AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.
1791 Tullie Circle, N.E./Atlanta, GA 30329
404-636-8400

TC/TG/TRG MINUTES COVER SHEET

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

TC/TG/TRG NO.: TC 4.1 DATE: July 2, 2011

TC/TG/TRG TITLE: LOAD CALCULATION DATA AND PROCEDURES

DATE OF MEETING: June 27, 2011 LOCATION: Montreal, QC, Canada

MEMBERS PRESENT	YEAR APPTD	MEMBERS ABSENT	YEAR APPTD	EX-OFFICIO MEMBERS AND ADDITIONAL ATTENDANCE
Voting		Voting		Visitors
Chris Wilkins	2009	[none]		
Rolando Legarreta	2009			Bob Howe
Chip Barnaby	2010	Non Voting		Mo Hosni
Steve Bruning	2008	Lucy Armankwah		Wendell Humphres
Bob Doeffinger	2007	David Ariyo		Rachel Spitler
Glenn Friedman	2009	Lynn Bellenger		John Wright
Curt Pedersen	2007	Andrew Braum		
Jim Pegues	2010	Jui-Chen Roger Chang		
Jeff Spitler	2007	Charlie Curcija		
Larry Sun	2008	Joe Ferdleman		
		John Filler		
Non-Voting		Nick Gmitter		
Dan Fisher		Martin Gough		
Stephen Roth		Doug Hittle		
Som Shrestha		Robert Hopper		
Branislav Todorovic		Stephen Kavanaugh		
Gary Wingfield		Ken-Ichi Kimura		
		Suzanne LeViseur		
		Larry Lisenbee		
		James Norman		
		Brian Rock		
		Thomas Romine, Jr.		
		Arun Veda		

DISTRIBUTION:

All Members of TC/TG/TRG

ADDITIONAL DISTRIBUTION:

TAC Chairman:	Charles H. Culp, III
TAC Section Head:	Michael R. Bilderbeck
Chapter Tech Transfer:	Harris M. Sheinman
Research Liaison:	Dr. Pradeep Kumar Bansai
ALI/PDC:	John H. Nix, II
Special Publications:	William S. Fleming
2013 HB Fundamentals:	Peter Simmonds, PhD
Standard Liaison:	James R. Tauby, P.E.
Manager of Standards:	Stephanie C. Reinche
Staff Liaison:	Michael R. Vaughn

These meeting minutes were approved by a vote of TC 4.1 on January 23, 2012.

June 27, 2011
Committee Meeting Minutes
TC4.1 Load Calculations Data and Procedures
Montreal, QC, Canada

1. Meeting called to order by Chris Wilkins at 2:25pm
2. Roll Call
   a. 10 of 10 voting members present. Quorum is present.
3. Introductions
4. Membership
   a. Voting members rolling off after this meeting - Bob Doeffinger, Curt Pedersen, Jeff Spitler
   b. Voting members rolling on as of July 1 - Dan Fisher, Doug Hittle, Suzanne LeViseur
5. Approval of January 2011 Las Vegas Meeting Minutes.
   a. Motion to approve: Bob Doeffinger.
   b. Seconded: Glenn Friedman
   b. Vote: 10-0-0
6. Research Chair Report (Bob Doeffinger)
   a. WS-1616-RP - Revise Load Calculation Application Manual - has been approved.
   b. There are 8 to 10 research projects in the queue for funding. ASHRAE expects to fund 2 in the fall 2011 bidding cycle. Dr. Reddy (Research Liaison) will lobby to have 1616-RP included in the fall bidding cycle.
   c. PES members for 1616-RP appointed by chair are:
      - Steve Bruning
      - Bob Doeffinger
      - Glenn Friedman
      - Rolando Legarreta
      - Jim Pegues (PES Chair)
      - Chris Wilkins
   b. New Research - Study of attic and plenum loads proposed.
7. Program Chair Report (Glenn Friedman)

   Montreal Summer Meeting - June 2011

   a. Seminar 2 - BIM Load Calculations - Pain or Pleasure - Held Sunday morning. Well attended.
   b. In Chicago (January 2012) revisit the issue of whether to schedule the next installment in the BIM Load Calcs series of seminars in 2012 or 2013.
   c. Mo Hosni has a presentation in the Poster Session, Tuesday 11am-1pm. The presentation covers plug load modeling.

Chicago Winter Meeting - June 2012

d. Seminar on Mobile and Tablet PC Applications for Load Calculations
   - Speakers: Chip Barnaby, Stephen Roth, Nick Long (NREL).
   - Format: Three short presentations by speakers, then roundtable discussion.
   - Session Chair: Glenn Friedman
   - Cosponsorship: Seek cosponsorship from TC 1.5.
   - Larry Sun advises: Submit this as a Seminar, request a 90-minute time slot, document the fact this uses an innovative panel discussion format, choose a title. The Track Chair has been informed about this proposed seminar and is interested.
   - Tentative Title: *Loads on the Move: Mobile Applications*

e. Motion: TC 4.1 to sponsor 90 minute seminar on mobile and tablet PC applications for load calculations with a panel discussion format.
   - Motion by: Jeff Spitler
   - Seconded by: Chris Wilkins
   - Vote: 10-0-0

San Antonio Summer Meeting - June 2012

f. Conference Paper Session on Dual Façade Load Calculations
   - Three to four papers on dual façade cooling and heating load calculations.
   - Dr. Todorovic to recruit speakers.
   - If speakers available exceeds 3 to 4, the extra speakers could be grouped in a Seminar.
   - Conference paper abstracts for San Antonio are due September 26, 2011.

g. Motion: TC 4.1 to sponsor conference paper session on dual façade cooling and heating load calculations as priority 1 for San Antonio.
   - Motion by: Glenn Friedman
   - Seconded by: Steve Bruning
   - Vote: 10-0-0

h. Action item for committee members: review the list of future programs for discussion at Chicago.

8. Handbook Chair Report

a. Residential Load Calculation Chapter (Chip Barnaby)
   - Chip is working on the revision.
   - The changes to the clear sky solar algorithm will affect coefficients used in the calculation procedure.
   - Chip will investigate the inquiry submitted by an ASHRAE member about residential load calculation issues.

b. Non-Residential Load Calculation Chapter (Steve Bruning)
   - Status: Drafts for several of the chapter revisions have been submitted by committee members.

- Action: Rolando Legarreta - For the altitude correction table, keep the altitude correction equation, shorten the table to include a smaller set of altitudes and add one or more examples.
- Action: Jim Pegues - Integrated the data from the Chris Wilkins / Mo Hosni ASHRAE Journal article on plug loads into the internal heat gain tables.
- Action - Jim Pegues - Complete the equation summary table. Synchronize with the nomenclature sections being assembled by Stephen Roth.
- Action: Stephen Roth - Consider using the nomenclature section from the Residential Chapter as a starting point for the nomenclature section in the Non-Residential Chapter.
- Nomenclature section - This issue will be revisited at next meeting. Stephen Roth's initial work pointed out challenges involving use of the same character or variable for multiple different applications. There is concern that revising equations in the chapter to avoid nomenclature duplicates will involve a large amount of work and a risk of introducing errors.
- Action: Jeff Spitler to review Load Calculation Application Manual to see if it is using nomenclature consistent with Non-Residential Chapter.
- Action: All - Submit remaining drafts for chapter revisions by Fall 2011 so a final draft can be assembled ahead of the Chicago meeting.

9. Standards Chair Report (Glenn Friedman)

    a. SPC 203 - MOT / Determining Heat Gain of Office Equipment Used in Buildings
        - Committee is still lacking sufficient "producer" members.
        - Cannot qualify for ANSI consensus status if producers are lacking.
        - TC 9.9 is one possible source of members. Reaching out to that committee.
        - Considering a strategy of releasing an "advisory public review" of the standard to attract attention from producers. Still investigating this approach.
        - Committee is in the process of constructing the first draft of the standard.

10. Liaison Reports
    a. Research (Dr. Agami Reddy)
        - Nothing further to report beyond Bob Doeffinger's subcommittee report.
        - Dr. Reddy will push for inclusion of 1616-RP in the Fall 2011 bidding cycle due to the time sensitive nature of the project. He will also note that it produces a publication that generates revenue for ASHRAE.
        - It is possible ASHRAE may expand the projects being released for bidding in Fall 2011 from 2 to 3.

    b. Section Head (Walter Gronzdik, Michael Bilderbeck)
        - Walter had no issues of concern. He is the outgoing Section Head.
        - Michael is the incoming Section Head. Noted the issue of speaker ratings for ASHRAE programs.

11. Web Site (Chris Wilkins)

    a. Walter Gronzdik noted three needs for the web site:
        - A visible, active e-mail link to the committee chair.

- Posting of the TC meeting agenda one month ahead of each ASHRAE meeting.
- Posting of the TC draft minutes one month ahead of each ASHRAE meeting.

12. Old Business

    [None]

13. New Business

    a. ASHRAE FAQs for TC 4.1
        - Chris received draft FAQs from ASHRAE HQ regarding common questions received about load estimating. HQ was asking for approval or revision of the FAQ responses.
        - Chris asked Larry Sun to review the FAQs and report back to committee:
        - Motion: Approve FAQ responses as originally drafted (with minor edits at the discretion of Larry Sun)
        - Motion by: Larry Sun
        - Second: Curt Pedersen
        - Vote: 10-0-0

14. Adjournment

    a. Motion to adjourn: Jeff Spitler
    b. Second: Larry Sun
    c. Vote: 10-0-0.
    d. Meeting adjourned at 4:15 PM

Attachments:

Meeting Agenda
Handbook Sub-Committee Report
Program Sub-Committee Report
1616-WS
ASHRAE FAQ Draft Responses
Attendance Sign-in Sheet
TC 4.1 Roster as of 7/1/2011.

Agenda for - TC4.1 Load Calculation Data & Procedures

Montreal

June 27, 2011

TC4.1 Load Calculation Data and Procedures
Monday, 2:15 PM to 4:15 PM
St. Lambert (Hilton, Lower Level)

1.	Call to Order	Chris Wilkins
2.	Roll Call	Jim Pegues
3.	Introduction of Visitors	Chris Wilkins
4.	Approval and/or Corrections to Albuquerque Meeting Minutes	Chris Wilkins
5.	Liaison Comments	
	Section Head	Walter Grondzik
	Chapter Technology Transfer	Andrew Cochrane
	Research	Agami Reddy
	Handbook	Peter Simmonds
	ALI/PDC	Filza Walters
	Programs	?
	Standards Liaison	James Tauby
	Staff-Research/Tech Services	Michael R. Vaughn
	Staff-Standards	Stephanie Reiniche
6.	Research Subcommittee Report	Robert Doeffinger
7.	Programs Subcommittee Report	Glenn Friedman
8.	Standards Subcommittee Report	Glenn Friedman
9.	Handbook Subcommittee Report	
	Residential Chap 17	Chip Barnaby
	Non-Residential Chap 18	Steve Bruning
10.	ASHRAE Website for TC 4.1	Jim Pegues
11.	Old Business	Chris Wilkins
12.	New Business	Chris Wilkins
13.	Adjournment	Chris Wilkins

Meetings

TC 4.1 Load Calculation Data and Procedures (20/10)
Monday 2:15-4:15p (Hilton, Lower Level) St. Lambert
Sponsoring: Seminar 2: BIM Load Calculations: Pain or Pleasure? Phase 2 of the Case Study Involving the ASHRAE HQ Building.

TC 4.1 Handbook
Sunday 3:00-4:00p (Hilton, Lower Level) St. Leonard

TC 4.1 Research
Sunday 4:00-5:00p (Hilton, Lower Level) St. Leonard

TC 4.1 Programs & Standards
Sunday 5:00-7:00p (Hilton, Lower Level) St. Leonard

Introduction of officers and voting members for 2011:

Chris Wilkins	Chair	Voting
Rolando Legarreta	ViceChair	Voting
James Pegues	Secretary	Voting
Steven Bruning	Handbook Subc Chair	Voting
Robert Doeffinger,Jr	Research Subc Chair	Voting
Glenn Friedman	Stds/Prog Subc.Chair	Voting
Chip Barnaby		Voting
Curtis Pedersen		Voting
Jeff Spitler		Voting
Larry Sun		Voting

Handbook Subcommittee

E American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

TC4.1 Load Calculation Data & Procedures
Montreal, QC
June 25 – June 29, 2011

Handbook Subcommittee Agenda

Sunday, June 26, 3:00 PM to 4:00 PM
Hilton, St Leonard

1. **Handbook Committee Liaison Comments: Peter Simmonds, Liaison to TC4.1.**

2. **Schedule for 2013 HoF Chapters:**
   2011 January – Assign revisers, discuss revisions
   2011 June – Rough draft overall chapters
   2012 January – Full draft overall chapters reviewed by Handbook subcommittee
   2012 April – Deadline for new research results to be incorporated in chapters
   2012 June – Final chapters approved by full TC
   2012 July 12 – Chapter 17 submitted to Simmonds/ASHRAE
   2012 July 19 – Chapter 18 submitted to Simmonds/ASHRAE
   2013 June – HoF Published

4. **Chapter 17 Residential Loads:**
   Discuss revision list

5. **Chapter 18 Non-Residential Loads:**
   Update on master example using renovated ASHRAE HQ
   Discuss revision list
   Review revisions submitted to date

		TC4.1 Handbook Subcommittee 2009 HOF Chapter 17
		Residential Cooling and Heating Load Calculations
Reviser:		**Possible Improvements List**
		January 31, 2011
Doeffinger, Hittle, Barnaby	R-1	Review empahsis on infiltration and ventilation relative to typical residential construction. Coordinate with Chapter 16 and possible revisions to that chapter. Reviewer comment that I&V emphasis is "overblown".
Barnaby	R-2	Incorporate editiorial comments from Som Shrestha Word file.
Barnaby	R-3	Example - recheck infiltration load - very high relative to the rest of the load components. Re-examine appropriatness of calculation method for typical residential construction.
Barnaby	R-4	Chapter addersses warm-up load but not cool-down. Research availability of data and incorporate.
Barnaby	R-5	Recheck example- load for uninsulated slab edge very high relative to other components.
Barnaby	R-6	Add explanation of rational behind single RLF for all opaque exposures - simplification.

		TC4.1 Handbook Subcommittee 2009 HOF Chapter 18
		Nonresidential Cooling and Heating Load Calculations
Reviser:		**Possible Improvements List**
		January 31, 2011
Bruning, Doeffinger	G-1	Improve quality of existing Figures.
Bruning	G-2	Add more Figures – "picture is worth 1000 words"
Pegues	G-3	Provide an equation summary table in conjunction with flow chart, listing of data required and references for where to find it. Similar to what had in past chapters for older methods and in current Chapter 17. See Pegues comments.
Bruning	G-4	Provide better data on appropriate absorptivity and emissivity values for common construction materials, along with illustration of sensitivity of result to those inputs. Check with TC4.4 on data they plan to publish. Reference accordingly.
Bruning	G-5	Address impact inside convection coefficient assumptions has on load calculations. Use research results from 1416-RP.
Pedersen	G-6	Update/clean-out references where appropriate.
Legaretta .	G-7	Add example of altitude adjustment in air calculations and illustrative table of impact on
Doeffinger	G-8	Improve ventilation and infiltration coordination with Chapter 16. Add realistic example of infiltration calculation, perhaps a tabular summary.
Bruning	G-9	Add clearer reference to Chapter 14 for derivation of Equations 13 and 14.
Roth	G-10	Add complete list of variables with definitions at end of chapter.
Doeffinger	I-1	Solicit internal heat gain information from other TCs. Review past, present and planned research projects for potential data. Decide where it is appropriate to include data versus just reference other chapters. Incorporate results from 1104-RP and 1395-RP as appropriate.
Doeffinger	I-2	Table on Medical Equipment – may be updated by RP-1343 (TC 9.6).
Wilkins	I-3	Table on Laboratory Equipment – TC 9.10 had research project on plan to obtain heat gain data. Need to determine if work statement written and offer to participate in PMS to obtain
Wilkins	I-4	Tables on Load Densities for Office – is updated data available? Research project needed to update measurements?
Pegues	I-5	Revise internal load tables for more consistant presentation of radiant/convetive data. See Pegues comments.
Wingfield	S-1	Underfloor Air – add more available information to address impact of UFAD on load calculations.
Bruning	S-2	Add discussion of zoning and impact on load calculations.
Bruning	E-1	Update master example to use renovated ASHRAE HQ plans.
Bruning	E-2	Include both perimeter and interior spaces as single room examples.
Bruning	E-3	Example Table 36 - include slabe edge loss or explanation why not needed.
Bruning	E-4	Example - add psychrometric diagram of block loads for air handlers. Address building air balance of OA, EA and infiltration.

[redacted]

Table 25 Common Sizing Calculations in Other Chapters

Subject	Volume/Chapter	Equation(s)
Duct heat transfer	ASTM *Standard* C680	
Piping heat transfer	Fundamentals Ch. 3	(35)
Fan heat transfer	Fundamentals Ch. 19	(22)
Pump heat transfer	Systems Ch. 43	(3), (4), (5)
Moist-air sensible heating and cooling	Fundamentals Ch. 1	(43)
Moist-air cooling and dehumidification	Fundamentals Ch. 1	(45)
Air mixing	Fundamentals Ch. 1	(46)
Space heat absorption and moist-air moisture gains	Fundamentals Ch. 1	(48)
Adiabatic mixing of water injected into moist air	Fundamentals Ch. 1	(47)

$$q = p \times HF \quad (41)$$

$$HF = F_p \Delta t \quad (42)$$

where

q = heat loss through perimeter, Btu/h [redacted]
F_p = heat loss coefficient per foot [redacted] of perimeter, Btu/h·ft·°F [redacted], Table 24
p = perimeter (exposed edge) of floor, ft [redacted]

Surfaces Adjacent to Buffer Space. Heat loss to adjacent unconditioned or semiconditioned spaces can be calculated using a heating factor based on the partition temperature difference:

$$HF = U(t_{in} - t_b) \quad (43)$$

Infiltration

~~All structures have some air leakage or infiltration. This means a heat loss because the cold, dry outdoor air must be heated to the inside design temperature and moisture must be added to increase the humidity to the design value. Procedures for estimating the infiltration rate are discussed in Chapter 16.~~

~~Once the infiltration rate has been calculated, the resulting sensible heat loss, equivalent to the sensible heating load from infiltration, is given by~~

Infiltration of outside air through openings into a structure is caused by thermal forces, wind pressure, and negative pressure with respect to outside created by mechanical systems either planned or unplanned.

Typically in building design, the mechanical systems are designed to maintain a positive building pressure and infiltration need not be considered other than ancillary spaces such as entryways and loading areas.

Infiltration is treated as a room load and has both sensible and latent components.

During winter conditions this means heat and humidity loss because cold dry air must be heated to design temperature and moisture must be added to increase the humidity to design condition. Typically during winter conditions, where controlling indoor humidity is not a factor, infiltration is reduced to a simple sensible component. During cooling conditions both sensible and latent components are added to the space load to be treated by the air conditioning system.

Procedures for estimating the infiltration rate are discussed in Chapter 16. The infiltration rate is reduced to a volumetric flow rate (cfm) at a known dry bulb, wet bulb condition. Along with indoor air condition, the following equations define the infiltration sensible and latent loads.

$$(44) \qquad q_s = 60(\text{cfm}/v)\,c_p(t_{in} - t_o)$$

[redacted]

where

cfm [redacted] = volume flow rate of infiltrating air

c_p = specific heat capacity of air, Btu/lb$_m$·°F [redacted]

v = specific volume of infiltrating air, ft^3/lb$_m$ [redacted]

Assuming standard air conditions (59°F [redacted] and sea-level conditions) for v and c_p, Equation (44) may be written as

$$(45) \qquad q_s = 1.10(\text{cfm})(t_{in} - t_o)$$

[redacted]

The infiltrating air also introduces a latent heating load given by

$$(46) \qquad q_l = 60(\text{cfm}/v)(W_{in} - W_o)D_h$$

[redacted]

where

W_{in} = humidity ratio for inside space air, lb$_w$/lb$_a$ [redacted]

W_o = humidity ratio for outdoor air, lb$_w$/lb$_a$ [redacted]

D_h = change in enthalpy to convert 1 lb [redacted] water from vapor to liquid, Btu/lb$_w$ [redacted]

For standard air and nominal indoor comfort conditions, the latent load may be expressed as

$$(47) \qquad q_l = 4840(\text{cfm})(W_{in} - W_o)$$

[redacted]

The coefficients 1.10 in Equation (45) and 4840 in Equation (47) are given for standard conditions. They depend on temperature and altitude (and, consequently, pressure).

Examples to follow:

Warehouse (Winter)
Office (Summer/Winter)

HEATING SAFETY FACTORS AND LOAD ALLOWANCES

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. 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. Such measures are less conservatively applied today with newer construction. A combined warm-up/safety allowance of 20 to 25% is fairly 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 cooldown load.

OTHER HEATING CONSIDERATIONS

Calculation of design heating load estimates has essentially become a subset of the more involved and complex estimation of cooling loads for such spaces. Chapter 19 discusses using

Altitude Correction

The change in specific volume due to an altitude correction will affect the results of heating and cooling loads when calculating airflow requirements. Most of the performance data published by manufacturers and the Standard Psychrometric Charts generally assume equipment operation at sea level. When the project is located at a significant higher altitude, allowances must be made.

The following Load Calculation Formulas need to be corrected for altitude:

1. Q *(sensible heat)(Btu/hr)* $= 1.08 \times cfm \times \Delta t$.
2. Q *(latent heat)(Btu/hr)* $= 0.68 \times cfm \times \Delta W$
3. Q *(total heat)(Btu/hr)* $= 4.5 \times cfm \times \Delta h$

Sea Level constants 1.08 (sensible heat), 0.68 (latent heat), and 4.5 (total heat) these constants have to be corrected for altitude.

The following Table values should be used in lieu of constants.

AIR EQUATION CONSTANTS FOR ALTITUDE

ALTITUDE (FEET)	SENSIBLE HEAT (BTUH/HR.CFM.°F)	LATENT HEAT ($Gr.H_2O$)	TOTAL HEAT Lb DA/Hr.CFM
20,000	0.49	0.306	2.025
15,000	0.56	0.382	2.520
10,000	0.69	0.470	3.105
9,000	0.77	0.483	3.195
8,000	0.74	0.504	3.330
7,000	0.77	0.525	3.465
6,000	0.80	0.545	3.60
5,000	0.83	0.566	3.735
4,000	0.86	0.586	3.870
3,500	0.88	0.600	3.960
3,000	0.90	0.613	4.050
2,500	0.91	0.620	4.095
2,000	0.93	0.634	4.185
1,500	0.95	0.647	4.275
1,000	0.96	0.654	4.320
500	0.98	0.668	4.410
0	1.08	0.681	4.500

Reference: Carrier Corporation's *Engineering Guide for Altitude Effects*, 1967

2013 HOF Chapter 18 - Non Residential Cooling and Heating Load Calculation

Proposed changes to Tables 8 and 9 (highlighted with yellow background)

Submitted by Jim Pegues, 6/18/2011

Table 8 Recommended Heat Gain from Typical Computer Equipment

Equipment	Description	Nameplate Power Consumption, W	Average Power Consumption, W	Fraction of Heat Gain that is Radiant
Desktop computer[a]	Manufacturer A (model A); 2.8 GHz processor, 1 GB RAM	480	73	0.10[a]
	Manufacturer A (model B); 2.6 GHz processor, 2 GB RAM	480	49	0.10[a]
	Manufacturer B (model A); 3.0 GHz processor, 2 GB RAM	690	77	0.10[a]
	Manufacturer B (model B); 3.0 GHz processor, 2 GB RAM	690	48	0.10[a]
	Manufacturer A (model C); 2.3 GHz processor, 3 GB RAM	1200	97	0.10[a]
Laptop computer[b]	Manufacturer 1; 2.0 GHz processor, 2 GB RAM, 17 in. 430 mm screen	130	36	0.25[b]
	Manufacturer 1; 1.8 GHz processor, 1 GB RAM, 17 in. 430 mm screen	90	23	0.25[b]
	Manufacturer 1; 2.0 GHz processor, 2 GB RAM, 14 in. 355 mm screen	90	31	0.25[b]
	Manufacturer 2; 2.13 GHz processor, 1 GB RAM, 14 in. 355 mm screen, tablet PC	90	29	0.25[b]
	Manufacturer 2; 366 MHz processor, 130 MB RAM, 14 in. 355 mm screen)	70	22	0.25[b]
	Manufacturer 3; 900 MHz processor, 256 MB RAM (10.5 in. 265 mm screen)	50	12	0.25[b]
Flat-panel monitor[c]	Manufacturer X (model A); 30 in. 760 mm screen	383	90	0.40[c]
	Manufacturer X (model B); 22 in. 560 mm screen	360	36	0.40[c]
	Manufacturer Y (model A), 19 in. 480 mm screen	288	28	0.40[c]
	Manufacturer Y (model B), 17 in. 430 mm screen	240	27	0.40[c]
	Manufacturer Z (model A), 17 in. 430 mm screen	240	29	0.40[c]
	Manufacturer Z (model C), 15 in. 380 mm screen	240	19	0.40[c]

Source: Hosni and Beck (2008).

[a]Power consumption for newer desktop computers in operational mode varies from 50 to 100 W, but a conservative value of about 65 W may be used. Power consumption in sleep mode is negligible. Because of cooling fan, approximately 90% of load is by convection and 10% is by radiation. Actual power consumption is about 10 to 15% of nameplate value.

[b]Power consumption of laptop computers is relatively small: depending on processor speed and screen size, it varies from about 15 to 40 W. Thus, differentiating between radiative and convective parts of the cooling load is unnecessary and the entire load may be classified as convective. Otherwise, a 75/25% split between convective and radiative components may be used. Actual power consumption for laptops is about 25% of nameplate values.

[c]Flat-panel monitors have replaced cathode ray tube (CRT) monitors in many workplaces, providing better resolution and being much lighter. Power consumption depends on size and resolution, and ranges from about 20 W (for 15 in. 380 mm size) to 90 W (for 30 in. 760 mm). The most common sizes in workplaces are 19 and 22 in. 480 and 560 mm, for which an average 30 W power consumption value may be used. Use 60/40% split between convective and radiative components. In idle mode, monitors have negligible power consumption. Nameplate values should not be used.

5

Table 9 Recommended Heat Gain from Typical Laser Printers and Copiers

Equipment	Description	Nameplate Power Consumption, W	Average Power Consumption, W	Fraction of Heat Gain that is Radiant
Laser printer, typical desktop, small-office type[a]	Printing speed up to 10 pages per minute	430	137	0.30[a]
	Printing speed up to 35 pages per minute	890	74	0.30[a]
	Printing speed up to 19 pages per minute	508	88	0.30[a]
	Printing speed up to 17 pages per minute	508	98	0.30[a]
	Printing speed up to 19 pages per minute	635	110	0.30[a]
	Printing speed up to 24 page per minute	1344	130	0.30[a]
Multifunction (copy, print, scan)[b]	Small, desktop type	600	30	d
		40	15	d
	Medium, desktop type	700	135	d
Scanner[b]	Small, desktop type	19	16	d
Copy machine[c]	Large, multiuser, office type	1750	800 (idle 260 W)	d (idle 1.00[c])
		1440	550 (idle 135 W)	d (idle 1.00[c])
		1850	1060 (idle 305 W)	d (idle 1.00[c])
Fax machine	Medium	936	90	d
	Small	40	20	d
Plotter	Manufacturer A	400	250	d
	Manufacturer B	456	140	d

Source: Hosni and Beck (2008).
[a]Various laser printers commercially available and commonly used in personal offices were tested for power consumption in print mode, which varied from 75 to 140 W, depending on model, print capacity, and speed. Average power consumption of 110 W may be used. Split between convection and radiation is approximately 70/30%.
[b]Small multifunction (copy, scan, print) systems use about 15 to 30 W; medium- sized ones use about 135 W. Power consumption in idle mode is negligible. Nameplate values do not represent actual power consumption and should not be used. Small, single-sheet scanners consume less than 20 W and do not contribute significantly to building cooling load.
[c]Power consumption for large copy machines in large offices and copy centers ranges from about 550 to 1100 W in copy mode. Consumption in idle mode varies from about 130 to 300 W. Count idle-mode power consumption as mostly convective in cooling load calculations.
[d]Split between convective and radiation heat gain was not determined for these types of equipment.

6

Current Data for Plug Load Design Factors

By

Christopher K. Wilkins
Mohammad H. Hosni

For submission to ASHRAE Journal

7

Plug loads are an important contributor to a building's peak air conditioning load and energy consumption. Plug loads over time have evolved to become a larger percentage of a building's overall heat gain. Two factors are responsible for this increased significance. First, over time, computer use has continued to increase resulting in a much larger number of personal computers in use in buildings, and second, advances in building techniques have improved envelopes and reduced that portion of the load/energy use. As building envelope and system technology have improved, computer technology has advanced also. Lower energy notebook computer and LCD monitor use are more widespread while at the same time, computing power, use of peripherals, and use of enhanced or multiple monitors have increased.

The industry is moving towards a much greater focus on low energy and even net zero energy buildings. Part of this industry movement results in a need to design based on the lowest possible plug load assumptions. Every project or application is different and engineers are often asked to apply their judgment for plug load assumptions without the benefit of all the needed or available information. This article is intended to provide data and recommendations that will allow engineers to make these important decisions on just how low they can go in terms of plug load assumptions for a specific project or application.

Historical Perspective

Computer use in buildings started to become prevalent and began to be a consideration in building air conditioning loads in the 1980's. At that time, loads were generally calculated based on the nameplate data on the computers and other electronic equipment. In the late 1980's, computer use was beginning to become more wide-spread as it was common to see a computer on nearly every desk in office buildings. In this era, the authors observed that it was not uncommon for air conditioning systems to be sized for plug loads of 3-5 w/ft^2 [32-54 w/m^2].

In 1991, an article was published in the ASRHAE Journal [1] that reported some research done in Finland where the actual load from computers and other equipment was measured and compared to the nameplate data. This relatively modest effort revealed that the measured load of this equipment was typically only 20%-30% of the nameplate data. This revelation provided the first hard evidence of this issue and changed the way that plug loads were considered in load and energy calculations.

This work in Finland was followed up by work of Wilkins and McGaffin in 1994 [2] that reported measurements in five US General Services Administration (GSA) office buildings in the Washington, DC area. Their work included informal measurement of a large sample of individual equipment items as well as measurements at panels that served computer equipment within a given area of the building. The results allowed further verification of the nameplate discrepancy of individual equipment but also allowed for the first time the ability to measure the actual plug load of an area and the determination of the load diversity factor based on measured data.

ASHRAE followed up this informal research with the execution of two research projects;

RP-822 (1996) "Test Method for Measuring the Heat Gain and Radiant/Convective Split from Equipment in Buildings" [3] and RP-1055 (1999) "Measurement of Heat Gain and Radiant/Convective Split from Equipment in Buildings" [4]. The experimental results from these two ASHRAE sponsored research projects corroborated the earlier findings but did so in a more formal and traceable manner. All of this work led to a widely referenced ASHRAE Journal article in 2000 [5]. This data was incorporated into the Handbook of Fundamentals starting in 1997 and then significantly expanded in the 2001 Edition.

Current ASHRAE Handbook Data

Data presented in the 2009 ASHRAE Handbook of Fundamentals, Chapter 18, Nonresidential Cooling and Heating Load Calculations relative to office equipment loads (or Plug Loads) is based largely on the research and publications cited above. Data is presented in a number of formats and breakdowns but can be best summarized by considering Table 11 in Chapter 18 which offers that a "medium density" office building will have a plug load of 1.0 w/ft^2 [10.8 w/m^2]. It is believed that this value of 1.0 w/ft^2 [10.8 w/m^2] has been widely used in the industry since the mid 1990's. The co-authors believe that this value is and always has been somewhat conservative when used in office environments but its use has proven to provide an appropriate balance to cover potential future loads while not introducing significant over-design in building systems.

Trends to Date

This approach and recommended load factor have remained roughly the same since the mid 1990's. Computer technology has certainly changed since that time but until fairly recently, there was not any apparent need to change the use of 1.0 w/ft^2. In fact a comprehensive study was conducted by Koomey et al [6] and reported in December of 1995 where it was predicted that plug loads in office buildings would decrease modestly through at least 2010 (see Figure 1). This decrease was expected to be due to technical advances that would result from Energy Star and other related programs. Their predictions were based on energy usage, not peak load values but it is believed that these trends would be similar and in fact, history has now proven this to be the case. Office equipment has become more efficient and overall plug load intensity has decreased.

Current State of Plug Loads

Predicting the future of the Information Technology (IT) world is not attempted here but recent studies, as described below, have provided new data that gives a clearer picture of the current state of plug loads. It is important to understand the current state of the equipment that contributes to plug loads and how this equipment now in use differs from the equipment that was in use at the time 1.0 w/ft^2 [10.8 w/m^2] was found to be an appropriate load factor. Hosni and Beck have recently completed the latest ASHRAE sponsored research project RP-1482, entitled "Update to Measurements of Office Equipment Heat Gain Data," [7] where measurements were obtained from an up-to-date sample of office equipment including notebook computers (laptops) and flat screen (LCD) monitors.

Table 1 shows how this most recent data compare to previously referenced work as well as some other data from Kawamoto [8] and Moorefield [9] for some of the most common office equipment. Desktop computers show a trend toward increasing peak energy but the sleep mode has become much more effective over time. This increase in the desktop computer peak wattage has been offset by the lower power consumption of LCD monitors. Use of a notebook computer in place of a desktop computer and an LCD monitor workstation would result in a fairly significant reduction in peak wattage. It is clear that notebook computer's popularity, flexibility, cost, and computational power have expanded their use and is expected to result in a meaningful reduction in plug load power levels.

In the work by Moorefield, four modes of operation for computers and monitors were considered that included active, idle, sleep, and standby. These categories were determined by statistical grouping of the measured data and not based on internal operation of the equipment. Power consumption during what was referred to as sleep and standby were in general both very low and correspond to the findings for what was called either idle or sleep mode by Hosni in RP-1482. For the purposes of load calculation discussions, it seems that consideration of only two modes, active and sleep is appropriate. Moorefield also reported periods of Notebook computer operation with power levels as high as 75 W but no explanation for what contributed to this was provided.

Notebook computers may introduce a secondary peak condition that could occur when the internal battery is charging while at the same time the notebook is in full use. This condition may increase the power consumption by as much as 10 W during the charging period according to informal measurements by Hosni. The data shown in Table 1 represent the peak for fully charged battery condition.

Recognizing that computers and monitors represent the largest share of the plug loads in most conventional office buildings, the power reduction during idle operation will certainly have a significant impact on energy consumption and may be having an impact on the peak cooling load as well. The question to be answered in terms of peak air conditioning load is how much of the equipment is in sleep mode at the time of peak air conditioning load. To answer this, diversity factor must be considered.

Diversity Factors

Diversity factors were not presented in the work by Moorefield but the data that were collected did allow for an approximation of diversity factor to be calculated. Energy use data were collected from groups of individual items of equipment and then these groups of data were averaged. Diversity is then the average measured energy divided by the peak measured energy. In this case, the peak measured represents the average of the peaks for all equipment of the given type that was in the study.

Figures 2 and 3 represent detailed curves for desktop computers and monitors. A single week of data was chosen and presented that represents the higher end of usage. Table 2 represents a summary of this data. The diversity factor for notebook computers in Table 2 was not derived directly from measured data in the same way as was possible with desktop computers and monitors. For the purposes of the table and the development of load factors discussed below, the diversity factor for notebooks was assumed to be the same as for desktop computers.

Impact on Load Factors

The most useful form of this data for use by engineers performing load calculations is when it is presented as a load factor such as watts per square foot (w/ft^2). This new equipment and diversity factor data were coupled with some general assumptions and used to generate the updated load factor data presented in Table 3. It can be seen that if 100% Notebook use is assumed and typical diversity factors are applied, plug loads could realistically be as low as 0.25 w/ft^2 [2.7 w/m^2]. Even light and medium use of desktop computers results in plug loads below the traditional 1.0 w/ft^2 [10.8 w/m^2]. More extreme scenarios can be considered such as the case where all workstations employ 2 full-sized monitors that can result in plug load of 1.0 w/ft^2 or more. The most extreme scenario considered assumes very dense equipment use with no diversity at all and results in a plug load factor of 2.0 w/ft^2 [21.5 w/m^2].

The load factors presented are based on hypothetical conditions with the best available data applied to them. Each of these includes a factor to account for some level of peripheral equipment such as speakers. This analysis suggests that there will be many cases where the design plug load can be assumed to be below the traditional value of 1.0 w/ft^2 [10.8 w/m^2] without risk of under-designing the system. There are many factors that could impact the actual plug load for a specific space or building and careful consideration must be given to the assumptions used for any given condition.

Conclusions

Nearly all building projects today have a goal of using the minimum energy possible and having a small overall carbon footprint. Computer equipment used in offices has been a part of the overall trend towards energy use reduction. It is now possible to realistically conceive of an office space that could have a peak plug load as low as 0.25 w/ft^2 [2.7 w/m^2]. When this lower plug load level is coupled with the lower lighting power density targets, the result is that the building internal loads are being reduced to very low levels.

Employing a very low plug load assumption in an attempt to design ultra-low energy buildings would of course come with some risk. The occupant at the time of design may have fully embraced a low-energy office mentality but there exists a possibility that in the future, there may be new occupants with less dedication or focus on energy efficiency. Office technology will likely continue to evolve and there may be different equipment in use with different energy consumption in the future. This uncertainty notwithstanding, the new data does suggest that the time has come to reexamine the use of 1.0 w/ft^2 [10.8 w/m^2] as the default industry norm.

References

1. Wilkins, C. K., R. Kosonen and T. Laine. 1991. An analysis of office equipment load factors. ASHRAE Journal, 33(9):38-44.

2. Wilkins, C. K. and N. McGaffin. 1994. Measuring computer equipment loads in office buildings. ASHRAE Journal, 36(8):21-24.

3. Hosni, M.H., B.W. Jones, J. M. Sipes, and H. Xu. 1996. Test method for measuring the heat gain and radiant/convective split from equipment in buildings. ASHRAE Final Report for Research Project 822-RP.

4. Hosni, M.H., B.W. Jones, and Y Xu. 1999. Measurement of heat gain and radiant/convective split from equipment in buildings. ASHRAE Final Report for Research Project 1055-RP.

5. Wilkins, C. K. and M. H. Hosni. 2000. Heat gain from office equipment. ASHRAE Journal, 42(6):31-39.

6. Koomey, J., Cramer, M., Piette, M. and Eto, J. 1995. Efficiency improvements in US Office Equipment: expected policy impacts and uncertainties, LBNL, Berkeley, CA.

7. Hosni, M.H. and B.T. Beck. 2010. Update to Measurements of Office Equipment Heat Gain Data. ASHRAE Final Report for Research Project 1482-RP.

8. Kawamota, K, et al. 2001. Electricity used by office equipment and network equipment in US: Detailed report and appendices. LBNL, Berkeley, CA.

9. Moorefield, L., Frazer, B., and Bendt, P. 2008. Office Plug Load Field Monitoring Report. Ecos, Durango, CO.

Table 1 Office Equipment Loads Over Time

	Desktop Computer (watts)		LCD Monitor (watts)		CRT Monitor (watts)		Notebook Computer (watts)	
	Active	Sleep	Active	Sleep	Active	Sleep	Active	Sleep
Wilkins-McGaffin (1994)	56	56	-	-	60	60	-	-
Wilkins-Hosni (2000)	55	20	-	-	55	0	-	-
Kawamoto (2001)	55	25	-	-	85	5	15	3
Moorefield (2008)	79	2	34	1	71	3	31*	2
Hosni (2010)	69	1	30	1	-	-	28	1

* Referred to as Idle mode in Moorefield's study. Active mode was indicated as 75 watts which may have included battery charging.

Table 2 Recommended Diversity Factors for Office Equipment

Device	Recommended Diversity Factor
Desktop Computer	75%
LCD Monitor	60%
Notebook Computer	75%

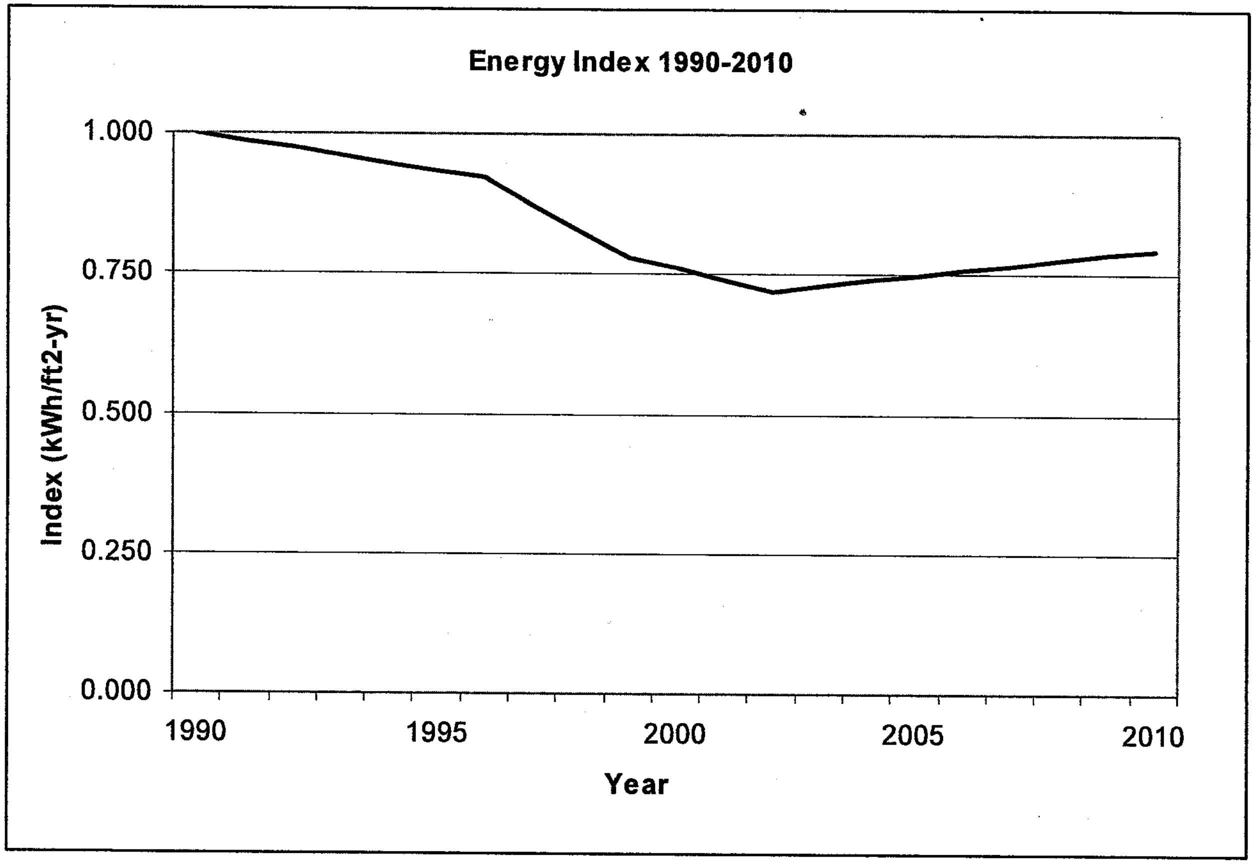

Figure 1 Plug Load Index 1990-2010 [6]

15

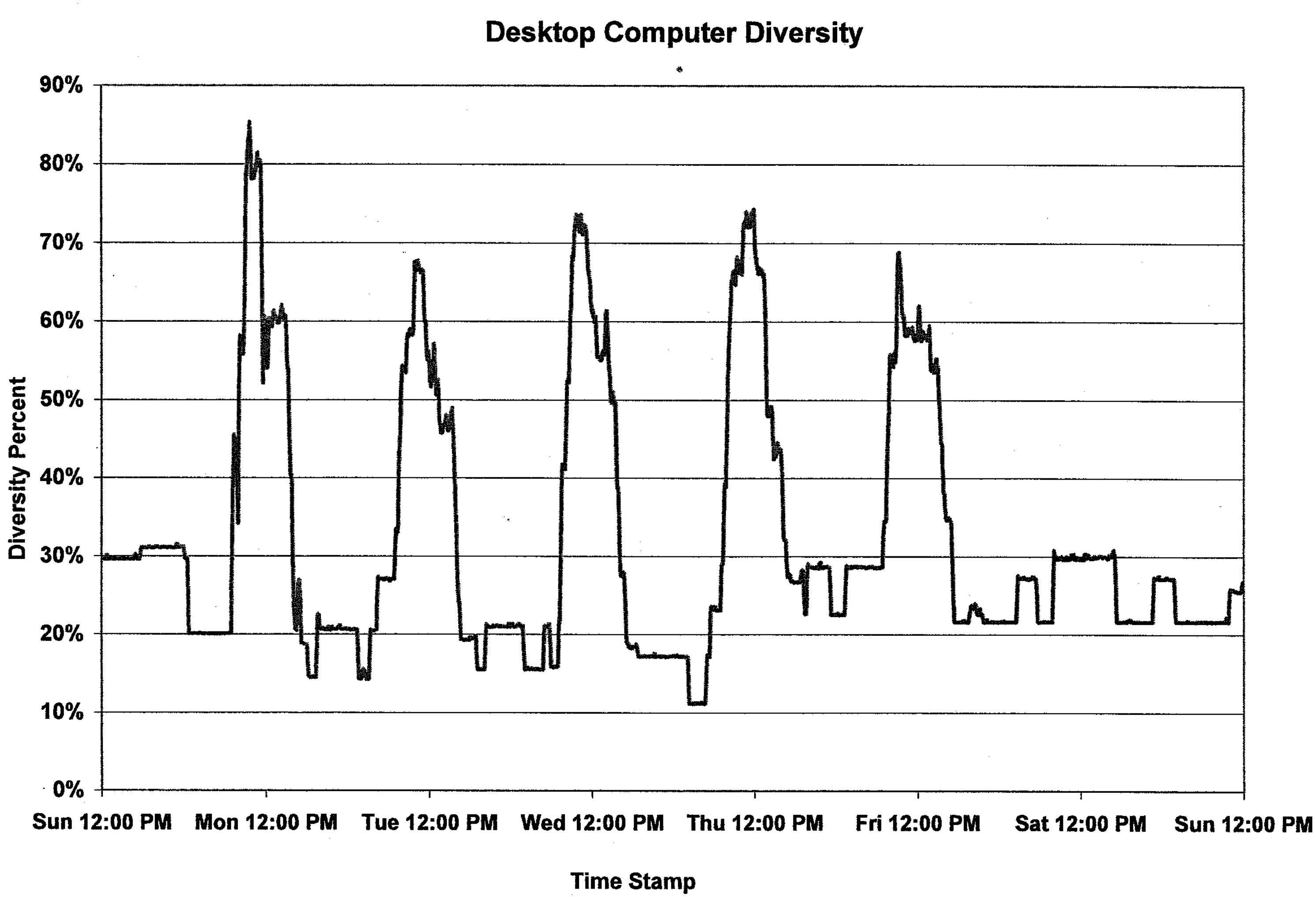

Figure 2 Desktop Computer Diversity

16

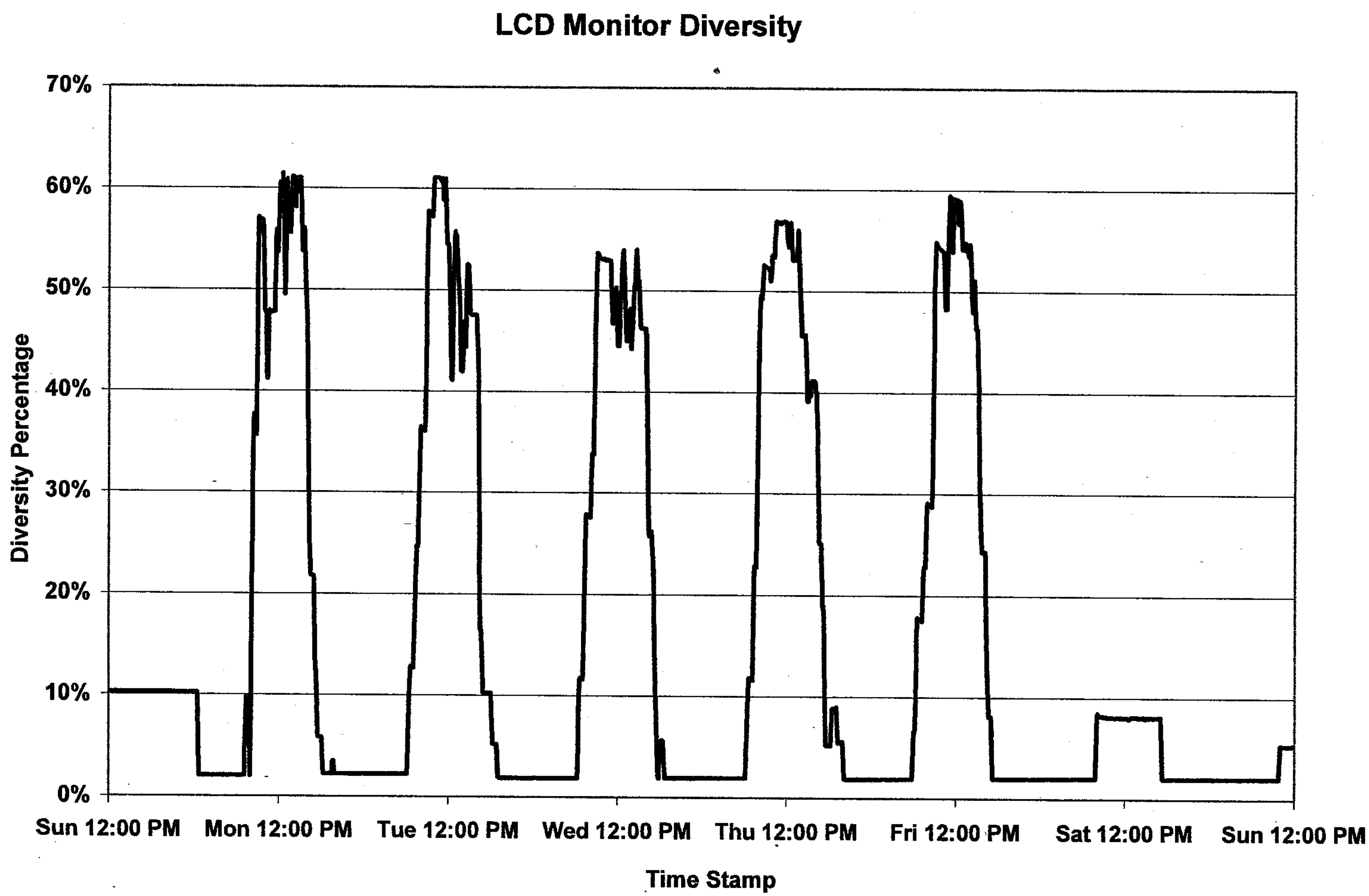

Figure 3 LCD Monitor Diversity

17

Table 3 Plug Load Factors

Type of Usage	Load Factor (watts/ft2)	Description
100% Notebook-Light	0.25	167 ft2/workstation, all notebook use, 1 printer per 10, speakers and Misc.
100% Notebook-Medium	0.33	125 ft2/workstation, all notebook use, 1 printer per 10, speakers and Misc.
50% Notebook-Light	0.40	167 ft2/workstation, 50% notebook/50% desktop, 1 printer per 10, speakers and Misc.
50% Notebook-Medium	0.50	125 ft2/workstation, 50% notebook/50% desktop, 1 printer per 10, speakers and Misc.
100% Desktop-Light	0.60	167 ft2/workstation, all desktop use, 1 printer per 10, speakers and Misc.
100% Desktop-Medium	0.80	125 ft2/workstation, all desktop use, 1 printer per 10, speakers and Misc.
100% Desktop-2 Monitors	1.00	125 ft2/workstation, all desktop use, 2 monitors, 1 printer per 10, speakers and Misc.
100% Desktop-Heavy	1.50	85 ft2/workstation, all desktop use, 2 monitors, 1 printer per 8, speakers and Misc.
100% Desktop-Full On	2.00	85 ft2/workstation, all desktop use, 2 monitors, 1 printer per 8, speakers and Misc., no diversity

Programs Subcommittee

TC 4.1 Meeting, Programs
Montreal, Canada, June 27, 2011

Glenn Friedman, Program Chair

1. Current Programs
    a. Montreal
    Seminar 2: BIM Load Calculations: Pain or Pleasure? Phase 2 of the Case Study Involving the ASHRAE HQ Building
        1. SEMINAR

            Speaker #1: Steve Bruning
            Speaker #2: Chris Wilkins
            Speaker #3: Stephen Roth
        2. Mo Hosni has a poster session
2. Future Programs
    a. Chicago 2012 Winter Conference, January 21 to 25, 2012, at the Palmer House Hotel.
    b. Deadlines
        - Aug. 12 — Seminar, Forum, TPS and CPS Program Proposals Due
        - Sep. 16 — Notifications of Seminar and Forum Accept/Reject Distributed
        - Dec. 9 — Upload of PPTs Begin
        - Jan. 6, 2012 — All PPTs Due Online
    c. Chicago Tracks

Track 1 Energy Efficiency - New Technologies and Applications

Track Chair: Kelley Cramm, Email: kelley.cramm@hei-eng.com

Energy technology is changing rapidly. Keeping up with the latest technology and applications is a daunting task. This track will highlight programs that present the latest approaches to energy efficiency. Programs will provide information on systems and equipment. In addition, applications, particularly case studies will give examples of successful projects.

Track 2 Integrated Design

Track Chair: Dennis Knight, Email: dknight@wholebuildingsystems.com

As our industry seeks to reduce our use of fossil based fuel sources, increase energy efficiency, reduce energy consumption and reduce the use of natural resources, more efficient, integrated and intra-disciplinary approaches to designing, constructing, operating and maintaining our facilities will be needed. This track seeks papers on how the integrated building design and integrated project delivery processes are currently being applied to build better buildings and how those processes and workflows need to evolve if we are to meet our commitments of net zero energy buildings over the next two decades. Papers discussing actual case studies of real life projects, lessons learned and ongoing research projects studying new project delivery methods are highly encouraged to submit for presentation.

Track 3 Specialized Applications - Healthcare, Laboratories and Data Center

Track Chair: Ginger Scoggins, Email: gscoggins@engineereddesigns.com

High-intensity HVAC applications, such as laboratories, hospitals, and data centers, are growing in complexity by leaps and bounds. Energy use is a major concern in these environments. In addition, regulations are becoming more stringent for air quality, temperature constraints, and filtration requirements, and legal ramifications are becoming more commonplace when designers fall short of meeting these requirements. This track focuses on design recommendations, regulations, and lessons learned for these specialized environments that can challenge the knowledge of most engineers. From case studies to code requirements, the goal of this track is to inform session attendees of state-of-the-art design practices that can meet current and upcoming regulations while conserving energy in the process.

Track 4: Energy Modeling Applications

Track Chair: Bill Dean, Email: bill.dean@nrc.ca

Building Developers and Urban Planners are using Energy Modeling and Building Information Modeling programs to make decisions about our future communities. This track seeks papers and programs that address the range of different modeling tools available, their use and specific applications including systems, buildings and communities. Sessions that address an integrated approach from modeling through the end designs including planners, owners, architects, engineers and operations personnel are encouraged.

Track 5 Installation, Operation & Maintenance of HVAC Systems

Track Chair: Sarah Maston, Email: sarah@advancedbuildingperformance.com

With low energy and zero energy buildings becoming more prevalent, there are many issues that arise with installation, startup, commissioning and O&M. Making sure that the design intent of these more complicated HVAC systems is understood by all team members and building operators is key to the building's success. This track will address an array of topics including lessons learned, improvement of process and team communications and effort to improve the installation, startup, O&M of HVAC systems.

Track 6: High Performance Buildings

Track Chair: Mike McDermott mxm@grummanbutkus.com

High performance building refers to a building that is designed, constructed, and capable of being operated in a manner that increases environmental performance and economic value over time. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that high performance buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

Efficiently using energy, water, and other resources

Protecting occupant health and improving employee productivity

Reducing waste, pollution and environmental degradation

This track seeks papers that cover the most important element(s) of the building that lead to its designation as a high performance building. In addition, all papers should review other aspects of the building that contribute to energy performance. This may include both the equipment and operational strategies, and how these elements are integrated into the whole building, both functionally and aesthetically. Consider addressing lessons learned of successes and failures. To the extent possible, include actual data for existing buildings. An important issue in building energy performance is the gap between expectation (simulation) and actual performance. Delineate where energy is being saved. Provide Construction and operating costs (total and cost/ft2)

Track 7: HVAC & R Systems and Equipment

Track Chair: Pamela Androff, Email: pamela.androff@gmail.com

Equipment and systems are the building blocks of HVAC&R design. However, choosing the best combination for a building can be a daunting task. Both common and uncommon strategies exist and successful buildings come with all types: traditional, non-traditional, and hybrids. This track seeks papers and programs that will assist designers and engineers in deciding which system or equipment (or combination thereof) to use in a given application and how operators shall maintain it.

Track 8: Professional Skills

Track Chair: Rob Risley, Email: rrisley@fpl.com

People judge other people in one of four ways: how you look; how you act; what you say; and what you do. The Professional Skills track of ASHRAE is focused on all of these items with emphasis on the final two items – what you say and what you do. The Professional Skills track is designed to help professional engineers and others to develop in the areas of presentation skills, business acumen, understanding the areas of accounting, finance and customer service, human resources, contract and collections, and legal issues. In short, the Professional Skills Track can cover all aspects of business management and business ownership that do not involve the actual engineering of projects and systems.

Track 9 HVAC & R Fundamentals and Applications

Track Chair: Julia Keen, Email: jkeen@ksu.edu

From the basics of engineering to the most specific of applications, this track seeks papers and programs that will cover a vast array of topics. It will assist the newest of designers to grasp the basic understandings of the industry as well as aid the most experienced of engineers in their future designs.

Track 10 Refrigeration

d. Chicago
   1. Proposals
   2. SEMINAR: Mobile app and tablets for load calcs. Is this an appropriate topic? What are the simplifications. Cloud computing. Photographic recognition. Joint venture with TC1.5.
      a. Steven Roth
      b. Chip Barnaby
      c. NREL, Nick Long? (Chip will talk with him)
      d. Someone to be the voice of reason, a TC4.1 person about what are the shortcuts and why is that a concern?
      e. Possibly add a moderated panel discussion as the last portion of this seminar.
      f. Glenn to Chair.
      g. Voted unanimously.
   3. Dual Façade as a conference paper in a year or more in advance.
   4. Future Programs Thoughts
      a. Load Calculations Process Flow from Zoning through selection
         i. Zoning
         ii. Space loads
         iii. Air side
         iv. Refrigeration side
         v. The Art of Zoning
            - Zoning criteria
         vi. Modeling results for poor zoning
      b. What is the difference between energy modeling and load calculations

i. Design day
ii. TMY file versus handbook approach
iii. Peak load (combined with TC4.7 to explore the difference, this could be a good one hard session)

c. Brainstorming list of other seminar topics:
i. Ventilation and infiltration
ii. How Load Calculations Interact with Other ASHRAE Chapters
- Weather
- Infiltration
- Building skin color
- Ventilation
- Fenestration, dynamic windows

iii. Space loads versus systems loads
- Space loads definition
- System effects on loads
- Outside of the space load effects on systems

iv. TC1.7 Legal/Business Practices Risks of Loads Calc Codes Being so Hidden
v. Forum on what is the Standard of Care for load calculations. Standard of Care. Mitchell Swan.
vi. Rule of Thumb Load Calculations: short cut load calculations for field load calcs in mobile devices.
vii. Design day schedules, diversity factors
viii. Dual facades

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2012 ASHRAE Annual Conference

June 23 – 28
San Antonio, TX
www.ashrae.org/sanantonio

2011
June 20, 2011 — San Antonio Conference Site live
Feb. 13 — Seminar, Forum, TPS and CPS Program Proposals Due
May 4 — Upload of PPTs Begin

TC4.1 Programs Subcommittee Meeting Notes by Glenn Friedman

SEMINAR: Mobile app and tablets for load calcs. Is this an appropriate topic? What are the simplifications. Cloud computing. Photographic recognition. Joint venture with TC1.5.

1. Stephen Roth
2. Chip Barnaby
3. NREL, Nick Long? (Chip will talk with him)
4. Someone to be the voice of reason, a TC4.1 person about what are the shortcuts and why is that a concern?
5. Possibly add a moderated panel discussion as the last portion of this seminar.
6. Glenn to Chair.
7. Voted unanimously.

Short talks with longer moderated roundtable. Moderator will use cards for audience input. CEC would like to entertain this type of creative format. This would be a 90-minute slot. Motion for 90-minute seminar with moderated questions. Moved by Spitler, second my Bruning. Discussion. Request early session (not Wednesday). TC1.5 will support. Nick Long's boss talked with Chip and Nick is in. This is priority 1. Vote 10-0-0.

Title: Loads on the Move: Mobile Apps

Dual Façade as a conference paper in a year or more in advance. Abstracts are due September 26. Conference paper session in San Antonio with 3-4 abstracts so we can get at least 3 to submit. The intent is to have technical load calculations as a basis as a future load calculation handbook addition. Number 1 for San Antonio. Vote 10-0-0.

Larry Sun is the program liaison. Forums are going to be hard to get through. Consider a seminar. Larry brought up the concern that mobile apps are a deviation from traditional TC4.1 seminars.

Research Subcommittee

WORK STATEMENT COVER SHEET

Date: **May 10, 2011**

(Please Check to Insure the Following Information is in the Work Statement)

A. Title	X
B Executive Summary	X
C. Applicability to ASHRAE Research Strategic Plan	X
D. Application of the Results	X
E. State-of-the-Art (background)	X
F. Advancement to State-of-the-Art	X
G. Justification and Value to ASHRAE	X
H. Objective	X
I. Scope / Technical Approach	X
J. Deliverables/Where Results will be Published	X
K. Level of Effort	
Project Duration in Months	X
Professional-Months: Principal	X
Professional-Months: Total	X
Estimated $ Value	X
L. Other Information to Bidders (optional)	X
M. Proposal Evaluation Criteria & Weighting Factors	X
N. References	X

Title: **Revise Load Applications Manual (2009)**

WS# **1616**
(To be assigned by MORTS - Same as RTAR #)

Results of this Project will affect the following Handbook Chapters, Special Publications, etc.:
Special Publication:
Load Calculation Applications Manual, 2nd Ed.

Responsible TC/TG: **TC 4.1 - Load Calculation Data & Procedures**

Date of Vote: **May 4, 2011**

For		10
Against	*	0
Abstaining	*	0
Absent or not returning Ballot	*	0
Total Voting Members		10

This W/S has been coordinated with TC/TG/SSPC (give vote and date):
(not applicable)

Has RTAR been submitted ? **Yes**

Strategic Plan Theme/Goals: **2010-2015 Strategic Plan, Goal #10 : "Significantly increase the understanding of energy efficiency, environmental quality and the design of buildings in engineering and architectural education.**

Work Statement Authors:
James Pegues

Proposal Evaluation Subcommittee:
Chair: **James Pegues**
Members:
Steven Bruning
Robert Doeffinger
Gary Wingfield

Project Monitoring Subcommittee:
(If different from Proposal Evaluation Subcommittee)
(same as proposal evaluation subcommittee)

Recommended Bidders (name, address, e-mail, tel. number):

Dr. Daniel Fisher
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405-744-5900 dfisher@okstate.edu

Dr. Douglas Hittle
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Dr. Mo Hosni
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Dr. Curtis Pedersen
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612-325-0060 cpederse@uiuc.edu

Dr. Jeffrey Spitler
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405-744-5900 spitler@okstate.edu

(Three qualified bidders must be recommended, not including WS authors.)

Potential Co-funders (organization, contact person information):
(none)

	Yes	No	How Long (weeks)
Is an extended bidding period needed?		X	
Has an electronic copy been furnished to the MORTS?	X		
Will this project result in a special publication?	X		
Has the Research Liaison reviewed work statement?	X		

* Reasons for negative vote(s) and abstentions
There were no negative votes or abstentions.

Use additional sheet if needed.

WORK STATEMENT 1616
SPONSORING TC/TG/SSPC: TC 4.1 - Load Calculation Data and Procedures
CO-SPONSORING TC/TG/SSPCs *[None]*

Title:

Revise Load Calculation Applications Manual (2009)

Executive Summary:

ASHRAE has a 32-year history of special publications dealing with peak load calculation, selling nearly 4400 copies since 1998. After publication of the 2009 *Load Calculation Applications Manual*, significant advances in state of the art for load calculations occurred via ASHRAE research projects RP-1453, RP-1363, RP-1311 and RP-1362. The updated Applications Manual will incorporate these research results and material from the ASHRAE Handbook - Fundamentals chapters 4, 14, 15, 16, 18 and 26. Publishing this information in an application manual allows it to reach a wider audience and increases the effectiveness of the material for practitioners and for educational applications.

Applicability to the ASHRAE Research Strategic Plan:

This project supports goal #10 in the 2010-2015 ASHRAE Research Strategic Plan: "Significantly increase the understanding of energy efficiency, environmental quality and the design of buildings in engineering and architectural education. The proposed project will incorporate the results of four recent ASHRAE-funded research projects (RP-1363, RP-1453, RP-1311, RP-1362) into a new edition of the *Load Calculation Applications Manual*. Each of the four research projects makes significant advances in the art of load estimating which contribute to more accurate and effective building designs. By publishing this information in an application manual, a format likely to be more widely used in engineering and architectural education (and in engineering practice) than the *Handbook - Fundamentals* alone, the research results will reach a wider audience. That in turn will contribute to greater understanding of effective methods of building design through accurate peak load estimating.

Application of Results:

This research project will produce an ASHRAE Special Publication: the *Load Calculation Applications Manual, 2nd edition.* Separate versions of the manual using IP units and SI Metric units will be produced.

State-of-the-Art (Background):

ASHRAE research project RP-1326, Load Calculation Applications Manual, produced an application manual representing current state of the art for peak cooling and heating load procedures and data. By publishing this information in an application manual it was hoped the information would reach a wider audience than that reached by the Handbook - Fundamentals alone, thereby increasing the effective use of the information by our industry.

The 2009 edition of the *Load Calculation Applications Manual* utilized information from the *2005 Handbook - Fundamentals* and the decades of ASHRAE and industry research the Handbook is based upon. A few pertinent research projects, among many, contributing to this information were projects dealing with:

- The Heat Balance Method (Pedersen, Fischer and Liesen, 1997).
- The Radiant Time Series Method (Spitler, Fisher, and Pedersen, 1997).
- Design Weather Data (Thevenard and Humphries, 2005).
- Clear Sky Solar Radiation Profiles (Threlkeld, 1963).

- Calculation of solar heat gain for fenestration with shading devices (Klems and Warner, 1997)
- Heat gain from lighting fixtures (Fisher and Chantrasrisalai, 2006).
- Heat gain from commercial cooking equipment (Fisher, 1998).
- Heat gain from office equipment (Wilkins and Hosni, 2000).

Shortly after the first edition of the *Load Calculation Applications Manual* was finished, four ASHRAE research projects were completed which made significant advances in procedures and data for clear sky solar radiation profiles, design weather data, calculation of solar heat gain for fenestration shading devices and heat gain from commercial cooking equipment. This creates an information gap between the first edition of the Applications Manual and the new state of the art. The objective of this proposed project is to close the information gap by incorporating the new research into a second edition of the Applications Manual.

Advancement to the State-of-the-Art:

Four ASHRAE research projects completed in 2009 made important advances in the state of the art for estimating peak cooling loads:

- **RP-1453 -** Updating ASHRAE Climatic Data for Design and Standards **-** Provides new procedures for accurately representing design day clear sky solar radiation profiles. These replace existing procedures originally formulated in the late 1950s and early 1960s. This project also provided new climatic design data based on the latest weather observations worldwide.
- **RP-1363 -** Generation of Hourly Design Day Weather Data **-** Provides new procedures for accurately representing design day dry-bulb and wet-bulb temperature profiles.
- **RP-1311 -** Improving Load Calculations for Fenestration with Shading Devices **-** Provides new procedures and data for calculating solar heat gain for fenestration and fenestration shading devices such as blinds, shades, drapes, and screens.
- **RP-1362 -** Revised Heat Gain and Capture and Containment Exhaust Rates for Commercial Cooking Appliances **-** Provides new data for kitchen equipment heat gains, based on current equipment types and the latest measurement techniques.

Inclusion of results from RP-1453, RP-1363, RP-1311 and RP-1362 will bring the *Load Calculation Applications Manual* up to par with state of the art information in the *2009 Handbook - Fundamentals*.

Ongoing ASHRAE research is also likely to further advance the state of the art and will be worthy of inclusion in a revised Application Manual. Among the ongoing projects worthy of consideration:

- **RP-1482 -** Update to Measurements of Office Equipment Heat Gain Data **-** Will provide new data for office equipment heat gains, based on current equipment types and the latest measurement techniques (project completed during 2010)
- **RP-1416 -** Development of Internal Surface Convection Correlations for Energy and Load Calculation Methods **-** Will provide new data and procedures for determining internal surface convection coefficients (project due to be completed in summer 2011).

In addition to documenting state-of-the-art load calculation procedures, the manual also demonstrates the use of the procedures with examples. Because load calculation procedures have undergone significant changes, the example must be updated to incorporate these new calculations. This also provides an opportunity to update the example subject to use the post-renovation ASHRAE HQ building. In this way use of state-of-the-art procedures for a state-of-the-art building can be demonstrated.

Justification and Value to ASHRAE:

The Load Calculation Applications Manual special publication was created with the objective of gathering information related to load calculations from multiple chapters of the ASHRAE Handbook - Fundamentals into a single focused volume. Chapters contributing information to the Applications Manual include:

- Chapter 18 - Non-Residential Cooling and Heating Load Calculations
- Chapter 14 - Climatic Design Information
- Chapter 15 - Fenestration
- Chapter 16 - Ventilation and Infiltration
- Chapter 4 - Heat Transfer
- Chapter 26 - Heat, Air and Moisture Control in Building Assemblies - Material Properties

Publishing this information in an application manual allows it to reach a wider audience and increases the effectiveness of the material, particularly for education, but also for general industry uses.

This Manual has greatest value when it represents the current state-of-the-art in load calculation procedures and data. TC 4.1 believes an update to the Manual is justified each time significant changes to the state-of-the-art occur, but no more frequently than the 4-year Handbook-Fundamentals cycle. Since the publication of the 2009 edition of the Manual, the state-of-the-art has advanced with significant changes to both load calculation procedures and data. Updating the Manual to the new state-of-the-art will preserve its value both to industry and to ASHRAE.

Finally, ASHRAE has a long history of producing special publications focusing on load calculation procedures. The table below lists the previous special publications covering this subject and includes sales figures for the most recent editions.

Publication Title	Publication Date	Units Sold
Load Calculation Applications Manual	2009	1160 (IP), 36 (SI)
Cooling and Heating Load Calculation Principles	1998	3168
Cooling and Heating Load Calculation Manual, 2nd Edition	1992	no data
Cooling and Heating Load Calculation Manual, 1st Edition	1979	no data

Objectives:

The objective of the project is to revise the *Load Calculations Application Manual, 1st edition* to produce a second edition. The second edition will

- Incorporate results from recently completed ASHRAE research projects RP-1453, RP-1363, RP-1311 and RP-1362.
- Consider incorporating results from ASHRAE research projects RP-1482 and RP-1416, due to be completed in 2010 and 2011 respectively, if completed in time and if they provide relevant data for the Manual.
- Update the example problems to utilize floor plan and construction data for the renovated ASHRAE HQ building.
- Update the software spreadsheets included with the manual to incorporate the new load calculation procedures.
- Produce separate IP units and SI Units versions of the manual.

Finally, it should be noted TC 4.1's longer term goal is to place the *Load Calculation Applications Manual* on continuous maintenance, synchronizing its revision with the publication of the *Handbook - Fundamentals* so that both publications continually represent state of the art for cooling and heating load estimating procedures and data. This proposed project is the first step in establishing a continuous maintenance regime.

Scope/Technical Approach:

The project will be supervised by a Project Monitoring Subcommittee (PMS) of TC 4.1. The project consists of the following tasks required to update components of the 2009 edition of the *Load Calculation Applications Manual*.

Task 1: **Develop List of Proposed Revisions** - Review chapters 1-11, appendices A-G and the CD-ROM contents for the 2009 *Load Calculation Applications Manual* to identify required revisions. The criteria for making revisions shall be new data or procedures in the following which supercede existing data and procedures outlined in the 2009 edition:

- Research projects RP-1453, RP-1363, RP-1311, and RP-1362,
- Research projects RP-1482 and RP-1416 (if research has been completed),
- Information found in Chapters 4, 14, 15, 16, 18 and 26 of the *2009 ASHRAE Handbook - Fundamentals*.

Results of the review will be used to produce a list of proposed revisions for PMS approval.

Initial survey of the 2009 *Load Calculation Applications Manual* indicates necessary revisions include, but are not limited to the following:

a. **Chapter 3 - Thermal Property Data.** Update thermal property tables to match data in the *2009 Handbook* - *Fundamentals*. This work mainly involves 5-10 pages of indoor attenuation coefficient data for internal shading of windows.

b. **Chapter 4 - Environmental Design Conditions.** (1) Revise explanation of derivation of hourly design-day outdoor dry-bulb and wet-bulb profiles and associated examples, (2) Update all weather data tables to use data from the *2009 Handbook* - *Fundamentals*.

c. **Chapter 6 - Internal Heat Gain.** (1) Update Table 6.2 to use lighting power density data from *ASHRAE Standard 90.1-2010*, (2) Update Tables 6.5, 6.6 and 6.7 to use new kitchen appliance data from the *2009 Handbook* - *Fundamentals* Chapter 15 tables 5A, 5B, 5C.

d. **Chapter 7 - Fundamentals of RTSM.** (1) Replace data in Tables 7.1 and 7.2 with data generated using the new ASHRAE solar radiation algorithms documented in the *2009 Handbook - Fundamentals*, (2) Revise section 7.5 item 4 to document the new procedures for calculating solar heat gain for fenestration with internal shades, (3) Revise examples 7.1 and 7.2 to use outputs from updated spreadsheets using revised algorithms for solar flux and heat gain.

e. **Chapter 8 - Application of the RTSM - Detailed Example.** The general format of this chapter can be preserved, but all specific data used in the example must be revised. This includes (1) updating all building diagrams and descriptions of input data to use data for the renovated ASHRAE HQ building, (2) replacing all data in tables and graphs to use new outputs from the updated spreadsheets using both the new input data and the revised calculation algorithms.

f. **Appendix B - Spreadsheet Implementation of RTSM.** Revisions in this Appendix flow from changes to the load calculation spreadsheets (see *CD-ROM Contents* below). Screen images of spreadsheet tables and VBA code require revision. Discussion of contents of input and results tables also require revision.

g. **Appendix D - Solar Radiation and Heat Gain.** Basic format of the appendix can be reused, but the content must be completely revised and enlarged to document the *2009 ASHRAE Handbook - Fundamentals* procedures for calculating clear sky solar flux, solar heat gain and heat gain for fenestration with internal shades.

h. **Appendix G - Correction Factor for High Conductance Surface Zones.** Graphical results in Figures G.1 and G.2 require revision based on use of *2009 ASHRAE Handbook* - *Fundamentals* calculation results for solar heat gain.

i. **Load Calculation Applications Manual CD-ROM Contents.** A CD-ROM is included with this manual. It contains ASHRAE design weather data and load calculation spreadsheets:

- Replace all data in the Stations folder with weather station data, IP index and SI index tables from the *2009 ASHRAE Handbook - Fundamentals.*
- Update the load calculation spreadsheets. There are 17 spreadsheets on the CD. These spreadsheets include Visual Basic for Applications (VBA) programming to implement the ASHRAE load calculation algorithms. An initial survey indicates 2 spreadsheets require significant revision to the VBA algorithms, 10 spreadsheets require moderate revision to update data tables, algorithms and results, and 5 spreadsheets require only minimal or no change to content. These revisions constitute software development. Therefore software principles for design, development and testing should be used to ensure product quality.

Task 2: **Make Chapter and Appendix Revisions.** Make the revisions to Application Manual chapters and appendices approved by the PMS.

Task 3: **Make CD-ROM Content Revisions.** Make the revisions to CD-ROM data and spreadsheets approved by the PMS. This work includes design of new spreadsheet VBA algorithms, software implementation and testing.

Task 4: **Produce Load Calculation Application Manual IP Units Edition.** Assemble the results of Tasks 2 and 3 into the complete IP units edition manuscript.

Task 5: **Produce Load Calculation Application Manual SI Units Edition.** Using the IP units edition as a starting point, produce a second manuscript with the same technical content which displays all numerical results using SI Metric Units.

Task 6: **Final Report and Technical Paper.** The contractor will prepare a complete final report documenting project results. The Preliminary Report should be incorporated in the Final Report, with modifications as appropriate.

Deliverables/Where Results Will Be Published:

Progress, Financial and Final Reports, Technical Paper(s), and Data shall constitute required deliverables ("Deliverables") under this Agreement and shall be provided as follows:

a. Progress and Financial Reports

Progress and Financial Reports, in a form approved by the Society, shall be made to the Society through its Manager of Research and Technical Services at quarterly intervals; specifically on or before each January 1, April 1, June 10, and October 1 of the contract period.

Furthermore, the Institution's Principal Investigator, subject to the Society's approval, shall, during the period of performance and after the Final Report has been submitted, report in person to the sponsoring Technical Committee/Task Group (TC/TG) at the annual and winter meetings, and be available to answer such questions regarding the research as may arise.

b. At initiation of the project, the Principal Invevstigator shall provide a proposed schedule for completing project milestones and deliverables including:

(1) List of proposed revisions to 2009 edition.
(2) Draft revisions to all chapters and appendices identified in (1)
(3) Draft revisions to all CD-ROM data and spreadsheets identified in (1)

(4) Complete manuscript for Load Calculation Applications Manual, IP units edition.
(5) Complete manuscript for Load Calculation Applications Manual, SI units edition.
(6) Final Report
(7) Material for ASHRAE Seminar presentation.

Items 1-5 are described in "c" below. Item 6 is described in "d". Item 7 is described in "e".

c. Deliverables for Tasks 1 through 6 in "Scope/Technical Approach" above:

(1) List of proposed revisions to the 2009 edition of the *Load Calculation Applications Manual* for PMS approval.

(2) Draft revisions to all chapters and appendices identified in (1) for PMS approval.

(3) Draft revisions to all CD-ROM data and spreadsheets identified in (1) for PMS approval. Interim reports on VBA algorithm design and/or testing results may be required by the PMS.

(4) Complete manuscript for revised *Load Calculation Application Manual*, IP units edition for PMS approval.

(5) Complete manuscript for revised *Load Calculation Application Manual*, SI units edition for PMS approval.

(6) Final Report (see item "c" below).

d. Final Report

A written report, design guide, or manual, (collectively, “Final Report”), in a form approved by the Society, shall be prepared by the Institution and submitted to the Society’s Manager of Research and Technical Services by the end of the Agreement term, containing complete details of all research carried out under this Agreement. Unless otherwise specified, six copies of the final report shall be furnished for review by the Society’s Project Monitoring Subcommittee (PMS).

Following approval by the PMS and the TC/TG, in their sole discretion, final copies of the Final Report will be furnished by the Institution as follows:

- An executive summary in a form suitable for wide distribution to the industry and to the public.
- Two bound copies
- One unbound copy, printed on one side only, suitable for reproduction.
- Two copies on CD-ROM; one in PDF format and one in Microsoft Word.

e. ASHRAE Seminar Presentation

The Principal Investigator (PI) shall prepare and deliver a Seminar presentation at an ASHRAE Winter Meeting or Annual Meeting describing the content of the revised manual and notable additions or enhancements with respect to the 1st edition of the manual. The Seminar presentation will be delivered after submission of the Final Project Report and formal approval by the TC. The purpose of the Seminar presentation is to publicize the value of the revised manual and promote sales.

f. Data

The Institution agrees to maintain true and complete books and records, including but not limited to notebooks, reports, charts, graphs, analyses, computer programs, visual representations etc., (collectively, the "Data"), generated in connection with the Services. Society representatives shall have access to all such Data for examination and review at reasonable times. The Data shall be held in strict confidence by the Institution and shall not be released to third parties without prior authorization from the Society, except as provided by GENERAL CONDITION VII, PUBLICATION. The original Data shall be kept on file by the Institution for a period of two years after receipt of the final payment and upon request the Institution will make a copy available to the Society upon the Society's request.

g. Project Synopsis

A written synopsis totaling approximately 100 words in length and written for a broad technical audience, which documents 1. Main findings of research project, 2. Why findings are significant, and 3. How the findings benefit ASHRAE membership and/or society in general shall be submitted to the Manager of Research and Technical Services by the end of the Agreement term for publication in ASHRAE *Insights*

The Society may request the Institution submit a technical article suitable for publication in the Society's *ASHRAE JOURNAL*. This is considered a voluntary submission and not a Deliverable.

All Deliverables under this Agreement and voluntary technical articles shall be prepared using dual units; e.g., rational inch-pound with equivalent SI units shown parenthetically. SI usage shall be in accordance with IEEE/ASTM Standard SI-10.

Level of Effort:

The expected project budget is $100,000 with approximately 75% allocated to the principal investigator and 25% allocated to an assistant. The anticipated project duration is 18 months spanning 3 ASHRAE meetings.

Other Information for Bidders (Optional):

See References section below.

Proposal Evaluation Criteria:

1. Contractors demonstrated understanding of Work Statement as revealed in proposal (15%).
2. Quality of methodology proposed for conducting research (20%).
3. Contractor's capability in terms of facilities and relevant prior research (20%).
4. Qualifications of personnel for this project (25%).
5. Probability of contractor's research plan meeting the objectives of the Work Statement (15%).
6. Performance of the contractor on prior ASHRAE projects (no penalty for new contractors) (5%).

References:

ASHRAE Research Completed Prior to 2009

Fisher, D.R. 1998. New recommended heat gains for commercial cooking equipment. *ASHRAE Transactions* 104(2):953-60.

Fisher, D.E. and C. Chantrasrisalai. 2006. Lighting heat gain distribution in buildings. ASHRAE RP-1282, *Final Report.*

Klems, J.H. and J.L. Warner. 1997. Solar heat gain coefficient of complex fenestrations with a venetian blind for differing slat angles. *ASHRAE Transactions* 103(1):1026-1034

Pedersen, C.O., D.E. Fisher, and R.J. Liesen. 1997. Development of a heat balance procedure for calculating cooling loads. *ASHRAE Transactions* 103(2):459-468.

Spitler, J.D., D.E. Fisher, and C.O. Pedersen, 1997. The radiant time series cooling load calculation procedure. *ASHRAE Transactions* 103(2).

Spitler, J.D. 2009. *Load Calculation Applications Manual*. ASHRAE Research Project 1326.

Thevenard, D. and R. Humphries. 2005. The calculation of climatic design conditions in the 2005 ASHRAE Handbook - Fundamentals. *ASHRAE Transactions* 111(1):457-466.

Threlkeld, J.L. 1963. Solar irradiation of surfaces on clear days. *ASHRAE Transactions* 69:24.

Wilkins, C.K. and M.H. Hosni. Heat gain from office equipment. *ASHRAE Journal* 42(6):33-44.

New ASHRAE Research Completed During 2009

Hedrick, R. 2009. Generation of hourly design-day weather data (RP-1363). ASHRAE Research Project, *Final Report*.

Swierczyna, R., P.A. Sobiski, and D. Fisher. 2009. Revised heat gain and capture and containment exhaust rates from typical commercial cooking appliances (RP-1362). ASHRAE Research Project, *Final Report*.

Thevenard, D. 2009. Updating the ASHRAE climatic data for design and standards (RP-1453). ASHRAE Research Project, *Final Report*.

Wright, J.L., C. Barnaby, M.R. Collins and N.A. Kotey. 2009. Improving load calculations for fenestrations with shading devices. ASHRAE Research Project RP-1311, *Final Report.*

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ASHRAE Draft FAQs

ASHRAE Technical FAQ

ID	14
Question	Does ASHRAE sell software for residential load calculation?
Long Answer	Software available in the ASHRAE bookstore would be made available at www.ashrae.org/bookstore. ASHRAE develops procedures and methods for calculating heating and cooling loads. Software developed by ASHRAE incidental to the research project is not designed for general use and is not published. Algorithms are made available for independent software vendors. By policy, ASHRAE cannot certify, endorse or recommend any products. ACCA - Air Conditioning Contractors of America - www.acca.org.
ASHRAE Pubs	2009 ASHRAE Handbook - Fundamentals, Chapter F17
Topic References	load calculation, heating load, cooling load, size, tons

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	ACCA
2		
3		
4		
5		

ASHRAE Technical FAQ

ID	15
Question	Does ASHRAE sell software for commercial load calculation?
Answer	Software available in the ASHRAE bookstore would be made available at www.ashrae.org/bookstore. ASHRAE develops procedures and methods for calculating heating and cooling loads. Software developed incidental to the research project is not designed for general use and is not published. Algorithms are made available for independent software vendors. By policy, ASHRAE cannot certify, endorse, or recommend any products. US DOE - U.S. Department of Energy - www.eere.energy.gov/buildings/tools_directory
ASHRAE Pubs	• Load Calculation Applications Manual • ASHRAE Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings • 2009 ASHRAE Handbook - Fundamentals, F18
Topic References	load calculation, heating load, cooling load, size, tons

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	ACCA
2		US DOE
3		
4		
5		

ASHRAE Technical FAQ

ID	21
Question	Does ASHRAE have an easy method for heating and cooling load calculation?
Answer	Use the methodology given in the 2009 ASHRAE Handbook - Fundamentals, Chapter F18. Although Chapter F18 of the 2009 ASHRAE Handbook - Fundamentals contains only heat balance and radiant time series methods of calculating cooling loads, other methods are provided in previous issues of the Fundamentals volume. ASHRAE Technical Committee (TC) 4.1 has determined that time must be considered in the conversion of heat transfer to loads at cooling equipment. Although these can be determined through repetitious manual methods, the proliferation of desktop computers makes them a logical choice as a tool for calculating loads.
ASHRAE Pubs	• 2009 ASHRAE Handbook - Fundamentals, Chapter F18. • Load Calculation Applications Manual • ASHRAE Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings
Topic References	load calculation, heating load, cooling load, size, tons

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	ACCA
2		
3		
4		
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ASHRAE Technical FAQ

ID	77
Question	How can I calculate heating and cooling load for a commercial building?
Answer	Use the methodology given in the 2009 ASHRAE Handbook - Fundamentals, Chapter F18. The ASHRAE publication titled Load Calculation Applications Manual is the most comprehensive publication on the subject that ASHRAE makes available. ASHRAE develops procedures and methods for calculating heating and cooling loads. Software developed incidental to the research project is not designed for general use and is not published. Algorithms are made available for independent software vendors. By policy, ASHRAE cannot certify, endorse or recommend any products. The handbook and/or individual chapters of the handbook may be purchased and downloaded on-line at our website, www.ashrae.org or by calling 1-800-527-4723 in the USA and Canada or 1-404-636-8400 worldwide.
ASHRAE Pubs	2009 ASHRAE Handbook - Fundamentals, Chapter F18 Load Calculation Applications Manual ASHRAE Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings
Topic References	load calculations, heating load, cooling load, size, tons

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	
2		
3		
4		
5		

ASHRAE Technical FAQ

ID	78
Question	How can I calculate heating and cooling loads for a residential facility?
Answer	Use the methodology given in the 2009 ASHRAE Handbook - Fundamentals, Chapter F17. ASHRAE develops procedures and methods for calculating heating and cooling loads. Software developed incidental to the research project is not designed for general use and is not published. Algorithms are made available for independent software vendors. By policy, ASHRAE cannot certify, endorse or recommend any products. The handbook and/or individual chapters of the handbook may be purchased and downloaded on-line at our website, www.ashrae.org or by calling 1-800-527-4723 in the USA and Canada or 1-404-636-8400 worldwide.
ASHRAE Pubs	2009 ASHRAE Handbook - Fundamentals, Chapter F17
Topic References	load calculations, residential heating load, cooling load, size, tons

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	ACCA
2		
3		
4		
5		

ASHRAE Technical FAQ

ID	89
Question	Which load calculation methods or software packages are recommended by ASHRAE?
Answer	By policy, ASHRAE cannot certify, endorse or recommend any commercial products. ASHRAE recommends that any product used follow the methodology given in the 2009 ASHRAE Handbook - Fundamentals, Chapter F17 & F18. Although Chapter F18 of the 2009 ASHRAE Handbook - Fundamentals contains only heat balance and radiant time series methods of calculating cooling loads, other methods are provided in previous issues of the Fundamentals volume. The handbook and the other ASHRAE publications may be purchased and/or individual chapters of the handbook may be purchased and downloaded on-line at our website, www.ashrae.org or by calling 1-800-527-4723 in the USA and Canada or 1-404-636-8400 worldwide.
ASHRAE Pubs	2009 ASHRAE Handbook - Fundamentals, Chapter F17 & F18
Topic References	load calculation software

	Cognizant ASHRAE Committees	Refer to Organization
1	TC 4.1	
2		
3		
4		
5		

Sign-In Sheet and Current Roster

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231957 035 Non-voting
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Term in Position: 07/01/2009 to

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