

AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIR-CONDITIONING
ENGINEERS, INC.

1791 Tullie Circle, NE / Atlanta, GA 30329
404-636-8400

TC/TG/TRG MINUTES COVER SHEET

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

TC/TG/TRG No. TC 4.7 DATE: February 26, 2012

TC/TG/TRG TITLE: Energy Calculations

DATE OF MEETING: January 24, 2012 LOCATION: Chicago

| MEMBERS PRESENT | YEAR APPTD | MEMBERS ABSENT | YEAR APPTD | EX-OFFICIO MEMBERS & ADD'L ATTENDANCE |
|--------------------------------------|------------|--------------------------------|------------|---|
| Jeff Haberl (CHAIR) | 2010 | Jan Hensen | 2008 | See attendance list for additional attendees. |
| Tim McDowell (V CHAIR) | 2010 | Iain Macdonald (SCM SC CHR) | 2009 | |
| Joe Huang (SEC, APP SC CHR) | 2010 | Russ Taylor | 2010 | |
| Chip Barnaby (HDBKSC CHR) | 2010 | | | |
| Chris Balbach (PRGM SC CHR) | 2010 | | | |
| Bass Abushakra (RES & DDM SC CHR) | 2011 | | | |
| Joel Neymark (STDS SC CHR) | 2011 | | | |
| Dan Fisher | 2011 | | | |
| Robert Sonderegger | 2008 | | | |
| Michael Wetter | 2011 | | | |

Total attendance of voting members: 10 present, 3 absent.

DISTRIBUTION

ALL MEMBERS OF THE TC/TG/TRG

| | |
|-------------------------------|-----------------------------------|
| TAC CHAIR | Michael Bilderbeck , Charles Culp |
| TAC SECTION HEAD | |
| SPECIAL PUBLICATIONS LIAISON | William Fleming |
| STANDARDS LIAISON | James Tauby |
| HANDBOOK LIAISON | Peter Simmonds |
| RAC RESEARCH LIAISON | Srinivas Garimella |
| PROF DEV COMM LIAISON | John Nix |
| CHAP TECH TRANSFER LIAISON | Harris Sheinman |
| STAFF LIAISON (RESEARCH) | Michael Vaughn |
| STAFF LIAISON (TECH SERVICES) | Michael Vaughn |
| STAFF LIAISON (STANDARDS) | Stephanie Reiniche |

These draft minutes have not been approved and are not the official, approved record until approved by this committee.

**ASHRAE TC 4.7 Energy Calculations
Chicago Meeting**

MOTIONS AND ACTION ITEMS

MOTION: Dan Fisher moved, Chris Balbach seconded, to accept minutes (unanimous voice consent)

MOTION: Huang moved and Chris seconded, that TC 4.7 approve the revised WS and resubmit it to RAC before it meets in April 2012. Motion carried 7-0-1, CNV.

MOTION: Robert moved to approve the RP-1404 pending suggested changes to the final report, Barnaby seconded. Motion passes 7-0-1, CNV.

MOTION: Dan moved to accept the final report for RP-1416, pending final changes as discussed, Second by Sonderegger. Motion passes,8-0-0, CNV.

MOTION:Tim moved, and Chris seconded, that TC 4.7 approves the RTAR on “Data-driven building models for smart meter.” Motion passed 8-0-0 CNV.

MOTION: Dan moved, seconded by Tim, that TC 4.7 co-sponsor TC-5.33’s RTAR on “experimental evaluation of the thermal and ventilation of stratified air distribution systems coupled with passive beams”. Motion passed 7-0-0 CNV.

MOTION: Chris moved, seconded by Barnaby, to approve the Program Plan. Motion carried 8-0-0 CNV

MOTION: Chip Barnaby moved, and Dan Fisher seconded, that TC 4.7 co-sponsor a TC 4.1 seminar on load calculations versus annual simulations for load calculations. . Motion passes 6-2-0 CNV

MOTION: Dan Fisher moved, seconded by Balbach, that the TC chair write a letter to the CEC suggesting that presenters can attend their session for free, but not to go to any other sessions. Motion passes 6-2-0 CNV

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DATE OF MEETING: January 24, 2011 LOCATION: Chicago

| TC/TG/TRG MEETING SCHEDULE | | | | | |
|--|---------------------------|---------------|-----------------------------------|--------------------------------|------------------|
| LOCATION – past 12 months | | DATE | LOCATION - planned next 12 months | | DATE |
| Montreal | | June 28, 2011 | San Antonio | | June 26, 2012 |
| Las Vegas | | Feb. 1, 2011 | Dallas | | January 29, 2013 |
| TC/TG/TRG SUBCOMMITTEES | | | | | |
| Function | | | Chair | | |
| Program | | | Chris Balbach | | |
| Research | | | Bass Abushakra | | |
| Handbook | | | Chip Barnaby | | |
| RESEARCH PROJECTS – Current | | | Monitoring | Report Mode | |
| Project Title | Contractor | | Comm.Chm. | At Meeting | |
| Appendix 1 | | | | | |
| LONG RANGE RESEARCH PLAN | | | | | |
| Rank | Title | W/S Written | Approved | To R & T | |
| | Appendix 2 | | | | |
| HANDBOOK RESPONSIBILITIES | | | | | |
| Year & Volume | Chapter Title | No. | Deadline | Handbook Subcom. Chair/Liaison | |
| 2009 Fundamentals | Energy Estimating Methods | 19 | June 2012 | Barnaby/Simmonds | |
| STANDARDS ACTIVITIES - List and Describe Subjects | | | | | |
| SPC 140 Standard Method of Test for Building Energy Software – Joel Neymark | | | | | |
| SPC 205 Data Exchange Protocols for Energy Simulation of HVAC&R Equipment Performance - Chip Barnaby | | | | | |
| TECHNICAL PAPERS from Sponsored Research - Title, when presented (past 3 yrs. present & planned) | | | | | |
| Appendix 3 | | | | | |
| TC/TC/TRG Sponsored Symposia - Title, when presented (past 3 yrs. present & planned) | | | | | |
| Appendix 4 | | | | | |
| TC/TG/TRG Sponsored Seminars - Title, when presented (past 3 yrs. present & planned) | | | | | |
| Appendix 5 | | | | | |
| TC/TG/TRG Sponsored Forums - Title, when presented (past 3 yrs. present & planned) | | | | | |
| Appendix 6 | | | | | |
| JOURNAL PUBLICATIONS - Title, when published (past 3 yrs. present & planned) | | | | | |
| None | | | | | |

Attendance

Below is a complete listing of attendees at this meetings. It includes the voting members of the committee listed on the first page

| Last Name | First Name | Affiliation | E-mail | Status 06/12 VM Voting CM Corres. V Visitor |
|----------------------|-------------------|--------------------------------|-------------------------------------|---|
| Abushakra | Bass | Milwaukee School of Eng. | abushakr@msoe.edu | VM |
| Anderson | JR | Anderson Engineering | JRHazel@BellSouth.net | V |
| Bae | Nuri | Univ. of Michigan | nuri@unich.edu | V |
| Balbach | Chris | Performance Systems Develop. | cbalbach@psdconsulting.com | VM |
| Baltazar | Juan-Carlos | Texas A&M University | jcbaltazar@tamu.edu | V |
| Barnaby | Chip | Wrightsoft | CBarnaby@wrightsoft.com | VM |
| Beausoleil- Morrison | Ian | Carleton University | Ian_Beausoleil-Morrison@carleton.ca | CM |
| Bosworth | David | BuildLab | bosworth@buildlab.net | V |
| Cockerham | Keith | DLB Associates | kcockerham@DLBassociates.com | CM |
| Cook | Malcolm | Loughborough Univ (UK) | malcolm.cook@lboro.ac.uk | V |
| Cornick | Steve | Nat'l Research Council Canada | Steve.Cornick@nrc.ca | V |
| Davidson | Tom | DLB Associates | tdavidson@dlbassociates.com | V |
| Degelman | Larry | TAMU | ldegelman@suddenlink.net | CM |
| Eley | Charles | CoMNET | charles@eley.com | V |
| Ellis | Peter | Big Ladder Software | peter.ellis@bigladdersoftware.com | CM |
| Fisher | Dan | Oklahoma State Univ | DFisher@okstate.edu | VM |
| Frame | Sara | Eaton's Energy Solutions Group | sara.a.frame@eaton.com | V |
| Franconi | Ellen | Rocky Mountain Institute | efranconi@rmi.org | V |
| Friedman | Glenn | Taylor Engineering | gfriedman@taylor-engineering.com | V |
| Gmitter | Nick | DLB Associates | ngmitter@dlbassociates.com | V |
| Gopal | Raj | Gopal Associates | rgopalrmr@yahoo.com | V |
| Griffin | David | Etc Group, LLC | eldergriffin@gmail.com | V |
| Haberl | Jeff | TAMU | jhaberl@tamu.gov | VM |
| Hartley | Doug | Working Buildings | DEHartley@workingbuildings.com | V |
| Haves | Philip | LBNL | phaves@lbl.gov | CM |
| Huang | Joe | White Box Technologies | yjhuang@whiteboxtechnologies.com | VM |
| Im | Piljae | ORNL | imp1@ornl.gov | V |
| Judkoff | Ron | NREL | ron.judkoff@nrel.gov | CM |
| Kim | Hyojin | TAMU | hyojinkim@tees.tamus.edu | V |
| Kinney | Kris | SCIenergy | kriskinney@scienergy.com | CM |
| Kolderup | Erik | Kolderup Consulting | erik@kolderupconsulting.com | V |
| Krarti | Moncef | University of Colorado | krarti@colorado.edu | CM |
| Kruis | Neal | NREL | neal.kruis@nrel.gov | V |

Attendance (continued, page 2 of 2)

| Last Name | First Name | Affiliation | E-mail | Status 06/12 VM Voting CM Corres. V Visitor |
|------------------|-------------------|-------------------------------|--------------------------------------|---|
| Malherek | Elyse | McQuay | elyse.malherek@mcquay.com | V |
| McDowell | Tim | TESS | Mcdowell@tess-inc.com | VM |
| McHugh | Jonathan | MEC | jon@nchughenergy.com | V |
| Neymark | Joel | J. Neymark & Assoc | neymarkj@msn.com | CM |
| O'Keefe | Michael | Big Ladder Software | michael.okeefe@bigladdersoftware.com | V |
| O'Neill | Zheng | UTRC | oneillz@utrc.etc.com | V |
| Paulus | Mitch | Milwaukee School of Eng. | paulusm@msoe.edu | V |
| Pegues | Jim | Carrier | james.f.pegues@carrier.utc.com | V |
| Phelan | Jerry | Bayer Material Science | jerry.phelan@bayer.com | V |
| Pruett | John | ZMM, Inc. | jap@zmm.com | V |
| Reddy | T. Agami | Arizona State Univ | reddyta@asu.edu | V |
| Reilly | Sue | Group 14 Eng. | sreilly@group14eng.com | CM |
| Roth | Amir | DOE | amir.roth@ee.doe.gov | V |
| Sharma | Chandan | FSEC | csharma@fsec.ucf.edu | V |
| Sonderegger | Robert | Itron, Inc. | Robert.sonderegger@itron.com | VM |
| Stovall | Therese | Oak Ridge National Laboratory | stovalltk@ornl.gov | V |
| Studer | Eric | TNZ Energy Consulting | studer@TNZEnergy.com | V |
| Swartz | Keith | Energy Center of Wisconsin | kswartz@ecw.org | V |
| Wang | Liping | LBNL | lwang@lbl.gov | V |
| West | Scott | Jacobs Engineering | scott.west@jacobs.com | V |
| Wetter | Michael | LBNL | mwetter@lbl.gov | VM |
| Xiong | Zeyu | Oklahoma State Univ | zeyu.xiong@okstate.edu | V |
| Zuo | Wangda | LBNL | wzuo@lbl.gov | CM |

Appendix 1**TC 4.7 RESEARCH PROJECTS STATUS****ASHRAE
Technical Committee 4.7 Energy Calculations
(January 24, 2012)****Active projects**

| # | Title | Joint TC | Cog SC/ Contractor | PMSC | Dates / status |
|----------|---|-----------------|--------------------------------------|--|---|
| 1416-RP | Development of Internal Surface Convection Correlations for Energy and Load Calculations | 4.1 | Sim/Comp, Univ of Texas | Dan Fisher (Chair), Steve Bruning, Jan Kosny | NCX to Feb 2012 recommended by PMS in Montreal, but no record of vote by Full Committee . |
| 1404-RP | Modeling, Analysis, and Reporting Protocols for Predicting Annual Energy Performance from Short-Term Building Energy Monitoring | | DDM, Milwaukee School of Engineering | R. Sonderegger (Chair) J. Haberl, V. Smith | NCX to Feb 2012 approved by Full Committee in Montreal |

Appendix 2
RESEARCH PLAN

ASHRAE
Technical Committee 4.7 Energy Calculations
2011 Research Plan (January 24, 2012)

| Title | Society status | TC 4.7 Status | Actors or TC 4.7 Prime Contact | Subcommittee* |
|---|---------------------------------|--|---|----------------------|
| Active projects | | | | |
| 1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations | project underway | Sixth PMS meeting held in Montreal Jun '11, NCX recommended by PMS thru Feb 2012 | Contractor: UTexas PMS: Dan Fisher (chair), Steve Bruning, Jan Kosny | SCM |
| 1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring | project underway | Third PMS meeting held in Montreal Jun'11. Project. NCX granted thru Feb 2012 | Contractor: UMilwaukee PMS: Robert Sonderegger (chair), Jeff Haberl, Vern Smith | DDM |
| WSs approved by TC | | | | |
| 1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-factor and SHGC have been defined | WS returned to committee Jun'10 | WS authors to revise WS in response to RAC comments, and resubmit to TC 4.7 for revote, TC4.5 c-sponsorship also needs to be revoted | Joe Huang (WS author), proposed PES Jeff Haberl (chair), Chip Barnaby, Tim McDowell, + TC4.5 rep to be determined | A |
| WS under development | | | | |
| 1456-RP Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations (Phase Two) | RTAR unnecessary for Phase Two | WS under development | Joe Huang , Simon Rees, Eric Kolderup, Malcolm Cook, Iain MacDonald | SCM |
| co-sponsored WS led by other TC | | | | |
| WS-1413 Developing standard procedures for filing missing weather data (TC 4.2 lead) | Contractor selected June'11 | Co-sponsorship approved by full committee Jun'08 | Didier Thevenard (TC 4.2 chair) | DDM |

Appendix 3
TECHNICAL PAPERS FROM SPONSORED RESEARCH

| RP | Title | Contractor | Approved | Paper |
|-----------|--|---------------------------|-------------------------|---|
| 1051 | Procedures for Reconciling Computer-calculated Results with Measured Energy Data | Drexel | Chicago January 2006 | Reddy, T.A., 2006. "Literature Review on Calibration of Building Energy Simulation Programs: Uses, Problems, Procedures, Uncertainty and Tools", ASHRAE Transactions, vol 112(1). |
| 1051 | Procedures for Reconciling Computer-calculated Results with Measured Energy Data | Drexel | Chicago January 2006 | Sun J. and Reddy T.A., 2006, "Calibration of Building Energy Simulation Programs Using the Analytic Optimization Approach (RP-1051)", Int. J HVAC&R Research 12(1) 177-196. |
| 1051 | Procedures for Reconciling Computer-calculated Results with Measured Energy Data | Drexel | Chicago January 2006 | Reddy, T.A., I. Maor and C. Ponjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part I: General Methodology", accepted for publication in Int. J HVAC&R Research. |
| 1051 | Procedures for Reconciling Computer-calculated Results with Measured Energy Data | Drexel | Chicago January 2006 | Reddy, T.A., I. Maor and C. Ponjapornpon, 2006, "Calibrating Detailed Building Energy Simulation Programs with Measured Data- Part II: Application to Three Case Study Office Buildings", accepted for publication in Int. J HVAC&R Research. |
| 865 | Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796) | Univ Nebraska, Texas A&M | July 2002 | Yuill, G., Haberl, J. 2006. "Accuracy Tests for Simulations of VAV Dual Duct, Single Zone, Four Pipe Fan Coil and Four Pipe Induction Air Handling Systems (4796)," ASHRAE Transactions-Research, Vol. 112, Pt. 1 (January). |
| 865 | Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796). | Univ. Nebraska, Texas A&M | July 2002 | Yuill, G., Haberl, J., Caldwell, J. S. 2005. "Accuracy Tests for Simulations of Constant Volume, Dual Duct and Variable Volume Air Handling Systems (4796, RP-865)," ASHRAE Transactions-Research, Vol. 111, Pt. 2, No. 4796, pp. 137 – 153 (June). |

Appendix 3 (continued)
TECHNICAL PAPERS FROM SPONSORED RESEARCH

| | | | | |
|------|--|----------------------------|---------------|--|
| 1050 | Development of an Inverse Model Toolkit | Univ. of Dayton, Texas A&M | December 2001 | Kissock, K., Haberl, J., Claridge, D. 2003. "Inverse Model Toolkit (1050-RP): Numerical Algorithms for Best-Fit Variable-Base Degree-Day and Change-Point Models," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 425 – 434. |
| 1050 | Development of an Inverse Model Toolkit | Univ. of Dayton, Texas A&M | December 2001 | Haberl, J., Claridge, D., Kissock, K. 2003. "Inverse Model Toolkit (1050-RP): Application and Testing," ASHRAE Transactions-Research, Vol. 109, Pt. 2, pp. 435 – 448. |
| 1093 | Diversity Factors and Schedules for Energy and Cooling Load Calculations | Texas A&M | June 2000 | Abushakra, B., Haberl, J., Claridge, D. 2004. "Overview of Literature on Diversity Factors and Schedules for Energy and Cooling Load Calculations (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1 (February), pp. 164 – 176. |
| 1093 | Diversity Factors and Schedules for Energy and Cooling Load Calculations | Texas A&M | June 2000 | Claridge, D., Abushakra, B., Haberl, J. 2003. "Electricity Diversity Profiles for Energy Simulation of Office Buildings (1093-RP)," ASHRAE Transactions-Research, Vol. 110, Pt. 1, pp. 365 – 377 (February). |

Appendix 4
TC/TG/TRG SPONSORED TRANSACTIONS SESSIONS

Current as of January 2012

PRESENT:

PLANNED:

PAST:

Louisville, June 20-24, 2009

Transaction “Improving Load Calculations for Fenestrations with Shading Devices”

Chicago, January 24-28, 2009

HVAC&R Research Seminar “Synthesis of Optimum HVAC System Configurations”

New York City/January 2008

How Low Can You Go?

Recent Advances in Energy Simulation (Chair: Dan Fisher)

How Low Can You Go? Low-Energy Buildings Through Integrated Design (Chair: Dru Crawley)

Application of Inverse Models (Chair: Jeff Haberl)

Appendix 5
TC/TG/TRG SPONSORED SEMINARS
Current as of January 2012

PRESENT:**Chicago, January 21-25, 2012**

“Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling

Chair: Chris Balbach

Speakers: Chip Barnaby, Mark Hydeman, Neal Kruis

“Improving Energy Modeling Consistency”

Chair: Joe Huang

Speakers: Erik Kolderup, Alan Daly, Ellen Franconi

“Integrated Multi-domain Simulations for Innovative Building Design and Operation, Part One”

Chair: Wangda Zuo

Speakers: Jan Hensen, John Zhai, Ian Beausoleil-Morrison

“Integrated Multi-domain Simulations for Innovative Building Design and Operation, Part Two”

Chair: Jerone Gagliano

Speakers: Michael Wetter, Wangda Zuo, Yao-Jung Wen, Christoph Van Treeck

PLANNED:**San Antonio, June 23-27, 2012**

“Three perspectives on SPC 205P” (title TBD)

Chair: Chip Barnaby

Three proposed speakers, including a consumer of 205P, a product manufacturer, and a software vendor

Follow-up on model calibration (title TBD)

Chair: Chris Baker

Speakers: Jason Steinbock, Xia Fang, Joe Huang

“Using measured data of various fidelity with simulations”

Chair: Dave Bosworth

Speakers: Eric Bonnema, Jesse Dean, Tim McDowell

“Methods for quantifying water savings using regression models”

Chair: Chris Balbach (may be changed)

Speakers: Chris Balbach, Jerone Gagliano, Jeff Haberl

“Uncertainty and shortcomings in using building energy simulations” (resubmittal of Chicago seminar)

Chair: Joe Huang

Speakers: Jan Hansen, Tianzhen Hong, Moncef Krarti, Agami Reddy

PAST:**Montreal, June 25-29, 2011**

Modeling Protocols for Building Energy Simulations for Code Compliance and Other Regulatory Programs (Chair: Joe Huang)

Building Simulation 103: Inverse Modeling Toolsn (Chair : Chris Balbach)

Operation-oriented Flexible Building Systems Modeling (Chair: Wangda Zuo)

Simulation Quality Assurance (Chair : Carol Gardner)

Appendix 5 (continued)
TC/TG/TRG SPONSORED SEMINARS

Las Vegas, Jan 29-Feb 2, 2011

Building Energy Simulation 102 (Chair: Keith Cockerham)
Energy Modeling of Existing Buildings (Chair: Sue Reilly)

Albuquerque, June 26-30, 2010

Building Energy Simulation 101 (Chair: Tim McDowell)
Simulation of HVAC/R equipment and systems using the limited data published by manufacturer
(Chair: Michael Wetter)

Orlando, January 23-27, 2010

Web-based Programs for Calculating Energy Code-Compliance (Chair: Larry Degelman)
How to Assess the Performance of Sustainable Buildings (Chair: Moncef Krarti)

Louisville, June 20-24, 2009

Energy modeling of large buildings systems

Salt Lake City June 21-25, 2008

Use of Equation Solvers for Simulation (Chair: Michael Wetter)

New York City/January 2008

How to model nothing – Energy Modeling for Zero Net Energy Buildings: Parts 1 & 2 (Chair: Jan Kosny)

Long Beach/June 2007

Simulation Support for the 2007 Solar Decathlon (Chair: Kamel Haddad)

Dallas/January 2007

Use of Equation Solvers for Simulation (Chairs: Jean Lebrun/Mike Wetter)
Applications of Computer Simulation in High Performance Buildings (Chair: Martha Brook)

Québec City/June 2006

None

Chicago/January 2006

How and Why to Calibrate a Simulation to Measured Data (Chair: Robert Sonderegger)
Application and Experiences with the New Simulation Software (Chair: Dan Fisher)

Denver/June 2005

Neglected Topics in Building Simulation (Chair: Ian Beausoleil-Morrison).

Orlando/January 2005

What to do When Data Misbehave (Chair: Agami Reddy)

Appendix 6
TC/TG/TRG SPONSORED FORUMS

Current as of January 2012

PRESENT:

Jan 21-25, 2012 – Chicago

None

PLANNED (w/priorities):

None

PAST:

Chicago, January 24-28, 2009

“Limitation of Energy Simulations for NZEB” (Chair: Tim McDowell)

Chicago/January 2006

“What Controls Modeling Capabilities are Needed for Energy Simulations?” (Chair: Philip Haves)

ASHRAE TC 4.7 Energy Calculations
Tuesday, January 24, 2012, 6:00-8:30 p.m.
Chicago

Minutes of TC 4.7 Full meeting

6:05 Meeting called to order by Chair Jeff Haberl

6:10 Introductions

6:14 Roll call by Tim McDowell

6:16 Review of agenda and minutes (Haberl)

MOTION: Dan Fisher moved, Chris Balbach seconded, to accept minutes (unanimous voice consent)

6:17 Liaisons

Craig Wray described the establishment of a new MTG (Multidisciplinary Task Group) on high-efficiency air-handling systems. The task is to write a roadmap for making air-handling systems more efficient.

Bass Abushakra volunteered to be the TC 4.7 representative to the MTG.

Craig said they're looking for new partners. Work is mostly coordination, since the research will still be carried out in the TCs.

There are no more liaisons.

6:20 Membership

Jeff has been working with Tim to review the membership. There will be people will be rolling on and rolling off. New candidates for joining TC4.7 are probably all in attendance at this meeting.

6:22 Announcements (all made by Jeff ,unless indicated otherwise):

- ASHRAE is going through a rebranding effort. There is a new logo that shows ASHRAE going literally from blue to “green”. There is also a new tagline and a change to using only its acronym.
- The Hightower Award winner is Don Beaty of TC 9.9. TC 4.7 should be mindful of promoting members who can be candidates.
- Asked to submit a list as potential candidates for volunteers to help with the Advance Energy Design Guide. Those interested should contact Jeff.
- Learned at the TC chair Breakfast that a TC member is not authorized to speak for the TC.
- Details on the TC 4.7 program will be referred to Program SC chair Chris Balbach.
- There is going to be a new page on the TC 4.7 web site for Request for Help.
- There are also going to be options for TCs to hold conference calls via the ASHRAE web site. Those interested should contact Mike Vaughn for help in set up.
- Information on upcoming conferences will also be referred to Chris Balbach.

Subcommittee reports**Applications:** (Huang)

- WS-1588 on “Representative Layer-by-layer descriptions for fenestration systems with specified bulk properties such as U-factor and SHGC” was returned from RAC in August with relatively minor comments. If the WS is not resubmitted, it will expire on August 2012. The WS author (Huang) has reworked the WS in response to RAC comments and circulated paper copies among the voting members.

Minutes of TC 4.7 Full meeting (continued)

MOTION: Huang moved and Chris seconded, that TC 4.7 approve the revised WS and resubmit it to RAC before it meets in April 2012. Motion carried 7-0-1, CNV.

- There was also discussion on a potential RTAR forwarded from the DDM SC to compare LEED buildings to metered data, but so far there hasn't emerged a champion within the SC to move the RTAR forward.

Data-Driven Models (Abushakra)

- There are two new RTARs under development: one on comparing LEED buildings to metered data, which got moved to the Applications SC in Montreal (see above), and another by Robert Sonderegger on "Data Demand Models for Smart Meters". Robert will present this RTAR later during the Research SC report.

Simulations and Component Models (McDowell)

- Long discussion on how to use simulations properly, but later thought this topic is better to be taken up by Applications SC.
- Discussion on Research focused on several RTAR ideas:
 - (1) natural and hybrid ventilation (Phase Two of RP-1456)
 - (2) two possible RTARs from TC 5.5 on chilled beams
 - (3) RTAR on Modelica that requires action and thus deferred to the Applications SC
 - (4) Standard 140 does not have the bandwidth to deal with XXX ? (unclear what was said)
 - (5) Uncertainty of inputs and outputs in simulations

Research (Abushakra)

- At the Research Subcommittee Chairs' breakfast, the following were mentioned:
 1. The availability of Grants-in-aid for students
 2. ASHRAE now has 71 projects under contract; Out of the 71, 12 are being contracted; 5 RTARs and 5 URPs are now being discussed.
 3. TC encouraged to produce new projects There are currently only 6 RTAR and 2 WS.
 4. Most common reason for WSs being returned are: (1) inadequate explanation of relationship to ASHRAE, (2) not clear how the project advances the state-of-the-art, or (3) the budget is not in line with work to be completed.
 5. TC 4.7 has one voting member, and one alternate for the MPG on high-efficiency air-handling systems that Craig had mentioned earlier.
- Status of ongoing projects given by the PMS chairs
 - **1404-RP "Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring"**(Robert Sonderegger). The fundamental question for the project is, "Is it possible to use monitor building data to predict annual building energy performance?" Hopes this will be last PMS meeting for the project. Three test cases were studied, using hourly data, daily data only, and utility data only. The expected results show that under good instances, short-term monitoring may be adequate and is very seasonally dependent. For daily data, one month may be sufficient especially if obtained during the swing season. The project also tells when to stop monitoring, i.e., when temperatures reach the annual temperature. The best results are obtained combining utility with measured data. The statistics used are the Net Mean Bias. The COV (Coefficient of Variance) improved from 20% to 10% when utility bills are combined with hourly and daily data, i.e., two weeks of hourly data and one month of daily data. The PMS has received the draft final report, and a number of editorial

Minutes of TC 4.7 Full meeting (continued)

comments have been communicated to the contractor, but nothing really significant. The PMS is generally very pleased with the project and gives the PI and co-PI high marks.

MOTION: Robert moved to approve the RP 1404 pending suggested changes to the final report, Barnaby seconded. Motion passes 7-0-1, CNV.

- **1416-RP “Development of Internal Surface Convection Correlations for Energy and Load Calculations”** (Dan Fisher). Measured correlations are developed and included in the HOF, and simplified version incorporated in fenestration portion of HOF. One paper has been printed in HVAC&R, and one other paper is being planned. Contractor has done a great job.

MOTION: Dan moved to accept the final report for RP-1416, pending final changes as discussed, Second by Sonderegger. Motion passes, 8-0-0, CNV.

- **1413-RP “Developing standard procedures for filing missing weather data”** (TC 4.2 lead, reported by PMS member Chip Barnaby). The project started several months ago, and are looking to various interpolation methods. The methods will probably vary depending on duration and parameter. The contractor is doing well.
- **1468-RP** (co-sponsored with TC 1.5) Jeff Haberl took the liberty to describe the project, although he is the contractor and thus might present a biased point of view. The objective of the project is to create a procedure or test for converting BIM models into thermal models. There are several commercial packages that do this, but with different results. There are three participating vendors - AutoDesk, Bentley, and Archicad. Reconciling DOE-2.1E w/eQUEST and EnergyPlus was difficult, so everyone decided it was a bad idea and dropped the task. BIM models have a lot of detail, while thermal models have very skimpy details, e.g., walls have no thickness, and no guidance is given on where in a wall to take the dimension, or on walls and windows that are curved vertically and horizontally. A dozen BIM files have been completed, with GBs of data sitting on a server somewhere. The Table of Contents contains images of the BIM and simulation rendering of about 30+ features. The PMS chair is David Branson. The final report is expected by San Antonio.

- **New WSs and RTARs** (Abushakra)

1. Joe Huang gave a very brief overview of the discussion during the Applications SC about a RTAR on "In-situ procedures for LEED buildings". Phil Haves has volunteered to convene a working group to draft a RTAR for San Antonio, but it's unclear how much relationship between Phil's new idea, which focuses more on a calibration protocol, and the original RTAR. Discussion was cut short because there was no action item.
2. Robert Sonderegger described a RTAR on "Data-driven building models for smart meters". Currently the PUC uses very prescription models to fill when data is missing. Objective is to show that DDM methods can do much better than the prescription models. The technique must be applicable to millions of meters. Several use cases have been defined for data loss due to power outage, and demand response. The budget is shown as 100K, and the project duration 18 months. Robert said that his company can supply lots of raw data, so the contractor will not have to worry about data gathering.

MOTION: Tim moved, and Chris seconded, that TC 4.7 approves the RTAR on “Data-driven building models for smart meter.” Motion passed 8-0-0 CNV.

Minutes of TC 4.7 Full meeting (continued)

3. Bass described the status of a RTAR on "Modelica models for the evaluation of supervisory control strategies in the ASHRAE Handbook". There was a letter ballot 9-4-2 in the Fall, after which the RTAR was submitted to RAC. RAC has returned it. Michael Wetter will respond to RAC's comments, and then resubmit the revised RTAR to the TC for a letter ballot.
4. Dan Fisher was asked to describe a RTAR from TC 5.3 Room Air Distribution on "experimental evaluation of the thermal and ventilation of stratified air distribution systems coupled with passive beams". Dan said that he has read over the RTAR and thinks it is in pretty good shape.

MOTION: Dan moved, seconded by Tim, that TC 4.7 co-sponsor TC-5.3's RTAR on "experimental evaluation of the thermal and ventilation of stratified air distribution systems coupled with passive beams".

Chip asked whether TC5.3 is serious about having TC 4.7's co-sponsorship, because it could cause a lot of hassle. Phil and XX suggests an informal change in the title. Motion passed 7-0-0 CNV.

Dan agreed to be the liaison for the PES.

Handbook (Barnaby)

A short meeting was held just prior to this meeting. The deadlines are May 12th for the final draft and delivery to ASHRAE by June 16th. There will be conference call in two and a half weeks to develop a specific work plan, at which point the SC may be calling on various members for help. There's much more to do. (see minutes of the Handbook SC meeting in Appendix E)

Program (Balbach)

There were two seminars sponsored by TC 4.7 in Chicago on Monday. Both were well received and well attended. There is another program item scheduled for tomorrow (Wednesday) (see Program Plan in Appendix F)

Chris announced two upcoming activities:

- (1) ASHRAE Hi-Performance Building Conference Mar 11-13, 2012 in San Diego. There is a call for posters.
- (2) Energy Modeling Conference Oct 1-3 in Atlanta.

Chris mentioned that registration fees for future ASHRAE conferences will go down (\$400?), but that fees for speakers will be discounted by 75% by Dallas, instead of being free.

ASHRAE needs volunteers to review conference papers. Those interested please see Jeff or Chris. Jeff said that the TC's membership list will be submitted to ASHRAE CEC as possible volunteers to be reviewers.

Chris then described the program for the next ASHRAE meeting in San Antonio (reading from the Program Plan as taken from the ASHRAE website). Themes have been replaced by Tracks. People with ideas for seminars in San Antonio are encouraged to contact Chris. The most important element for a successful seminar is the chair.

Chris then moved on to TC 4.7's proposed program for San Antonio. There are five program items (see Program Plan in Appendix F for details).

Minutes of TC 4.7 Full meeting (continued)

Chris then asked various people who have volunteered to chair or present papers to described their programs (all seminars).

MOTION: Chris moved, seconded by Barnaby, to approve the Program Plan. Motion carried 8-0-0 CNV

MOTION: Chip Barnaby moved, and Dan Fisher seconded, that TC 4.7 co-sponsor a TC 4.1 seminar on load calculations versus annual simulations for load calculations. Motion carried 8-0-0 CNV

Phil Haves suggested that the TC chair write a letter to CEC suggesting that presenters can attend their session for free, but not to go to any other sessions.

MOTION: Dan Fisher moved, seconded by Balbach, that the TC chair write a letter to the CEC suggesting that presenters can attend their session for free, but not to go to any other sessions. Motion passes 6-2-0 CNV

Standards (Judkoff)

- Ron Judkoff reported on standards. Standard 140 is the 10th and TC4.7 the Seventh most popular of the 130 standards that ASHRAE published.
- Just completed revision of Standard 140, available in the bookstore. The biggest thing was adding mandatory language to the standard. It allows the IECC and IGCC to feel comfortable referencing ASHRAE standards. Went to 90.1 SC meeting, and informed them of the new standard. 90.1 was not aware of this development, so special language was given to 90.1 to bring them up to date. In addition to mandatory language, BESTTEST & RESNET were added to Standard 140. Also added furnace tests.
- Standard 140 is used in a lot of venues, and IRS won't allow tax credits and software for tax credits without being qualified. 10 software have qualified HAP, Trace, EnergyPlus, DesignBuilder, etc.
- Florida refers to Standard 140.
- Ron did not go to Sydney, but Joel did, and noted that 26 of the 296papers at IBPSA Sydney.
- Talked a lot about work intended to accomplish the net year. will add the ground coupling tests that had been approved and delayed due to the mandatory language change.
- Multi-zone simulations being talked about, but not that far along. Field trials with Haberl/Yuill procedure (). While working for DOE residential program, came up with more residential tests in retrofit applications.
- Don't know how much 140 is referenced, but it's cited and used in many countries around the world.

SPC205 (Barnaby)

- Chip B said SPC 205 standardized representation of equipment. will define three sections : front matter for how matter is presented, 1 section for chiller, 1 section for unitary equipment.

GPC 20 (Barnaby)

GPC 20 gives guidance on how to write use cases for our domain. An RTAR is approved and to fund use cases for operations and maintenance. Forgot article for journal will be written for what they're trying to do.

SPC 209. "Energy Simulation Aided design for Hi-Performance Buildings" has been approved, with Jason as chair.

New Water Standard 191. (Chip reported) got shot down in flames, but SC is recovering and in relatively good footing.

New MTG already covered by Craig Wray, so will not be repeated.

Jeff asked Kris Kinney to report on the Web site. Kris updated to new ASHRAE logo, is in process of working out the links that got broken. Jeff encouraged members to give comment to Kris on the web site.

Related Activities

4.1 (Chip Barnaby) some change to clear sky model , approval of loads calc manual, new project to incorporate

4.2 (Steve Cornick) getting ready for 2013.

4.3 (infiltration & ventilation) no report

4.5 (fenestration - Peter Lyons) RP-1588 and beta version of Window 7 by LBNL (they're looking for window testers), also shading library in beta at LBNL.

6.5 (radiant heating and cooling) no report

7.5 Smart building systems no report -remove Michael Wetter's name

7.6 system energy utilization no report - remove Bass' name

BldgSmart (IAI) (Phil H) they are running tests of 3-D CAD.

IBPSA (Wetter), Had a good meeting with 80 members, well attended, workshops to be held in 3-4 locations in North America over the next 4 months. Approved chapters include Boston, New York, Raleigh, San Francisco, Washington DC, Philadelphia, Portland, and the Twin Cities.

IBPSA- Canada (Ian Beausoleil-Morrison) announced new conferences.

IBPSA World established two IBPSA fellows - Phil Haves & Curt Pedersen. New affiliates include Turkey, Italy, Nordic. Now total 23 associates. On the Building Simulation Journal, the number of articles continue to grow, making it a challenge to get reviewers. Volunteer reviewer are welcomed., see Ian.

IBPSA-England (Malcolm Cook) running their first conference this year 140 abstracts, hoping to convert to 74 papers at Loughborough U Sept 2012. The web site is BSO12.org.

BPI-2400-2-2011 (Chris B) standard that applies to exist standard, requires simulations, but not necessarily hourly. This is being driven by regulatory issues. Home Star several year back sunk, and turned into bill 25E, delivering performance-based tax credits. This standard is a foundation for that

bill to happen. The procedure must be expandable and extensible to large scale. Bill has bipartisan support. Group called Building Star, similar to Home Star, looking into possible extension to commercial buildings. 25E will take a year to pass, if it does.

Joe Huang mentioned that EnergyPlus has been made open-sourced, and that he intends to make DOE-2.1E eventually also open-sourced.

Guideline 14 (Jeff Haberl) didn't take note

COMNET (Charles Eley) completed a series of seminar in October. expanded to three options -tax credit, standard, etc. may work for ASHRAE Bldg EQ program, but that will be delayed. COMNET is being reorganized as a NPO. The technical committee also being restructured. Interested people should contact Charles at charles@eley.com..

Old Business

need people to review FAQs assigned to TC4.7 (jeff). no more than an hrs work (Tim). Kris Kinney said were on the web site and volunteered to do this review.

Jeff mentioned that the bookstore came out with a book "Building Energy Modeling" with no knowledge or input from TC 4.7.

MOTION: Chip moved, seconded by Huang, that the chair write a letter to XXX questioning the review of ASHRAE-printed material. passed 8-0-0 CNV

Meeting adjourned 8:50

Attachments

- A. Agenda
- B. Simulations and Component Models Subcommittee Agenda and Minutes
- C. Data-Driven Models Subcommittee Agenda and Minutes
- D. Applications Agenda and Minutes
- E. Handbook Subcommittee Minutes
- F. Program Plan
- G. SSPC 140 Agenda and Minutes

Attachment A
Agenda
ASHRAE TC 4.7 Energy Calculations – Main Meeting
Tuesday 6:00-8:30pm Wabash (3)

- | | |
|---|--------------------|
| 1. Roll call and introductions | Huang |
| 2. Accept agenda & approve minutes of previous meeting | Haberl |
| 3. Announcements/Liaisons How to get on email list. | Haberl |
| 4. Membership | Haberl |
| 5. Subcommittee reports | |
| 5.1 Applications | Huang |
| 5.2 Data-Driven Modeling | Abushakra |
| 5.3 Simulation and Component Models | Macdonald/McDowell |
| 5.4 Research | Abushakra |
| • 1404-RP Modeling, analysis, and reporting protocols for predicting annual energy performance from short-term building energy monitoring (Milwaukee School of Engineering) | |
| • 1416-RP Development of Internal Surface Convection Correlations for Energy and Load Calculations (TC 4.1/4.7 Univ. of Texas at Austin) | |
| • 1413-RP Missing weather data (co-sponsored with TC 4.2) – underway (underway Univ. of Okla). | |
| • 1468-RP BIM to thermal modeling (co-sponsored with TC 1.5) | |
| • 1588-WS Procedure to create hypothetical layer-by-layer fenestration descriptions when only the bulk properties such as U-Factor and SHGC have been defined. | |
| • RTAR: of Modelica Models for the Evaluation of Supervisory Control Strategies in the ASHRAE Handbook (need to record vote) | |
| • Requests for co-sponsorship | |
| 5.2 Handbook | Barnaby |
| 5.3 Program | Balbach |
| 5.4 Standards | Neymark |
| • SSPC 140 SMOT for Eval Bldg Energy Analysis Computer Programs (Neymark) | |
| • SPC 205 – Std. Repr. of Perf. Data for HVAC&R Eq. & Other Fac'l Eq.(Barnaby) | |
| • SGPC 20 Documenting HVAC&R Work Process and Data Exchange Requirements (Barnaby) | |
| • New Standard “Energy Simulation Aided Design for High Performance Buildings” (Glazer) | |
| • New Water Standard 191 | |

Attachment A
Agenda (continued page 2 of 2)
ASHRAE TC 4.7 Energy Calculations – Main Meeting
Tuesday 6:00-8:30pm Wabash (3)

- New MTG.EAS Energy Efficient Air-Handling Systems – Needs volunteer appointed (Neymark?) (Wray)

5.5 Web Site

Kinney

6. Related activities reports

| | |
|---|----------------|
| TC 2.8 Building Environmental Impacts and Sustainability | Crawley |
| TC 4.1 Load Calculation Data and Procedures | Pedersen |
| TC 4.2 Climate Information | Degelman |
| TC 4.3 Infiltration & Ventilation Requirements | MacDonald |
| TC 4.5 Fenestration | Barnaby |
| TC 6.5 Radiant Heating and Cooling | Sommer |
| TC 7.5 Smart Building Systems (now includes TC 7.4) | Wetter |
| TC 7.6 Systems Energy Utilization | Abushakra |
| BuildingSMART (formerly IAI International Alliance for Interoperability) | Haves |
| IBPSA: USA, SimBuild ; Canada, eSim IBPSA | Wetter, Hensen |
| BPI-2400-2-2011 Standardization Qualification of Whole-house Energy Savings | Balbach |
| Est. | Huang |
| Potential for open source simulation (DOE-2) | Haberl |
| Guideline 14 | |

7. Old Business

Haberl

8. New business

Haberl

9. Executive Session

Haberl

10. Adjourn

Haberl

Attachment B
TC 4.07 Simulation and Component Models Subcommittee
Monday, 23 January, 2012
6:00-7:30pm, Salon 6/7 (3rd floor)

Agenda

- 1) Introductions and Agenda Review (5 minutes)
- 2) Approval of minutes (5 minutes)
- 3) Program (20 minutes)
 1. 2012 Winter (Chicago)
 Monday, January 23, 2012, 8:00 AM-9:30 AM, **Seminar 18 (Basic)**
Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling
 Monday, January 23, 2012, 2:15 PM-3:45 PM, **Seminar 28 (Intermediate)**
Improving Energy Modeling Consistency
 Wednesday, January 25, 2012, 8:00 AM-9:30 AM, **Seminar 44 (Advanced)**
Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 1
 Wednesday, January 25, 2012, 11:00 AM-12:30 PM, **Seminar 53 (Advanced)**
Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 2
 2. 2012 Annual/Summer (San Antonio)
 3. 2013 Winter (Dallas)
- 4) Research (50 minutes)
 1. Active Research (5 minutes)
 1416-RP *Development of Internal Surface Convection Correlations for Energy and Load Calculations* (Contractor: UTexas; PMS Chair: Fisher)
 2. Work Statements (20 minutes)
 WSxxxx *Develop comprehensive performance rating procedure for unitary equipment*
 (co-sponsor request from TC 8.1; Barnaby)
 WS/RTARxxxx *Assess and Implement Natural and Hybrid Ventilation Models in Whole-building Energy Simulations* (Phase Two) (Huang, Cook, Kolderup, Macdonald, Rees)
 3. RTARS (20 minutes)
 RTAR1629 *Testing and Modeling Energy Performance of Active Chilled Beam Systems*
 (co-sponsor request from TC 5.3; Macdonald)
 RTARxxxx *Development of Modelica Models for the Evaluation of Supervisory Control Strategies in the ASHRAE Handbook* (Wetter)
 RTARxxxx *Air-to-air heat exchange* (co-sponsor request from TC 5.5; Macdonald)
 4. Research Plan/New ideas (15 minutes)
 Validation Issues (Haves, Macdonald)
 Uncertainty (Haves, Macdonald)
- 5) AOCB (10 minutes)

Attachment B (continued page 2 of 4)
(TC 4.7 Simulation and Component Models Subcommittee)

Attendance

| Name | Affiliation | E-mail (deleted) |
|-------------------------|---------------------------------|-------------------------|
| Tim McDowell | TESS | |
| Jeff Haberl | TAMU | |
| Payam Delgoshaei | PSU | |
| Madhu Iyengar | TC9.9 | |
| Kirby Nelson | | |
| T. Agami Reddy | ASU | |
| Dane Bosworth | BuildLab | |
| Eric Studer | TNZ Energy Consulting | |
| Amir Roth | DOE/EERE | |
| Michael Wetter | LBL | |
| Hyojin Kim | TAMU | |
| Nuri Bae | University of Michigan | |
| Antonio Huizar | kW Engineering | |
| Sean Harleman | kW Engineering | |
| Li Zhang | Carrier Corp | |
| Dan Fisher | OSU | |
| Bereket Nigusse | FSEC | |
| Chandan Sharma | FSEC | |
| Ery Djunaedy | University of Idaho | |
| Malcolm Cook | Loughborough University | |
| Ian Beausoleil-Morrison | Carleton University | |
| Robert Sonderegger | Itron, Inc | |
| Chris Baker | The Weidt Group | |
| Wangda Zuo | LBL | |
| Chris Balbach | Performance Systems Development | |
| Keith Cockerham | DLB Associates | |
| Mitch Paulus | MSOE | |
| Kelsey Van Tassel | Sustainable Engineering Group | |
| Bass Abushakra | MSOE | |
| Peter Armstrong | MASDAR Institute | |
| Juan-Carlos Baltazar | TAMU | |
| Tom Webster | UC Berkeley | |
| Wilmer Pasut | US Berkeley | |
| Fred Bauman | UC Berkeley | |
| Joe Huang | White Box Technologies | |
| Therese Stovall | ORNL | |
| Som Shrestha | ORNL | |
| Erik Kolderup | Kolderup Consulting | |

Minutes

- Meeting started at 6:00 PM by Tim McDowell.
- Introductions were made

Program

- There is about one month left to get program items for San Antonio to ASHRAE by Feb 15th.

Attachment B (continued page 3 of 4)
(TC 4.7 Simulation and Component Models Subcommittee)

- TC 4.1 would like to partner with TC 4.7 – difference between load calculations with RTS versus simulation programs “Run things twice loads and energy models”, looking for co-sponsorship. Dan Fisher volunteered to be the TC 4.7 liaison.
- A.Reddy told the subcommittee that he had been at a previous meeting where folks were asking why do different programs get different answers? Would this be a good topic for a session. There was some discussion about whether or not this is needed. Several mentioned that there are fundamental differences between programs.
- P.Haves reminded the subcommittee that what ASHRAE needs to do is to show ASHRAE members how simulation can be used to help them, not so much what is wrong with simulation. What’s useful.
- D.Fisher suggested that the input uncertainty might be a good topic for a seminar.
- J.Huang said he just got done finishing Seminar 28, that discussed how do you adjust a model to calibrate it. This was very well received.
- J.Huang said that the topic of how to calibrate was a much better topic that “uncertainty” might not be. Use cases where models were calibrated, and how the calibrated model was then used.
- C.Balbach suggested continuing the good work, perhaps something with Guideline 14?
- M.Cook said that there might be a seminar on best practice for using simulation tools.
- M.Wetter thought that a discussion of the risks associated with simulation might be a good idea. Or from a design engineer’s perspective, how do you address these issues.
- A.Reddy agreed that source & cause of uncertainty and error would be a good topic.
- M.Cook said that TC 4.10 was working up a seminar on Thermal Comfort modeling that might be of interest.

Research

- **Work Statements from the previous meetings:**
 - **Rating of unitary equipment** – no progress
 - **Natural and hybrid ventilation (phase 2)** – J.Huang, - no progress, perhaps Phase 2 could get more and/or better data to improve the results from Phase 1
ACTION: J.Huang will work on this with help from others
- **RTARS from the previous meetings:**
 - **RTAR 1629 Chilled beams?** F.Bauman said that they were working on this but did not have this done yet.
ACTION F.Bauman said that they have another one on passive chilled beams he will pass to the subcommittee

Attachment B (continued page 4 of 4)
(TC 4.7 Simulation and Component Models Subcommittee)

- **Modelica modeling RTAR.** This was approved by letter ballot, but M.Wetter said this was returned. Asked for several questions to be answered: how to use existing tools? Can it get DOE co-sponsor? Does it just have to focus on building models? What about systems models?
- T.McDowell felt these could be addressed with editorial changes.
ACTION: M.Wetter will address the comments with help from others and recirculate for comment to the TC for review and approval.
- **RTAR on air to air heat exchange;** No progress on this since Montreal.
- **New Ideas**
 - F.Bauman handed out copies of a research topic that was addressing passive beams to circulate air across a cooling coil.
Data would be used to generate new design guides, algorithms, etc.
TC 5.3 was sponsoring, looking for TC 4.7 cosponsor
ACTION: F.Bauman agreed to present Tues at the main meeting for a vote to co-sponsor
 - P.Haves brought up validation issues and uncertainty
On validation, P.Haves said that Standard 140 was just a Standard Method of Test – SMOT. At the meeting there was a discussion as to how to apply simulation to different cases. This seems to address why can simulation get the right answer. Part of the issue is the algorithms. Do they represent the real physics? There seems to be a backlog of model validation. Lots of new models, but very little validation.
On uncertainty, P.Haves said that there was a need for simulation to have “error bars”. This was very unusual for engineering since most fields have error bars.
Simulation results need error bars. What are the errors in the inputs. We are clear to say why it does not agree: weather, occupants. However, we are not helping to explain what is wrong. If we had bounds on the inputs this would help. If we had procedures on how to characterize the inputs this would help.
In general terms there is a challenge to TC 4.7 – how can simulation output be made more useful. How do we maximize the usefulness of simulation? How do we develop procedures for quantifying simulation uncertainty?
AReddy asked if simulation should be aid design or be used to simulate reality?
- Building labeling?
K.Cockeran asked if TC 4.7 could be helpful with the ABEQ program? This needs the uncertainty to be answered.

Meeting Adjourned

Attachment C
TC 4.07 Data Driven Models Subcommittee
Monday, 23 January, 2012
7:30—9:00pm, Salon 6/7 (3rd floor)

Minutes

(Agenda and Attendance not available)

- Bass called the meeting to order at 7:47
- Introductions
- Attendance around 30
- Approval of minutes 7:48 - skipped to full meeting for approval

Program (7:49)

- There was nothing in the program at Chicago
- BA would like to encourage more activity from w/i the SC
- BA turned the meeting over to Chris Balbach on program, but before doing that BA described the technical paper RP-1404 for Dallas, wonders if there are others who are interested in participating and then turn it into a Technical Session.
- Chris Balbach reviewed the program (7:52)
- Idea from Nick Long that could fit in with RP-1404 for a symposium
- Robert Sonderegger asked for clarification on whether we were talking about one or two symposium? Robert said that RP-1404 has done very well, and has two papers in hand, which are being held back to make sure they're consistent with other papers, so there are three papers in hand for Dallas.
- BA encouraged more ideas for the program.
- Zulfi asked whether there could be data-mining thousands of runs. Robert Sonderegger said that he had an RTAR on this for years, but it didn't get picked up by ASHRAE.

- BA said that people would like to hear about any experiences in analyzing monitored data and what was learned from it.

RTARs

- 8:01 BA moved the agenda to discussing RTARs
- There is one RTAR in the works developed by Robert Sonderegger with the title, "Data driven building models for smart meters".
- BA thinks it's in fine shape and intends to forward it to the full TC.
- BA asked Robert to described the RTAR, but RS asked for 10 minutes to refresh his memory.
- BA mentioned another draft RTAR on "In-situ procedures for energy performance of LEED Certified Buildings"
- Agami said that having LEED in the title is a red flag to ASHRAE, maybe change the title?
- BA asked for volunteers to review the RTAR.
- There was uncertainty whether the building models were accessible. Some said that LEED applications do not require submitting the input files, some said no.
- Someone (guy next to Keith) said perhaps the title should be changed to "how well does Appendix G predict energy performance of high-performance buildings ?" and avoid the use of LEED in the title.
- Agami asked whether this can be related to ASHRAE's Building EQ (Energy Quotient)?

-
- Joe Huang asked for clarification on the objectives of the RTAR, i.e., is it to find out why the simulation results are so different from the measured data, or why are the buildings performing so differently than expected?
 - Jeff Haberl suggested that Huang take the RTAR to Applications for further discussion.
 - The agenda returned to Robert Sonderegger to describe his RTAR. Robert said that
 - ASHRAE is in much better than private companies to apply DDM methods to smart meter data, and proceeded to mention several use cases for filling missing data, demand response, establish baselines etc. For Smart Meters this procedure must be completely automated. The current methods are poor, so improvements should be relatively easy.
 - Jeff Haberl asked what kind of models would be best? Robert replied that he doesn't have any preconceived ideas about this, except that he wants the contractor to look also at suitability.
 - Bass said he wants to take the RTAR to the full committee. Tim McDowell thought that would be difficult given there's been no review of the RTAR. Bass agreed to circulate the RTAR tonight for everyone to review.
 - Bass then asked for new ideas, such as using DDM to estimate water use?
 - Jeff Haberl talked about some work he's done on using change-point model to estimate water usage.
 - Michael Wetter asked Jeff why is there interest in knowing water use in individual buildings?
 - Jeff Haberl said that water use has an electricity component to it, and that there is also water shortage in parts of Texas.
 - Since it's close to 9 pm, Bass Abushakra said he wants to wrap up the meeting, and asked that anyone interested in developing an idea and wants his (Bass') help to come and get a business card from him.
 - meeting adjourned

Attachment D
TC 4.7 Applications Subcommittee
Tuesday, 24 January 2012
3:30-5:00pm Salon 4

Agenda

- 1) Introductions and Agenda Review (5 minutes)
- 2) Program (15 minutes) (Chris Balbach)
 - a. 2012 Winter (Chicago)
Seminar 28: *Improving Modeling Consistency* (chair Joe Huang) , presenters: Ellen Franconi, Erik Kolderup, Allan Daly (Monday 1/23 2:15-3:45)
 - b. 2012 Summer (San Antonio)
 - c. 2013 Winter (Dallas)
 - d. Beyond
- 3) Research (65 minutes)
 - a. Existing Work Statements (5 minutes)
 - 1588-WS Representative Layer-by-Layer Descriptions for Fenestration Systems with Specified Bulk Properties such as U-Factor and SHGC (co-sponsored by TC 4.5) (Joe Huang)
 - b. Ideas for new RTARS or other research activities (15 minutes each)
 - Update on TC 4.7 involvement in the review of COMNET and other COMNET-related activities (Ellen Franconi if available, others).
 - Update on Hi-Performance Buildings TPS (Jason Glazer, if available)
 - Should TC 4.7 maintain a set of prototypical building models and input files, possibly building on DOE's "Reference Building Models" (Bass Abushakra, Joe Huang)
 - Reconciling differences in computer simulation results (Joe)
- 4) Any other ideas and burning issues (time permitting) (5 minutes)

Attachment D (continued)
(TC 4.7 Applications Subcommittee)

Attendance List

| Name | Affiliation | E-mail |
|-----------------|---------------------------------|---------------|
| Xiang He | Oklahoma State University | |
| Chris Balbach | Performance Systems Development | |
| Sue Reilly | Group 14 Eng. | |
| David Bosworth | Cornell | |
| John Pruett | ZMM, Inc. | |
| Ron Judkoff | NREL | |
| Hyojin Kim | TAMU | |
| Michael Wetter | LBNL | |
| Richard Liesen | US Army Corps of Eng | |
| Bass Abushakra | Milwaukee School of Eng. | |
| Wangda Zuo | LBNL | |
| Kamel Haddad | NR Canada | |
| Keith Cockerham | DLB Associates | |
| Chris Baker | The Weidt Group | |
| Tim McDowell | TESS | |
| Jeff Haberl | TAMU | |
| Peter Lyons | DesignBuilder Australia | |
| Therese Stovall | Oak Ridge National Laboratory | |
| Larry Degelman | TAMU | |
| Jerone Gagliano | Performance Systems Development | |
| Mitch Paulus | Milwaukee School of Eng. | |
| Ery Djunaedy | Univ. of Idaho | |
| Joe Huang | White Box Technologies | |
| Joel Neymark | J. Neymark & Assoc | |

Minutes

- J.Huang started the meeting at 3:37 PM
- Introductions were then made.
- J.Huang then asked the subcommittee to review the agenda, which was projected on the screen.

PROGRAM

- C.Balbach reviewed the upcoming ASHRAE conferences: San Diego, March 2012; Energy Modeling conference, October, Atlanta, 2012.
- Chris Baker, Waite group, One suggestion for a seminar was to see how well modeling agreed with utility data, perhaps a broader look to see if we can produce simulations that represent real buildings (all one program). After the buildings were constructed there was a walk through to see what's in it. Weather and occupancy were then corrected. Purpose was to see how accurate were the design predictions at predicting the metered data. What was found in some buildings was the they did not agree and it was due to the heating being off.

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- J.Huang had an idea for a seminar for how different programs simulate specific things. For example how well does DOE-2 work when hooked to Atticsim. Problem is that it gets odd results, for example a heating penalty when not expected for white roofs. Perhaps this is due to the difference in the heat balance method vs weighting factor method. The final test would be to determine what is causing this.
 - S.Reilly said she might have something to contribute to such a seminar.
 - K.Cocharan said that perhaps one could have a forum to look at 'what is the state of the art' for simulation.
 - J.Huang said that it was suggested at the last Seminar that there be a follow-on to the seminar at Chicago.
 - J.Huang said that Fred Bauman said they were just finishing up on their analysis for the 4 Times Square building.
 - C.Balbach said one idea for a Forum was to talk about how energy models can be used in operation.
 - R.Judkopf said he would offer up a paper on a test for calibration methods.

RESEARCH

- J.Huang said that there was an idea that was passed to him from the Data Driven subcommittee regarding how well LEED simulations actually reflect real use?
- J.Huang then discussed the WS "Representative layer-by-layer descriptions for fenestration systems with specified bulk properties such as U-factor and SHGC". He discussed the comments from RAC:
- J.Huang also said that TC 4.7 needed to contact TC 4.5 to get agreement on the need.
- J.Huang took the WS to TC 4.5, where it was well received.
- J.Huang mentioned that TC 4.7 had previously approved the WS, so there would not be a need to revote it.

NEW RTARS

- Update on TC 4.7 involvement in COMNet related activities. TC 4.7 has been reviewing COMNet. J.Huang has asked C.Eley to come to the full committee meeting. C.Eley agreed to come to the full meeting.
- Update on Jason Glazer's Standard for the use of Modeling for Standards. This was approved for ASHRAE and it was set up, but they have not had a meeting yet. There is a way to join on the ASHRAE web site if folks are interested.
- Next item: should TC 4.7 maintain a set of prototypical building models? There is a set of reference models at NREL, but these may or may not have been vetted.
- B.Abushakra said that the models are useful. They encompass most of the building sector. He thought such a library would be useful for testing data driven models.
- P.Haves said that the PNNL set was used for codes. He thought that whatever gets done be done with some caution. For example, how are these models going to be maintained?
- R.Judkopf said that the reference buildings were developed to be a consensus of efforts in 2005.

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- J.Huang said he started the files in DOE-2, then translated to EP+, and he thought they were consistent.
 - J.Huang asked the committee what would be the use of the models? Should ASHRAE actually get the library and then do something with them.
 - K.Haddad asked if 90.1 should get involved?
 - J.Huang that this would be a good idea. 90.1 is completely reliant on these models from NREL.
 - J.Huang said that he has heard rumblings that the models for 90.1 need further review.
 - B.Abushakra asked about what would the funding be used for?
 - R.Judkopf said that NREL knows a lot more about big box stores than is in the models and it would be nice to have a mechanism to do this.
 - J.Haberl said there was a need to look more clearly at the prototypical models as they don't seem to represent all types of buildings across the country.
 - J.Huang suggested that prototypical models might be "rubber like" to allow them to stretch, etc.
 - R.Leisen said that there was a TRP-1651 that was looking at this now and that this needed to be looked into.
 - J.Haberl suggested that it might be interested to have macro parameters across multiple buildings to allow for what ifs across building types.
 - K.Cocheran thought these would be useful for ASHRAE
 - J.Haberl said that would help with this effort.
 - Question: what to do since CBECs has been discontinued? Dodge-McGraw Hill? BOMA?
 - J.Huang then discussed the RTAR about "whether or not ECB or Appendix G buildings do not live up to expectations"
 - J.Gagliona said that one suggestion was how to take the LEED simulation or Appendix G simulation and develop an agreed procedure to make it match real consumption.
 - J.Huang said that there were lots of examples of how to do this...the real operations of buildings were such and such...should 90.1 change their operating assumptions. There was lots of sensitivity about this. What would those parameters be?
 - T.McDowell said that what J.Huang just said did not reflect with the current RTAR.
 - J.Huang thought this might involve getting the utility bills, getting the original input file and seeing how they agree or not.
 - P.Haves said that we need some sort of a protocol to go from the design model to something that's more useful – a systematic procedure. Make the model reflect the bad parts of the building, make it separate those things from the know things that aren't working.
 - J.Huang said that the utility bills only reflect the actual use.
 - J.Haberl suggested a title "calibrated simulation for performance based architecture" or "calibrated simulation to measure the performance of a new building".

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- K.Cocheran said that a lot of the LEED buildings have gone back to get the LEED EB...and went back to get the data to do this. He thought that there would be a number of these that might be available.
 - T.McDowell said that he felt that there was too much confusion...
 - P.Haves thought development of a protocol to take the design protocol to go to the actual conditions. These would allow for the actual performance to be assessed. This would take heat out of current argument. Calibration will play a part.
 - J.Haberl suggested an "ASHRAE ABEL AB" for "As Built".
 - B.Abushakra said that the protocol would help to identify the causes in the differences in the actual performance and the simulated performance of the design model.
 - S.Reiley thought that some of the problem is the 'Mis-application' of simulations. Simulations are mis-applied if they are used to rate the building operator without putting actual operation back into the model.
 - P.Haves agreed to write an RTAR. J.Haberl agreed to help with this.

OTHER IDEAS

- J.Haberl said there was a need for more advice on BIM to thermal models. P.Haves agreed that there is a need for this, information as to how to model standard practice.

MEETING ADJOURNED 5:00 PM

Attachment E
ASHRAE TC 4.7 Energy Calculations
Handbook Subcommittee
Tuesday, January 24, 2012, 5 – 6 PM
Palmer House, Chicago, IL

Minutes**Attendance**

| Who | Affiliation | eMail |
|-----------------|---------------------|-------|
| Ron Judkoff | NREL | |
| Tim McDowell | TESS | |
| Jeff Haberl | TAMU | |
| Joel Neymark | JNA | |
| John Pruet | ZMM | |
| Erik Kolderup | Kolderup Consulting | |
| Chip Barnaby | Wrightsoft | |
| Hyojin Kim | TAMU | |
| Chris Baker | | |
| Mitch Paulus | | |
| Kamel Haddad | NRCAN | |
| Bereket Nigusse | FSEC | |
| Therese Stovall | ORNL | |

The approved, revised chapter manuscript must be delivered to ASHRAE by June 16, 2012 – this is before the SA meeting. This requires completion of final draft by May 1, 2012.

A working group has been formed (see Action Items) to plan how complete the required revisions. A conference call will be held in the next few weeks. Chip Barnaby will schedule a conference call to identify two classes of revisions – high priority and optional (aka “A” and “B” lists).

Chip Barnaby will check whether any survey results were received.

Kamel Haddad volunteered to help with revisions.

Action Items

| Who | What | When |
|---|--|----------------------------|
| Jeff Haberl / TAMU students | Assemble updated references. Identify recent research projects that should be cited. | Feb. 15, 2012 |
| Chip Barnaby | Set up Doodle poll for planning conference call to be held Feb. 2 – 10. | January 30, 2012 |
| <i>Working group --</i> Chip Barnaby, Erik Kolderup, Ron Judkoff, Joel Neymark, John Pruit | Planning conference call. Goal is to assemble “A” and “B” lists of needed changes | Per results of Doodle poll |
| Working group + others to be coerced later | Perform revisions | Draft by May 1, 2012 |
| TC 4.7 | Vote approval | June 1, 2012 |
| Chip Barnaby | Submit to ASHRAE | June 16, 2012 |

Attachment F
TC 4.7 Program Plan

January 21- 25, 2012, Chicago IL

Theme: N/A!

TC 4.7 SPONSORED PROGRAMS PRESENTED AT CHICAGO:

MONDAY: SEMINAR 18: Standard 205P: Hassle-Free Equipment Performance Data for Energy Modeling
Chair: Chris Balbach, P.E. Speakers: Charles S. Barnaby, Mark Hydeman, P.E., Neal Kruis,
Attendance:

MONDAY - SEMINAR 28: Improving Energy Modeling Consistency
Chair: Joe Huang, Speakers: Erik Kolderup, P.E., Thomas White, P.E., Ellen Franconi,
Attendance:

WEDNESDAY - SEMINAR 44: I Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 1
Chair: Wangda Zuo, Ph.D., Speakers: Jan Hensen, Ph.D., John Zhai, Ph.D., Ian Beausoleil-Morrison, Ph.D
Attendance:

WEDNESDAY SEMINAR 53: Integrated Multi-Domain Simulations for Innovative Building Design and Operation, Part 2
Chair: Jerone Matthew Gagliano, P.E. Speakers: Michael Wetter, Ph.D., Wangda Zuo, Ph.D., Yao-Jung Wen, Christophe Von Treeck/Sebastian Stratbucker
Attendance:

ASHRAE High Performance Buildings Conference - A Focus on Deep Energy Savings
March 12-13, 2012, San Diego, CA
Call for Posters due February 3rd

Energy Modeling Conference: Tools for Designing High Performance Buildings
October 01 - 03, 2012 Atlanta, GA, USA
Abstracts due: 2/15/12, Decisions: 3/15/12 Accepted speaker forms due: 4/15/12 Presentations due: 9/1/12
Conference: 10/12

Next ASHRAE Meeting: June 23 - 27 2012 / San Antonio TX WEBSITE
(<http://ashraem.confex.com/ashraem/s12/cfp.cgi>) OPEN

Track 1 HVAC&R Systems & Equipment
Track 2 HVAC&R Fundamentals and Applications
Track 3 Integrated Energy Systems

Track 4 Building Modeling Applications

Track Chair: Pam Androff Email: pamela.androff@gmail.com

In our modern times, building design almost always demands some version of modeling, but the debate continues as to what is the most effective method to simulate various building systems. The stakes are especially high for building designs that require validation in effectiveness prior to installation. This track seeks papers and programs that focus on understanding, manipulating, and optimizing building design choices via modeling.

The programs will cover modeling fundamentals, building component contributions, system right-sizing, 3-D computer simulation advantages, and advanced energy modeling techniques

Attachment F
TC 4.7 Program Plan (continued, page 2 of 4)

Track 5 Refrigeration Applications
 Track 6 Indoor Environmental Applications
 Track 7 Integrated Building Controls

SAN ANTONIO PROGRAMS SCHEDULE:

| | |
|-------------|--|
| February 13 | Seminar, Forum, TPS and CPS Program Proposals Due |
| February 13 | Technical Papers Final Reviews |
| March 7 | Final Technical Papers Due |
| March 9 | Revised Conference Papers Due |
| March 16 | Notifications of Seminar and Forum Accept/Reject Distributed |
| March 30 | Conference Papers Accept/Reject Notifications |
| April 5 | Final Conference Papers Due |
| May 4 | Upload of PPTs Begin |
| June 4 | All PPTs Due Online |
| June 23 | Speaker's Lounge Opens |

POTENTIAL SEMINAR SUBMISSIONS FOR SAN ANTONIO

SEMINAR # 1 CHAIR: (Chip Barnaby / Neal Krus) TITLE – 3 perspectives on SPC 205P (Chip)

3 speakers who would be a consumer of 205P, and product manufacturer complying w/ 205P and a software vendor working w/ 205P data

SEMINAR #2 CHAIR Keith Cockerman –“Calibration 102” – follow-up to seminar 28

Joe Huang- Fred Bauman (Simulation calibration of New York Times) New case studies of calibration

SEMINAR #3 CHAIR – CHRIS BAKER (WEIDT GROUP) –Topic - Calibration? Follow up on

White Box (Joe Huang) RE: differences between different programs for same process AtticSim coupling w/ DOE-2 vs EnergyPlus;
 Weidt Group on 10 school model calibrations;
 Speaker from Group 14 (Sue Reilly) RE: Informed energy audits for MF;
 Speaker from NREL (Ron Judkoff?) RE: BESTEST-EX

SEMINAR #4 CHAIR – DAVE BOSWORTH TITLE: Using measured data of various fidelity with simulations

Speaker from NREL (Eric Bonnema) RE: AEDG – use of building profiles (schedules, to inform modeling;
 Speaker from NREL (Jesse Dean) RE: NREL RSF - Generating fully articulated models from building sub-metered data);
 Speaker TES (Tim McDowell) RE: How to calibrate and what can be learned when very detailed measured data of system output of a collection of components (flow rate, temp, pressure) are available (how to we take that data and match it to a theoretical model and extract value).

SEMINAR #5 CHAIR – CHRIS BALBACH TITLE: "Method for Quantifying Water savings using Regression Models"

Speaker 1 (Chris Balbach) - Can reliable baseline regressions be determined (across different geography) using monthly bills and average monthly dry bulb (or another variable) across the country? (need 5 - 7 different locations and a decent 12month data set for each bldg). Quantifying CV-RMSE-> Uncertainty to say whether or not (2) is valuable;
 Speaker 2 (Jerone) - Determining Water Savings associated w/ a specific project Pick one building where a prediction of savings was made. Determine pre, post and predicted and evaluate uncertainty, etc. Do we have a property where Can we get it for ONE bldg;

Attachment F
TC 4.7 Program Plan (continued, page 3 of 4)

Speaker 3 – (Jeff Haberl) - "How to convert predicted savings to societal energy savings" (JEFF HABERL will present this). This is going to be dependent on details for each muni water system, etc)

Other ideas from prior TC 4.7 subcommittee meetings?

1) TC4.7 (Simulation and Component Models) Seminar Chair: Joe Huang:
 Topic Reasons or Causes for Uncertainty in Building Energy Simulation
 Speakers: Ian, NREL, Jan Hansen

2) TC4.7 (Applications) Seminar Chair: **Chair Needed** (Tim McDowell) EK – submit & Fail...
 Topic Building Simulation 104 Analysis of uncertainty....Uncertainty validation and calibration input uncertainty, output uncertainty of the result...
 Speakers Phil Haves, Nick Long, Ron Judkoff

3) TC4.7 (Data Driven Models) Seminar Chair: Bill Koran
 Topic UNCERTAINTY Technical
 Speakers TBD

Code-Compliance

Scheduled

Organized by: TC 4.7 (Applications)
 Chair: Larry Degelmann
 Status: Moved from Dallas. (Jeff Haberl, Eric Richmond, Paul Mathew).

Seminar "How to Assess the Performance of Sustainable Buildings"

Scheduled

Organized by: TC 4.7 (Data Driven Models)
 Chair: Moncef Krarti
 Status: 4 speakers (B. Koran, Bass Abushakra, David Claridge)

Seminar "Computer Simulation of Supermarkets"

Not scheduled

Organized by: TC 10.7 (co-sponsored by 4.7)
 Chair: Van D. Baxter, ORNL
 Status: Since 7/09. Has 4 speakers

Transaction "Use of 'equation solvers' for Simulation"

Organized by: TC 4.7 (Data Driven Models)
 Co-Chair: Jean Lebrun/Michael Wetter
 Status: Have 1 paper (Lebrun), need one more paper.

Forum "Should ASHRAE Develop a Standard for Simulation Aided Design of High Performance Buildings"

Track: Sustainability/LEED
 Organized by: TC 4.7 (Applications)
 Chair: Jason Glazer
 Status: Since 6/08

Conference Paper "Use of Building Energy Simulation in Energy Code and Policy Analysis"

Organized by: TC 4.7
 Chair: Russ Taylor
 Status: Since 1/09. 3 speakers (R. Taylor, R. Brahme, K. Otto)

Attachment F
TC 4.7 Program Plan (continued, page 4 of 4)

Seminar “Simulation Support for the Solar Decathlon”

Track: Applications

Organized by: TC 4.7 (Applications)

Chair: Kamel Haddad

Status: Since 6/07. Has speakers.

Seminar “Shoot-out of Code Compliance Simulation for Residential Buildings”

Organized by TC 4.7 (Applications)

Chair: Jeff Haberl

Seminar “Simulation of HVAC/R equipment and systems using the limited data published by manufacturer”

Track: Systems and Equipment

Organized by: TC 4.7 (Simulation and Component Models)

Chair: Michael Wetter

Status: Since 6/08. Joel Neymark, Vincent Lemort, Stephane Bertagnolio & Jean Lebrun, Craig Wray.

Seminar “You don't know what you've got 'till it's checked! The importance of QA in benchmarking energy analysis results”

Organized by: TC 4.7 (Simulation and Component Models)

Chair: Russ Taylor

Status: Since 1/08. Had two speakers (summer 09).

Attachment G
SSPC 140
(Standard MOT for the Evaluation of Building Energy Analysis Computer Programs)
Monday, January 23, 2012 2:15 – 6:15 PM
LaSalle 5, Palmer House
Chicago, IL
Chair: Ron Judkoff

SSPC 140 Meeting Summary –1/23/12 (submitted 1/24/12)

Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs.

- **ANSI/ASHRAE Standard 140-2007 listed with ASHRAE’s 10 Most Popular Standards and Guidelines.** It is 7th (recently moving up from 8th) on the list of 111 Standards and 18 Guidelines. See http://www.techstreet.com/lists/ashrae_standards.tmpl
- **Standard 140-2011 continuous maintenance revision was published in January;** the CM revision integrates the following:
 - Standard 140-2007
 - 140-2007 Addendum A (updated modeler reports to match content and format of those used for posting Standard 140 results on the DOE Tools Directory web site)
 - 140-2007 Addendum B (HERS BESTEST)
 - 140-2007 Addendum C (ICC language changes)
 - Errata related to Section 5.4 (Furnace tests)
 - **Kudos to Steve Ferguson (ASHRAE Standards Staff) and ASHRAE Pubs Staff.**
- **Current IRS rules** (IRS notice 2008-40, published Apr 2008) relating to the deduction for energy efficient **commercial buildings** require software used for assessing tax credits be tested to Standard 140-2007. Currently **11 programs are qualified**; since Jan 2011, **one** was added; **four** programs qualified updated versions. **New submittals** brent.griffith@nrel.gov
Qualified programs listed at www1.eere.energy.gov/buildings/qualified_software.html
- **Current IRS rules** (IRS notice 2008-35, published Mar 2008) for evaluating **residential building** energy efficiency tax credits; **5 tools are qualified** for this purpose so far. Tools are required to conform to RESNET’s 05-001 (Nov 17, 2005) and 06-001 (June 1, 2006), which include NREL’s HERS BESTEST (recently included in Std 140-2011), along with equipment modeling and other modeling tests developed by RESNET. **Direct new submittals to RESNET**, P.O. Box 4561, Oceanside, CA 92052-4561. Qualified programs listed at: <http://www.irs.gov/businesses/small/industries/article/0,,id=155445,00.html>
- **Latest versions of IECC and IGCC to cite 140-2011 (will update from 140-2007 + addenda)**
- **90.1 ECB SubC working on updating its reference to Std 140; currently at 140-2004**
- FL Bldg Code using 140 for comml; HERS and FL-HERS BESTEST, and RESNET tests for resl.
- ASHRAE Standard 140, “BESTEST”, and/or the NREL/IEA underlying BESTEST methodology reports and papers were cited in 26 of the 392 Building Simulation 2011 (Sydney) papers

Standard 140-2011, Proposed Addendum A (BESTEST In-Depth Slab-On-Grade Ground-Coupling adaptation by NREL/JNA) was approved by SSPC 140 for publication/public review via letter ballot closed Apr 22, 2010, and completed Public Review with no comments during Fall 2010. Publication is on hold pending revisions to comply with ICC language requirements; those revisions will have to be public reviewed (as we did for 140-2007-C).

Attachment G (continued, page 2 of 4)
SSPC 140 Meeting Summary

Standard 140-2011, Proposed Addendum B (BESTEST Multi-Zone Non-Airflow adaptation by NREL/JNA) initial draft was submitted to SSPC 140 for initial review Feb 27, 2010. It will be redistributed to the PC after revisions to comply with ICC language requirements. Content includes:

- Analytical verification conduction test
- Comparative tests of
 - The effect of shading on a window, where a shading device is affixed to the window of a neighboring zone
 - The effect of shading on a window by a neighboring zone of the building
 - Internal windows

Standard 140-2011, Proposed Addendum C (ASHRAE RP-865 Airside-Mechanical Equipment tests adaptation): NREL is proceeding with adaptation for Standard 140 of **ASHRAE RP 865 (by Yuill and Haberl)** – air-side mechanical equipment analytical verification test cases. RP 865 includes 78 test cases over 7 air-distribution systems with similarly varied loads, set points and economizer controls. The tested systems are: four pipe fan coil (FC), single-zone air conditioner (SZ), constant volume terminal reheat, VAV, single fan constant volume dual duct, dual fan VAV dual duct, four pipe induction. **The initial draft spec, distributed Mar 2011, includes a subset of 10 total test cases for FC and SZ systems. 6 sets of simulation results received to date; deadline for submittal of results before next spec rev begins is March 15, 2012. The spec will be revised, and additional cases considered as indicated by user comments. Several rounds of simulation trials are expected, with incremental expansion of the test specification. Completion of the work is planned for 2013. After that the test suite will be submitted to SSPC 140 for publication/public review recommendation.**

BESTEST-EX BUILDING PHYSICS TEST CASES. SSPC 140 VOTED TO ADAPT THESE (JAN 23, 2012). THE TEST CASES ARE BASED ON THE CURRENT 140-2011 SEC 7 (HERS BESTEST 1995) CASES, WITH IMPROVEMENTS TO A NUMBER OF INPUT ASSUMPTIONS ESTABLISHED IN THE LITERATURE AND PER RECOMMENDATIONS OF THE INDUSTRY WORKING GROUP THAT DID SIMULATION TRIALS. THE BESTEST-EX PHYSICS CASES ONLY INCLUDE A SUBSET OF THE PARAMETRIC VARIATIONS OF HERS BESTEST. TO MAXIMIZE DIAGNOSTIC CAPABILITY OF STANDARD 140, IT IS NECESSARY TO HAVE BOTH SETS OF TESTS.

REFERENCES TO STANDARD 140 IN STANDARD 90.1. PEGUES, JUDKOFF AND NEYMARK ARE WORKING WITH JASON GLAZER (90.1 ECB SUBC CHAIR) ON RECOMMENDATIONS FOR UPDATING 90.1'S REFERENCING OF 140 (TO GO FROM 140-2004 TO 140-2011). CHANGES WOULD OCCUR FOR 90.1-2013

References to Standard 140. Standard 140 is referenced by:

- IRS, Standard 90.1
- Standard 189 (High Performance Green Building Design) Appendix D
- IECC, IGCC
- The newly developing COMNet (BPI, Energy Foundation et al) User's Manual.
- Implicitly referenced for ASHRAE Building Energy Quotient IF that is based on the COMNet User's Manual;
- RESNET plans to reference Section 7 tests after they are published (in 140-2011)

Attachment G (continued, page 3 of 4)
SSPC 140 Meeting Summary

- Florida Building Commission
- Various international references.

BESTEST-EX UPDATE

This is a **new comparative test suite (publication of all materials completed Sep 2011) for testing the ability of software used for modeling residential retrofits to predict energy savings**. Part of the test process also tests the ability to initially calibrate the model of the existing building (pre-retrofit). The **Phase-1 Test Procedure** includes a set of **building physics tests with calibrated energy savings test versions of the physics tests**. The test cases are **based on HERS BESTEST, but with improvements** including to equivalent constant surface coefficients (lower values based on recent advancements in the modeling state of the art) and Sherman-Grimsrud infiltration modeling. Test case **parametric variations** include the following retrofits: **air sealing, attic insulation (blown cellulose), wall insulation (blown cellulose), thermostat setback, low-e windows, exterior shading, cool roof, and all retrofits combined**. There are also a number of **targeted calibration scenarios** including targeted high and low space heating energy consumption base case scenarios, and fully random selection base case scenarios. Future test cases would be developed for BESTEST-EX to address furnace and space cooling system retrofits, duct leakage, and domestic hot water modeling. Additionally, other building physics test cases for BESTEST-EX could be cross-referenced from HERS BESTEST.

Empirical Data Based Tests: NREL is also examining the feasibility of developing tests for residential modeling software applying existing empirical data sets. This is challenging as it requires both sufficient utility billing data AND building input description data for a given data set.

Listing of test suites either included in Std 140 or listed in Annex B18 (of Std 140) is included below. (Included per Jan 2010 request by TC 4.7 Chair; a more comprehensive listing requires a literature survey.)

Analytical Verification Tests and Comparative Tests already in Standard 140 (or with addenda in progress)

- NREL/IEA 12/21 “IEA BESTEST” (building thermal envelope fabric load tests)
- NREL/IEA 22 “HVAC BESTEST Volume 1” (analytical verification tests)
- NREL/IEA 22 “HVAC BESTEST Volume 2” (comparative tests)
- NRCan/IEA 22 “Furnace BESTEST” (analytical verification and comparative)
- NREL/HERS Council “HERS BESTEST” (comparative tests, simplified residential)
- NREL/IEA-34/43 “Ground-Coupled Slab-On-Grade In-Depth Tests” (analytical verification)
- NREL/IEA-34/43 “Multi-Zone Non-Airflow” (analytical verification and comparative)
- ASHRAE RP-865 “Air-Side Mechanical Equipment Analytical Verification Tests”

Other Analytical Verification and Comparative Tests

- NREL “BESTEST-EX” (comparative physics and calibration tests, existing homes)
- ASHRAE RP-1052 “Development of an Analytical Verification Test Suite for Whole Building Energy Simulation Programs – Building Thermal Fabric
- “RADTEST Radiant Heating and Cooling Test Cases”
- IEA-34/43 Airflow Tests by Japan (final report still in progress)

Attachment G (continued, page 4 of 4)
SSPC 140 Meeting Summary

Empirical Validation Tests

- IEA-34/43: “Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools (EMPA, Switzerland)
- IEA-34/43 “Chilled Water and Hot Water Mechanical Equipment and Control Comparative and Empirical Validation Tests (empirical and comparative, TUD, Germany)
- IEA-34/43 “Double-Skin Façade Empirical Validation Tests” (Aalborg U., Denmark).
- IEA 22 “Daylighting/HVAC Interaction Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US)
- IEA 22 Economizer Control Tests for the Empirical Validation of Building Energy Analysis Tools (Iowa ERS, US and Spain)
- “ETNA BESTEST Empirical Validation Test Specification (NREL and Electricite de France)
- IEA ECBCS Annex 42: Comparative Testing and Empirical Validation of Annex 42 Models for Residential Cogeneration Devices (NRCan)
 - http://cogen-sim.net/index.php?pg=&download=Annex_42_ST_B_Final_report_on_comparative_testing_and_empirical_validation.pdf
- New Research: There is a possibility of developing a test facility for empirical validation of software used to model retrofits of existing building (i.e., software that is currently the subject of the BESTEST-EX test suite). Such a test facility would be expensive relative to developing comparative and analytical verification tests, but such expense would be well justified if U.S. energy policy moves towards supporting energy efficiency retrofits of energy-inefficient houses that comprise a large portion of the current U.S. housing stock.

Full SSPC 140 meeting notes are available from the Chair on request.

END