



180 Technology Parkway
Peachtree Corners, GA 30092
404-636-8400

FINAL APPROVED MINUTES
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 2/23/2025

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

DATE OF MEETING Monday 2/10/2025 LOCATION Orlando Hilton, Lake Florence B (Lobby Level)

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Chip Barnaby	2022			Starr Amey (City of Tampa)
Liam Buckley	2024			Charlie Curcija (LBNL)
Glenn Friedman	2024			Daniel Guzman (NAVFAC)
Suzanne Levisieur	2022			Ed Jankowski (ACCA)
Ardeshir Moftakhari	2022			Rolando Legarreta (Alegro Engr)
Jim Pegues	2024			Yapan Liu (Fraunhofer USA)
Rachel Spitler	2022			James Lowry (ZMM)
Chris Wilkins	2021			Dhyan Patel (Texas A&M)
				Brian Rock
				Stephen Roth (Carmel Software)
				Larry Sun (DMB)
				Russell Taylor (Carrier)
				M. Weiland
				Graham S. Wright (Phius)
DISTRIBUTION: All Members of TC/TG/MTG/TRG plus the following:				
TAC Section Head: Kyle Gluesenkamp			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	

These minutes were approved by a 7-0-0-0-CNV TC 4.1 committee vote on June 23, 2025

TC 4.1 Web Site: <https://tc0401.ashraetcs.org/>



ASHRAE Technical Committee 4.1

ASHRAE TC 4.1
Load Calculation Data & Procedures
Full Committee Meeting Agenda
2025 ASHRAE Winter Conference
Hybrid Meeting
In-Person: Orlando Hilton, Florence B (Lobby Level)

Summary of Votes Taken

	Motion	Result	Vote
1	Approve Indianapolis Summer 2024 meeting minutes	Passed	7-0-0-0-CNV
2	Approve revised WS-1959 for submission to RAC	Passed	6-0-0-1-CNV
3	Approve RTAR for Simplified Method for Calculating Heating Warm-Up Loads for submission to RAC	Passed	7-0-0-0-CNV

Summary of Action Items

	Assigned To	Action
1	James Lowry, Glenn Friedman, Jim Pegues	Organize and evolve concepts for program presentations on (1) Load Calculations using BIM models, and (2) Load Calculation Workflows for young engineers, for Winter Conference in Las Vegas
2	Ardi Moftakhari, Graham Wright, Russ Taylor, Glenn Friedman	Collaborate to refine the draft RTAR for 24-hour dynamic heating load calculation
3	Jim Pegues	Develop straw man outline for reorganized 2029 Handbook chapters: Load Calculation Theory and Load Calculation Workflow
4	Jim Pegues	Poll committee members on their favorite example of successful organization of material about load calculations.
5	Jim Pegues	Schedule a web meeting mid way between winter and summer meetings for TC 4.1 members to discuss the new straw man outline for 2029 Handbook chapters.
6	Chris Wilkins	Collect more information on the research idea involving using AI to convert a BIM model into an analytical model for load calculations.

1. **Call to order [2:15 PM ET]** Rachel Spitler

2. **ASHRAE Code of Ethics Commitment** Rachel Spitler

"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>)

3. **Roll call – Determination of a Quorum** Jim Pegues

8 of 8 voting members present. Quorum exists

TC 4.1 Web Site: <https://tc0401.ashraetcs.org/>



ASHRAE Technical Committee 4.1

4. Introductions All

5. Scope, Mission Statement Rachel Spitler

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.

6. Agenda additions

None

7. Liaison reports

Liaisons

a. Section Head

Kyle Gluesenkamp

Reminder that roster updates are due at this meeting.

b. Chapter Technology Transfer

Christopher Adams

Liaison did not attend.

c. Research

Dennis Landsberg

Liaison attended research subcommittee meeting on Sunday

d. Handbook

Eric Granzow

Liaison did not attend.

e. Staff, Research/Tech Services

Steven J Hammerling

Liaison did not attend

f. Standards

Mr Philip J Naughton

Liaison did not attend

g. TAC Chairman

James S Bennett

Liaison did not attend



ASHRAE Technical Committee 4.1

8. Chair's Report

Rachel Spitler

a. TC Chairs Breakfast

- ASHRAE is working to establish a Young Engineers at ASHRAE (YEA) Conference Mentorship Program. Involves mentoring YEA members at ASHRAE conferences. Contact youngengineers@ashrae.org if interested or for more information.
- ASHRAE 2025-2028 Strategic Plan will be released in June. A draft copy is available now upon request.
- Fellows nominations are due May 1.
- ASHRAE TAGs participating in ISO working groups. ISO/TC 205/WG9 Heating and Cooling Systems overlaps with TC 4.1's scope. If interested in being on the US TAG, attending ISO meetings as a US expert, or serving as a TAG resource for document review, contact Kai Nguyen (knguyen@ashrae.org).
- MTG-CEA – Multidisciplinary Task Group for Controlled Environment Agriculture. Relates to indoor grow facilities. One of the MTG's activities concerns how to calculate cooling and heating loads for grow facilities. Cannabis industry is driving this committee, but what is developed will have wider application to other kinds of indoor agriculture applications.
Rolando Legarreta is TC 4.1's representative. Next web meeting occurs Tuesday, Feb 12, 9-11am. Rachel will ask Stephen Roth if he is able to attend as Rolando has a conflict.

9. Approval of minutes from 2024 Summer Meeting

Rachel Spitler

Motion: Approve Indianapolis Summer 2024 Meeting Minutes

Motion By: Glenn Friedman

Second By: Jim Pegues

Vote: 7-0-0-0-CNV (for-against-abstain-absent-Chair-Not-Voting)

10. Subcommittee reports

a. Programs:

James Lowry

- No programs at Orlando winter conference.
- No programs planned for Phoenix summer conference
- Plan is to put forward 2 programs for Las Vegas (winter conference 2026)
- First idea – Load Calculations using BIM models.
- Second idea – Loads workflow. Targeting young engineers.
- Third idea – Liam Buckley is composing a proposal for a program and will submit.
- Glenn Friedman and Jim Pegues volunteered to help James organize and evolve the concept and content for the presentations for ideas 1 and 2.

b. Research:

Ardi Moftakhari

- RP-1861 – Heat gain from imaging equipment. No update. They have not yet published results. Project had been delayed by lack of access to facilities during COVID pandemic. They have now collected the data but had not yet processed the data.
- RP-1923 – Climate data update for 2025 HOF – Data has been collected, processed, and submitted for publication in the 2025 ASHRAE Handbook – Fundamentals and in the Weather Data Viewer. Final report is being written.
- RP-1857 – Simplified method for ground conduction – Project has started.



ASHRAE Technical Committee 4.1

c. Research (continued):

- WS-1959 – Update people heat gain data for cooling load calculations – Work Statement (WS) was returned by RAC with comments. Comments have been addressed. Ready to resubmit WS to RAC

Motion: Approve revised WS-1959 for submission to Research Activities Committee.

Motion By: Chris Wilkins

Second By: Suzanne Levisseur

Vote: 6-0-0-1-CNV (for-against-abstain-absent-Chair-Not-Voting)

- RP1850 – Evaluates shapes of cooling design day weather profiles (temperature and humidity) based on measured weather data. Currently Work Statement is being revised and will be resubmitted to RAC. Ardi asked TC 4.2 to revise the scope to include heating design day data. TC 4.2 is the lead sponsor and TC 4.1 is co-sponsoring.
- RTAR – Simplified method for calculating heating warmup load – Chris Wilkins is leading development of RTAR. More accurate estimation of warm up load is important for heat pumps. With boilers, oversizing had little economic or operational consequences. With heat pumps there are large economic, space, and operational issues. You can calculate warmup with a detailed 24-hour transient calculation. But what is needed for more simplified calculation that designers can easily apply.

Motion: Approve RTAR for Simplified Method for Calculating Heating Warm Up Loads for submission to RAC, subject to editing by RTAR author

Motion By: Chris Wilkins

Second By: Suzanne Levisseur

Vote: 7-0-0-0-CNV (for-against-abstain-absent-Chair-Not-Voting)

- RTAR – 24-hour dynamic heating load calculation for sizing heat pumps. Development led by Graham Wright. Graham is a representative from SPC 227P, Passive Building Design Standard. Concerned about oversizing of heating load for passive building applications. A 24-hour steady periodic dynamic load calculation is needed to consider all factors adequately. A 24-hour design heating day weather profile is needed considering temperature and solar radiation. May need two separate profiles, one representing a clear cold day and one representing a cloudy milder day for consideration. Would like to reference the design heating day and the calculation method in Standard 227P. Ultimate goal is for Standard 227P to be referenced by stretch building codes.

Discussion indicated the focus of the proposed research project is defining how to construct the 24-hour steady periodic design heating day weather profiles.

ACTION: Ardi will work with Graham to refine the draft RTAR. Russ Taylor and Glenn Friedman also volunteered to help with this activity.

- RTAR – Update to residential load calculation method and data. Concept still being developed.
- Research Concept: Research on use of AI to convert BIM model into analytical model that can be used for load calculations. ACTION: Chris will collect more information to advance this idea.



ASHRAE Technical Committee 4.1

d. Handbook

Jim Pegues

- Updated chapters 17 and 18 due to be published in June in 2025 ASHRAE Handbook – Fundamentals.
- Work on 2029 Handbook chapters has already begun. Have been discussing a major reorganization of material to better serve needs of consulting engineers and young engineers.
- ACTION: Jim to develop straw man outline arranging material in two chapters: Theory and Workflow. Workflow is to have a kind of “cookbook” design, describing what to do first, what to do next, etc., describing what data to collect and how to use it in calculations in each step, with references to the Theory chapter for background principles and fundamental concepts.
- ACTION: Jim to poll committee members on their favorite example of successful organization of material on load calculations. In subcommittee, several past editions of ASHRAE Handbooks as well as other technical publication were mentioned. To serve as examples guiding organizations of the 2029 chapters.
- ACTION: Jim to schedule a web meeting mid-way between winter and summer meeting to present straw man proposal and advance discussion.
- Issue of mathematics was tabled as a lower-level issue to deal with once an outline is established.
- For further details, see Handbook Subcommittee Report attached to these minutes.

e. Standards

Glenn Friedman

- Currently no activity on TC 4.1's two standards: Standard 183-2024 – *Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings* and Standard 203-2018 (RA 2021) – *Method of Test for Determining Heat Gain of Office Equipment Used in Buildings*.

f. Web Site

Jim Pegues

- Web site is up to date.

11. Old Business

Rachel Spitler

None

12. New Business

Rachel Spitler

- a. Air Conditioning Contractors of America (ACCA) is preparing to revise Manual J Residential Load Calculation and has invited Glenn Friedman to participate in that work.
- b. ISO Working Group 205 - Cooling and Heating Systems. Anyone who is interested in this working group, please contact Rachel for information. ASHRAE involvement in this working group is part of an ongoing effort to harmonize standards.



ASHRAE Technical Committee 4.1

13. Adjourn [4:04 PM EDT]

Rachel Spitler

Motion: Adjourn
Motion By: Chip Barnaby
Second: Chris Wilkins

Attachment:

Attachment 1 – Handbook Subcommittee Report

Attachment 1:

TC 4.1 Handbook Subcommittee Report



ASHRAE Technical Committee 4.1

TC 4.1 Handbook Subcommittee - Report

February 9, 2025

Handbook Subcommittee Chair:

james.f.pegues@carrier.com

rev1

Agenda:

1. Status and Schedule
2. Proposed 2029 Reorganization of Chapters 17 and 18

Discussion:

1. Status and Schedule

- a. Chapter 17 and 18 submitted for publication during July, 2024.
- b. Waiting for publication proofs to review.
- c. 2025 Handbook will be published in June, 2025.
- d. Starting work on 2029 Handbook. Publication submission will be in July, 2028.

2. Proposed 2029 Load Calculation Chapter Reorganization

- 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. Present fundamental concepts of steady state loads using design heat loss as the application and examples. Then explain 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.
- b. Topic 1 - Proposed Plan of Attack
 - Proposal:
 - Develop and refine an outline for Non-Residential Loads material until acceptable to committee.
 - Evaluate ways to merge in material for Residential Loads
 - Rearrange existing chapter material into the new format – there will be gaps where new material is needed.



ASHRAE Technical Committee 4.1

- Use the rearranged material as the baseline for filling gaps, adding new material, revising material to speak to primary audience better.
- Iterate until acceptable to committee.

Conclusions:

- General support for this approach from the subcommittee

b. Topic 2 - Winter 2025 Straw Man Outline for Non-Residential Material

- a. Did not discuss the straw man outline in the agenda. Instead discussed general concepts, requirements, and tactics related to how to develop the initial outlines for reorganized chapters.

Conclusions:

- Consider organizing as 2 chapters: Theory and Workflow. This addresses key needs and resolves usage issues with the current chapters.
- Providing a Workflow chapter (or 'cookbook' or 'guide') is very important for meeting young engineer needs as well as consulting engineer needs.
- ACTION: Jim to poll meeting attendees on what they feel are good examples of successful organization of material. In the meeting several people noted past editions of the Handbook – Fundamentals or other technical resources that were effective. Then review outlines to discover effective organizational tactics that can be used in our chapters.

Feedback:

- Need “manual of procedures” material. Young engineers particularly need guidance on what do I do first, what do I do next, etc...
- Need a guideline for new engineers. What to do. Include a workflow diagram. Young engineers are very visual.
- A cookbook is a good analogy. What are the ingredients and what do you with them. That's part of what students struggle with.
- Carrier had a manual that could serve as a guide for organization. Liked the presentation. The material is very dated, but the presentation approach was good (either referring to Load Estimating Technical Development Program (TDP) or the Carrier System Design Manual).
- 1997 Handbook was a good example of organization
- 1989 Handbook was a good example of organization
- What you really need is animations to illustrate thermal processes to communicate building physics concepts. Students are very visual these days.



ASHRAE Technical Committee 4.1

- Organize material as one chapter with theory and one chapter with workflow (cookbook). Dividing the material that way provides more usability. Workflow chapter can keep referring back to theory chapter. Theory doesn't get in the way of application data. All the tables of heat gain data etc. would be in the workflow chapter. The workflow chapter could have separate parts for residential and non-residential if we decide those need to be separate.

d. Topic 3: Mathematics

Revisit and clarify the issue of mathematics being an obstacle to effective chapter use. Is it all math a problem, or only some math?

Proposal:

- Keep simple algebraic equations, but always introduce with a plain-English description of the calculation concept, followed by the equation. Algebraic equations are useful as a concise statement of principles
- Where possible move equations to "Summary of Equations" table so it is not in the middle of the text. Reference the equations in the text.
- For the complex math in the Heat Balance discussion, position at the end of section so it follows conceptual discussion.

Conclusions:

- Table this issue for now. Sort out organization of chapters first and establish an outline. Then figure out math as a lower-level implementation detail.
- Consider that young engineers struggle with certain math and heat transfer issues. Navigating that issue will be important for success of the revised chapters.

Feedback:

- From experience teaching students the Radiant Time Series Method (RTSM), students seem to struggle with summation symbols and summation concepts. Students have a heat transfer class as a prerequisite. Seem to understand conduction and convection as steady processes. They have trouble with radiation heat transfer. And the fact that heat transfer in a building is multi-mode and transient causes students great difficulty in comprehension
- For consulting engineers, basic algebraic equations are OK. For software developers heavy duty math is needed,
- Consider moving the heavy-duty math to the Load Calculation Application Manual (LCAM).



ASHRAE Technical Committee 4.1

Use of Mathematical Equations in 2025 Handbook Chapter 18

Topic in Chapter 18	Use of Equations
2. Internal Heat Gains	Simple, single-line algebraic equations. 1 or 2 per page.
3. Infiltration	14 simple algebraic equations. All serve a purpose, provide examples
4. Fenestration Heat Gains	4 simple algebraic equations. All serve a purpose.
5. Heat Balance Method	Equations are more complex and theoretical here. Write out as human readable (qualitative statements first, and then provide in mathematical notation afterwards.
6. Radiant Time Series Method	Several simple algebraic equations. All serve a purpose The imposing equations are the time series equations. Make sure the concept is clearly explained in words first, and then provide the equation after.
7. Heating Load Calculation	Several simple algebraic equations. All serve a purpose. The ground conduction equations are more complex. Possibly shift these to a “Table of Heating Load Calculation Procedures” to move them out of the main text.
8. System Heating and Cooling Load Effects	A few simple algebraic equations. All serve a good purpose.
Table 26. Summary of RTS Load Calc Proc.	All equations with definitions. But this is segregated at the end of the discussion.
9. Example	Intense use of equations, but the equations are critical for demonstrating the procedure.