**M I N U T E S**

# DRAFT

## TECHNICAL COMMITTEE
## 4.1 LOAD CALCULATIONS AND PROCEDURES

2020 Summer Virtual Meeting

**June 19, 2020**

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

1. Call to Order by Chairman - Suzanne LeViseur

2. Roll Call by Rolando Legarreta – 8 of 8 members present.

| | | |
|---|---|---|
| Suzanne LeViseur | Chair – Voting | X |
| Glenn Friedman | Voting | X |
| Rachel Spitler | Voting | X |
| James Pegues | Voting | X |
| Charles Barnaby | Voting | X |
| Steven Bruning | Voting | X |
| Robert Doeffinger | Voting | X |
| Elyse Malherek | Voting | X |
| Jingjuan Feng (Dove) | Non-voting - Vice Chair | X |
| Rolando Legarreta | Non-voting - Secretary | X |

3. Introduction of Visitors by Suzanne LeViseur

| | |
|---|---|
| James Bennett | Section Head Liaison |
| Natasha Milesi Ferreti | Incoming Research Liaison |

4. Approval and/or Corrections to Previous Meeting Minutes presented by Suzanne LeViseur
   Rachel's and Jeff Spitler – Last name incorrectly spelled; shall be Spitler, not Spittler.
   Som's Last Name incorrectly spelled.
   Reference for KC Programs needs to be removed; shall reference Programs Report.

   Orlando Meeting Minutes –Jim Pegues moved to approve meeting minutes. Rachel Spitler second the motion.
   Orlando Meeting Minutes approved with listed corrections above 7-0-0-1 (Chairman not voting).

5. Liaison Comments –
   Section Head – James Bennett - Present
   Reminder that this year Roster Rollover will not take effect until August 1, 2020.
   Activity Forms are due July 21, 2020; Activity Report from TC4.1 shall be emailed a few days after the meeting.
   Suzanne (Chairman) to be presented a Certificate of Appreciation during the Chicago Meeting.
   Sub-Committee Chairs shall attending the Chairs training –
   Programs Scheduled for July 7 from 1-2 PM (All times are eastern times)
   Research Scheduled for July 14 from 10-12 PM
   Any scheduled meetings can be found in the ASHRAE365 App.

   Suzzanne LeViseur asked James Bennett about the High Tower Award and TC 4.1 had nominated one person.
   Mr. Bennett asked if there was an awards coordinator within the TC; (TC4.1 does not have an awards coordinator.
   Som Shrestha, PhD volunteered to be TC4.1 Awards Coordinator

   TAC Chairman – Jay Kohler – Not Present

   Chapter Technology Transfer Chair - Christopher Adams – Not Present

   Research Liaison - David Claridge – Not Present
   Incoming Research Liaison – Natasha Milesi Ferreti - Present
   Natasha Introduced herself to the group as the incoming Research Liaison.

   Handbook Liaison - Bass Abushakra

   Staff Liaison - Steven Hammerling

6. Research Subcommittee Report Som Shrestha, PhD

Reference attached Research Sub-Committee Report

**RP 1729: Experimental Verification of Cooling Load Calcs for Radiant Systems**
Glenn Friedman – No more active research work on the project; Research team has two Journal Papers that will be distributed to the PMS; Glenn thanked Chip Barnaby for his active participation to help the Research team to implement the findings in the toolkit.
Project is ready for closure.
Ardi (Ardeshir Moftakhari) thanked the PMS and Chip Barnaby for the support received during the research. Also mentioned that this coming Monday there is a pre-recorded presentation of results of experiments; and will not be focused on experiments.

Jim Pegues moved to approve the final report and project closure. Steve Bruning second the motion.
Motion Passed 7-0-0-1 (Chairman Not Voting).

**RP 1778 Heat and Moisture Loads from Commercial Dish room Appliances and equipment.**
Rolando Legarreta Liaison with TC5.10 and on the PMS reported that the final report was complete, the tables in Chapter 18 have been updated with the research results. The PMS had voted to approve pending TC5.10 and TC4.1 approval to accept.

Jim Pegues moved to approve the final report and project closure. Steve Bruning second the motion.
Motion Passed 7-0-0-1 (Chairman Not Voting).

**RP 1816 – Reporting Energy Use and Heat Gain from Imaging Equipment.**
Glenn Friedman is the Liaison, all background work has been done; but due to the pandemic, experimental data can not be gathered as different hospitals do not allowed external people on site.

**RP 1847 – Updating Climatic design information for the 2021 ASHRAE Handbook, Standards 169, and the Handbook of Smoke Control Engineering.**
Jim Pegues is the Liaison, There were some WS delays and it didn't get approved until April 2019; but the data is collected and ready for the new HB.
A new WS will be prepared for the 2025 HB; with the intent to submit to RAC by December 2020 to get the project on time for the 2025 HB; This new project will per Chip Barnaby will encompass identifying additional weather elements needed such as rainfall, climate statistics, etc. If any other items, we know should be considered; we should let TC4.2 know about it.

**RP 1850 Evaluation of AHSRAE Design Day Procedure against recorded weather data.**
Glenn Friedman was supposed to be the Liaison, but due to a confusion in HQ, Steve Bruning was part of the PMS; Steve participated in the PES meeting and made a recommendation; 3 Bids were received and scored, and a recommendation was sent to RAC. Approximate Start Date 9/1/2020 or later. Moving Forward Glenn Friedman will be the Representing TC4.1 in the PMS.

Project approved by RAC at this meeting may be delayed; Budget is unknown, and a series of cutbacks may happen pending ASHRAE Board Approval.

**WS 1857 – Improved simplified methodology for describing and calculating heat conduction between buildings and the ground.**
Glenn Friedman is the TC4.1 is the Liaison with nothing to report at this time.

**WS for Load Calculation Manual:** Jim Pegues is pending to confirm if there is a market for it with ASHRAE Publications.

Chip Barnaby to draft an RTAR for next meeting; during this cycle of the Res Chapter (Chapter 17) will be published unchanged using the same data from RP 1199; it has been a long time from that research and we should focus attention for the 2025 HB or beyond.

Ardi will draft the RTAR using RP 1729 as reference for the concept of Load Calculations for Radiant Time Series for both lightweight and radiant slabs; with the intent to submit by August 15 deadline. If anyone is interested in helping, please contact Som. If the August 15 deadline is not achieved, the next deadline will be December 15.

Natasha Milesi Ferreti (Incoming Research Liaison), mentioned the research project for Load Calculations for Indoor Agriculture; Steve Bruning Mentioned that at the MTG meeting this was discussed and Rolando recommended that TC4.1 should be involved a co-sponsor. Rolando volunteered to be the PMS and should contact TC 2.2 for TC4.1 to co-sponsor.

7. Programs Subcommittee Report by Rachel Spittler
   (See attached Programs Report)
   TC 4.1 did not have any programs for Virtual Conference due to the short period of time provided at the last meeting.
   Any Programs for the Winter 2021 Meeting should be submitted by August 3.
   Topics discussed for possible Programs for the Winter 2021 Meeting:
   Climate Change and Load Calculations – Jim Pegues offered to help Rachel putting this program together.
   Fundamentals of Load Calculations - The last similar program was presented 5 or 6 years back; this seminar should focus on new engineers what they need to know, how to approach.
   Stephen Roth mentioned that since the last program there are several new tools and updated tools that it should be incorporated into the program.
   Rachel mentioned hat this is part of another program under consideration (Comparison of Load Calculation Software; for this presentation, the committee members expressed interest in using the new ASHRAE HQ building; Steve Bruning will contact Mike Vaughn to obtain the Revit Model (If possible),

   Brian Rock, Stephen Roth, Vrunda Patel offered to help Rachel to put a program together for the 2021 Winter Meeting for Fundamentals of Load Calculations; and Comparison of Load Calculation Software for the Winter 2022 Meeting.

   Jim Pegues, made a motion to organize a Fundamentals of Load Calculation Program for the Winter 2021 Meeting; Glenn Friedman Second the Motion; Motion carries 7-0-0-1 (CNV).

   Jim Pegues made a motion to organize a Program for Climate Change and the effect on Load Calculations; Glenn Friedman Second the motion. Motion carries 7-0-0-1 (CNV).

8. Standards Subcommittee Report by Glenn Friedman

   ANSI/ASHRAE/ACCA Standard 183 was re-affirmed this year; Voting was email ballot.
   ANSI/ASHRAE Standard 203-2015 - will come back next year (2021) for consideration.

   No actions needed on Standards at this time.

9. Handbook Subcommittee Report by Jim Pegues (Chapter 18 Non-Residential)
   Reference attached Handbook Sub-committee Report.
   Jim Pegues and Chris Wilkins will work on wordsmithing paragraphs that can possibly gt members in trouble when referencing radiant cooling.
   Jim Pegues, Rachel Spitler, and Rolando Legarreta will proof the Kitchen Equipment Data and wording.
   Discussions regarding results of RP 1789 – Radiant cooling loads and Building Warm-up factors; Chris and Jim will work on re-wording.
   From the discussions – Seems that warm-up loads would be a perfect research project to establish values based on energy modeling and loads.
   In order to have the Chapters approved by the committee all final wording and revisions will be made to both Chapter 1 and Chapter 18 by the end of next week. An Email Ballot will be issued on

6/26/2020; with responses before July 4. To be able to submit by the July 12 deadline.

10. ASHRAE Website for TC4.1 by Jim Pegues
    Website is current.

11. Old Business by Suzanne LeViseur
    None

12. New Business by Suzanne LeViseur
    There is a SDL (Self Directed Learning) Course in load calculations for review; Jim Pegues offered to participate as a reviewer.
    Reminder: Virtual Conference is only $99.00

13. Adjournment
    Chip Barnaby Motioned to Adjourn the meeting.
    Steve Bruning Second the motion.
    Meeting adjourned at 4:02 PM (Eastern Time)

# ASHRAE Technical Committee 4.1

## TC 4.1 Research Subcommittee Meeting Report

### Virtual Meeting
**Meeting Date June 12, 2020**

Research Subcommittee Chair: Dr. Som Shrestha shresthass@ornl.gov
Research Liaison for Section 4:
Professor David Claridge from Texas A&M University, effective July 1, 2019 until July 31, 2020.
Starting August 1, 2020 new Research Liaison will be Natascha Milesi-Ferretti
rl4@ashrae.net

Section 4 Research Subcommittee Chairs meeting is on Tuesday, 7/14 - 10 am ET
ASHRAE research project database http://research.ashrae.org/html/

1. RP 1729: Experimental Verification of Cooling Load Calculations for Spaces with Non-Uniform Temperature Radiant Surfaces.
   Sponsoring Committees TC 4.1 and TC 5.3 (Room Air Distribution)
   PMS Chair Glenn Friedman
   PMS members Chris Wilkins, Som Shrestha, Dove Feng, and John Bade
   PI: Atila Novoselac, Contractor: University of Texas, Austin

   - 2/3/20: TC approved to recommend extending the contract date to Oct 31, 2020 to finish the implementation of the modified HBM into the ASHRAE's load calculations toolkit
   - The contractor, with help from Chip Barnaby, implemented the Modified Heat Balance Method in the ASHRAE load toolkit. They tested the model on the default load toolkit room model and with experimental data.
   - Ardeshir Moftakhari will present an ASHRAE conference paperer based on this project "Experimental Study on Cooling Loads of Radiant and All-Air Systems" on June 22, 2020 (VC-20-C051)
   - Two journal papers will be submitted to the ASHRAE's Science and Technology for Built Environments.

2. RP 1778: Heat and Moisture Load from Commercial Dish room Appliances and Equipment.
   Sponsoring Committees TC 5.10 (Kitchen Ventilation) and TC 4.1.
   TC 4.1 liaison on the PMS - Rolando Legarreta
   PI: Richard Swierczyna, Contractor: Frontier Energy, Inc.

   - The contractor submitted a draft report before the 2020 winter conference for review
   - and evaluation by the PMS. A no-cost extension was approved for 6 months, the new contract expiration date is July 31, 2020.

3. 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

   - The contract was finalized on Oct 29, 2019
   - The first portion of the tasks have been completed
   - The second portion includes on-site testing. MRI test sites are Massachusetts, Tennessee, and California. The hospitals are Massachusetts General Hospital, University of California San Francisco Medical Center, and St. Thomas Hospital (Tennessee).

4. RP 1847: Updating climate design information for the 2021 ASHRAE Handbook, Standards 169, and the Handbook of Smoke Control Engineering.
   Sponsoring Committees TC 4.02 (Climatic Information), 4.1, and 5.6 (Fire and Smoke Control)
   TC 4.1 liaison on the PMS - James Pegues
   PI: Michael Roth, Contractor: Klimaat

   - The contract was finalized on Jan 30, 2019. Work start date Apr 1, 2019
   - The contractor is making amazing progress, well on track
   - WS of a new project started

5. RP 1850: Evaluation of ASHRAE Design Day Procedure against recorded weather data.
   Sponsoring Committees TC 4.02 (Climatic Information), TC 4.1, and TC 5.6 (Radiant Heating and Cooling).
   TC 4.1 liaison on the PMS - Glenn Friedman, Steve Bruning represented TC 4.1 in the PES

   - ASHRAE called for Bid in Apr 2020
   - PES for 1850-TRP made a recommendation for a contractor to TC 4.2 and TC 4.2 voted unanimously to recommend a contractor to RAC
   - Scheduled Project Start Date: September 1, 2020 or later

6. WS 1857: Improved simplified methodology for describing and calculating heat conduction between buildings and the ground. Results of this Project 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) and TC 4.1
   TC 4.1 liaison - Glenn Friedman

7. Work Statement for updating Load Calculation Manual - James Pegues volunteered to check with ASHRAE Special Pubs if there is still a market

8. Updating Residential Chapter in Handbook - Chip Barnaby volunteered to draft an RTAR with James Pegues and Stephen Roth's help

9. Ardeshir Moftakhari volunteered to draft an RTAR to extend the RTS method for radiant systems

**TC 4.1 Programs**
**Virtual, Friday, June 12, 2020**

Rachel Spitler rspitler@cyntergy.com, Programs Chair

# *PROGRAMS*

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

2. **Current Program:**

    a. None.

3. **Future Program**:

    a. Submission deadline is Monday, August 3rd, 2020 for the 2021 Winter Conference (Chicago). The meeting itself is January 23-27, 2021.
    b. Phoenix, AZ conference is June 26-30, 2021. No information beyond that yet.
    c. Future Program Ideas
        i. Fundamentals of Load Calculations – Things New Engineers Need to Know Before Starting Loads [Winter 2021]
        ii. Climate Change and Load Calculations [Winter 2021]
        iii. Comparison of Load Calculation Software using New ASHRAE HQ Building
        iv. 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]
        v. Ventilation and Infiltration
        vi. 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]
        vii. 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]

**TC 4.1 Programs**
**Virtual, Friday, June 12, 2020**

**PROGRAM TRACKS for Chicago**:

Track 1: HVAC&R Fundamentals and Applications **Track Chair: Robert Cox**
**Email: bob.cox@jacobs.com**

Track 2: Systems and Equipment **Track Chair: Marianna Vallejo**
**Email: marianna.vallejo@jacobs.com**

Track 3: Refrigeration and Refrigerants **Track Chair: Gary Debes**
**Email: gary.debes@comcast.net**

Track 4: Environmental Health through IEQ **Track Chair: Stephen Idem**
**Email: sidem@tntech.edu**

Track 5: Building Performance and Commissioning for Operation and Management **Track Chair: Lee Riback**
**Email: lee.riback@gmail.com**

Track 6: Energy Conservation **Track Chair: Nivedita Jadhav**
**Email: nivi2307@gmail.com**

Track 7: International Design **Track Chair: Farhan Mehboob**
**Email: farhan.mehboob@smehboob.com**

Track 8: Standards, Guidelines and Codes **Track Chair: Kyle Inge**
**Email: kinge@burns-group.com**

# ASHRAE Technical Committee 4.1

## TC 4.1 Handbook Subcommittee
## Chapter 18 Non-Residential Load Calculations
## Discussion Topics

**June 19, 2020**

Handbook Subcommittee Chair: james.f.pegues@carrier.com
rev4

## Topics:

1. Updates to Tables 16 and 17 (Conduction Time Series Factors) are now complete.
2. Material in section 4.2 on cooking appliance heat gain updated. Revision being reviewed by Rachel Spitler and Rolando Legarreta.
3. Revisions made to 7.2 Heating Safety Factor and Load Allowances.

The following blocks show the original material highlighted yellow and the proposed 6/12 changes highlighted orange.

### 7.2 Heating Safety Factor and Load Allowances

*Following revisions proposed.*

Before mechanical cooling became common in the second half of the 1900s, and when energy was less expensive, buildings included much less insulation; large, operable windows; and generally more infiltration-prone assemblies than the energy-efficient and much tighter buildings typical of today. In the past, allowances of 10 to 20% of the net calculated heating load for piping losses to unheated spaces, and 10 to 20% more for a warm-up load, were common practice, along with other occasional safety factors reflecting the experience and/or concern of the individual designer. Today such safety allowances are more conservatively applied with modern construction practices. A combined warm-up/safety allowance of 20 to 25% is common but varies depending on the particular climate, building use, and type of construction. Engineering judgment must be applied for the particular project. Armstrong et al. (1992a, 1992b) provide a design method to deal with warm-up and cool down loads. In addition computer modeling of the transient warm-up load can be used to determine the extra heating capacity needed for warm-up.

~~In recent years an additional consideration for choosing safety allowances has emerged. As modern energy codes successively require higher insulation levels for opaque envelope and fenestration, and require measures to reduce envelope air leakage, building peak heating loads have become smaller and smaller. The additional heating capacity needed to warm up a building from set back to occupied setpoint temperature is only partly dependent on envelope insulation levels. As a result the ratio of required warmup heating capacity to peak heating load has increased over time. Where a 20 to 25% safety allowance may have been sufficient for warm up in past decades, 20 to 25% may no longer be sufficient for modern buildings with greatly reduced peak heating loads. Designers should take this into account on a project by project basis when choosing a safety allowance.~~

4. RP-1729 Discussion

   a. Revisions proposed by subcommitte at 6/12 meeting implemented (orange highlights below). Original material proposed by Chris Wilkins is in yellow.

### 1.1 Terminology

*Added paragraph*

The current terminology presented here has been developed over time based on the assumption that heat will be removed from a space through a convective (air system) based cooling process. Recent research (ASHRAE RP-1729) has shown that when cooling is provided through a predominantly radiant based cooling system, the conversion of heat gain to cooling load can differ from convective based systems. It is always important to make a distinction between the room load and the HVAC system load. This is true for both convective based systems and radiant cooling systems. This chapter deals with calculation of the room cooling load. For radiant cooling systems, those room loads should be applied to calculation of HVAC system loads using principles described in the 2020 Handbook – HVAC Systems and Equipment, Chapter 6 – Radiant Heating and Cooling. ~~some of the discussion that is predicated on air systems will no longer be fully applicable.~~ This chapter will continue to remain largely based on convective or air system based room cooling loads but some key differences that would exist with radiant systems will be pointed out.

### Heat Flow Rates

*Added paragraph*

With radiant based cooling systems, radiant gains will still be absorbed by surfaces in the space but their conversion to cooling load can be very different than would occur with convective or air based cooling systems. The first difference occurs if the radiant gain strikes the radiant cooling surface directly. In this case, the radiant gain will be converted to cooling load immediately as the heat is absorbed directly by the active radiant cooling system. Other radiant gains will be absorbed by non-active surfaces in the space. In these cases, though, the heat gain could be converted to cooling load either by convection to the space air or through radiation exchange with the active radiant cooling surface. ASHRAE research project 1729-RP found that in general, the radiant system will maintain the non-active surfaces at a temperature below the room air and that most absorbed radiant gains are converted to cooling load by exchange with the radiant cooling system. It was found this resulted in less stored heat and less time lag between the heat gain and its conversion to cooling load as compared to conventional air based systems.

## 5. Heat Balance Method

### 5.1 Assumptions

*Revisions in first 2 paragraphs; addition of third paragraph*

All calculation procedures involve some kind of model; all models require simplifying assumptions and, therefore, are approximate. The most fundamental assumption that is inherent in the traditional heat balance solution is that air in the thermal zone can be modeled as **well mixed**, meaning its temperature is uniform throughout the zone. ASHRAE research project RP-664 (Fisher and Pedersen 1997) established that this assumption is valid over a wide range of conditions. This assumption remains the same both for convective air system-based cooling systems and radiant cooling systems.

The next major assumption is that the surfaces of the room (walls, windows, floor, etc.) can be treated as having

1. Uniform surface temperatures
2. Uniform long-wave (LW) and short-wave (SW) irradiation
3. Diffuse radiating surfaces
4. One-dimensional heat conduction within

The resulting formulation is called the **heat balance (HB) model**. Note that the assumptions, although common, set certain limits on the information that can be obtained from the model. When using heat balance to solve for the cooling load in a space with radiant cooling, not all of the assumptions 1-4 above will apply. In particular, not all surfaces will have uniform surface temperatures.

ASHRAE Research Project RP-1729 developed modifications to the current implementation of heat balance to allow for solution when radiant cooling is the primary cooling system. The principles of heat balance still apply. Radiant and convective exchanges of heat are all modeled based on the same fundamental principles. Similar considerations are required

when using heat balance for load calculation with under floor air distribution (UFAD) systems. With UFAD, the floor is maintained at a lower temperature due to the below-floor air supply so the resulting heat exchange interactions mimic radiant systems more than convective systems. The discussion that follows is primarily focused on the use of heat balance with convective air system based cooling systems.

## 6. Radiant Time Series (RTS) Method

### 6.2 Overview

*Added paragraphs.*

It should be noted that the RTS and CTS factors presented in this section were derived using heat balance method solutions with the assumption of an air based system. Specific values have not been developed that would take into account radiant cooling systems. In the case of the CTS factors, conduction through an exterior opaque wall is not expected to be meaningfully different whether a radiant or convective cooling system is used. In reality, the radiant cooling system will alter inside surface temperature of the exterior wall so there will be di-fferences in the resulting heat exchange mechanics. However, based on modeling and testing completed as part of ASHRAE RP-1729, the impact on the timing and magnitude of conduction heat gains is small (5% to 10%) in relation to the overall space load.

RTS factors are used to model the conversion of stored radiant heat gains to cooling loads. As is described in Section 1.1, there is an appreciable difference in the conversion of these heat gains for radiant systems compared to convective or air based systems. For a cooling system using radiant ceiling panels, stored heat gains are generally converted more quickly than air-based systems and result in a higher peak instantaneous cooling load. This is due to the low mass of the ceiling panels. For a cooling system using floor radiant cooling (cooling pipes embedded in the concrete floor), heat gains are generally converted more slowly than air-based systems and result in lower peak instantaneous cooling load. This is due to the high mass of the active cooling surface (the floor). ~~Stored heat gains in general are converted more quickly and result in higher instantaneous cooling loads or heat extraction required when radiant cooling is used.~~ RP-1729 found that the radiant time series method could be used with radiant cooling systems but only if the RTS factors were revised. To date, RTS factors based on radiant cooling systems have not been developed beyond the pilot examples developed for RP-1729.

b. Synchronizing guidance with Chapter 6, HVAC Systems and Equipment Handbook

*2020 Handbook – HVAC Systems and Equipment*, Chapter 6 – Radiant Heating and Cooling, Section 4 Design Procedure – Contains the following statement:

Panel design requires determining panel area, type, and arrangement as well as the supply water temperature and flow rate. Panel performance is directly related to indoor space conditions. Air-side design also must be established. Heating and cooling loads may be calculated by procedures covered in Chapters 17 and 18 of the 2017 *ASHRAE Handbook—Fundamentals*. For cooling load calculations, the procedure based on the heat balance (HB) method is recommended, because other simplified methods developed for all-air systems (such as the radiant time series [RTS] method) are not as appropriate for radiant-system applications (Feng et al. 2013b, 2014). The procedure is as follows:

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# TC Sign-in Sheet

Meeting Info: __Summer 2020 – Virtual Meeting_____ Date:___06-19-2020_____

| Name | Affiliation | E-mail | Member (Voting, Corresponding, or Guest?) | YEA Member? (Yes/No) |
|---|---|---|---|---|
| Suzanne LeViseur | Member | | Chair - Voting | |
| Glenn Friedman | Standards Sub-Committee Chair | | Voting | |
| Rachel Spitler | Program Sub-committee Chair | | Voting | |
| James Pegues | Member | | Voting | |
| Charles Barnaby | Member | | Voting | |
| Steven Bruning | Member | | Voting | |
| Robert Doeffinger | Member | | Voting | |
| Elyse Malherek | Member | | Voting | |
| Jingjuan Feng | Non-Voting | | Vice Chair | |
| Rolando Legarreta | Non-Voting | | Secretary | |

| Name | Affiliation | E-mail | Member (Voting, Corresponding, or Guest?) | YEA Member? (Yes/No) |
|---|---|---|---|---|
| Som Shrestha | Non-Voting | | Research Sub-Committee Chair | |
| Balakrishnan Panicker | Guest | | | |
| Brian Rock | Corresponding Member | | | |
| Christian Bach | Corresponding Member | | | |
| Danielle Monfet | Provisional Corresponding Member | | | |
| Dustin Bremmer | Guest | | | |
| James Lowry | Corresponding Member | | | |
| Jamie Bennett | Non-Voting | | Section Head | |
| Jason DeGraw | Corresponding Member | | | |
| Jeff Spitler | Corresponding Member | | | |

| Name | Affiliation | E-mail | Member (Voting, Corresponding, or Guest?) | YEA Member? (Yes/No) |
|---|---|---|---|---|
| Liam Buckley | Corresponding Member | | | |
| Mathew Dahlhausen | Corresponding Member | | | |
| Mini Malhotra | Corresponding Member | | | |
| Stephen Roth | Corresponding Member | | | |
| Tianli Feng | Guest | | | |
| Vrunda Patel | Corresponding Member | | | |
| Chris Wilkins | Corresponding Member | | | |
| Ardeshir Moftakhari | Guest | RP1729 | | |
| Larry Sun | Corresponding Member | | | |
| Natasha Milesi Ferreti | Non-Voting | | Incoming Research Liaison | |