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DRAFT

TC/TG/MTG/TRG MINUTES COVER SHEET

(Minutes of all Meetings are to be distributed to all persons listed below within 60 days following the meeting.)

TC/TG/MTG/TRG No. TC 4.1 DATE 1/23/2024

TC/TG/MTG/TRG TITLE Load Calculation Data & Procedures

DATE OF MEETING Monday 1/22/2024 LOCATION Marriott Marquis Chicago, History (2)

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Brian Rock				Jim Pegues
Rolando Legarreta				Mark Malkin
Chris Wilkins				Russell Taylor
Som Shrestha				Dennis Landsburg
Chip Barnaby				Jeff Spittler
Suzanne LeViseur				Liam Buckley
Larry Sun				Steve Bruning
Stephen Roth				Ardi Moftalchan
Glenn Friedman				Daniel Howard
Robert Doeffinger				Rachel Spittler
				Ed Janowiak
				Atila Novoselal
				Michael Roth
				Austin Moore
				Keaton Pottebaum
				James Lowry
				Charles Christers
				Isabelle Vezina
DISTRIBUTION: All Members of TC/TG/MTG/TRG plus the following:				
TAC Section Head: Patrick C. Marks			SH4@ashrae.net	

All Committee Liaisons As Shown On TC/TG/MTG/TRG Rosters (Research, Standards, ALI, etc.)	Staff: shammerling@ashrae.org
Mike Vaughn, Manager Of Research & Technical Services	MORTS@ashrae.net

Note: These draft minutes have not been approved and not the official, approved record until approved by the TC.



ASHRAE Technical Committee 4.1

ASHRAE TC 4.1 Load Calculation Data & Procedures

Full Committee Agenda

2024 ASHRAE Winter Meeting
Hybrid Conference
In-Person: Marriott Marquis Chicago, History (2)

a. Call to order [2:15 PM CDT] Rolando Legarreta

b. ASHRAE Code of Ethics Commitment Rolando Legarreta
"In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interests." (See full ASHRAE Code of Ethics: <https://www.ashrae.org/about-ashrae/ashrae-code-of-ethics>)

c. Roll call – Determination of a Quorum Rachel Spitler

Suzanne LeViseur	06/30/2024	Chris Wilkins	06/30/2025
Stephen Roth	06/30/2024	Larry Sun	06/30/2024
Rolando Legarreta	06/30/2025	Som Shrestha	06/30/2024
Brian Rock	06/30/2024		
Chip Barnaby	06/30/2024		

Quorum was determined with 8 of 8 present.

d. Introductions All

- In Person Sign-In sheet
- Any updates to the agendas? No.

e. Scope, Mission Statement Rolando Legarreta
Scope: TC 4.1 is concerned with the identification and compilation of engineering data and the development of procedures for calculating heating, cooling, refrigeration, and ventilating loads of structures.

Mission Statement: To serve practitioners by advancing the data and procedures of load calculations.

f. Agenda additions All

g. Liaison reports (as they arrive) Liaisons
a. Section Head Patrick C. Marks

Patrick talked about the ASHRAE Strategic Plan: It is currently open for comments until March 2024. At the TC breakfast, brainstormed at the Section 4 breakout on initiatives for strategic plan. Suzanne L. says there is an issue with the link to the strategic plan. Patrick will check on it.



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b. Research

Dennis Landsberg

Dennis mentioned that the backlog for RPs is 0, so there is lots of money available for research.

h. Chair's Report

Rolando Legarreta

a. Announcement from TC Chairs Breakfast Meeting

- i. There is a new committee to maximize the global impact of ASHRAE. It will start interacting with TCs to make information from ASHRAE more global: GTIC: Global Technical Interactions Committee.
- ii. Decarbonization: What the task force has been doing that past couple of years. 6 additional guidelines to be worked on. By 2050, all existing buildings to be NET-0. Guidelines will be posted for review and asking members to post comments.
- iii. Presentation from government affairs dept. Happy to help with lobbying support for local, state, and federal governments.
- iv. Did breakout sessions for Session 4:
 - i. How do we interact with other TC 4s?

i. Approval of minutes from 2023 Summer Meeting

Rolando Legarreta

Voting on Tampa Meeting Minutes: Chris Wilkins motioned, Stephen Roth seconded. Vote passes 7-0-0-0-CNV.

j. Subcommittee reports

i. Programs:

Rachel Spitler

- 1 program this morning on doing loads in 50 minutes: Jim P, Steve B, Chris W, Liam B, Larry Sun
- Submission deadline for June meeting is February 26th.
- Thing we settled on for future seminars is:
 - Dealing with uncertainties in Load calcs: Chris and Rolando
 - Sensitivity for unknown materials, infiltration. 3 presentations and 3 speakers. SOM said may be able to find someone for this seminar.
- Jeff Spitler mentioned Seminar 22: Based on TC 4.1 research : Ardi and Artilla? Talked about results of this research. Lots of interest.

ii. Research:

Ardi

- i. RP-1816: This is the MRI and medical imaging research project: they have gathered data and are working on processing it; there are no summaries of the data yet; how the data will be presented in a table is still being determined. Glenn Friedman gave an update on this RP at the end of this meeting. He said that the team basically went silent. Were not even prepared to report to the TC. Assume will give an update soon?
- ii. RP-1923: Climatic Design for 2025 ASHRAE Handbook: Project is on-track. There will be a 25-year period of record.



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- iii. RP-1857: Improvement and simplified methodology for describing and calculating heat conduction between buildings and the ground. Check with Glenn on the status of this. Glenn gave an update on this at the end of the meeting. Have not heard anything official on getting

funded. Chip says that the contractor needs a student who needs to get a Visa. Could be 6 months to a year.

New RTARs/WSs:

1850-TRP: Need for updating residential load calculation procedures

WS-1959: People loads.

Motion to approve the WS given addressed comments from RAC.

Reaching out to TC 2.1- Human Physiology and Human Environment for co-sponsorship.

Do a vote now or email ballot later on? More success if co-sponsorship.

Going to ask for a vote by email ballot in February. Must get it in by March 15 for RAC to considerate it this period.

Comments about the Research meeting this morning:

Budget estimating guideline is coming out. Any budget must go through this process.

Any work statement, can be co-sponsored by other TCs. It will increase chance that it is approved.

- iv. Handbook: Jim Pegues
- a. Jim P: Coming to end of publication cycle for 2025 HoF. Chapter 17 and 18 for Commercial/Res.
 - b. 3 separate discussions:
 - 1: Chapter 17 (Res): Proposal to submit chapter with no-changes since may be doing an entire re-write by the 2029 version. Chip will do an editorial review and goal to have in June 2024.
 - 2: Chapter 18 (Non-Res): 1st part: # of planned changes in terms of update to tables: medical equipment heat gain. TC 4.7 made change to weather data, design heating load calcs for decarb applications. In decarb world, is UADeltaT applicable or steady periodic design day. UADeltaT is still applicable and appropriate but steady periodic design could be applicable.
 - a. When decarb is discussed, do we need to calculate loads differently. May be more demand for steady period design calcs in the future.
 - Will work with Chris W, UADeltaT is appropriate for most apps, but steady periodic design for passive design.
 - 3: Looking ahead to 2029 HoF. Brian Rock made a proposal to significantly revise both the Res and Non-Res chapters. What are good and bad about them? The idea is: just 2025 finishing up, puts us in a good position for 2029.
- v. Standards: Glenn Friedman
- Nothing on standards at this time.



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vi. Web site:

Jim Pegues

Everything is up to date.

k. Old Business

Rolando Legarreta

Publications:

Pubs requested that TC 4.1 reevaluate some of the TC 4.1 publications that are starting to become dated:

i. Updating ASHRAE/ACCA Res Heating and Cooling Load Calc Procedures (1996):

Chris W: How do we target the Res chapter?

Chip B: There is a toolkit for this publication. On GitHub. Not much action with it.
For now, do nothing.

ii. Load Calc Applications Manual (IP and SI). The Jeff Spitler publication (2014): Do we do an update to it?

Rolando asked do we do an update? Chris says we don't necessarily need to do it.

Steve Bruning: Since it's a 2014 doc, it has 2011 data. Jeff S. says that there will be quite a few updates at this point.

Jim Pegues: Because it's more than 10 years old, do we work on an update? Jeff Spitler: Says for student use, it is fine.

Steve Bruning: The time to update would be after the publication of the 2025 handbook.

PTAR instead of RTAR (publication update instead of research). Need to justify funding.
PTAR is still funded from Research. Still need to work on a WS.

iii. Last item: Annotated guide to load calcs and algorithms: 1996. Literature review prior to the toolkit. Lays out different methods. It's very dated according to Jeff Spitler. There are some newer methods. Don't know how they are selling it. JS wouldn't mind if it went out of publication.

Can we post older docs on data.ashrae.org?

Can we post older books from the 60s somewhere?

Decision: Keep the top 3 (The Res Heat/Cool, the IP and SI versions of the Load Calc App Manual). Take the 4th one off bookstore and make available on some archive website.

l. New Business

Rolando Legarreta

New MTG: MTG-CEA (Control Environment Agriculture) - Steve Bruning is the liaison from TC 4.1.

Need another liaison. It covers cannabis facilities amongst others. Robert Doeffinger volunteered to be the other liaison.

m. Adjourn [3:35: PM CDT]

Rolando Legarreta

Chris Wilkins motioned; Larry Sun seconded.

Appendix A

TC 4.1

Research Subcommittee Report



ASHRAE Technical Committee 4.1

Research Subcommittee - Agenda

TC 4.1 Load Calculation Data and Procedures

Sunday, January 21, 2024

Research Subcommittee Chair: Ardi Moftakhari ardeshir@okstate.edu

Research Liaison for Section 4: Natascha Milesi-Ferretti rl4@ashrae.net

Agenda:

1. TC 4.1 sponsored ongoing projects:

1.1 RP 1816: Reporting the Energy Use and Heat Gain from Imaging Equipment.

Sponsoring Committees TC 9.06 (Healthcare Facilities), TC 4.1, and 4.7 (Energy Calculations)

TC 4.1 liaison on the PMS: Glenn Friedman

PI: Walt Vernon, Contractor: Mazzetti

- This project was stalled during the pandemic. The project has restarted. MRI equipment has been metered and data is being gathered.
- Glenn's last feedback: The researchers have collected data from equipment and currently working on data processing. They plan to present their results and analysis to the committee.

1.2 RP 1923 Prepare Climatic Design Conditions for 2025 ASHRAE Handbook

Sponsoring Committees TC 4.2, co-sponsored by TC 4.1

PI: Michael Roth, Klimaat Consulting

Project period: 24 months

Total cost to ASHRAE: \$148,000

TC 4.1 liaison on the PMS: Jim Pegues

Project launched in July 2022 and is on schedule.

Key Objectives:

- Increasing number of stations offered (in 2021 9237 stations offered)
- Improving data screening / quality control
- Reducing technical debt
- Formalizing processing software so it can be reused more easily
- Automating generation of US county-based climate zone classification

Stretch Goal

- Parameterizing diurnal temperature profile shape based on time of year, latitude etc.
- I.e. A new recommendation for design day temperature profile shapes. Very relevant to TC 4.1
- Overlaps with intent of 1850-TRP in some ways.

Approach:



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- Have all software and processes established and verified during 2023
 - When 2023 complete year data available at the start of 2024, run processing for all stations in one huge batch.
 - Submit data for publication.
-
- Jim's update in 2023 Summer conference: The goal is to wrap up the project in a year, and publish in 2025 handbook. They will include the most recent data (2004-2023) for publication in the handbook. They are looking for a different way to define the design day for the load calculations based on specific site location instead.
 - Jim's update in 2024 Winter conference: The investigator has been just received 2023 data and plan to work on the data processing/analysis. The project is in good shape and on track.

1.3 RP 1857: Improved simplified methodology for describing and calculating heat conduction between buildings and the ground.

This project's results will affect the following Handbook Chapters, Special Publications, etc.:
Handbook of Fundamentals, Chapters 17, 18, and 19. Standard 90.1

Sponsoring Committees: TC 4.7 (Energy Calculations), TC 4.1, and TC 4.4 (Building Materials and Building Envelope Performance)

TC 4.1 liaison on the PES: Glenn Friedman

Project period: 24 months

- The PES has received bids and voted. This is going to the TC 4.7 Executive Committee for review on Tuesday 2/7/2023 in the afternoon. Glenn Friedman is invited to this meeting as part of the PES. The results of the bids and PES work are confidential at this time. Glenn has volunteered to continue the PMS representing TC 4.1, if the research is funded and moves forward.
- Glenn's update in 2023 Summer conference: still in the contract negotiation phase with ASHRAE
- Glenn's update in 2024 Winter conference: No progress. The PI has not yet started the project because he is waiting for his foreign student to arrive.

2. Work statements and RTARs:

2.1 1850-TRP Evaluation of ASHRAE's Design Day Procedure Against Recorded Weather Data

Project sponsored by TC 4.2, co-sponsored by TC 4.1

It appears this project is waiting to bid.

- No update. Should check with Natasha.

2.2 TC 4.2 WS "A decision and evaluation framework to validate weather time series and statistics for use in building performance analysis and design."

Sponsoring Committees: TC 4.2, TC 4.7 and TC 4.1

TC 4.2 contact: Parag Rastogi

The WS was rejected by RAC for funding and suggested addressing RAC comments and resubmitting as an RTAR. Has to contact Parag from TC 4.2 to get update.



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2.3 WS-1959 “Update People Load Data for Cooling Load calculations”

Lead: Christopher Wilkins

- RTAR was approved by the RAC. Chris has completed a draft work statement 1959 for the people load update research.
- The WS draft was shared with TC members. Members provided comments to Chris to revise the WS. TC to vote on the WS virtually sometime before the March deadline.
- Glenn, Jim, and Chris are interested to serve on PES and PMS from 4.1
- Chris and Ardi met with TC 2.1 and they agree to co-sponsor this WS and include one member on PES and PMS if gets accepted.

3. Potential research topics or tasks

3.1 Update procedure for residential load calculation and data in handbook

- Chip to follow up with residential committee to see if they have interest on a research project for developing updated load calc procedure and data for residentials

3.2 Warm up load calc procedure for buildings with heat pumps

- Chris and Ardi to work on preparing an RTAR on the topic

3.3 Dynamic heat load calc for high-performing and net zero buildings with heat pumps

- Graham and Ardi to work on preparing and RTAR on the topic

4. Research Subcommittee Chairs meeting updates

- RAC has provided a total budget of \$5.5M in 2022-2023. RAC has decided to increase the RP funding to \$250K-\$350K.
- Budget estimating guidelines coming.
- Encourage co-sponsoring WS
- Guidance to be provided for PES
- Include coversheet with how you responded to the comments.

Appendix B

TC 4.1

Program Subcommittee Report

TC 4.1 Programs
Chicago, Sunday January 21, 2024

Rachel Spitler rspitler@cyntergy.com, Programs Chair

Programs subcommittee meeting started around 4:30 PM.

PROGRAMS

Report By: Rachel Spitler rspitler@cyntergy.com, Chair.

1. MBO:

- a. Description: Provide essential knowledge about load calculations data and procedures through training.
Metric: Presenting programs at conferences.

2. Current Program:

Seminar 23: *Speed Seminar: Load Calculations in 50 Minutes!* will be 8:00 AM on Monday, January 22 in Great Lakes E (Marriott Marquis Chicago)

Summary: A rapid-fire seminar discussing fundamentals of load calculations geared toward students and new engineers in the industry. The topics presented include Load Fundamentals, Weather Data, Building Envelope, Internal Loads and Systems and Zoning. This presentation covers the most important fundamental factors to understand and consider in performing a load calculation.

Speakers: Jim Pegues, Steven Bruning. Chris Wilkins, Liam Buckley, Larry Sun

Chair: Rachel Spitler

3. Future Program:

Submission deadline is Monday, February 26 for the 2024 Annual Conference (Indianapolis, Indiana). The meeting itself is June 22-26, 2024.

- a. The 2025 Winter conference is scheduled for February 8-12, 2025 in Orlando, Florida.
- b. Future Program Ideas
 - i. Further Considerations in the Transition to the Heat Balance Method using New ASHRAE HQ Building [follow-up to June 2022 seminar]
 - ii. Seminar on Load Calculations using BIM Models
 - iii. Seminar including Workflow of Process for Cooling and Heating Load Calculations (Forum or Seminar) & Energy Calculations, Energy vs. Load Processes, Sample Comparisons of Loads results from different Energy softwares (Sun/Landreth, Roth?) [TC 4.7]
 - iv. Ventilation and Infiltration
 - v. Load Calculations for Dehumidification & Load Calculations and Equipment Selections for Water Cooled [Peak Load vs. Water Cooled] & Load Calculations and Sizing for Evaporative Cooling [Essentially, moisture ties it together]
 - vi. Dealing with Uncertainties in Load Calculations
Distilling Infiltration Data Info into Load Inputs (Chris)
Sensitivity for Infiltration
Sensitivity on Unknown Materials (Rolando)
 - vii. Loads & System Equipment and Sizing [Orlando – Feb 2025]
Loads & Systems – Jim Pegues
Loads & Equipment Selections
Decarbonization Implications

TC 4.1 Programs
Chicago, Sunday January 21, 2024

viii. How Load Calculations Interact with Other ASHRAE Chapters
[Communicate with other TCs for this]

- Weather
- Infiltration
- Building skin color [Som – TC 4.4]
- Ventilation [Som to help connect]
- Fenestration, dynamic windows [Som to help connect]

c. Dealing with Uncertainties in Load Calculations will be recommended to the full committee for the June meeting. Chris Wilkins and Rolando Legarreta will be involved in further discussions.

Programs subcommittee meeting ended at 4:59 PM.

TC 4.1 Programs
Chicago, Sunday January 21, 2024

PROGRAM TRACKS for Indianapolis:

Track 1: Fundamentals and Applications Track Chair: Atilla Biyikoglu

Email: abiyik@gazi.edu.tr

Track 2: HVAC&R Systems and Equipment Track Chair: Ng Yong Kong

Email: nyk@nyk.com.my

Track 3: Research Summit Track Chair: Kristin Cetin

Email: cetinkri@msu.edu

Track 4: Professional Development Track Chair: Ahmed Abdelsalam

Email: ahmed.abdel-salam@usask.ca

Track 5: Electrification: Possibilities and Pitfalls Track Chair: Kevin Brown

Email: kevin@kbsquared.net

Track 6: Artificial Intelligence and the Built Environment Track Chair:

Vinod Venugopal

Email: vinodpvgopal@gmail.com

Track 7: Building Life Cycle Assessment Track Chair: Money Khanna

Email: khannamoney@gmail.com

Track 8: Legislation, Standards, Codes and Guidelines Track Chair: Cindy

Callaway

Email: cindy.callaway@p2sinc.com

Appendix C

TC 4.1

Handbook Subcommittee Report



ASHRAE Technical Committee 4.1

TC 4.1 Handbook Subcommittee - Report

January 21, 2024

Handbook Subcommittee Chair: james.f.pegues@carrier.com

rev1

Agenda:

1. Work Schedule for 2025 Handbook – Fundamentals

Work Phase	Date or Timeframe	Description
1. Review	Thru Dec 2022	Review chapter to identify revisions and additions.
2. Construction	Jan 2023 – May 2024	Make revisions and additions
3. Approval	Jun 2024	TC 4.1 votes to approve revisions
4. Submission	Ch 17 - Jul 12, 2024 Ch 18 – Jul 19, 2024	Submit revised chapters to ASHRAE staff.
5. Publication	Jun 2025	Handbook published

2. Chapter 17 – Residential Load Calculations

Results of Committee Discussion:

- Proposal to submit chapter with no changes this cycle, due to pending research and rewrite for 2029 cycle.
- ACTION: Chip Barnaby to perform editorial review and to check references. If any minor changes are needed they will be made in advance of summer conference (~June 1 to allow time for committee review)
- Committee to vote approval for submission at summer conference in June.

3. Chapter18 – Non Residential Load Calculations

3.1 Current Planned Revisions

Results of Committee Discussion:

- See Table A.1 for summary of current planned revisions for 2025 edition.
- ACTION: Jim Pegues to collaborate with Chris Wilkins to develop a statement for the design heating load section to note that $U \times A \times \Delta T$ is acceptable, but for decarbonization or high performance or passive design applications there are other methods that can be applied.
- TC 4.1 to vote approval for submission at summer conference in June.



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3.2 Design Heating Load Calculations for Decarbonized Applications in Cold Climates

Results of Committee Discussion:

- Agreement that traditional $U \times A \times \Delta T$ heating calculation is appropriate and has wide application and should continue to be included in Chapter 18.
- TC 4.1 may be way ahead of the curve considering steady-periodic design heating calculation. In other seminars or committees discussing decarbonization the issue of enhanced design heating load calculations is to be raised others. While TC 4.1 doesn't feel steady periodic design heating calculation at this time, this topic likely will become more important in the future and it may be necessary for TC 4.1 to ultimately devise such a calculation procedure.

Background on this Subject:

Committee previously considered the question: Is a steady-periodic calculation for design heating load needed to properly size capacity for heat pumps in cold climates – to accurately determine warm-up load?

Action: 2023 Summer Conference in Tampa – Workshop 2: *Decarbonized Heating in Cold Climates: Are Enhanced Heating Load Calculations Required?*

Conclusions and Feedback from Workshop:

- Traditional single-point $U \times A \times \Delta T$ calculation is still appropriate and is appropriate for future decarbonized applications given the no-setback and optimal start-stop control approaches to these applications.
- There could be a role for an alternate steady-periodic, heat balance calculation for niche applications like passive design or resilience applications.

3.3 Proposal to Reconfigure Load Calculation Chapters

Results of Committee Discussion:

- ACTION: Jim Pegues to draft a second iteration of reorganized chapter outline for discussion at summer conference.
- Initially develop an outline as if all the material – fundamentals, steady state loads, dynamic loads, examples, and mathematics are all in one chapter. Later we will determine if it stays as 1 chapter or is divided into separate chapters.
- Whether Residential is a separate chapter or combined in the larger chapter is to be determined. Initially propose content as part of the one unified outline.
- In the Fundamentals portion of the chapter include (1) both steady state heating and cooling examples (with suitable warnings that steady state cooling should never be used for actual projects), (2) stress the components of a load, (3) mention radiant /convective split.
- Use an overall approach that has fundamentals and a qualitative discussion of load calculations in the first part, then a more detailed discussion of the data and the methods, then examples, and in a later part the mathematics. It was felt the heavy use of mathematics in the existing



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chapter intimidates some readers and inhibits use of the chapter. If that is placed at the back of the chapter, that can overcome that problem.

- Brian Rock noted that while consulting engineers and younger engineers are a primary audience, we can't lose sight of the many other audiences for the chapter.

Background Information on this Topic:

a. Background

- Proposal from Atlanta Conference (Feb 2023) - To better serve primary audience (consulting engineers), particularly early career engineers, reorganize and rewrite material in the chapters. An initial chapter to present fundamental concepts of steady state loads using design heat loss as the application and examples. Second chapter explains dynamic cooling and heating loads based on Radiant Time Series (cooling) and Heat Balance (Cooling and Heating) with all the technical details needed there. Describe how to acquire inputs and how to use outputs. Provide lots of examples.

Table 3.1 2021 Chapter 17 – Residential Cooling and Heating Load Calculations (16 pages)

- | |
|---|
| <ol style="list-style-type: none">1. Residential Features (0.5p)2. Calculation Approach (0.5p)3. Other Methods (0.25p)4. Residential Heat Balance Method (0.25p)5. Residential Load Factor Method (0.5p)6. Common Data and Procedures (6.0p)7. Cooling Load (3.0p)8. Heating Load (1.0p)9. Load Calculation Example (2.25p)10. Symbols (0.5p)11. References (0.75p) |
|---|



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Table 3.2 2021 Chapter 18 – Non-Residential Cooling and Heating Load Calculation (67 pages)

1. Cooling Load Calculation Principles
 - 1.1 Terminology (1.5p)
 - 1.2 Cooling Load Calculation Methods (0.5p)
 - 1.3 Data Assembly (0.5p)
2. Internal Heat Gains
 - 2.1 People (0.25p)
 - 2.2 Lighting (3.0p)
 - 2.3 Electric Motors (1.0p)
 - 2.4 Appliances (9.5p)
3. Infiltration and Moisture Heat Gains
 - 3.1 Infiltration (1.5p)
 - 3.2 Latent Heat Gain from Moisture Diffusion (0.5p)
 - 3.3 Other Latent Loads (0.25p)
4. Fenestration Heat Gain
 - 4.1 Fenestration Direct Solar, Diffuse Solar, and Conductive Heat Gains (0.5p)
 - 4.2 Exterior Shading (0.25p)
5. Heat Balance Method
 - 5.1 Assumptions (0.25p)
 - 5.2 Elements (3.0p)
 - 5.3 General Zone for Load Calculation (0.25p)
 - 5.4 Mathematical Description (1.25p)
 - 5.5 Input Required (0.75p)
6. Radiant Time Series (RTS) Method
 - 6.1 Assumptions and Principles (0.25p)
 - 6.2 Overview (1.5p)
 - 6.3 RTS Procedure (0.25p)
 - 6.4 Heat Gain Through Exterior Surfaces (14.5p)
 - 6.5 Heat Gain Through Interior Surfaces (0.25p)
 - 6.6 Calculating Cooling Load (1.0p)
7. Heating Load Calculations
 - 7.1 Heat Loss Calculations (2.5p)
 - 7.2 Heating Safety Factors and Load Allowances (0.25)
8. System Heating and Cooling Load Effects
 - 8.1 Zoning (0.25p)
 - 8.2 Ventilation (0.25p)
 - 8.3 Air Heat Transport Systems (3.0p)
 - 8.4 Central Plant (0.25)
9. Example Cooling and Heating Load Calculations
 - 9.1 Single-Room Detailed Cooling Load Example (12p)
 - 9.2 Effect of Orientation on Peak Cooling Load Magnitude and Time (1p)
 - 9.3 Effect of Cooling Load Diversity on Peak Block Load (1 p)
 - 9.4 Single-Room Detailed Heating Load Example (0.5p)
 - 9.5 Conclusion (0.25)
10. Previous Cooling Load Calculation Methods (0.5p)
- References (2.5p)



Table 3.3 Straw-Man Proposal for Reorganized Chapters in 2029 Handbook

Chapter 17 – Load Calculation Fundamentals

1. Load Calculation Principles
 - 1.1 Terminology
 - 1.2 Fundamental Principles of Heating Load Calculation
 - 1.3 Fundamental Principles of Cooling Load Calculation
 - 1.4 Data Assembly
2. Heating Load Calculations
 - 2.1 Heat Loss Calculations
 - 2.2 Heating Safety Factors and Load Allowances
3. Example Heating Load Calculations
 - 3.1 Single-Room Detailed Heating Load Example

Chapter 18 – Cooling and Heating Load Applications

1. Introduction to Load Calculation Applications
 - 1.1 Audience, Approach, Intent of Chapter
 - 1.2 Cooling Load Calculation Methods
 - 1.3 Overview for Radiant Time Series Cooling Load Calculations
 - 1.3.1 Assumptions and Principles
 - 1.3.2 RTS Procedure
 - 1.3.3 Calculating Cooling Load
 - 1.3.1 Summary Table of RTS Equations
 - 1.4 Overview for Heat Balance Cooling Load Calculations
 - 1.4.1 Assumptions
 - 1.4.2 Key Elements
 - 1.4.3 Input Required
 - 1.4.1 Summary Table of Heat Balance Equations
2. Internal Heat Gains
 - 2.1 People
 - 2.2 Lighting
 - 2.3 Electric Motors
 - 2.4 Appliances
3. Infiltration and Moisture Heat Gains
 - 3.1 Infiltration
 - 3.2 Latent Heat Gain from Moisture Diffusion (0.5p)
 - 3.3 Other Latent Loads
4. Fenestration Heat Gain
 - 4.1 Fenestration Direct Solar, Diffuse Solar, and Conductive Heat Gains (0.5p)
 - 4.2 Exterior Shading
5. Application of Radiant Time Series (RTS) Method
 - 6.1 Calculation of Internal Loads
 - 6.2 Calculation of Fenestration Loads
 - 6.4 Calculation of Exterior Surface Heat Gains and Loads
 - 6.5 Calculation of Interior Surface Heat Gains and Loads
 - 6.6 Calculating Room Cooling Load



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continued...

6. System Load Effects

- 8.1 Zoning
- 8.2 Ventilation
- 8.3 Air Heat Transport Systems (3.0p)
- 8.4 Central Plant (0.25)

7. Example Radiant Time Series Cooling Load Calculations

- 9.1 Single-Room Detailed Cooling Load Example (12p)
- 9.2 Effect of Orientation on Peak Cooling Load Magnitude and Time (1p)
- 9.3 Effect of Cooling Load Diversity on Peak Block Load (1 p)
- 9.5 Conclusion (0.25)

8. Previous Cooling Load Calculation Methods (0.5p)

References (2.5p)



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A. 2025 PLANS

1. Current Proposed Revisions for 2025 Handbook

Section	Modification or Addition	Assignment
Table 2	Update to use LPD data from ASHRAE 90.1-2022	Jim Pegues
Tables 4A, 4B	Update to use motor efficiency data from ASHRAE 90.1-2022	Jim Pegues
Table 6	Update with results from 1816-RP, Energy Use and Heat Gain from Medical Imaging Equipment	Jim Pegues
Table 13	Single Layer Glazing Data – Validate vs latest WINDOW software version. Update if necessary	Jim Pegues
Table 18	Check material layer properties against Chapter 26. Update if necessary.	Jim Pegues
Tables 16,17	Revise wall and roof CTS tables if material properties in Table 18 change.	Jim Pegues
Figures 9,10	Check data in graphs versus latest CTS tables. Update if necessary.	Jim Pegues
Sections 9.1 thru 9.5	Example Problem a. Revise results if material layer properties and CTS tables change. b. Revise results for TC 4.2 change to solar constant (from 1367 to 1361.1 W/sqm).	Jim Pegues



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B. REFERENCE MATERIAL

Table 1. Evaluation of Data Tables in 2021 Edition Chapter 18

Table #	Content	Last Updated	Comments
1	Occupant Heat Gains	2017	See Table 4, Chapter 9
2	Lighting Power Densities	2021	90.1-2019. Update to 90.1-2022
3	Lighting Fixture Heat Gains	2017	LED data added in 2017.
4A	Motor Minimum Efficiencies 60hz Genl Purpose	2021	90.1-2019. Update to 90.1-2022
4B	Motor Min Efficiencies – Polyphase Small Motors	2021	90.1-2019. Update to 90.1-2022
5A	Unhooded Electric Kitchen Appliances	2013?	2009 research data
5B	Hooded Electric Kitchen Appliances	2017	RP-1631 2015.
5C	Hooded Electric Kitchen Appliances – During Idle	2017	2009 data but contents expanded.
5D	Hooded Gas Kitchen Appliances – During Idle	2017	2009 data but content expanded
5E	Hooded Solid Fuel Appliances – During Idle	2013?	2009 data
5F	Warewashing Equipment	2021	From RP-1778 (2020)
6	Typical Medical Equipment	1999?	
7	Typical Laboratory Equipment	1999?	
Table #	Content	Last Updated	Comments
8A	Typical Desktop Computers	2017	Bach + Sarfraz, RP-1742, 2018
8B	Typical Laptops and Docking Stations	2017	Bach + Sarfraz, RP-1742, 2018
8C	Typical Tablet PC	2017	Bach + Sarfraz, RP-1742, 2018
8D	Typical Monitors	2017	Bach + Sarfraz, RP-1742, 2018
9	Typical Printers	2017	Bach + Sarfraz, RP-1742, 2018
10	Heat Gain for Miscellaneous Equipment	2017	Bach + Sarfraz, RP-1742, 2018
11	Load Factors for Types of Offices	2017	Bach + Sarfraz, RP-1742, 2018
12	Diversity Factor for Different Equipment	2017	Bach + Sarfraz data
13	Single Layer Glazing Data – Window 7.4.6	2021	Window 7.7.10 LBNL 2019 data.
14	Rad/Convective Splits for Internal Heat gains	2010?	Nigusse 2007
15	Solar Absorptance Values of Various Surfaces	?	Data from 1990, 2000, 1971
16	Wall Conduction Time Series Tables	2021	Synched with latest material data
17	Roof Conduction Time Series Tables	2021	Synched with latest material data
18	Thermal Properties of Layers	2021	Synched with chapter 26
19	Nonsolar RTS Values, Light to Heavy Construct.	?	Still valid
20	Representative Solar RTS Values, Light to Heavy	?	Still valid



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21	RTS Representative Zone Constructions	?	Still valid
22	Average U-Factor for Basement Walls	?	Still valid
23	Average U-Factor for Basement Floors	?	Still valid
24	Heat Loss Coefficient Fp of Slab Floors	?	Still valid
25	Common Sizing Calculations in Other Chapters	?	Check and update references
26	Summary of RTS Load Calculation procedures	2013	Still valid
27	Room Characteristics – Opaque Envelope + Fenestration	2021	Valid
28	Room Characteristics – Internal Heat Gains	2021	Valid
29	Monthly/Hourly 5% Design Temperatures	2021	Valid
30	Lighting Load	2021	Valid
31	Radiant Time Series and Conduction Time Series Factors for Example Problem	2021	Valid
32	Input Data for Calculation of Sol-Air Temperatures	2021	Valid
33A	Wall Component of Solar Irradiance for July	2021	Valid
33B	Wall Sol-Air Temperatures, Heat Input, Heat Gain, and Cooling Load for July	2021	Valid
8B	Typical Laptops and Docking Stations	2017	Bach + Sarfraz, RP-1742, 2018
Table #	Content	Last Updated	Comments
34	Window Heat Gain for July (No Blinds or Overhang)	2021	Valid
35	Window Cooling Loads for July (No Blinds or Overhang)	2021	Valid
36	Window Cooling Loads for July (Blinds and No Overhang)	2021	Valid
37	Window Cooling Loads for July (Blinds and Overhang)	2021	Valid
38	Example Office Cooling Loads, July Design Day	2021	Valid
39	Example Office Cooling Loads, September Design Day	2021	Valid
40	Room Peak Cooling Loads for Different Room Orientations	2021	Valid
41	Peak Heating Load Calculation	2021	Valid



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Table 2. Evaluation of Figures in 2021 Chapter 18

Fig #	Content	Last Updated	Comments
1	Heat Gain vs Cooling Load Flow Diagram	?	Still valid.
2	Thermal Storage Effect of Load from Lights	?	Still Valid
3	Lighting Heat Gain for Recessed Fluorocnt Fixtures	2006	Fisher et al
4	Office Eqpt Load Factor Comparison	1994	Wilkins + McGaffin
5	Schematic of Heat Balance Processes in Zone	?	Still valid
6	Schematic of Wall Conduction Processes	?	Still valid.
7	Schematic View of General Heat Balance Zone	?	Still valid
8	Overview of Radiant Time Series Method	?	Still Valid
9	CTS for Light to Heavy Walls	?	Check
10	CTS for Walls with Similar Mass and Various Ins.	?	Check
11	RTS for Light to Heavy Construction	?	Check
12	Heat Flow from Below Grade Surface	?	Still valid
13	Ground temperature amplitude	?	Still valid
14	Below Grade Parameters	?	Still valid
15	Schematic of Typical Return Air Plenum	?	Still valid.
16	Single-Room Example office	2021	Still valid

Table 3. Research Projects that may Yield Data

#	Subject	Comments
1816-RP	Energy Use and Heat Gain from Imaging Equipment	Could provide data for updating or supplementing Chapter 18 Table 6.
1850-TRP	Evaluation of ASHRAE Design Day Procedure against Recorded Weather Data	Co-sponsor with TC 4.2. Approved and out for bid. Results not likely to be ready in time for 2025 HOF.
1857-RP	Improved simplified methodology for describing and calculating heat conduction between buildings and the ground.	Co-sponsor with TC 4.7. Winning bidder being chosen at winter meeting. Results not likely to be ready in time for 2025 HOF.
1923-RP	Prepare climatic design conditions for 2025 ASHRAE Handbook – Fundamentals and ASHRAE Standard 169	Co-sponsor with TC 4.2. Stretch goal of characterizing design day profile shapes based on latitude, time of year could affect Chapter 18.
RTAR	Formalizing thermal comfort calculations for children.	TC 2.1. May provide occupant heat gains
RTAR	Heat Gain from Refrigeration Equipment	Cognizant TC?



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Table 4. Tasks Carried Over From 2017 Handbook Cycle

#	Subject	Comments
1	Synchronize variable naming	Deferred from 2021. (assigned to Jim Pegues)
2	Rooms with radiant cooling systems	Incorporate further information about calculating room loads in rooms using radiant cooling systems. Specifics TBD.