Welcome!

Welcome to the ASHRAE TC 9.9 Virtual Meeting!

No need to say hello, we will begin promptly at 10:00 am EST

Agenda

- Introduction
- Programs
- Handbook
- Research

Housekeeping

Audio

- Attendees are muted upon entry
- Do not un-mute your line
- If you are joining via computer and phone line, ensure both are muted

Video

- We encourage you to keep your video off
- If you do enable your video, be mindful that you are on display! Turn off your video when needed.

Q&A

- Use the chat function to ask questions
- Our moderator will share questions throughout the presentation with the speaker to answer.
- If you need to speak, please use the Raise Hand button and the moderator will enable your microphone.

Attendance

- Please complete the attendance form found at the URL at the bottom of this slide

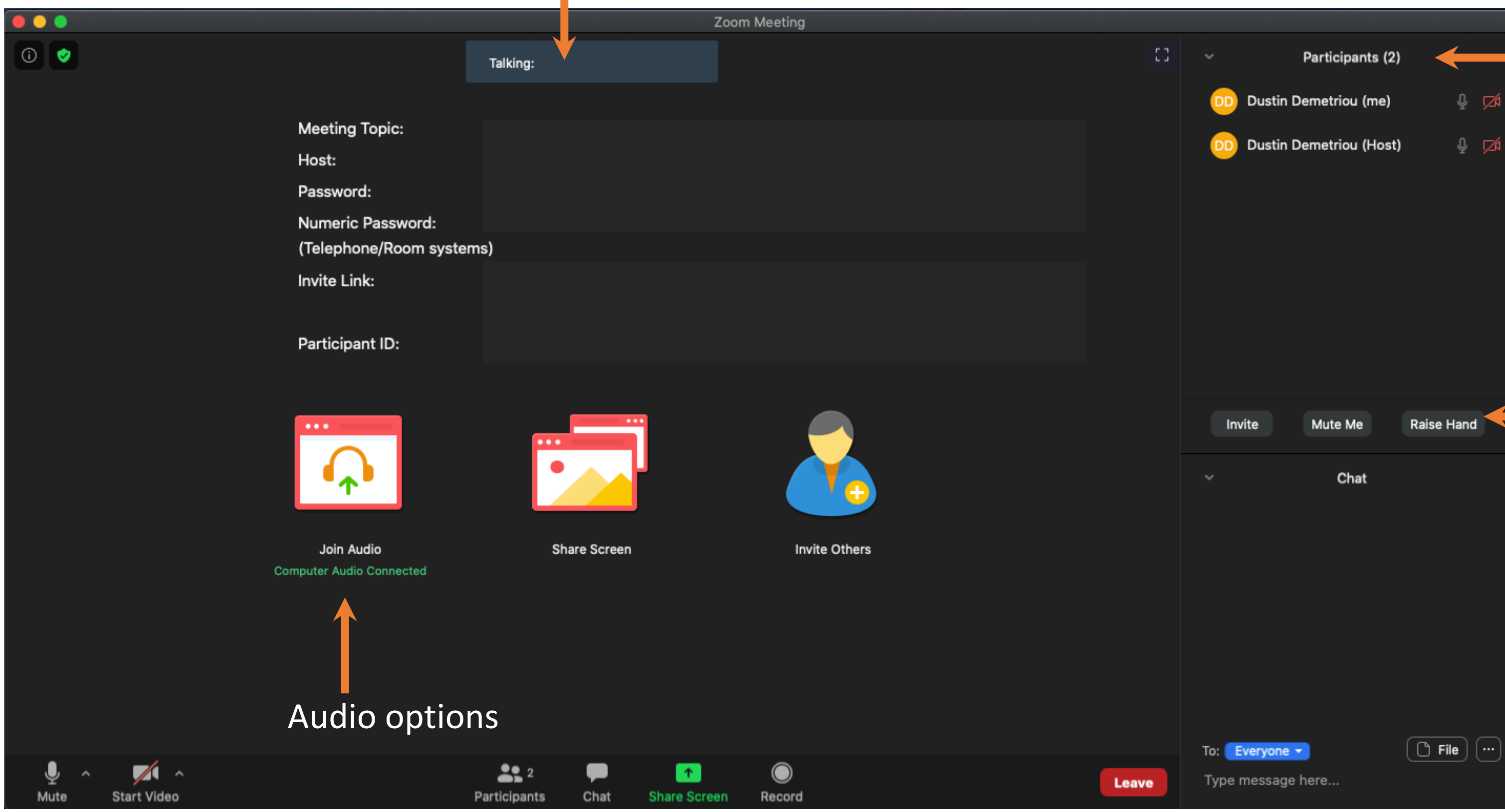
Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment

ASHRAE Winter Conference 2021
Virtual

Zoom Controls

Full Zoom Window

Speaker



Participant panel

Raise hand

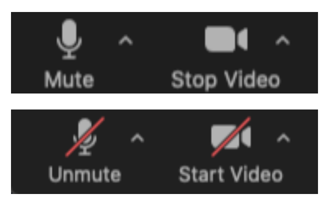
Chat panel

Audio options

Toggle chat panel on/off

Turn video on / off

Mute / unmute audio

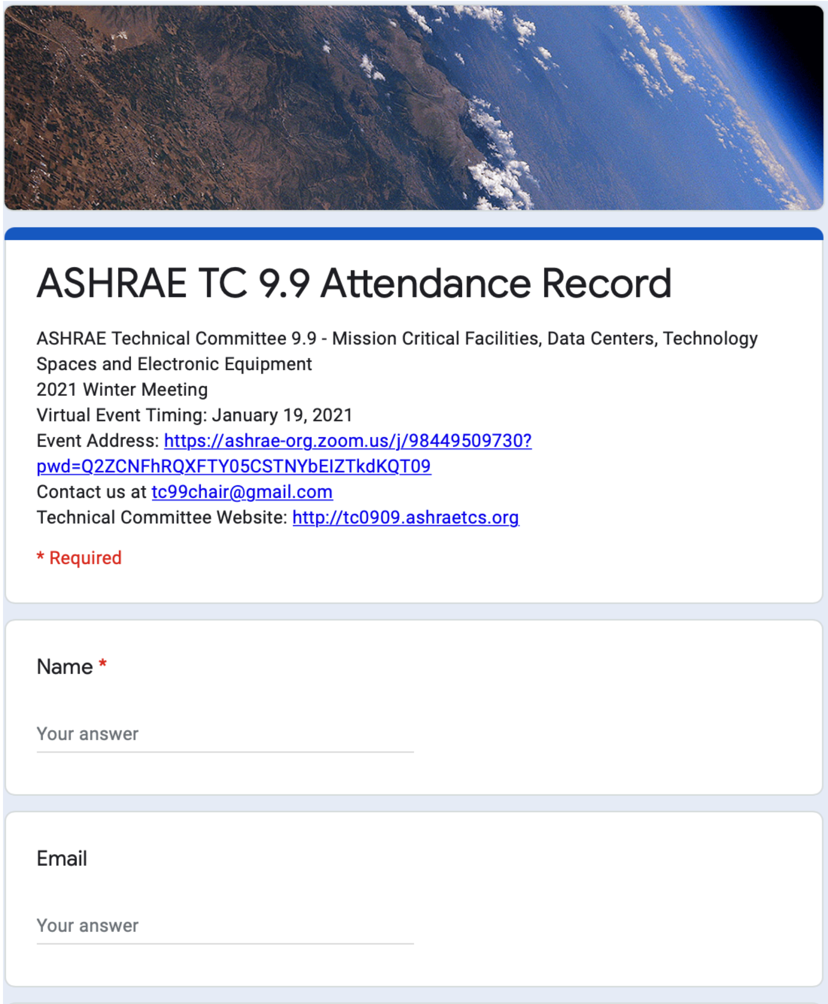


Audio and Video ON

Audio and Video OFF

Attendance: http://bit.ly/tc99-attendance

Attendance



ASHRAE TC 9.9 Attendance Record

ASHRAE Technical Committee 9.9 - Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
2021 Winter Meeting
Virtual Event Timing: January 19, 2021
Event Address: https://ashrae-org.zoom.us/j/98449509730?pwd=Q2ZCNFhRQXFTY05CSTNYbEIZTkdKQT09
Contact us at tc99chair@gmail.com
Technical Committee Website: http://tc0909.ashraetcs.org

* Required

Name *

Your answer

Email

Your answer

Attendance is being recorded using a Google Form. Please make sure you complete the form at:

http://bit.ly/tc99-attendance

ASHRAE Code of Ethics

As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.

A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.

B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.

C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.

D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.

E. We shall avoid real or perceived conflicts of interest whenever possible and disclose them to affected parties when they do exist.

F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.

G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.

H. Activities crossing national and cultural boundaries shall respect the ethical codes of the seat of the principal activity.

Agenda

Monday, January 18, 2021
TC 9.9 Program, Handbook, and Research
10:00 AM – 12:00 PM EST
Location: Virtual

Topic		**Time**	**Presenter**
Introduction	Welcome and Introductions	10	Dustin Demetriou
Programs	2021 Winter Virtual and 2021 Summer Phoenix	15	Nick Gangemi
Handbook	Chapter 20	10	Bob McFarlane
Research	1675-RP: Guidance for CFD Modeling of Data Centers	15	Mark Seymour
	Sea Salt Filtration RTAR and WS	15	Roger Schmidt
	Wetted Materials Research	10	Mark Steinke
	Open Discussion on Research Topics	15	All

Programs Update

ASHRAE Virtual Winter Meeting

Nick Gangemi, Program Chair

ASHRAE VIRTUAL WINTER CONFERENCE

February 9-11, 2021

What to Expect:

- Three days packed with learning and live discussions with top experts
- Special sessions covering the latest on the COVID-19 pandemic
- 8 Tracks with 40 live and more than 80 on-demand sessions (most with PDHs), available for 18 months
- Updates from Society leaders, Women in ASHRAE keynote presentation and recognition of ASHRAE Honors and Awards recipients
- Virtual technical tours, social events, meet-ups, and networking opportunities

Virtual February 9 - 11, 2021

- **Tracks**
  - **HVAC&R Fundamentals and Applications**
  - **Systems and Equipment**
  - **Refrigeration & Refrigerants**
  - **Environmental Health Through IEQ**
  - **Building Performance and Commissioning for Operation and Management**
  - **Energy Conservation**
  - **International Design**
  - **Standards, Guidelines and Codes**
  - **Mini Track**

Wednesday, February 10, 10:30 AM - 11:30 AM

Seminar 14 (Basic)

What You Need to Know About ANSI/ASHRAE Standard 90.4: The Energy Standard for Data Centers (LIVE)

Track: Standards, Guidelines and Codes
Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment, SSPC 90.4, SSPC 90.1
Chair: Joseph Gangemi, Life Member, Data Aire, Orange, CA

The 2019 version of Standard 90.4 was officially recognized in Standard 90.1 as the Alternate Compliance Path for Data Centers, defined as greater than 10 kW and 20 W/sf power density. Smaller facilities are defined as Computer Rooms and remain governed by Std. 90.1. Standard 90.4 has already been adopted in the state of Washington and is pending adoption in other jurisdictions. But it will be widely recognized as Std. 90.1-2019 is adopted, so it is important that designers understand its substantial differences from 90.1, and the advantages it offers for achieving compliance in Mission Critical Data Center designs.

1. The Origin of ANSI/ASHRAE Std. 90.4, Its Purpose and Format and Using the Electrical Loss Component (ELC) Metric
Robert McFarlane, Member*, Shen Milsom & Wilke, LLC, New York, OR*
2. Understanding the Mechanical Load Component (MLC) and Tradeoff Options in ANSI/ASHRAE Std. 90.4
Vali Sorell, P.E., Member*, Microsoft Corporation, Charlotte, NC*
3. The Relationship between Standards 90.1 and 90.4, and the Importance of 90.4 to Mission Critical Facilities
Timothy Peglow, P.E., Member*, MD Anderson, Houston, TX*

Thursday, February 11, 3:00 PM - 4:20 PM

Seminar 32 (Intermediate)

Climate Control Solutions for What is Next, Moving from Hyperscale to The Edge (LIVE)

Track: HVAC&R Fundamentals and Applications
Sponsor: 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
Chair: Herb Villa, Member, Rittal North America, Newark, NJ

IT is expanding from traditional data centers to very small, localized Edge deployments. Climate control must be able to support this migration. The move to The Edge is driven by the exponential growth of IoT. Supporting a variety of applications, Edge deployments support real time data collection and analysis, allowing near real time reaction to shifting market demands. Employing the same core components (enclosures, power, security), the unique demands at The Edge warrant a renewed review all systems, with this seminar focusing on adapting climate control solutions from the hyperscale arena for use in the Edge space.

1. Climate Control Solutions for What's Next
Suzanne Krantz*, Rittal North America, Schaumburg, IL*

On Demand

Seminar 77 (Intermediate)

Smart Indoor Environmental Models for Data Centers

Track: Building Performance and Commissioning for Operation and Management
Sponsor: 4.10 Indoor Environmental Modeling, 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
Chair: Wangda Zuo, Ph.D., Member, Colorado University at Boulder, Boulder, CO

This session aims to highlight smart indoor environmental modeling approaches for real-world practice. We will discuss the advantages and disadvantages of full scale CFD modeling and compact models. Then we will illustrate where and when the compact models can be used with examples from real world practices in data centers.

It's Always Smart to be Accurate – or Is It?
Mark Seymour, *Member, Future Facilities, London, United Kingdom*
Using Compact Models for Improving IT Equipment Modeling in Data Center Simulations
Dustin Demetriou, Ph.D., *Member, IBM, Poughkeepsie, NY*
A Compact Rack Model for Data Center Modeling
James VanGilder, P.E., *Member, Schneider Electric, andover, MA*

2021 ASHRAE Annual Conference
Phoenix, AZ | Jun 26–30, 2021

The 2021 ASHRAE Annual Conference will be held in Phoenix, AZ!

Phoenix Tracks

Track 1: Fundamentals and Applications

Chair: Sonya Pouncy, sonyapouncy@gmail.com

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.

Track 2: HVAC&R Systems and Equipment

Chair: Rupesh Iyengar, rupesh_iyengar@yahoo.com

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.

Track 3: Research Summit

Chair: Kristen Cetin, cetinkri@msu.edu

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.

Phoenix Tracks

Track 4: Professional Development

Chair: Marites Calad, mcalad@norman-wright.com

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.

Track 5: Design, Control, and Operation of Critical Environments

Chair: Raul Simonetti, raul.simonetti@carel.com

Critical environments often present design, control, and operation challenges that require innovation, attention to detail, and a thorough understanding of the intended operational parameters. This track includes innovative designs and strategies that adapt to the standards and special requirements presented by healthcare, cleanrooms, data centers, laboratories, isolation rooms, and pharmacies. Papers and presentations will also address how controls systems, smart building technologies, and security systems and other technologies are adapting to the emerging needs of critical environments.

Track 6: HVAC&R for Indoor Plants & Animals

Chair: Ryan MacGillvray, ryan.macgillivray@dwel.com

This track addresses HVAC&R systems design for controlled environments that host plants & animals. Papers and programs in this track will present the challenges and opportunities associated with energy and water utilization for indoor growing spaces, including standards and regulations that guide the design of plant & animal habitats. Environmental parameters for indoor agriculture, including controlling temperature, humidity, air movement, air quality will be covered. This track will also address reducing consumption of energy & water and compare how crop types and animal species impact HVAC analysis and design.

Phoenix Tracks

Track 7: Future Proofing - Renewable, Regenerative, and Resilient

Chair: Andy Cochrane, acochrane@industrialairinc.com

The HVAC&R industry faces many challenges including climate change, pandemics, natural disasters, catastrophic accidents, and terrorism. Rising to meet these challenges are a host of technologies and strategies, including grid-enabled buildings, demand response, decarbonization, resiliency, zero energy design, energy-efficiency and renewable energy systems. This track invites papers, abstracts, seminars and forums that highlight the innovative technologies and strategies that are reimagining our relationship with the built environment now and into the future.

Track 8: Hot, Hot, Hot

Chair: Nohad Boudani, nohadb@inco.com.lb

The world is warming. The built environment faces increased challenges to meet the demand for comfortable Indoor and outdoor environments in warmer climates. This track is for papers and presentations that address humidity control, outdoor cooling, passive cooling, water scarcity considerations, other design opportunities, and innovative technologies that help HVAC&R professionals adapt to the hottest climate trends.

Track 9: To be Announced

Important Dates for Phoenix

Web Site Open for Extended Abstracts and Program Proposal Submittals

- The 2021 ASHRAE Annual Conference is now accepting Extended Abstract papers and program proposals.
- Extended Abstracts are being accepted for the Research Summit track only. Extended Abstracts can be up to 3 pages in length and must be prepared using the Word template. **Extended Abstracts are due February 15, 2021.**
- **Proposals for Seminars, Forums, Workshops, Panels and Debates are being accepted through February 18, 2021.**

For more information or to submit an Extended Abstract or a program proposal, click here https://ashraem.confex.com/ashraem/s21/cfp.cgi

Important Dates for Phoenix

Wednesday January 13, 2021: Revised Conference Papers/Final Technical Papers Due

Monday February 15, 2021: Extended Abstracts Due

Thursday February 18, 2021: Conference and Technical Paper Final Accept/Reject Notifications

Monday February 22, 2021: Program Submissions Due

Friday March 19, 2021: Extended Abstract Accept/Reject Notifications

Friday April 2, 2021: Program Submissions Accept/Reject Notifications

Program Types

- **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.
- **Conference Paper Sessions-**
  - 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.

Program Types

- **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.

- **Forums-**
  - Forums are “off-the-record” discussions held to **promote a free exchange of ideas**.
  - Limited reporting to allow **individuals to speak confidentially** without concern of criticism.
  - There are **no papers** attached to these forums.

Attendance: http://bit.ly/tc99-attendance

Program Types (cont.)

- **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

- **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**.

Program Types (cont.)

- **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.

Technical Papers

Technical Papers:

- Technical Papers are presented by authors at ASHRAE **Winter and Annual Conferences**.
- Technical Papers submitted for review must be both technically accurate and clearly written.
- Technical Papers undergo a **rigorous double-blind review** and must be **approved by three reviewers** knowledgeable in the subject matter.
- Technical Papers can be **up to 30 double-spaced manuscript** pages in length, including tables and charts, and a maximum of 12 figures (not counted in the page count).
- Accepted Technical Papers are **available as hard-copy preprints** in the bookstore during the conference.
- The Technical Papers must be presented at the conference in order to be **published in *ASHRAE Transactions***, where they will be included with questions and answers (if any).

Conference Papers

Conference Papers:

- Conference Papers are **shorter than Technical Papers**, undergo a **less stringent review** and can be **prepared closer to the conferences**.
- Unlike Technical Papers, **abstracts** of Conference Papers are **submitted first** for review.
- Upon acceptance, papers are due three months after abstract acceptance, **undergo a single-blind review** (the author(s) names are included in the paper; however, reviewer's remain anonymous), and must be **approved by two reviewers**.
- Upon approval, papers are scheduled for oral presentation.
- Conference Papers can be **no more than 8 single-spaced pages** in length total (includes text, tables, figures, etc.).

Nick Gangemi, Program Chair

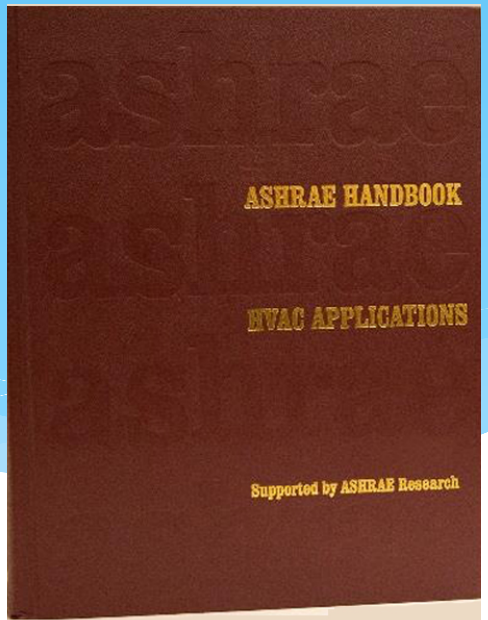
585-721-8795

Nick.GANGEMI@bureauveritas.com

ASHRAE HANDBOOK "Applications"

Moved to Chapter 20 in 2019 Publication

"Data Centers & Telecommunication Facilities"



NEXT UPDATE

- 2023 “Applications” Handbook
- Revision Due Date: June 2022 Summer Meeting
  - <u>Approved at HQ</u>
- Means Approved by TC Board At or Before Meeting

  Revision Submissions By March 1, 2022

REVIEWS TO DATE

* Benjamin Petschke
  * International References
  * Improvements & Additions to "Raised Floor" Paragraphs
  * Improvements & Additions to CRAH Paragraph
  * Improvement to Downflow CRAC/CRAH Paragraph
  * Correction to "Top Blow" CRAC/CRAH Sentence
  * Improvement to PUE Paragraph
  * Improvements & Additions to "Economizer" Section of Energy Efficiency Section

REVIEWS TO DATE

* Gerardo Alfonso
  * Add Latency Issues Re: IoT, IA, & Real Time Applications
  * Update 90.4 & BICSI 002 Date References
  * Include New BICSI 009-2019 Reference w/ Summary
  * Include TGG #79 Reference w/ Summary
  * Update Std. 127 Date Reference
  * Include Drawing for CFD
  * Reference TGG #68 White Paper In Addition to Mention of PI
  * Include TC 9.9 Book #14 – DCIM

REVIEWS TO DATE

- Sushil Kumar
  - Review In Process
- NO OTHER REVIEW OFFERS IN TWO YEARS!!

UPDATE STATUS

- “Handbook” Wants “Major Topics” List for 2023
  - Purposes:
    - For “Handbook” to Anticipate Work Load
    - To Get Chapters Thinking Ahead

CHAPTER REVIEW FORM

ASHRAE® HANDBOOK
CHAPTER REVIEW FORM

Handbook Volume Reviewed: ____________ Volume Year: _____ Date: ________

Chapter No. ________ Chapter Title ____________________

1. Does this chapter, in your opinion, truly reflect the state of the art? Yes ☐ No ☐ Somewhat ☐
   If you answered "no" or "somewhat," please indicate typical example(s) below or provide an attachment.

2. Check the description that most nearly categorizes the relevance and balance between theory and practice in this chapter:
   - ☐ a. Too much theory, not enough practical application.
   - ☐ b. Just about right.
   - ☐ c. Too little theory to support the recommendations.
   - ☐ d. Obsolete—remove this subject from ASHRAE publication.
   - ☐ e. Other: ____________________

3. Tables in this chapter are (check all that apply):
   - ☐ a. Clear and understandable.
   - ☐ b. Adequately footnoted.
   - ☐ c. Properly referenced in the text.
   - ☐ d. Sufficient for the average user.
   - ☐ e. Too voluminous for a Handbook chapter.
   - ☐ f. Inadequately documented.
   - ☐ g. Not required (please list specific tables):
   - ☐ h. Other: ____________________
     1. Please identify tables prompting negative comments:
     2. Please suggest tables, if any, that should be added to make the chapter more useful:

4. Equations and derivations are (check all that apply):
   - ☐ a. Clear and understandable.
   - ☐ b. Sufficient for the average user.
   - ☐ c. Properly referenced in text.
   - ☐ d. Properly footnoted to identify variables.
   - ☐ e. Too voluminous for a Handbook chapter.
   - ☐ f. Inadequately documented.
   - ☐ g. In need of improvement.
   - ☐ h. Not required (please list specific equations or passages):
   - ☐ i. Other: ____________________
     1. Please identify derivations/equations prompting negative comments:
     2. Please suggest alternatives:

5. The examples given in this chapter are (check all that apply):
   - ☐ a. Clear and understandable.
   - ☐ b. Adequate for the average user.
   - ☐ c. Appropriately interfaced with the text.
   - ☐ d. Mathematically correct.
   - ☐ e. Use the tables as indicated by the text.
   - ☐ f. Inappropriate.
   - ☐ g. Obsolete.
   - ☐ h. Too complicated.
   - ☐ i. Useless.
   - ☐ j. Not required (please list specific examples):
   - ☐ k. Other: ____________________
     1. Please identify examples prompting negative comments:
     2. Please identify sections that need more explanation or examples to clarify them:

CHAPTER REVIEW FORM

6. The figures and graphics in this chapter are (check all that apply):

- ☐ a. Clear and understandable.
- ☐ b. Adequate for the average user.
- ☐ c. Appropriately interfaced with the text.
- ☐ d. Properly footnoted.
- ☐ e. Hard to read.
- ☐ f. Inappropriate.
- ☐ g. Obsolete.
- ☐ h. Not required (please list specific figures): ______________________
- ☐ i. Other: ______________________

   1. Please identify figures or graphics prompting negative comments:

   2. Please suggest additional figures, if any, that should be added to the chapter:

7. ASHRAE maintains a reputation as the "Standard of the Industry" in HVAC&R matters, with the Handbook series serving as its "bible." In this context, and on an ascending scale from 0 to 7, please rate your overall evaluation of this chapter as a worthy representative of and contributor to this traditional role:

- ☐ 7 Couldn't be better in any way.
- ☐ 6 Well done—only nominal review required.
- ☐ 5 Okay, but needs update more often.
- ☐ 4 Technically correct, but needs editing.
- ☐ 3 Technically acceptable, but needs amplification.
- ☐ 2 Not technically up to date, but better than nothing.
- ☐ 1 Completely revise and update or drop immediately.
- ☐ 0 Drop from Handbook or any other publication.

COMMENTS:

☐ **Do you wish to receive feedback from this chapter's TC, in response to your comments?** (Please note that any contact information you provide will be used only for this purpose, and will not be shared with any other parties.)

Name (optional):

Contact information (optional):

Return Completed Review to
Mark Owen, Handbook Editor
mowen@ashrae.org
ASHRAE, 1791 Tullie Circle, Atlanta, GA 30329

PLEASE SEND UPDATES TO ME

- Please Send to Bob McFarlane:
    - rmcfarlane@smwllc.com
- Requesting Assistance in Reviewing Suggestions
    - Subject Matter Experts on Specific Suggestions
    - Two Board Members to Expedite Board Approval
    - Don Beatty for "Relevance" Review

Research

Mark Seymour

Research Topics

- General ASHRAE research situation
- 1675-RP: Guidance for CFD Modeling of Data Centers
- Sea Salt Filtration RTAR and WS
- Wetted Materials Research
- Open Discussion on Research Topics

Project Update

1675-RP: Guidance for CFD Modeling of Data Centers

Cheng-Xian (Charlie) Lin and Beichao Hu
Florida International University

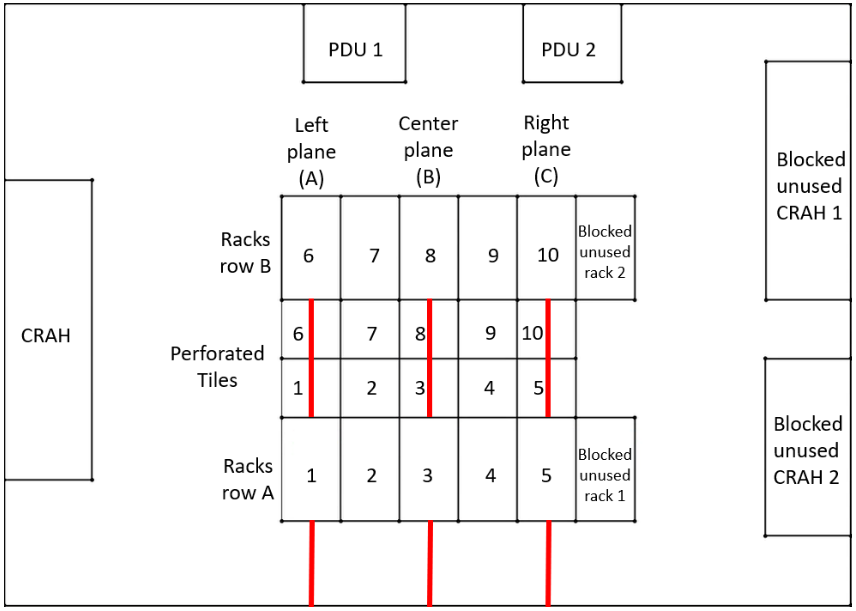
Yogendra Joshi and Dhaval Patel
Georgia Institute of Technology

01/14/2021

Table of Contents

Project Objectives

- To develop general CFD modeling guidance for data center applications
- Experimental and CFD work
  - Two physical configurations:
    - Baseline configuration
    - Alternative configuration (with blockage in plenum)
  - Parameters variations (~ 25 cases)
    - Server flow rates
    - Supply temperatures
    - Supply flow rates
    - Rack loading
    - Underfloor blockage



Data Center Lab at Georgia Tech

Project Timeline

- FIU Project kick-off April 2016 – 24 months
- Suitable lab space finally identified via Subcontract with Georgia Tech August 2018
- Initial CFD models completed March 2019
- Server simulators received March 2019
- Lab measurements started October 2019
- Lab measurements completed December 2020
- CFD comparisons – ongoing throughout
- Sensitivity study completion and guidance production intended March 2021

Overview of Recent Progresses

- Experimental work:
  - Verification of server and instruments conducted
  - Testing data collected for all tasks
- CFD work:
  - Numerical simulations conducted simultaneously
  - Temperature/velocity and flow rate results being compared to testing data
- Project management:
  - Multiple technical consultations with some PMS members
  - FIU and GA Tech weekly online meetings
- Final Report
  - In preparation

Plans for the Next Few Months

- Complete all the data analysis and guideline development
- Submit the final report to ASHRAE
- Will need an extension – 6 months applied for

Experiment Progress

Dhaval Patel

Table of Content

Recent Progress

- Changes made to the sensor setup
- Measured pressure drop over perforated tile
- Investigated server simulator flow rate and fan power
- Repeatability testing
- Built and tested different blockages to obtain a different flow
- Completed proposed test case measurements

Layout

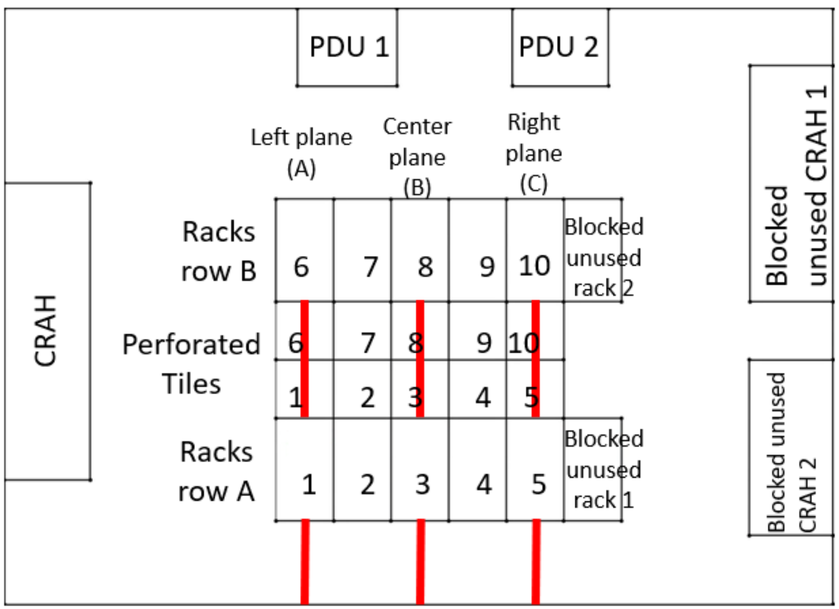


Figure 1 – Room layout. Red line shows the racks temperature measurements were taken in.

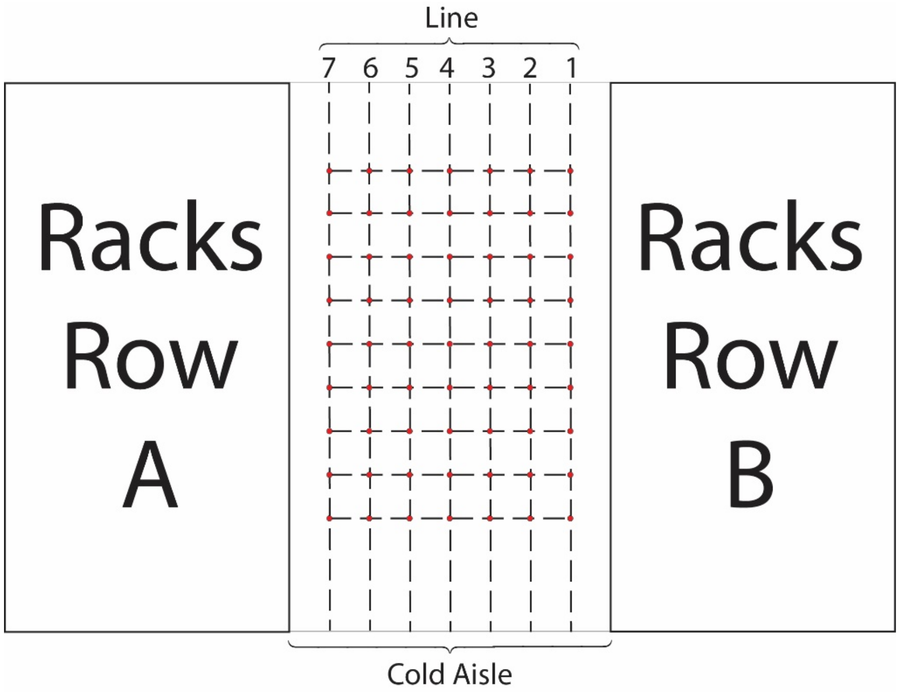
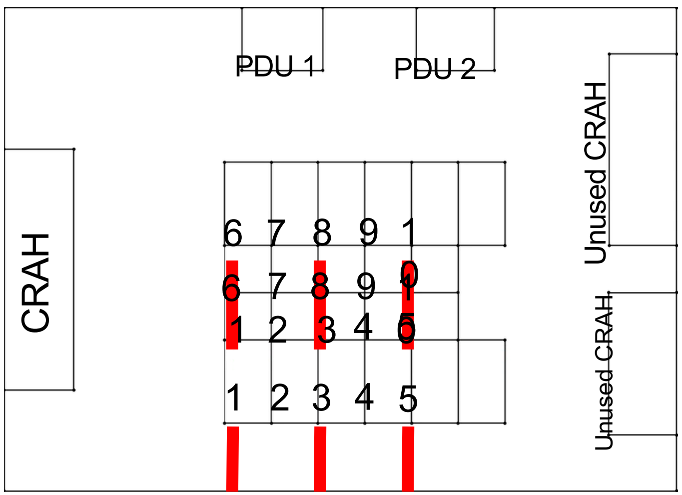
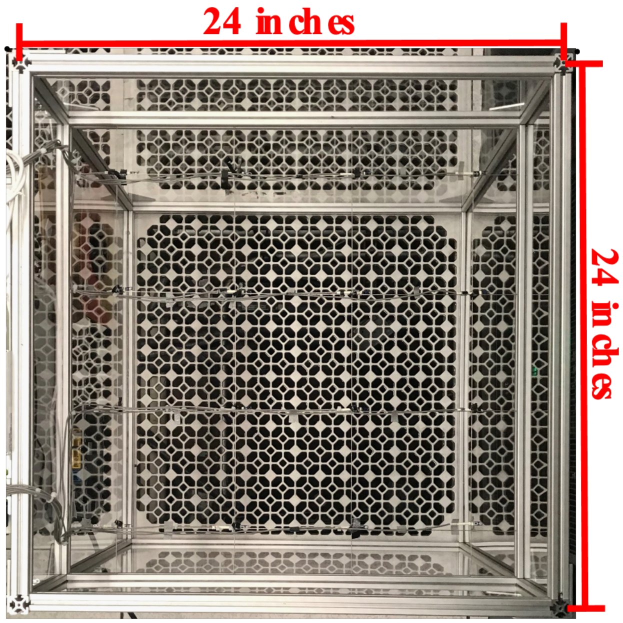


Figure 2 – Rack layout. Intersection between the numbered dotted lines represents the sensor placement.

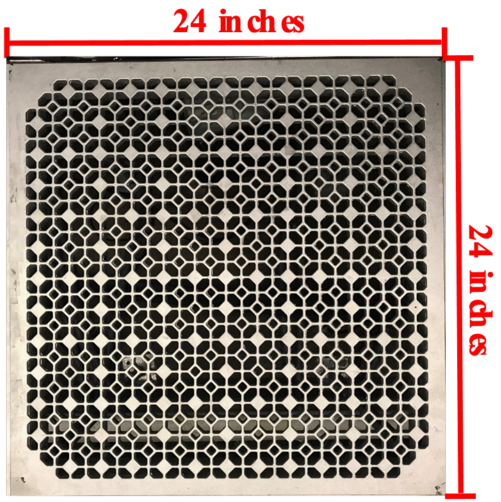
Background information

- Figure to the top right shows the geometry in the lab

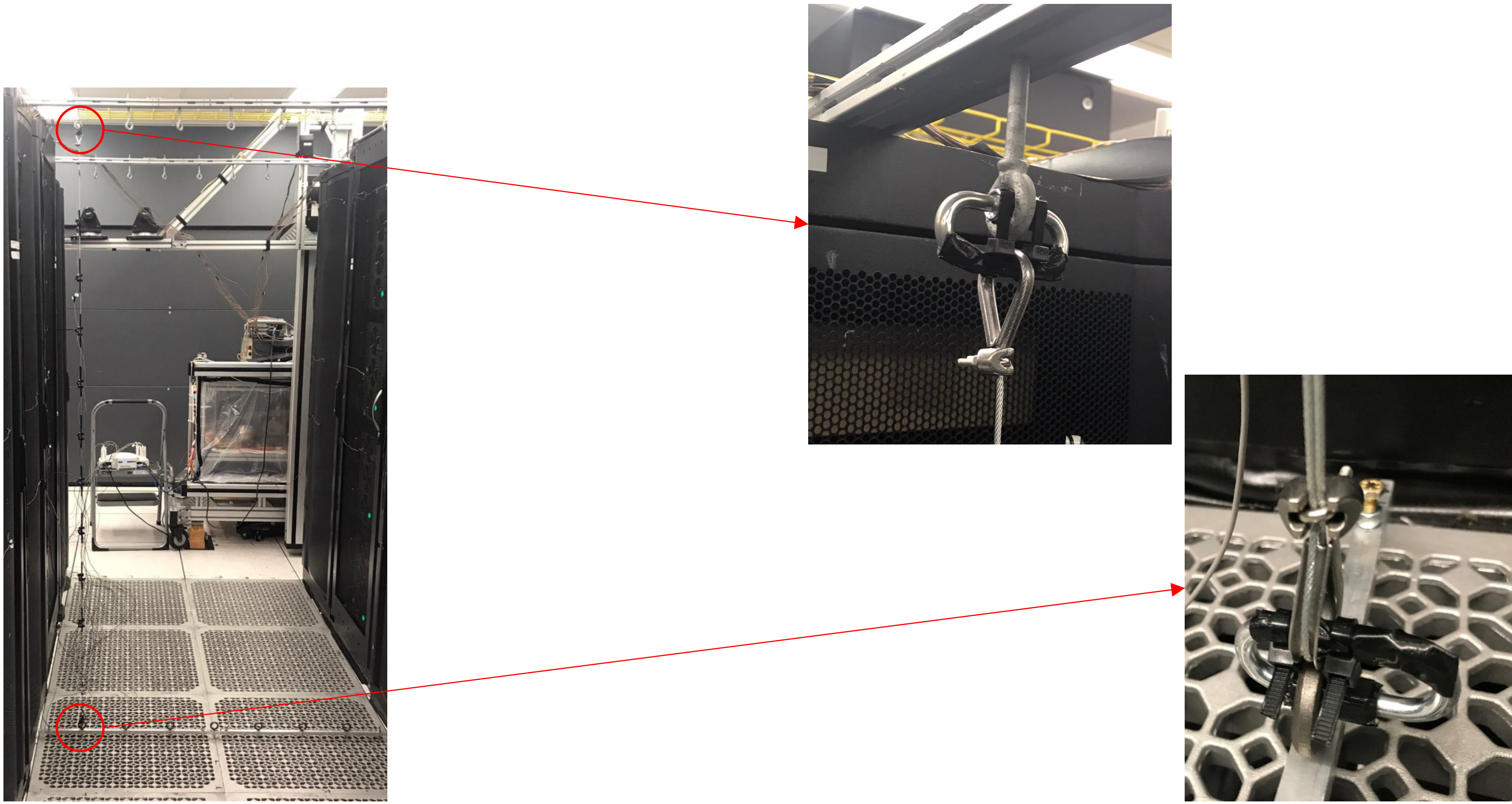




- Figure to the left shows the tool used to measure the tile air flow rate, and the tile to the right are tiles being used for the current project.

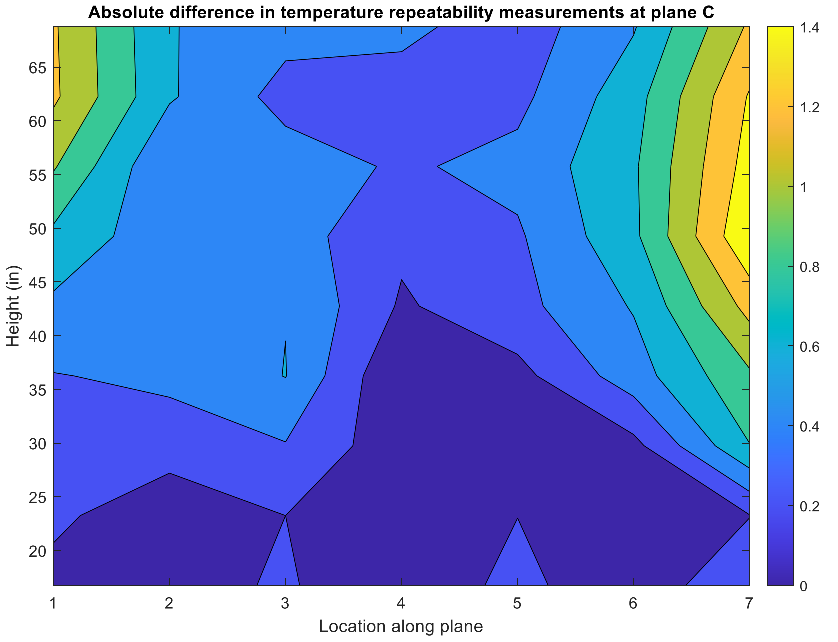


Sensor Setup – Cold Aisle



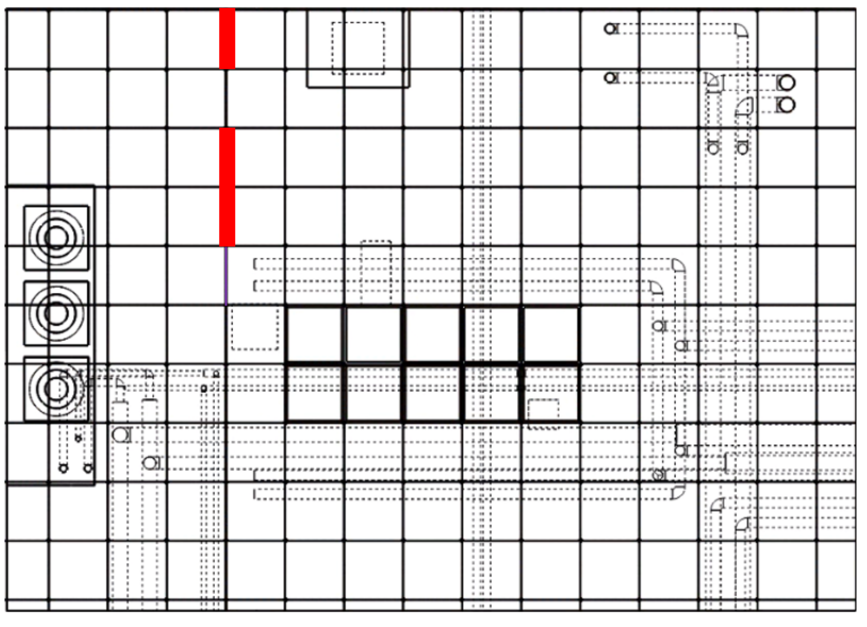
Repeatability Testing

- Repeatability measurements taken for case 2 on Sept. 10th and Nov 23rd
- Planes A and B provide repeatable measurements
- Plane C is repeatable for most locations, but the temperature varies above 1°C at C1 and C7

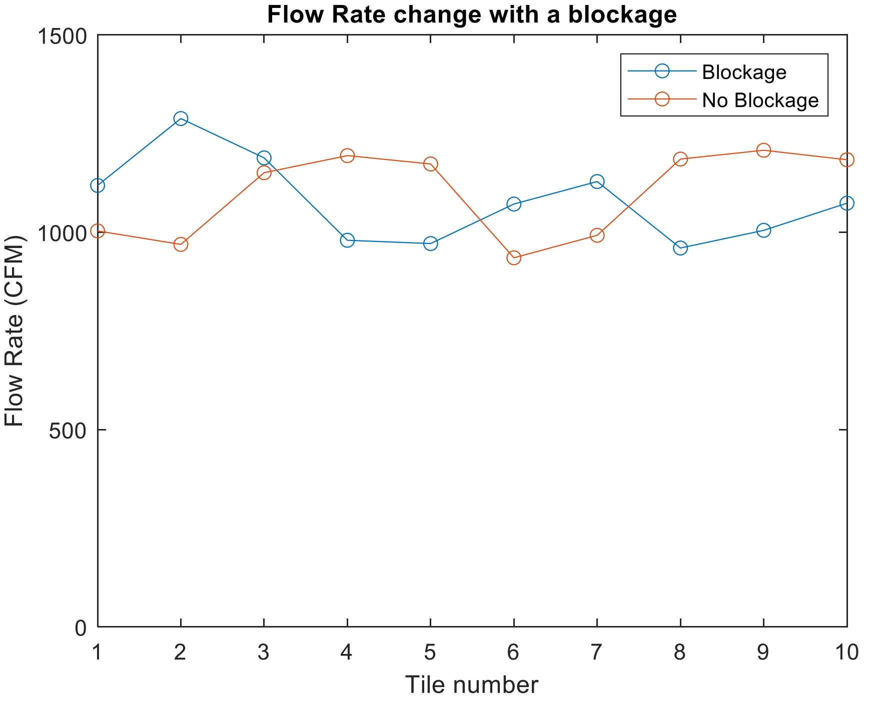


Temperature Difference (°C)							
Height (inches)	Location						
	C1	C2	C3	C4	C5	C6	C7
68.75	1.22	0.61	-0.47	-0.45	-0.29	-0.58	-1.23
62.25	1.24	0.62	-0.33	-0.31	-0.35	-0.72	-1.42
55.75	1.02	0.40	-0.49	-0.37	-0.46	-0.77	-1.49
49.25	0.76	0.46	-0.49	-0.24	-0.37	-0.76	-1.59
42.75	0.56	0.41	-0.60	-0.18	-0.34	-0.62	-1.27
36.25	0.39	0.44	-0.61	0.00	-0.14	-0.51	-0.97
29.75	0.38	0.32	-0.39	0.06	0.04	-0.14	-0.79
23.25	0.25	-0.02	-0.20	-0.11	-0.20	0.01	-0.19
16.75	-0.12	-0.14	-0.22	-0.06	-0.25	-0.05	-0.39

Blockage Selection



Blockage plan



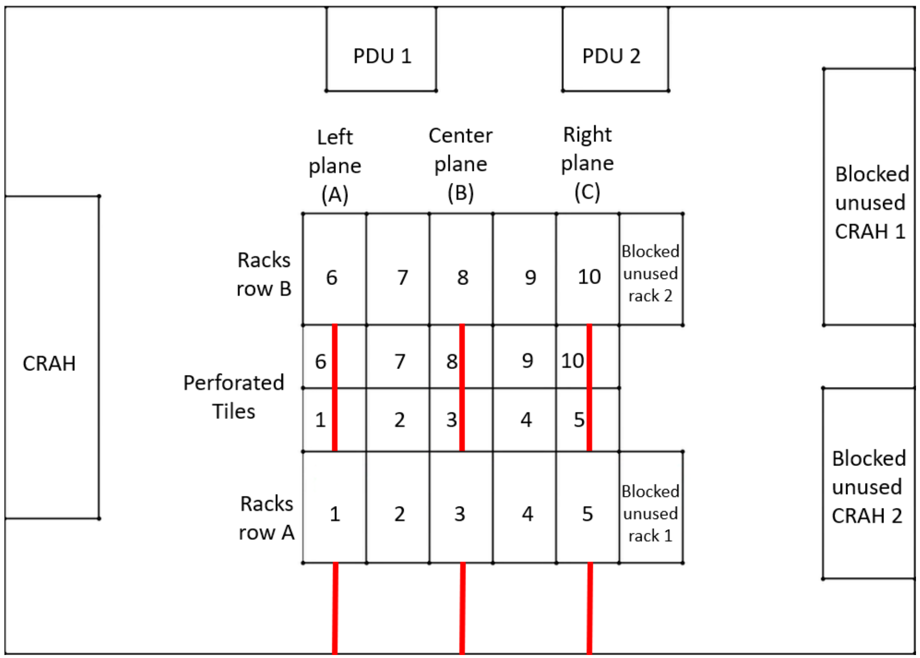
CFD Modeling Progress

Beichao Hu

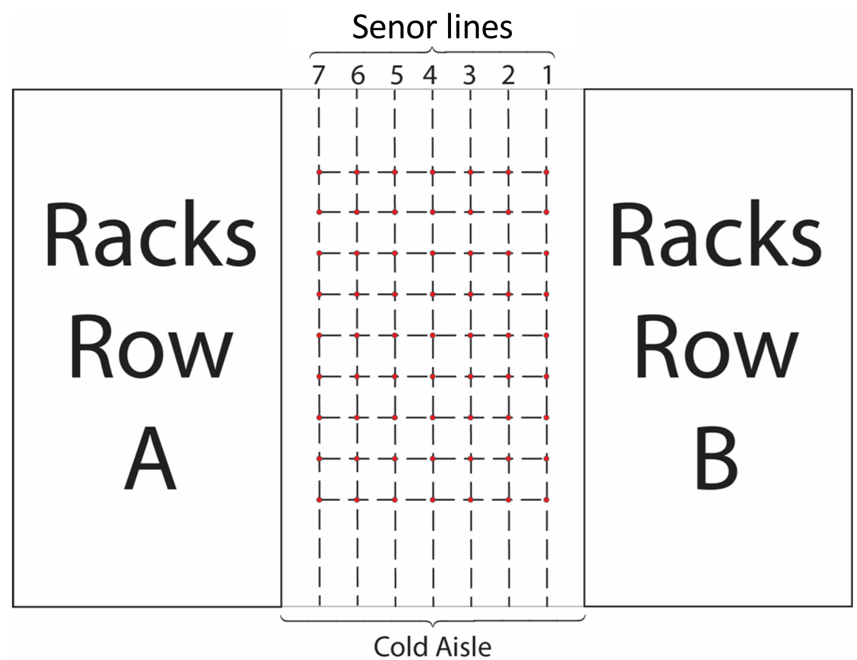
Recent Progress

- Perforated tiles were calibrated.
- CFD results were validated.
- Repeatability tests vs time were investigated.
- Blockage locations were tested.
- CFD simulations and experiments were finished for each scenario.
- In the process of writing the final report.

Layout of the data center

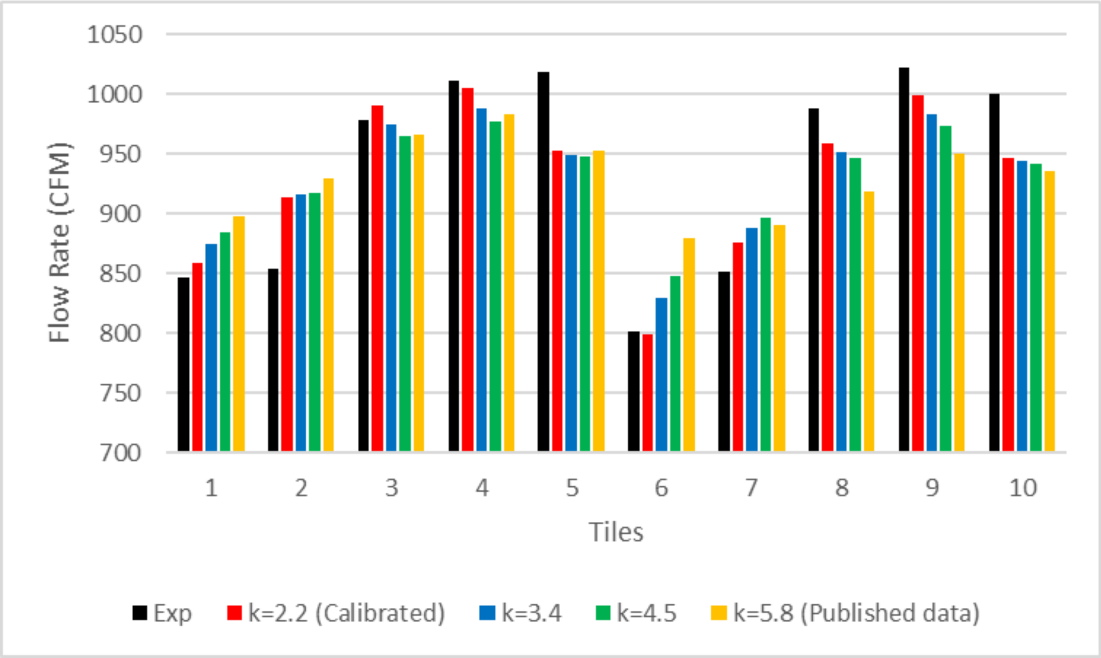


Plan view

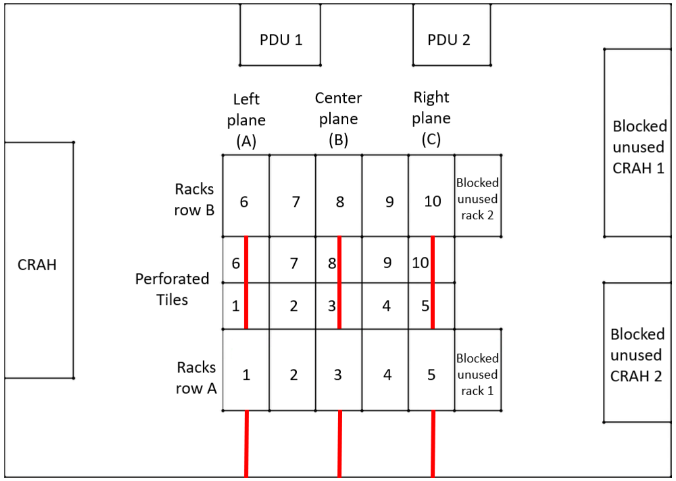


Elevation view

Tile Pressure Loss Calibration



Tile flow rate at different pressure loss coefficient



$$\Delta p = \frac{1}{2} k \rho v^2$$

Δp : Pressure loss across the perforated tile (Pa)

k: Pressure loss coefficient

ρ: Density of air (kg/m^3)

v: Air velocity (m/s)

The published data from manufacturer was found to be inaccurate and the pressure loss coefficient was later calibrated both experimentally and through a detailed CFD simulation.

Case studies

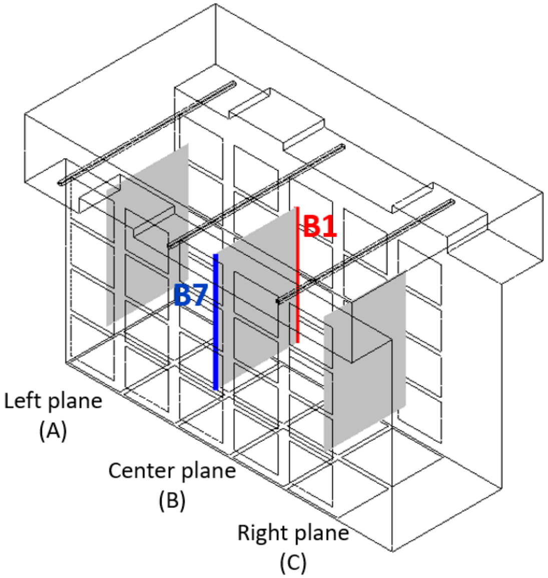
A few representative cases were selected for studies, including undersupplied, balanced supplied and oversupplied cases. Only the result of case 1 to 4 are presented. The case 9 to case 12 shows a similar trend as those of case 1 to 4.

	case 1	case 2	case 3	case 4
Rack power (kw)	8	8	8	8
Rack flow rate (CFM)	1110	1110	1110	1110
Total supply flow rate (CFM)	13200	11000	8500	7500
Supply air temperature (°C)	12	12	12	12
Supply/Rack air flow rate	1.2	1.0	0.8	0.7

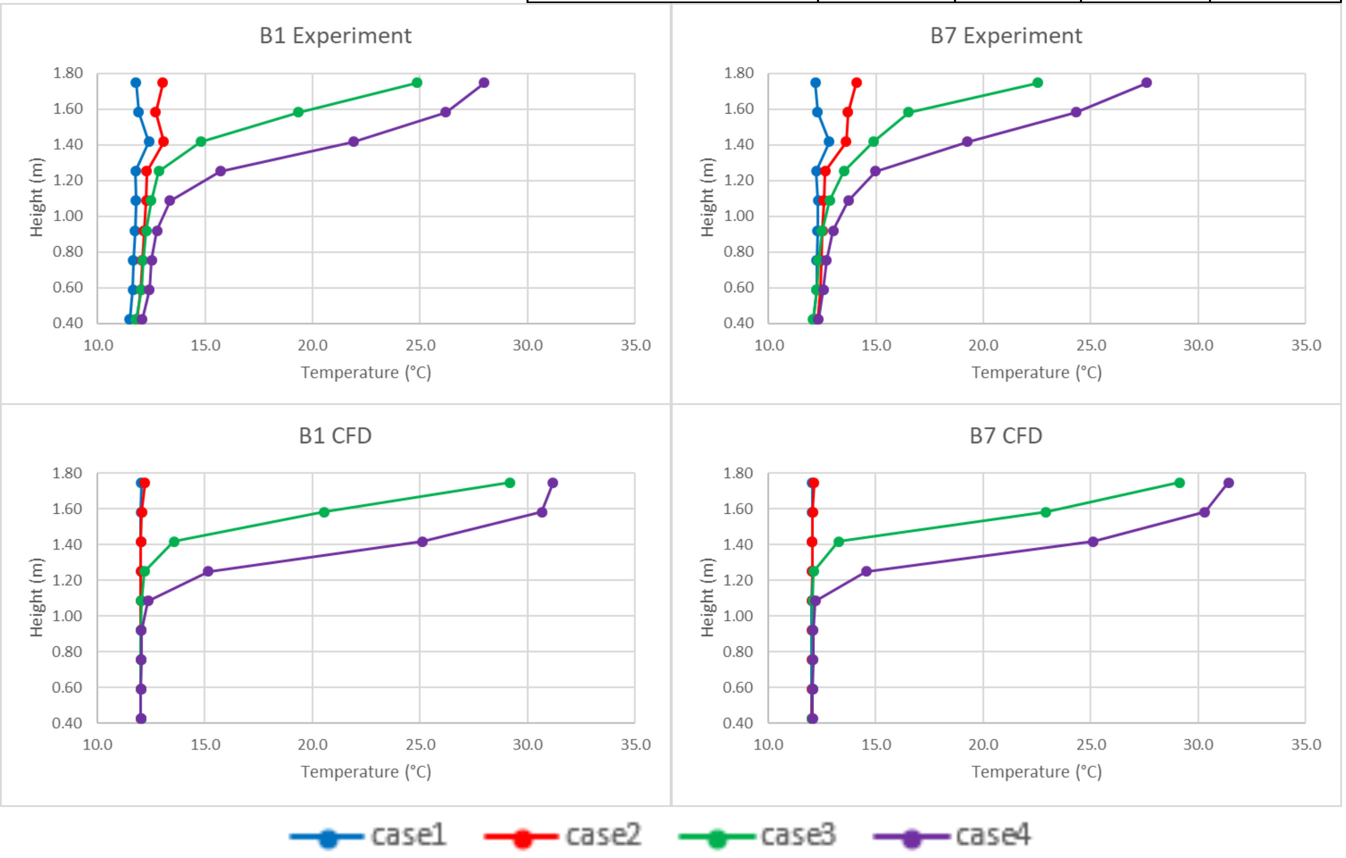
	case 9	case 10	case 11	case 12
Rack power (kw)	8	8	8	8
Rack flow rate (CFM)	800	920	1220	1385
Total supply flow rate (CFM)	9300	9300	9300	9300
Supply air temperature (°C)	12	12	12	12
Supply/Rack air flow rate	1.2	1.0	0.8	0.7

Temperature Comparisons

	case 1	case 2	case 3	case 4
Rack power (kw)	8	8	8	8
Rack flow rate (CFM)	1110	1110	1110	1110
Total supply flow rate (CFM)	13200	11000	8500	7500
Supply air temperature (°C)	12	12	12	12
Supply/Rack	1.2	1.0	0.8	0.7

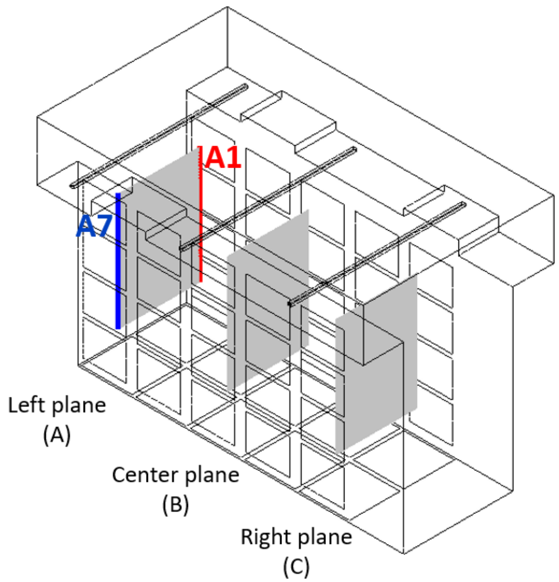


Sensor lines in the cold aisle

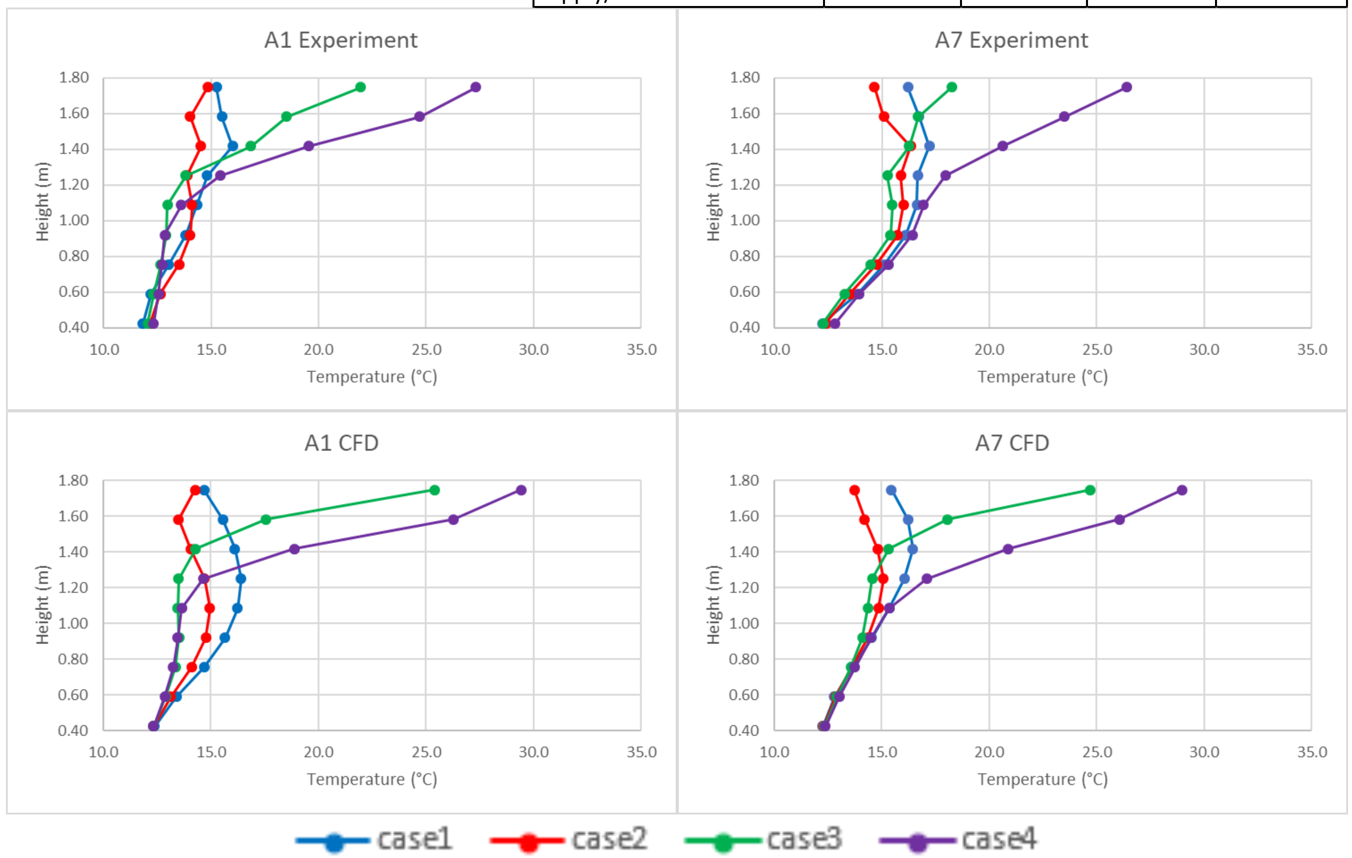


Temperature Comparisons

	case 1	case 2	case 3	case 4
Rack power (kw)	8	8	8	8
Rack flow rate (CFM)	1110	1110	1110	1110
Total supply flow rate (CFM)	13200	11000	8500	7500
Supply air temperature (°C)	12	12	12	12
Supply/Rack	1.2	1.0	0.8	0.7

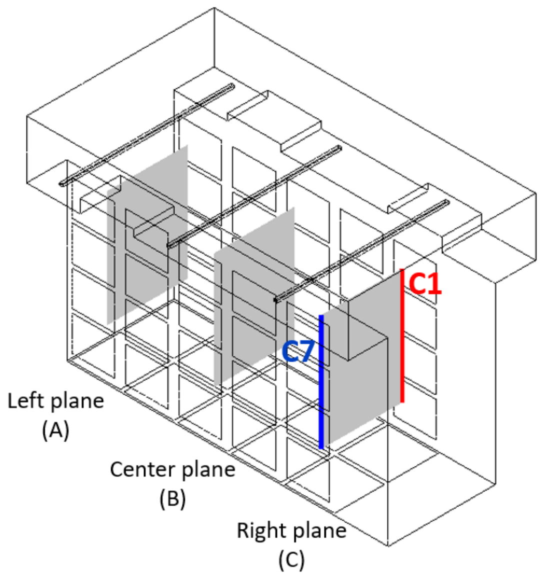


Sensor lines in the cold aisle

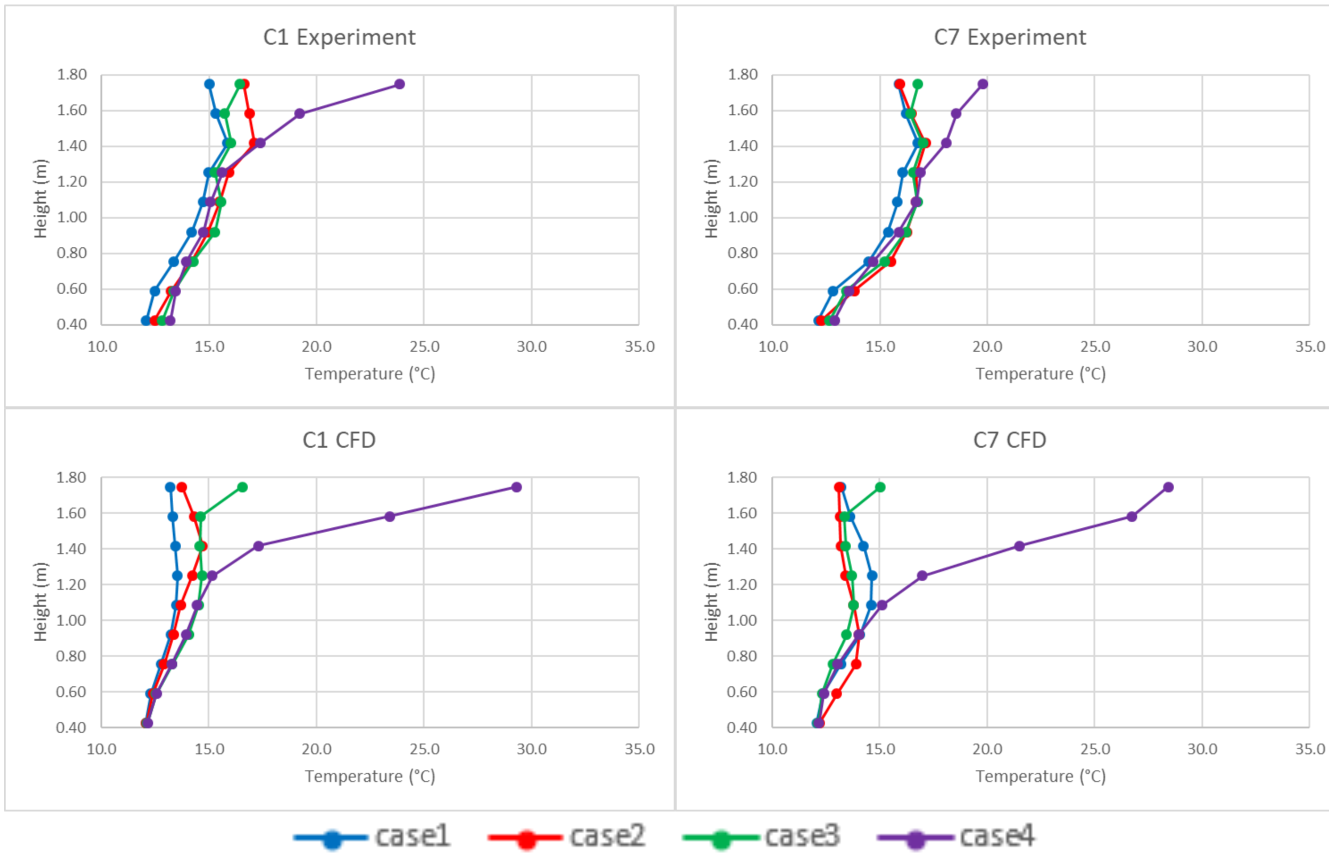


Temperature Comparisons

	case 1	case 2	case 3	case 4
Rack power (kw)	8	8	8	8
Rack flow rate (CFM)	1110	1110	1110	1110
Total supply flow rate (CFM)	13200	11000	8500	7500
Supply air temperature (°C)	12	12	12	12
Supply/Rack	1.2	1.0	0.8	0.7



Sensor lines in the cold aisle

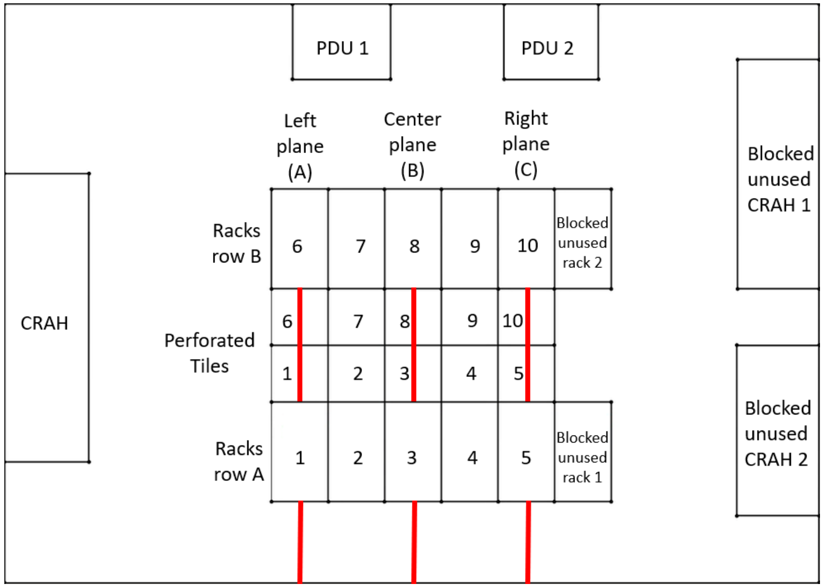


Repeatability tests

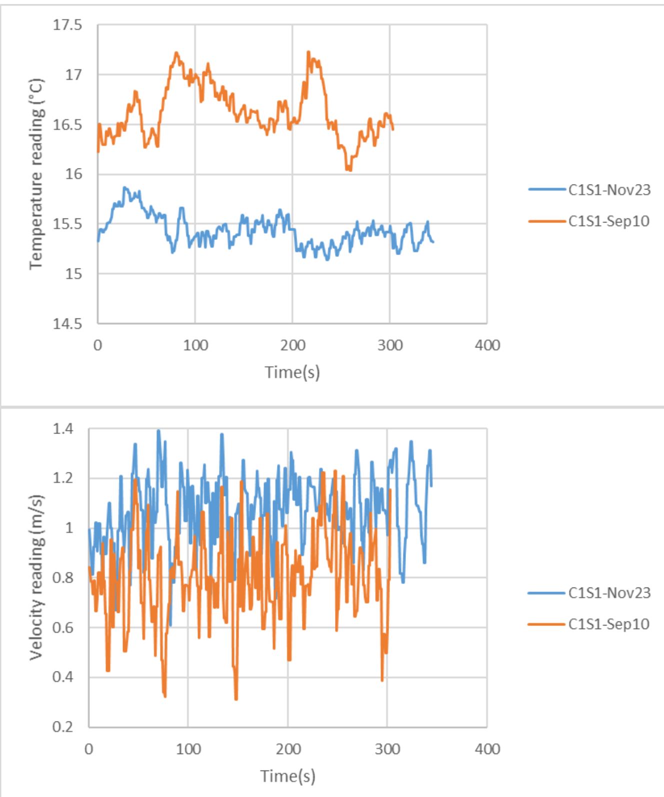
Repeatability tests were taken at Sept 10th and Nov 23rd.

Case 2 was selected as the baseline case.

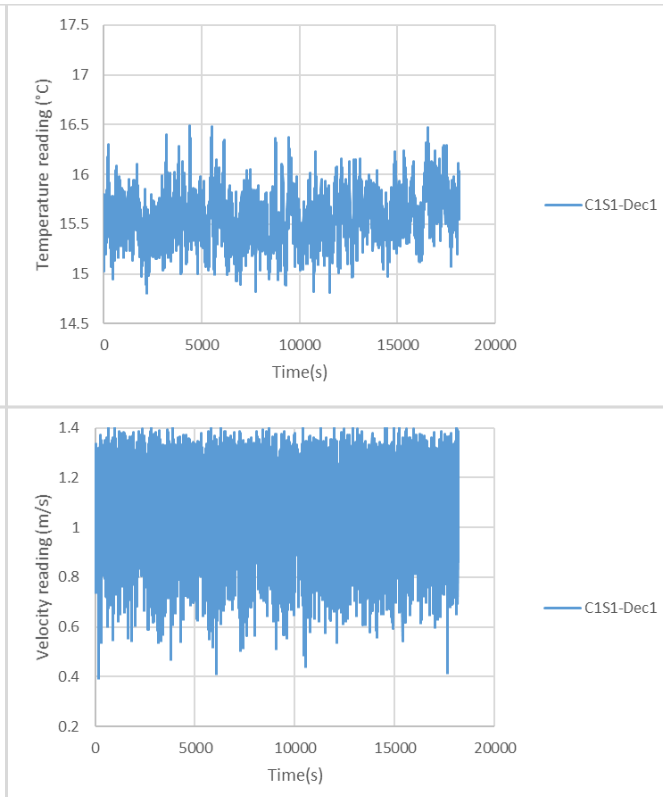
	case 2
Rack power (kw)	8
Rack flow rate (CFM)	1110
Total supply flow rate (CFM)	13200
Supply air temperature (°C)	12
Supply/Rack air flow rate	1.2



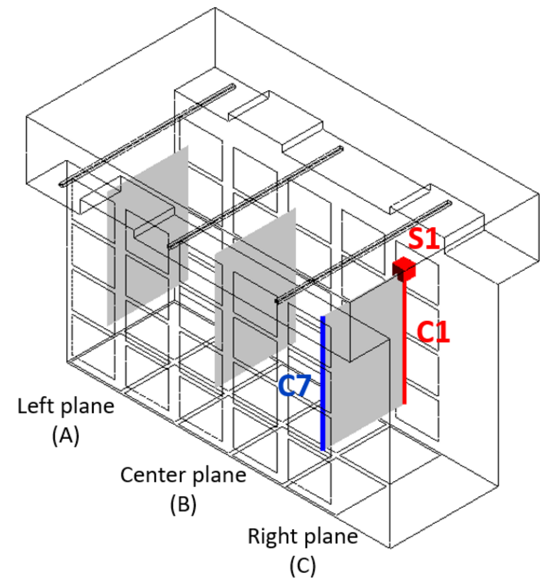
Repeatability tests vs time



Sensor readings in repeatability tests



Sensor reading over 5 hours



Sensor location in the cold aisle

Thank You !

Sea Salt Filtration Research

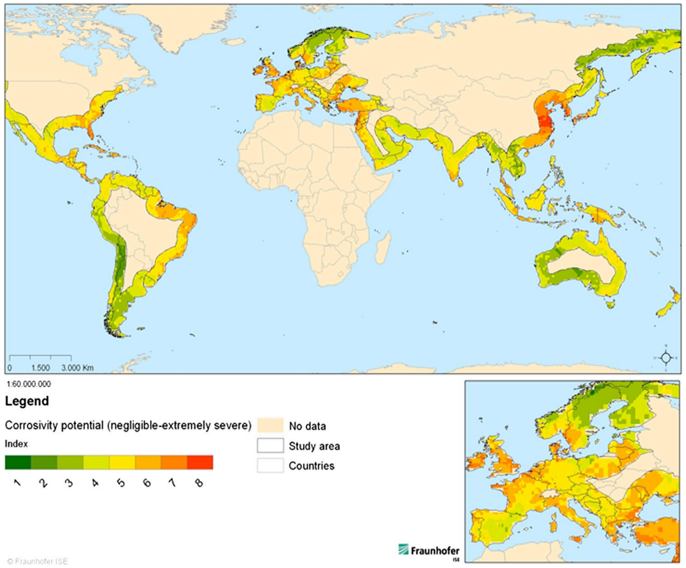
Roger Schmidt

ASHRAE Research Work Statement Proposal

Study of the Corrosion Impact on Information Technology Equipment in Data Centers Located in Coastal Regions with High Sea Salt Concentrations and the Level of Filtration Required to Maintain Reliable Operation of this Equipment

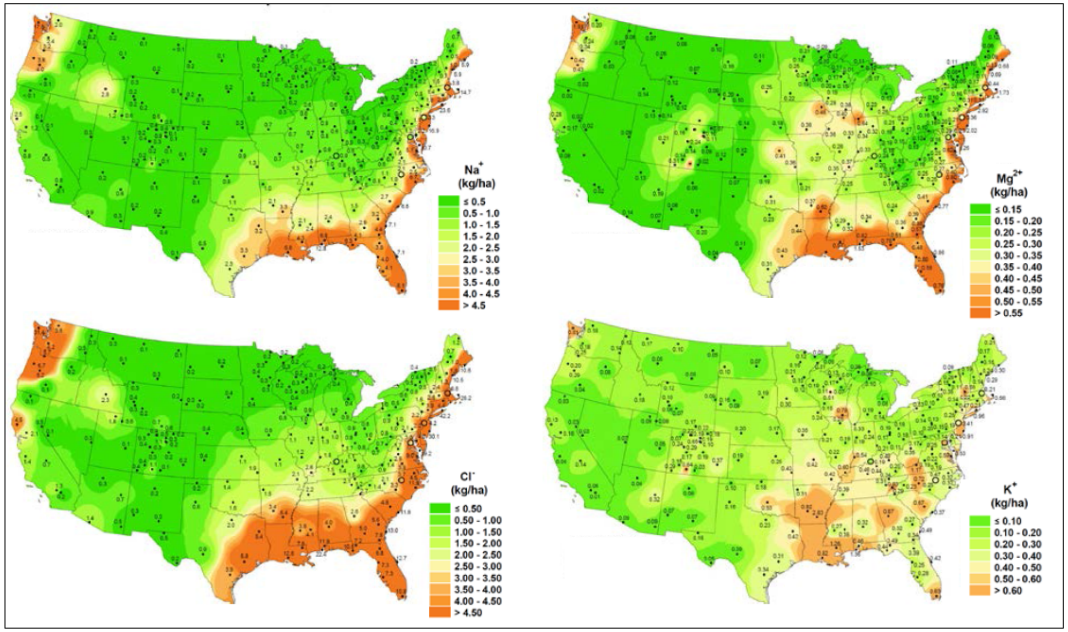
- No investigations have focused on the filtration required of sea salts such that corrosion or degradation of electronic equipment located in these coastal regions can be minimized.
- In addition, there is no investigation on the corrosion in marine environments of materials used in constructing IT equipment, principally copper, silver, and PCB's (printed circuit boards)
- This research aims to provide the proper filtration and to verify the current environmental guidelines for information technology equipment (ITE) in marine environments to maintain or expand the opportunity for increased free-cooling hours and improve data center energy efficiency globally.
- Draft Work Statement submitted Dec 15th

World's Coastal Regions rated by level of Corrosivity



Sponsor: TC 9.9 Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
Coordinated with: TC 2.3 Gaseous Air Contaminants and Gas Contaminant Removal Equipment

Sea salt aerosols are characterized by high concentrations of Na, Mg, and Cl as shown in the figure



Despite the enormous amount of studies on NaCl particle-induced corrosion, **no investigations have focused on the filtration required of sea salts such that corrosion or degradation of electronic equipment located in these coastal regions can be minimized. Neither has there been an investigation on corrosion of materials used to construct IT equipment, principally copper, silver, and PCB's (printed circuit boards)**

A primary challenge in addressing this problem is the 'environment scenario'.

The transient nature of the conditions – changing temperature, changing relative humidity, changing atmospheric conditions and contaminant, are important and without a well-defined boundary on the 'environment scenario' there will forever be challenges in the acceptance of the corrosion results. The objectives of this research are to determine those marine environmental conditions where air side economization is acceptable for reliable operation of any electronic equipment including those inside data centers.

The specific project deliverables will be:

- Detailed literature review to understand the importance of field variables – such as temperature, moisture content, and salt concentration (fine particulates and airborne water droplets) – and their effects on corrosion of copper, silver and PCB's in order to properly design a set of experiments.
- Detailed description of experimental methods used and justification of design of experiments.
- Results showing the effects of moisture (dew point) combined with varying levels of sea salts in airborne forms on corrosion of copper, silver and PCBs used in electronic equipment in data centers.
- Results of the effect on corrosion of electronic equipment from of the sea salts by applying filtering prior to the sea salt contaminated air entering the data center.
- Development of new guidelines for operating data centers in marine environments.
- Technical paper(s) summarizing the results of the research, including new guidelines for operating data centers reliably and in the most efficient manner world-wide. In due course these guidelines may form the basis for a new standard.

Proposed Research on Wetted Materials

Mark Steinke

RTAR – Wetted Materials Research

Background

- Liquid Cooling Guidelines book contains a listing of wetted materials for the FWS and TCS loops
- Latest water-cooling white paper "Water-Cooled Servers - Common Designs, Components, and Processes" identified the growing list of wetted materials being used by ITE manufactures
  - Not an endorsement of these materials just an acknowledgement that the list is growing
  - More liquid cooled solutions coming to market
  - This was most debated topic of the WP
- Every ITE manufacturer should be investigating
- Every customer should be asking

Excerpt from Water Cooling White Paper

Table 2: Common Wetted Materials Found in Water-cooled Servers.

Material	FWS	TCS
Acrylonitrile Butadiene Rubber (NBR)	X	
Aluminum & Alloys	X [a]	X [a]
Brass; with < 15% Zinc	X	X
Brass; Chrome Plated	X	X
Brass; Nickel Plated	X	X
Carbon Steels [b]	X	
Copper [c]	X	X
Copper Alloys: < 15% Zinc and Lead Free [c]	X	X
Polyoxymethylene (POM)	X	
Ethylene propylene diene monomer (EPDM)	X	X
Fluoroelastomer (FKM)	X	
Fluorinated Ethylene Polypropylene (FEP)		X
Polyamide (PA)	X	
Polychloroprene (CR)	X	
Polyethylene		X
Polyoxymethylene (POM)	X	
Polyphenylene Sulfide (PPS)		X
Polytetrafluoroethylene (PTFE)	X	
Polypropylene (PP)	X	
Polysulfone or Polyphenylsulfone (PSU,PPSU)	X	X
Silicone	X	
Stainless Steel; Solution Treated and Passivated [d]	X	X
Thread Sealant [e]	X	X
Teflon Tape [e]	X	X

Materials in **bold** font were originally listed in the Liquid Cooling guideline book [1].

RTAR – Wetted Materials Research

Purpose

- Every ITE manufacturer should be performing own studies and results are typically propriety to that company.
- Begin work on a RTAR to study wetted materials in liquid cooled systems
- Provide validation of a basic set of wetted materials for use
- Develop testing roadmap to validate other or emerging wetted materials
- Provide a common set of recommended wetted materials that can be expanded over time using this process

RTAR – Wetted Materials Research

Action

- Form small group interested in research topic
- Begin to RTAR work statement
- Goal of having RTAR work statement ready by summer meeting
- Contact if interested in participating
  - Mark Steinke
  - Dustin Demetriou
  - Roger Schmidt
  - Mark Seymour

Agenda

Tuesday, January 19, 2021
TC 9.9 Main Meeting
10:00 AM – 2:00 PM EST
Location: Virtual

Topic		Time	Presenter
Introduction	Welcome and Introductions	5	
	What is TC 9.9 Presentation	15	Dustin Demetriou
	TC 9.9 Officers and Membership	10	
Program		5	Nick Gangemi
Webmaster		5	Ecton English
Liaison Reports	Standard 90.1	10	Rick Pavlak
	Standard 90.4	10	Dave Kelley
	SPC-127	10	John Bean
	AHRI 1360	10	Dave Kelley
	SSPC 300, Guideline 1.6	10	Terry Rodgers
	MTG.CYB	10	Ecton English
	COVID-19 Impact on the Data Center Industry	20	John Groenewold
Break		15	
International	International Update	10	Don Beaty
	Dubai Data Center Course	10	Demetriou / Seymour
Industry Engagement	LBNL / DOE	10	Steve Greenberg
	OCP Liquid Cooling Workgroup	10	Nigel Gore
Publications	Edge Technical Bulletin	5	Jon Fitch
	Technical Bulletin Strategy	10	Jon Fitch
	Cold Weather Shipping White Paper	5	Joe Prisco
	Thermal Guidelines 5th Edition	15	R. Schmidt
IT Subcommittee	Hot Aisle Considerations for Human Health	10	John Gross
	Water Cooling White Paper	15	Dave Moss
	IEC Connector Harmonization	5	Roger Schmidt

Attendance

ASHRAE TC 9.9 Attendance Record

ASHRAE Technical Committee 9.9 - Mission Critical Facilities, Data Centers, Technology Spaces and Electronic Equipment
2021 Winter Meeting
Virtual Event Timing: January 19, 2021
Event Address: https://ashrae-org.zoom.us/j/98449509730?pwd=Q2ZCNFhRQXFTY05CSTNYbEIZTkdKQT09
Contact us at tc99chair@gmail.com
Technical Committee Website: http://tc0909.ashraetcs.org

* Required

Name *

Your answer

Email

Your answer

Attendance is being recorded using a Google Form. Please make sure you complete the form at:

http://bit.ly/tc99-attendance

Thank You

TC 9.9 Website:
tc0909.ashraetcs.org