ibpsaNEWS

volume 20 number 1 www.ibpsa.org

Apr 2010

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The newsletter of the International Building Performance Simulation Association ISSN 1993-8586

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President's message

Dear IBPSA friends,

You may be surprised to see that you are still stuck with me as president of IBPSA, although I noted in the previous IBPSA News that that was my last President's message.

The reason for this is that it was more time consuming than expected to prepare a new slate for the IBPSA Board.

The IBPSA Board is made up of four elected officers, four elected members-at-large, the past President, plus a member elected from each of the IBPSA Affiliates.

In accordance with the IBPSA Bylaws, the retiring Board submitted nominations for the new Board to the full IBPSA membership on February 12, 2010. You should have received this information together with a voting ballot shortly thereafter via your Regional Affiliate Representative.

According to the Bylaws, the new Board proposal should be sent at least three months before the actual voting. This is the reason why you were asked to vote now or wait the 3-month comment period. You may submit further nominations that must be received by the Secretary at least one month before final voting begins. If you provide the name of a write-in candidate, be sure the candidate has agreed.

A second call for final votes will be made when the 3 months have elapsed. After that, voting will remain open for 30 days. Please note that Regional Affiliate Representatives are elected by their respective Affiliate members and are not part of this election.

The nominees are listed below along with their respective offices. Following each name is the nominee's company affiliation and associated IBPSA Affiliation. If the nominee has an additional appointment (function) within IBPSA, this is also added following the name.

President: Ian Beausoleil-Morrison (Carleton University, Canada)
Vice-President: Charles "Chip" Barnaby (Wrightsoft Corporation, USA)
Secretary: Lori McElroy (Sust., Scotland)
Treasurer: Michael Wetter (Lawrence Berkeley National Lab, USA)

Immediate Past President: Jan Hensen (Eindhoven University of Technology, Netherlands) (No vote required. This position is automatic.)

Members-at-large:

Michel Bernier (École Polytechnique de Montréal, Canada)
Jonathan Wright (Loughborough University, UK)
Christoph van Treeck (Fraunhofer-Institut für Bauphysik, Germany)
Drury Crawley (U.S. Department of Energy, USA)

It is VERY important that we have good voter participation. It is important to our organization's future and to assure that members are well represented by its leadership.

Vote as you please, but please vote by returning your marked ballot to Gerhard Zweifel at the e-mail address **Gerhard.Zweifel@hslu.ch.**

Jan Hensen

IBPSA's first Outstanding Young Contributor

Veronica Soebarto interviews Jeff Spitler, who was IBPSA's first Outstanding Young Contributor and continues to contribute to building simulation today, nearly 20 years on.

Everyone who claims to know about building simulation and energy calculation will, or should, know the name Jeffrey Spitler. He is the co-author of the well-known book "Cooling and Heating Load Calculation Manual" with Faye McQuiston, first published in 1992, the author of the 2010 "Load Calculation Application Manual" and co-author of the 5th and 6th editions of the book "Heating, Ventilating and Air-Conditioning Analysis and Design" also with McQuiston and Jerald Parker.

What many may not know is he is the first person who received the Outstanding Young Contributor Award from IBPSA, back in 1991.

His work in the area of building simulation and energy modeling has never stopped, particularly through his involvement in ASHRAE, and of course, IBPSA. He was IBPSA President from 2002 to 2005 and still serves IBPSA in his capacity as the Conference Location Coordinator. Jeff Spitler is ASHRAE Fellow as well as Regents Professor and C.M. Leonard Professor at Oklahoma State University, working in the Mechanical and Aerospace Engineering Department. He has written 125 papers and books and three of his papers have received ASHRAE best technical paper awards; two of those were co-authored with IBPSA Treasurer Chip Barnaby.

I am sure you all want to know more about this first IBPSA Outstanding Young Contributor who never stops contributing to the world of building simulation.

About yourself, research and teaching

Veronica Soebarto (VS): Could you tell us what attracts you to focus your work and research in the area of building simulation, load calculation, heating and cooling, as opposed to, for example, the actual design and manufacture of the HVAC system or equipment itself, or any other mechanical engineering areas?

Jeff Spitler (JS): I suppose it's mainly the particular set of opportunities that I've had that have led me in this direction. Like many a student before and after me, I started in mechanical engineering with an interest in cars, airplanes, and other machines. I became interested in heat transfer and computer simulation during my junior and senior years and started working for Curt Pedersen my senior year at University of Illinois after taking ME 323, "Design of Thermal Systems" under him. I worked on an experimental project on interior convective heat transfer in rooms, starting with such mundane tasks as coating some of the walls with aluminum foil and re-routing duct work. When I graduated with my BSME, I went directly on to do two things: 1) Take over on the experimental project when the previous MS student graduated and 2) Begin learning about BLAST so that I could both answer questions on it and further develop it as part of the BLAST Support Office. I continued with both activities through most of my MSME and PhD work. This particular combination of experimental and simulation research kept all of my efforts in areas more-or-less aligned with HVAC-consulting-type engineering rather than equipment design. Further opportunities to work in load calculations and ground-source heat pump systems arose when I started as an Assistant Professor at Oklahoma State University and I've continued in the same vein ever since then.

VS: Would you like to tell us what made you write books on heating and cooling load calculations? Do you think we now have sufficient resources or references in this area?

JS: The first few books and the most recent book were all deliverables of ASHRAE Research Projects and so I suppose I was mainly motivated by the need to start and keep an active research program going. By the time Faye McQuiston and Jerald Parker asked me to contribute to the 5th Edition of Heating, Ventilating, and Air Conditioning Analysis and Design, I had enough experience to not be too daunted at the size of the writing project.

Do we have sufficient resources or references? Probably not – I think most of our references and certainly the ones I have written have a great deal of room for improvement! Given the infinite variations in buildings and the complexities of building physics, I find it difficult to find the right balance between keeping the treatment simple enough for beginners and including many of the details. On top of that, new developments in methods and building technology will, of course, require new and revised treatments in the future.

VS: So in your view what (specific) area(s) in building performance simulation still need(s) much further research? … Are you planning to write another book to address this or these topic(s)?

JS: Three areas come to mind:

Ease of use- despite years and years of development, user interfaces for building simulation programs are still (in my opinion) more difficult to use than desirable and obtaining input data for nearly every facet of the building and its systems also tends to be time-consuming.

Second is quality assurance — as I work with graduate students, who are typically bright but have limited experience in building design and simulation, I'm often reminded of just how difficult it is to get everything in the building description "right" or close enough to "right" to give a reasonable answer.

The third is flexibility to handle new system configurations — many simulation environments have been developed with the promise to allow rapid development of models for new system configurations. Perhaps the perfect environment or tool is out there — I think the latest candidate is Modelica — but I'm still in search of a tool that will allow us to quickly connect different components together and then perform a robust dynamic simulation for a wide range of configurations and component types.

I would like to write a couple more books, but I'll probably stick to more settled topics.

VS: What do you tell your students are the most important aspects of building performance simulation?

JS: Keeping in mind that we are usually developing models that are firstly used in-house for research, including parametric studies, some of the things that I tell my students include:

- Make sure you understand the physics before you try to develop models.
- The first requirement for a dynamic model is usually that it gets the steady-state results correct.
- Examples and case studies should be based on realistic examples.

About you and IBPSA

VS: How did you get to be involved in IBPSA 20 years ago?

JS: IBPSA got its start after the Building Energy Simulation conference in Seattle in 1985. All of the early organizational meetings were held just before the biennial ASHRAE meetings and most of the people sitting around the table were also active in the ASHRAE Energy Calculations Technical Committee (TC 4.7). Although I was a PhD student at the time, I regularly attended the TC 4.7 meetings and was invited to come along to the IBPSA meetings; a few years later I was invited to serve on the board and served continuously until this year.

VS: What impact did the IBPSA Outstanding Young Contributor Award have on you, your work and research? What made you, and still makes you, have continuous enthusiasm in being actively involved in IBPSA, nearly 20 years after you received that award?

JS: Awards like the IBPSA Outstanding Young Contributor Award are very important to academics early in their careers when there is significant pressure to show external recognition. While the primary indicators are publications and successful research proposals, these awards provide additional confirmation of "quality." While it is perhaps difficult to attribute specific outcomes to a single award, for me it served as the justification to go to BS'91 in Nice where I met quite a few building simulation researchers who don't often come to ASHRAE meetings. The next year, I came on to the IBPSA Board and have been pretty active in IBPSA ever since.

What gave me the continuous enthusiasm to be actively involved in IBPSA 20 years after the award? Good question – I think service in a young society such as IBPSA can be quite rewarding as you have the chance to have a significant influence on the society's activities. But for any young researcher, I highly recommend service to your professional society as a worthwhile activity. IBPSA has many, many opportunities for volunteers!

VS: Who was your valuable mentor in the early days – around the time you received the Outstanding Young Contributor Award?

JS: Curt Pedersen, my PhD advisor, was (and still is) my most important mentor. Until I started working for him, I had little idea about what professors actually did, besides teaching classes. From Curt, I learned about all aspects of being a professor – teaching, research, writing, advising graduate students and service. Much of what my colleague Dan Fisher (another one of Curt's advisees) and I do here is modeled on what we learned working for Curt. Curt's overall support made it possible to go to a number of professional meetings where I established relationships that have been an integral part of my success. I also had some very valuable advice, counsel, and support from Ed Sowell, the first president of IBPSA.

VS: What were your goals when you became the President of IBPSA, 11 years after your received the award? Do you think you achieved your goals when you left IBPSA presidency in 2005? Could you tell us what achievements you made during that period?

JS: My main goals were to improve the operation of the board by organizing the board responsibilities differently, engaging the regional affiliate representatives and changing the by-laws to better reflect how we needed to work. I do think I achieved those goals and Jan Hensen has made further improvements with the establishment of board committees. IBPSA also grew substantially during my tenure – mostly thanks to some hard-working board members that I had the pleasure to serve with!

VS: What would you like to see happen in the future for the building simulation area in general?

JS: I would quite like to see improved access to weather and other environmental data; standards and standard methods of tests for a wide range of components, e.g. windows, heat pumps, chillers, and cooling towers so that practitioners (and researchers!) can quickly and painlessly model these components; and improvements in the three areas I mentioned earlier: ease of use, quality assurance, and robust and flexible system simulation environments. Finally, I would like to see the day when design simulations and building operation are brought together so as to better facilitate energy efficiency, indoor environmental quality, occupant productivity and safety.

VS: Finally, would you also like to tell us your wish list for IBPSA?

JS: Several things come to mind – first, continued success in our conference series; second, continued expansion around the world; third, that IBPSA would grow large enough with a large-enough revenue stream to justify at least one full-time staff person.

VS: Thank you for your time.

Forthcoming events calendar

Date(s)	Event	Information
2010		
21-23 April 2010	**9th Indoor Air Quality Meeting (IAQ 2010)** Chalon-sur-Saone, France	www.chateaudegermolles.fr/spip.php?rubrique44
30 April - 01 May 2010	**BESS2010: High Performance Building Enclosures** Pomona, California, USA	www.sgh.com/news-publications/news-events/recent/51001.html
09-12 May 2010	**CLIMA 2010** Antalya, Turkey	www.clima2010.org
18-21 May 2010	**eSim 2010** Winnipeg, Canada	www.esim.ca
26-30 June 2010	**ASHRAE 2010 Annual Conference** Albuquerque, New Mexico	www.conferencetoolbox.org/ASHRAE2010/
27 June - 02 July 2010	**Renewable Energy 2010** Yokohama, Japan	www.re2010.org/eng-conf/conference/index.html
30 June - 02 July 2010	**Central Europe Towards Sustainable Building 2010** Prague, Czech Republic	www.cesb.cz/en
09-13 August 2010	**SIMBUILD 2010: 4th IBPSA-USA National Conference** New York City, USA	http://ibpsa.us/simbuild2010/
06-08 September 2010	**Modelling and Simulation (AfricaMS 2010)** Gaborone, Botswana	www.iasted.org/conferences/home-685.html
16-19 September 2010	**4th International Solar Cities Initiative (ISCI) Conference** Dezhou, China	www.chinasolarcity.cn
22-24 September 2010	**BauSIM 2010: 3rd IBPSA-Germany+Austria Conference** Vienna, Austria	http://bausim2010.ibpsa-germany.org
22-24 September 2010	**SB10 Conference** Espoo, Finland	www.ril.fi/web/index.php?id=761
28 September - 01 October 2010	**EuroSun 2010** Graz, Austria	www.eurosun2010.org/cms/
29 September - 01 October 2010	**3rd International Conference on Passive & Low Energy Cooling for the Built Environment (PALENC 2010)** Rhodes Island, Greece	http://palenc2010.conferences.gr

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14 October 2010	**Symposium Event 2010** TU Eindhoven, the Netherlands	**www.ibpsa-nvl.org/cms/index.php?id=66&tx_ttnews[tt_news]=3&cHash=fa4edd8447a0233bcfcb143193dc6715**
26-28 October 2010	**AIVC Conference** Seoul, Korea	**www.aivc2010.org**
09-10 November 2010	**IBPSA France Conference** Moret-sur-Loing, France	**http://colibpsa.insa-lyon.fr**
13-15 December 2010	**SSB 2010: 8th International Conference on System Simulation in Buildings** Liege, Belgium	**www.ssb2010.ulg.ac.be**

*Note that the dates in this calendar **include** any pre and/or post-conference workshop days*

18-21 May 2010
Winnipeg, Canada
www.esim.ca

eSim 2010: IBPSA-Canada's biennnial conference

IBPSA-Canada's biennial conference, eSim, brings together professionals, academics and students interested in building performance simulation issues and applications. The 2010 conference is hosted by Manitoba Hydro, in collaboration with the National Research Council of Canada. It will be held in Winnipeg, Canada on May 19 and 20, 2010 (pre-conference and post-conference workshops on May 18 and 21, 2010).

Themes

- Recent developments for modelling the physical processes relevant to buildings (thermal, air flow, moisture, lighting)
- Algorithms for modelling conventional and innovative HVAC systems
- Methods for modelling the whole-building performance, including integrated resource management, renewable energy sources and combined heat, cool and power generation
- Building simulation software development and quality control approaches
- Use of building simulation tools in code compliance and incentive programs
- Moving simulation into practice. Case studies of innovative simulation approaches
- Validation of building simulation software
- User interface and software interoperability issues
- Architectural and engineering data visualization and animation
- Optimization approaches in building design

Venue

The newly constructed Manitoba Hydro Place located in downtown Winnipeg will play host to eSim 2010. The building is touted as one of the most energy efficient buildings of its kind in North America and is a model of the benefits of building simulation. For more information visit Manitoba Hydro's website, **www.hydro.mb.ca/projects/downtown/final_design.shtml**.

For more information, to submit an abstract and to apply for student travel sponsorship from IBPSA-Canada (Canadian students only) visit the conference website,**www.eSim.ca.**

09-13 August 2010
New York City, USA
http://ibpsa.us/simbuild2010/

SimBuild 2010: IBPSA-USA's 4th biennnial conference

IBPSA-USA will hold the fourth of its biennial conferences on building simulation from 11-13 August 2010 in New York University's Kimmel Center in Greenwich Village in Lower Manhattan, preceded by workshops on 09 and 10 August. SimBuild 2010 aims to improve the design and operation of buildings through advances in the modeling and simulation of building performance. It is open to all, world-wide.

The programme, pricing and opening date for early bird registration (not finalised when *ibpsa*NEWS went to press) will be published on the conference web site at **http://ibpsa.us/simbuild2010/program.shtml**.

22-24 September 2010
Vienna, Austria
http://bausim2010.ibpsa-germany.org

BauSIM 2010: IBPSA-Germany+Austria's 3rd biennial conference

IBPSA-Germany-Austria will hold its 3rd biennial conference in Vienna, Austria on September 22-24, 2010 at the Vienna University of Technology. BauSIM 2010 aims to bring together practitioners, researchers and developers working in the field of building performance simulation and related applications, and will be hosted by the University's Department of Building Physics and Building Ecology. The main theme will be "Building Performance Simulation in a Changing Environment". Papers will be presented in both English and German, and selected contributions will be published in the Ernst&Sohn journal BAUPHYSIK.

For more information, visit **http://bausim2010.ibpsa-germany.org.**

22-24 September 2010
Espoo, Finland
www.ril.fi/web/index.php?id=761

SB10: Sustainable Building conference on Sustainable Community

SB10 is being organised by the Finnish Association of Civil Engineers (RIL) and the VTT Technical Research Centre as part of the Finnish Sustainable Community programme, which is designed to encourage research institutes, universities and companies to engage in international collaboration by exchanging information and networking companies and research groups. The conference will examine sustainable neighbourhood solutions with global optimisation and local design, differentiation and branding, active end-user involvement, paradigm shift and new business opportunities.

Venue

SB10 is being held in the Dipoli conference centre on the Otaniemi campus in Espoo, the second largest city in Finland. Espoo has five regional centres, each the size of a medium-sized Finnish city, rather than one main centre. The Otaniemi campus is in the south east of the city, approximately 10 kilometers from Helsinki and 25 kilometers from Helsinki airport.

Otaniemi accommodates 16,000 students and 16,000 technology oriented professionals, with 40-50 new hi-tech companies founded each year. Dipoli is one of the premier prestigious venues — and the greenest congress centre — in Finland.

Themes

1. **Sustainability assessment of buildings and cities**
   - the use of Building Information Models – buildingSMART
   - assessment methods and tools for LCA based Carbon Footprint calculation
   - indicators and rating tools
   - case studies
2. **Managing Life Cycle performance**. The focus is on facilities in buildings and their immediate neighbourhood, particularly:
   - indoor environment
   - usability, adaptability, accessibility, safety and security
   - positive stimulation and value creation
   - benchmarking systems and schemes
3. **Sustainable processes**. Life cycle processes in the built environment including:
   - sustainable renovation/retrofit/ refurbishment
   - sustainable business models, risk management
   - process models, new tasks and actor roles, integrated methods and tools
   - incentives, barriers; process innovation, systemic innovation
4. **Sustainable solutions**. Products, services and product-services on:
   - passive houses, zero energy and energy positive buildings
   - exergy optimisation on different scale and scope
   - low energy solutions and the use of renewables; matching energy demand and production
   - components, systems and infrastructure; product and service innovation
5. **Well-being**. Quality of life aspects related to:
   - sustainable lifestyles
   - sustainable architecture
   - user behaviour and social innovation
   - future trends and prospects
6. **Land use planning**
   - new tools: collaborative planning, public participation, e/m-governance, soft GIS
   - urban-nature interaction, urban metabolism; densities and polynuclearity; functional segregation, mixed land use; technical and social infrastructure
   - accessibility, mobility and car dependence; public transport systems; traffic calming; emissions and noise reduction
   - education, legislation

Fees and registration

Registration will open shortly through the conference website. Fees until 01 July 2010 will be on a scale from 500 euro for students to 780 euro for other non-members of RIL. After 01 July they will increase to 610 - 890 euro.

28 September - 01 October 2010
Graz, Austria
www.eurosun2010.org/cms/

EuroSun 2010

EuroSun, organised jointly by ISES Europe and the IEA's Solar Heating & Cooling programme, is Europe's largest conference on solar thermal energy. The venue is the city of Graz, Cultural Capital of Europe in 2003 and one of the sunniest places in Austria, surrounded by vineyards.

Conference topics include:

- Solar energy in architecture
- Net zero energy buildings
- Energy efficiency in buildings through solar applications
- Large-scale solar thermal applications
- Advanced solar domestic hot water heating
- Solar space heating with a high solar fraction
- Solar energy for industrial and commercial applications
- Solar cooling and air conditioning
- Solar collector technology
- Thermal energy storage
- Engineering and simulation tools
- Testing and certification
- Solar radiation and solar energy availability
- Other solar energy related topics
- Other components of solar thermal systems

For information about fees and registration visit the conference web site at **www.eurosun2010.org/cms/**.

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29 September - 01 October 2010
Rhodes island, Greece
http://palenc2010.conferences.gr

PALENC 2010; 3rd International Conference on Passive & Low-Energy Cooling for the Built Environment

The joint 3rd Palenc, 5th EPIC (European Conference on Energy Performance & Indoor Climate in Buildings) and 1st Cool Roofs Conference will focus on the application of passive cooling techniques in the urban environment. Cities already suffer the 'heat island' effect, and this will be exacerbated by global climatic change. The use of peak electricity for cooling is increasing rapidly, and spells of high discomfort conditions are becoming more frequent. At the same time, increases in living standards and inappropriate architecture and urban planning have prompted increased use of air conditioning in many parts of the world, and particularly in hot climates.

Venue

Rhodes (or Rodos) is an island in the Aegean Sea, the largest of the Dodecanese and the third largest of all the Greek islands, covering nearly 1400 square kilometres and with a population over 110,000. An island of forest-covered hills and low mountains, it is one of the most developed in the Mediterranean and has every holiday amenity including large and modern hotels, a yachting harbour, and entertaining night life as well as a rich legacy of archaeological treasures. Rhodes airport has direct flights to Athens, other Aegean islands and major cities abroad. The conference venue is the Rodos Palace, a deluxe resort complex 5 minutes from the centre of Rhodes city.

Themes

PALENC 2010 will focus on the use of passive cooling techniques able to improve the environmental performance of urban spaces and buildings. Topics are expected to include:

- Solar control
- Thermal mass
- Natural & hybrid ventilation
- Advanced control systems and techniques
- Innovative materials & components, including advanced glazing, facade and HVAC technologies
- Ground, evaporative & radiative cooling
- Microclimate
- The heat island & canyon effects
- Demand side management
- Legislation, including results from the application of the European Directive
- Education & distance learning
- Thermal comfort & indoor environmental quality
- High efficiency air conditioners
- Cool roofs and other mitigation techniques
- Extreme low energy buildings and buildings with positive energy
- The existing building stock: technical, economic and social issues in upgrading
- Opportunities & barriers for integrating renewables into the built environment
- International and national policies for energy management

The target audience includes industrial manufacturers and developers of building components, consultant engineers, designers and architects, researchers, policy makers and officials involved in housing, construction and energy, and people involved in standardization.

Registration

Registration is through the conference web site. Fees are 290 euros for students and 580 euros for other delegates until 31 May 2010, and then increase to 315 and 630 euros respectively.

Visit the conference web site at **http://palenc2010.conferences.gr** for further information.

26-28 October 2010
Seoul, Korea
www.aivc2010.org

AIVC 2010 Conference: Low Energy and Sustainable Ventilation Technologies for Green Buildings

During the 3 days of this conference, a whole range of topics related to low energy and sustainable ventilation technologies for green buildings will be presented and discussed in keynote presentations, short and long oral presentations, poster sessions and workshops.

The topics include:

- Natural and mechanical ventilation systems for near zero energy buildings
- Air filtering and cleaning
- HVAC systems
- Ventilation standards and regulations
- Building airtightness
- Condensation and mould growth
- Retrofitting
- Performance prediction
- Case studies
- Commissioning
- Ventilation performances in practice
- Air quality
- Healthy buildings
- Sustainable technologies for building ventilation
- Environmental impact of ventilation systems.

For more information visit **www.aivc2010.org**.

13-15 December 2010
Liege, Belgium
www.ssb2010.ulg.ac.be

SSB 2010: 8th International Conference on System Simulation in Buildings

The University of Liege's Thermodynamics Laboratory will host SSB 2010 on December 13-15, 2010. The conference is being organized in collaboration with the International Energy Agency (Energy Conservation in Building and Community Systems) and with the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

Presentations will include some of the latest results from the IEA-ECBCS Annexes 47 "Cost Effective Commissioning of Existing and Low-Energy Buildings" and 48 "Heat Pumping and Reversible Air Conditioning", HarmonAC "Harmonizing Air Conditioning Inspection and Audit Procedures in the Tertiary Building sector" and the more recent IEA-ECBCS Annex 53 "Total Energy Use in Buildings: Analysis and Evaluation Methods".

For further information visit **www.ssb2010.ulg.ac.be** or email **ssb2010@guest.ulg.ac.be**.

Software news

EnergyPlus version 5.0 available April 2010

Dru Crawley, DOE

The latest release of the EnergyPlus building energy simulation program, Version 5.0, became available in early April. A few key new features include:

- wind turbine module (horizontal and vertical axis turbines)
- new utility EP-Compare which allows users to graphically compare results from two simulations
- added HVAC templates for Zone: WaterToAirHeatPump and Plant: MixedWaterLoop
- slab and basement pre-processors integrated to run automatically prior to EnergyPlus simulation
- improved methodology for electric load dispatch via the electric load center
- outdoor air unit module for make-up air and DOAS, data set of refrigerated cases, refrigeration loops can now model CO2 secondary loops, zone-side impacts of refrigerant piping heat exchange added
- 2-node ConductionFiniteDifferenceSimplified model
- analytical and Euler zone balance solutions
- ZoneVentilation: DesignFlowRate object which calculates ventilation rates based on winds and stack effects
- steam baseboard with radiant heat
- electric radiant/convective baseboard
- predefined output table for DX Cooling Coils as part of EquipmentSummary report which summarizes calculated capacity and SEER values, and
- new translation capability added to allow translation of EnergyPlus web site into 50 languages.

We have updated and extended capabilities throughout the existing building envelope, daylighting, and HVAC equipment and systems portions of the program, along with many other enhancements and speed improvements. Two new application guides (Tips & Tricks, External Interface) and a new validation report (IEA BESTEST Chilled and Hot Water Systems) are also available. More information on these and other new features is available on the EnergyPlus web site, **www.energyplus.gov**. EnergyPlus V 5.0 has been tested on both Windows 7 and Mac OSX Snow Leopard.

The OpenStudio plugin for Google SketchUp has also been updated to work with EnergyPlus V5.0. Both EnergyPlus V5.0 and the OpenStudio plugin are available for download at no cost from **www.energyplus.gov**.

Building Energy Tools Directory

Dru Crawley, DOE

The web-based Building Energy Tools Directory at **http://buildingtools.energy.gov** (NEW URL!) contains information on more than 380 building-related software tools from more than 20 countries around the world. Haven't visited lately? In the past six months, another 13 new tools have been added, and they are Acuity Energy Platform, AIRWIND Pro, Building Performance Compass, BuildingAdvice, COLDWIND Pro, EcoDesigner, EnergyPeriscope, eQUEST, GPM PV+, Green Energy Compass, Shading II, SolarDesignTool, and Utility Manager.

For each tool in the directory, a short description is provided along with information about technical expertise required, users, audience, input, output, validation, computer platforms, programming language, strengths, weaknesses, technical contact, availability and cost. A **new link** is also provided for directly translating the web pages into more than 50 languages.

If you know of a tool (yours?) that isn't in the directory, send details in an email message to Dru Crawley at **Drury.Crawley@ee.doe.gov**. The 'Submit a tool' page at **http://buildingtools.energy.gov/submit.cfm** explains what information is required for an entry in the Directory.

News from IBPSA affiliates

IBPSA affiliates are asked to submit a report to the IBPSA Board each year to keep Board members informed about their activities and membership. These are too detailed to include in *ibpsa*NEWS, so affiliates have been asked to make their latest annual report available through their web sites, and this section includes only selected, recent news. Other news from affiliates may be available from their websites; the URLs for these are available on the IBPSA Central web site at **www.ibpsa.org/m_affiliates.asp**.

IBPSA-Brazil

Nathan Mendes

IBPSA-Brazil has been working on the consolidation of the use of simulation nationwide, thanks to the Brazilian Building Energy Efficiency Regulation code, which has started labelling buildings on a voluntary basis. IBPSA-Brazil is also providing support to the creation of a web-based platform for distance learning of building simulation and dissemination of nationwide whole-building energy simulation software.

IBPSA-Canada

IBPSA-Canada will hold its biennial eSim conference in Winnipeg, Canada on 19 and 20 May 2010, with pre-conference and post-conference workshops on 18 and 21 May respectively. There are further details in the *Forthcoming events* section of this *ibpsa*NEWS, on **page 10**.

IBPSA-England

IBPSA-England joined with UCL and CIBSE on 17 February 2010 to hold an evening seminar on 'Building Simulation in Practice', with Michael Lim of AECOM (better known under its former name, Faber Maunsell) as guest speaker. Dr Lim spoke about a range of different approaches to simulation, including 'quick and dirty' modelling. For more information, see **www.ibpsa-england.org**.

IBPSA-Netherlands+Flanders

Marcel Loomans/Wim Plokker

Simulation for energy efficient and energy-producing built environments

IBPSA-NVL is organizing a Dutch IBPSA NVL 2010 Event on 14 October 2010 at TU Eindhoven, the Netherlands, with the aim of bringing practice and research together. The morning session of the event is dedicated to building practice, and we are particularly interested in hearing the experiences of professionals in using building simulation. You are welcome to contribute if you have an interesting example which shows the added value of building simulation in design practice. We are also interested in new developments and opportunities that will increase the use of building simulation in practice.

The afternoon will be devoted to five presentations on the state-of-the-art and future developments in building simulation. The main topic will be simulation for an energy efficient built environment, particularly in the context of:

- Energy at the district level
- Design process
- Management
- Regulations, rating tools and labeling
- Quality of the indoor environment

If you are interested in making a presentation, please send an abstract of 250 words or less to **IBPSA-NVL.2010.Event@tue.nl** as soon as possible.

IBPSA-India

INDSim10 – A National Seminar on Building Energy Simulation

IBPSA India Chapter was formed in January 2009 with the objective of promoting and strengthening Building Performance Simulation practice, research and education in India. As a step towards achieving its goal of improving the energy efficiency of the built environment, IBPSA-India recently organized a national seminar INDSim10 on 14 February 2010 at CEPT University, Ahmedabad.

Nearly 75 professionals in architecture, mechanical engineering, civil engineering, and facilities management with an interest in Building Energy Simulation attended the Seminar from across India to discuss the role and value of simulation tools in the design of the building envelope, sustainable design, and the integration of renewable energy sources.

Dr. R. N. Vakil, Director of CEPT University, opened the Inaugural Session with a welcome speech. He told participants about CEPT University's collaboration with national and international organizations on education and research in the environmental field, and described CEPT's state-of-the-art Centre of Sustainable Environment and Energy, set up (with help from USAID) to work in the area of building simulation and material testing.

Dr. Vishal Garg, President of IBPSA-India, followed with a talk about the objectives, structure and activities of the association. He stressed the value of energy simulation in improving environmental conditions without degrading the environment, and in helping policy makers to envisage future scenarios and frame strategies as well as for practitioners. Dr Garg asserted that the aim of IBPSA-India is to achieve energy efficiency in buildings and compliance of energy performance standards at every level.

Dr. Drury Crawley from the US Department of Energy then made a (specially recorded) presentation on *Simulation and Net-Zero Energy Buildings,* focusing on the USA's Energy Efficient Commercial Buildings initiative, the use of energy simulation for achieving NZEB, and the capabilities of the EnergyPlus and Open Studio software tools.

The first technical session was chaired by Dr-ing Jyotirmay Mathur. This began with a presentation from Ms. Surekha Tetali from the International Institute of Information Technology, Hyderabad, on *Development of a tool to reduce EnergyPlus Simulation run time using parallel computing*. Ms. Tetali spoke about the use of data parallelization to speed up simulations, with annual runs divided into several shorter-period runs each handled by a separate computer. She introduced the audience to the ideas behind the development of a proposed tool to speed up EnergyPlus, and went on to discuss the methodology followed for achieving accuracy in the results of the chunked simulations when compared to the annual simulation.

A presentation by Shivraj Dhaka from Malaviya National Institute of Technology, Jaipur on the *Assessment of Thermal Comfort Improvement Using Calibrated Simulation* talked about a room model made in a composite climate, calibrated with the help of IPMVP protocol. The paper compared thermal comfort achieved in a virtual model with that in a real test case.

Ms. Rohini Singh from Sikka Associates Architect's, New Delhi used her presentation on the *Effect of Surface Reflectance on Lighting Energy Efficiency in Interiors* (based on her dissertation for a Masters degree at CEPT University) to argue that interior design is not exclusively the domain of architects or designers, and needs equal inputs from engineers and energy specialists. In her research, Ms. Singh analyzed a typical office space model by varying the surface reflectance of its interior surfaces such as floors, desk tops, partitions and ceilings. She used her results to discuss the relationship between color, its reflectance, visual comfort and lighting power density, and suggest guidelines for the use of color to enhance and better the visual comfort with optimum lighting power density.

Principal Energy Analyst SMH Adil from low carbon consulting firm Global Evolutionary Design chaired the post lunch session, which consisted of four presentations. In the first of these, Mr. Neeraj Kapoor from Kalpakrit Sustainable Environments Pvt. Ltd in Delhi spoke about *Performance Analysis of Affordable Housing Project, Bhiwadi*, focusing on naturally ventilated apartment blocks designed by their firm in the north of India. Their design demonstrates the use of innovative elements to harness favorable climatic conditions as well as protect occupants from harsh and unfavorable outdoor conditions.

In the second presentation, *Cool Roof in Indian Context – Cooling Perspective*, Ms. Avlokita Agrawal, a green building consultant from New Delhi explained the meaning, importance and benefits of Cool Roof. She emphasized the feasibility of cool roofs in India, supporting her argument with data obtained from a case study she had undertaken. She also explained construction methods and technology for cool roofs.

Energy Efficiency: An Approach to Sustainability by Prof Anand Achari from Rizvi college of Architecture, Mumbai accentuated the importance of considering life cycle and decreasing resource intensity in the design of sustainable buildings. He argued that synergy, if achieved over the life span of a built form, leads to cost effectiveness over the entire lifecycle and results in a safe, secure, accessible, flexible, aesthetic, productive and thus sustainable building.

The final presentation by Mr. Sushanth Pandavni from Mechartés Researchers Pvt. Ltd, New Delhi, introduced Computational Fluid Dynamics (CFD) and explained the roles of thermal, air-flow and relative humidity simulations in designing for thermal comfort with minimum power requirements. Mr. Pandavni also spoke about improvements in Indoor Air Quality (IAQ) in certain critical areas like clean rooms, operating theaters etc, and the ability of IAQ simulations to ensure compliance with quality standards. He demonstrated how effectively tools can be used to predict the removal of pollutants produced by moving and idling vehicles in a basement car parking area and develop design requirements for air in parking areas.

IBPSA-Poland

Dariusz Heim

Recent and upcoming events

The Polish Science and Technology Conferences, which started in 1987, have provided a forum for scientists representing the building industry, engineering, environmental studies and architecture. Although most papers focus on building physics, there has been an increasing number on numerical methods in engineering sciences. IBPSA-Poland first assisted in the organization of the 12th Conference in June 2009. A programme of over 100 presentations from nearly all technical universities in Poland, and from other countries, included eight on modelling and simulation of buildings and surroundings:

- Effect of wind on evacuation of burned gas from home gas appliances – a case study
- Dynamic simulation of buildings: comparison between different approaches
- Hourly model 6r1c of building heat dynamics
- Hourly method of calculation of energy consumption in Air Handling Units
- Validation of calculating method of energy use of buildings in accordance with the Bestest procedure
- Building information management systems as a future use of computer aid design tools
- Numerical simulation of turbulent flow in surface layer of architectural elements with complex geometry
- Analysis of air flow through vertical gaps in partitions of fully exposed buildings.

Selected papers and other conference proceedings were published in the third special issue of the Polish journal *Energia i Budynek* (*Energy and Building*) under the auspices of IBPSA-Poland.

The 13th Polish Science and Technology Conference will take place in June 2011. In the meantime, the 10th International Symposium ENERGODOM will be held in Kraków in September 2010. This will focus on energy efficiency in buildings and include a panel on energy simulation organized by IBPSA-Poland.

IBPSA-Switzerland

IBPSA-Switzerland held a seminar on new applications for simulation at Hochschule Luzern, the Lucerne University of Applied Sciences and Arts, Luzerne, Switzerland on 23 March. For more information, see **www.ibpsa.ch/Events/tabid/83/Default.aspx**.

IBPSA-USA

A need to train and certify energy modelers

As evidenced by recent conferences in the building simulation community, there is an increased interest in certifying the reliability of persons doing simulations whereas before, simulation tool certification had been the focus. In addition to a growing popularity of the simulation profession, the basis of knowledge needed to be established, defined and publicized.

Developing or applying simulation models used to be enough; but now, more attention is being brought to bear on the responsibility of the modelers. Evolving over the past year, IBPSA-USA has become involved in efforts toward education and certification of building simulators. Long active in certification testing, ASHRAE has recently developed a Building Energy Modeling Professional (BEMP) certification program in collaboration with IBPSA-USA and the Illuminating Engineering Society of North America (IESNA). The purpose of this certification is to certify individuals' ability to evaluate, choose, use, calibrate, and interpret the results of energy modeling software when applied to building and systems energy performance and economics. It also certifies individuals' competence to model new and existing buildings and systems with their full range of physics. The program was first launched on 27 January 2010 with a pencil and paper examination in conjunction with ASHRAE's Winter Conference in Orlando, Florida. Following that inaugural test, certification examinations have now become available in testing centers located throughout the United States and worldwide since the beginning of March 2010 — see **www.ashrae.org/BEMP**.

In support of the efforts toward certification and possible training of responsible building simulators, IBPSA-USA has started a Building Energy Modeling Book of Knowledge (BEMBOOK) wiki and issued a Request for Proposal to develop training material for energy modelers. The purpose of the BEMBOOK is to provide information about the building simulation profession and a common reference for practitioners and novices alike.

IBPSA-USA's meeting at ASHRAE's Winter Conference in Orlando, Florida in January 2010

The BEMBOOK wiki is a web-based, free content project to develop an online compendium of the domain of Building Energy Modeling (BEM). The intention of the wiki is to delineate a cohesive body of knowledge for building energy simulation. It will be undergoing intensive initial development in the upcoming months. The wiki can be found at **http://bembook.su-per-b.org**. IBPSA-USA invites all interested members of the community of building energy modelers and related disciplines to contribute to developing, maintaining and refining the BEMBOOK compendium on this wiki. Individuals or groups interested in contributing to the effort should contact Joe Deringer at **jderinger@su-per-b.org**.

The Requests for Proposal are for developing training material and presenting two workshops at the SimBuild 2010 conference, to be held in August in New York (See *Forthcoming events*). One workshop will be focused on thermal and HVAC modeling, and another workshop will be focused on lighting modeling. IBPSA-USA intends to release the training material under an open-source license to make it widely accessible. More information regarding the workshop is posted on **www.ibpsa.us**.

IN SITU DETERMINATION OF THE MOISTURE BUFFERING POTENTIAL OF ROOM ENCLOSURES

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ABSTRACT

Moisture buffering by the room enclosure can have an important influence on the variation in interior relative humidity. A characterisation to qualify and quantify this moisture buffering effect is given in a complementary paper (Janssen and Roels, 2009a, 2009b). Starting from this methodology, this paper proposes a method to determine the hygric inertia of an entire room in situ. To do so, a humidifier is placed in the room and a moisture production scheme is imposed over an interval of some days. The moisture buffer capacity is determined inversely from the resulting variations in interior relative humidity. The methodology is validated in well controlled climatic chamber experiments and afterwards applied to a real room.

INTRODUCTION

Air quality (Mudarri and Fisk, 2007), occupant comfort (Fang et al., 1998; Toftum and Fanger, 1999), durability of building parts and energy performance (Li et al., 2006; Osanyintola and Simonson, 2006; Pavlovas, 2004) are highly connected with the interior relative humidity (RH). Recently more and more attention goes to the ability of finishes and objects to passively control the RH. Indeed, interior finishes (gypsum plaster, wooden floor,…) and interior objects (books, carpets, furniture,…) are able to absorb moisture when the RH increases and release moisture when the RH decreases, which makes a passive dampening of the RH possible. Consequently, this phenomena should be taken into account to come to a more integrated approach in which more accurate constraints are used to determine the risk on condensation, moulds (Sedlbauer, 2002) and fungi (Passanen et al., 2000) and to develop healthy and comfortable buildings. Therefore, an assessment of the moisture buffering by the entire room enclosure is necessary. The moisture exchange between indoor air and hygroscopic materials is however a very complicated problem and until now, a comprehensive simulation of moisture transport and storage in interior elements remains unrealistic. Recently, Janssen and Roels introduced, based on the Moisture Buffer Value of a single element described by Rode et al. (Rode et al., 2007), a production-adapted moisture buffer potential and demonstrated that the hygric inertia of an entire building zone can be determined from its different contributing components, independent of the boundary conditions considered (Janssen and Roels, 2009a, 2009b). Furthermore, they showed that the determined hygric inertia of a building zone can be used for a qualitative comparison, but also as a quantitative design value, since it is easily implementable in existing building energy simulation tools by means of an effective capacitance model or a buffer storage model.

Though, due to the abundance of finishes and objects in a room, the determination of the buffer potential of all the separate finishes/objects is also a time-consuming or even unrealistic job. Therefore, in this study, starting from the methodology presented by Janssen and Roels (2009a, 2009b), a method is proposed to determine the moisture buffer potential of room enclosures in situ. To do so, a humidifier is placed in the room, imposing a moisture production scheme. Both the evaporated water and the temperature and RH in the room are continuously logged. Based on the measured RH-increase and decrease during the experiment, the ventilation rate and hygric inertia of the room can be inversely determined by solving the moisture balance of the room with the effective capacitance model. Using the effective moisture penetration depth model, based on the measured RH-course an effusivity and adjustment thickness factor can be determined with which the exact RH-course can be predicted.

An introductory section reiterates the characterisation of the single-element and room-enclosure moisture buffer potential and their implementation in the moisture balance. The second section presents a methodology for the in situ determination of the moisture buffer potential of room enclosures. In the third section, the methodology is validated by well controlled experiments in a large climatic chamber. To do so, the hygric inertia of the room (HIR) is determined based on the moisture buffer value of the separate finishes and objects and is afterwards compared to the hygric inertia obtained following the above mentioned methodology. In a fourth section, the methodology is applied to a real room.

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IMPLEMENTATION OF HYGRIC INERTIA IN MOISTURE BALANCE

Moisture balance for room air and enclosure

The evolution of the vapour pressure, vapour concentration or dew point in the inside air can be predicted with the moisture balance. Assuming ideal convective mixing and no surface condensation, supposing air exchange with the exterior environment only, and neglecting the temperature dependency of the air density, the moisture balance for the room air can be written as:

$$\frac{V}{R_v T_i} \cdot \frac{\partial p_{vi}}{\partial t} = (p_{ve} - p_{vi}) \frac{nV}{3600 R_v T_i} + G_{vp} - G_{buf} \quad (1)$$

with V (m³) the volume of the zone, T_i (K) the indoor air temperature, $V/(R_v T_i)$ (m³.kg/J) the moisture capacity of the zone air, $p_{vi/e}$ (Pa) the partial vapour pressure of indoor/outdoor air, n (1/h) the air change rate per hour, G_{vp} (kg/s) the indoor vapour production and G_{buf} (kg/s) the moisture exchange between indoor air and room enclosure.

Single-element and room-enclosure Moisture Buffer Potential characterisation

Recently, several proposals to characterise the Moisture Buffer Potential (MBP) of single finishes and objects have been presented. One of these proposals is to use the amplitude of the moisture accumulation in a finish/object exposed to cyclic step changes in ambient RH (Japanese Industrial Standard A 1470-1; Draft International Standard 24353; Nordtest Moisture Buffer Value protocol (Rode et al., 2007)). In the Nordtest cyclic steps of 8 hours 75% RH followed by 16 hours 33% RH are imposed and the 'Moisture Buffer Value' (MBV) of a finish is defined as:

$$MBV_{8h} = \frac{m_{max} - m_{min}}{A.(\varphi_{high} - \varphi_{low})} \quad \text{(kg/(m².\%RH))} \quad (2)$$

with $m_{max/min}$ (kg) the maximum/minimum moisture mass of the sample, A (m²) the exposed surface of the sample and $\varphi_{high/low}$ (-) the high/low RH level applied in the measurements (here respectively 75% and 33%). For an object the definition becomes:

$$MBV'_{8h} = \frac{m_{max} - m_{min}}{\varphi_{high} - \varphi_{low}} \quad \text{(kg/\%RH)} \quad (3)$$

Analogue to Eq. (2) and (3) also a $MBV^{(')}_{1h}$ can be defined, this time with m_{max} the moisture mass of the sample after one hour high RH.

Illustratively, Figure 1 shows for wood-wool cement board and a bookshelf with books the first two cycles of the measurements of the $MBV_{1h}^{(')}$ and $MBV_{8h}^{(')}$ (Vereecken, 2008). Based on these values a production-interval adapted Moisture Buffer Value (MBV^*) can be determined (Janssen and Roels, 2009a, 2009b):

$$MBV^{(')}* = \alpha.MBV^{(')}_{8h} + (1-\alpha).MBV^{(')}_{1h} \quad (4)$$

with α (-) a weighting factor:
- 0 h < production interval $\leq$ 2 h: $\alpha = 0.0$;
- 2 h < production interval $\leq$ 6 h: $\alpha = 0.5$;
- 6 h < production interval $\leq$ 10 h: $\alpha = 1.0$;

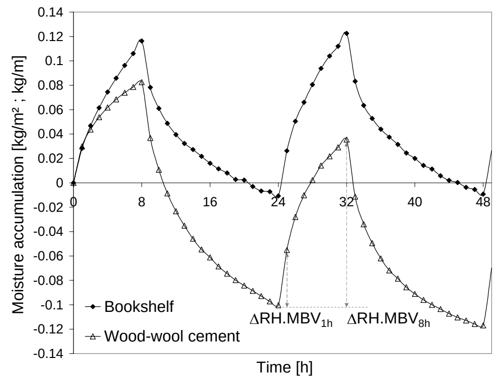

Figure 1 $MBV^{(')}$ characterisation of wood-wool cement board and of a bookshelf (1m)

Furthermore, Janssen and Roels (2009a, 2009b) showed that using the $MBV^{(')*}$-values of all the finishes and objects in a room a production-interval adapted HIR^*-value can be determined, which characterise the moisture buffer potential of the room:

$$HIR^* = \frac{\sum A_k.MBV_k^* + \sum MBV_l^{'*}}{V} = \alpha.HIR_{8h} + (1-\alpha).HIR_{1h} \quad (5)$$

with A_k (m²) and MBV_k^* (kg/(m².%RH)) respectively the area and moisture buffer value of finishing material k , $MBV_l^{'*}$ (kg/%RH) the equivalent moisture buffer value of element l, V (m³) the volume of the room, α (-) a weighting factor (see above) and $HIR_{1h/8h}$ (kg/(m³.%RH)) respectively the short and long term hygric inertia of the room given by:

$$HIR_{1h/8h} = \frac{\sum A_k.MBV_{k,1h/8h} + \sum MBV'_{l,1h/8h}}{V} \quad (6)$$

Implementation of HIR* in the EC-model

The moisture exchange between room air and room enclosure in Eq. (1) can be simplified using the Effective Capacitance (EC-) model. The EC-model assumes the mass of moisture buffered in the hygric inertia of the room M_{buf} (kg) in equilibrium with the room humidity and proportional to the HIR^*-value of the room enclosure. That allows to write the moisture exchange G_{buf} of Eq. (1) as:

$$G_{buf} = \frac{\partial M_{buf}}{\partial t} = \frac{100.HIR^*.V}{p_{v,sat}(T_i)} \frac{\partial p_{vi}}{\partial t} \quad (7)$$

with 100 a unit conversion factor to bring the kg/(m³.%RH) unit of HIR^* back to kg/m³. Eq. (7) transforms Eq. (1) into:

$$\left(\frac{V}{R_v T_i} + \frac{100.HIR^*.V}{p_{v,sat}(T_i)} \right) \frac{\partial p_{vi}}{\partial t} = (p_{ve} - p_{vi}) \frac{nV}{3600 R_v T_i} + G_{vp} \quad (8)$$

Note that the exact RH-course can not be determined using the EC-model. This is an inherent shortcoming of the EC-model, due to the assumption that the material humidity is the same as the RH in the room.

To predict the exact RH-course, the EMPD-model could be used. A discussion of this model can be found in (Janssen and Roels, 2009a, 2009b).

PROPOSED METHODOLOGY FOR IN SITU DETERMINATION OF HIR

Determining the hygric inertia of a room based on the moisture buffer potential of the different contributing components is due to the abundance of finishes and objects in a room still a time-consuming or even unrealistic job. Therefore, a methodology to determine the hygric inertia of a room in situ is proposed. Applying this methodology, a humidifier is placed in the room and during a period of some days a moisture production is imposed. The amount of evaporated water is continuously logged together with the RH and temperature. Consequently, knowing the outdoor conditions during the experiment, the hygric inertia can be determined by inversely fitting the moisture balance (Eq. (8)).

Due to the imposed moisture production a rise of interior RH is obtained, followed by a fall of interior RH during the period without moisture production (Figure 2). The amplitude of the RH-increase and RH-decrease can be plotted for different HIR^*-values in function of the ACH, as shown in Figure 3a. The curves which represent the theoretical total RH-increase in function of air change rate (dotted lines) show a descending course. On the other hand, the curves corresponding to the theoretical RH-decrease (continuous lines) first show a rising course. With an ACH = 0 no decrease would occur. So increasing the ACH first results in an increase of the RH-amplitude since a larger ACH corresponds to a lower RH at the end of the period without moisture production. However as an increasing ACH also affects the RH-increase during the moisture production period, from a certain moment this feature will be more important than the extra decrease in the period without moisture production.

Assuming that the ACH remains constant during the experiment, the measured RH-increase and decrease (Figure 3b) have to intersect the predicted RH-changes for the same HIR^*-value and ACH (indicated by the dots in Figure 3c). Note that the graphs (so also the methodology) is not valid when condensation occurs (e.g. light coloured part of the curves of HIR^*= 0.0 and HIR^*= 0.2 g/(m³.%RH)).

The implemented moisture production scheme can be chosen based on the most typical moisture production scheme in the room. However, a more all-embracing method is to determine the HIR_{1h} and HIR_{8h} of the room, exploring respectively a short term (cycli of 1 hour humidity followed by 5 hours inactivity) and a long term (8 hours humidifying followed by 16 hours inactivity) production scheme. Knowing HIR_{1h} and HIR_{8h}, the hygric inertia of the room in case of other production schemes can be determined as described in (Janssen and Roels, 2009a, 2009b). As an alternative, the HIR_{1h}-value - or other HIR^*-values corresponding to a production scheme smaller than 8 hours humidifying - could be determined based on the long term experiment. To do so, the curves for the RH-increase during the first hour – or during the implemented moisture production – should be drawn in function of the ACH and the curve which intersects the measured RH-increase by the ACH as found in the determination of HIR_{8h} should be searched.

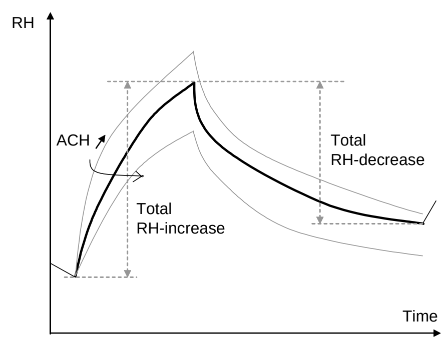

Figure 2 Schematic figure of the determination of the RH-increase and RH-decrease

VALIDATION

Test setup in the VLIET-test building

The methodology is validated in a large climatic chamber (1.8m x 6.54m x 2.7m) in the VLIET-test building at the K.U.Leuven. Beforehand, the moisture buffer potential of the different finishes and objects placed in the room was determined. Figure 4 shows the setup of the finishes and objects in the large climatic chamber. Table 1 gives the finishes and objects, together with their moisture buffer potential determined using the methodology *a)*

b)

c)

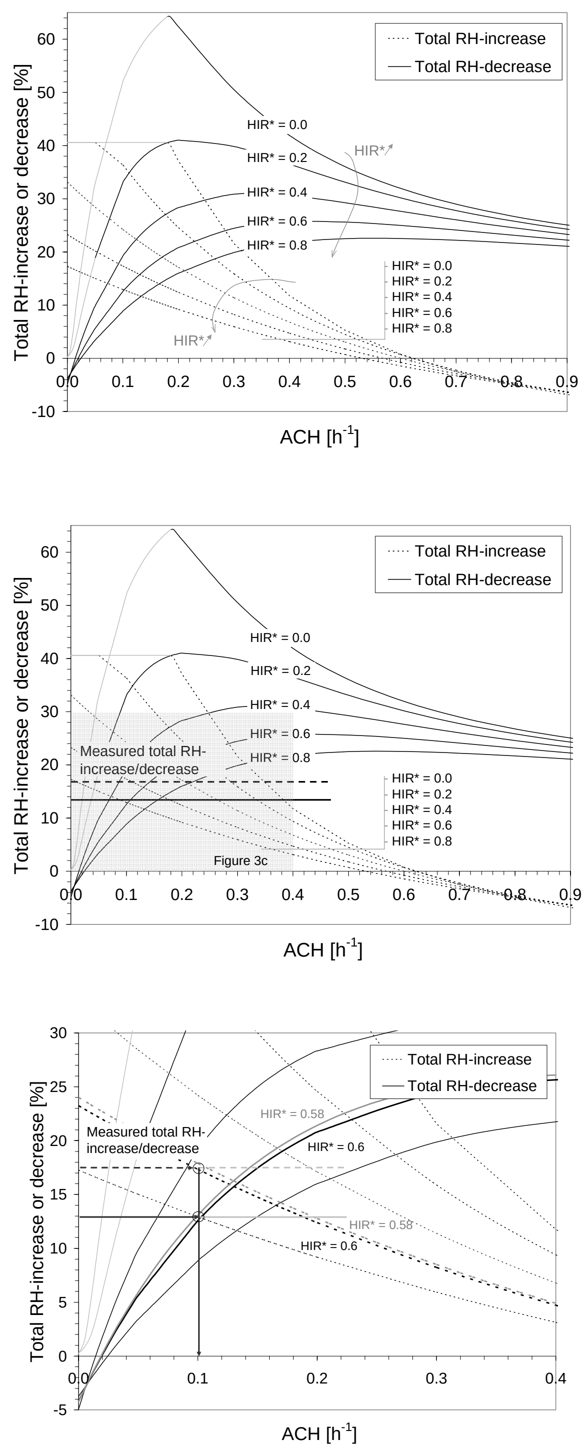

Figure 3 Schematic figure of the determination of the HIR-value: a) draw the theoretical curves of the total RH-increase and decrease, b) draw the measured total RH-increase and decrease, c) look for the curves which intersect the measured RH-increase and decrease at the same HIR-value and ACH. In this case a HIR*-value of 0.59 g/(m³.%RH) is obtained*

described in (Roels and Janssen, 2006). Using Eq. (5), these values result in a HIR_{8h} of 0.51 g/(m³.%RH) and a HIR_{1h} of 0.16 g/(m³.%RH) for the considered enclosure.

In the climatic chamber a humidifier was placed, which imposed a moisture production over a certain period. Behind the humidifier, a small ventilator was placed to mix the moisture in the room air. The evaporated amount of water was continuously logged, together with the temperature and RH. The influence of the outdoor conditions was minimised since the chamber was fairly air and vapour tight. To stabilize the conditions in the room, the experiment was starting one day after entirely locking the room. To have only moisture exchange with the in reality to moisture exposed sides, the back and the edges of the finishes were sealed with respectively plastic foil and aluminium tape.

Figure 4 Test setup in the climatic chamber in the VLIET-test building

Results

The experiment was explored for a long (8 hours humidification followed by 16 hours without humidification) as well as a short (cycli of 1 hour humidification followed by 5 hours without humidification) moisture production scheme. Executing a long term experiment resulted in a HIR_{8h}-value of 0.59 g/(m³.%RH) (see Figure 3 for the determination), which is in close agreement with the calculated value of 0.51 g/(m³.%RH) based on the moisture buffer values of the different elements. A small ACH (0.1 h^{-1}) was obtained, which is in agreement with the expectations since the precise air and vapour tight sealed construction. Using this ACH, a HIR_{1h}-value of 0.04 g/(m³.%RH) was obtained, which is far below the calculated value of 0.16 g/(m³.%RH).

When executing a short term moisture production scheme a HIR_{1h}-value of 0.07 g/(m³.%RH) was obtained, which is still an underestimation of the calculated value.

The smaller agreement of the HIR_{1h}-value can be due to some experimental facts as a lower surface transfer coefficient in the room than in the small climatic chamber, the fact that the water vapour will rise while most elements were placed on the ground, the difference between the RH-level in the room and the small climatic chamber, etc. Note also that the HIR_{1h}-value is especially important for zones with a short production scheme, which is for example the case in bathrooms. During occupation of this rooms a large moisture production can be observed, while in the in situ experiment the HIR_{1h}-value was determined for a small moisture production. To have a more accurate prediction of the HIR_{1h}-value, a larger moisture production should be provided.

Figure 5 compares the measured and in situ determined RH-course for both experiments. As can be seen the measured and the in situ determined hygric inertia are in the same order of magnitude.

The exact course can not be determined using the EC-model. This is an inherent shortcoming of the EC-model. To predict the exact RH-course, the Effective Moisture Penetration Depth (EMPD-) model should be used. Therefore, the equivalent effusivity b_{eq} and adjustment factor a_{eq} can be determined based on the HIR_{1h} and HIR_{8h} as described in (Janssen and Roels, 2009a, 2009b) or with for example the solver in Excel, making the difference between measured and predicted course as small as possible. Figure 6 shows the with the

Table 1

Dimensions and beforehand determined MBV_{1h} and MBV_{8h} of the hygric elements placed in the test room

MATERIAL	AREA ; LENGTH	MBV_{1H}	MBV_{8H}
	m² ; m	g/(m$^{(2)}$.%RH)	g/(m$^{(2)}$.%RH)
Wood-wool cement board	0.834	1.17	3.32
Wood-fibre board	9.375	0.36	1.15
Pile of journals (20 x 29 cm²)	0.225	0.84	2.64
Pile of newspapers 1 (20 x 29 cm²)	0.180	0.91	3.23
Pile of newspapers 2 (20 x 29 cm²)	0.175	0.91	3.23
Pile of books (17.5 x 25 cm²)	0.300	0.71	2.45
Books in rack (17.5 x 25 cm²)	0.305	0.71	2.45

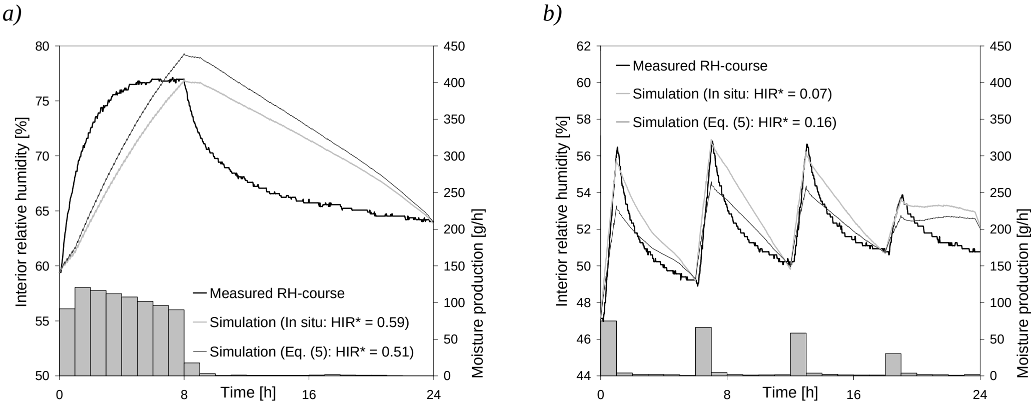

Figure 5 Measured and predicted RH-course (EC-model) in the large climatic chamber during the a) long term and b) short term experiment

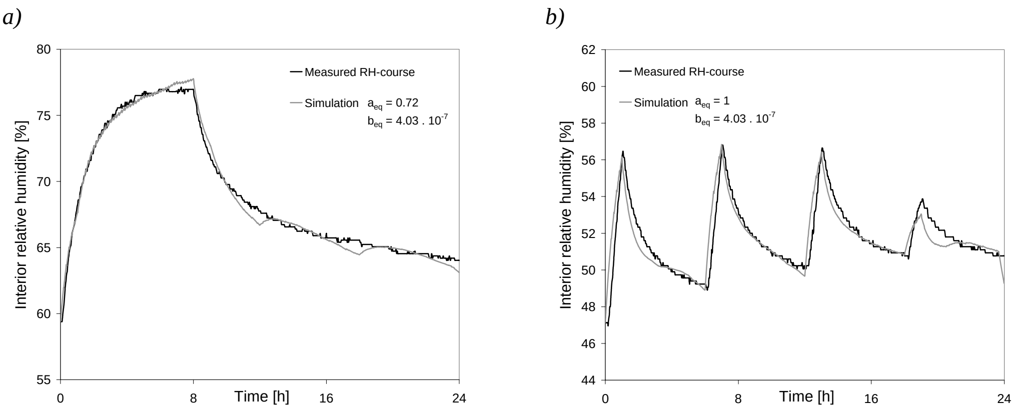

Figure 6 Measured and predicted RH-course (EMPD-model) in the large climatic chamber during the a) long term and b) short term experiment

EMPD-model predicted RH-course. The parameters b_{eq}, a_{eq} and the ACH (constant per 6 hours) were determined by fitting the RH-course. As can be seen, using the EMPD-model the exact RH-course can be predicted. Details of applying the EMPD-model for in situ determination of the moisture buffering potential can be found in (Vereecken et al., 2010). Note however that knowing the peaks in RH is in most studies the most important, so the more simplified EC-model will often be sufficient to analyse most problems.

APPLICATION ON A STUDENT'S ROOM

Test setup in a student's room

In a second step, the proposed methodology was used to determine the hygric inertia of a student's room (5m x 2.8m x 2.5m). Figure 7 gives an inside view of the room. The walls of the room were constructed with autoclaved aerated concrete finished with a coated gypsum plaster. Floor and ceiling consisted of a concrete slab finished with a coated gypsum plaster at the bottom.

Before starting the experiment, to increase the accuracy, possible air gaps around windows and door were sealed with plastic foil. The indoor conditions in the room were stabilized during one day, after which the experiment was started. During a period of three days a moisture production scheme consisting of 8 hours humidification followed by 16 hours without humidification was implemented. The amount of evaporated water was continuously logged together with the temperature and RH.

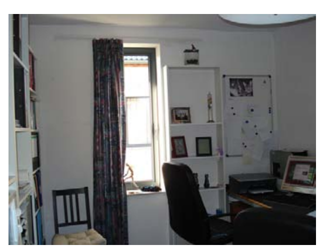

Figure 7 Inside view of the student's room

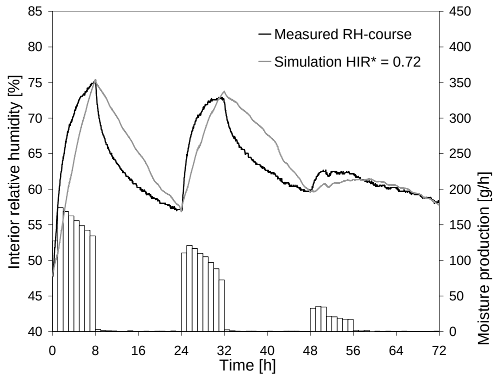

Figure 8 Measured and predicted RH-course (EC-model) in the student's room

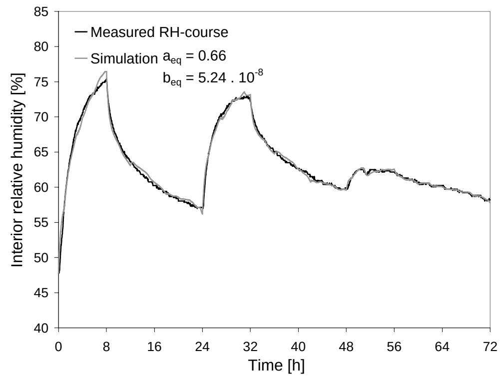

Figure 9 Measured and predicted RH-course (EMPD-model) in the student's room

Results

The first day of the experiment (after the day to stabilize the indoor conditions) was used to determine the hygric inertia of the room, resulting in a HIR_{8h}-value of 0.72 g/(m³.%RH). Using the results obtained during the long term experiment, also the HIR_{1h}-value was determined, resulting in a value of 0.18 g/(m³.%RH). In the determination, assumption was made that all the infiltration air was coming from outside. The measured and predicted RH-course is shown in Figure 8, together with the implemented moisture production. As can be seen the predicted minimum and maximum RH during the first day agree with the measured minimum and maximum RH determined with the HIR-value. Indeed, this was the condition in the determination of the HIR-value. Furthermore, when using the HIR-value determined during the first day, also a good agreement for the minimum and maximum RH of the second day is found. Using the EMPD-model the RH-course can be more accurate predicted. Figure 9 compares the real RH-course with the RH-course determined with the EMPD-model. A rough estimation of the exposed surface (in this case an estimation of 166 m² is used) is sufficient (Janssen and Roels, 2009a, 2009b).

DISCUSSION AND CONCLUSION

Interior relative humidity (RH) plays an important role in the air quality, the occupant's comfort, the appearance of building parts and the energy performance. Objects and finishes in a room are able to absorb and release moisture and as a consequence dampen the peaks in RH. Several authors stress the importance of the room enclosure, especially hygroscopic objects as books etc., to dampen the peaks in RH. These effects can be expressed with the HIR-value (Janssen and Roels, 2009a, 2009b), which can be determined based on the moisture buffer potential of the different elements/finishes separately. However, the abundance of elements and finishes in a room makes the determination of the moisture potential of all the elements a time-consuming or even unrealistic job. Therefore, in this paper, a methodology was proposed to determine the hygric inertia in situ. To do so, a humidifier was placed in the room, implementing a moisture production scheme. The hygric inertia was determined by inversely fitting the moisture balance.

In a large climatic chamber at the K.U.Leuven the proposed methodology has been validated for a short and long moisture production scheme. The in situ determined hygric inertia in the long term experiment showed to be in close agreement with the calculated value based on the moisture buffer potential of the different elements separately. On the other hand, the agreement between the calculated and in situ determined hygric inertia in the short term experiment was less and the short term hygric inertia determined with the long term experiment was even in less agreement with the calculated value. This can be due to some experimental facts as a larger volume of the room compared to the chamber, a different surface transfer coefficient in the room and the climatic chamber, the small variation in RH during the in situ experiment, the fact that the water vapour will rise while most elements were placed on the ground, the fact that the minima and maxima obtained with the EC-model are not entirely the same as the measured values,…

In a second step, the methodology has been applied on a student's room with unknown hygric inertia. Here, a HIR_{8h}-value of 0.72 g/(m³.%RH) and a HIR_{1h}-value of 0.18 g/(m³.%RH) were obtained. Applying these values to predict the response of the room for the next days also a good prediction was observed. As an inherent feature of the EC-model it is however not possible to simulate the exact RH-course. To do so, the EMPD-model can be used. A more detailed discussion of this model is given in (Vereecken et al., 2010).

It should be noted that in the proposed methodology a few assumptions are made. To determine the hygric inertia a constant ACH during the entire day is assumed. Although during the experiment the ventilation system is closed and the windows or other air gaps are sealed, the construction will not be entirely airtight. Therefore, to reduce the influence of outdoor conditions, the experiment is preferably performed on a day without much wind. The in situ determined value will also be slightly different from experiment to experiment. This is not only due to the variety of the influence of the outdoor conditions, but also to the variety in starting conditions, the implemented moisture production in the experiment, etc. Though the scope of the proposed methodology is to get a rough idea of the hygric inertia of the room using an easy experiment.

It can be concluded that the proposed methodology, although some simplifications are made, forms an easy and fast tool to come to a good estimation of the hygric inertia of a room. Main advantage of the methodology is that the HIR*-approach – compared to the standard methodologies – makes a comprehensive characterisation of the hygric inertia of an entire building enclosure possible, since also multilayered interior finishes and multidimensional interior objects as furniture, carpets, drapes, books, etc. can easily be taken into account. Furthermore, the determined HIR*-value can easily be implemented in the EC-model.

ACKNOWLEDGEMENTS

The results in this paper have been partially obtained within KUL OT/04/28 ‘Towards a reliable prediction of the moisture stress on building enclosures’, funded by the K.U. Leuven and IWT 3E90050 ‘Global performance approach and economic analysis of interior insulation with regard to renovation projects’ funded by the Flemish Government. These financial supports are gratefully acknowledged.

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EXTERNAL COUPLING BETWEEN BES AND HAM PROGRAMS FOR WHOLE-BUILDING SIMULATION

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ABSTRACT

This paper discusses a procedure for the two-way run time external coupling between Building Energy Simulation (BES) and building envelope Heat, Air and Moisture (HAM) programs for enhanced whole-building simulation. The coupling procedure presented here involves a description of the relevant physical phenomena at the interface between the programs, domain overlaps, coupling variables, coupling strategy and types of boundary condition. The procedure is applied using the programs ESP-r and HAMFEM, where the implementation and verification issues are discussed. This work concludes that the coupling between BES and HAM programs is feasible, and it can potentially enhance the accuracy in whole-building simulation.

INTRODUCTION

Simulation of heat, air and moisture (HAM) transfer for the whole building is important for a detailed analysis of performance aspects such as condensation and mould growth risk, indoor air quality, thermal comfort and energy consumption.

Several types of buildings might benefit from whole-building HAM simulation. In historical buildings, for instance, it is necessary because the physical domains (heat – air – moisture) and the geometrical domains (outdoor – envelope – indoor) are closely linked. Also new low-energy high-performance buildings require detailed simulation due to the use of passive cooling, heating and integrated control strategies.

Generally, Building Performance Simulation (BPS) programs are focused on a specific geometrical domain in combination with one or more physical domains. Furthermore, they have strong capabilities, but also some particular deficiencies in terms of boundary conditions, physical models and resolution in space and time. In whole-building HAM simulation, three types of programs can be identified, Building Energy Simulation (BES) (Crawley et al., 2008), building envelope HAM transfer programs (HAM) (Hens, 1996), and finally Computational Fluid Dynamics (CFD). The first two are addressed in this paper.

BES programs, such as ESP-r and EnergyPlus, are intended to study the whole-building energy performance and thermal comfort issues. These analyses are mainly focused on heat transfer, therefore only simplified models for moisture and air transfer in the building envelope are adopted. Contrary to this, HAM programs, such as HAMFEM, WUFI, MATCH and CHAMPS, allow detailed HAM transfer modelling. This is important for several performance indicators (Hagentoft, 1996), but it is however restricted to a single geometrical domain (a component of the building envelope) rather than the whole building.

Due to the different assumptions and simplifications present in both types of programs, the modelling uncertainty in the results of BES and HAM programs is potentially high, which could justify the efforts to combine their capabilities in a single simulation environment (Cóstola et al., 2008). In the present context, modelling uncertainties are those related with the assumptions and simplifications made about the physical processes involved in the problem under analysis, rather than the ones related to the input parameters (Mirsadeghi et al., 2009).

Two relevant examples of modelling uncertainty can be found in the results of the BESTEST (Judkoff and Neymark, 1995) and the IEA Annex 41 inter-model comparison for whole-building HAM simulation (Woloszyn and Rode, 2007). Those two examples are described below to highlight the importance of modelling uncertainty in whole-building HAM simulation. Figure 1 shows the results of annual cooling energy demand predicted by different BES programs for the BESTEST case 900 building. Differences up to 70% can be observed between the different programs. This is a good indication of modelling uncertainties, because the input parameters are precisely defined.

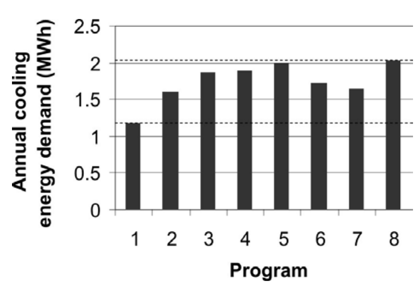

Figure 1 BESTEST case 900

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A common assumption in BES programs, which is adopted in the results present in Figure 1, is the negligible effect of moisture transfer and moisture accumulation in building components. Results from Annex 41 - Subtask 1 – Common Exercise 1 (BESTEST revised) show that when moisture transfer is taken into account, the modelling uncertainty is even higher, as shown in Figure 2 (dashed line indicates the range of values from Figure 1). In the original BESTEST, the results were published after a second round of simulations, where programs with outlier results could correct some coding mistakes or assumptions in order to bring their results closer to the average. This is not the case for the results in Figure 2, which are "blind", i.e. no adjustment was performed in any program based on the overall results. Even considering this fact, the spread in the results is high (variations up to 150%), indicating the relevance of moisture transfer and accumulation in the results of this particular performance indicator and building.

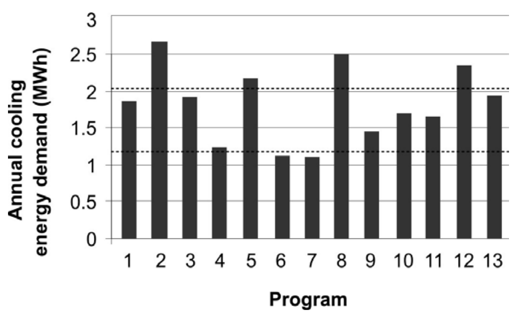

Figure 2 BESTEST case 900 with moisture transfer

While moisture transfer modelling represents a major deficiency in BES programs, HAM programs model it with a very good agreement between themselves, as described in Hagentoft et al. (2004). Therefore, the combination of the capabilities of these tools is relevant and can potentially improve BPS accuracy. However, there are several ways to address this need for integration.

In the past, several projects were carried out in order to include moisture transfer in BES programs, e.g. the research by Nakhi (1995) on the program ESP-r, or to extend HAM programs to perform whole-building simulation, e.g. the programs WUFI-Plus and CHAMPS-BES (Nicolai, 2007). In these cases, internal coupling was used, with the usual drawbacks of this software development strategy. As a result, most of those programs might not provide some state of the art models or are still missing some features that have become standard in new and/or other programs. This can be exemplified by the exclusion of liquid water boundary conditions in the "BESTEST revised" because many whole-building simulation programs could not handle this input. However, liquid load is a standard feature in many HAM programs.

In this sense, external coupling presents a suitable approach to address the combination of BES and HAM programs capabilities (Trcka et al., 2006a; Trcka et al., 2006b).

One-way external coupling is a straightforward technique for a first investigation of the coupling between these two programs, where one program performs a stand-alone simulation and its results are used to provide boundary conditions to the other program with no interaction on time step bases. This alternative was investigated by Costola et al. (2008) and will not be addressed here.

This paper deals with two-way external coupling between BES and HAM programs, i.e. the programs exchange data during run-time. It provides a theoretical framework and a procedure for this purpose. The proposed procedure is implemented in the BES program ESP-r (Clarke, 2001) and in the HAM program HAMFEM (Janssen et al., 2007), and the changes in each code are briefly discussed, followed by verification issues in the implementation. Finally, general conclusions about the coupling procedure are presented.

COUPLING FEATURES

Domain overlap

The first issue in the coupling between BES and HAM programs is the domain overlap between those programs, i.e. both are dedicated to the calculation of the temperature distribution inside the wall, using however different sets of equations. While in BES only the 1D Fourier equation is solved, the HAM programs solves the more comprehensive set of coupled equations for the 1D, 2D or 3D transfer of heat, air and moisture. Here, two possible approaches to solve the domain overlap problem are introduced: suppression of the overlapped domain in the BES program, or the synchronization of both programs in the overlapped domain.

Figure 3 schematically represents the suppression of the overlapped domain in BES. It is simple in nature, but complex concerning the implementation because it involves deep modifications in the problem description in the program. The definition of a few interface nodes at the surfaces is an advantage, because the programs only need to exchange information for these nodes.

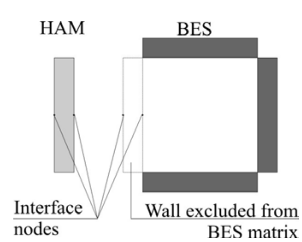

Figure 3 Suppression of the overlapped domain

Figure 4 schematically represents the synchronization of domains. It aims to keep both programs calculating the temperature distribution inside the wall, exchanging data for all these nodes. In this case, the heat transfer equations in the BES program should be modified to include moisture related terms, such as heat storage, changes in the thermal conductivity and sink/source terms for latent heat. Although possible, synchronization presents no major benefits because, as the suppression, it requires deep modifications in the problem description in the program. The number of interface nodes is much higher when compared with the suppression approach, and stability and convergence problems can be expected due to the strong interaction between the BES and HAM programs.

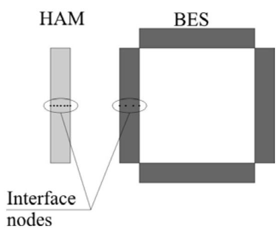

Figure 4 Synchronization of the overlapped domains

In this paper, the suppression of the overlapped domain in the BES program is adopted, and the implications of this approach are discussed in the section about modifications in the BES code.

Geometrical features and 1D versus 2D-3D simulation

Most BES programs calculate heat transfer through building components in only one dimension, while many HAM programs can provide also 2D or 3D calculations. The difference in dimensions in BES and HAM programs do not represent a problem, because it is possible to run a 1D simulation in most of the HAM programs, so the problem description is done in the same level in both programs.

However, two issues should be highlighted concerning this topic.

Firstly, the relevance of air transfer modelling in 1D is highly reduced for lightweight constructions, which is exactly where the air transfer is more relevant due to the high number of joins and potential leakage in this type of construction. It happens, among other reasons, because the buoyant flow inside the wall cannot be reproduced by the 1D model. Li et al. (2007), provide a good example of the importance of 2D effects in air transfer in the building envelope. Therefore, in spite of this recognized importance (Hagentoft, 1996), air transfer is often neglected in 1D calculations. In the present paper, this is also done when 1D simulations are performed by the HAM program.

Secondly, BES programs usually treat the building components as a single entity, i.e. the whole wall is considered as a single element, with uniform state and boundary conditions over the whole surface. This approach compromises the analysis of local problems such as mould growth and condensation in spots near edges and corners. Although it presents a limitation, the discretization of the building components in several co-planar 1D elements, the so called surface discretization as presented in Figure 5, does not necessarily improve the resolution of the model. The problem in the surface discretization in BES is related to the empirical algorithms used to estimate the surface averaged convective heat transfer coefficients, which often requires the length of the surface as an input. When the length of the surface is reduced by the discretization, BES wrongly calculates the transfer coefficient, and potential improvements in the accuracy of the results can consequently become compromised. Coupling between BES and CFD can overcome this limitation and it could make the surface discretization a useful strategy when coupling BES-CFD with HAM programs.

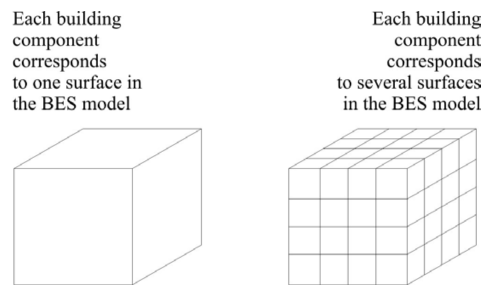

Figure 5 Surface discretization in BES

In the present work, no CFD simulation is included, but it clearly represents the next step in order to improve the accuracy and resolution of HAM whole-building simulation. The BES-HAM-CFD coupling could also be used to simulate 2D or 3D details, as presented in Figure 6, where the difference in the length of the building component is exemplified. In this case, coupling variables representing fluxes should not be described in terms of absolute values, e.g. W, but as function of the surface are, e.g., W/m^2. This approach is expected to reduce the importance of the difference in the component length/surface for most of the cases.

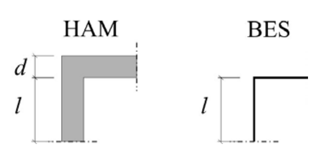

Figure 6 Geometrical differences when simulating 2D details

Coupling variables

As described in the previous section, the surface of building components is defined as the interface between the BES and HAM programs. In the HAM program, the boundary condition (bc) can usually be defined in two forms, as a state (Dirichlet bc) or a flux (Neumann bc). While both forms are possible, the use of Neumann bc for the HAM program presents a clear advantage concerning the coupling with BES programs: it allows the HAM program, which has more a comprehensive model of the building envelope, to calculate the state at the surface node. After that, the BES program can use the states calculated by the HAM program as boundary condition, and perform the calculation to obtain the fluxes of each quantity at the surface. This structure is schematically presented in Figure 7 and is adopted in this paper.

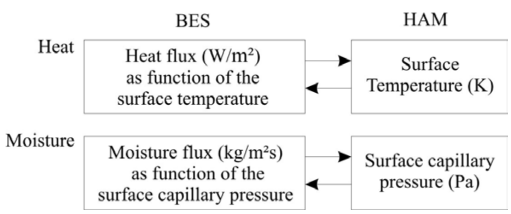

Figure 7 Coupling variables

The flux bc could be imposed in two different ways, as an integrated value or as a function of the surface node state which is the option described in Figure 7.

The integrated value consists of the sum of all fluxes at the surface, as exemplified in Figure 8. Using the state calculated by the HAM program as a boundary condition, BES solves all the unknown states of the nodes in the model, and afterwards calculates the various fluxes at that boundary.

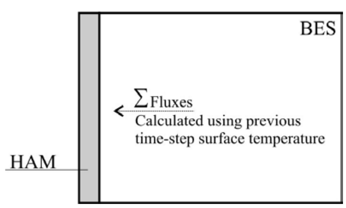

Figure 8 Scheme representing the integrate flux

For the heat flux, the integrated value to be delivered to the HAM program is:

$$Q^{t+1} = Q^t_{SW} + Q^t_{cg} + Q^t_{hvac} + Q^t_{Conv} + Q^t_{LW} \quad [1]$$

where Q^t_{SW}, Q^t_{cg} and Q^t_{hvac} are respectively the gains due to shortwave radiation, casual gains due to occupancy, equipments and lighting, and the radiant fraction of the HVAC system, being those terms independent of the surface temperature (T_s). In fact, Q^t_{hvac} depends on T_s, but it is not taken into account in the present work. The terms Q^t_{Conv} and Q^t_{LW} are the gains due to convection and longwave radiation, respectively, which are dependant on T_s. In this case, Q^t_{Conv} and Q^t_{LW} are calculated using data known at time t, T_s^t.

Obtaining the integrated flux is straightforward, because many BES programs provide post-processing facilities to calculate the heat flux at a given node. However, the use of integrated values in HAM programs present two drawbacks. The first is the delay due to the use of flux values based on the state at the previous time step. The second, and more important, is the adoption of the "Newton-Raphson" scheme by some HAM programs, e.g. HAMFEM. This scheme improves the convergence of the highly non-linear coupled equations of heat, air and moisture transfer in the building component, but it requires knowledge about the derivatives of the flux at the boundary regarding the node state. In this case, it is necessary to have the boundary condition in the flux equation form.

The flux equation describes the total flux as a function of the surface temperature, so additional parameters are required, as represented for the case of the heat flux in Figure 9:

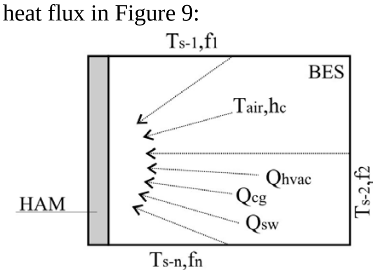

Figure 9 Scheme representing the some parameter of the flux equation

Some additional values required are the convective heat transfer coefficient (h_c), air temperature (T_{air}), all surface temperatures (T_{s-n}) and the view factors (f_n).

The heat flux equation is described below:

$$Q^{t+1} = Q^t_{SW} + Q^t_{cg} + Q^t_{hvac} + Q^t_{Conv}(T_s^{t+1}) + Q^t_{LW}(T_s^{t+1}) \quad [2]$$

where T_s^{t+1} is unknown and will be calculated by the HAM program.

From the discussion above, it is clear that obtaining the flux equation requires more information, and consequently more efforts for its implementation. The final equation however is very simple, because all terms in Eq. [2] are linear or can be casted into the linearized format, so independent and dependent terms can be grouped, resulting in:

$$Q^{t+1} = a \, . \, T_s^{t+1} + b \quad [3]$$

In Figures 8 and 9, only the internal surface is represented, but in reality, one equation is calculated for each surface, for each time step in BES.

In this paper, the flux equation form is adopted, due to its applicability to a wider range of HAM programs.

Coupling strategy

Several previous works on coupling demonstrate the computational benefits of using the loose coupling strategy, even with the short time step value required to avoid large errors and instability. Assuming the loose coupling strategy, it is necessary to define a convenient data exchange rate to preserve stability and accuracy.

In BES programs, the time step length is often defined based on previous case studies, rather than in time step independence tests for each model. Clarke (2001) exemplifies that 1 hour is a good trade-off between accuracy and computational effort in BES simulation. It is known that the accuracy of BES simulation depends on the wall composition and node distribution, and implicit schemes mask the discretization errors in time and space. However, using adaptative time steps is not common in BES.

In HAM programs, the use of an adaptative time step is more common, particularly due to the necessity of convergence between the coupled system of equations for HAM transfer. The time step can vary from one hour to a few seconds depending on the boundary conditions, particularly when liquid water boundary conditions is present.

Considering the limitation of BES programs in terms of time step independency, the definition of the data exchange rate in BES-HAM coupled simulations cannot be performed based on general rules. However, values obtained from case studies can be considered as an initial indication for the definition of data exchange rate in other simulations. The best practice is to test the sensitivity of the simulation results to the data exchange rate value.

In this paper, the time step in BES (Dt^{BES}) is defined arbitrarily to be 15 minutes, while the time step in the HAM program is adaptative, so the different programs work in different rates (multi-rate). The data exchange rate is equal to the higher time step, in this case the BES one. Programs run in parallel after data exchange. Figure 10 shows schematically the coupling strategy, time steps and data exchange rate used in this paper.

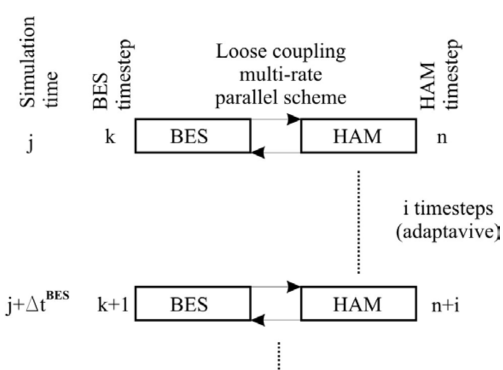

Figure 10 Coupling strategy

Inter-process communication (IPC)

IPC is a purely computational issue in coupled simulations, however its importance goes from basic aspects such as the time expended in the simulations to more general aspects, such as the popularization of coupled simulations.

Previous studies about coupling used mainly platform-dependant IPC with coding specifically adapted for the model under analysis (Djunaedy, 2005; Trcka, 2008). These codes are hard to reuse for others, therefore they are rarely included in new versions of the programs. In order to avoid this situation, a platform-independent IPC with low possibilities of hardcoding should be adopted in the current project.

An alternative in IPC is the Building Controls Virtual Test Bed (BCVTB) (Wetter and Haves, 2008), which is “modular, extensible, open-source software platform that allows designers, engineers and researchers of building energy and control systems to interface different simulation programs.” While introducing relevant improvements in the dissemination of coupled simulations, the BCVTB concentrates in the hands of one developer the tasks of learning the programs, their codes, and also the BCVTB. In spite of using sockets, which is a multi-platform IPC, BCVTB is currently designed for use on a single computer, which should run all programs.

Due to these reasons, it was decided to adopt a more traditional approach in the present work, using a small TCP/IP sockets library written in “C”, which is compiled with each program, and allows their communication during the simulation. This approach allows multiple users to run each of the programs involved in the simulation from different computers. Once the coupling procedure is defined, as described in the previous sections, different developers with different expertises can implement the necessary modifications in their codes to perform the coupled simulation.

PROTOTYPE FEATURES

Based on the coupling procedure described in the previous section, a prototype program was developed using the BES program ESP-r and the HAM program HAMFEM. In this section, the main changes in each code are discussed.

Modifications in HAMFEM

HAMFEM is a 3D HAM program developed at the K.U. Leuven using the finite element method. As many academic codes, the program is written in Fortran 90, has no graphical interface and no control over the quality of the input data. One important feature is the high level of hardcoded information in the program, e.g. the boundary conditions are implemented directly in the code for each model/simulation. This feature represents a serious concern when quality assurance aspects are considered, but it facilitates the coupling with other programs because the coding process for boundary condition implementation is well documented and straightforward. In HAMFEM, the main modifications were focused on the implementation of the bc provided by ESP-r. As discussed in the previous section, HAMFEM uses Neumann bc during the coupled simulations, with the fluxes obtained from ESP-r as flux equations, such as Eq. 3. Due to the iterative solution process of the coupled equation of heat, air and moisture transfer by HAMFEM, the boundary condition is recalculated for each iteration for each equation.

Considering the boundary condition for the moisture balance calculation, the flux equation obtained from ESP-r is modified in HAMFEM to include the wind-driven rain term (Blocken and Carmeliet 2004). This approach was adopted because ESP-r has no database for catch ratios, while HAMFEM includes detailed data concerning this parameter (Blocken and Carmeliet 2004).

Modifications in ESP-r

While in HAMFEM the modifications are small and simple, in ESP-r code the modifications affect the core of the program. The complexity and extension of modifications necessary to perform a coupled simulation seems to be proportional to the code size and history. ESP-r is a code with more than 3 decades of continuous development, it has a graphic interface, extensive quality assurance procedures, and other features that can make the learning curve for users and developers rather unattractive. A positive point in ESP-r structure is its modularity, so the code related to air flow network or HVAC systems is completely separate from the core module, responsible for the building heat balance. The modifications described here applies only to the bps module.

Two major modifications were implemented in ESP-r: (1) extraction of the flux equation for the surfaces of each coupled building component; (2) suppression of nodes from the ESP-r matrix corresponding to the coupled building components. Each modification is briefly discussed in the paragraphs below.

1. Obtaining the heat flux parameter described in Figure 9 is simple due to the availability of all necessary data in a single subroutine responsible for the post processing in each time step. The flux equation, obtained in this way, considers the heat balance in the time step, and is based on calculated states of all nodes for that time step. The flux equation can be used in the two-way coupling, which is the aim or the present paper, but it can also be exported from a stand-alone ESP-r calculation, using the trace facilities, for posterior use as boundary conditions in one-way coupling with any HAM program.

2. As discussed in a previous section, the domain overlap between BES and HAM programs can be overcome by the suppression of overlapped nodes from one program. ESP-r is very suitable for this purpose, due to the procedure adopted to form and solve the heat balance matrix of each zone. In ESP-r, the zone matrix is partitioned for each building component, which means that suppression of one building element does not affect the others. The building component matrices are coupled with the matrix for the air and surfaces nodes. In this matrix, the surface temperature of the coupled building component is known, so its equation should be removed from the matrix. Some terms related to the heat exchange between the coupled surface and the surrounding can also be calculated by multiplying the known temperature with the corresponding coefficients in the matrix, where the result is transported to the right-hand side of the matrix.

Figure 11 schematically shows the air and surface nodes matrix, at time equal to t+1. Assuming that the first line represents the coupled building component, this line is suppressed from the matrix, as well as the columns with the cross-coupling coefficients relative to this building component, resulting in the matrix indicated in dark gray (magenta). For each one of the remaining nodes, the cross-coupling coefficients relative to the coupled building component are multiplied by the surface temperature at time equal to t, as calculated by HAMFEM, and transported to the right-hand side of the equation.

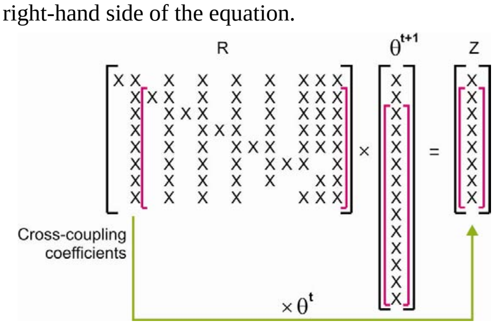

Figure 11 Scheme of ESP-r surface nodes matrix (after Clarke, 2001)

Concerning the moisture terms, the modifications are much smaller. The only relevant modification is the inclusion of the flux from/to the building component into the air node moisture balance.

One important limitation of the current implementation is the impossibility of placing control/sensor nodes in the coupled building component. Concrete core activation and other techniques were there is heat injection/extraction inside the building component cannot be simulated using this coupling procedure.

Another important, but rather philosophical aspect of the current implementation is the disassembling of the ESP-r core. In the case where all the building components are coupled with HAMFEM, the only node remaining in ESP-r calculation is the air node. One might argue that in this case, ESP-r is reduced to a sophisticated pre and post processor for the HAM program. In fact, many of the ESP-r qualities are based in pre and post, and also in the integration with other domains, such as AFN, HVAC system, CFD, renewable energies, etc. In this sense, much of ESP-r is preserved in the present coupling procedure.

It is clear that ESP-r stand-alone is highly optimized for 1D calculations of heat transfer in building components, and the current prototype cannot compete in terms of computational efficiency for problems involving only heat transfer.

VERIFICATION

Several measures were adopted to verify the implementation of the coupling procedure described in the previous sections.

Considering the complexity involved in any kind of coupling, it is advisable to perform the implementation and verification in steps.

The first step in the implementation was the facility to export the flux equation from ESP-r. This implementation is easily verified confronting exported data with the values obtained from the standard ESP-r output. Using the surface temperature and the flux equation, it is possible to calculate the integrated heat flux at the surface for each time step, and this value can be compared with the hourly values for the flux at the surface, also obtained using ESP-r graphic interface.

The second step in the implementation was the facility to suppress building components from ESP-r calculation. Based on a stand-alone ESP-r simulation, the surface temperature of the suppressed building component is obtained. Then, the modified version is tested using this surface temperature as the one that would be provided by the HAM program in the final prototype. In both simulations, the overall ESP-r results are almost the same, and the implementation is considered verified for this part.

The approach used in the previously discussed verifications can be described as self-coupling, because it aims to reproduce results from the program itself. This technique proved to be valuable during the implementation of modifications aiming coupled simulations.

The verification in the IPC functions is straightforward, because it consists only of the comparison of three values: the original ones calculated by the program, the sent values by the IPC function and the received values by the other program. For this purpose, ESP-r and HAMFEM were tested separately, and small programs emulate the behaviour of the program that was not under test. The values agree completely and the IPC is considered verified.

Concerning HAMFEM, two major verifications procedures were adopted.

Firstly, part of the HAMSTAD exercises (Hagentoft et al., 2004) were reproduced, in order to assure that the present code complies with the previous versions which complied with the HAMSTAD results.

Secondly, the program was tested using one-way coupling based on the flux equation obtained from ESP-r stand-alone simulations, using the facility to export “surface flux to HAM model”. The same material properties, spatial and temporal discretizations were used in ESP-r and in HAMFEM, and only heat transfer is considered. Using the flux equation from ESP-r, HAMFEM should be able to reproduce the surface temperatures calculated by ESP-r stand-alone. Result are obtained from simulations of the west wall of the BESTEST case 600 building. Figure 12 shows the comparison of HAMFEM and ESP-r results, in the form of a probability density plot of the differences found between their calculated internal surface temperature. As expected, the difference is negligible for most of the cases, but some larger differences occur, probably due to the difference in the numerical methods and the coarse grid used in the simulations, i.e. the ESP-r default grid. The comparison is considered successful.

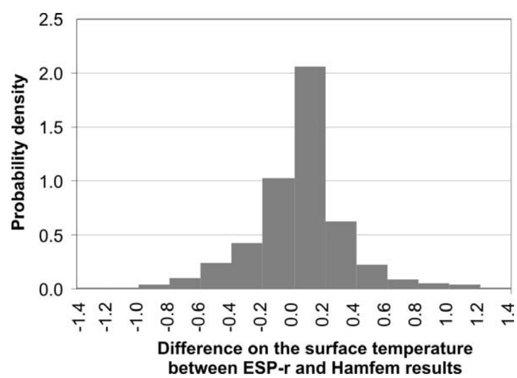

Figure 12. Comparing ESP-r and HAMFEM results

CONCLUSION

This paper concludes that:

1. the external coupling between BES and HAM programs is viable and feasible,
2. it can potentially improve the accuracy of whole-building performance simulation,
3. the suppression of the overlapped domain in the BES program presents the best cost-benefit ratio to solve the domain overlap problem,
4. 1D heat and moisture calculations proves to be the simplest approach to perform BES-HAM coupled simulations,
5. 2D and 3D simulations in the HAM program coupled with BES depend, among other factors, on improvements of the convective transfer coefficients in BES, and the most suitable approach for this seems to be BES-CFD coupling,
6. the use of surface discretization to improve the geometrical resolution in stand–alone BES programs presents drawbacks related to the empirical relations for transfer coefficient calculation, and should therefore be avoided,

7. concerning the coupling variables, the HAM program should be responsible for the calculation of the states of the boundary nodes, so Neumann bc should be used in the HAM program, and Dirichlet bc in the BES program,
8. based on literature review and the physical phenomena involved, multi-rate loose coupling with parallel execution seems to be the most suitable coupling strategy,
9. IPC using “C” socket libraries proves to be easily implemented and flexible in its application,
10. HAMFEM and ESP-r proved to be suitable codes for BES-HAM coupling, and some of the implemented facilities, such as exporting “surface flux to HAM model”, can be readily used with any HAM code,
11. self-coupling proved to be a valuable technique for verification, particularly is in BES,
12. one-way coupling proved to be a useful technique for verification purposes.

Future work should concentrate on the validation of the prototype and on a coupling necessity decision procedure.

ACKNOWLEDGEMENT

This research is funded by the “Institute for the Promotion of Innovation by Science and Technology in Flanders” as part of the SBO-project IWT 050154 “Heat, Air and Moisture Performance Engineering: a whole building approach”.

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Building Simulation 2013: Call for Proposals

The board of IBPSA is pleased to issue the following call for proposals from parties interested in hosting Building Simulation 2013. A complete proposal should be sent to the Conference Location Coordinator, Jeff Spitler (**spitler@okstate.edu**), as soon as possible. Discussions with Jeff of potential proposals prior to the due date are strongly encouraged. The proposal should address the following items:

- proposed venue
- dates
- details of conference secretariat
- organization time line
- detailed budget in local currency and in US dollars
- discussion of possibilities for sponsorship
- details of the conference presentation schedule (e.g. number of parallel and plenary sessions), publication of proceedings etc.
- details of accommodation, including costs, for delegates
- social events
- options for pre and post conference tours
- options for program for accompanying persons
- plans for organization of an IBPSA Regional Affiliate Organization, if applicable
- involvement of existing or planned IBPSA Regional Affiliate(s)
- experience of organizing committee with IBPSA and with organizing similar conferences.

To assist your decision there are several documents available for your review:

- **www.ibpsa.org/IBPSA-Regionalization-Guide.pdf** describes IBPSA's regionalization plans: we schedule all of the Building Simulation conferences in regions with existing affiliates or regions that are starting a new affiliate organization. In a region currently without an affiliate, we will only consider holding the conference there if a regional affiliate organization will be in place by the time of the conference.

- Final reports for the Building Simulation'03, '05, and '07 conferences, which include details of organization, finances (e.g. planned budget and actual expenses), post-conference surveys and other information useful to organizers of future Building Simulation conferences are here:
  - **www.ibpsa.org/BSRFP/BS2003_final_report.pdf**.
  - **www.ibpsa.org/BSRFP/BS2005_final_report.pdf**.
  - **www.ibpsa.org/BSRFP/BS2007_final_report.pdf**.

- **www.ibpsa.org/BSRFP/Sponsor_Exposure.pdf** contains suggestions regarding the exposure and benefits of Building Simulation sponsors.

- **www.ibpsa.org/BSRFP/BS_05_MOA.pdf** serves as an example for the contract which will be agreed between IBPSA and the organizers of Building Simulation '13.

Important instructions for preparing a budget and formatting the proposal should be obtained directly from Jeff Spitler; please request these by email.

Proposals will be evaluated using the following criteria:

- Attractiveness and accessibility of location – is this location likely to attract delegates from around the world? (10%)
- Affordability of venue – is the combination of registration fee and accommodation costs likely to not be a hurdle to potential delegates? (In this respect, a range of accommodation types including student dorms or the like is a benefit.) (10%)
- Quality of conference plan and facilities – are the facilities and conference plan conducive to a well-run conference? (10%)
- Likelihood of financial success — will the conference financial plan likely lead to breaking even (at least.)? A financial plan that does not rely on unconfirmed sponsorships to break even is strongly preferred. (30%)
- Support of IBPSA goals – will choosing this proposal help draw new members into IBPSA (in new regions) or support membership in existing regions? (10%)
- Diversity of location - is this location sufficiently distant from recent conferences? (10%)
- Regional participation – is the proposal well-supported by volunteer effort from the regional affiliate and/or nearby regional affiliates? (10%)
- Experience of members of the organizing committee with IBPSA and with organizing IBPSA affiliate conferences or conferences similar to Building Simulation. (10%)

The final decision regarding the location of Building Simulation 2013 resides with the IBPSA Board of Directors and will be made following a thorough evaluation of all submitted proposals.

Other IBPSA announcements

IBPSA Corporate membership

The International Building Performance Simulation Association (IBPSA), is a non-profit international society of building performance simulation researchers, developers and practitioners, dedicated to improving the performance of the built environment. It is IBPSA's mission to advance the science and application of building performance simulation in order to improve the design, construction, operation, and maintenance of new and existing buildings worldwide.

IBPSA disseminates information through a semi-annual newsletter, central and regional websites, and through a biennial conference, this to-date having been held in the USA, China, Brazil and Japan, among other countries.

IBPSA has a worldwide membership of over 2000, the membership being supported through 18 regional affiliates located in countries spanning 5 continents. Corporate members are companies or organisations that have an interest in the research, development, or application of building performance simulation.

Corporate Membership

Corporate members of IBPSA have the benefit of:

- The company (or organisation) logo on the IBPSA website (**www.IBPSA.org**), with a link to the company's own website.
- The company logo, contact information, and a half-page advertisement in the IBPSA newsletter, which is published twice a year and distributed to the 2000 members worldwide. The newsletter is freely available on the IBPSA Central website.
- A free copy of the biennial conference CD.

There are two categories of Corporate membership, standard and gold. Fees are US$750 per annum for standard corporate membership and US$5,000 per annum for gold corporate membership. Gold corporate members have the benefit of the company logo and contact details being placed in a prominent position on the IBPSA website, and are offered a full-page rather than half-page advertisement in the IBPSA newsletter. Free corporate membership may also be granted to sponsors of the biennial conference.

An application form can be downloaded from the IBPSA Central website at **www.ibpsa.org/m_membership.asp#_Corporate_Members**.

For further information please contact:

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IBPSA Fellow nominations due 01 June

As announced in the IBPSA News Volume 19 No 2, October 2009, nominations for the inaugural class of IBPSA Fellows are due on June 1, 2010. This membership grade will recognize individuals who have made outstanding contributions to the field of building performance simulation. New Fellows will be elected on a two-year cycle, culminating with recognition at the biennial Building Simulation conferences.

> "A member who has attained distinction in the field of building performance simulation, or in the allied arts or sciences, or in teaching of major courses in said arts and sciences, or who by way of research, simulation code development, original work, or application of building simulation on projects of a significant scope, has made substantial contribution to said arts and sciences, and has been active in the field for the last ten (10) years is eligible for election to the grade of Fellow by the Board of Directors."

Nominations may be made by IBPSA members other than the nominee. The application package will include details of the nominee's qualifications, a CV, supporting letters, and other relevant materials. The details of the nominee's qualifications shall include summaries of accomplishments in one or more of the following categories: industrial leadership, research, simulation code development, application of building simulation on projects of significant scope, educational leadership, and significant technical contributions to the allied arts and sciences. The application form and instructions are available at **www.ibpsa.org/m_membership.asp#_IBPSA_Fellow**.

Journal of Building Performance Simulation update

The first issue of Volume 3 (2010) of Journal of Building Performance Simulation, the official journal of IBPSA, has been published. This issue contains the following papers:

Daum, David and Morel, Nicolas. *Assessing the total energy impact of manual and optimized blind control in combination with different lighting schedules in a building simulation environment*. Journal of Building Performance Simulation, 3 (1), 1-16.

Stuhlenmiller, Tobias and Koenigsdorff, Roland. *Optimum thermal storage sizing in building services engineering as a contribution to virtual power plants*. Journal of Building Performance Simulation, 3 (1), 17 – 31.

Frenette, Caroline D.; Beauregard, Robert; Abi-Zeid, Irène; Derome, Dominique and Salenikovich, Alexander. *Multicriteria decision analysis applied to the design of light-frame wood wall assemblies*. Journal of Building Performance Simulation, 3 (1), 33 – 52.

Jacob, Dirk; Dietz, Sebastian; Komhard, Susanne; Neumann, Christian and Herkel, Sebastian. *Black-box models for fault detection and performance monitoring of buildings*. Journal of Building Performance Simulation, 3 (1), 53 – 62.

Raslan, Rokia and Davies, Mike. *Results variability in accredited building energy performance compliance demonstration software in the UK: an inter-model comparative study*. Journal of Building Performance Simulation, 3 (1), 63 – 85.

Air Information Review (AIR)

The AIR (Air Information Review) is a quarterly newsletter containing topical and informative articles on air infiltration and ventilation research and application. It is published quarterly by AIVC (Air Infiltration and Ventilation Centre), headquartered in Belgium. The most recent issue is March 2010. All past issues can be found at **www.aivc.org/frameset/frameset.html?../Air/air.html~mainFrame**; pdf copies (without hyperlinks) can be freely downloaded.

To illustrate typical content, the December 2009 issue contained:

- New Technical Note 65: Recommendations on Specific Fan Power and Fan System Efficiency
- Ventilation and IAQ in New Homes With and Without Mechanical Outdoor Air Systems
- Studying the effect of indoor sources and ventilation on the particulates concentrations in dining halls
- A dynamical version of the Fanger Thermal Comfort model
- International workshop: Innovative products and systems for energy efficient building
- 31th AIVC Conference 2010: Low Energy and Sustainable Ventilation Technologies for Green Buildings
- National Research Council of Canada's Indoor Air Initiative
- CLIMA 2010 - Announcement
- BUILD UP, The European portal for energy efficiency in buildings
- Best Paper Award at the 30th AIVC Conference & 4th BUILDAIR Symposium
- Advanced Energy Design Guides
- New ASHRAE Health-Care Facility Design Guide
- WHO handbook on indoor radon - a public health perspective
- Information on AIVC supported conferences and events

IBPSA affiliates

URLS for IBPSA affiliates' websites and email addresses for their contact persons are available on the IBPSA Central web site at **www.ibpsa.org/m_affiliates.asp**.

	contact:
IBPSA Australasia	**Paul Bannister**
IBPSA Brazil	**Nathan Mendes**
IBPSA Canada	**Jeff Blake**
IBPSA China	**Da Yan**
IBPSA Czech Republic	**Martin Bartak**
IBPSA England	**Malcolm Cook**
IBPSA France	**Etienne Wurtz**
IBPSA Germany	**Christoph van Treeck**
IBPSA India	**Rajan Rawal**
IBPSA Japan	**Harunori Yoshida**
IBPSA Netherlands + Flanders	**Wim Plokker**
IBPSA Poland	**Dariusz Heim**
IBPSA Scotland	**Lori McElroy**
IBPSA Slovakia (no web site yet)	**Jozef Hraska**
IBPSA Spain	**David Garcia**
IBPSA Switzerland	**Gerhard Zweifel**
IBPSA UAE	**Khaled Al-Sallal**
IBPSA USA	**Charles "Chip" Barnaby**

IBPSA Corporate Members

Gold Corporate Members

	US - DOE United States Department of Energy www.energy.gov 1985-2011
	ESRU (Energy Systems Research Unit) University of Strathclyde www.esru.strath.ac.uk 2009-2011
	SUST www.sust.org 2009-2011

Corporate Members

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	BRE www.bre.co.uk 2009-2011
	DesignBuilder www.designbuilder.co.uk 2009-2011

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Corporate Members (continued)

	Environmental Design Solutions www.edsl.net 2009-2011
	EQUA Simulation Technology Group www.equa.se 2009-2011
	Integrated Environmental Solutions www.iesve.com 2009-2011
	VABI www.vabi.nl 2009-2011

Full details of corporate membership are given on **page 41**.

IBPSA Central contacts

Newsletter Submissions

To submit Newsletter articles and announcements:
Veronica Soebarto (Newsletter Editor-in-Chief)
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Email: **veronica.soebarto@adelaide.edu.au**

IBPSA President

Jan Hensen
Eindhoven University of Technology, Netherlands

IBPSA Secretary and Regional Affiliate Liaison

Drury Crawley
US Department of Energy, USA

Conferences committee

Ian Beausoleil-Morrison chair and contact for information about IBPSA Building Simulation conferences
Members: Michel Bernier, Jan Hensen, Roberto Lamberts, Jeff Spitler (future conference location coordinator), Yingxin Zhu

Honors and Awards committee

Lori McElroy chair
Members: Ian Beausoleil-Morrison, Wim Plokker, Jonathan Wright, Gerhard Zweifel

Membership Development committee

Jonathan Wright chair
Members: Chip Barnaby, Dru Crawley, Karel Kabele (Affiliate Developments), Roberto Lamberts, Lori McElroy, Jeff Spitler, Christoph van Treeck

Public Relations committee

Larry Degelman chair
Members: Marion Bartholomew (Newsletter Editor), Roberto Lamberts (Webmaster), Veronica Soebarto (Newsletter Editor-in-Chief), Etienne Wurtz

Website committee

Roberto Lamberts chair
Members: Chip Barnaby, Dru Crawley, Karel Kabele, Christoph van Treeck

IBPSA Corporate Address

148 Fanshaw Avenue
Ottawa, Ontario K1H 6C9
Canada

For additional information about IBPSA, please visit the Association's web site at **www.ibpsa.org**. For information on joining, contact your nearest regional affiliate.

IBPSA's mailing list has been consolidated into another listserver known as BLDG-SIM, which is a mailing list for users of building energy simulation programs worldwide, including weather data and other software support resources. To **subscribe** to BLDG-SIM, to unsubscribe or to change your subscriber details, use the online forms at **http://lists.onebuilding.org/listinfo.cgi/bldg-sim-onebuilding.org**.

To post a message to all members, send email to **bldg-sim@lists.onebuilding.org**.

The BLDG-SIM list is provided by GARD Analytics. If you have any questions, please contact the list owner Jason Glazer at **jglazer@gard.com** or +1 847 698 5686.

Privileges and obligations of IBPSA Members and Affiliates

All members are encouraged and entitled to take part in the activities of IBPSA, subject to constitutional or special provisions by the management of IBPSA. The aims of the activities are to disseminate information and aid the progress of IBPSA's efforts and image.

All members have the right to participate in meetings of IBPSA, but the right to vote is subject to the provisions for voting as contained in the present By-Laws. Members holding their membership through an Affiliate are not eligible to vote if the Affiliate has not submitted its membership roster to the Secretary of IBPSA. Affiliates, therefore, need to keep their membership rosters up to date and communicate them to the Secretary.

All members joining IBPSA must undertake to observe the IBPSA constitution and By-Laws and all obligations arising from them. They must also accept the obligation to contribute to the accomplishment of the activities of IBPSA according to their particular competence.

Any member may submit any communication for consideration at a General or Special Meeting of IBPSA or the Board of Directors. The Board will indicate its decision on the proposals within a reasonable timeframe that allows for an IBPSA Board meeting, either in person or by e-mail.

Affiliates are entitled to appoint one representative to the Board and take part in activities of IBPSA. Affiliates, upon joining IBPSA, must undertake to observe the IBPSA constitution and By-Laws and all obligations arising from them. Special obligations of Affiliates include annual notification to the Secretary of IBPSA of the following items:

1. the name of the Affiliate's board representative
2. the Affiliate's membership roster
3. reports of meetings and/or conferences held by the Affiliate, and
4. other information or reports requested by the Board.

Resignation and Termination

Affiliates wishing to terminate their affiliation may do so at any time subject to 90 days notice. Notice of termination must be transmitted in writing to the Secretary. If all communications from an Affiliate to the Board have ceased for a period of two years prior to any Board meeting, that Affiliate will be considered to have resigned.

CALL FOR PAPERS

New to Taylor & Francis for 2008

Journal of Building Performance Simulation

Official journal of the International Building Performance Simulation Association (IBPSA)

EDITORS:
Ian Beausoleil-Morrison, *Carleton University, Canada*
Jan Hensen, *Eindhoven University of Technology, The Netherlands*

Taylor & Francis would like to invite you to submit your article to *Journal of Building Performance Simulation*

The ***Journal of Building Performance Simulation*** (***JBPS***) is the official journal of the International Building Performance Simulation Association (IBPSA). IBPSA is a non-profit international society of computational building performance simulation researchers, developers, practitioners and users, dedicated to improving the design, construction, operation and maintenance of new and existing buildings worldwide.

The ***JBPS*** is an international refereed journal, publishing only articles of the highest quality that are original, cutting-edge, well-researched and of significance to the international community. The journal also publishes original review papers and researched case studies of international significance.

The wide scope of ***JBPS*** embraces research, technology and tool development related to building performance modelling and simulation, as well as their applications to design, operation and management of the built environment. This includes modelling and simulation aspects of building performance in relation to other research areas such as building physics, environmental engineering, mechanical engineering, control engineering, facility management, architecture, ergonomics, psychology, physiology, computational engineering, information technology and education. The scope of topics includes the following:

- Theoretical aspects of building performance modelling and simulation.
- Methodology and application of building performance simulation for any stage of design, construction, commissioning, operation or management of buildings and the systems which service them.
- Uncertainty, sensitivity analysis, calibration, and optimization.
- Methods and algorithms for performance optimization of building and the systems which service them.
- Methods and algorithms for software design, validation, verification and solution methods.

Submissions

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Volume 1, 2008, 4 issues per year
Print ISSN 1940-1493 Online ISSN 1940-1507

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