air Quality and Air Distribution Systems
  - o Ahmed Abdel-Salam – ahmed.abdel-salam@usask.ca
- o Comfort, Indoor Environmental Quality and Energy Efficiency
  - o Kristen Cetin – cetinkri@msu.edu
- o HVAC&R Controls
  - o Alekhya Kaianathbhatta – alekhya\_k@rogers.com
- o Project Delivery Methods
  - o Ehab Mamdouh Abu Taleb – ehab.mamdouh@ipecc-eg.net

### ii. Deadlines for Tampa 2023 Annual Conference

Friday, January 6, 2023 | Website opens for Seminar, Workshop, Panel, Debates and Forums

Friday, February 24, 2023 | Technical Paper Final Accept/Reject Notifications

**Monday, February 27, 2023 | Debate, Panel, Seminar Form, Workshop Proposals Due**

Wednesday, March 29, 2023 | Extended Abstract Paper Due and Conference Papers Due

Friday, April 14, 2023 | Debate, Panel, Seminar, Forum Workshop Accept / Reject Notifications

Wednesday, April 26, 2023 | Conference Paper Abstract Accept / Revise / Reject Notification

Wednesday, May 10, 2023 | Revised Conference Papers, Technical Papers Due

Sunday, May 21, 2023 | Conference Paper Accept / Reject Notifications

- iii. Reviewers needed for Tampa Conference Papers\*\* - volunteer reviewers can sign up for specific papers to be reviewed between March 29 and April 20, 2023: <https://www.signupgenius.com/go/9040e4caa2fa7f85-20232#/>

### • Research (10') \*

Clark

- Subcommittee meets immediately prior to this meeting. Link for those attending remotely: <https://events.rdmobile.com/Sessions/Details/1612478>  
\*Draft minutes from Research subcommittee are attached.
- Active Research Projects (RP)- 1835-RP, "Characterizing the Performance of Induced Flow Stacks"
- Work Statements (WS)
- Research Topic Acceptance Request (RTAR)
  - Effect of exhaust terminations on jet mechanics and resulting required intake separation (62.2)
  - Updating garage ventilation rates for current populations of vehicles (electric cars)

- PTAR (Publication): Guide for successful simulation of outdoor airflow around the built environment
- On Hold / Inactive
- New Ideas
- RTAR= Research Topic Acceptance Request

Name	Champions	Status/Actions
RTAR/PTAR Combo - Infiltration vs. Pressurization impact with ERVs -Consult with TC 5.5 ERVs	Josephine Lau Duncan Phillips and Craig Wray Moh Rafati on TC 5.5	Sub Committee: "Developing guidance for ventilation design related to high buildings and pressurization." John, Craig, Ian Jordan, Josephine, Steve Taylor, Duncan  HOLD
Electric Vehicle effects on Garage Exhaust Requirements	Steve Taylor	Jordan drafted RTAR
Enhance the current Stack Height Reduction Factor Methodology for Plume Dispersion Calculations for stacks from screen height to 2.5 x screen height	Carter/Parker	No update
Multi-family residential 10 ft separation distance requirement question Should there be better guidance	Iain Walker / John Carter	Jordan drafted RTAR
TC 9.12 is looking at vents at the top of Tall building stairwells and elevators. This might be a joint project with 4.3	Duncan Phillips	No update
Updating the 0.8 Ventilation effectiveness value default in Std 62.1 for heating. Provide some additional guidance or simplified equation to determine approximate factor.	Frank Godbout	Frank Godbout- suggestion based on internal research. A white paper is attached from him.

- Deadlines:
- Interim meeting ? No interim Research subcommittee meeting, instead, interim prodding for outstanding items.

--- 5'-10' Break (est. 6 pm EST) ---Craig motioned to skip

- **Handbook (20')**

Vasan

- Chapter Status – Handbook timeline overview is attached
- Updated timeline provided from the handbook meeting

Volume	Chapter	Lead	Status
2025 Fundamentals	Chapter 16 Ventilation and Infiltration	Marianne Touchie, Cara Lozinsky, Justin Berquist	Reviewing the chapter in depth, harmonizing the chapter with other chapter. Contact Marianne if you want to be involved or object to the streamlining. marianne.touchie@utoronto.ca
2025 Fundamentals	Chapter 24 Airflow Around Buildings	Ted Stathopoulos	Working to ensure print copy gets updated this time. Starting to contact interested parties.
2027 Applications	Chapter 45 Building Air Intake and Exhaust Design	Ryan Parker	To be published in June

- Revision information
  - Access files, for revision, via <https://authoring.ashrae.org/>
  - **Chapter reviews:** If you have colleagues who are practicing in or otherwise interested in any of our topics, please ask them to review our as-published chapters. They can submit their reviews via [http://xp20.ashrae.org/secure/handbook/chapter\\_review/](http://xp20.ashrae.org/secure/handbook/chapter_review/)
  - Website for our revisers: <https://www.ashrae.org/technical-resources/ashraehandbook/ashrae-handbook-central>
- Deadlines
- Any suppliers known for Figure of “Type H Exhaust Stack Drain” (Ch 46, Fig 2) \*\*

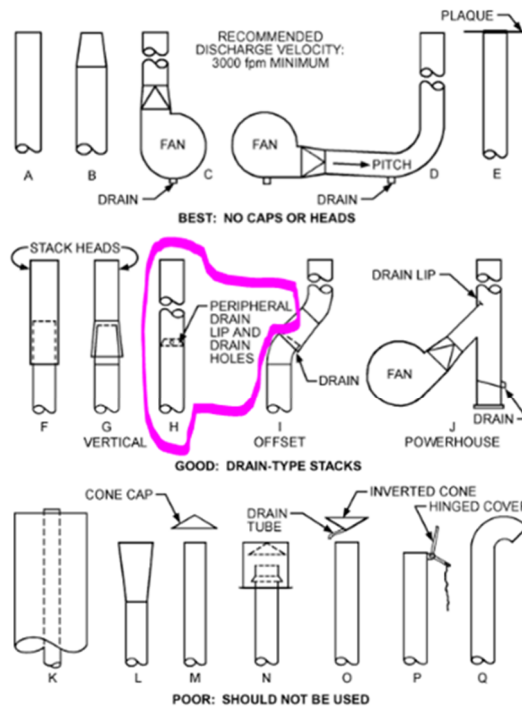


Fig. 2 Stack Designs Providing Vertical Discharge and Rain Protection

- Standards (15') \*
  - 62.1 Ventilation and Acceptable Indoor Air Quality
    - Guideline 42P currently out for limited public review
    - Workgroup for upgrading filtration requirements. Contact Meghan McNulty if interested.
    - Alleged logic holes are being investigated.
  - 62.2 Ventilation and Acceptable IAQ in Low-Rise Res Bldgs
    - Iain Walker filling in – Still awaiting the decision of the appeals panel on unvented combustion.

Emmerich



- Development of Change Proposals – toilet exhausts, multi family dwellings and separation of inlets and outlets and types of each, Is there a need for a room by room ventilation requirement (brought up by CO2 and sleeping research), considering smoking changes
- 161 Air Quality Within Commercial Aircraft
  - Last published in 2018, companion guideline in 2021. We are the cognizant TC.
- Other Standards of interest
  - 241P Standard to Address Mitigation of Airborne Infection Transmission (Working Title) – Unofficial Members have been named – Iain Walker, Steve Taylor. First meeting has not been scheduled.
    - Craig Wray – This will propose mitigation techniques. 129 is also relevant.
    - Ed Light suggests not to just maximize ventilation.
  - 90.1 Energy
    - NIST is working to update their method for calculating infiltration (current method is for 1-2 story house from the 70's)
  - 170 Ventilation of Healthcare Facilities – no one present for update
- Website/Basecamp (5') Parker/Morris
- Honors & Awards (5') Nicholson/Hassaan
  - Honors and awards flowchart overview:  
<https://www.ashrae.org/file%20library/membership/honors%20and%20awards/membership-honors---awards-flow-chartaw.pdf>

## 11. Old Business

## 12. New Business

- New York Healthcare Protocol: \*\* Aligning all of Healthcare in NYS and providing playbook & roadmap to decarbonizing their existing facilities (not in conflict w/TFBD Healthcare Design Guide in development); looking for IEQ advisory members, preferably from New York state or nearby. – Tony Abate is interested in helping.
- Door opening air exchange \*\*
  - Discussion that this is not as simple as it seems. Looking for Volunteer to draft response or provide papers that were mentioned.

## 13. Next Meeting

- Interim full committee (April?) or subcommittee meetings
  - Tuesday March 21 – 11:30 am ET/ 8:30am PT

- 2023 Annual Conference: June 24-28, Tampa, FL  
<https://www.ashrae.org/conferences/2023-annual-conference-tampa>

ASHRAE Annual and Winter Conference dates:

Future Winter Conferences	Future AHR Expos	Future Annual Conferences
Feb. 4-8, 2023 – Atlanta, GA	Feb. 6-8, 2023 – Atlanta, GA	June 24-28, 2023 – Tampa, FL
Jan. 20-24, 2024 – Chicago, IL	Jan. 22-24, 2024 – Chicago, IL	June 22-26, 2024 – Indianapolis, IN
Feb. 8-12, 2025 – Orlando, FL	Feb. 10-12, 2025 – Orlando, FL	June 21-25, 2025 – Phoenix, AZ
Jan. 31-Feb. 4, 2026 – Las Vegas, NV	Feb. 2-4, 2026 – Las Vegas, NV	
	AHR Mexico Sep. 19-21, 2023 – Mexico City	

14. Adjourn – Motion – Duncan Phillips

Membership Chair Jason Urso [jurso@tighebond.com](mailto:jurso@tighebond.com) for attendance corrections.  
ASHRAE.org bio for name/affiliation changes.

**TC 4.3 Member Roster**  
**Updated February 8, 2023**

TC 4.3 Roster / Attendance

Committee Meeting Attendance	Position	Lastname	Mid Name	Firstname	Full Name	Company	Start Date
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Vice Chair	Simpson		Isaac	Mr Isaac Simpson	DMG North, Inc.	07/01/2022
2/6/2023	TAC Section Head	Marks	C	Patrick	Mr Patrick C Marks, PE	Johnson Controls	07/01/2022
	TAC Chairman	Messmer	S	Craig	Mr Craig S Messmer, PE	Unico Inc	07/01/2022
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Stds Subcom Chair	Emmerich	J	Steven	Mr Steven J Emmerich	NIST	07/01/2019
	Staff Liaison	Hammerling	J	Steven	Mr Steven J Hammerling	ASHRAE	07/01/2019
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Secretary	Parker		Ryan	Dr Ryan Parker	RWDI	07/01/2022
	Resrch Subcom Chair	Clark	D.	Jordan	Dr Jordan D. Clark	The Ohio State University	07/01/2021
	Research Liaison	Landsberg	R	Dennis	Dr Dennis R Landsberg	L&S Energy Services Inc	07/01/2022
6/27/2022 8/2/2022	Program Subcom Chair	Lau		Josephine	Dr Josephine Lau, PhD	Univ of Nebraska-Lincoln	07/01/2019
	Pro CM	Araiza	Elise	Courtney	Miss Courtney Elise Araiza	Sanhua	06/28/2022
6/27/2022 (Wants to be involved) 8/2/2022	Pro CM	Beardy-Singh	B	Jordan	Mr Jordan B Beardy-Singh	CPP Wind Engineering and Air Quality Consultants	07/08/2022
	Pro CM	BRITO	ANDREW	VICTOR	Mr VICTOR ANDREW BRITO	Bard, Rao + Athanas Consulting Engineers	04/26/2022
	Pro CM	Cabral	Bettecnourt Moniz	Pedro	Mr Pedro Bettecnourt Moniz Cabral		09/14/2022
	Pro CM	DEGADWALA	RAJENDRA	BHAVIN	Mr BHAVIN RAJENDRA DEGADWALA	Integral Group	05/19/2022
	Pro CM	Doherty		Matthew	Mr Matthew Doherty	Oxygen8 Solutions Inc	02/17/2022
	Pro CM	Eam		Taekyoung	Mr Taekyoung Eam	KOREA CONTAM Simulation Lab.	07/24/2022
	Pro CM	Ebrahimifakhar		Amir	Mr Amir Ebrahimifakhar	University of Nebraska-Lincoln	12/11/2022
	Pro CM	Echevarria		Pablo	Mr Pablo Echevarria	Echevarria Romano SRL	08/26/2022
	Pro CM	Edwards		Wesley	Wesley Edwards		07/26/2022
	Pro CM	Fan		Xiaojun	Dr Xiaojun Fan, PhD	Technical University of Denmark	06/22/2022
	Pro CM	Farmer	A	Richard	Mr Richard A Farmer	Newcomb & Boyd	03/24/2022

6/27/2022 (Wants to be involved) 8/2/2022	Pro CM	Fox	TC 4.3 Ross	Joseph	Mr Joseph Fox, P.Eng.	Toronto District School Board	03/16/2022
	Pro CM	Fresconi	Philip	Luke	Mr Luke Philip Fresconi	Strobc Air Technologies	07/14/2022
	Pro CM	Godbout		Francois	Mr Francois Godbout	EffectiV HVAC Inc.	01/19/2023
6/27/2022 (Wants to be involved)	Pro CM	Hassaan	Abdelkader	Hossam	Mr Hossam Abdelkader Hassaan, Eng	Delta Construction & Manufacturing Co. (DCM)	06/29/2022
	Pro CM	Hoffmann		Gustavo	Mr Gustavo Hoffmann	Midea Carrier	06/28/2022
	Pro CM	Jose		Lejo	Mr Lejo Jose	Kaiterra	01/05/2023
	Pro CM	Junior	Santos	Carlos Luis Ribeiro dos Santos Junior, Eng	Mr Carlos Luis Ribeiro dos Santos Junior, Eng	Sicflux	06/28/2022
	Pro CM	Khamforoush		Azad	Mr Azad Khamforoush, Eng	Associated Engineering Ltd. (Ont.)	10/19/2022
6/27/2022 8/2/2022 2/6/2023	Pro CM	Lin		William	Mr William Lin, PhD	CPP Wind	07/08/2022
	Pro CM	Liu		Guopeng	Dr Guopeng Liu, PhD	Amazon	07/14/2022
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Pro CM	Lozinsky	H	Cara	Ms Cara H Lozinsky, P.Eng.	University of Toronto	03/22/2022
	Pro CM	Meyer		Matthew	Matthew Meyer	OSHA	05/10/2022
	Pro CM	Naik		Nitin	Mr Nitin Naik, Eng		08/21/2022
	Pro CM	Nawaz		Kashif	Dr Kashif Nawaz, PhD	Oak Ridge National Lab	05/03/2022
6/27/2022 (Wants to be involved) 2/6/2023	Pro CM	Nicholson	Douglas	George	Mr George Douglas Nicholson	ADeB Consultants Limited	03/31/2022
	Pro CM	Park		Beungyong	Prof Beungyong Park	Hanbat National University	11/10/2022
	Pro CM	Patel	Mukul	Vrunda	Vrunda Mukul Patel	Jacobs	09/22/2021
	Pro CM	Phan	Tran Bao	Long	Dr Long Tran Bao Phan	Coilmaster Corporation	06/27/2022
	Pro CM	Rafati		Mohammad	Dr Mohammad Rafati		02/06/2023
	Pro CM	Shen		Jialei	Jialei Shen		06/26/2022
	Pro CM	Singh		Satbir	Mr Satbir Singh	BEMCO	06/11/2022
	Pro CM	Surana		Shilpa	Mrs Shilpa Surana	2050 Partners	01/03/2023
	Pro CM	Surapaneni		Amulya	Amulya Surapaneni	Harris Company	10/19/2022

6/27/2022	Pro CM	Tang	TC 4.3 Role	Attendance	Miss Mengjia Tang		06/28/2022
	Pro CM	Tariq		Hassan	Mr Hassan Tariq	Amazon	02/06/2023
	Pro CM	Yang		Junjing	Dr Junjing Yang	National Environment Agency	08/20/2022
6/27/2022 8/2/2022 2/6/2023	Membership	Urso	R	Jason	Mr Jason R Urso, PE	Tighe & Bond	07/01/2022
2/6/2023 (Subcommittee & main meeting)	Member	Abate	M	Anthony	Mr Anthony M Abate	Clean Air Group	07/01/2021
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Member	Phillips	A	Duncan	Mr Duncan A Phillips	Rowan Williams Davies & Irwin	07/01/2021
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Member	Touchie		Marianne	Dr Marianne Touchie	University of Toronto	07/01/2021
6/27/2022	Member	Walker	S	Iain	Dr Iain S Walker	Lawrence Berkeley Laboratory	07/01/2020
6/27/2022 8/2/2022 2/6/2023	Hndbk Subcom Chair	Vasan		Neetha	Ms Neetha Vasan	RWDI	07/01/2022
6/27/2022, 2023 winter	Corresponding Member	Cui		yingying	Miss yingying Cui	NYC Department of Buildings	07/01/2021
6/27/2022	Corresponding Member	Davidovic		Danko	Dr Danko Davidovic	Huber Engineered Woods LLC	07/01/2017
6/27/2022	Corresponding Member	Dols	S	William	Mr William S Dols	Natl Inst Of Standards & Technology	07/01/2012
6/27/2022	Corresponding Member	Ehrman	G	Stephen	Mr Stephen G Ehrman, PE	AC Representatives	07/01/2021
6/27/2022, 2023 winter	Corresponding Member	Grahovac		Paul	Mr Paul Grahovac		07/01/2020
6/27/2022	Corresponding Member	Joseph		Darryl	Mr Darryl Joseph	Welch Morris + Associates	07/01/2021
6/27/2022, 2023 winter	Corresponding Member	Malhotra		Mini	Dr Mini Malhotra	Oak Ridge National Lab	07/01/2019
2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Wray	P	Craig	Mr Craig P Wray, P.Eng	Consulting Engineer	07/01/2003
6/27/2022 (Wants to be involved)	Corresponding Member	Presseller		Jim	Mr Jim Presseller	Daikin Applied	07/01/2022
6/27/2022 (Wants to be involved) 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Mason	D	Matt	Mr Matt D Mason, PE	TLC Engineering Solutions	07/01/2020
6/27/2022 (Wants to be involved) 8/2/2022	Corresponding Member	Stangl		Martin	Mr Martin Stangl	RWDI	07/01/2020
6/27/2022 (Wants to be involved) 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Casquero-Modrego		Nuria	Dr Nuria Casquero-Modrego, PhD	LBNL (Lawrence Berkeley National Lab)	07/01/2022
6/27/2022 2/6/2023	Corresponding Member	DeGraw	W	Jason	Dr Jason W DeGraw	ORNL	07/01/2022
6/27/2022 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Gross	Marcus	Gregory	Mr Gregory Marcus Gross	CPP Wind Engineering	07/01/2022

6/27/2022 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Morris	TC 4.3 Ross	By Attendance	Mr Bryan Morris	Sellen	07/01/2016
6/27/2022 8/2/2022	Corresponding Member	Clark	D.	Jordan	Dr Jordan D. Clark	The Ohio State University	07/01/2021
6/27/2022 8/2/2022, 2023 winter	Corresponding Member	Cochran	C	Brad	Mr Brad C Cochran	C P P Inc	07/01/2016
6/27/2022 8/2/2022	Corresponding Member	Hoch	J.	Peter	Mr Peter J. Hoch	Carrier Corporation	07/01/2021
6/27/2022 8/2/2022	Corresponding Member	Nino	G	Victor	Mr Victor G Nino	EcoBalance Technologies LLC	07/01/2022
6/27/2022 8/2/2022	Corresponding Member	Parekh		Anil	Mr Anil Parekh, M.A.Sc., PEng	Natural Resources Canada	07/01/2017
6/27/2022 8/2/2022 2/6/2023	Corresponding Member	DeAngelis	W	Darryl	Mr Darryl W DeAngelis	EBTRON	07/01/2007
6/27/2022 8/2/2022 2/6/2023	Corresponding Member	Ng		WenBin	Mr WenBin Ng	Univ Kuala Lumpur Malaysia France Inst	07/01/2022
6/27/2022 8/2/2022 2/6/2023	Corresponding Member	Rock	A	Brian	Mr Brian A Rock, FASHRAE, PE	The University of Kansas	07/01/2022
6/27/2022 8/2/2022 2/6/2023	Corresponding Member	Stathopoulos		Theodore	Mr Theodore Stathopoulos	Concordia University	07/01/2008
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Berquist	David	Justin	Mr Justin David Berquist	National Research Council	07/01/2021
6/27/2022 8/2/2022 2/6/2023 (Subcommittee & main meeting)	Corresponding Member	Trobich	S	Joan	Ms Joan S Trobich	Atmos Air	07/01/2022
	Corresponding Member	ABBASI	SAID	TABISH	Mr TABISH SAID ABBASI	A.H International	07/01/2021
	Corresponding Member	Arnstein	F	Joseph	Mr Joseph F Arnstein	Taylor Engineering	07/01/2021
	Corresponding Member	Balke	Christine	Elizabeth	Ms Elizabeth Christine Balke	Tesla	07/07/2018
	Corresponding Member	Barley	C	Dennis	Mr Dennis C Barley	NREL	07/01/2002
	Corresponding Member	Basil		Bassam	Mr Bassam Basil	Tepa ES	07/01/2022
	Corresponding Member	Bhargava		Akshay	Mr Akshay Bhargava	CMTA, Inc	07/01/2020
	Corresponding Member	BIST	SINGH	NIKHILESH	Mr NIKHILESH SINGH BIST	CEPT UNIVERSITY	07/01/2020
	Corresponding Member	Blanford	D	Michael	Mr Michael D Blanford	U.S Dept. Of Housing & Urban Development	07/01/2015
	Corresponding Member	Boome		Alexander	Mr Alexander Boome, IV, P.Eng, PE	NDY-TETRA Tech Co.	07/01/2006
	Corresponding Member	Bounds	T	Jeanine	Miss Jeanine T Bounds	Boundless Engineering, PLLC	07/01/2021
	Corresponding Member	Brown	R	Lance	Lance R Brown	Google	07/01/2016

	Corresponding Member	Cagliani	TC 4.3 Role	Attendance	Dr Mirco Cagliani	Mirco Cagliani	07/01/2022
	Corresponding Member	Camden	L	Heather	Ms Heather L Camden	E&C Engineers And Consultants Inc	07/01/2005
	Corresponding Member	Cardenal		Bernardo	Mr Bernardo Cardenal, PE	Rocamar Engineering Services Inc	07/01/2006
	Corresponding Member	Carl	J	Michael	Mr Michael J Carl, P.Eng	RWDI	07/01/2021
	Corresponding Member	Carson	Michael	Christopher	Mr Christopher Michael Carson	Carson Solutions	07/01/2021
	Corresponding Member	Carter	J	John	Mr John J Carter	CPP	07/01/2022
	Corresponding Member	Chen	(Yan)	Qingyan	Dr Qingyan (Yan) Chen	Hong Kong Polytechnic University	07/01/1997
	Corresponding Member	Condor	Sonny	Billy	Mr Billy Sonny Condor, Romero	Independent	07/01/2022
	Corresponding Member	Coronado Cabrera	Camila	Maria	Ms Maria Camila Coronado Cabrera	University of Oregon	07/01/2022
	Corresponding Member	Craig		Michael	Mr Michael Craig	RWDI	07/01/2020
	Corresponding Member	Damiano	A	Leonard	Mr Leonard A Damiano	Retired	07/01/2004
	Corresponding Member	Dobbs		Gregory	Dr Gregory Dobbs, PhD, LEED AP BEMP HPDP BESA		07/01/2006
	Corresponding Member	Duda	W	Stephen	Mr Stephen W Duda, PE	Southern Illinois University Edwardsville	07/01/2017
	Corresponding Member	Esmaeelpanah		Javad	Dr Javad Esmaeelpanah	RWDI Inc.	07/01/2019
	Corresponding Member	Fang		Xia	Ms Xia Fang	McKinstry	07/01/2019
	Corresponding Member	Feustel	E	Helmut	Dr Helmut E Feustel	Kessler & Luch GmbH	07/01/2003
	Corresponding Member	Freidberg	Alexander	Neil	Mr Neil Alexander Freidberg	Lousiana Pacific	07/01/2022
	Corresponding Member	Friedman	D	Todd	Mr Todd D Friedman	Friedman Engineering, LLC	07/01/2010
	Corresponding Member	Griffiths	M	Dianne	Ms Dianne M Griffiths, PE	Steven Winter Associates	07/01/2016
	Corresponding Member	Grot	A	Richard	Mr Richard A Grot	Lagus Applied Technology	07/01/1997
	Corresponding Member	Haghighat		Fariborz	Dr Fariborz Haghighat	Concordia Univ	07/01/1988
	Corresponding Member	Ho	L	Nathan	Mr Nathan L Ho	University of California, Irvine	07/01/2020
	Corresponding Member	Hyderboi		Sai vivek	Mr Sai vivek Hyderboi, Eng	LEMINAR AIR CONDITIONING COMPANY LLC	07/01/2021

	Corresponding Member	Inam	TC 4.3 Role	Attil/ Attendance	Mr Adil Inam	INTERCOL	07/01/2022
	Corresponding Member	Kato		Shinsuke	Prof Shinsuke Kato, PhD	The University of Tokyo	07/01/1993
	Corresponding Member	Kim		Yang-Seon	Dr Yang-Seon Kim	Wichita State University	07/01/2020
	Corresponding Member	Kumar		Mitesh	Mr Mitesh Kumar	ORISON QEHS LLP	07/01/2020
	Corresponding Member	Kuntz	W	Kenneth	Mr Kenneth W Kuntz	Greenheck Fan Corp	07/01/2021
	Corresponding Member	Lan		Li	Prof Li Lan	Department of Architecture	07/01/2021
	Corresponding Member	Li		Jiayu	Dr Jiayu Li	Berkeley Education Alliance for Research in Singapore	07/01/2022
	Corresponding Member	Liddament	W	Martin	Dr Martin W Liddament	Veetech Corp	07/01/2011
	Corresponding Member	Light		Ed	Mr Ed Light	Building Dynamics, LLC	07/01/2019
	Corresponding Member	Lindsay	B	Bruce	Mr Bruce B Lindsay	Trane Technologies	07/12/2017
	Corresponding Member	Liu		Shichao	Dr Shichao Liu	Worcester Polytechnic Institute (WPI)	09/11/2017
	Corresponding Member	Lstiburek	W	Joseph	Dr Joseph W Lstiburek	Building Science Corp	07/01/2004
	Corresponding Member	MacDonald	A	Iain	Dr Iain A MacDonald	National Research Council Canada	07/01/2013
	Corresponding Member	Massoud	Hussien	Mahmoud	Mr Mahmoud Hussien Massoud Engineer		07/01/2022
	Corresponding Member	Mathes	W	Dennis	Mr Dennis W Mathes	Lomanco, Inc.	09/13/2017
	Corresponding Member	Maurer	C	Christine	Miss Christine C Maurer	Advanced Energy	07/01/2014
	Corresponding Member	McGrail		Patrick	Mr Patrick McGrail	AKM Semiconductor, Inc.	07/01/2022
	Corresponding Member	Mendez		Felix	Mr Felix Mendez		07/01/2021
	Corresponding Member	Modera	P	Mark	Prof Mark P Modera, PhD, PE	UC Davis	07/01/2008
	Corresponding Member	Moftakhari		Ardeshir	Mr Ardeshir Moftakhari		07/01/2022
	Corresponding Member	Moore	C	James (Mike)	Mr James (Mike) C Moore, III	Stator LLC	07/15/2015
	Corresponding Member	Murakami		Shuzo	Mr Shuzo Murakami	Keio University	07/01/1997
	Corresponding Member	Musser	V	Amy	Dr Amy V Musser	Vandemusser Design, LLC	07/01/2003



	Corresponding Member	Neuman	A	TC 4.3 Role Attendance	Mr Victor A Neuman, PE		07/01/1999
	Corresponding Member	Novoselac		Atila	Dr Atila Novoselac	University Of Texas	07/01/2006
	Corresponding Member	O Donovan		Adam	Mr Adam O Donovan	Cork Institute of Technology	07/01/2021
	Corresponding Member	Olesen	Wilkens	Bjarne	Prof Bjarne Wilkens Olesen, PhD	ICIEE-DTU	07/01/2006
	Corresponding Member	O'Neill		Zheng	Dr Zheng O'Neill	Texas A&M University	07/01/2020
	Corresponding Member	Patel	Mukul	Vrunda	Vrunda Mukul Patel	Jacobs	07/01/2021
	Corresponding Member	Patel	Mukul	Vrunda	Vrunda Mukul Patel	Jacobs	07/01/2022
	Corresponding Member	Philip	Thomas	Dessy	Mr Dessy Thomas Philip	MSCEB	07/01/2022
	Corresponding Member	Pinkston	S	Paul	Mr Paul S Pinkston		07/01/2002
	Corresponding Member	Prather		Donald	Mr Donald Prather	FAZS (TM)	07/01/2009
	Corresponding Member	Priyadarshi		Sahil	Mr Sahil Priyadarshi	GreenTree Global	07/01/2020
	Corresponding Member	Rastogi		Parag	Dr Parag Rastogi	arbnco	07/01/2022
	Corresponding Member	Ratcliff	A	Michael	Mr Michael A Ratcliff	RWDI LLC	07/01/2015
	Corresponding Member	Raza		Tahir	Mr Tahir Raza	IES Consulting Engineers	07/01/2022
	Corresponding Member	Ryan	A	William	Dr William A Ryan, PhD	University of Illinois at Chicago	07/01/2007
	Corresponding Member	Saum	Wendell	David	Mr David Wendell Saum	Infiltec	07/01/1994
	Corresponding Member	Schopplein	R	Heather	Mrs Heather R Schopplein, PE	UMEC	07/01/2015
	Corresponding Member	Schuyler	D	Glenn	Mr Glenn D Schuyler	RWDI	07/01/1997
	Corresponding Member	Sekhar		Chandra	Prof Chandra Sekhar, PhD	National University of Singapore	07/01/2010
	Corresponding Member	Shamroukh		Mohammed	Mr Mohammed Shamroukh	Taqeef Refrigeration & Air Conditioning L.L.C	07/01/2021
	Corresponding Member	Sherman		Max	Dr Max Sherman		07/01/1993
	Corresponding Member	Shrestha	S	Som	Dr Som S Shrestha	Oak Ridge National Laboratory	07/01/2010
	Corresponding Member	Shrestha	Man	Prateek	Dr Prateek Man Shrestha	National Renewable Energy Laboratory	07/01/2021

	Corresponding Member	Snell	B TC 4.3 Rosedale	Attendance	Mr Donald B Snell	Liberty Building Forensics Group	07/01/2010
	Corresponding Member	Stephens		Brent	Dr Brent Stephens	Illinois Institute of Technology CAEE De	07/01/2013
	Corresponding Member	Svitak	Michael	Brandon	Mr Brandon Michael Svitak	Systemair	07/01/2021
	Corresponding Member	Swamidas		Deepak	Mr Deepak Swamidas	Beca Limited	07/01/2021
	Corresponding Member	Talbott	M	John	Mr John M Talbott	Talbott Consulting	07/01/2014
	Corresponding Member	Taylor	T	Steven	Mr Steven T Taylor, PE	Taylor Engineering LLC	07/01/2021
	Corresponding Member	Thrift	A.R.	Rae	Mrs Rae A.R. Thrift		08/11/2017
	Corresponding Member	Traboulsi	R	Samir	Dr Samir R Traboulsi, PhD., P. Eng., PE	Thermotrade/Ranec	02/01/2011
	Corresponding Member	Vasudevan		Joshua	Mr Joshua Vasudevan, Eng	Loughborough University	07/01/2021
	Corresponding Member	Venugopal		Vinod	Mr Vinod Venugopal		07/01/2021
	Corresponding Member	Wang		Jingjing	Jingjing Wang	Taylor Engineering	07/01/2016
	Corresponding Member	Weerasinghe	Kankanamage	Mulkirigala	Mr Mulkirigala Kankanamage Weerasinghe	Singco Engineering (Pvt) Ltd	07/01/2021
	Corresponding Member	Welburn		Colin	Mr Colin Welburn	Welburn Consulting	07/01/2020
	Corresponding Member	Werling	D	Eric	Mr Eric D Werling	DOE	07/01/2009
	Corresponding Member	Weston	A	Theresa	Dr Theresa A Weston	The Holt Weston Consultancy, LLC	07/01/2000
	Corresponding Member	Wilcox	A	Bruce	Mr Bruce A Wilcox		07/01/2003
	Corresponding Member	Wilson	J	David	Dr David J Wilson	Univ Of Alberta	07/01/1984
	Corresponding Member	Wisner	E	Chester	Mr Chester E Wisner	Ambient Air Technologies LLC	07/01/2005
	Corresponding Member	Wright		Buzz	Mr Buzz Wright, PE, FPE	Kelly Wright & Associates PC	07/01/2020
	Corresponding Member	Wu		Zhibin	Dr Zhibin Wu	SinBerBEST	07/01/2022
	Corresponding Member	Yang		Xudong	Prof Xudong Yang	Tsinghua University	07/01/2009
	Corresponding Member	Yu		Yuebin	Yuebin Yu, PhD		07/11/2016
	Corresponding Member	Yuan		Yu	Ms Yu Yuan	3M Innovation Singapore Pte Ltd	07/01/2021

	Corresponding Member	Yuill	P TC 4.3 Rosalinda	David Attendance	Dr David P Yuill, PE	University of Nebraska	07/01/2008
	Corresponding Member	Yuill	K	Grenville	Dr Grenville K Yuill		07/01/2013
	Corresponding Member	Yusuf		Bashir	Bashir Yusuf	University of North Carolina Charlotte	07/01/2022
	Corresponding Member	Zay		Zay	Mr Zay Zay	AA. Medical	07/01/2021
	Corresponding Member	Zeller	Brink	Trevor	Mr Trevor Brink Zeller	P2S Engineering	07/01/2020
	Corresponding Member	Zhang	S	Jianshun	Dr Jianshun S Zhang, PhD	Syracuse University	07/01/2008
6/27/2022 8/2/2022 2/6/2023	Chair	McNulty	Kara	Meghan	Ms Meghan Kara McNulty	Servidyne	07/01/2022

TC 4.3 W23 Guest Attendance

Committee				
Meeting Attendance	Name	Email	Affiliation/Company	Notes
6/27/2022	Mikael Salonvaara	salonvaaramh@ornl.gov	ORNL	Corresponding member, occasional email issues?
6/27/2022	Vincent Tang	vincent.tang@rwdi.com	RWDI	
6/27/2022	Jeremy Stockmans	jeremy@stockmans.ca	Systemair	
6/27/2022	Craig Wray	pharmeng@shaw.ca	Consulting Engineer	
6/27/2022	Samantha Chum	s.chum@mail.utoronto.ca	University of Toronto	
2/6/2023	Andrew Persily	andyp@nist.gov	NIST	
2/6/2023	Larry Schoen	LARRY@SCHOENENGINEERING.COM	Schoen Engineering Inc	
2/6/2023	Nitin Naik	nitin@dewpoint.in	Dew Point	
2/6/2023	Moh Rafati	mohammad.rafatinasr@fraserhealth.ca	Fraser Health	
2/6/2023	Mike Carl	mikejoemike@gmail.com	RWDI	
2/6/2023	Neil Freidberg	freidberg.neil@gmail.com	Louisiana Pacific	

## ASHRAE TC 4.3

### Ventilation Requirements & Infiltration:

#### Research Subcommittee Meeting

#### Draft Minutes

#### Winter Conference 2023 Meeting (Hybrid)

Monday, February 6, 2023, 4-5 pm EST, Omni Hickory (M3-North) or join virtually at  
<https://events.rdmobile.com/Sessions/Details/1612478>

Call to order     Clark

#### 1. Review Scope

Clark

*TC 4.3 is concerned with ventilation requirements and the analysis of infiltration, airflow around buildings, exhaust, and the re-entry of exhaust, including their interactions with indoor air quality and energy calculations for buildings and HVAC system design and operation performance and energy consumption.* <https://tc0403.ashraetcs.org/>

#### 2. ASHRAE Code of Ethics Commitments

Clark

**Code of Ethics Commitment:** *In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and we shall avoid all real or perceived conflicts of interests.* <https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics>

#### 3. Round of introductions

All

#### 4. Agenda additions

All

#### 5. Chair's Report from RSC Chair's Breakfast

Clark

- RAC budget up to 5.5M from 5.0 last year
- NIA,GIA,IRG, Homer Addams reinstated
- Considering 9 projects from backlog
- Several that recently went out didn't get any bids
- RTAR
  - Do your homework, do thorough lit review because RAC doesn't necessarily know subject matter deeply
  - Look @ strategic plan for ideas
- Want to reduce number of no cost extension
  - They understand inflation in grad school prices, materials
  - Don't limit to 150k

#### 6. Upcoming Deadlines

Clark

- i. Deadlines for Tampa 2023 Annual Conference

Friday, January 6, 2023 | Website opens for Seminar, Workshop, Panel, Debates and Forums

Friday, February 24, 2023 | Technical Paper Final Accept/Reject Notifications

**Monday, February 27, 2023 | Debate, Panel, Seminar Form, Workshop Proposals Due**

Wednesday, March 29, 2023 | Extended Abstract Paper Due and Conference Papers Due

Friday, April 14, 2023 | Debate, Panel, Seminar, Forum Workshop Accept / Reject Notifications

Wednesday, April 26, 2023 | Conference Paper Abstract Accept / Revise / Reject Notification

Wednesday, May 10, 2023 | Revised Conference Papers, Technical Papers Due

Sunday, May 21, 2023 | Conference Paper Accept / Reject Notifications

- ii. Reviewers needed for Tampa Conference Papers - volunteer reviewers can sign up for specific papers to be reviewed between March 29 and April 20, 2023:  
<https://www.signupgenius.com/go/9040e4caaac2fa7f85-20232#/>

## 7. Research Project Review

All

### i. Active Research Projects (RP)

ASHRAE Research Project 1835-RP, "Characterizing the Performance of Induced Flow Stacks

- Kicked off 2-7-23, no other updates

### ii. Work Statements (WS)

none

### iii. Research Topic Acceptance Request (RTAR)

1. Effect of exhaust terminations on jet mechanics and resulting required intake separation (62.2)
  - Submitted to RAC last meeting, no action, resubmitted
  - Received by RAC 2-6-23
2. Updating garage ventilation rates for current populations of vehicles (electric cars)
  - Do we want to move forward?
  - Update emission rates from 30 years ago
  - Overall design prescriptions using CFD for air distribution
  - **Clark to modify existing and send to Taylor**
  - \*2 meetings
3. PTAR (Publication): Guide for successful simulation of outdoor airflow around the built environment
  - Need champion-2 meetings
  - **Phillips to draft PTAR**

Clark suggested “3 Strikes” rule- if idea has been on docket for three meetings with no forward movement, will be removed

- Unanimous consent in room

Name	Champions	Status/Actions
Infiltration vs. Pressurization impact with ERVs		Sub Committee: “Developing guidance for ventilation design related to high buildings and pressurization.” Possible PTAR instead? Joint RTAR/PTAR? **2 meetings <b>Phillips and Wray to write PTAR</b>
Enhance the current Stack Height Reduction Factor Methodology for Plume Dispersion Calculations for 1- 2.5 x screen height	Carter/Parker	**2 meetings Idea from Parker <b>Parker to consider writing</b>
TC 9.12 is looking at vents at the top of Tall building stairwells and elevators. This might be a joint project with 4.3	Duncan Phillips	<b>Abandon</b>
Potential work following ETF transition	McNulty	Sample survey of existing building vent performance i.e. BASE study  Crowd-sourced database? CO2 or CO levels <b>McNulty to look deeper</b>
Adjustment of rates for density of air w/ altitude-do emissions change with altitude? How much do resulting rates change? Include perception changes	Phillips- framework, Taylor review	<b>Phillips to provide framework and Taylor to review</b>
Better ventilation effectiveness values	Frank Godbout	<b>Godbout to write RTAR</b> <b>Clark to send RTAR writing guide</b>
Submitted via email: Exploring the Impact of IAQ on Human Physiological Signals	Joonho Choi	<b>Choi to write RTAR</b>

Adjourned but continued in main meeting

In main meeting:

Resolved to use RSC meeting for new ideas only,

no new ideas in main meeting,

only update on status of RPs, WSs.

**End**



## Ez Factor Research Summary

In the last 12 months, Effectiv HVAC Inc. did several CFD room simulations following the guidelines presented in ASHRAE Standard 62.1 – 2019 and 2022 Normative Appendix C.

The purpose of this work was to evaluate the impact of various types of ceiling diffusers on Zone Air Distribution Effectiveness. Alternatively, we analyzed the impact on energy consumption, occupants' thermal comfort and indoor air quality.

We simulated a total of three rooms: one classroom, one shared office with cubicles, and one open space shared office. We did various simulations in each room, testing different types of diffusers in various operating conditions.

All rooms had ceiling supply and ceiling return of conditioned air. Although a few simulations were conducted in ventilation and air conditioning, most simulations were conducted in heating.

Table 6-4 of standard 62.1 states that an Ez Factor value of 0.8 should be used when heating the room with ceiling supply and ceiling return.

We noticed significant variations of Ez Factor within the breathing zone. However, every CFD simulation performed in heating resulted in an average Ez factor value in the breathing zone that is lower than 0.8.

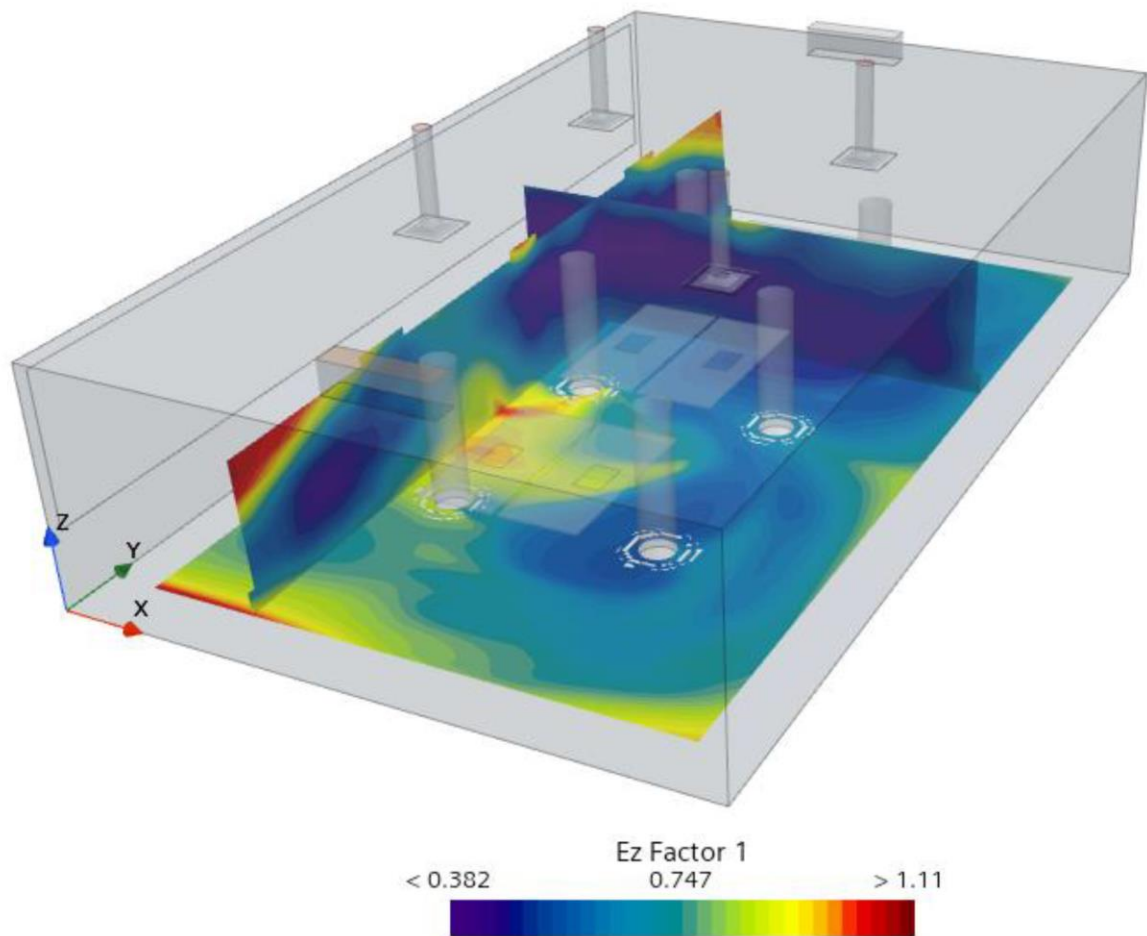
Although the results demonstrated a significant impact of the type of diffuser on zone air distribution effectiveness, we also noticed other factors that can considerably impact the Ez Factor value, mostly in heating, while working against air stratification. Some of the conditions which had the most impact in heating are the ceiling height, the difference between room temperature and supply temperature, the total cfm per cubic feet (total supplied air volume divided by room volume), and the presence of objects in the room obstructing air movement.

We believe that this finding could have a significant impact on Indoor Air Quality and decided to share our results with the Technical Committee 4.3.

You will find a summary of the results in the following pages for discussion purposes. We will be happy to share the complete CFD reports with whoever is interested, please reach out to Frank Godbout by email at [frank@effectiv-hvac.com](mailto:frank@effectiv-hvac.com).



Example of Ez Factor Distribution in the Breathing Zone

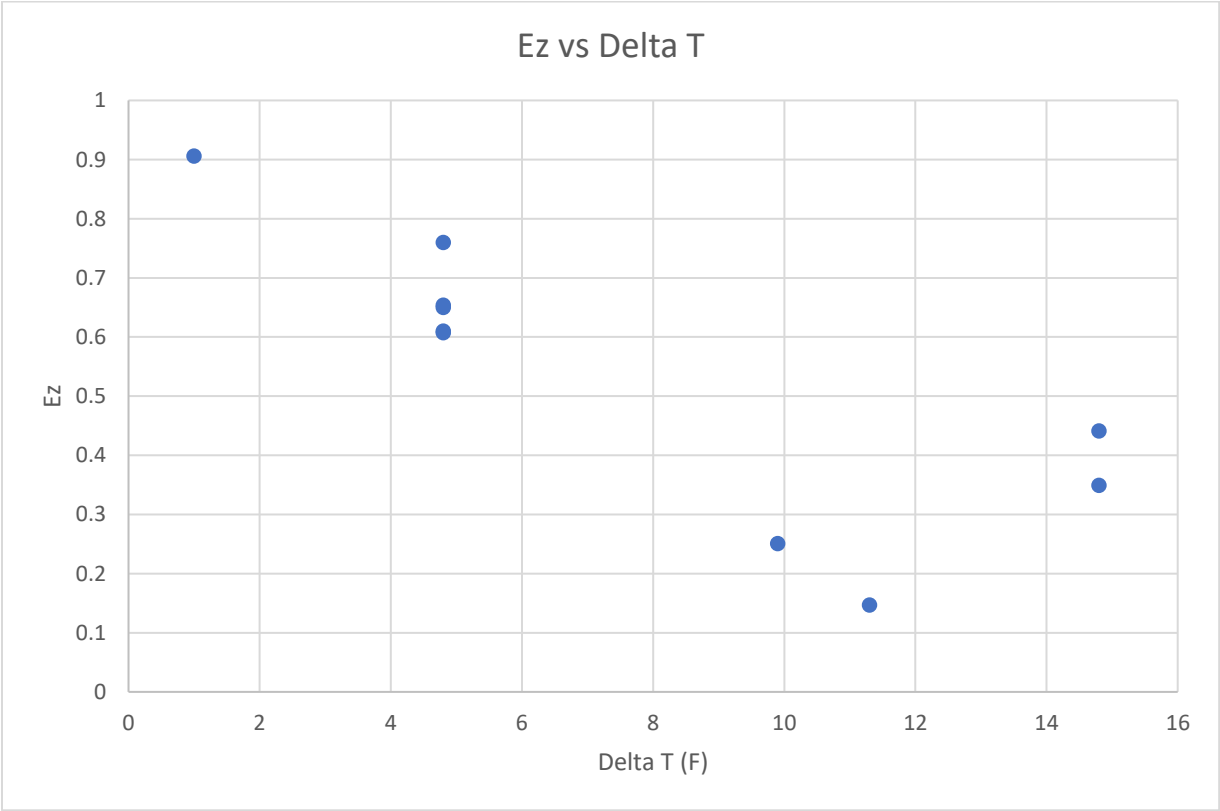
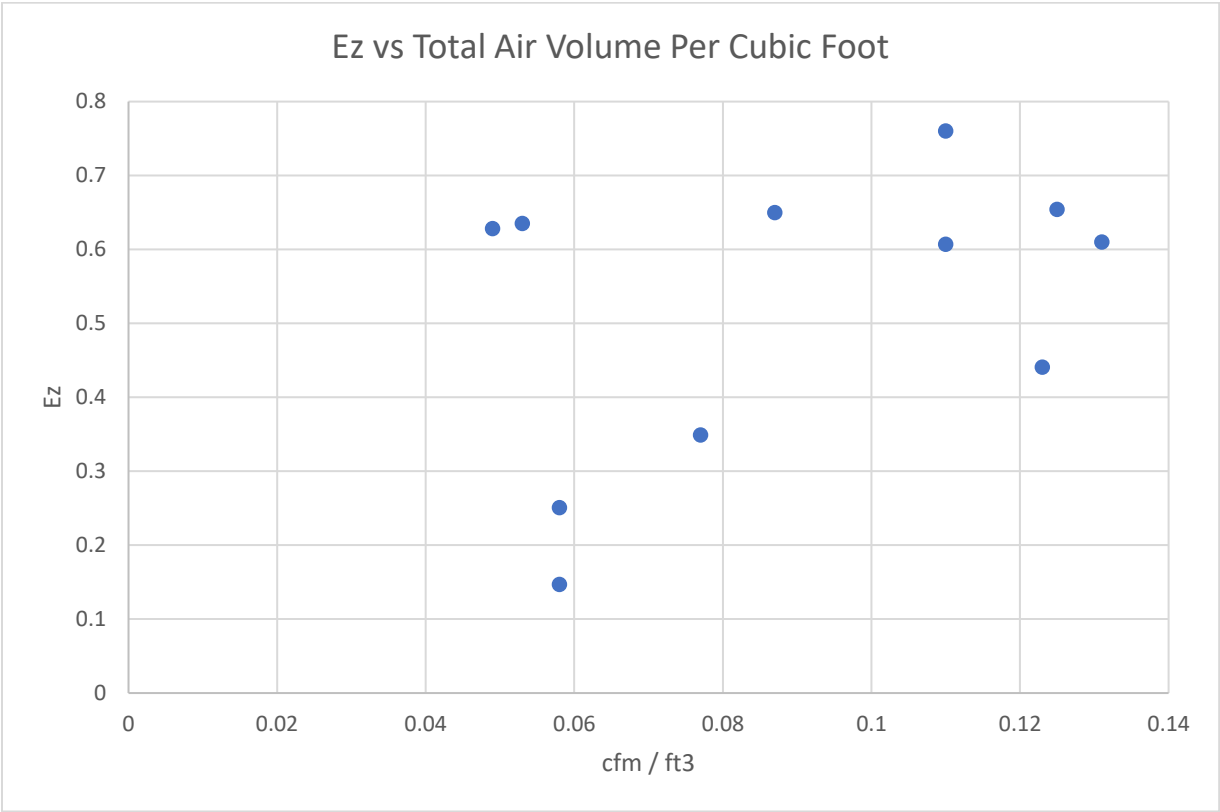


Summary of Results

Heating		Cooling		Ventilation	
Ez	0.251	Ez	0.91	Ez	0.906
	0.147		1.05		
	0.349				
	0.441				
	0.61				
	0.65				
	0.76				
	0.607				
	0.654				
	0.628				
	0.635				
Count	11	Count	2	Count	1
Min	0.147	Min	0.910	Min	0.906
Max	0.760	Max	1.050	Max	0.906
Average	0.521	Average	0.980	Average	0.906
Median	0.610	Median	0.980	Median	0.906

Important Note: most heating results in this study were obtained while trying to optimize Zone Air Distribution Effectiveness with diffusers providing better air mixing and a supply temperature of 80°F to reduce the temperature difference and minimize the effect of air stratification. In most applications with standard diffusers and 90°F supply temperature, it is fair to assume that most Ez values would have been lower than the results presented in this table.

Some Operating Conditions Affecting Ez Factor



## Project #1 - Classroom

### CFD Simulations Data

Application/Room	
Application Type	Classroom - Real Project
Room Dimensions	31.5 ft x 25.6 ft x 10.8 ft
Cubic Feet	8709
System Type	CAV, Variable Temperature
Nb of Diffusers/Inlets	4
Diffuser Type	AXO-S400 24" vs 3-Cone
Nb of Returns/Outlets	2
Nb of Occupants	32 students + 1 teacher
Nb of Computers	0
Nb of Desks	33
Other furniture	N/A
Cubicles Separators	No

### Heating Conditions

Outside Temperature	13.5 F
Setpoint	72 F
Outside Air	40%
Air Volume (cfm)	508
cfm / ft3	0.058

Heating Results	Sim 1	Sim 2	Sim 3
Occupants	Yes	No	No
Diffuser Type	AXO-S400	AXO-S400	3 Cone
<b>Energy Efficiency</b>			
Air Supply Temperature (F)	73	81.9	83.3
Delta T	1	9.9	11.3
<b>IAQ</b>			
Ez Factor	0.906	0.251	0.147
<b>Thermal Comfort</b>			
PPD*	8.27%	7.21%	7.48%

\*PPD: Predicted Percentage of Dissatisfied occupants, must be less than 20%

## Project #2 - NRC Test Report Using Standard 129-1997 (RA 200)

### CFD Simulations Data

Application/Room	
Application Type	Shared Office - NRC Physical Test
Room Dimensions	39 ft x 24 ft x 9 ft
Cubic Feet	8424
System Type	VAV
Nb of Diffusers/Inlets	4
Diffuser Type	(2x) AXO-S 24" + (2x) AXO-S400 24"
Nb of Returns/Outlets	2
Nb of Occupants	0
Nb of Computers	0
Nb of Desks	6
Other furniture	N/A
Cubicles Separators	Yes

### Heating Conditions

Outside Temperature	13.5°F
Setpoint	75.2°F
Outside Air	10%
Maximum Air Volume (cfm)	1100
Minimum Air Volume (cfm)	90

Heating Results	Sim 1	Sim 2	Sim 3
Air Supply Temperature	90°F	90°F	80°F
Delta T	14.8	14.8	4.8
Extra Window Transmissivity	-	0.37	-
<b>Energy Efficiency</b>			
Average air volume (cfm)	652	1032	1100
cfm / ft3	0.077	0.123	0.131
<b>IAQ</b>			
Ez Factor	0.349	0.441	0.61
<b>Thermal Comfort</b>			
Breathing Zone Temp	75.2°F	75.2°F	74.1°F
PPD*	5.39%	5.39%	5.84%

\*PPD: Predicted Percentage of Dissatisfied occupants, must be less than 20%

## Project #3 - Shared Office

### CFD Simulations Data

Application/Room	
Application Type	Shared Office - Fictive
Room Dimensions	40 ft x 24 ft x 9 ft
Cubic Feet	8640
System Type	VAV (except for 1 simulation)
Nb of Diffusers/Inlets	4
Diffuser Type	(2x) AXO-S 24" + (2x) AXO-S400 24"
Nb of Returns/Outlets	2
Nb of Occupants	0
Nb of Computers	0
Nb of Desks	6
Other furniture	N/A
Cubicles Separators	Yes

#### Heating Conditions (Near Maximum Air volume)

Outside Temperature	13.5°F
Air Supply Temperature	<b>80°F</b>
Setpoint	75.2°F
Delta T	4.8
Outside Air	10%
Maximum Air Volume	N/A

Minimum Air Volume	N/A
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Heating Results (Max VAV)	Sim 1	Sim 2	Sim 3	Sim 4
Diffusers	(6x) PLAY-S VAV	(4x) PLAY-S VAV	(4x) 3-Cone *Fix 950 cfm	(4x) 3-Cone VAV
<b>Energy Efficiency</b>				
Average air volume (cfm)	751	950	950	1078
cfm / ft3	0.087	0.11	0.11	0.125
<b>IAQ</b>				
CO2 PPM	N/A	981	1033	963
Ez Factor	0.65	0.76	0.607	0.654
<b>Thermal Comfort</b>				
Breathing Zone Temperature	74°F	75.2°F	74.2°F	75.2°F
PPD*	5.19%	5.24%	5.85%	5.18%

\*PPD: Predicted Percentage of Dissatisfied occupants, must be less than 20%

#### Heating Conditions (Near Minimum Air volume)

Outside Temperature	13.5°F
Air Supply Temperature	<b>40°F</b>
Setpoint	75.2°F
Delta T	4.8
Outside Air	10%
Maximum Air Volume	N/A

Minimum Air Volume	N/A
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#### Cooling Conditions (Near Maximum Air volume)

Outside Temperature	90 F
Air Supply Temperature	55 F
Setpoint	75.2 F
Delta T	-20.2
Outside Air	10%
Maximum Air Volume	N/A

Minimum Air Volume	N/A
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Heating Results (Min VAV)	Sim 1	Sim 3
Diffusers	(4x) PLAY-S VAV	(4x) 3-Cone VAV
<b>Energy Efficiency</b>		
Average air volume (cfm)	422	458
cfm / ft3	0.049	0.053
<b>IAQ</b>		
CO2 PPM	1720	1644
Ez Factor	0.628	0.635
<b>Thermal Comfort</b>		
Breathing Zone Temperature	75.2°F	75.2°F
PPD*	5.07%	5.07%

\*PPD: Predicted Percentage of Dissatisfied occupants, must be less than 20%

Cooling Results (Max VAV)	Sim 1	Sim 3
Diffusers	(4x) PLAY-S VAV	(4x) 3-Cone VAV
<b>Energy Efficiency</b>		
Average air volume (cfm)	1335	1325
cfm / ft3	0.155	0.153
<b>IAQ</b>		
CO2 PPM	797	790
Ez Factor	0.91	1.05
<b>Thermal Comfort</b>		
Breathing Zone Temperature	75.2°F	75.2°F
PPD*	14.70%	20.50%

\*PPD: Predicted Percentage of Dissatisfied occupants, must be less than 20%

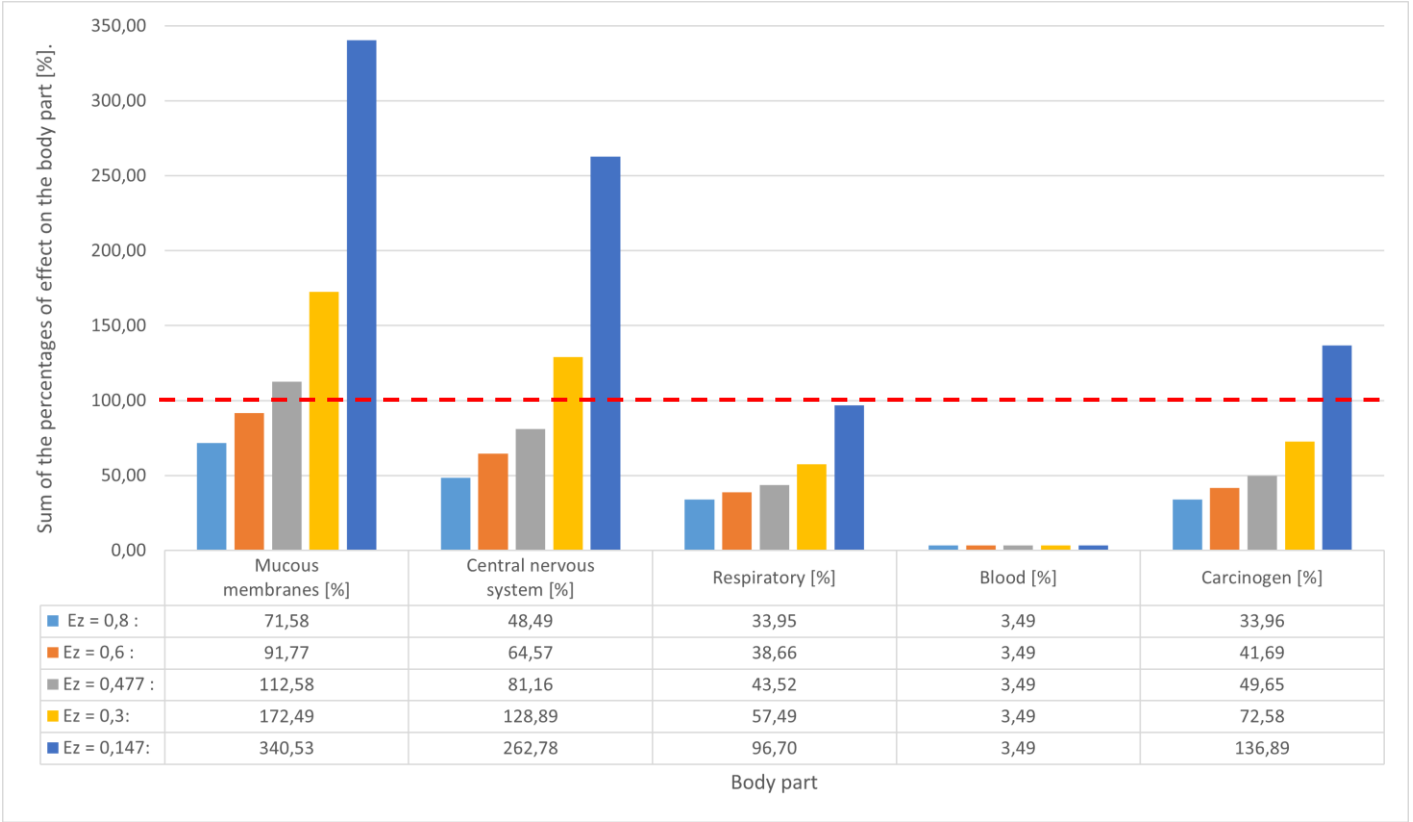
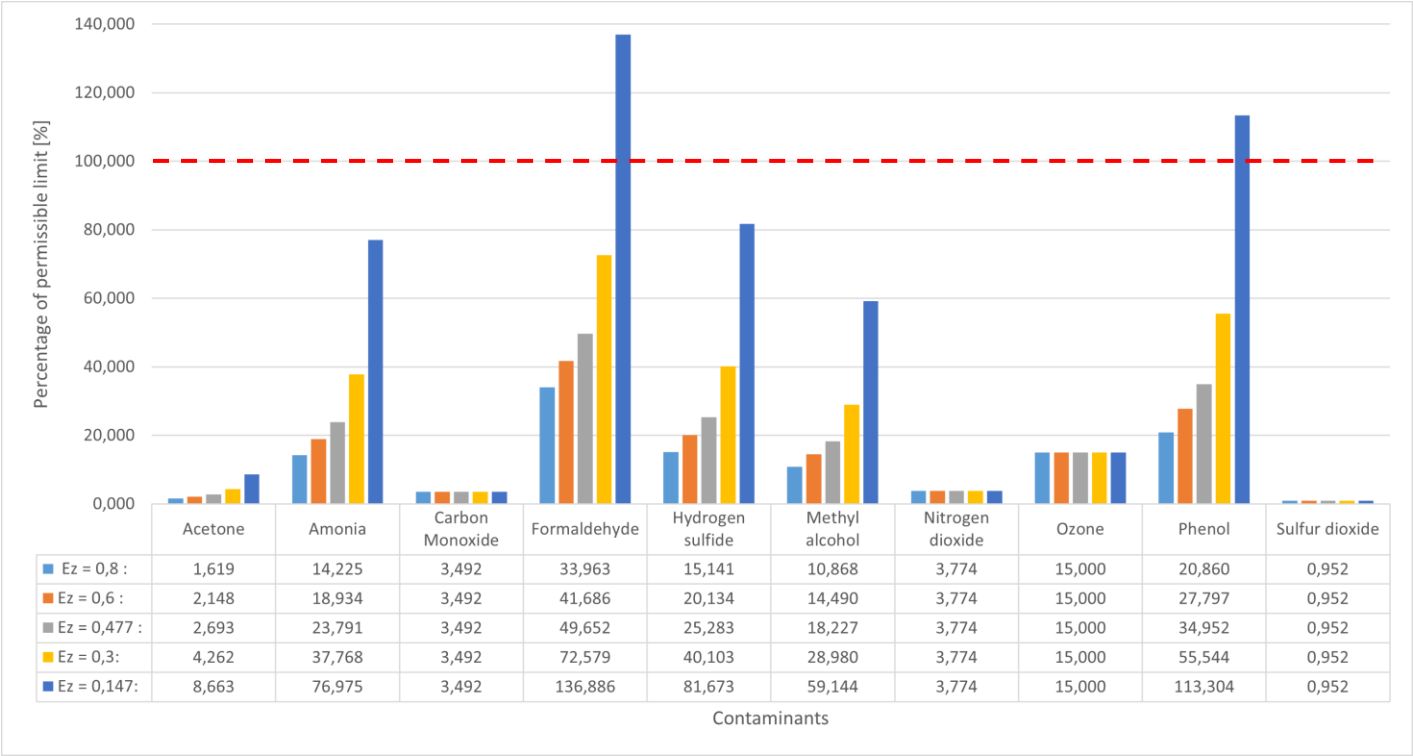
# Effectiv HVAC Inc.

## Analysis of the impact of the $E_z$ factor on contaminant concentrations using the IAQP procedure

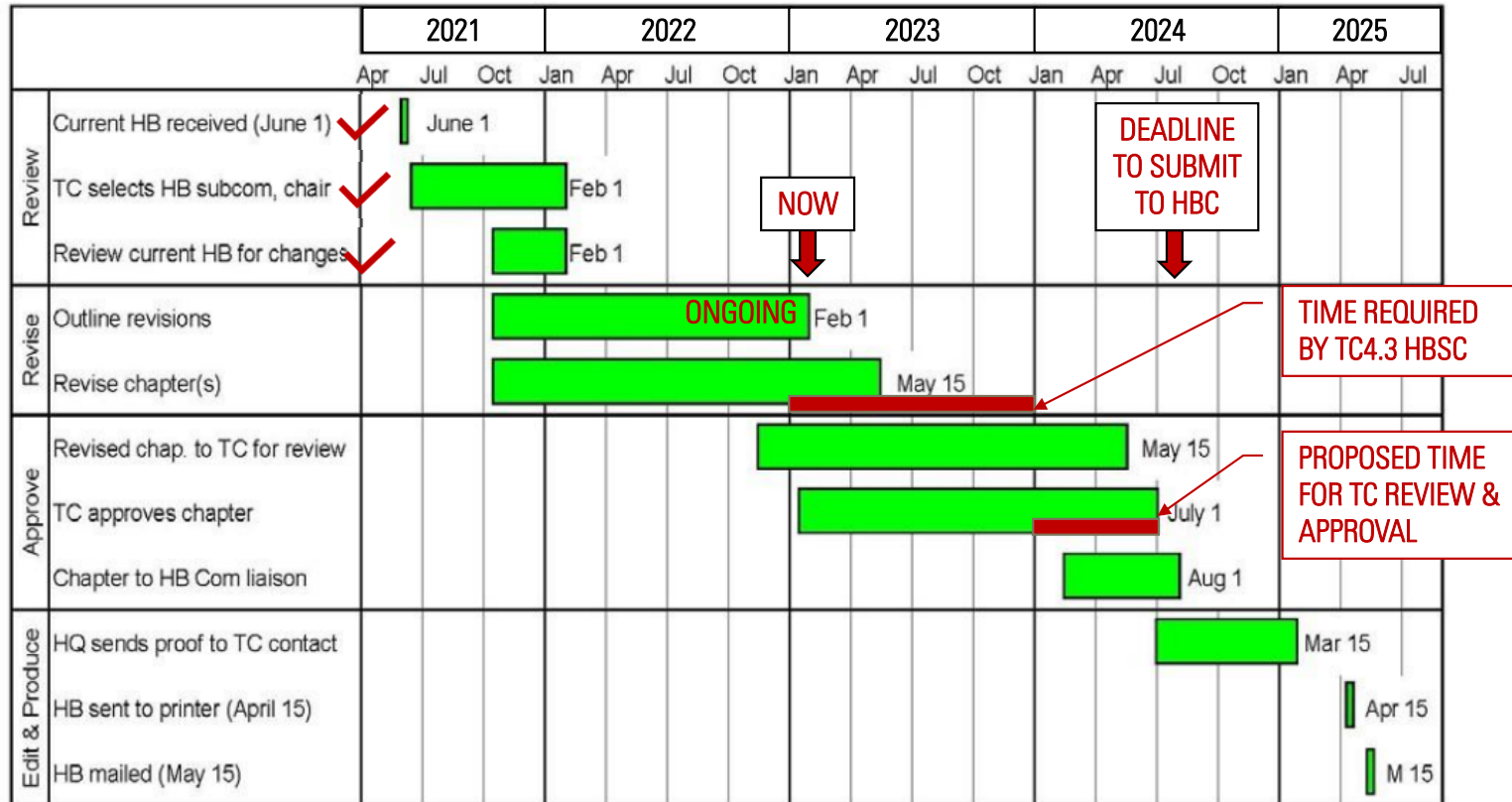
Study data :

$A_z$	186 m <sup>2</sup>		Zone floor Area
$P_z$	300 people		Zone population
$Q_v$	6000 CFM		Total supply air flow
$Q_v$	10194,06 m <sup>3</sup> /h		Total supply air flow
$E_z$	-		Zone air distribution effectiveness
	5	CFM/people	
$V_{oz} =$	1500	CFM	Zone outdoor airflow
$V_{oz} =$	2548,52	m <sup>3</sup> /h	Zone outdoor airflow
$E_f =$	0,6	%	Filter efficiency
$RV_r =$	4500	CFM	Flow rate of recirculated air
$RV_r =$	7645,55	m <sup>3</sup> /h	Flow rate of recirculated air

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## 2025 Handbook Revision Cycle – Based on Authors and Revisers Guide

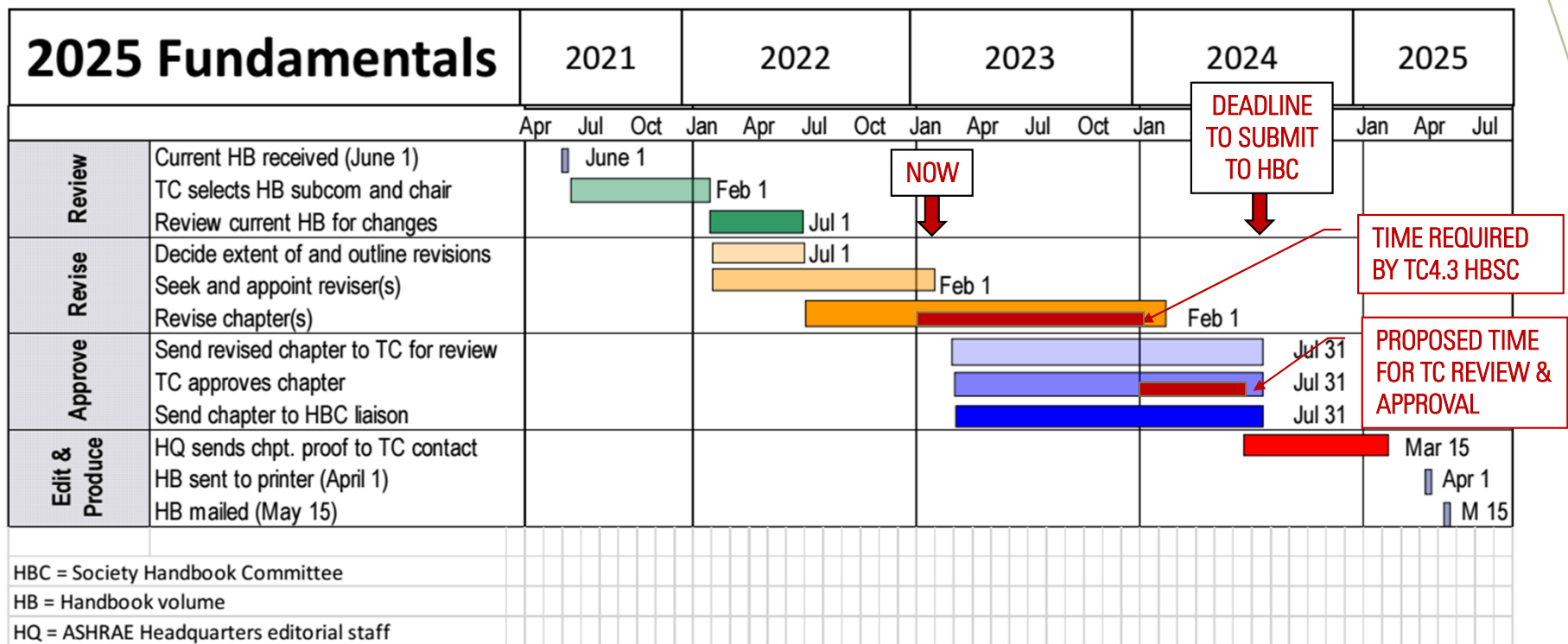


HB Com = Society Handbook Committee

HB = Handbook volume

HQ = ASHRAE Headquarters editorial staff





HBC = Society Handbook Committee

HB = Handbook volume

HQ = ASHRAE Headquarters editorial staff

**Subject: Air Exchange**

Thank you for offering to forward this question to TC 4.3.

I am interested in calculating "natural" air exchange, i.e., when windows and doors are open. (When doors move rapidly, there is an energy benefit).

The calculation is easy, except for determining the average air speed to use.

Is there an ASHRAE method to select average air speed?

Of course, we could use the average wind speed at each location, but I have a feeling it's more complicated than that.

Thank you for your help.

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**Discussion and Papers from TC4.3 Meeting**

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Window-opening behavior in US homes:

<https://onlinelibrary.wiley.com/doi/abs/10.1111/ina.12932>

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There is a big (and old) literature on airflow through big openings. [see attachments] I explicitly included the kiel and wilson work from U of A that was mentioned in the meeting. There are loads of natural ventilation design guides that are specifically for air flow through large openings driven by wind and stack effect. If the attached R&D info isn't what the questioner is looking for, they should read this book: [ASHRAE Design Guide for Natural Ventilation](#).

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Regarding the door pumping, see the following for some further info:

[https://www.researchgate.net/publication/327277833\\_Air\\_Inleakage\\_Due\\_to\\_Door\\_Opening\\_and\\_Closing](https://www.researchgate.net/publication/327277833_Air_Inleakage_Due_to_Door_Opening_and_Closing). This 2000 paper by Pete Lagus points to the earlier work by Kiel and Wilson in 1989 that I mentioned. The other work that I mentioned by Gren Yuill (763-RP, 1996) is listed already in the 2021 Handbook of Fundamentals Chp 16 (p.16.41). The related research report is available at: <https://technologyportal.ashrae.org/Report/Detail/420>.

European work on natural ventilation: the person who posed the questions should visit the AIVC (<https://www.aivc.org/>), CIBSE (<https://www.cibse.org/>), and REHVA (<https://www.rehva.eu>) for further info, or more preferably hire a consultant specializing in the issue. ASHRAE is not in the business of consulting engineering, nor should it be.

Note also that natural ventilation is used much less in North America. The following 2001 report from NIST provides some discussion related to the issue:

<https://www.govinfo.gov/content/pkg/GOVPUB-C13-4bfff386c2f003c32b2ebdb2fc1eabc6/pdf/GOVPUB-C13-4bfff386c2f003c32b2ebdb2fc1eabc6.pdf>