ibpsaNEWS

volume 20 number 2 www.ibpsa.org

Nov 2010

Inside:

- An interview with Lynn Bellenger, first female ASHRAE President
- Papers on predictive model-based control of building services and sensitivity analysis of the energy performance of an office
- Details of 13 forthcoming events — including **Building Simulation 2011** in Sydney, Australia
- News from IBPSA affiliates in Canada, the Czech Republic, England, Germany & the USA

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

Contents

President's message

Dear IBPSA colleagues and friends,

This page of the newsletter has been the domain of my good friend and colleague, Jan Hensen, for so long that my presence here probably seems as strange to you as it is to me. IBPSA is certainly a healthier and more vibrant organization today after more than four years of Jan's presidency, and I would like to take this opportunity to acknowledge his many contributions and the dedication he brought to bear to the position. My hope is that I will be able to adequately fill his shoes.

The completion of the election process in July has resulted in other changes to IBPSA's board. After many years of service Karel Kabele, Roberto Lamberts, and Larry Degelman are rolling off the board. I speak for all of us when I say thank you for your many contributions!

Our new Vice-President is Chip Barnaby whereas the reins of the Treasurer are passed to Michael Wetter, while Lori McElroy moves into the position of Secretary. The four directors-at-large are now Michel Bernier, Jonathan Wright, Christoph van Treeck, and Dru Crawley.

As a strategy to manage its growth, in 2007 IBPSA formed a number of committees to take responsibility for specific tasks and objectives. For example, the Awards and Honours committee took responsibility for soliciting nominations and making recommendations on IBPSA's Distinguished Service, Outstanding Young Contributor, Outstanding Practice, and Student Travel awards. Each committee had a chair and members were drawn from the elected board, regional affiliate representatives, and the general IBPSA membership.

The committee approach has proven successful and as a result some new committees are being formed and some adjustments are being made. Michel Bernier has taken over as chair of the conference committee. The mandate of the Awards and Honours committee is being split; Lori McElroy will chair the resulting Awards committee whereas Jeff Spitler will chair the IBPSA Fellows committee, which is tasked for managing the new IBPSA Fellow programme. Jonathan Wright will continue to chair the Membership Development Committee whereas Veronica Soebarto becomes chair of the Public Relations committee and Christoph van Treeck takes over as chair of the Website committee. Dru Crawley will chair the newly formed Regional Affiliate Development committee and Jan Hensen will chair the new Publications committee. Should you have an interest in becoming actively involved in one of these committees, I encourage you to contact the committee chair to express your interests. An extra pair of hands can always be put to work!

Plans are now underway for the annual IBPSA board meeting. This year's meeting will take place in Belgrade, Serbia in October and will be hosted by Professor Marija Todorovi of the University of Belgrade. Belgrade was selected for this year's meeting to help launch a new affiliate tentatively entitled IBPSA-Danube. A conference to be held in conjunction with the board meeting is being planned. We look forward to adding another vibrant and active affiliate to IBPSA's growing family.

Speaking of IBPSA affiliates, many have been very active this year. Successful building performance simulation conferences have been organized in many countries, including SimBuild, eSim, BauSim, and others, some of which you can read about in this issue and on IBPSA's website **www.ibpsa.org**.

The Journal of Building Performance Simulation, IBPSA's official journal, is now into its third and very successful year of operation. Both the quantity and quality of submissions to the journal have been growing at an impressive pace. Given this growth a decision has been taken to expand the journal in 2011 from 320 pages per year to 384 pages. The journal's website **www.informaworld.com/jbps** provides full information including the very preferential subscription rate for IBPSA members as shown on **page 46**.

Here's to the continuing success of our society and the growing interest in our domain.

Best regards,

Lynn Bellenger, first female ASHRAE President

Veronica Soebarto interviews Lynn G. Bellenger, ASHRAE's first female President and partner at Pathfinder Engineers & Architects, Rochester, N.Y.

*At the 2010 Annual Meeting recently held in Albuquerque, New Mexico, on June 26-30, ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) installed its new officers and directors. The new president, Lynn G. Bellenger, P.E., Fellow ASHRAE, partner, Pathfinder Engineers & Architects, Rochester, N.Y. Bellenger is ASHRAE certified as a Building Energy Modeling Professional and a High Performance Building Design Professional. Ms Bellenger's presidential theme is "Modeling a Sustainable World," emphasizing the roles of building simulation in creating and refining our vision of a building — its appearance, systems, operation, and performance. She states that if used effectively in an integrated design process for new buildings and in analyzing retrofit opportunities in existing buildings, building simulation will help us model a sustainable world (**www.ashrae.org/pressroom/detail/17563**).*

*Her vision is indeed in the very core of IBPSA's Mission & Vision (**www.ibpsa.org/m_about.asp**), and it is with this background IBPSA News approached Lynn Bellenger for an electronic interview, to which she has warmly responded.*

It is a complete privilege for me as the News' Editor-in-Chief to be able to have 'a conversation' with Ms Bellenger in her very busy schedule. I find her very inspiring; her thinking and views are so fundamental that I believe we all can learn from her in order to pioneer the use of building simulation in our respective regions (if we haven't fully done so).

My thanks to Lynn Bellenger for providing us with this very rare opportunity

About yourself, research and teaching

Veronica Soebarto (VS): The IBPSA USA members who are also active in ASHRAE may already know you, but other IBPSA members may only know of your name recently. Would you mind sharing with us a little bit about your background – your previous education, area of expertise, research and practice?

"My first computer model was of an existing laboratory building on the Xerox campus … I presented the results at the APEC annual meeting in San Francisco in the fall of 1975"

Lynn Bellenger (LB): My undergraduate degree is in mathematics from Principia College in Elsah, IL, a small liberal arts college on the bluffs overlooking the Mississippi River. I then studied environmental science at Rutgers University and was awarded a Masters Degree with a thesis topic of Energy Conservation in Industry. That described the work I was doing in Plant

Engineering & Maintenance at Xerox's major manufacturing facility in my hometown of Webster, NY.

My first computer model was of an existing laboratory building on the Xerox campus using HCC-III, a load analysis computer program developed by Automated Procedures for Engineering Consultants (APEC). APEC was a non-profit firm started in 1964 by five mechanical engineers from different parts of the country who pooled their resources to write computer programs for load analysis, energy analysis and piping design.

When I modeled the lab building, HCC-III was licensed and being used by over 200 member firms for new building design. To my knowledge, I was the first to use it to analyze an existing building. The model showed the HVAC systems were significantly over-designed, and the measured airflow was even higher. Rebalancing the systems to match the re-design reduced the airflow by 35%. I presented the results at the APEC annual meeting in San Francisco in the fall of 1975 and co-authored an article entitled "You Can Copy Xerox's Corporations Energy Conservation Program" in the May 1976 issue of Buildings Magazine. The talk was my first experience at public speaking and I was bribed into to doing it by the promise of a trip to Disneyland afterwards!

Today, of course, modeling is an essential component of sustainable design and we routinely do energy models for our own projects and as subconsultants to other firms.

VS: Reading the announcement of presidency of ASHRAE, I can't help but to ask you: how do you feel to be the first female president of a quite old (116 years!) large professional organization whose work and contributions have made so much impact around the world?

LB: It's an honor and privilege to serve as ASHRAE president, and every president I've known has commented on how esteemed ASHRAE is around the world. It's gratifying to see how pleased both the men and women in our industry are to have a female president of ASHRAE. I hope my role as president will encourage other women to become active in ASHRAE and share the professional growth, opportunities, and fellowship that I have enjoyed. I have to admit, it is fun to be first, and I look forward seeing other women in this role in the future.

VS: Your company, Pathfinder, Engineers & Architects LLP, offers services in mechanical, electrical and plumbing engineering, structural engineering, energy engineering, commissioning, and facilities architecture. In the inauguration of your ASHRAE presidency, you emphasized the importance of an integrated approach to building design. Similarly, you reiterated this in the recent hearing held by the US Government Management, Organization and Procurement to examine the US federal government's role in greening buildings. Is this principle based on the experience you encountered in your multi-disciplines company, or it is the other way around: that you have always believed in the importance of integrated building design, hence you founded your company and now bring ASHRAE to work within the realm of this philosophy?

LB: My emphasis on integrated building design is the natural outgrowth of the early training I received on viewing HVAC systems as systems and not merely a collection of components. Through my involvement with APEC and ASHRAE, I became well acquainted with Tseng-Yao (Terry) Sun, and he was a mentor to me in teaching a systems approach. When my partners and I founded Pathfinder in 1998, we practiced many of the concepts considered "green" today as just fundamental good design. But the emphasis on integrated design within ASHRAE certainly didn't begin with me. Our Technical Committees and many of our leading practitioners have espoused these principles for some time and there is growing recognition that we can only achieve our low energy and net zero energy goals for buildings using an integrated design approach.

About ASHRAE and IBPSA

VS: ASHRAE has developed various Standards and Guidelines and conducted research over so many years; all of which have made significant contributions to the betterment of the built environment in the US specifically and other places around the world. Do you think ASHRAE has achieved its goals, or do you think this is a continuing process and there is still a lot to be done?

LB: There is no question this is a continuing process. ASHRAE just adopted a Research Strategic Plan for 2010-2015 that outlines a number of technical challenges and needed research, including recommended projects related to modeling (**www.ashrae.org/technology/page/39**). Our key standards are continually advancing, and we've just started a new standard entitled Facility Smart Grid Information Model that is being co-sponsored by NEMA. And Technical Committee 4.7, Energy Calculations, is proposing a standard on HVAC&R Equipment Performance Data Exchange Protocols for Energy Simulation that is of particular interest to the modeling community.

VS: One of the most recent activities of ASHRAE is the development of ASHRAE's Building Energy Modeling Professional certification program, developed in collaboration with IBPSA USA and the Illuminating Energy Society of North America (IESNA). Could you tell us more about this initiative and program; how it came about, the process it had gone through, and how much involvement IBPSA USA has contributed to this program?

LB: There were several drivers for developing ASHRAE's Building Energy Modeling Professional certification program. The growing recognition of the influence and importance of modeling in sustainable design makes it imperative that we establish a way of distinguishing qualified practitioners.

"The growing recognition of the influence and importance of modeling in sustainable design makes it imperative that we establish a way of distinguishing qualified practitioners"

Another key driver is ASHRAE's Building Energy Quotient (Building EQ) program, which will feature both an "As Designed" and "In Operation" component. While the "In Operation" rating is based on actual energy use, the "As Designed" rating is based on the results of a building energy model. Careful and consistent energy modeling will allow modeling results to be compared with the results of models from other buildings. The certification is an essential element for guaranteeing the quality of the Building EQ program by assuring that there is a competent pool of building energy modelers. Building EQ is in the pilot phase now, with an anticipated go live date of April 1, 2011.

Building Energy Modeling Professional is ASHRAE's fifth certification program, so the process is well developed. While assembling a panel of experts for designing the program and writing examination questions, ASHRAE learned that IBPSA-USA was considering a similar certification. This quickly became a joint effort, with IBPSA-USA members playing a key role on the development team, along with ASHRAE and IES members. Of course, there is, and always has been, a large overlap of members who belong both to ASHRAE and IBPSA.

VS: How much do you think simulation or modeling can 'change' the world – the way we practice, build, and use our buildings? What can and can't simulation do or provide?

LB: Modeling is a powerful tool that enables us to play "what if" with a variety of design parameters to discover relationships and dependencies that otherwise might remain hidden. So, it certainly influences the way we design buildings. Understanding the energy impact of infiltration has led us to demand higher performance in the construction of the envelope, with requirements for continuous air barriers and envelope commissioning.

"We need to backup our input assumptions with measured data on major loads and observations on occupancy, lighting, and equipment schedules."

It may well have an impact on how we use our buildings, as owners question the differences between modeled and actual energy consumption. For despite our disclaimers that energy models do not predict future performance, there often is an expectation that actual performance will track the energy model. Building energy management systems can provide scheduling reports and trend logs that help identify the many variables "in real life" that cause actual consumption to differ from model results. And owners will increasingly use those tools, and even the models themselves, to understand and improve building performance.

"Employers need to understand that training is essential, both on how to approach energy modeling and on the specific programs being used"

In addition to designing new buildings, energy modeling is used for analyzing existing buildings and identifying cost effective retrofit measures. The energy model can't provide those insights unless we understand how energy is used in the existing building, and that requires more than just tweaking input parameters until the output matches the shape and magnitude of the utility bills. We need to backup our input assumptions with measured data on major loads and observations on occupancy, lighting, and equipment schedules. Building drawings provide critical information on these loads, but they cannot substitute for onsite data gathering. Calibration is an art and a science, and we need to learn how to calibrate our models without compromising integrity.

Many modeling projects are assigned to young men and women just entering the field. The simulation listservs are filled with posts by individuals who ask questions prefaced by the remark, "this is my first energy model." Employers need to understand that training is essential, both on how to approach energy modeling and on the specific programs being used. And providing those training opportunities is an area where ASHRAE and IBPSA can work together very effectively.

VS: Is there any other activities with IBPSA USA in the pipeline that you could share with us? What would you like to see more in the partnership between IBPSA USA and ASHRAE?

LB: IBPSA USA and ASHRAE presented a one-day workshop developed with the Rocky Mountain Institute on Building Energy Modeling Building at Sim-Build in August. It will be presented again on October 11th at the Pacific Energy Center in San Francisco, and in October and November in Boulder, Colorado, and Arlington, Texas.

Also, ASHRAE is planning a two day energy modeling conference in Atlanta in early April 2011, and IBPSA members are participating on the conference steering committee. The conference will feature numerous case studies as well as how to model specific systems.

The presentations at Sim-Build in New York in August highlighted the modeling-related research being conducted by graduate students in universities around the world. I'd like to see these efforts coordinated with the modeling needs identified in ASHRAE's Research Strategic Plan to accelerate the needed research.

VS: Still in relation to the above question, most recent work of ASHRAE and IBPSA USA in this area (building modeling, high performance buildings), focuses on non-residential buildings. Could you explain why this is the main focus despite the fact that energy use by or in residential buildings is as significant as that in non residential buildings?

LB: It's a matter of scale. We have a much better opportunity to impact energy use in commercial buildings. Residential buildings use 22% of primary energy in the US, while commercial buildings use 18% (Source: 2007 Buildings Energy Data Book), so the overall usage is similar, as you pointed out. But there are an estimated 107 million housing units in the U.S., compared with 8.9 million commercial buildings (**www.eia.doe.gov/emeu/cbecs/faq.html**). So the energy use per building is much higher in commercial buildings and that's where design and retrofit efforts typically are focused. Few residential building owners have the resources or can cost justify hiring a design professional.

VS: So do you think simulating residential building designs is not as important as simulating large, non residential buildings? What do you see as the real challenges of modeling residential buildings as opposed to non residential buildings?

LB: I think the opportunity for modeling residential buildings lies in developing more stringent standards or a document such as an Advanced Energy Design Guide that would identify recommended practices by climate zone, rather than modeling individual buildings. The Standard 90.2 project committee is working on an entirely new format for the 90.2 standard so that it will be easier to understand and be used by the typical residential builder and code official. They have developed a first working draft that contains both a prescriptive path as well as a performance path.

VS: In regard to the collaboration between ASHRAE and IBPSA USA, do you have any views or suggestions to other IBPSA affiliates around the world about the roles they can play in the betterment of the built environment in their respective countries?

LB: I would urge them to promote ASHRAE's Building Energy Modeling Professional certification, so that we have a common standard for energy modelers in the design community. I think there is an opportunity for them to assist with the research needs that have been identified in the Research Strategic Plan. Those needs include: (1) Develop more accurate methods to relate building energy simulation models to actual building energy use; (2) Improve alignment between energy standards, energy models, and utility bills; (3) Document actual energy savings and building performance improvements realized through integrated design; (4) Continue to develop BIM to automate the creation of energy models from architectural/mechanical/electrical BIM data files; (5) Develop models and design procedures for natural and hybrid ventilation systems; (6) Update existing energy analysis calculation engines to model building components and systems that will be needed to meet current and future Energy Standards, including the ultimate NZEB goals; (7) Improve whole building simulation tools to simultaneously analyze energy consumption, thermal comfort, visual comfort, indoor air quality and other performance metrics. And that's just a partial list!

"I think there is an opportunity for [IBPSA affilitates round the world] to assist with the research needs that have been identified in [ASHRAE's] Research Strategic Plan"

And finally ...

VS: Would you tell us more about your passion about the built environment, and why you chose to be an engineer, then leading a women-owned business enterprise offering services in mechanical, electrical and plumbing engineering, structural engineering, energy engineering, commissioning, and facilities architecture, and now leading one of the largest and oldest professional organizations in the world? Though you have accomplished so much, do you still have further goals and dreams that you would like to realize?

LB: While I didn't start my education intending to become an engineer, it was a natural progression from studying environmental science to working in energy conservation, and that has been the focus of my entire career.

My theme speech, Modeling a Sustainable World, opens with this paragraph, "I'd like to take you back in time to your childhood. To a time when you were dreaming of making a difference in the world, of being a powerful influence for good. That time is now. Never in the history of our industry has there been a greater need or a better opportunity to change the world. And the global community is looking to us to lead the way, to be the role models for the 21st century."

I remember those childhood dreams, and I truly believe we have an incredible opportunity to make a difference in the world by improving the energy performance and indoor environmental quality of the built environment.

I'm ASHRAE president for only a year, which is a remarkably short period of time. It will take more than one year to transform our design culture from a silo approach to true integrated design. I'm hopeful that my emphasis on early collaboration, strong communication, and modeling throughout the design process will have an impact on our industry and perhaps hasten that transformation

VS: Thank you very much once again for providing us with your valuable time and answers.

Events

The past 6 months …

As evidenced by recent conferences in the building simulation community, more attention is being brought to bear on the reliability of simulation tools and the modellers themselves. Several IBPSA affiliates have been busy, organising interesting conferences this year in various parts of the world.

IBPSA-Canada held its biennial conference, eSIM2010, in Winnipeg, Canada on 19-20 May. They have recently formed a joint task force with the Canadian Green Building Council (CaGBC) to create guidelines for LEED Canada submission requirements for modellers. IBPSA-England held a joint event with the CIBSE Building Simulation and Natural Ventilation groups at University College London. IBPSA-USA held its fourth national conference, SimBuild 2010, on 11-13 August at New York University's Kimmel Center in New York City. IBPSA-Germany held its third biennial German-Austrian IBPSA Conference, BauSIM2010, on 22-24 September in Vienna, Austria, while IBPSA-NVL held a Symposium Event; on 14 October at TU Eindhoven, the Netherlands, targeted at simulation of energy efficiency in producing our built surroundings.

More details of all these can be found in News from Affiliates on **page 20.**

The late change of venue for BS2011 delayed publication of this issue of *ibpsa*NEWS until after the dates of the first three events described in this section (on pages 12-14), a DYNASTEE workshop and AIVC's and IBPSA-France's 2010 conferences. The details of these remain interesting — especially the information about the DYNASTEE network — so, in a change from our usual focus on forthcoming events, we have included them nevertheless.

The future …

Date(s)	Event	Information
2010		
05-09 December 2010	**Buildings XI: Thermal Performance of the Exterior Envelopes of Whole Buildings XI International Conference** Clearwater Beach, Florida, USA	**www.ornl.gov/sci/buildings/2010/**
13-15 December 2010	**SSB 2010: 8th International Conference on System Simulation in Buildings** Liege, Belgium	**www.ssb2010.ulg.ac.be**
2011		
29 January - 02 February 2011	**ASHRAE Winter Conference** Las Vegas, Nevada, USA	**www.ashrae.org**
04-06 April 2011	**Microgen II: 2nd International Conference on Microgeneration & Related Technologies** Glasgow, UK	**www.supergen-hidef.org/microgenII/**

calendar continues over page

29 May - 02 June 2011	**NSB 2011: 9th Nordic Symposium on Building Physics** Tampere, Finland	**www.tut.fi/nsb2011**
05-10 June 2011	**Indoor Air** Austin, Texas, USA	**www.indoorair2011.org**
19-22 June 2011	**Roomvent Conference** Trondheim, Norway	**www.sintef.no/Projectweb/Roomvent-2011**
25-29 June 2011	**ASHRAE Summer Conference** Montreal, Canada	**www.ashrae.org**
10-15 July 2011	**ICWE13** Amsterdam, Netherlands	**www.icwe13.org**
28 August - 02 September 2011	**ISES 2011** Kassel, Germany	**www.swc2011.org**
14-16 November 2011 **ABSTRACT DEADLINE:** **31 JANUARY 2011**	**Building Simulation 2011** Sydney, Australia BS2011 was originally to have been held in Wellington, New Zealand, but has been moved for organizational reasons.	**www.bs2011.org**
08-12 July 2012	**Healthy Buildings 2012** Brisbane, Australia	**http://hb2012.org**

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

11-12 October 2010
Brussels, Belgium
http://re.jrc.ec.europa.eu/energyefficiency/

International workshop on Dynamic Methods for Building Energy Assessment

This workshop was jointly organized by the European Community's Joint Research Centre and the International Network for Information on Ventilation and Energy Performance — European Economic Interest Grouping (INIVE EEIG) to explore **DYN**amic **A**nalysis, **S**imulation and **T**esting applied to the **E**nergy and **E**nvironmental performance of buildings — DYNASTEE.

The workshop highlighted the status of DYNASTEE, classical approaches and new concepts, covering areas where intelligent analysis techniques can be used in areas such as energy performance contracting, energy certification of buildings, intelligent building management systems, building and component assessments as part of research, development and demonstration, certification, test cells and houses, in-situ measurements, near zero energy buildings, energy supply and demand, and integration of large fractions of wind and solar energy in buildings.

The DYNASTEE Network

DYNASTEE is an informal grouping of organisations actively involved in the application of tools and methodologies relative to this field. The objective of DYNASTEE is to provide a multidisciplinary environment for a cohesive approach to the research work related to the energy performance assessment of buildings in relation to the Energy Performance for Buildings Directive (EPBD). DYNASTEE, being a network of competence in the field of outdoor testing, dynamic analysis and simulation has 25 years experience and aims at transferring its knowledge to industry, decision makers and research. DYNASTEE functions under the auspices of the INIVE EEIG and constitutes a sustainable informal networking mechanism.

What are dynamic methods?

Dynamic analysis methods are techniques to analyse dynamic processes and to identify typical parameters of physical processes like energy flows in buildings. Dynamic methods take into account the aspect of time whereas a static analysis method does not. By dynamic evaluation techniques (parameter identification), dynamic effects due to accumulation of heat in the equipment, test room envelope and test specimen are properly taken into account. In general, parameter identification is needed to be able to derive the steady state properties from a short test with dynamic (e.g. fluctuating outdoor) conditions. Dynamic analysis, simulation and testing remains an area of high scientific interest.

The application of system identification techniques to the energy performance assessment of buildings and building components requires a high level of knowledge of physical and mathematical processes. This factor, combined with the quality of the data, the description of the monitoring procedure and test environment, together with the experience of the user of the analysis software itself, can produce varying results from different users when applying different models and software packages.

The developed dynamical methods will enable new methods for providing guidelines for improving buildings with the purpose of obtaining energy savings and optimizing efficient use of energy. Dynamic tools will indicate the most beneficial subject of improvement, as e.g. further insulation in the walls, tighten the building, change the windows, or insulate the roof and will be able to assess the thermal mass of the building.

It is expected that buildings in the future will play an active role in the integration of renewable energy in the energy system, and in order to operate such a system in an optimal way it is essential to have access to dynamical models for reasonable forecasts of the heat and electricity load for the household. Smart and intelligent meters are one of the big energy saving hopes by reducing the energy used in residential houses and public buildings, lowering the energy bill and carbon emissions.

For further information about the network e-mail **hans.bloem@jrc.ec.europa.eu**, European Commission - DG Joint Research Centre, or visit **http://re.jrc.ec.europa.eu/energyefficiency/**.

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 were presented and discussed in keynote presentations, short and long oral presentations, poster sessions and workshops.

The topics included:

- 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**.

09-10 November 2010
Moret-sur-Loing, France
http://colibpsa.insa-lyon.fr

IBPSA France conference 2010

IBPSA France's 2010 conference was held at Moret-sur-Loing, about 50 miles south of Paris — the home of EDF's central R&D laboratories.

The main theme of the conference was the reliability of building services. Topics included:

- Heating, ventilation and air conditioning systems
- Local energy sources: renewable energy, energy storage and CHP
- Thermal and visual comfort
- Air quality simulation
- Control systems
- Developments in thermal simulation
- Training model users

For further information please visit **http://colibpsa.insa-lyon.fr** or email **conference2010@ibpsa-france.net**.

05-09 December 2010
Clearwater Beach, Florida, USA
www.ornl.gov/sci/buildings/2010/

Buildings XI: 11th International Conference on the Thermal Performance of the Exterior Envelopes of Whole Buildings

Buildings XI, sponsored by BETEC, ASHRAE and organized by the Oak Ridge National Laboratory (ORNL), will be held in December at the Sheraton Sand Key Resort, Clearwater Beach, Florida. This conference will present two concurrent tracks:

- **Principles and Practices**, focusing on research and practical applications respectively, and
- **Case Studies**

Workshop topics will include air barriers; thermal mass; home energy use; a coll roof calculator; commercial building science; durability problems created by energy-efficient design; and DOE's Building Envelopes Roadmap. Further details of all the workshops are available at **www.ornl.gov/sci/buildings/2010/Workshops_11.shtm**.

For further information, visit **www.ornl.gov/sci/buildings/2010/**.

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).

Topics include:

- Advances in modeling of HVAC&R systems and components
- Recent developments in building energy simulation methods and tools
- Simulation assisted analysis and evaluation of building energy use
- Using models in commissioning, energy management and maintenance
- Using models in building energy audit and retrofit
- Case studies exhibiting in depth use of simulation tools

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". Proceedings will be published in a special edition of Building Simulation Journal.

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

04-06 April 2011
Glasgow, UK
www.supergen-hidef.org/microgenII

Microgen II: 2nd International Conference on Microgeneration & Related Technologies

Call for Abstracts

The University of Strathclyde in Glasgow is proud to host the 2nd International Conference in Microgeneration and Related Technologies in Buildings - MICRoGEN `II. The conference theme is enabling a highly distributed energy future, focusing on the diffusion of low carbon microgeneration technologies such as micro CHP, PV, micro wind, solar thermal, heat pumps and biomass heating within future, highly distributed energy systems. The conference is multi-disciplinary and is an opportunity for the many disparate stakeholders working in the field to meet and exchange knowledge at a time of rapid technological developments and changes to energy supplies and systems worldwide.

Papers are welcome in the following themes:

- Developments in microgeneration and enabling technologies
- Practical experiences with microgeneration
- Modelling and technical analysis of microgeneration systems
- Integrating demand side management and microgeneration

Further information can be found at **www.supergen-hidef.org/microgenII**.

05-10 June 2011
Austin, Texas, USA
www.indoorair2011.org

Indoor Air 2011

Indoor Air is the triennial conference of the International Society of Indoor Air Quality and Climate. The venue for 2011 is the University of Texas at Austin. Themes include:

- **Global climate**: Low energy buildings, climate change effects on IEQ
- **Sustainable/healthy buildings**: IEQ and green buildings, healthy homes
- **Outdoor Connections**: IEQ and regional air quality, persistent pollutants that originate indoors
- **Human health**: Children's health, disease transmission, emerging contaminants
- **Societal imperatives**: IEQ and affordable housing, environmental justice
- **Developing countries**: IEQ, health effects and solutions
- **Improvement motivators**: Regulations, legal action, surveys, cost analysis
- **Innovative solutions**: Source reduction, low-energy air purification, safe building decontamination
- **Innovations in practice**: Field studies
- **Fundamentals**: Building physics, chemistry, biology, sources, transport, sinks, climate and occupant responses

For further information, visit **www.indoorair2011.org**.

Building Simulation 2011

14-16 November 2011
Sydney, Australia
www.bs2011.org

The 12th biennial conference, Building Simulation 2011, will be held in Sydney, Australia, from 14-16 November 2011, co-hosted by IBPSA-Australasia and the Australian Institute of Refrigeration, Air-conditioning and Heating (AIRAH), Australia's leading HVAC industry body. BS2011 was originally to have been held in Wellington, New Zealand, but has been moved for organizational reasons. The new venue is the Sydney University of Technology's Aerial UTS Function Centre, a short distance from Sydney's spectacular harbour and the Darling Harbour entertainment quarter.

The collaboration between IBPSA and AIRAH will provide a unique forum for exchange of ideas and information between simulation researchers, simulation developers, building designers, and government legislators responsible for designing and enacting building codes which will increasingly include simulations. Simulation is a hot topic for building design in Australia, and a strong turnout is expected from the local user community.

Reflecting this unique mix of practitioners, developers and researchers, the conference theme is **Driving Better Design Through Simulation.** Building simulation is increasingly embedded in the design process through green rating tools, regulation and as a general means of optimizing design, and Building Simulation 2011 will explore current best practice and new horizons for the use of simulation, covering issues such as:

- How simulation can influence the design process
- The limitations of simulations in practice, and how these can be addressed
- Case studies of the use of simulation in practice, and the lessons learnt
- Use of BIM in simulation
- Simulation validation and testing
- Comparing simulation and real world outcomes
- Applications of simulation in regulatory processes
- New work in simulation development
- Advances in building physics
- Human aspects of the indoor environment
- Building services
- Energy capture and operation
- Software issues

Multiple parallel sessions will include topics covering all aspects of simulation including a full stream of peer-reviewed, applications-oriented papers. In addition, a program of technical tours and training courses is being arranged to help complete the week.

Abstracts are now invited with an abstract submission deadline of **31 January 2011;** on-line abstract submissions and conference registrations open in mid December 2010. There will be two streams of papers: research papers, refereed by academic reviewers and application papers, refereed by professionals. More details of the submission timetable and process are available at **www.bs2011.org/papers.html**.

IBPSA's Building Simulation conferences are traditionally social as well as working events for the association's worldwide community, and Sydney in spring is a particularly attractive place to get together. The team is planning an exciting social program, the highlight of which will be the conference dinner on a cruise over Sydney's famous harbour.

Sydney is one of the world's great cities. In addition to its spectacular harbour, it has glorious beaches, world-class sporting activities and friendly, easy going people and a laid-back lifestyle all contributing to a relaxed environment. In November the average maximum temperature is 26ºC, making it an ideal time to visit. The city's dining options are numerous, from an alfresco seafood lunch at Circular Quay to a three-course meal at Bondi Beach, and inspiration from Asian, European and Middle Eastern cuisines.

Travelling around Sydney is easy and economical. Sydney airport is a 20-30 minute trip by taxi from central Sydney and the conference venue, and there is a rail connection as well. Travel and attractions passes offer unlimited travel on the city's public transport system and discounted entry to many tourist attractions.

Sydney offers a spectacular range of things to do. You can:

- Climb the Sydney Harbour Bridge for a stunning 360-degree view of the harbour city.
- Take a backstage tour of the Sydney Opera House for a behind-the-scenes look at this World Heritage listed marvel or enjoy a star-studded drama, opera or ballet performance.
- Explore the vast waterways of Sydney Harbour on a yacht, high-speed jet boat or leisurely ferry ride.
- Visit world class museums and galleries, from the Museum of Contemporary Art to the Powerhouse Museum.
- See Australia's native animals as well as rare and endangered species from around the world at Taronga Park Zoo.
- Take a seaplane flight to lunch and admire the city's stunning harbour and coastline from the air.
- Take the plunge at Bondi, the most celebrated beach in Australia with its golden sands, great surf and stylish restaurants.

The regions close to Sydney offer a variety of astonishing natural attractions. Access is easy, either by a short flight, a comfortable drive or in the company of a specialist tour operator. Right in Sydney's backyard, the vast 1,000 metre high sandstone plateau of the Blue Mountains is part of a spectacular World Heritage Area offering bushwalking, delightful gardens and fine guesthouses. The Hunter Valley, home to some of Australia's finest wines, offers wine-tasting tours, hot-air balloon flights, championship golf courses and indulgent spas. On the coast, Port Stephens has 26 golden beaches and a bay bigger than Sydney Harbour for fishing, sailing, swimming and seeing dolphins in the wild.

For further information about the conference, Sydney and Australia, please visit **www.bs2011.org** or the Sydney Tourist Bureau at **www.sydneyaustralia.com**.

Software news

EnergyPlus Version 6.0 Available October 2010

The latest release of the EnergyPlus building energy simulation program, Version 6.0, became available in early October. 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. Documentation and the validation reports have also been updated.

A few key new features include:

- modeling CO2 concentration and controls
- surface heat transfer convection coefficient upgrades (many new correlations, reporting)
- transparent insulation material (TIM) capability added to conduction finite difference model
- basin heater model implemented in the single speed, two speed, multi speed and multi mode DX coil models
- single People, Electric Equipment, Lights, or Thermostat statements applicable to multiple zones
- report of pre-calculated hourly daylight factors
- all-off equipment operation scheme option added for Plant and Condenser Loops
- multi-cell feature added for three types of cooling towers: single speed, two-speed, and the variable speed
- enhanced Fan Coil model to allow capacity control with multi-speed and variable-speed fan
- modeling of electric transformers
- modeling/reporting of life-cycle costing
- new fan component model.

EnergyPlus V6 performs 25% time reduction in most simulation runs (from the previous V5 release). EP-Launch can utilize multiple processors to perform runs (simultaneously). When released Windows 6.3 will be able to export EnergyPlus IDF segments for window modeling.

More information on these and other new features is available on the EnergyPlus web site, **www.energyplus.gov**. EnergyPlus V 6.0 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 V6.0. Both EnergyPlus V6.0 and the OpenStudio plugin are available for download at no cost from the EnergyPlus web site **www.energyplus.gov**.

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-Canada

Jeff Blake

IBPSA-Canada's sixth biennial conference, eSim2010, was held in Winnipeg, Manitoba on May 19 and 20, 2010. The conference was hosted by Manitoba Hydro in collaboration with the National Research Council of Canada and was held at the newly constructed Manitoba Hydro Place, which is touted as one of the most energy efficient buildings of its kind in North America. The conference was attended by over 90 participants from across Canada in addition to a fair contingent of international guests. Pre- and post-conference workshops were run on May 18 and 21 and introduced participants to TRNSYS, eQUEST/CANQUEST, Daylighting Simulation and ESP-r modelling. Conference proceedings will be made available on the conference website in the coming weeks.

IBPSA-Canada's annual general meeting was held at the end of the day on May 20 where the outgoing president (Jeff Blake) installed the new board of directors and incoming president (Stephen Kemp).

IBPSA-Czech Republic

Martin Bartak

IBPSA Czech Republic is organizing the 6th (bi-annual) building simulation conference in Prague on November 8-9. Currently there are 50 abstracts submitted and we expect a similar number of participants will attend the conference. Information about this conference can be found at **www.ibpsa.cz**.

IBPSA-England

Malcolm Cook

IBPSA-England is now in its fifth year, steadily building its membership base and activities. In April 2010 the third Board was installed, and the following officers were duly elected: Malcolm Cook (Chair and first affiliate representative), Neveen Hamza (Vice-chair and second affiliate representative), Pieter De Wilde (Secretary), and Dejan Mumovic (Webmaster).

A joint event with the CIBSE Building Simulation and Natural Ventilation groups was held at University College London in May. Attracting 165 delegates, this event looked at the important topic of modelling natural and mixed-mode ventilation. Our second event was a regional seminar and took place at Loughborough University. The seminar examined the use of evolutionary algorithms for the optimum design and control of buildings. This topic sparked off discussions and debates of the pros and cons of optimizing building designs in this way. The seminar participants also discussed how industry might be encouraged to explore these opportunities.

Our final event for 2010 took place at Newcastle University on 8 October. The aim of this meeting was to understand the dialogue between users of building performance simulation programs and building designers with a focus on how this has an impact on architectural decisions at various stages in the design process. Invited speakers explained their practical experiences within the UK and how this has evolved over the last decade. The day included a workshop to open up the dialogue on whether architectural education needs to include building performance simulation in its curriculum so architects can assess their preliminary designs

---

IBPSA-Germany

Ardeshir Mahdavi & Bob Martens

The Germany-Austria Chapter of IBPSA recently held its biennial symposium, BAUSIM 2010, on 22-24 September 2010, hosted by the Department of Building Physics and Building Ecology, Vienna University of Technology, Vienna, Austria and chaired by Ardeshir Mahdavi (Director of the Department, on the right in the photo) and Bob Martens (on the left).

About BauSIM 2010

A reliable prediction of building performance is an essential prerequisite of a productive and dependable building design process. The development and the timely application of computational building performance simulation tools is an established area of research in building-related disciplines and professions (such as architecture, civil engineering, mechanical engineering, and environmental physics). There are, however, still sustained efforts needed to fully integrate building performance simulation in the practice of building

design and operation. The critical importance of such efforts has become even more evident, given a number of recent developments and discussions that highlight the urgency of increased eco-efficiency in building construction and maintenance. The BAUSIM 2010 conference theme, "Building Performance Simulation in a Changing Environment", made reference to some of these developments, including environmental challenges such as climate change and urban heat islands as well as occupancy-related issues pertaining to indoor climate, thermal and visual comfort, productivity, and the ability to control buildings' environmental systems. These challenges further highlight the significance of tools and processes for better building design and operation.

The BAUSIM 2010 call for abstracts resulted in a large number of promising submissions. Subsequent to the abstract review process, nearly 100 full papers were submitted, both in German (57 %) and in English (43 %). These contributions – as indicated by the book of the abstracts and the conference proceedings – are witness to the high quality and creativity of research and development efforts in the building performance simulation community. Participants from approximately 20 countries attended the conference in Vienna. A vibrant mix of German and English papers was presented in 18 sessions with the following topics: buildings and climate, CFD and energy; design, monitoring and validation; lighting simulation; standards and codes; systems simulation; thermal building simulation; ventilation and (thermal) comfort; thermal performance simulation; thermal retrofit; users issues. Two keynotes were delivered: Herbert Formayer, an Austrian meteorologist and climate researcher who discussed the foundation of numeric weather predication and climate change models, and Gotfried Augenbroe whose closing keynote addressed the critical question whether simulation can reveal how buildings really behave.

The conference's multiple sessions were generally well-attended and included intensive and productive discussions. A number of selected contributions from the conference will be published in the journal BAUPHYSIK (publisher: Ernst & Sohn - to appear in the December 2010 issue). The conference proceedings can be retrieved from **www.ibpsa-germany.org**.

IBPSA-USA

Timothy McDowell

IBPSA-USA held its 4th biennial conference, SimBuild 2010, in New York City, August 11-13, 2010. The conference was chaired by Michael Bobker of the City University of New York and held at New York University's Kimmel Center. The over 250 attendees heard keynote addresses by Lynn Bellenger, President of ASHRAE, and Dr. William Solecki, Director of the Institute for Sustainable Cities at the City University of New York. Over 65 papers were presented at the conference, as well as over 30 invited presentations. All of the papers and most of the presentations from the conference will be made available on the IBPSA-USA website (**www.ibpsa.us)**.

At the SimBuild conference, IBPSA-USA awarded its Achievement Award to Sanford Klein of the University of Wisconsin-Madison and its Practitioner Award to Charles Eley of Architectural Energy Corporation. Awards were also presented for the best paper to Rhys Goldstein, Alex Tessier, Azam Khan of Autodesk Research, Ontario, Canada for "Customizing the Behavior of Interacting Occupants Using Personas". An award for the best student poster was presented to Cory Estep and Monica Perez of Catholic University of America, Washington DC, and Richard Hubacker of ZGF Architects, LLP, Washington, DC, for "Limitations and Barriers to Developing a Calibrated Simulation". A modeling competition was held as part of the conference and the winner in the professional category was Keep Engineering out of Oakland, California while in the student category was the work by Mihir Shah and John Bynum of Texas A&M University. An honorable mention was awarded to Ron Nelson and Charles Hulebak from the University of New Mexico.

SimBuild 2010 attendees mingle in front of the New York City skyline

ASHRAE president Lynn Bellenger delivering her keynote address

A number of workshops on different software packages were held prior to the conference. This included the first presentation of the Building Energy Modeling workshop. The development of this workshop by the Rocky Mountain Institute was funded by IBPSA-USA with in-kind contributions by RMI and ASHRAE. It marks the first step in IBPSA-USA's mission to provide better educational opportunities in building performance simulation to its membership. The one-day workshop was offered again on October 11th at the Pacific Energy Center in San Francisco. The same workshop will be offered in October and November in Boulder, Colorado, and Arlington, Texas and at the ASHRAE meeting in Las Vegas, Nevada in January 2011. Details on the workshops will be available on the IBPSA-USA website (**www.ibpsa.us**)

The IBPSA-USA Board at the banquet

The Keep Engineering team receiving their award for winning the modeling competition in the professional category

PREDICTIVE MODEL-BASED CONTROL OF VENTILATION, LIGHTING, AND SHADING SYSTEMS IN AN OFFICE BUILDING

Matthias Schuss[1], Claus Pröglhöf[1], Kristina Orehounig[1], Sokol Dervishi[1], Mario Müller[2], Heinz Wascher[2], and Ardeshir Mahdavi[1]
[1]Department of Building Physics and Building Ecology,
Vienna University of Technology, Austria
[2] Hans Höllwart - Forschungszentrum für integrales Bauwesen AG,
Stallhofen, Austria

ABSTRACT

This paper reports on ongoing work toward implementing a predictive control approach for buildings systems for ventilation, lighting, and shading. The main objective of this method is the optimized control of multiple devices toward usage of passive cooling and natural lighting. Thereby, control options (various opening positions of windows, shades, etc.) are generated and computationally assessed using a combination of option space navigation via genetic algorithms and numeric simulation.

INTRODUCTION

In the last few years system and energy expenditures for space cooling have dramatically increased, even in central-European climatic zones. This has encouraged the efforts to develop and implement smart (energy-efficient) cooling methods. An intelligent control approach involving all relevant systems and endowed with the capacity of proactive (predictive) control is believed to have the potential to significantly reduce buildings' energy demand. Toward this end, passive cooling, advanced shading control, and increased usage of natural light is essential. Possibilities to use natural ventilation and building controls in existing buildings were presented in previous publications (Mahdavi & Pröglhöf 2004, 2005, and 2006; Mahdavi et al. 2008; Orehounig 2010; Pröglhöf 2010).

This paper further develops a new simulation-based predictive control approach (Mahdavi 2008; Mahdavi et al. 2009) with the capability to facilitate the application of the aforementioned sustainable indoor climate control systems. The core idea behind this approach is the use of numeric building performance simulation applications to predict – ahead of an actual control action – the consequences of multiple control options. Once the options are generated and virtually realized via simulation, they can be evaluated and ranked, thus providing a basis for optimal control decision making.

METHOD

To implement the proposed model-based control strategy a realistic setting is essential. Therefore, we selected two buildings for implementation. This paper focuses on one of these buildings, namely a modern office building ("Fibag") in Stallhofen, Styria, Austria (see Figure 1 to Figure 3). The building has a typical glass and aluminium façade (Figure 1). The primary structure is massive (concrete skeleton, floors, and staircases), but the internal (partition) walls may be described as lightweight.

Two test rooms in this building were selected for experiments. One room was used to test the control approach (see Figure 1 and Figure 3), whereas the second room was used as a reference room. The two test rooms are identical layout-wise and are located in the first and second floor above each other, facing north and east directions. The building is located in a rural, low-density, and low-rise context.

Figure 1. The Fibag Building

Paper presented at BauSIM 2010, 22-24 September 2010, Vienna, Austria; reproduced with the authors' permission

Figure 2. The test room

To demonstrate the feasibility of the simulation-based control approach in a multi-system context, sensors and actuators were deployed: The rooms are equipped with programmable room controllers, indoor environmental sensors (Figure 4), as well as actuators for the automated operation of windows (Figure 5) and blinds. Moreover, to monitor local climatic conditions, a weather station (Figure 6) was installed on top of the building.

Table 1 provides a description of all system components. A schema of the test system is illustrated in Figure 4.

Table 1 System components description

SYSTEM COMPONENT	DESCRIPTION
Indoor climate sensors	Compact indoor climate stations measuring air temperature, relative humidity and velocity as well as carbon dioxide and radiance
Outdoor climate sensors	Weather station measuring air temperature, relative humidity, precipitation, global irradiance, wind speed and wind direction.
User action and presence sensor	Presence: PIR - Sensor with settable threshold time Door opening: magnetic contact sensors
Window	Two synchronized sleepless settable drives for each window to control the window opening position continually
Shading device	Single drives with a special gear unit for height and angle positioning
Controllable lighting system	The room controller could set on/off and dimming levels between 10-100% of the total lighting power
Backbone and communication network	IP base communication with access to building data points and data history

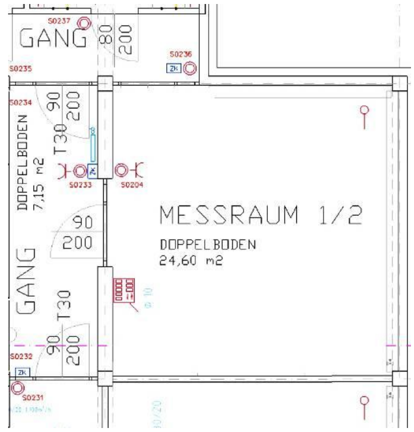


Figure 3. Floor plan of the test room

Figure 4. Internal sensor station

Figure 5. Automated Window

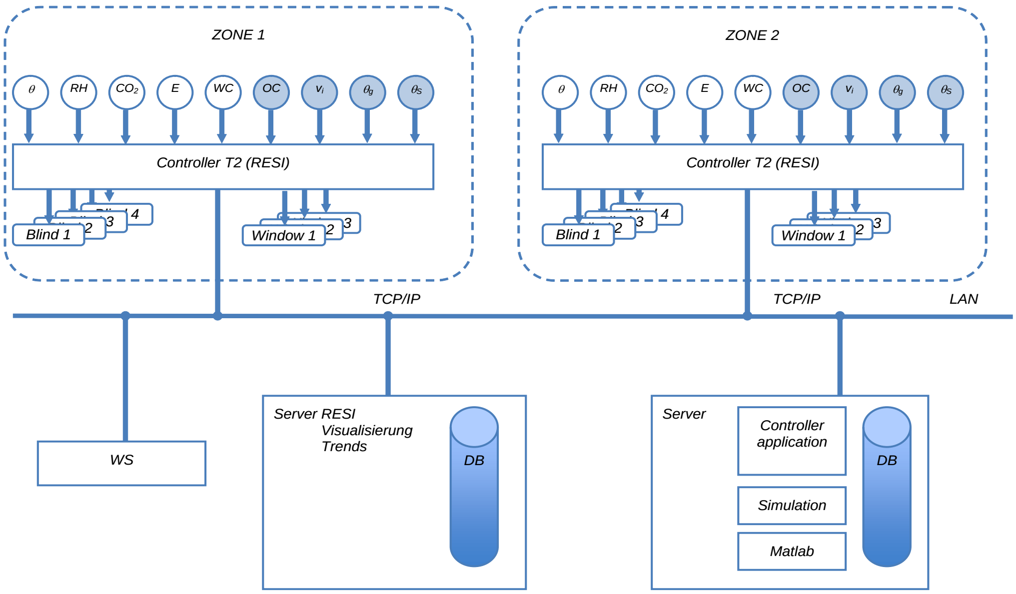


Figure 7. Schema of the test system

Figure 6. Weather station

The aforementioned model-based control approach is being implemented in the test room. Thereby, weather forecast information(Weather.com, 2010) is fed into simulation applications to regularly probe the implications of various control action alternatives in view of desirable indoor-environmental conditions. Thus, the likely optimal course of control action can be identified proactively toward optimization of energy and environmental performance of the building. An essential advantage of the proposed approach is its ability to consider the thermal storage capacity of the building's thermal mass more reliably. In order to better document the performance of the implemented control regime, we will use the second room as a reference room for comparison.

Predictive Control approach

The present paper attempts to further develop the predictive control approach (see Figure 8 and Mahdavi 2008). Instead of the previously applied combination of the greedy search method (combined with stochastic jumps), we know explore the potential of genetic algorithms toward navigation of the control options search space. This modification is necessary, since we would like to be able to generate and evaluate control options on a regular basis (i.e. in short time intervals). Moreover, temporal changes in the position of devices over time (operation schedules) must be considered for each simulation run. These leads to an explosion of the control options (schemes), which could be better tackled via genetic algorithms.

Thereby, weather forecasts (Weather.com 2010) together with expected values required for simulation input (e.g. internal gains) are the starting point for a series of multi-domain simulations (thermal and lighting) based on a genetically produced variation of alternative control states. The control process was implemented in MATLAB (MATLAB 2010) environment. The implementation deploys HAMBase (van Schijndel 2007) and Radiance (Radiance 2010) as incorporated simulation tools.

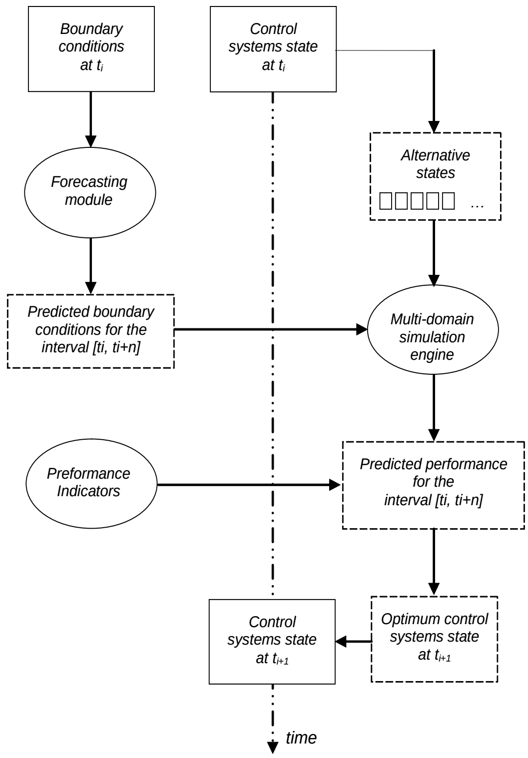


Figure 8. Illustration of the predictive simulation assisted control strategy

These simulations results are the basis for the evaluation process to generate optimum control decisions according to defined performance indicators. This predictive control approach operates in difference to the commonly used reactive feedback based standard control methods used in building systems control. Instead of using differences of the set values and actual values, this approach optimizes the system operation in a holistic way.

Alternative States

To feed the predictive control method with alternative operation states, the relevant device control schedules have to be produced. The generative process of schedules uses genetic algorithms. A number of default operation schedules are used together with randomized schedules as the initial setup. Needed state definitions and device attributes are stored in a predefined data structure (Figure 9) to generate the schedule automatically.

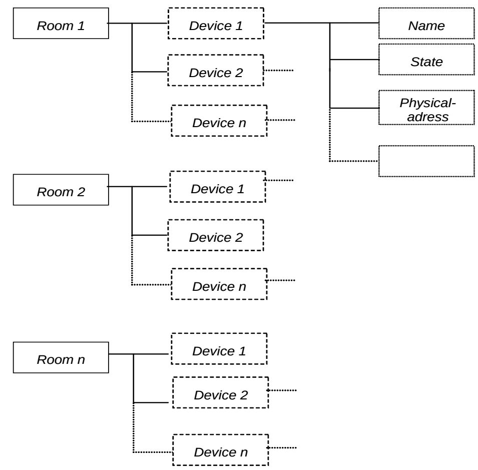


Figure 9. Schema for device attribute definition data structure

Based on the first generation simulation the best-ranked schedules were selected to generate new child schedules in a random multipoint crossover reproduction process (Figure 10). For this purpose, the high-ranked schedules are crossed with themselves as well as with additional randomly selected schedules dealing as parent elements.

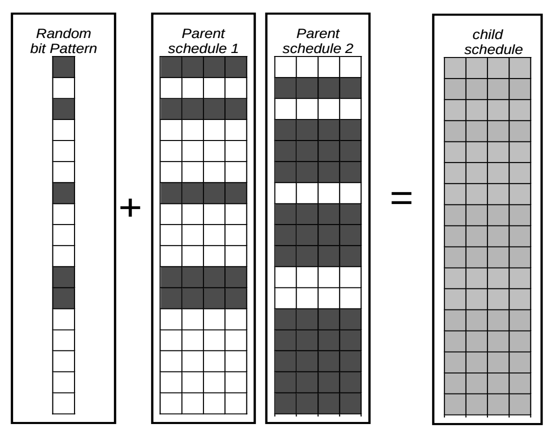


Figure 10. Illustration of the genetic multipoint crossover reproduction

The ranking is done by a number of performance indicators (discussed below) to estimate the fitness of each alternative state. Figure 11 illustrates this genetic approach.

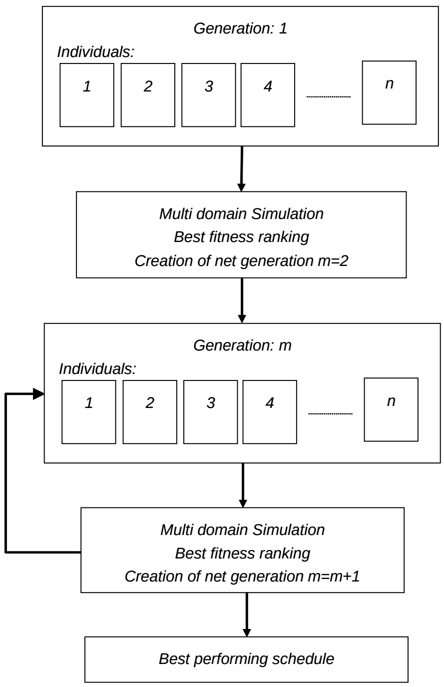


Figure 11. Illustration of the genetic generation of the desired operation schedules

Performance Indicators

A holistic evaluation of alternative system operation scenarios with related control system states is the core component of this control method. A set of building performance indicators weighted with associated weighting factors were used to evaluate the multi-domain simulation results and rank the alternative control state scenarios. The performance indicator i (Equation 1) is the weighted sum of all indicators i_x. The value of each indicator and the sum of the weighting factors w_x is in the range of 0 to 1. Hence i must be in the same range. The ranking of the alternatives is done by maximum to minimum sorting.

$$i = \sum i_x \cdot w_x \qquad (1)$$

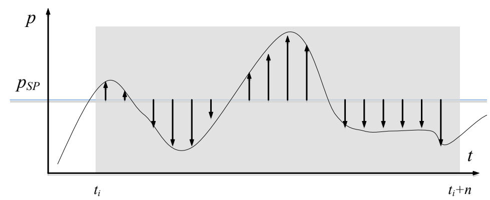
$$i, i_x, w_x \ni [0,1] \quad \text{and} \quad \sum_x w_x = 1$$

The calculation of each indicator is based on the simulated predictive trend of the related system parameter (e.g. air temperature of a room). For each specific parameter, the sum of deviations d_{period} is calculated for the future n time steps shown in Equation (2).

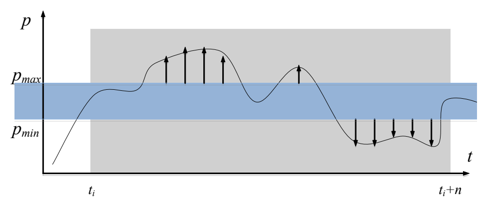
$$d_{period} = \sum_{k=t_i}^{t_i+n} d(k) \qquad (2)$$

The calculation of each deviation depends on a fixed set point or an acceptable parameter range as shown in Figure 12. The general indicator i_x could be derived either linearly (Figure 13), or exponentially (Figure 14).

The principle calculation procedure for power respectively energy indicators is presented in Figure 15 and expressed for HVAC and lighting power use.

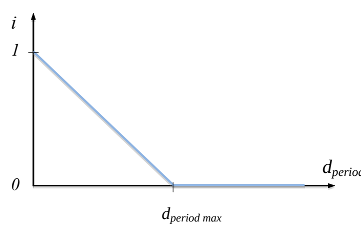


$$d(t) = |p(t) - p_{SP}(t)|$$



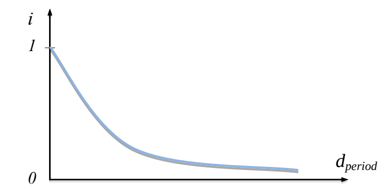
$$d(t) = \begin{cases} p_{\min} - p(t) & if \quad p(t) < p_{\min} \\ 0 & if \quad p_{\min} \le p(t) \le p_{\max} \\ p(t) - p_{\max} & if \quad p(t) > p_{\max} \end{cases}$$

Figure 12. Deviation d calculation for a general system parameter p.



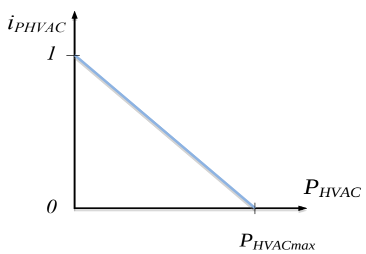
$$i_x = \begin{cases} 1 - \dfrac{d_{period}}{d_{period\max}} & if \quad d_{period} < d_{period\max} \\ 0 & if \quad d_{period} \ge d_{period\max} \end{cases}$$

Figure 13. General linear performance indicator i_x calculation.



$$i_x = 1 - e^{-c.d_{period}}$$

Figure 14. General exponential performance indicator i_x calculation.



$$i_{PHVAC} = \frac{1}{n}\sum_{t=t_i}^{t_i+n} 1 - \frac{P_{HVAC}(t)}{P_{HVAC_{\max}}}$$

$$i_{PL} = \frac{1}{n}\sum_{t=t_i}^{t_i+n} 1 - \frac{P_{Lighting}(t)}{P_{Lighting_{\max}}}$$

Figure 15. Performance indicator for power or energy related parameters, as expressed for HVAC or Lighting related power use P_{HVAC} and $P_{Lighting}$.

RESULTS

Data is being collected in both test rooms toward an objective documentation of the indoor-environmental conditions. To obtain an initial impression regarding the impact of window ventilation on indoor temperature, measurements of the external temperature θ_e [°C], the test room's air temperature θ_i [°C], and the window opening pos_w [%] are shown in Figure 16 for a typical summer week. Thereby, the influence of two instances of (manual) window operation can be seen. Both rooms have a very strong overheating tendency caused by the limited thermal mass and the oversized windows. The usual summer day temperature is in the range from 20 to 30°C with peaks up to 35°C.

Simulated natural ventilation

Parallel to the monitoring phase, thermal simulations were done to estimate the night cooling effect and virtually test the new control approach. For this purpose, measurements of air change rates were the starting point for different natural ventilation simulations in EDSL Tas (EDSL 2008). Figure 17 shows the external air temperature θ_e and the simulated indoor air temperatures θ_i for a typical summer week. The simulation was done for an air change of 0.4, 1.4 and 10 h^{-1} over 24 hours a day. A ventilation regime with an air change rate of 0.4 h^{-1} over the day (8am to 7pm) and 10 h^{-1} during the night hours was simulated as well. These simulations indicated the overheating tendency of the rooms, but also showed the potential of natural ventilation.

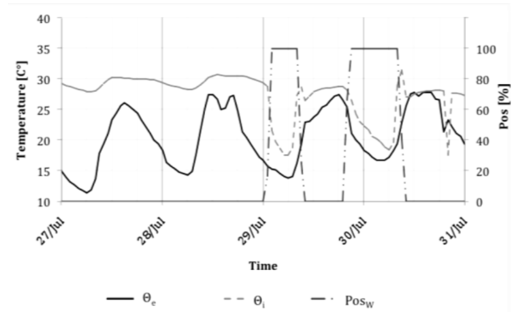


Figure 16. Measurements in first floor test room for period 21. – 31. July

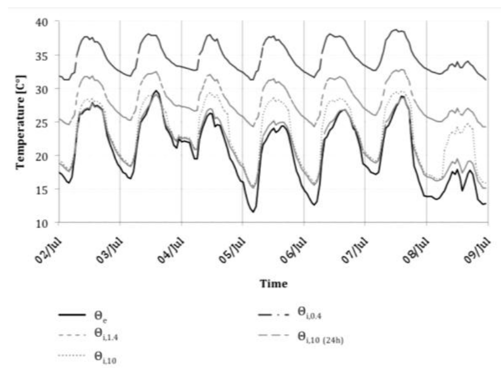
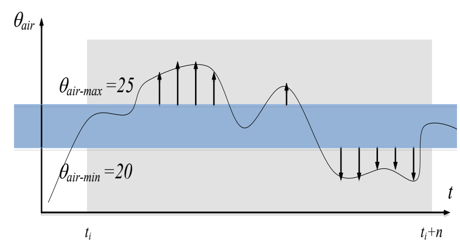


Figure 17. Simulated indoor air temperatures as a function of air change rates

Control approach Implementation

To demonstrate the advantages of the predictive control, a first implementation was done in a virtual setup. Based on the HAMBase simulation package (van Schijndel 2007) for MATLAB a thermal model of the two test rooms was created. Adaptations to HAMbase were carried out for the control of shading and the possibility to run single hour step simulations with stored data. The development and integration of the complete control system was also done in MATLAB. Components for the collection of required data (weather forecast, internal/external sensor data) and their storage into a sqlite database were programmed in C. These could be run independent of the control program as a service.

At this stage only the room air temperature was used as a performance indicator. The comfort zone for the room temperature was assumed to be the range between 20 and 25 °C (Figure 18).



$$d_\theta(t)=\begin{cases}\theta_{air-\min}-\theta_{air}(t) & if \quad \theta_{air}(t)<\theta_{air-\min}\\ 0 & if \quad \theta_{air-\min}\le\theta_{air}(t)\le\theta_{air-\max}\\ \theta_{air}(t)-\theta_{air-\max} & if \quad \theta_{air}(t)>\theta_{\max}\end{cases}$$

Figure 18. Deviation d calculation for the room air temperature

Result of a test using measured external climatic data and the HAMbase model is presented in Figure 19, Figure 20, and 22. Each plot shows the historical data including the real external air temperatures and the simulated indoor air temperatures on the left half of the plots. Simulated temperatures for all scenarios (generated via the aforementioned genetic approach) are presented in grey color on the right half side together with the status of windows (green) and shades (blue) for the best performing scenario (black). Concerning the status scale, 1 denotes fully open windows and fully closed shades.

These Figures represent 3 consequent days. They illustrate the large difference between weather forecast and actually measured temperatures. However, the performance of the system (i.e. identification of the best performing scenario) does not appear to be adversely affected by such weather forecast errors.

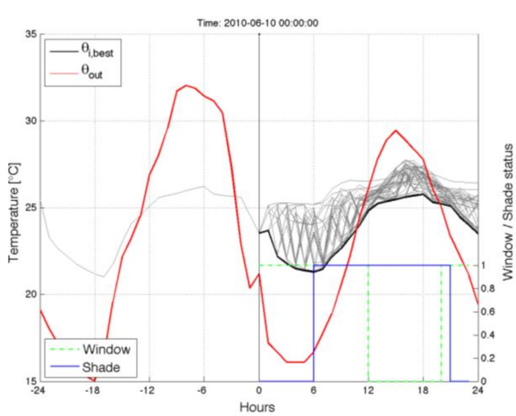


Figure 19. Temperature of the test room ($\theta_{i,sim}$), 2010-6-10 00:00

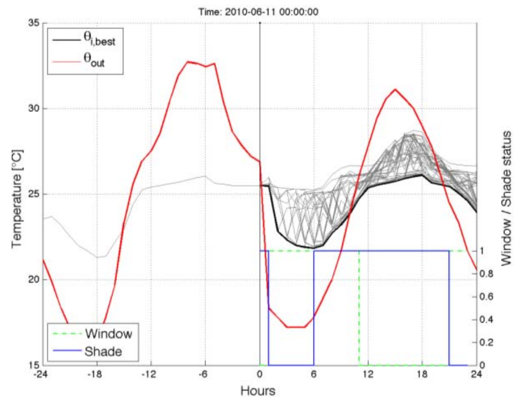


Figure 20. Temperature of the test room ($\theta_{i,sim}$), 2010-6-11 00:00

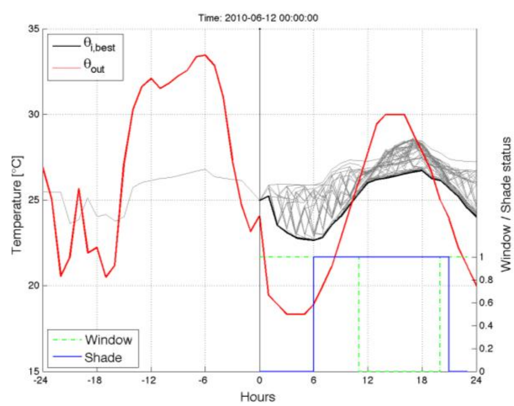


Figure 21. Temperature of the test room ($\theta_{i,sim}$), 2010-6-12 00:00

DISCUSSION

The scope and the initial results of a prototypical implementation of a simulation-assisted predictive control approach for passive cooling were presented in a recently constructed office building in Austria. Thereby, the potential of the method was primarily explored toward harnessing natural ventilation (via window elements equipped with software-controlled actuators) and solar control (via automated shading devices). The results thus far point to the potential of the proposed control method, which involves the dynamic and parametric use of numeric simulation of genetically generated alternative control options to proactively assess, compare, and evaluate control these options toward identification of the control actions that yield appropriate indoor-environmental conditions while minimizing energy use. Future efforts will focus on the long-term test and monitoring phases in occupied settings.

ACKNOWLEDGEMENT

The research presented in this paper is supported in part by funds from FFG "Naturally Cool" (Project-Nr: 817575) as well as the K-project "Multifunctional Plug & Play Façade".

REFERENCES

EDSL, 2008. A-TAS Version 8.5, Environmental Design Solutions Limited, www.edsl.net.

Mahdavi, A., Pröglhöf, C. 2004. Natural ventilation in buildings – Toward an integrated control approach, Proceedings of the 35th Congress on Heating, Refrigerating and Air-Conditioning, Belgrade, Serbia, pp. 93 - 102.

Mahdavi, A., Pröglhöf, C. 2005. A model-based method for the integration of natural ventilation in indoor climate systems operation, Proceedings of the 9th International IBPSA Conference, Building Simulation 2005, Montreal, Canada, pp. 685 - 692.

Mahdavi, A., Pröglhöf, C. 2006. A model-based approach to natural ventilation, Building and Environment, Elsevier, Volume 43(4), pp. 620 - 627.

Mahdavi, A. 2008. Predictive simulation-based lighting and shading systems control in buildings, Building Simulation, an International Journal, Springer, Volume 1, Number 1, ISSN 1996-3599, pp. 25 - 35.

Mahdavi, A., Orehounig, K., Pröglhöf, C. 2009. A simulation-supported control scheme for natural ventilation in buildings, Proceedings of the 11th IBPSA Conference, Building Simulation 2009, Glasgow, Scotland, pp. 783 - 788.

MATLAB, 2010. MATLAB Release 2010a, The MathWorks, Inc., http://www.mathworks.com.

Orehounig, K., Mahdavi, A., Pröglhöf, C., Schuss, M. 2010. Virtual implementation of a simulation-assisted passive cooling strategy in buildings, Proceedings of the 10th Rehva World Congress, Sahin N. (ed.), Antalya, Turkey.

Pröglhöf, C., Schuss, M., Orehounig, K., Mahdavi, A. 2010. Incorporation of a novel passive cooling method in an existing building, Proceedings of the 10th Rehva World Congress, Sahin N. (ed.), Antalya, Turkey.

Radiance, 2010. Radiance Synthetic imaging system Version 4, University of California, http://radsite.lbl.gov/radiance/.

Schuss, M., Pröglhöf, C., Orehounig, K., Mahdavi, A. 2010. A case study of model-based ventilation and shading controls in buildings, Proceedings of the 10th Rehva World Congress, Sahin N. (ed.), Antalya, Turkey.

van Schijndel, A.W.M. 2007 Integrated heat air and moisture modeling and simulation, PhD thesis, Eindhoven University of Technology, http://alexandria.tue.nl/extra2/200612401.pdf or http://sts.bwk.tue.nl/hamlab accessed June 2010.

Weather.com, 2010. National and Local Weather Forecast, Hurricane, Radar and Report, The Weather Channel Interactive, Inc., http://www.weather.com/.

SYSTEMIC APPROACH TO THE SENSITIVITY ANALYSIS OF THE ENERGY PERFORMANCE OF A MULTI-STOREY OFFICE BUILDING

Linda Pearce
School of Architecture, Landscape Architecture and Urban Design
University of Adelaide, SA, Australia

ABSTRACT

Little research has been done into robustness of 'green' commercial building performance and the consequent risk to both environment and investor of a building/occupant mismatch. This project describes a due diligence analysis on a 'green'-rated office building. The building was assumed to be a system consisting of envelope, services, occupants, economic and urban environment. A parametric differential sensitivity analysis tested the effects of short and long term changes. It was found that the 'green' building performance was most sensitive to occupant equipment load and changes in offices hours but was no less sensitive to changes than a hypothetical non-'green' building.

INTRODUCTION

Commercial buildings are becoming the focus for reducing energy use and greenhouse gas emissions through government initiatives (ABGR 2004) and private organisations (GBCA 2006). Incentives for changes in building form include the promise of lower building operating costs and higher rents due to a 'green' premium (Guidry 2004: 66).

Communicating a building's 'greenness' occurs through the building itself in the use of envelope devices (Williamson et al. 2003:27-39) and through adjunct marketing of the building assessment via devices such as rating tools. In Australia an energy rating is available through the Australian Building Greenhouse Rating scheme (ABGR 2004), while a wider environmental rating may be obtained through a Green Star assessment (GBCA 2006). These tools are designed to communicate the complexity of building performance to a wide non-specialist audience (GBCA 2006).

However, the life of a commercial building is long and ratings do not consider changes over that lifetime. These ratings are based either on pre-construction simulations, which assume a static configuration, or post occupancy data, which uses historical configurations and may not be predictive of the future since, in reality, there are a many sources of change during the building lifetime.

Most Australian commercial buildings are built to generate revenue streams for investors and few are owner-occupied (Kolganova 2006). During the building's lifetime ownership may change hands a number of times, from property developer to a succession of investment houses. Additionally, tenants do not sign lifetime leases. Thus, the initial intention for the use of the building may not be maintainable, thus diminishing robustness of the system (Spitler et al. 1989; Leyten & Kurvers 2005). The impact of this building-occupant mismatch may be degradation of performance and advertised rating.

While previous building sensitivity studies have focused on envelope optimisation, and assumed well behaved occupants, this study explored the consequences of building energy performance under non-optimal scenarios. It was hypothesised that the envelope only partially contributes to performance and that occupants and local environment further influence energy performance. To test this, the study modelled a 'green' rated office building. Inputs were altered to test sensitivity of building performance according to various hypothetical scenarios.

The key objectives of this research were

- To consider the building system holistically and identify relationships and drives of inputs to the building system;
- To test the sensitivity of the building's response to changes in the input and compare it to the response of a non-'green' building;
- To consider the wider context of the building and challenge assumptions about building users' expected behaviour;
- To test and evaluate a systemic approach on a small study as a precursor to further research.

Because rating tools are targeted at users outside of the building science community this study presents a range of outputs. Energy use is of interest to those concerned about energy security, while operating costs appeal to those focussed on financial performance. Greenhouse gas emissions are of interest to those concerned about a link between emissions and global warming. While all are

Paper presented at IBPSA Australasia 2006 conference, 20-21 November 2006, Adelaide, Australia; reproduced with the author's permission

interlinked, this study acknowledges that not all sensitivities appeal to all stakeholders.

In this paper, the use of systems thinking to justify extension of the building system beyond envelope and services is first described. Sensitivity analysis is discussed and then various test scenarios are introduced. The results of simulations are presented and the paper concludes with a discussion of the process, outcomes and their implications for the office building and its stakeholders.

METHODOLOGY

Systems thinking

This paper was triggered by an interest in building ratings. Because these ratings are aimed at people outside of research and design it is proposed that the system under investigation needs to be expanded. This raises the question of how to define the system beyond the physical boundaries of the building. The following summarises the basics of systems theory that is appropriate in dealing with human-physical interactions, such as a building system.

During the 20th century systems thinking emerged from the study of biology and ecology into the General Systems Theory (Checkland & Haynes 1994:190). Since then it has developed into various applications including the description of both hard systems, e.g., systems engineering and system dynamics, and soft systems, e.g., human activity systems (Checkland & Haynes 1994:192).

Systems may be open or closed (Williamson et al. 2003:82). A closed system occurs when all activities and the relationship between all activities can be studied, i.e., the system is bounded within the study. In an open system the system under study is influenced by activities outside of the observation. In reality the building system has little control over externalities such as energy prices or occupant behaviour and, so, needs to be treated as an open system.

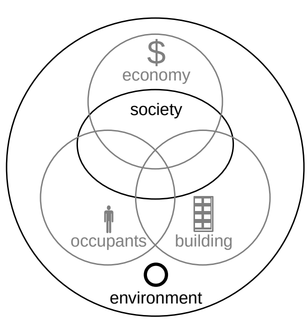


Figure 1: the building system (Williamson et al. 2003:82)

Williamson et al. (2003:82) place the building as one component in an extended triple bottom line system (figure 1). This is a hard and soft system in which the building and occupants are positioned within the basic environmental, economic and societal components.

A building system model definition depends on the desired outcomes. Building science researchers may simulate a building to test physical properties of building materials. Building designers may simulate a building to optimise the building configuration. Either of these situations fix certain parameters in order to test those of interest. In all, there are at least implicit assumptions about the behaviour of the occupants of the building. Using the triple bottom line as a guide a rich picture (Checkland & Haynes 1994) of the building system is given in figure 2.

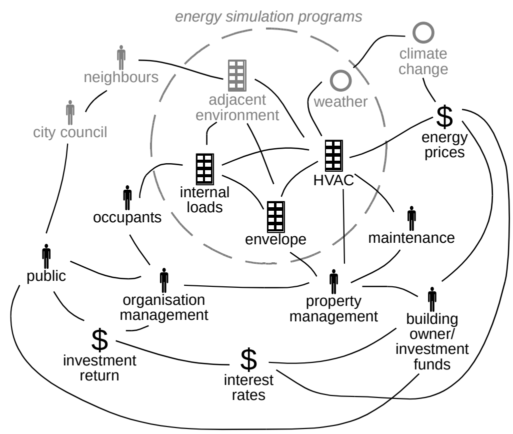


Figure 2: the building system rich picture (Checkland & Haynes 1994)

This conceptual model is not intended as an accurate system dynamics model. Instead, it is intended as a learning aid to express the building system's complexity beyond typical boundaries of energy simulation programs. This exploration highlights the involvement of various human stakeholders, which suggests that system inputs should not be considered to always be either static or logical, and any building performance is sensitive to these interconnections.

Sensitivity analysis

Sensitivity analysis is the observation of a system's response to the variation of one or more input parameters. The purpose of sensitivity analysis is to either optimise the design of a building system (O'Neill et al. 1991; Lam & Hui 1996; Tavares & Martins 2006), or identify risk factors associated with a building system components (Huang et al. 1993), or both (Spitler et al. 1989; Macdonald & Strachan 2001). The value of the input parameters may be deliberately chosen, as in parametric (systematic adjustment) Differential Sensitivity Analysis (DSA) or assigned a error probability distribution, as in Monte Carlo Analysis (MCA) (Lomas & Eppel 1992).

Sensitivity is expressed using sensitivity, elasticity or influence, coefficients. These are approximates of partial differentials of the system response function and are valid if the system is considered linear and superimposable over the range of perturbation (Lomas & Eppel 1992), e.g.,

$$SC = \frac{change\_in\_ouput}{change\_in\_input} = \frac{\partial OP}{\partial IP} \approx \frac{\Delta OP}{\Delta IP} \quad (1)$$

where OP refers to the output response and IP refers to input (Lam & Hui 1996). Literature research shows little agreement in sensitivity analysis methods. This function may have dimensions (Spitler et al. 1989; Lomas & Eppel 1992; Huang et al. 1993; Lam & Hui 1996; Tavares & Martins 2006), or be normalised (Spitler et al. 1989; O'Neill et al. 1991; Lam & Hui 1996).

This study uses a parametric differential sensitivity analysis. This method was selected in order to explore systematically explore changes of the building system in response to deliberate changes in input parameter.

Since, the objective of this study was to investigate real changes in building output (total energy, greenhouse gas emissions and annual operating cost) over various scenarios, comparison of normalised sensitivity coefficients is not appropriate. However, given that there is no uniform mathematical precedent, for the sake of pragmatism this study uses a dimensional percentage change in output (Tavares & Martins 2006), or output elasticity,

$$SC = \frac{OP - OP_{BC}}{OP_{BC}} \times 100\% \quad (2)$$

where *BC* refers to base case, i.e., the change in output is normalised against base case value as a percentage change.

Scenarios

So, if an office building is considered a system that includes components beyond the fabric of the building then any sensitivity analysis needs to identify possible system perturbations to study. One method for exploring beyond a single expectation is scenario planning, which aims to 'capture the richness and range of possibilities, stimulating decision makers to consider changes they would otherwise ignore' (Schoemaker 1995). Briefly, this method first notes the stakeholders, context and trends associated with a problem, and then develops themes or scenarios to test strategies against. It is a structured 'what-if' process.

The systems perspective aids in identifying first tier stakeholders and the context and trends influencing their behaviour. In the case of Australian office buildings these stakeholders include building developers, investment houses, tenants, property managers, councils and general public. Context and trends include the investment structure, the market pull of 'green' buildings, climate change and changing office accommodation needs (Laing et al. 1998).

Three narratives were selected for investigation – envelope sensitivities, occupant/building mismatch and external influences.

Envelope sensitivities cover changes in building components during the design phase. The complexity of HVAC parameter sensitivities requires a dedicated study and, though a candidate for this process, like geometry, climate and location, was beyond the scope of this study.

The mismatch between occupant behaviour and building design incorporates both short term and long term behaviour of tenants. Buildings are designed according to expected tenant behaviour. This translates into HVAC sizing according to expectations of thermostat levels and interior window treatment. However, because tenants are disconnected from the building developer and owner, it is possible that tenants will use the building in unexpected ways. This is particularly pertinent in the case of tenants who are not committed to environmentally sound policies occupying a building deemed 'green'. This scenario models changes in temperature settings, retrofit of blinds, changes in occupancy levels and increases in equipment and lighting use.

Finally, buildings exist in context and the final scenario models changes in external conditions. Other studies have shown that climate change will affect the energy use of office buildings (Frank 2005). This study will explore a change in urban environment, such as a new multi-storey building neighbour.

Case study building

Building sensitivity was tested with a 'paradigmatic' case study office building (Flyvbjerg 2004: 427) as a method of developing 'expert learning' through depth of research rather than creating context-independent knowledge (Flyvbjerg 2004: 421). The case study building is 'Green Star' rated and located in Adelaide, South Australia, which has a temperate climate of hot dry summers and mild rainy winters. The building modelled was a nine storey office building typical of recent Adelaide office stock.

It is located on the corner of busy roads with adjacent building restricted to two levels, apart from the eight story neighbour to the south. The building consists of underground car parking, 1200 m^2 ground level retail and 12000 m^2 of office accommodation over eight levels. Information about the building was obtained from communication with the architect, public sources and site visits.

The envelope on the north and east sides is predominately low-e double glazing (about 67%) and concrete panels on the west and south sides with minimal low-e glazing. Glazing to north and east has a one metre shading overhang.

The base case

The building's energy performance was modelled in Ener-Win-EC (Degelman 2006). No information was available about the performance of the occupied building at the time of writing, so no calibration of model was undertaken. Given that the objective of this study was to investigate relative changes in performance rather than absolute performance it was felt that this exercise remained valid. The base case parameters used are given in table 1.

While the shape of the building was available from drawings, details about services were not available so assumptions were made based on the Building Code of Australia, Australian Standards, ASHRAE standards and professional judgement.

The mass calculated for the concrete superstructure (floor and columns) was 602.5 kg/m^2. This does not include post occupancy fittings as it was assumed their contribution would be minimal relative to the superstructure figure. Program default properties were used for insulated concrete panel for spandrels (U=0.681 W/m^2.K) and default concrete floor and roof. Low-e glazing properties were obtained from the manufacturer.

The building was mechanically ventilated with variable air volume air conditioning. For modelling, the building was divided into occupied (retail and office) and unoccupied areas. Only occupied areas were modelled as having air conditioning, while some un-occupied areas, such as toilets, parking and communication rooms, were modelled with ventilation. Because the building is Green Star rated AS1668.2-1991 was used to set all ventilation needs, with ventilation set at 10 l/s/person in the occupied area. However, since no air conditioning specifications were available, the default was used with the base temperature was set at 22 ±1.5 deg C, as in the technical specifications.

Heating was not specified and a gas fired hot water boiler was assumed. Hot water usage was derived by assuming 15% of water used according to Green Star calculations (15.92 l/person/day) was hot, i.e., 2.4 l/person/day.

The base office occupancy was 10 m^2/person. Lights are fluorescent and no daylighting system was specified. The technical specification gives the maximum lighting power density of 15 W/m^2 and equipment power density of 25 W/m^2, however, the base case has been set at 10 W/m^2 for lighting and 15 W/m^2 for power, i.e, the equivalent of a lap top computer. The program adds these two internal loads so this paper will report a combined figure for lighting and equipment loads.

The base case used the program default occupancy

Table 1: Parameter simulation ranges

CATEGORY	PARAMETER	BASE CASE	INPUT RANGE	COMMENT
Building envelope	Overhangs	0.4	0 (no overhang), 1 (shading = window height)	Shade height/shade
	Daylighting	No daylighting system	200-500 lux daylighting system installed	Office area only
	Glazing Area	67%	60-30% low-e	Office area only
	Natural ventilation	0	1 (low),10 (high) l/s/m^2	
Occupant behaviour	Lights and equipment load	25 W/m^2	20,30,35,40 W/m^2	40 W/m^2 is specified building maximum
	AC temperature	22.5±1.5°C	20.5±1.5°C -23.5°C±1.5°C	22.5±1.5°C is specified
	AC range	22.5±1.5°C	Up to ±3°C	
	Occupancy density	10m^2/person	Down to 8m^2/person	Office only
	Occupancy profile	Default (derived from ASHRAE 90.1-1989)	1 hr extra per day, full occupancy 3 hrs extra per day, partial occupancy	Longer work weeks without and with flexitime.
	Retrofit of blinds	Glass SHGC=0.36 Trans=0.47	Translucent SHGC=0.26, Trans=0.4 Opaque SHGC=0.19, Trans=0.23	
External changes	New Neighbour buildings	Existing tall building to south	Tall buildings to North (22m), East (30m), West (7.5m). Tall buildings to North, East, West @ <10m.	Realistic and hypothetical new neighbours
Non-'green'	Non-'green'	Base case of 'green' building	40% glazing, concrete spandrels, no overhang, single glazed-low e and tinted plate, U=1.4W/m^2.K	Remove envelope features considered to contribute to improved performance

schedules for an office building. These assumed a 9-5 work day with an hour long lunch break in which some occupants leave the office.

The study used the simulation program's default weather data for Adelaide, which is from the World Meteorological Organisation (Degelman 2006). A single weather simulation was repeated for all tests, so as to simulate a single year.

Simulation

The input parameter ranges for three narratives and a non-'green' case are given in table 1. Envelope parameters were selected to test decisions about key envelope decisions usually associated with building energy performance.

The occupant parameter selection assumed the following behaviour scenarios:

- Equipment power densities changing according to computing needs, e.g., administration vs. computer games development
- Tenants turning the air conditioning down to allow for different workplace dress codes, e.g., accountants vs. call centre (Cena & de Deer 2001) and tenants increasing the temperature range to adjust to winter and summer clothing fashions
- Increased density of tenants due to business growth
- Tenants working longer hours at full occupancy (e.g., professional offices) or tenants working longer hours at partial occupancy (flexi time)

External changes were demonstrated by modelling hypothetical multi-story buildings on all sides of the case study.

Three outputs were examined - total annual building energy, total annual operating costs and total annual greenhouse gas emissions. The energy modelling program provided a total annual energy figure and breakdown into annual use of gas energy (space heating and hot water) and electrical energy (air conditioning, fan energy, lighting and power).

The total annual operating costs were derived from the annual building energy output. Gas, electricity and water costs were based on local supplier tariffs for commercial buildings and are indicative only due to price competition between retail suppliers.

The total annual greenhouse gas emissions were also derived from the annual building energy output. Greenhouse gas emissions are location dependent and, for South Australia, full fuel cycle emission factors are 73.8 $kgCO_{2-e}$/GJ for gas and 1.007 $kgCO_{2-e}$/GJ electricity (AGO 2005:31,33).

RESULTS AND DISCUSSION

Overall the building was found to be heat rich, and consumes more electricity annually (6390 GJ) than gas (440 GJ) due to the air conditioning load required to offset the lighting and equipment load in Adelaide's hot dry summer.

Figures 3, 4 and 5 show the output sensitivities of annual energy use, operating cost and emissions of all scenarios tested, in which the base case building is represented by 0%. Overall the relative changes in these outputs tracked each other due to the dominance in electrical energy demand.

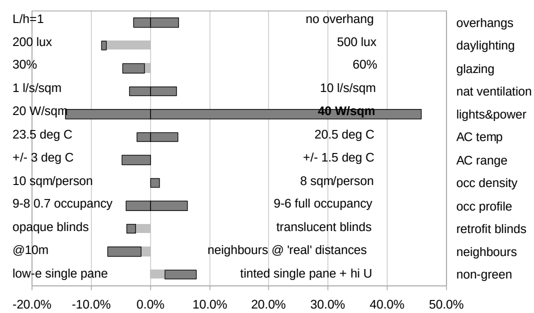


Figure 3: Sensitivity range in annual energy use (base case = 0%)

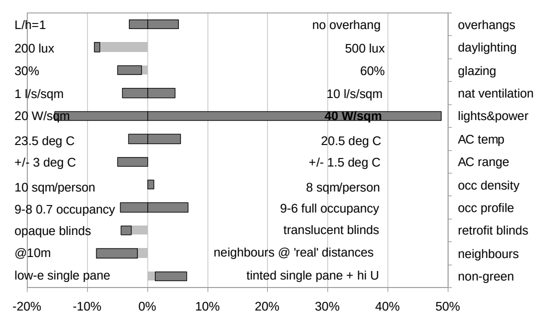


Figure 4: Sensitivity range in annual operating costs

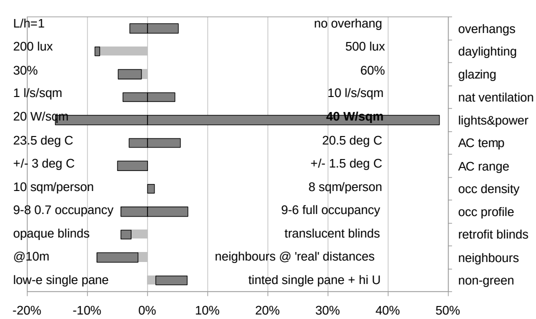


Figure 5: Sensitivity range in annual emissions

Changes in envelope parameters resulted in a change of less than 10% of all outputs. Removing overhangs increased outputs by 5%, daylighting resulted in a step change of -8% and reducing glazing reduced all outputs by up to 5%. Natural ventilation varied according to ventilation rate. In reality, natural ventilation would be limited by the need to reduce traffic noise and pollution in order to maintain internal environment quality standards.

The occupant behaviour parameters showed similar sensitivities to the envelope sensitivities except for lighting and equipment load. If a tenant decided to turn down the thermostat because, say, workplace dress protocol included formal suits, then there is a corresponding increase in energy use, operating costs and emissions of around 5%. However, if the temperature range is widened by ±3°C to, say, correspond to winter and summer fashions, there is a 5% energy reduction.

The default occupancy schedules of the simulation program are based on the assumption of a 9-5 work day. If the office housed tenants with a longer working week (say, fully occupied 45 hours) there is a 7% increase in all outputs. If the office is tenanted by a firm that has long but irregular hours, say 9-8 with 70% occupancy, then all outputs are reduced by around 5%, assuming occupants turn off their computers when they are absent.

Occupancy density modelled hot water usage and latent and sensible heat changes. This changes little according to decreasing space per person. However, their associated equipment and lighting is the most sensitive parameter modelled. Increasing the base case of 25 W/m^2 as a base case to the building technical specification maximum of 40 W/m^2 resulted in significant increases energy (46%), operating costs (49%) and greenhouse gas emissions (48%). Thus, decisions about office equipment, and changes in office equipment technology, have the potential to make a significant impact on the building performance.

A new neighbour building is a case of circumstance beyond the control of the building owner or tenant. Modelling shows that even with the hypothetical new neighbour worst case scenario all outputs are reduced by less than 6%, due to increased shading and consequent reduction of air conditioning load.

The base case 'green' building was also compared to a non-'green' building, in which a combination of envelope features were removed or changed. It shows that a similar performance may be obtained by reducing glazing and single pane low-e glazing, even without overhangs. Replacing the low-e glazing with tinted plate and reducing wall insulation increases energy use sensitivity by a maximum of 8%.

'Green' vs. non-'green'

In order to test any relative advantage of selecting a 'green' building over a non-'green' building the outputs most sensitive to occupant behaviour were compared using both models. The non-'green' building chosen for the test was the 'worst' case scenario – tinted single plate glass (40% wall area), no over hangs and increased U-value.

It was found that the non-'green' building exhibited similar performance sensitivities to the 'green' building. Figure 6 shows the comparative sensitivities of the 'green' and non-'green' buildings under a range of lighting and equipment loads. The non-'green' building is less sensitive to changes in equipment load (41.1% vs. 45.7% annual energy use sensitivity), but still exhibits large sensitivity to the building maximum load.

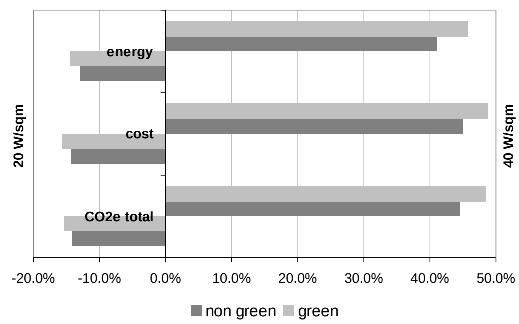


Figure 6: sensitivity comparison for 'green' and non-'green' buildings under different equipment loads

The non-'green' building is also less sensitive to reduction in air conditioning temperature. Figure 7 shows that the total annual energy use of the non-'green' building was increased by 3.1% as compared to 4.2% in the 'green' building. The operating costs and emissions are similar due to the increased heating load required during winter to offset the reduced insulation.

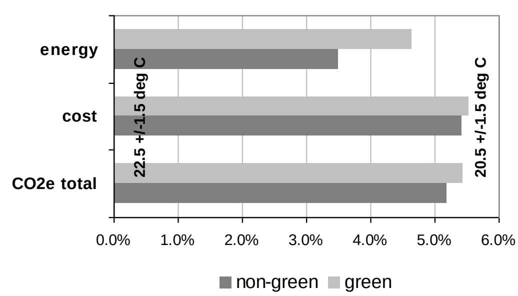


Figure 7: sensitivity comparison for air conditioning temperature between' green' and non-'green' buildings.

The sensitivities of both buildings to changes in occupancy schedules are given in figure 8. For all outputs the non-'green' building was less sensitive to longer working hours.

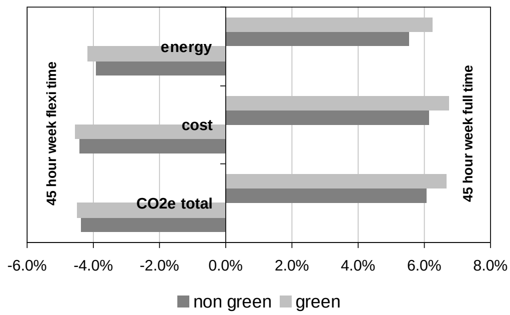


Figure 8: sensitivity comparison for occupancy schedule between 'green' and non-'green' buildings.

In all scenarios the non-'green' building is marginally less sensitive to changes, but with penalties to energy, operating cost or greenhouse gas performance. The average percentage increase of energy, costs and emissions of the non-'green' building over the case study building on a scenario by scenario basis, for these models, is presented in table 2.

Table 2: Average Non-'Green' building penalties above case study building

SCENARIO	ENERGY	COST	EMISSIONS
Load	6.8%	5.7%	5.8%
Inc over BC	*458 GJ*	*$19600*	*104 t*
Aircon temp	7.4%	6.6%	6.7%
Inc over BC	*498 GJ*	*$22700*	*120 t*
Occ profile	7.7%	6.4%	6.6%
Inc over BC	*518 GJ*	*$22000*	*118 t*

Regardless of this performance degradation, this non-'green' building base case model, at 146 $kgCO_{2\text{-}e}/m^2$ using Adelaide emission factors, receives that same ABGR 'excellent' rating as the 'green' building (137 $kgCO_{2\text{-}e}/m^2$) despite removal of envelope features normally associated with improved performance.

In summary, the major contributor to building performance sensitivity is the equipment the tenant brings with them. Changes in working hours, changes in thermostat settings and adjacent construction work do affect outputs, but no more than decisions about envelope at design stage. The non-'green' building of typical construction performs similarly to a base case 'green' building, with an approximate 6-7% penalty. The overriding sensitivity is post-occupancy changes in office lighting and equipment load which is highly dependent on business requirements and management processes.

CONCLUSION

A systemic process was proposed as an organising strategy for modelling the complexity of human-building interaction. The building was considered in its wider context and scenarios were used to identify alternative narratives of building use. It was intended to explore the richness of the system and identify relative sensitivities rather than identify definitive building responses.

A case study multi-story office building located in Adelaide, South Australia, was modelled using energy performance software. The building was selected because it had been previously rated as having excellent energy performance. Simulations were designed to test the sensitivity of the building's energy performance under a number of scenarios. These scenarios explored envelope decision making, occupant behaviour and local environment changes. It was found that performance was more sensitive to changes in occupant behaviour than decisions about the envelope.

The building was then compared to a hypothetical non-'green' building to investigate the relative sensitivity of the most significant occupant behaviours. It was found that the non-'green' building was marginally less sensitive to changes, but with increases of energy use, operating costs and emissions. Thus, the 'green' building does indeed offer better performance than the non-'green' building, but only if the occupant behaviour is controlled.

The advantage of using scenarios based on the wider building system was that awareness is increased beyond implicit behavioural assumptions and a greater range of possibilities could be tested. Considering the longevity of building life, exploring different future configurations may offer a more accurate performance assessment of a building and identify and mitigate performance risks.

Case study methodology was useful to investigate the process. Further research is required to identify sensitivities of HVAC, geometry, climate and location. The process is also open to developing other narratives, such as change in use, or refining future risks by weighting occupant behaviour sensitivities with likelihood functions.

Two implications could be made from the research results. First, the building performance is dynamic and should not be divorced from its context and occupants. This, in turn, implies that the building should not be classified according to a single predicted or historical scenario because its performance is likely to change over its lifetime. There exists a risk associated with a building/ occupant mismatch that building owners must address if they wish to retain the rating, and all benefits, such as market premium, that come with that rating.

Second, due to the configuration of this building and its Adelaide location, operating costs and greenhouse gas emission rating factors, all outputs exhibited similar responses. The fact that these outputs behave similarly opens the opportunity for parallel messages about office buildings. Where the building investment community may not respond to concerns about greenhouse gas emissions or a need for reducing reliance on non-renewable energy, this systemic approach demonstrates that it is valid to communicate the attractiveness of reduced operating costs that result from considered design expertise and managing occupant behaviour, and still achieve goals of reduced impact on the environment as a side effect.

ACKNOWLEDGEMENTS

Thanks go to Veronica Soebarto for supervising this honours project. Also, thanks to Larry Degelman for his generous help with the simulation software.

REFERENCES

ABGR (2004) *About ABGR*, Australian Building Greenhouse Rating Scheme, Department of Environment and Conservation, (NSW), http://www.abgr.com.au/new/default.asp?DocID=261, accessed on 1/3/6.

AGO (2005) *AGO Factors and Methods Workbook*, Australiand Greenhouse Office, Department of the Environment and Heritage, http://www.greenhouse.gov.au/workbook/pubs/workbook-2005.pdf, accessed on 3/7/6.

Cena, K. & de Deer, R. (2001) "Thermal comfort and behavioural strategies in office buildings located in a hot-arid climate", *Journal of Thermal Biology*, **26**: 409 - 414.

Checkland, P. B. & Haynes, M. G. (1994) "Varieties of systems thinking: the case of soft systems methodology", *System Dynamics Review*, John Wiley & Sons, **10**(2-3): 189-197.

Degelman, L. O. (2006) *Ener-Win EC*, College Station, Texas, http://members.cox.net/enerwin/.

Flyvbjerg, B. (2004) "Five misunderstandings about case-study research", in *Qualitative Research Practice*. C. Seal, G. Gobo, J. F. Gubrium and D. Silverman Eds., London and Thousand Oaks, CA, Sage**:** 420-434.

Frank, T. (2005) "Climate change impacts on building heating and cooling energy demand in Switzerland", *Energy and Buildings*, **37**: 1175-1185.

GBCA (2006) *Green Star: an Environmental Rating System for Buildings*, Green Building Council of Australia, http://www.gbcaus.org/gbc.asp?sectionid=88&docid=952, accessed on 3/2/6.

Guidry, K. (2004) "How Green is Your Building? An appraiser's Guide to Sustainable Design", *The Appraisal Journal*, American Institute of Real Estate Appraisers(Winter): 57 - 68.

Huang, Y. J., Hanford, J. W. & Piraino, M. (1993) "The Impact of Variations in Building Parameters and Operating Conditions on Commercial Building Energy Use and Load Shapes", *Proc. IBPSA Conference*, Adelaide, Australia, Aug 16-18: 215-222.

Kolganova, A. (2006) *Australia versus the world. A bird's eye view on property securities*, Vangard Investments, http://www.vanguard.com.au/Financial_Advisers/Research_Support/Australia_versus_the_world_A_view_on_property/, accessed on 4/4/6.

Laing, A., Duffy, F., Jaunzens, D. & Willis, S. (1998) *New Enviornments for Working*, Construction Research Communications Ltd., London.

Lam, J. C. & Hui, S. C. (1996) "Sensitivity Analysis of Energy Performance of Office Buildings", *Building and Environment*, **31**(1): 27-39.

Leyten, J. L. & Kurvers, S. R. (2005) "Robustness of buildings and HVAC systems as a hypothetical construct explaining differences in building related health and comfort symptoms and complaint rates", *Energy and Buildings*, **38**: 701-707.

Lomas, K. J. & Eppel, H. (1992) "Sensitivity analysis techniques for building thermal simulation programs", *Energy and Buildings*, **19**: 21-44.

Macdonald, I. & Strachan, P. (2001) "Practical application of uncertainty analysis", *Energy and Buildings*, **33**: 219 - 227.

O'Neill, P. J., Crawley, D. B. & Schliesing, J. S. (1991) "Using Regression Equations to Determine the Relative Importance of Inputs to Energy Simulation Tools", *Proc. IBPSA Conference*, Nice, France, August 20 - 22: 283 - 289.

Schoemaker, P. J. H. (1995) "Scenario Planning: A Tool for Strategic Thinking", in *Strategic Development: Methods and Models*. R. G. Dyson and F. A. O'Brien Eds., Chichester, England, John Wiley & Sons Ltd**:** 185-207.

Spitler, J. D., Fisher, D. E. & Zietlow, P. E. (1989) "A primer on the use of influence coefficients in building simulation", *Proc. IBPSA Conference*, Vancouver, British Columbia, Canada, June 23-24: 299-304.

Tavares, P. F. A. F. & Martins, A. M. O. G. (2006) "Energy efficient building design using sensitivity analysis-a case study", *Energy and Buildings*: article in press.

Williamson, T., Radford, A. & Bennetts, H. (2003) *Understanding Sustainable Architecture*, Spon Press, London.

Designing the smoke ventilation system for a Metro station using CFD

Shishir Gupta and Parameshwar Patil

Objective

The stations and tunnels of the Metro railway in Kolkata, West Bengal lack an effective emergency ventilation system. The objective of this project is to modify the ventilation system in subway station premises to vent out smoke in case of fire.

Existing system

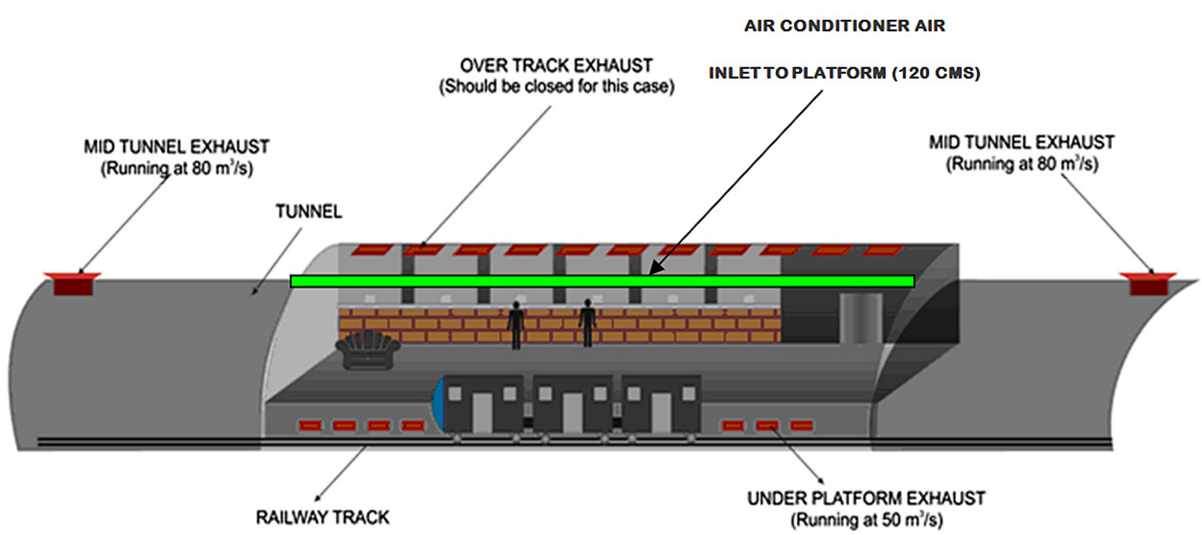


Fig 1: The existing ventilation system in the Metro Station.

The existing ventilation system is equipped to supply only normal ventilation for human comfort and physiological requirements. The supply air is provided by air-conditioned inlet openings in the station with a capacity of 120 CMS. The heat generated by the train brakes is exhausted using under platform exhausts as shown in Fig1.

Design using CFD simulation

Optimization techniques based on CFD (Computational Fluid Dynamics) were used to establish the capacity and location of emergency ventilation required in the station. An over-track exhaust (OTE) system was introduced to vent out smoke in case of emergency. A total of eight simulations were carried out to arrive at the final design, and results for this and for two of the unsuccessful designs described here.

Design 1 (unsuccessful)

Design parameters:

a) Total exhaust capacity using OTE = 80CMS
b) All the OTE openings exhaust equal amounts of air
c) Fresh air supplies through A/C inlet and under platform exhaust (UPE) are closed
d) The fresh air supply is through natural openings in the station (Stairs & Ramps) with a total capacity of 80 CMS
e) Fire Load capacity = 15 MW.

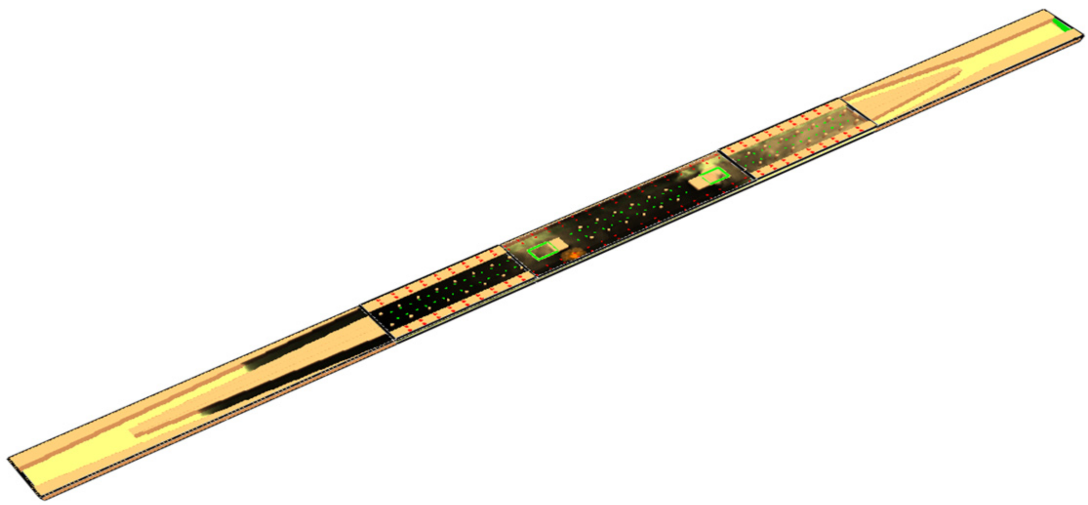


Fig. 2: Isometric view of smoke dispersion, 10 minutes after start of fire

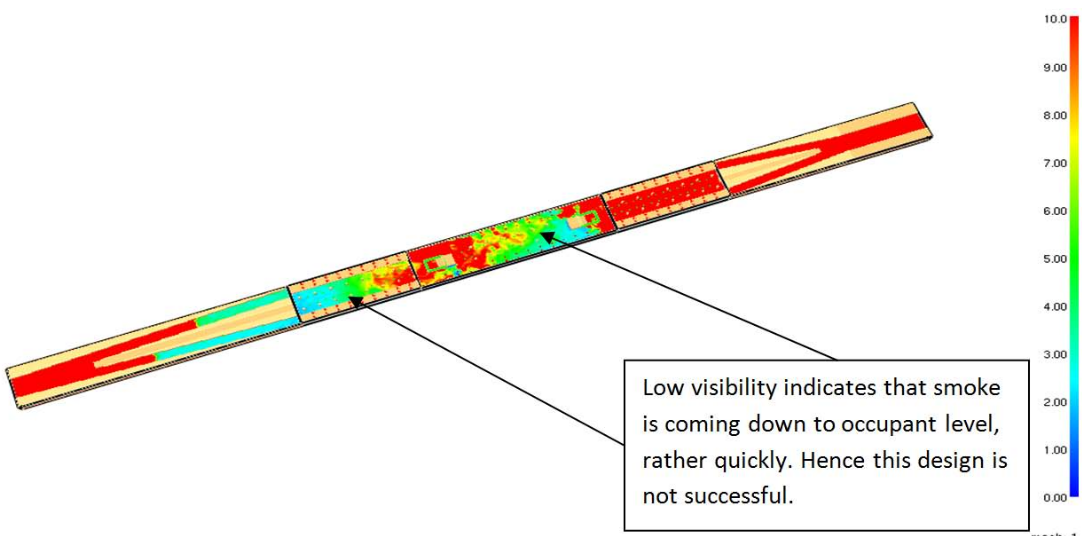


Fig. 3: Visibility level (in meters) at human head height, 10 minutes after start of fire

Design 2 (unsuccessful)

Design parameters:

a) Total exhaust capacity using Over Track Exhaust(OTE) = 80CMS
b) The entire OTE opening exhausts equal amount of air
c) Mid tunnel exhaust fans at both sides of the station and the exhaust closest to the Fire source are closed
d) Mechanical fresh air is supplied to the station by equally distributing in three sections
e) Fire Load capacity = 15 MW.

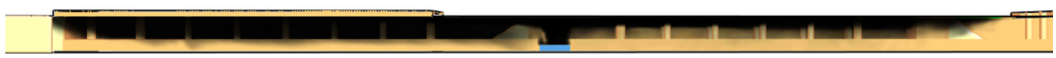


Fig 4: Front view of smoke dispersion, 10 minutes after the start of fire

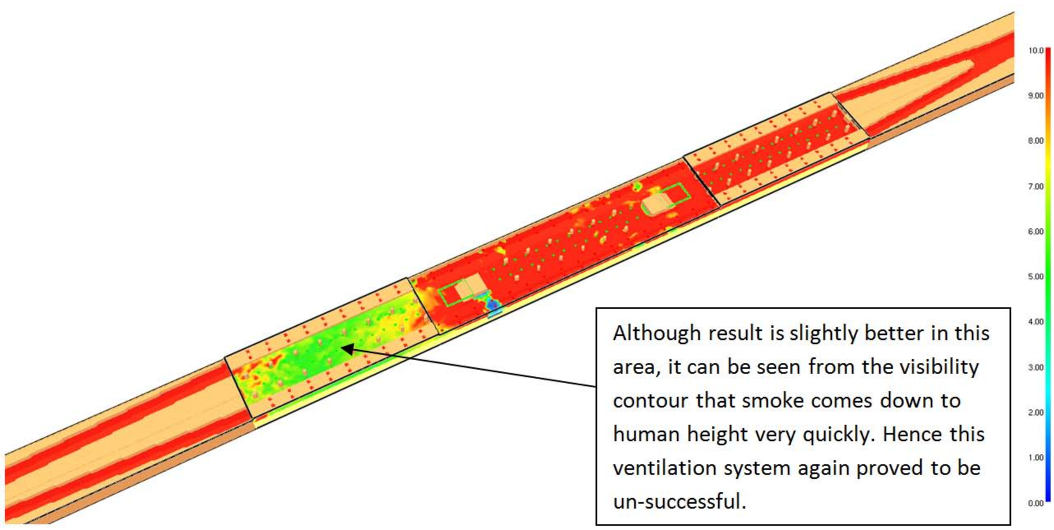


Fig 5: Visibility level (in meters) at human head height, 10 minutes after start of fire

Design 3 (successful & finalized)

After simulating various possible ventilation system configurations in the underground station we arrived at a system which would vent out smoke effectively in case of emergency.

Design parameters:

a) Total exhaust capacity using Over Track Exhaust(OTE) = 80CMS
b) OTE openings exhaust equal amounts of air
c) In emergency situation the Under Platform Exhaust (UPE) acts as an Under Platform Supply (UPS) with a capacity of 60CMS and the remaining 20CMS is supplied through the natural openings in the station (Stairs & Ramps)
d) Mid-tunnel exhaust fans at both sides of the station and the exhaust closest to the fire source are closed
e) The A/C openings inside the station are completely closed because these were pushing smoke on to the

platform during the fire scenario, causing poor visibility and a risk of suffocation for human occupants

f) Fire Load capacity = 15 MW.

Fig 6: Train fire in a typical station and the working design

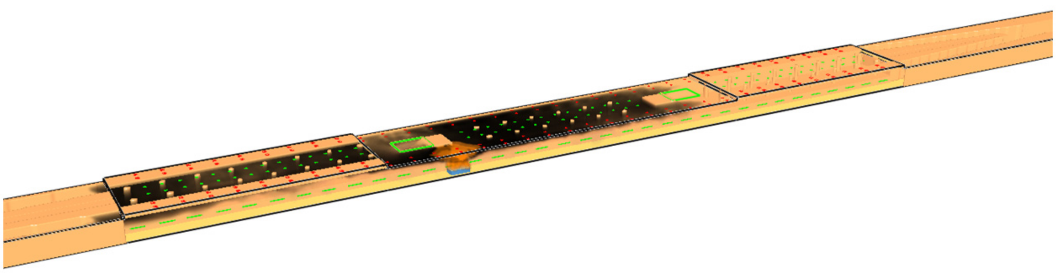


Fig 7: Isometric view of smoke dispersion, 10 minutes after the start of the fire

Fig 8: Front view of smoke dispersion, 10 minutes after the start of the fire

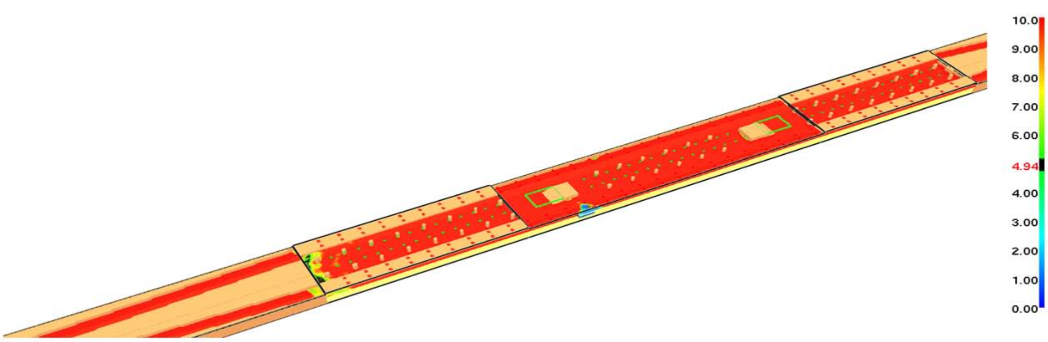


Fig 9: Visibility level (in meters) at human head height, 10 minutes after the start of the fire

Conclusion

Optimization technique using CFD analysis was used to design the emergency ventilation system in the Kolkata metro railway to vent out smoke in case of fire. The optimized design system can evacuate the smoke effectively, reduce the contamination of poisonous gases and improve the visibility level, providing assistance to fire fighters by creating a clear smoke-free path to approach the fire location.

IBPSA announcements

Nominations now open for IBPSA 2011 Awards

Nominations are now open for IBPSA 2011 Awards. IBPSA makes three awards for outstanding work in the building performance simulation field at each Building Simulation conference, providing there are qualified candidates, and also offers several travel awards to enable graduate students to attend the conference.

The awards for outstanding work are:

IBPSA Award for Distinguished Service to Building Simulation

This award recognizes an individual who has a distinguished record of contributions to the field of building performance simulation, over a long period.

IBPSA Outstanding Young Contributor Award

This award recognizes an individual at the beginning of their career who has demonstrated potential for significant contributions to the field of building simulation.

IBPSA Outstanding Practice Award

This award recognizes an individual, group or firm who has made significant contributions to the effective application and/or advancement of building simulation in practice.

Each award consists of a certificate and $500 (US).

For more information about both the outstanding work and student travel awards, including details of the evidence required to support nominations and information about submission deadlines, please visit **www.ibpsa.org/m_awards.asp** or contact Lori McElroy, chair of the Awards Committee, at **lori@sust.org**.

Journal of Building Performance Simulation update — and a discounted subscription offer

The **second 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:

De Wilde, P. and Tian W. The role of adaptive thermal comfort in the prediction of the thermal performance of a modern mixed-mode office building in the UK under climate change, Journal of Building Performance Simulation, 3 (2), 87 – 101

Kämpf, J.H., Wetter, M. and Robinson D. A comparison of global optimization algorithms with standard benchmark functions and real-world applications using EnergyPlus, Journal of Building Performance Simulation, 3 (2),103 – 120

Roeleveld, D., Naylor, D. and Oosthuizen, P. A simplified model of heat transfer at an indoor window glazing surface with a Venetian blind, Journal of Building Performance Simulation, 3 (2),121 – 128

Mahdavi, A. and Dervishi, S. Approaches to computing irradiance on building surfaces, Journal of Building Performance Simulation, 3 (2),129 – 134

Haldi, F and Robinson, D. Adaptive actions on shading devices in response to local visual stimuli, Journal of Building Performance Simulation, 3 (2),135 – 153,

Tanimoto, J. and Hagishima, A. Total utility demand prediction system for dwellings based on stochastic processes of actual inhabitants, Journal of Building Performance Simulation, 3 (2), 155 – 167

The **third issue of Volume 3** (2010) of Journal of Building Performance Simulation is a Special Issue on The Role of Building Performance Simulation in the Optimization of Healthcare Building Design. This issue contains the following papers:

Choudhary, C., Bafna, S. Heo, Y., Hendrich, A. and Chow, M. A predictive model for computing the influence of space layouts on nurses' movement in hospital units, Journal of Building Performance Simulation, 3 (3), 171 – 184

Dunston, P.S., Arns, L.L., and McGlothlin, J.D. Virtual reality mock-ups for healthcare facility design and a model for technology hub collaboration, Journal of Building Performance Simulation, 3 (3), 185 – 195

Short, C.A., Cook, M., Cropper, P.C. and Al-Maiyah, S. Low energy refurbishment strategies for health buildings, C. Alan Short; Malcolm Cook; Paul C. Cropper; Sura Al-Maiyah, Journal of Building Performance Simulation, 3 (3), 197 – 216

Hernández, A. L., Lesino, G., Rodríguez, L. and Linares, J. Design, modelling and computational assessment of passive and active solar collectors for thermal conditioning of the first bioclimatic hospital in Argentina, Journal of Building Performance Simulation, 3 (3), 217 – 232

Cropper, P.C., Yang, T., Cook, M., Fiala, D. and Yousaf, R. Coupling a model of human thermoregulation with computational fluid dynamics for predicting human–environment interaction, Journal of Building Performance Simulation, 3 (3), 233 – 243

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:

Jonathan Wright,
Department of Civil and Building Engineering,
Loughborough University, Loughborough,
Leicestershire, LE11 3TU, UK
Tel: +44 (0)1509 222621
Email: **J.A.Wright@lboro.ac.uk**

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

	ARUP www.arup.com 2009-2011
	Bentley Hevacomp www.bentley.com/en-US/Products/Building+Analysis+and+Design/Hevacomp.htm 2009-2011
	BRE www.bre.co.uk 2009-2011
	DesignBuilder www.designbuilder.co.uk 2009-2011

continues over page

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 47.

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**.

IBPSA Australasia	contact:	**Paul Bannister**
IBPSA Brazil		**Nathan Mendes**
IBPSA Canada		**Stephen Kemp**
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		**Mitsuhiro Udagawa**
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 committee chairs & contacts

Regional Affiliate Liaison Committee
Dru Crawley

Conferences Committee
Michel Bernier

Membership Development Committee
Jonathan Wright

Awards Committee
Lori McElroy

Website committee
Christoph van Treeck

IBPSA Fellow Committee
Jeff Spitler

Publication Committee
Jan Hensen

Public Relations Committee
Veronica Soebarto

IBPSA News
Veronica Soebarto, Editor-in-Chief
Marion Bartholomew, Editor

To submit Newsletter articles and announcements:
Veronica Soebarto (Newsletter Editor-in-Chief)
University of Adelaide, Australia
Email: veronica.soebarto@adelaide.edu.au

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

Manuscripts will be considered on the condition that they have been submitted only to ***Journal of Building Performance Simulation***, that they have not been published already, and that they are not under consideration for publication or in press elsewhere. All submissions should be in English. Papers for submission should be sent to the Editors at j.hensen@tue.nl. For full submission details, please see the journal's homepage www.informaworld.com/jbps and click on the "Instructions for Authors" tab.

To register to receive an alert when the first issue is published, please visit:
www.informaworld.com/jbps

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

Institutional Rate (print and online access)	US$468	£240	€374
Institutional Rate (online only)	US$444	£228	€355
Personal Rate (print only)	US$156	£80	€125
IBPSA member subscription (print only)	US$49	£25	€39

TAYLOR & FRANCIS GROUP ONLINE SERVICES

Alerting services from informaworld™
To receive the table of contents for ***Journal of Building Performance Simulation*** visit the Journal homepage at www.informaworld.com/jbps

To sign up for other table of contents, new publication and citation alerting services from **informa**world™ visit: www.informaworld.com/alerting

Online Access
Online access is included with a print institutional subscription to the Journal or alternatively is available as an online only option. For further information connect to: www.informaworld.com/jbps

Online Sample Copies
A fully searchable sample copy of this journal will soon be available at www.informaworld.com/jbps

informaworld™ Librarians' Area
Visit our web resource for Librarians and Information Professionals at: www.informaworld.com/librarians

eupdates Taylor & Francis Group

eUpdates
Register your email address at www.informaworld.com/eupdates to receive information on books, journals and other news within your areas of interest.

crossref Member

CrossRef
An international active reference linking service. Visit www.crossref.org for more information.

To the Librarian

Please include this journal in your next serials review meeting with my recommendation to subscribe:

From ______________________

Dept ______________________

Date ______________________

Please note this Taylor & Francis journal offers either print & online or online only subscriptions for institutions.

To find out more about our journals, please visit: www.informaworld.com/journals

For further information or to subscribe, please contact:

T&F Order Processing, T&F Informa UK Ltd, Sheepen Place, Colchester, Essex CO3 3LP

Telephone: +44(0)20 7017 5544
Fax: +44(0)20 7017 5198
Email: tf.processing@informa.com

Taylor & Francis
Taylor & Francis Group