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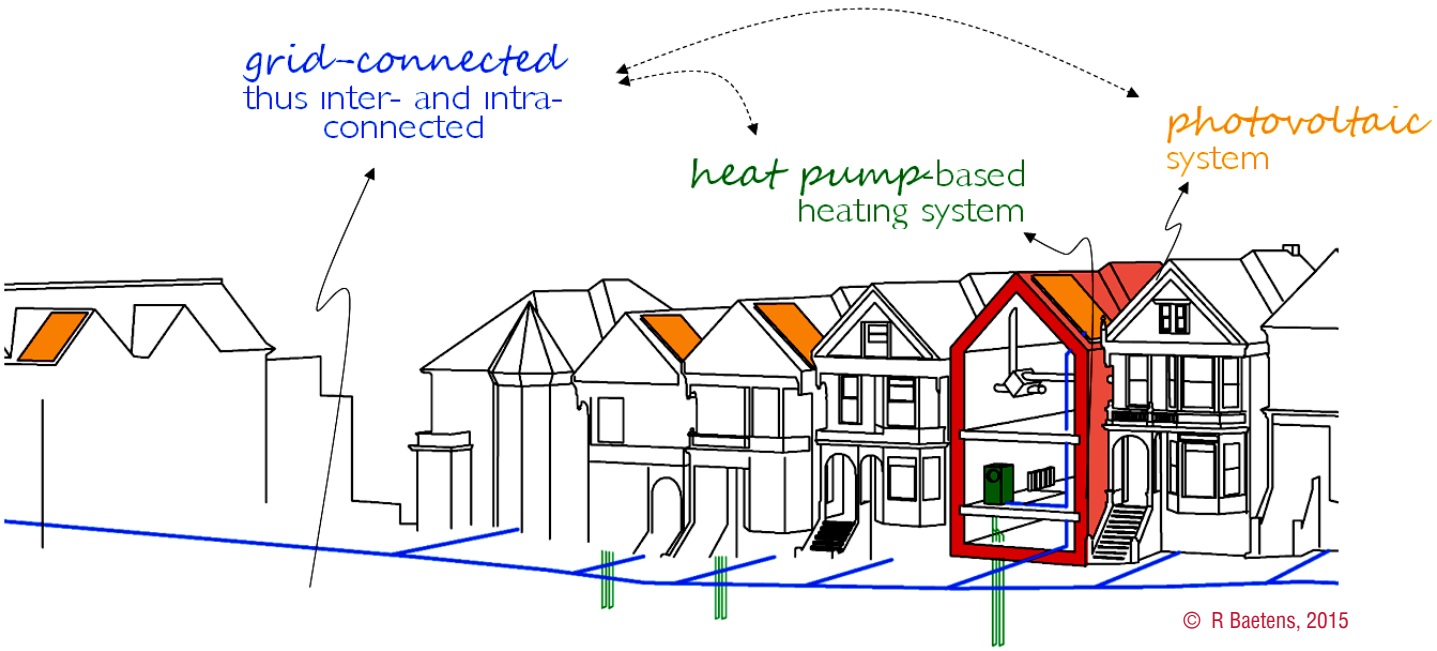
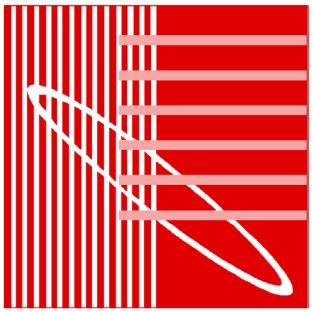


Big ideas in OpenIDEAS: a framework for modelling everything from occupants to districts …



Contents

President's message

Dear IBPSA Colleagues and Friends,

We are now about two months away from the next edition of IBPSA's most visible undertaking – Building Simulation 2015 will be held in Hyderabad, India December 7 – 9. This conference will be the 14th in the Building Simulation series ,which dates back into the 1980s. More than 400 papers have been accepted for presentation. The authorship breakdown is about 50% from Europe, 20% from Asia, 20% from North America, and 10% from South America and Oceania. Thus, the meeting promises to be a truly international gathering and will provide an unmatched opportunity to exchange ideas with colleagues from around the world.

In addition to technical sessions, BS 2015 includes social gatherings, presentation of IBPSA awards, announcement of the 2015 class of IBPSA Fellows, honoring winners of the Student Modeling Competition, IBPSA Board activities (see below), and pre- and post-conference training workshops. More information is found at **www.bs2015.in** and on **page 12** in this edition of *ibpsa*NEWS.

Leading up to Hyderabad, the 2015 IBPSA Board of Directors election is underway. Under our revised procedures put in place last year, half of the BoD is elected each year and Directors serve for 2 years. This year's ballot includes 7 candidates for 5 At Large positions and requests membership approval of 14 uncontested Affiliate Directors, including those nominated by our recently-approved regional groups from Mexico, Pakistan, and Portugal.

Building Simulation conferences are also the time for IBPSA planning and governance meetings. In Hyderabad, BoD committees will meet on December 6, the Annual General Meeting will be held on December 8, and the BoD will meet on December 10. All meetings are open and you are encouraged to attend. Alternatively, talk to any Director during the conference or, if you cannot make the trip to BS 2015, send comments and suggestions via your Affiliate.

As discussed in my message in the April issue of *ibpsa*NEWS, the BoD is working to select near-term activities that will support building performance simulation worldwide. We need ideas! There are projects that do not require much work – just some initiative on the part of one or two members. One example is the IBPSA LinkedIn group set up by Mike Barker. That group now has 5800 members and is used actively to exchange news in our field. Another is unmethours.com, the question-and-answer resource for the modeling community sponsored by Big Ladder Software and IBPSA-USA. These examples show that relatively modest projects can make big contributions.

To wrap up: there is still time to make your plans to attend BS 2015 to hear state-of-the-art technical information, network with researchers and practitioners, and help guide IBPSA's future. I look forward to seeing you there.

Projects and work at Tsinghua University, China

a conversation with Da Yan

*In a continuation of ibpsa*NEWS's *feature describing the work of research institutes, university faculties and other organizations that are actively involved with IBPSA related research Christina Hopfe spoke to Da Yan, Associate Professor at the School of Architecture, Tsinghua University, China. Da is also the operating agent of the IEA EBC Annex 66 with more than 100 participants from more than 20 countries.*

Christina J Hopfe (CJH): Could you please start by introducing your (research) group at Tsinghua University, and your main research areas?

Da Yan (DY): The Building Energy Simulation and Policy Group (BESPG) was established in 2005, and it is now one of the biggest groups in the Building Energy Research Centre of Tsinghua University. The group's main research topics are Building Performance Simulation research, Occupant Behaviour simulation and application in buildings, National Building Energy status and Policy Study.

CJH: How many PhD students/ postdocs do you have currently working in these fields?

DY: So far, there are six PhD students, three Masters students, two undergraduate students and one postdoc working in these fields. We warmly welcome candidates from all over the world to apply for our PhD and postdoc positions.

CJH: You are currently involved in the IEA-EBC Annex 66. Could you please tell us a little about this project and outline your role in it?

DY: The aim of Annex 66 is to study the Definition and Simulation of Occupant Behavior in Buildings. There are significant interactions between occupants and the built environment. Occupants' expectation of comfort drives them to adjust various controls, such as adjusting the thermostat in spaces, opening windows for ventilation, switching on lights, and consuming domestic hot water, etc. This makes occupant behavior, building performance and energy use strongly correlated, so a holistic scientific approach is required to study them.

The research in Annex 66 is mainly concerned with occupant movement and presence models in buildings, occupant action models in residential and commercial buildings, integration of occupant behavior models with BEM programs, and applications in building design and operations. Currently, around 120 participants from 24 countries are working in this joint effort. We are looking forward to exciting and fruitful outputs by the end of 2017.

CJH: In terms of teaching, could you please outline the different undergrad or postgrad (eg MSc) courses in the domain of building performance that you teach at Tsinghua University? Do you notice a growing interest, as evidenced by the total number of students enrolled in these programs increasing or decreasing?

DY: I'm now teaching two postgraduate courses relating to building performance simulation. The first one is *Building indoor thermal environment simulation and application*, which focuses mainly on how to apply building simulation tools in real applications. The second is *Building performance simulation methodology*, and is mostly focused on theory and methodology in building performance simulation. These two courses are the most popular graduate student courses in our department, and the number of students enrolled is quite stable.

CJH: What are the main links between your group and other universities and partners in research and teaching, nationally and internationally?

DY: In the area of building performance simulation and occupant behaviour we are working closely with Lawrence Berkeley Laboratory, the University of Texas in San Antonio, the University of Tennessee, the Polytechnic University of Torino, Nagoya University and others. In the area of building energy status and policy research we are cooperating with the International Energy Agency in building an energy technical roadmap for the emerging economy.

CJH: Which (research) project(s) would you like to see taking off in the next 5 to 20 years' time?

DY: Currently, the use of simulation technology integrated with real measured data to analyse energy saving potential and fault detection is one of the biggest challenges and an interesting topic in my group. In addition to this, a model combining occupant behaviour with grid demand side response is another hot topic for the next 5 to 10 years.

CJH: Building performance simulation in 50 years' time: How do you imagine/ want it to be?

DY: Up to now, simulation parameters such as weather data, envelope and system parameters have been studied extensively. But there is still a large discrepancy between simulation results and actual measurements. That is why our group is now exploring human behaviour in buildings. I hope that in 50 years we will not only achieve a good understanding of human behaviour but also that it will be widely applied in simulation modelling. I also hope that the application of simulation will not be limited to case studies but will also be embedded in construction standards and national construction policy.

CJH: One final question: Are you currently looking for national or international collaborations — and if so, in what area, and what sort of expertise are you looking for?

DY: Sure. I'm looking forward to cooperation both national and international in all my research fields. Especially in occupant behaviour simulation and application in Buildings and Demand side response.

CHJ: Thank you!

If you would like to publicise the work of your faculty or research group in a future *ibpsa*NEWS interview please contact Christina Hopfe (**C.J.Hopfe@lboro.ac.uk**).

OpenIDEAS

a conversation with Ruben Baetens and Roel De Coninck

The OpenIDEAS framework is an open framework developed for integrated district energy simulations. The software development is a collaborative project, originally between three different departments of the KU Leuven (building physics, thermal engineering, and electrical engineering) and 3E (a consultancy company in Brussels).

Christina Hopfe spoke to Ruben Baetens from the Building Physics Section of the Civil Engineering Department at KU Leuven and with Roel De Coninck from 3E in Brussels and the Division of Applied Mechanics and Energy Conversion, Department of Mechanical Engineering, KU Leuven

Christina J Hopfe (CJH): First of all, could you please briefly explain the context of OpenIDEAS?

Ruben Baetens (RB): The original idea behind OpenIDEAS arose from the recognition that we are moving towards a residential building stock with an increased penetration of heat pumps for space heating and domestic water, which raises many interesting research questions. How can we implement renewable energy sources? Do they have an impact on the electricity distribution grid? If so, can we adapt the building design to influence its impact? Or, what is the potential of an adapted district energy management control?

Roel De Coninck (RDC): To tackle these questions, we needed a simulation environment able to take into account the interactions between buildings (and their services) and the electricity distribution grid. As the existing simulation frameworks all failed to fulfill this requirement and co-simulation techniques were not yet well-established, we developed OpenIDEAS. OpenIDEAS is an open-source framework developed for Integrated District Energy Assessment by Simulation (hence the name 'OpenIDEAS'). The framework originally focused on simulating and controlling dwellings as part of an energy network at district level with a focus on integration with the low-voltage grid, but its approach is being generalized to a larger context such as district heating systems or shared energy infrastructures in general. The software is a collaborative project, originally between three departments of the KU Leuven (i.e. Civil, Mechanical, and Electrical Engineering) and 3E (a consultancy company in Brussels).

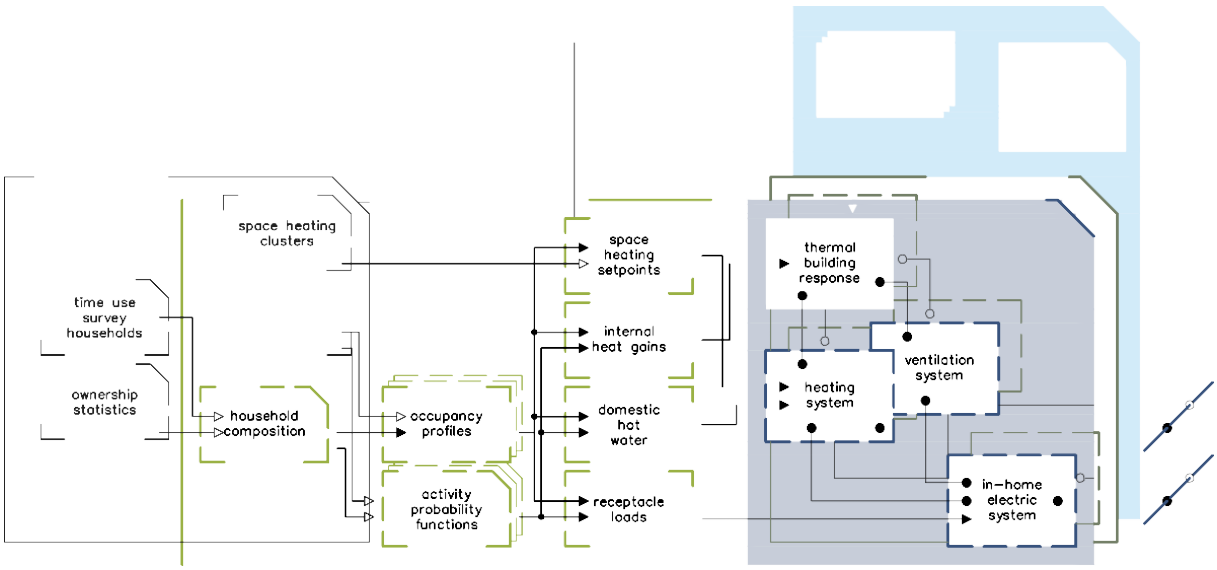
RB: Then, once the main components of OpenIDEAS were found viable, it introduced us to the IEA EBC Annex 60 where common ground is being developed for the interoperability of similar new building and district simulation environments, for example the Buildings and AixLib library of LBNL and RWTH Aachen respectively.

CJH: Could you please explain the components of the OpenIDEAS framework?

RDC: The OpenIDEAS framework has four main components: the IDEAS library, the StROBe module, the FastBuildings library and the GreyBox module.

RB: In general, the IDEAS Library forms the core of the OpenIDEAS framework and integrates multi-zone thermal building energy simulations including both building envelope and HVAC systems, and electric distribution system simulations. It differs from existing district energy modeling environments in the white-box approach of the modeled physics instead of going to highly simplified models. Here, the StROBe module generates the boundary conditions in a residential context, i.e. stochastic residential occupant behavior regarding electrical loads, set points for zone heating or cooling and domestic hot water consumption as input for integrated (building and) district energy simulations with IDEAS.

RDC: Combining the IDEAS library and the StROBe module allows researching different design options at the scale of residential districts. Next, a low-order building library was needed, mainly for including model predictive controls at this scale and continued upscaling of the models, and that is where the two remaining components originate from. The FastBuildings library provides low-order alternatives for the white-box models in IDEAS. It focuses on single- and multi-zone building energy models to use as embedded models in control algorithms, forecasting algorithms or fault detection and diagnosis. Here, obtaining a good control model remains crucial and the GreyBox module takes care of the required model identification of the low-order models as presented in FastBuildings based on measurement signals.



Overview of the OpenIDEAS Framework for integrated district energy assessments by simulation; based on IDEAS for the transient simulation of the (building and) district energy system, on StROBe for its boundary conditions regarding stochastic occupant behaviour, and on GreyBox for generating low-order component models through system identification of measurement signals based on their implementation in FastBuildings. [Baetens et al., 2015]

The GreyBox module is the only component of the OpenIDEAS framework that is currently not publicly available as open-source software.

CJH: How are these four components implemented?

RDC: You may already have noticed that I made a distinction between 'libraries' and 'modules': two of the components are implemented as Modelica libraries and the remaining as Python modules to suit their different characteristics.

RB: Both IDEAS and FastBuildings are Modelica libraries as they are governed by differential algebraic equations with 'time' as the main variable.

The IDEAS library contains descriptions of a whole set of building and system components in a white-box implementation based on DAE equations representing components such as walls, windows and thermal zones for buildings; boilers, heat pumps, radiators and pipes for the heating systems; solar collectors and ground-coupled heat exchangers as sources for renewable energy; photovoltaic systems, lines and batteries as electrical system components. The concept of a Modelica library allows multiple multi-zone buildings to be defined in a single simulation. Here, all thermal and fluid components are based on the Fluid.Interfaces and Fluid.BaseClasses developed in the IEA EBC Annex 60 to ensure a numerically robust implementation of all HVAC components and interchangeability with existing Modelica libraries focusing on building (and district) simulations.

The FastBuildings library defines the same wall, window and thermal zone components for buildings in a complementary low-order implementation.

StROBe is structured in separate Python classes and their methods describe the household data, behavioral probabilities, and the resulting space heating set points, receptacle loads, hot water withdrawals and internal heat gains based on clustered Time-Use Survey and Household Budget Survey data. The Household(..)class forms the core of the module. At instantiation, the individual members of a household and the appliances they own are defined, with all occupants allocated to one of the predefined clusters based on their employment types. Then, we start by generating occupancy chains for each individual independently at a ten-minute resolution, based on a combination of survival analysis and heterogeneous Markov chain methods, and the probabilities from the designated clusters. Additionally, all activities are defined for each household member as a function of the possible occupancy states and designated clusters. Starting from the previous step, one-minute profiles are generated for receptacle loads and domestic hot water by modeling their switching behavior in the Equipment(..)class based on a heterogeneous discrete-time Markov chain method and defining durations based on survival analysis, and ten-minute profiles are generated for the space heating set points based on the clustering of set point observations and the clear link between the average occupancy patterns obtained from clustering the time use surveys. The Feeder(..)class then combines this approach to obtain results for an entire neighborhood based on the general concepts of Monte Carlo methods.

RDC: Finally, the Greybox Python module aims to find the model candidate and corresponding set of parameters for a dataset from a monitored building and a set of model candidates from the FastBuildings library. The Case(..)class forms the core of the module whose object represents an (un-) successful attempt to obtain a model for the given building, and keeps track of the model structure, the identification data, the initial guess, solver settings and the results of a single parameter estimation attempt. The GreyBox(..)class object contains many different case instances and its methods gather the main functionality of the module dealing with the required data handling, model selection, defining of initial guesses, the effective parameter estimation, validation and model selection. Two features of the toolbox deserve explicit mentioning. First, a Latin hypercube sampling procedure is implemented to obtain a good set of initial guesses in order to increase the chance of finding a

global optimum of the non-convex parameter estimation problem. Second, a forward selection approach avoids over-fitting and returns the simplest model that results in the lowest model error on cross-validation.

CJH: Can you describe one or two of the main problems you had to face in developing the tool and how these were tackled?

RDC: Developing a framework for district energy simulations starting with a clean sheet indeed came with expected (and unexpected) difficulties, but I'll stick to the most important ones.

First, combining building envelope, thermal system and electric system models in a single simulation based on DAE equations integrates a wide range of time constants which we aimed to solve as a single model with traditional variable step-size DAE solvers. This has been most difficult to tackle for the case studies we're aiming for. Using and co-developing the IEA EBC Annex 60 BaseClasses has helped us in ensuring the differentiability of a majority of the implemented systems of equations. However, we have found that upscaling our cases to larger districts still seems to be inefficient, i.e. cubic for our given stochastic boundary conditions. We are currently attempting to approach this problem by combining fixed step-size DAE solvers with redefining the smallest time constants in our simulations or by moving towards a co-simulation approach in the future; but we're sure improving the computational efficiency of the environment will remain an issue during the entire time span of development.

RB: Second, whereas most occupant behavior models focus on a single variable for building simulation, the behavioral model we had to develop required the combination of multiple vectors (i.e. electricity, heating, water, gains) to be modeled for multiple dwellings. This put some restrictions on the available modeling methods to come to a good fit for purpose: we needed to make sure the autocorrelations of the variables are correct, and to make sure the cross-correlation between the different variables within the same household are correct. Moreover, the cross-correlation of the variables between the different households also needs to be correct if it is to generate a useful representation on the loads of the building and the district energy system. To tackle this, we started by clustering the time-use survey data based on behavioral observations which allows us to use a combination of survival analysis and heterogeneous Markov chains to model the occupancy of each household member. Next, we use the explicitly modeled occupancy time series as a prerequisite for all other variables, again based on a combination of survival analysis and heterogeneous Markov chains.

CJH: What validation and testing procedure did you use?

RB: Validation is indeed crucial for every modeling environment, though we prefer to use the term 'verification' in the given context. Here, the main verification applies to the IDEAS and StROBe components, as the other components generally depict methodologies for system identification.

The verification of the IDEAS library is approached as a classic building and energy transient simulation environment. We started from inter-model comparisons such as the BESTEST 600- and 900-series for the transient building model components and a MATLAB implementation of the load flow analysis based on the backward-forward sweep technique. However, as most inter-model comparisons focus on rather theoretical situations which may differ markedly from typical use cases, we extended this approach with comparisons to measurements such as the IEA EBC Annex 58 Twin House experiment for transient building models and laboratory measurements of heating system components.

Verification of the occupant behavior in the StROBe module is, however, more complex as we are talking about verifying a model focusing on a topic that is intrinsically stochastic in nature. We followed a similar dual path here. We started from a comparison with known standards on the simultaneity of loads in hot water and low-voltage distribution systems which focus on the inter-household cross-correlation of loads. Subsequently we compared the model with load profile measurements from parallel projects, which allows benchmarking the intra-household autocorrelation of electrical loads.

CJH: Finally, where can users download the framework and/or access the code?

RDC: As mentioned earlier, OpenIDEAS is an open-source development and its complete source code is available for download or fork at **https://github.com/open-ideas**, and we welcome everybody who wants to contribute to its development.

In the mean time, a much broader elaboration on the OpenIDEAS framework can be found in our overview paper at BS2015 , while the details on implementation can be found in the dissertations of Ruben Baetens, Juan Van Roy, Bart Vebruggen and myself, Roel De Coninck.

CJH: Thank you both very much. I look forward to listening to your presentation at the Building Simulation Conference in Hyderabad in December. ■

Forthcoming events

Date(s)	Event	Web site
2015		
03-04 November 2015	**CIBSE Building Performance Conference** London, UK	**www.cibse.org/cibse-conference-2015/conference**
07-09 December 2015	**BS2015** Hyderabad, India	**www.bs2015.in**
2016		
23-27 January 2016	**ASHRAE Winter Conference** Orlando, Florida, USA	**www.ashrae.org/membership--conferences/conferences/2016-ashrae-winter-conference**
07-10 April 2016	**9th Windsor Conference** Windsor, UK	**http://windsorconference.com**
14-15 April 2016	**CIBSE Technical Symposium: Integration for whole life building performance** Edinburgh, UK	**www.cibse.org/technical-symposium-2016**
03-06 May 2016	**eSim 2016** Hamilton, Ontario, Canada	**www.esim.ca**
23-24 May 2016	**Biennial IBPSA-France Congress** Marne la Vallée, France	**www.ibpsa.fr**
25-29 June 2016	**ASHRAE 2016 Annual Conference** St Louis, Missouri, USA	**http://ashraem.confex.com/ashraem/s16/cfp.cgi**
11-13 July 2016	**PLEA 2016** Los Angeles, California, USA	**http://plea2016.org**
10-12 August 2016	**ASHRAE & IBPSA-USA: SimBuild 2016** Salt Lake City, Utah, USA	**www.ashrae.org/simbuild2016**
12-14 September 2016	**Building Simulation and Optimization BSO16** Newcastle upon Tyne, UK	**www.bso16.org**
2017		
11-14 June 2017	**NSB 2017: 11th Nordic Symposium on Building Physics** Trondheim, Norway	**www.ntnu.edu/web/nsb2017/home**

Note that the dates in this calendar may, but do not necessarily, include pre and/or post-conference workshop days

03-04 November 2015
London, UK
www.cibse.org/cibse-conference-2015/conference

CIBSE Building Performance Conference & Exhibition

The second Building Performance Conference and Exhibition will be held at the QEII Conference Centre in Westminster, central London. The event will focus on the developments, innovations and best practices that can improve energy efficiency in both new and existing buildings – to deliver, not just promise, better building performance.

It is designed to address the interests of everyone in the supply chain, including officials from government, professional institutions, and trade bodies; senior management throughout the construction industry and its clients; engineers, consultants and specifiers; facilities managers; contractors; and manufacturers and suppliers. It will:

- keep delegates informed about changes to legislation, and the most critical issues facing today's built environment professionals
- give them an opportunity to learn from the most innovative and influential practitioners, and discover some of the most cost effective solutions to delivering building performance
- receive up to 10 hours of CPD over the two days
- network with over 300 other industry professionals, clients and suppliers from around the world. ■

07-09 December 2015
Hyderabad, India
www.bs2015.in

IBPSA's 14th international conference will bring together academics, researchers and professionals from a broad range of science and engineering disciplines with the aim of sharing the latest technology and innovations and spearheading the practical application of building simulation in developing nations. The International Institute of Information Technology – Hyderabad (IIITH) is acting as secretariat, and the Conference has support from organizations such as ASHRAE, ISHRAE, Indian Green Building Council, the Administrative Staff College of India and the Malaviya National Institute of Technology. Autodesk is a Platinum Sponsor and Saint Gobain a Silver Sponsor.

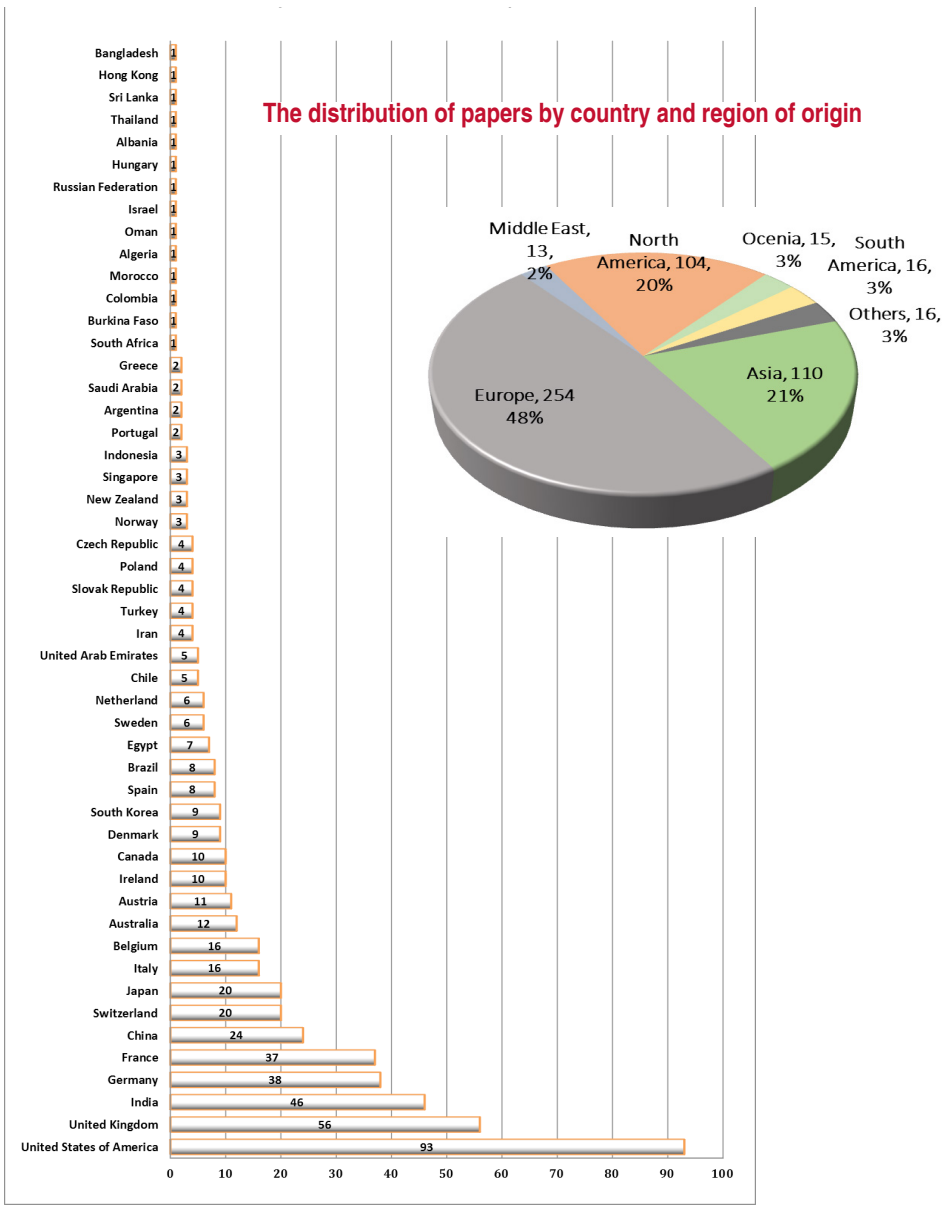
BS 2015 will feature a wide range of topics including:

- Thermal simulation
- Thermal comfort
- Daylight simulation
- Simulation of natural ventilation

- Simulation for passive measures
- Building-integrated photovoltaic systems
- Simulation for Code compliance
- Urban Scale simulation

The conference programme will include both oral presentations with question-and-answer sessions and poster sessions. There will be workshops on the energy performance of buildings and other building-related aspects such as acoustics, fire and water both before and after the main conference.

There has been an overwhelming response to the Call for Papers: with submissions now closed, 528 have been received from 51 different countries all over the world.



As part of the conference, IBPSA organized a Student Modelling Competition with the twin aims of encouraging wider participation in the conference and providing a competitive forum for student members of the building simulation community. The brief was to use computer simulation to design and test a mixed-mode operation strategy for a new office building located in the composite climate of New Delhi in India. The entries were evaluated by Sanyogita Manu (CEPT University, India), Vishal Garg (IIIT, Hyderabad), Malcolm Cook (Loughborough University, UK), and Christian Struck and Gerhard Zweifel (HSLU, Switzerland). The evaluation looked for evidence of accurate and intelligent use of simulation, integrated design, energy performance and design robustness.

Students were asked to submit a Statement of Intent (SOI) in the first place. 45 SOIs were received from 24 institutes spanning 12 countries, and full entries were eventually received from 10 groups and 5 individuals in India, the USA, UK, Germany, Switzerland and Romania. One group entry and two individual entries will be selected as winning entries. The winners will receive complimentary registration to participate in BS2015, a cash prize of $500US (per group/individual), and a certificate.

India is the second-fastest growing economy in the world and its construction sector is the country's second-largest economic activity, so with such a full and exciting programme of papers from all round the world we expect this conference to attract a rich mix of local and international participants.

Conference venue and accommodation

Hyderabad, India's 6th most populous city, has a vibrant mix of academic institutes and industries and is emerging as a global hub for Information Technology The IT industry's growth is driving both commercial and residential construction. Hyderabad leads the green building movement in India, with the local presence of the Indian Green Building Council, and it has a rich heritage of UNESCO Asia-Pacific historical sites.

BS2015 will be held at the state-of-the-art Hyderabad International Convention Centre (HICC), which has space for 32 breakout sessions, and the keynote session hall can accommodate over 1000 delegates.

Early Bird booking has closed, but delegates may still register through the conference website, **www.bs2015.in**. Accommodation can also be booked via the website at selected hotels and guest houses in and around the conference venue; prices at the hotels range from 2750 to 7740 INR for a single room including breakfast.

We look forward to receiving you in the city of smiles, lights, a thousand faces, and endearingly called the Pearl City. Hyderabad offers a variety of tourist attractions ranging from heritage monuments, lakes and parks, gardens, resorts and museums to delectable cuisine and a delightful shopping experience.

Further information

Please visit **www.bs2015**.in for further information and regular updates about the conference. ■

14-15 April 2016
Edinburgh, UK
www.cibse.org/technical-symposium-2016

CIBSE Technical Symposium: Integration for whole life building performance

CIBSE is holding a Technical Symposium in April next year at Heriot Watt University in Edinburgh, Scotland, on the topic of integration for whole life building performance: professional collaborative delivery of effective and efficient analysis, design, construction and operation of buildings.

The cost of attendance is being kept as low as possible (presenters circa £60) thanks to valuable support from sponsors and volunteers. An informal reception (included) will be held on the first evening in the magnificent Edinburgh Castle.

Formal papers, case studies or poster presentations have been invited from researchers, designers, contractors, building operators and others on any relevant topic, including:

- Whole life costing and environmental assessment.
- Integrating leading edge products and systems into building environmental engineering.
- Professional collaboration - lessons for the future.
- Interdisciplinary working - barriers and opportunities.
- Fusing passive and active building systems.
- Performance of integrated building solutions.
- Benchmarks, Standards and Regulations for building performance.
- Education and skills for collaborative design and operation.
- BIM for integrated design, construction, commissioning, operation and maintenance.
- Closing the design and operation loop.
- Labelling and certification for procurement and operation.
- Education, communication and skills for collaborative and integrated building design and operation
- Collaborating with clients to properly deliver sustainable building operation
- Creating, maintaining and assuring FM processes and procedures
- Integrating monitoring and feedback into lifetime building operation
- Case studies and measured performance of buildings and systems in use

All papers and posters will be peer reviewed, and those accepted will be web published by CIBSE after the event as a freely accessible 'open-access' resource for both CIBSE members and the wider society. Selected papers may be chosen by the Symposium committee for development and publication in BSERT.

Abstract submissions have now closed. ■

03-06 May 2016
Hamilton, Ontario, Canada
www.esim.ca

eSim 2016: IBPSA-Canada's 9th biennial conference

ABSTRACT SUBMISSION DEADLINE 15 OCTOBER!

eSim 2016 will be held at McMaster University in Hamilton, a port city on Lake Ontario in southern Canada. The conference consists of two days with over 75 peer-reviewed paper presentations expected, as well as two days of theory and software-based educational workshops, a technical tour, and a banquet. This year's conference is expected to attract over 200 delegates as the well-established eSim event continues to grow. IBPSA-Canada is among the largest IBPSA regional affiliates and eSim traditionally attracts delegates from 10 or more countries.

McMaster University is a large, high-ranking educational institution. Hamilton is a city of about 700,000 located just west of Toronto in the Golden Horseshoe region of Southern Ontario, a prosperous region of 9 million people with major transportation hubs and numerous tourist attractions. Local scenic natural features include Lake Ontario, Niagara Falls and the Niagara Escarpment. Typical May weather sees clear days and highs of 20°C, so there should be ample opportunity to enjoy the local natural beauty.

Conference themes include all aspects of building simulation, ranging from the simulators themselves to results of modeling. Coverage includes modeling physical processes (energy, occupant comfort, daylighting, etc.); the use of simulation in experimental research; control methods; community energy systems; building simulation tools; the use of tools with building code/incentive programs; and performance visualization/validation. Specific themes include:

- Modelling Physical Processes: Recent developments for modelling the physical processes relevant to building performance (thermal, air flow, moisture, lighting)
- Experimental Research: The use of experimental approaches to support modelling and simulation research work
- Algorithms: Methods and algorithms for modelling conventional and innovative building systems (including envelope, lighting, controls, HVAC, renewable energy and distributed generation systems)
- Whole Building Performance: Methods for modelling and characterizing whole building performance, including interactions between systems within the building, and interactions between the building and its surrounding neighbourhood and community
- Occupant Comfort: Methods for modelling and characterizing occupant comfort and well-being (including thermal comfort, acoustic performance, air-quality, ventilation and lighting)
- Occupant behaviour: Methods for simulating occupant behaviour in buildings
- Software Development: Building simulation software development and quality control approaches

- Simulation Tools Use 1: Use of building simulation tools in building design, optimisation, code compliance and incentive programs
- Simulation Tools Use 2: Use of building simulation tools in stock- and sector-modelling studies at neighbourhood, community, municipal and national scales
- Moving simulation into practice: Case studies of innovative simulation approaches
- Validation: Application of validation methods and technques to building simulation software
- Interface: User interface and software interoperability issues
- Visualization: Architectural and engineering data visualisation and animation

Key dates

- **Paper abstracts due:** **Thursday 15 October 2015**
- Abstract acceptance: 02 November 2015
- Full papers due: 08 January 2016
- Reviewers comments: 05 February 2016
- Final papers due: 26 February 2016
- Early Bird registration ends: 01 March 2016

Abstract should be 100 to 150 words and provide a concise description of the paper. They should clearly identify the unique contributions and major conclusions of the proposed paper. Information about paper formatting is available at **http://esim.mcmaster.ca/index.php/2016/index/pages/view/submissions**.

Further information

For more information please visit the conferemce website, **www.eSim.ca**. Direct questions to eSim 2016 Chair, Marilyn Lighthouse (**lightsm@mcmaster.ca**) or Co-chair, Jeff Blake (**jeff.blake@canada.ca**). ■

11-13 July 2016
Los Angeles, California, USA
www.plea2016.org

PLEA 2016: Cities, Buildings, People — Towards Regenerative Environments

The Passive and Low Energy Architecture Association (PLEA), Cal Poly Pomona, the University of Southern California, and Cal Poly San Luis Obispo are hosting the 2016 PLEA Conference in Los Angeles, California, from 11 to 13 July 2016. This is the first time since its inauguration in 1981 that the United States will have hosted a PLEA conference.

The theme of PLEA 2016 is *Cities, Buildings, People: Towards Regenerative Environments*, exploring the interactions between people and buildings to achieve livable, regenerative environments at multiple scales. PLEA values both research and practice, and each track will strive to combine exemplary case-studies and research papers. All papers will be considered, with special consideration to those addressing:

- **Strategies, Tools and Simulation Methods:** Advances in computing power and software development have made performance analysis tools widely

available. This track will explore measurement and performance in all areas and scales including energy, transportation, and daylight.

- **Passive Strategies for Resilient Cities:** The importance of passive cooling and heating techniques has long been recognized. This track will explore recent advances and their contribution to the development of resilient buildings and cities.
- **Carbon Neutral Design:** Synergies and opportunities to achieve net-zero energy and carbon-neutrality in buildings, neighborhoods, districts and cities. This track will explore new directions in city planning and urban design.
- **Sustainable Design Education:** It is impossible to solve today's environmental problems without the knowledge necessary to implement appropriate design strategies at multiple scales. This track will explore design education and best practices at all levels including innovative methods, experiences and teaching techniques.
- **Regenerative Design:** This track will explore ideas and examples of processes that restore, renew or revitalize their own sources of energy and materials maximizing closed-loop input–output systems. Special emphasis will be given to research that explores the connection between water, materials and energy at multiple scales, from systems to buildings to cities.

Abstracts are due by **08 November 2015** and should be a maximum of 500 words. Those submitting selected abstracts will be invited to submit a final paper which will be published in the Conference Proceedings. A template, more detailed information, instructions and online submission will be available soon at **www.plea2016.org**.

SBSE will provide several scholarships to presenting students and with financial support from the Jeff Cook foundation will provide scholarships to presenters from less developed countries. ■

10-12 August 2016
Salt Lake City, Utah, USA
www.ashrae.org/simbuild2016

ABSTRACT SUBMISSION DEADLINE 16 OCTOBER!

SimBuild 2016: Building Performance Modeling

On August 10-12, 2016, ASHRAE and IBPSA-USA will jointly host SimBuild 2016 at the Salt Lake Hilton Hotel in Salt Lake City, Utah. The conference will cover two-and-a half days and will be preceded by two days of training seminars and short courses.

The first ASHRAE and IBPSA-USA joint conference in 2014 was a huge success in its ability to bring the building energy analysis and performance simulation community together and provide the conference content to serve attendees. SimBuild 2016 seeks to build upon that success and further improve the industry's ability to accurately model building performance, keeping pace with advances in computing, data and automation and helping modelers make better decisions through the application of simulation and modeling over the entire building life cycle.

Modelers, software developers, owners and researchers will address the practices of energy modeling and building performance simulation using existing simulation tools,

software development, and future simulation research and applications.

The conference seeks papers on the following topics:

- Energy efficiency
- HVAC component modeling and load analysis
- Urban scale modeling
- Lighting and daylighting
- Combined use of tools
- Co-simulation
- Optimization
- Algorithm advances
- Computational fluid dynamics
- Data exchange and interoperability
- Energy auditing
- Life cycle cost and economic analysis
- Model calibration and validation
- Automation and scripting
- Modeling of tall buildings
- Weather data for modeling
- Occupant comfort
- Heat, air, moisture modeling
- Uncertainty analysis
- Big data applications for large scale simulations
- Reality capture for modeling
- Data visualization and user experience

In addition, papers describing workarounds, case studies, how to's, challenges, barriers and cloud-based solutions are encouraged.

Paper Abstracts (400 or less words in length) are due by **16 October 2015**. If accepted, papers are due by 15 January 15 2016. The conference papers will be a maximum of eight pages in length. Abstracts can be submitted electronically via **http://ashraem.confex.com/ashraem/ibpsa16/cfp.cgi**. Papers will undergo a double-blind review and will need to receive two "accept" reviews in order to be accepted for the conference.

For future updates, continue to visit **www.ashrae.org/simbuild2016**. ■

12-14 September 2016
Newcastle, UK
www.bso16.org

BSO 2016: 3rd IBPSA-England conference

IBPSA-England's 3rd conference, Building Simulation & Optimization 2016, will be held in the Great North Museum at the University of Newcastle on 12-14 September 2016.

IBPSA-England's first conference, held at Loughborough University, and second, at University College London (UCL), were a major success and the participants' numbers continue to rise significantly. The conference team have been busy with organization and we are delighted that accommodation and venue bookings are now complete and are ready for participants to start their bookings.

The built environment's impact on climate, human wellbeing and natural resources underpins an increasing demand for building and urban performance modelling. The role of performance modelling has expanded from facilitating energy regulatory compliance

to enabling a wider discourse on how designed buildings, from a single building to the urban scale, are predicted to perform before they are actually built.Although advances in building and urban simulation tools have leapt forward in terms of their computational power and data visualization capabilities there are still major challenges relating to data integration and interpretation. This conference seeks to explore the extent of these simulation challenges and demonstrate how optimization techniques can be used systematically to inform optimized design and operation strategies.

Conference themes

- Progress in simulation tools and optimization methods
- Application of environmental and sustainability modelling to case studies
- New directions in building environmental modelling including BIM and visualization methods
- Progress in modelling micro-urban environments

Key dates

ABSTRACT SUBMISSION DEADLINE 01 NOVEMBER!

- **Abstracts due: 01 November 2015**
- Full papers due: 13 March 2016
- Paper review deadline: 16 April 2016
- Paper review notification: 01 May 2016
- Final papers due: 01 June 2016
- Review process completed: 22 July 2016
- Final decision to authors: 30 July 2016
- Early Bird registration: 15 August to 04 September 2016

Abstract submissions are welcome. Formatting information is available from, and submissions can be uploaded through, the conference website at **www.bso16.org//submissions**.

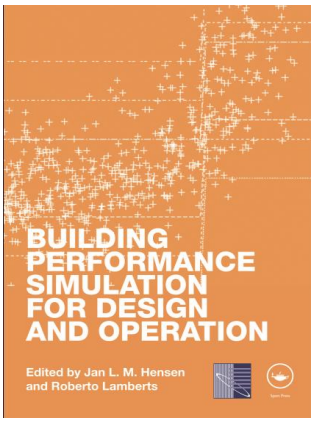
All accepted full papers will be published in proceedings with an ISBN number.

Further information

Further information is available from the conference website, **www.bso16.org**.

If you have any queries please do not hesitate to contact Conference chair **Neveen.hamza@newcastle.ac.uk** or Conference secretary **Anne.fry@newcastle.ac.uk**. ■

Building Performance Simulation for Design and Operation



Jan L.M. Hensen and **Roberto Lamberts**

Effective building performance simulation can reduce the environmental impact of the built environment, improve indoor quality and productivity, and facilitate future innovation and technological progress in construction. It draws on many disciplines, including physics, mathematics, material science, biophysics and human behavioural, environmental and computational sciences. The discipline itself is continuously evolving and maturing, and improvements in model robustness and fidelity are constantly being made. This has sparked a new agenda focusing on the effectiveness of simulation in building life-cycle processes.

Building Performance Simulation for Design and Operation begins with an introduction to the concepts of performance indicators and targets, followed by a discussion on the role of building simulation in performance-based building design and operation. This sets the ground for in-depth discussion of performance prediction for energy demand, indoor environmental quality (including thermal, visual, indoor air quality and moisture phenomena), HVAC and renewable system performance, urban level modelling, building operational optimization and automation.

Produced in cooperation with the International Building Performance Simulation Association (IBPSA), and featuring contributions from fourteen internationally recognised experts in this field, this book provides a unique and comprehensive overview of building performance simulation for the complete building life-cycle from conception to demolition. It is primarily intended for advanced students in building services engineering, and in architectural, environmental or mechanical engineering; and will be useful for building and systems designers and operators.

Selected Table of Contents

1. The Role of Simulation in Performance Based Building 2. Weather Data for Building Performance Simulation 3. People in Building Performance Simulation 4. Thermal Load and Energy Performance Prediction 5. Ventilation Performance Prediction 6. Indoor Thermal Quality Performance Prediction 7. Room Acoustics Performance Prediction 8. Daylight Performance Predictions 9. Moisture Phenomena in Whole Building Performance Prediction 10. HVAC Systems Performance Prediction 11. Micro-cogeneration System Performance Prediction 12. Building Simulation for Practical Operational Optimization 13. Building Simulation in Building Automation Systems 14. Integrated Resource Flow Modelling of the Urban Built Environment 15. Building Simulation for Policy Support 16. A View on Future Building System Modelling and Simulation

January 2011 |536pp | Hb: 978-0-415-47414-6 | £65.00

About the Authors

Jan L. M. Hensen *(Ph.D. & M.S., Eindhoven University of Technology) has his background in building physics and mechanical engineering. His professional interest is performance-based design in the interdisciplinary area of building physics, indoor environment and building systems. His teaching and research focuses on the development and application of computational building performance modelling and simulation for high performance.*

Roberto Lamberts *is a Professor in Construction at the Department of Civil Engineering of the Federal University of Santa Catarina, Brazil. He is also currently a board member of the IBPSA, Vice-President of the Brazilian Session and Counsellor of the Brazilian Council for Sustainable Buildings.*

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Software news

Climate.OneBuilding.Org: A new web resource for building simulation climate data

Dru Crawley and Linda Lawrie

A new web resource with free weather data in EPW format is now available: **http://climate.onebuilding.org**. This has been produced by Dru Crawley and Linda Lawrie as a purely voluntary activity.

A few of the features

- Annual and **monthly** design conditions from Chapter 14, 2013 ASHRAE Handbook-Fundamentals
- **Design conditions from another location** in the 2013 Fundamentals substituted when none are available for that location
- Annual **design conditions calculated from source weather data** in absence of ASHRAE design conditions.
- Frequent updates as new weather data sets and design conditions are released
- Consistent, validated, specific location naming:
  - USA_VA_Arlington-Reagan.Washington.National.AP or USA_VA_Sterling-Washington.Dulles.Intl.AP instead of Washington, DC
- **Hourly precipitation** in a separate file for direct use in simulations (where source data includes precipitation)
- **Extensive quality checking** to identify and correct data errors and out of normal range values where appropriate. All changes - alternate design condition locations and corrections to data - are documented on the web site for each data set.

Weather Data Sets Currently Available

- **ITMY** ** NEW **
  6 locations, Iran, developed by Iran Building and Housing Research Center
- **RMY 2012*** ** NEW **
  69 locations, Australia, 50% (A), 33% (B) and 17% (C) solar weight versions, developed for the Australian National House Energy Rating Scheme (NatHERS) 2012 by NIWA
- **IMS*** ** NEW **
  4 locations, Israel, developed by Technion using data from the Israel Meteorological Service (IMS)

- **BBSR*** ** NEW **
  15 locations, Germany, current (jahr, somm, wint) and 2035 (jahr, somm, wint) versions, developed by BBSR (Bundesinstitut für Bau-, Stadt- und Raumforschung) and DWD (Deutscher Wetterdienst)
- **NIWA** ** NEW **
  18 locations, New Zealand, developed by NIWA (New Zealand National Institute of Water & Atmospheric Research) for EECA (Energy Efficiency and Conservation Authority)
- **CWEC**
  80 locations, Canada, developed by Numerical Logics in collaboration with Environment Canada and the National Research Council of Canada
- **California Climate Zone Data**
  16 locations (CTZ v2) and 86 locations (CTZ 2010), California Title 24, United States of America, developed for the California Energy Commission
- **Chinese Standard Weather Data (CSWD)**
  270 locations, China, developed by Department of Building Science and Technology at Tsinghua University and China Meteorological Bureau
- **TMY3**
  1020 locations, United States of America, Puerto Rico, US Virgin Islands, and Guam Pacific, developed by National Renewable Energy Laboratory

New Data Sets in Progress

- INMET* 412 locations and TRY* 17 locations, Brazil (under review)
- ISHRAE 2014* 59 locations, India (under review)
- IMGW 61 locations, Poland (under review)
- SWERA 156 locations, 13 countries (under review)
- TMY3a* 1020 locations, USA (updated Jan 2015)
- and a few others on which work has just started.

Elements 1.0.4: Open-source tool for creating and editing custom weather files

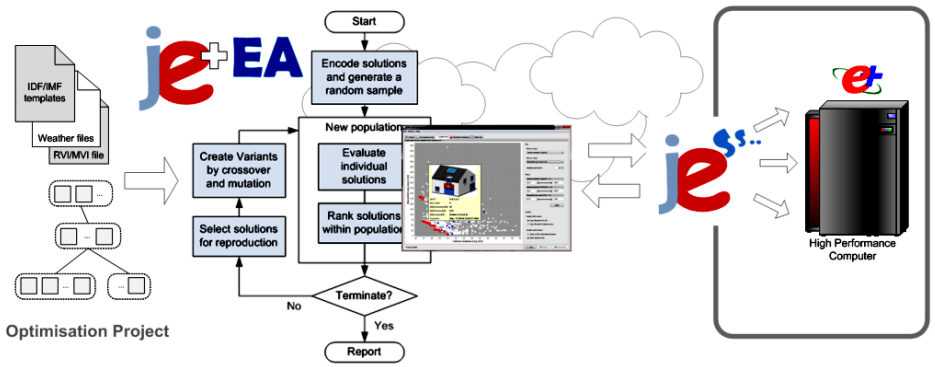
Elements 1.0.4 is now available for download. This is a minor bug-fix update for our free, open-source tool for creating and editing custom weather files on Windows and Mac.

The goal of the Elements project is to develop a comprehensive, integrated application suitable for handling all of the common tasks associated with weather files. Elements was developed by Big Ladder Software with the generous funding and collaboration of Rocky Mountain Institute. For more information and to download visit **http://bigladdersoftware.com/projects/elements/**.

jEPlus and jEPlus+EA v1.6: An EnergyPlus simulation manager for parametrics

Parametric analysis is often used for exploring design options and identifying the relationship between design parameters and performance. jEPlus has been developed specifically for performing complex parametric analysis with EnergyPlus (all versions) and TRNSYS. It originated in software developed by Yi Zhang of Energy Simulation Solutions and Ivan Korolija of IESD, De Montfort University, and with help from several other collaborators it has evolved progressively since then. It is extensively documented at **www.jeplus.org**.

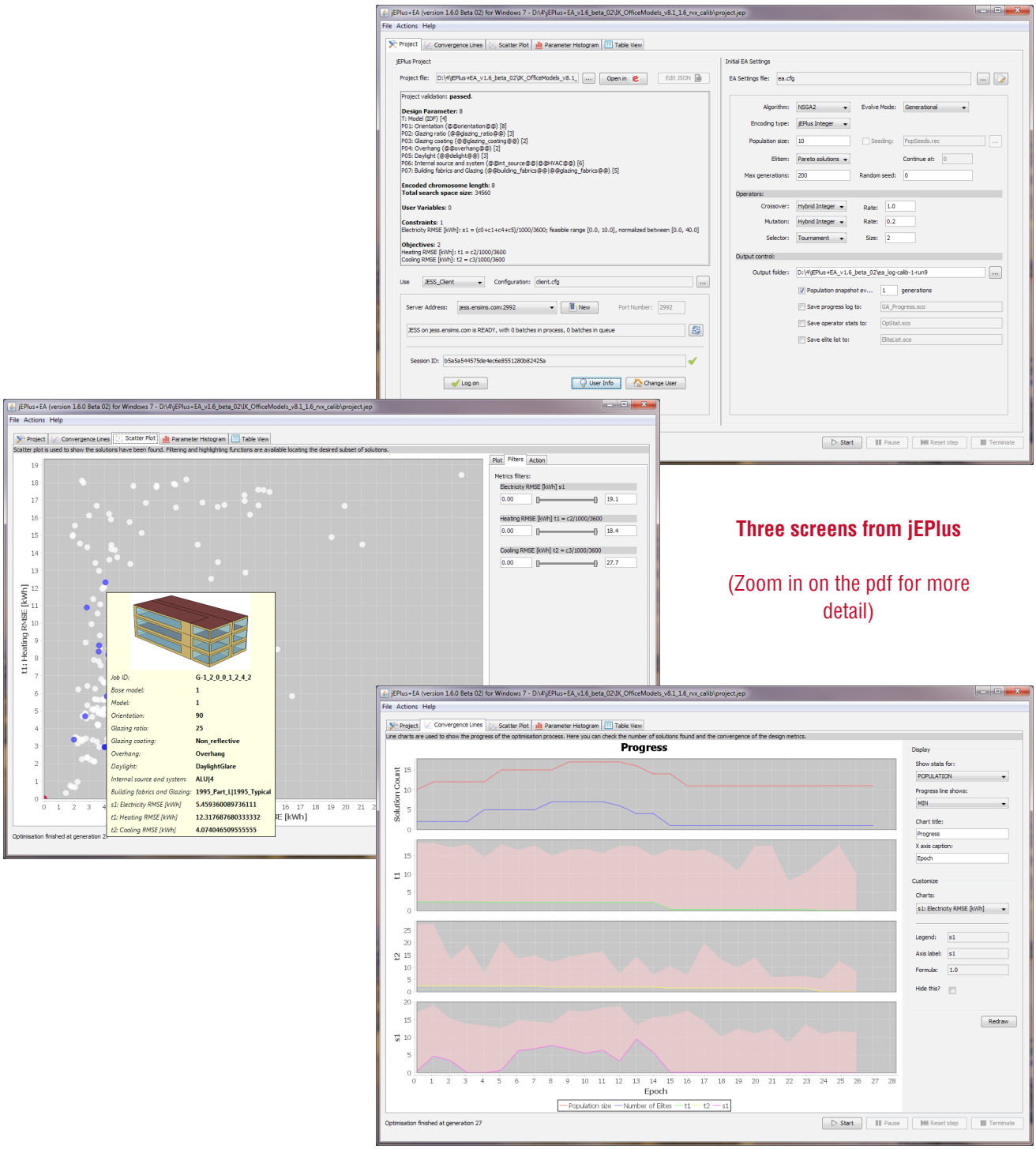
jEPlus provides a GUI for defining design parameters, editing models, managing simulation runs, and collecting results. With the GUI, hundreds of thousands of simulation cases may be created in a matter of minutes. jEPlus+EA is an optimisation tool built on jEPlus. It employs a highly customized multi-objective optimisation algorithm that works effectively on a wide range of problems. Interactive charting tools are built into the GUI to help users explore the design solutions. It is also integrated with the JESS Online simulation service (**www.ensims.com**) to run simulations fast and efficiently.



The latest release of jEPlus and jEPlus+EA v1.6 includes the following features:

- Complete GUI providing controls needed for setting up and managing parametric and optimization projects
- Flexible syntax for specifying parameter values, including user-defined combinations, probabilistic distribution sampling, and inline calculation
- Collecting simulation results from E+ time series (eso/mtr) and tabular (csv/sql) outputs
- Executing user's own Python scripts for post-processing
- Defining objective and constraint functions for optimisation
- Versatile and highly efficient optimisation algorithm requiring little attention from the user
- Interactive optimisation process and charting for exploring design solutions
- Managing parallel simulations locally or running simulations online using the JESS service

- Command-line and programming interface for easy integration with other tools and programming languages
- Comprehensive documentation including tutorials on sensitivity analysis and model calibration applications.



Three screens from jEPlus

(Zoom in on the pdf for more detail)

IEA EBC Annex 66: Survey on assumptions about occupants made by BPS users

Liam O'Brien

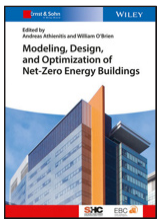
International Energy Agency – Energy in Buildings and Communities (IEA-EBC) Programme Annex 66: Definition and Simulation of Occupant Behavior in Buildings is currently in the first year of its working phase. It involves about 100 experts and 12 participating countries.

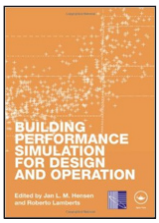
To better understand the assumptions and common practice about occupants in building performance simulation, we are conducting an international survey. The goal of this brief anonymous 38-question survey, aimed at practitioners (architects, engineers, other building modellers), is to inform researchers and software tool developers of current practices and attitudes about occupant modelling. The results will be securely and anonymously stored. Participant information will not be shared with anyone. A summary of the aggregate results will be publicly released in approximately Summer 2016.

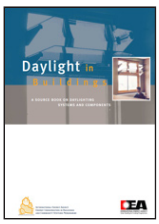
The survey can be completed at: **http://goo.gl/forms/sbvCS6z5Zw**.

When the survey closes (we anticipate in late November 2015), participants who provided an email address at the end of their completed survey will be randomly selected to win one of the following generously donated prizes:

- 2 copies of the book *Modeling, Design, and Optimization of Net-Zero Energy Buildings* edited by Andreas Athienitis and William O'Brien.
- 1 copy of the book *Building Performance Simulation for Design and Operation*, edited by Jan Hensen and Roberto Lamberts
- 1 one-year subscription to the *Journal of Building Performance Simulation*
- 3 BeeWi Bluetooth color LED smart light bulbs
- 4 hard copies of *Daylight in Buildings - A source book on daylighting systems and components*
- 2 copies of the printed proceedings of SimAUD 2015 (Symposium on Simulation for Architecture and Urban Design)





More details about Annex 66 can be found at **http://Annex66.org**.

Modelica Buildings Library 2.1.0 released

Lawrence Berkeley National Laboratory (LBNL) has released the Modelica Buildings library 2.1.0, which is fully compatible with version 2.0.0.

Version 2.1.0 adds the package Buildings.Fluid.FMI that provides containers for exporting thermofluid flow components as FMUs. It also updates the temperature sensor to optionally simulate heat losses, and it contains bug fixes for the trace substance sensor if used without flow reversal.

Improvements have been made to various models to reduce the simulation time, and to Buildings.Examples.Tutorial.Boiler to simplify the control implementation.
For a detailed list of changes, see **http://simulationresearch.lbl.gov/modelica/releases/v2.1.0/help/Buildings_UsersGuide_ReleaseNotes.html#Buildings.UsersGuide.ReleaseNotes.Version_2_1_0**.

For more information and download, visit **http://simulationresearch.lbl.gov/modelica/**.

The development page is **https://github.com/lbl-srg/modelica-buildings**.

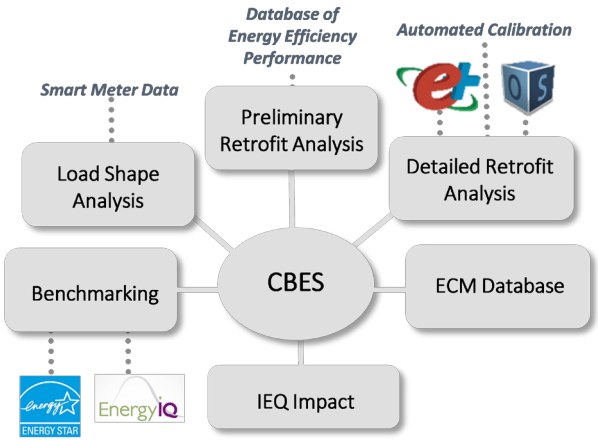
Commercial Building Energy Saver: An energy retrofit analysis toolkit

LBNL has developed a web-based retrofit analysis toolkit, Commercial Building Energy Saver (CBES), intended to be used for small and medium office and retail buildings. Small commercial buildings in the United States consume 47% of the total primary energy of the buildings sector. Retrofitting small and medium commercial buildings poses a huge challenge for owners because they usually lack the expertise and resources to identify and evaluate cost-effective energy retrofit strategies. The CBES Toolkit enables calculating the energy use of a building, identifying, and evaluating retrofit measures in terms of energy savings, energy cost savings and payback. The CBES Toolkit includes a web app (APP) for end users and the CBES Application Programming Interface (API) for software developers to integrate CBES with other energy software tools.

The toolkit provides a rich set of features including: (1) Energy Benchmarking providing an Energy Star score leveraging Energy Star and EnergyIQ API, (2) Load Shape Analysis identifying potential building operation improvements, (3) Preliminary Retrofit Analysis using a custom developed pre-simulated database, and (4) Detailed Retrofit Analysis utilizing real-time EnergyPlus simulations.

CBES includes 75 configurable energy conservation measures (ECMs) that encompass IAQ, technical performance and cost data, for assessing seven different prototype buildings at 6 vintages and 16 climate zones in California. The load shape analysis identifies low- or no- cost improvement opportunities based on statistical analysis and

smart meter data at 15-minute intervals of electricity use. The preliminary retrofit analysis utilizes the Database of Energy Efficiency (DEEP), a data bank for screening and evaluating retrofit measures for commercial buildings generated from 10 million building energy simulations conducted using EnergyPlus at the U.S. National Energy Research Scientific Computing (NERSC) Center. The detailed retrofit analysis employs advanced automated calibration algorithms to attune inputs prior to simulating energy savings of ECMs. For the detailed retrofit analysis, on-demand energy simulations using OpenStudio and EnergyPlus calculates the energy performance of the building with user configurable ECMs. The figure (right) illustrates key components of the CBES Toolkit:



CBES is flexible enough that the user can jump to any level of retrofit analysis, after the common inputs are provided. For those who wish to extend beyond California, a national version can be found at the 2030 Districts portal (**http://2030districts.org**). CBES targets a broad audience including building owners, facility managers, energy managers, building operators, energy auditors, designers, engineers and consultants. CBES provides a new contribution to the field by enabling data and model driven retrofit decision making for small and medium business owners, leveraging different levels of assessment dependent upon the project goal, data availability, and user experience.

The project was funded by the California Energy Commission under the Public Interest Energy Research (PIER) Program. Project partners include Bay Area Climate Collaborative, five Bay Area cities, and C3 Energy. The project was led by Mary Ann Piette, the Director of Building Technology and Urban Systems Division of LBNL. Tianzhen Hong, a staff scientist and deputy leader of the simulation research group of LBNL, led a team to develop the CBES software. More details are available at **http://cbes.lbl.gov**.

References

T Hong, MA Piette, Y Chen, SH Lee, S Taylor-Lange, R Zhang, K Sun, P Price,*Commercial Building Energy Saver: An Energy Retrofit Analysis Toolkit*, Applied Energy, 2015

SH Lee, T Hong, MA Piette, G Sawaya, Y Chen, TL Taylor-Lange, *Accelerating the energy retrofit of commercial buildings using a database of energy efficiency performance*, Energy, 2015

SH Lee, T Hong, MA Piette, S Taylor-Lange, *Energy Retrofit Analysis Toolkits for Commercial Buildings: A Review*, Energy, 2015

An occupant behavior simulation tool

Occupant behavior (OB) has an important influence on building energy and environmental performance. The modeling and simulation of OB is crucial to provide a valuable insight into energy use in buildings and improve prediction and evaluation of building performance. To this end, an OB simulation tool has been developed under the collaboration of two teams from Tsinghua University and Lawrence Berkeley Laboratory.

The tool is based on an OB model proposed by the Tsinghua team. In this model, OBs are represented by zone-level movement and control actions. Generally, the model is in probabilistic form and supports the personalized definition of OB in terms of behavioral pattern. Each pattern has a set of simple, intuitive parameters. In this way, the uncertainty and diversity of occupant behavioral characteristics can be simplified and quantified.

Specifically, the zone-level movement model is based on Markov Chain theory and an Event mechanism. A high-order transition probability matrix (Figure 1) is used to describe the probability of an occupant moving from one space to another. The elements of the matrix are changed by events (like going to the office, leaving work, having a meeting, etc.) at every time step. Given the matrix of each occupant, his/her location can thus be predicted according to his/her previous location. This movement model is feasible for multi-zone scenarios with only a few input parameters. Various movement patterns can be defined for different occupants in the building in terms of different movement events.

$$P_{t,t+1} = \begin{bmatrix} P_{00} & P_{01} & \cdots & P_{0n} \\ P_{10} & P_{11} & \cdots & P_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ P_{n0} & P_{n1} & \cdots & P_{nn} \end{bmatrix} \qquad X(t) = i \xrightarrow{p_{ij}} X(t+1) = j$$

Figure 1: Transition probability matrix of each occupant

The control action model is based on a conditional probability function and memoryless hypothesis. It relates the probability of each action to movement events, environmental parameters, other object states, etc. Given the conditional probability function, each action can be predicted according to the occupant's contextual status. The basic model has been applied to turning on/off an air conditioner (AC), turning on/off a light, turning on/off a computer, opening/closing a window, etc. Various patterns for each action can be defined for occupants with different behavioral habits. **Table 1** shows an example of AC behavior definition, including 5 turn-on patterns and 4 turn-off patterns with various conditional probability functions.

No.	Turn on pattern description	Model
1	Never turn on AC	$P=0$
2	Turn on AC when occupied and feeling hot	$P=\begin{cases}1-e^{-\left(\frac{T-u}{\lambda}\right)^k}, T\geq u & \text{when occupied}\\ 0, T<u\end{cases}$
3	Turn on AC when entering the room and feeling hot	$P=\begin{cases}1-e^{-\left(\frac{T-u}{\lambda}\right)^k}, T\geq u & \text{when entering}\\ 0, T<u\end{cases}$
4	Turn on AC when entering the room	$P=P_{enter}$
5	Turn on AC when working time begins	$P=P_{on\_time}$

No.	Turn off pattern description	Model
1	Turn off AC when feeling cold enough	$P=\begin{cases}1-e^{-\left(\frac{u-T}{\lambda}\right)^k}, T\leq u & \text{when occupied}\\ 0, T>u\end{cases}$
2	Turn off AC when leaving the room	$P=1-e^{-\left(\frac{t_{leave}}{\lambda}\right)^k}$
3	Turn off AC when working time ends	$P=P_{off\_time}$
3	Never turn off AC	$P=0$

Table 1: Example of control action's definition

Based on the proposed movement and control action model, the OB simulation tool

includes two modules: an occupant movement module and an occupant actions module. This tool can be integrated with building simulation programs (BEP) as illustrated by **Figure 2**. The movement module generates the room occupancy data as a pre-processor, while the action module should be coupled with the BEP and exchange data with it. Through the co-simulation of the OB tool and BEP, with a few behavioral parameters for each occupant, the movement and actions of occupants and their energy use can be reproduced. **Figures 3 to 6** illustrate the graphical user interface of inputs and outputs of the OB simulation tool.

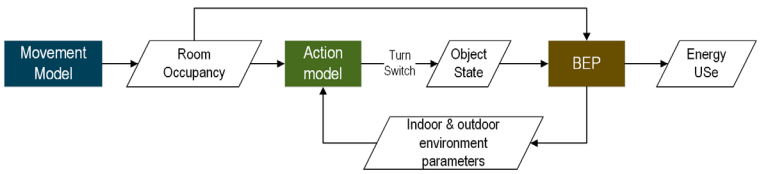


Figure 2: Integration and co-simulation of OB tool and BEP

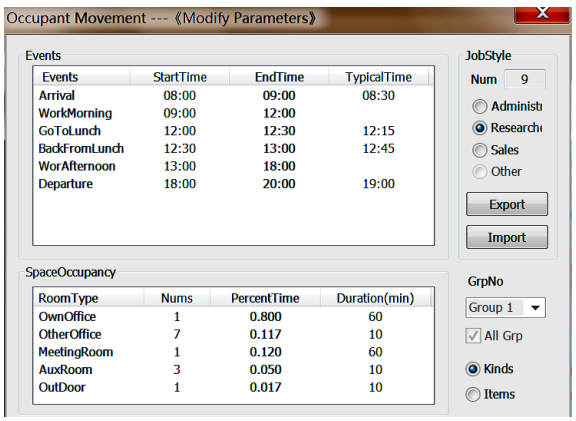


Figure 3: Inputs of movement module

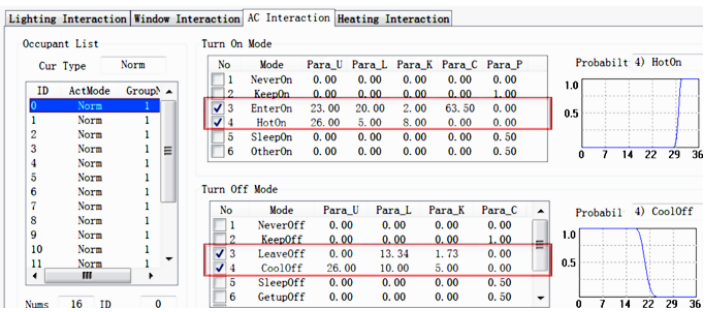


Figure 4: Inputs of action module

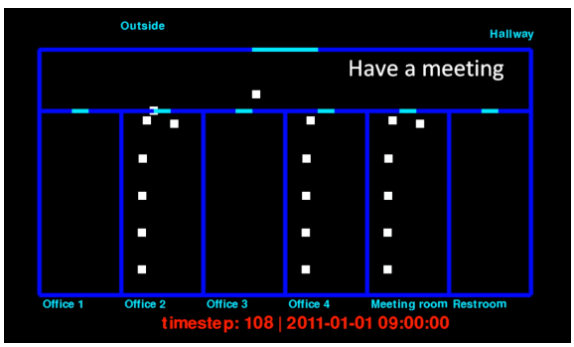


Figure 5: Outputs of movement module

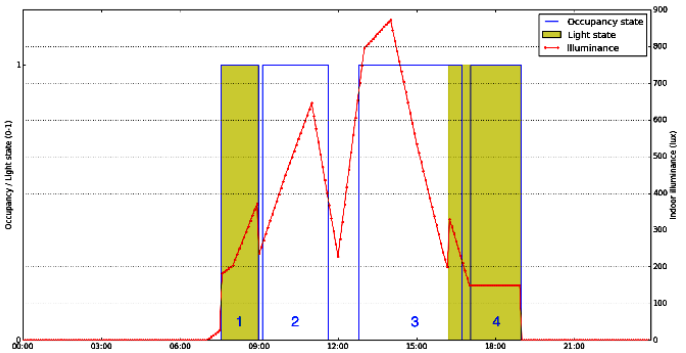


Figure 6: Outputs of action module

It is intended to be an independent sharing tool that supports co-simulation with most whole-year energy simulation programs, such as DeST, EnergyPlus, etc. For more information, please contact **wangchuang02@mails.tsinghua.edu.cn**. ■

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 ibpsaNEWS, 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/?page_id=29.

IBPSA-Australasia

Special Interest Evenings

Two special interest evenings — short seminars held at the end of a working day — have been held this year. The intent of these seminars is to get more people in the building performance simulation industry talking to one another and discussing hot topics.

The first took place in Melbourne on 10 February 2015. This session was focussed around computational fluid dynamics, or CFD, in the built environment, and hosted three guest speakers: Nicki Parker (IBPSA Australasia Vice President) from AECOM, Jason Gaekwad, formerly of Aurecon, and Andrew Ooi from the University of Melbourne. The presentations varied from performance in data centres to computational wind engineering and complex physics in double skin facades. Over 20 people participated, and several signed up for membership.

The second event was held in Sydney on 14 July, and focussed on energy modelling. Three speakers presented: Dr Paul Bannister (IBPSA Australasia President) of Energy Action, who spoke on supply air temperature control optimisation for VAV systems; Quentin Jackson (IBPSA Australasia Affiliate Rep) of Aurecon, who presented on early stage use of simulation in design processes; and Trevor Lee of Exemplary Systems, who presented on weather data and the use of weather data in the simulation driven calibration of monitoring and targeting of building performance. There were around 40 attendees, including members and non-members.

There was great feedback from both events and a big appetite for similar events in the future. Copies of the presentation can be found on the IBPSA Australasia website, **http://ibpsa-australasia.org**. The Sydney event was filmed and it is intended that the video will be available from the website once edited.

Activities for the next 12 months

IBPSA Australasia held its AGM in Sydney on 13 August 2015, and aside from the usual administrative matters, most discussion was focussed on the activities schedule for the next 12 months. Key activities agreed on included:

- Seminars similar to those presented recently, to be held in Sydney, Melbourne, Brisbane and Wellington
- Possible national conference in 2017
- Development of a training program for simulators

Overall, it has been a very successful 12 months for IBPSA-Australasia thanks to the efforts of the Board members (Paul Bannister, Nicki Parker, Quentin Jackson and Kazi Hossain) and the contributions of the general membership and speakers at the events held so far. ■

IBPSA-China

Seminar on Annex 66 and Occupant Behavior in Buildings

The 2nd Chinese Seminar on Annex 66 and Occupant Behavior in Buildings was held in Beijing University of Technology on 15 January 2015.

Occupant behavior modeling is one of the current research foci in the building energy simulation field, and IEA's EBC Annex 66 aims to do research on the standard definition, simulation methodologies and application of occupant behavior.

About 20 researchers from 6 universities in China attended the seminar. Participants presented their research related to occupant behavior, and specific tasks were discussed in order to promote collaboration among institutes.

Academic visit of IBPSA former president

In January 2015, the former president of IBPSA, Professor Jan Hensen, visited Tsinghua University in Beijing for a three-day academic exchange. On 12 January Prof Hensen gave a lecture on *Building energy performance simulation: challenges and opportunities*. On the second day, he discussed several topics with Yingxin Zhu, Xudong Yang, Da Yan and other researchers, including the application of occupant behavior simulation in building energy performance, the balance between user comfort and energy consumption, and future prospects for building energy simulation. ■

IBPSA-France

Past events

A two day workshop was organized under the aegis of IBPSA-France and hosted by the French Thermal Science Society's (SFT) annual conference at University of La Rochelle, on 26-27 May 2015. The theme of the first day was the progress of building simulation from district to city level with presentations from architects, urbanists and civil engineers. The second day addressed the questions of coupled heat, air and moisture simulation

applied to buildings with special attention to bio-sourced material applications. All presentations are available on the IBPSA France website at **http://ibpsa.fr** .

Forthcoming events

The SIMUREX scientific school will take place on 26-31 October 2016 at Porticcio, Corsica, France. This will focus on recent developments in simulation in three major themes:

- Users' role in the energy simulation of buildings
- District level building simulation
- Simulation of the environmental performance of buildings.

For more information please visit **http://simurex.ibpsa.fr** .

The next biennial IBPSA France congress will take place on 23-24 May 2016, at Marne la Vallée. The congress will be hosted by CSTB (French Scientific and Technical Centre for Buildings). News and call for papers will soon be posted on the conference website **http://conference2016.ibpsa.fr** . ■

IBPSA-Korea

Kwang-Woo Kim, President, IBPSA-Korea

Symposium on issues and prospects for building energy performance assessors

On 19 March 2015, IBPSA-Korea co-hosted a symposium on issues and prospects for building energy performance assessors, in collaboration with the Korean Institute of Architectural Sustainable Environment and Building Systems (KIAEBS). The symposium included four keynote speeches followed by a panel discussion. The keynotes addressed accelerating the energy retrofit of residential and commercial buildings, Korean green policy support for energy assessors, case studies for building energy performance assessment, and prospects for building energy assessors.

3rd IBPSA Asia conference

IBPSA-Korea is pleased to host the 3rd IBPSA Asia conference (ASIM 2016) on 27-29 November 2016 in Jeju Island, South Korea. The first conference at Tongji University in Shanghai, China and the second conference at Nagoya University in Nagoya, Japan were a major success. Further information is available from the conference website (currently under construction), **www.ibpsa.kr/asim2016**. ■

IBPSA-Switzerland

Achim Geissler

IBPSA-CH held a "Feierabendseminar" (after-work seminar) on 9 June on the topic of building automation and simulation, with two presentations from commercial companies. There was a lively discussion, which led to the conclusion that quite a lot more work is needed in this area in order to optimize planning.

On 9 September IBPSA-CH organised a session focussing on building simulation at CISBAT '15, the international building and urban science conference held this year in Lausanne. The session featured six presentations and seven posters, and was well attended.

IBPSA-CH is proud to announce that this year's international student energy modelling competition has been won by two Swiss teams, one from ETH Zurich's new Integrated building systems Master's course *Whole building simulation*, and the other from the Lucerne University of Applied Sciences. The competition aims to provide a competitive forum for students within the building simulation community. This year's topic was to design a sustainable office building in New Delhi with a mixed-mode ventilation strategy and optimize the design of the building using building performance simulation. The prize will be awarded at BS 2015 in Hyderabad in December 2015. We congratulate the winners! For more information on the competition see **http://bs2015.in/modelling_competition.php**.

On 3 August the IBPSA-CH web site (**www.ibpsa.ch**) introduced a new membership policy such that one or two members of the board now review each application prior to acceptance. This change was necessary as a prerequisite for members to feel safer in sharing information via the members' area of the site. Group forums have also been added to the members' area, and the membership has been reviewed; this led to a reduction in membership, which is now at slightly over 50 members. We hope that this number will increase again in the near future. ■

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See the IBPSA Central web site at http://www.ibpsa.org/?page_id=29 for details of affiliate websites and contacts. Affiliate representatives are voting members of the IBPSA Board of Directors except where shown.

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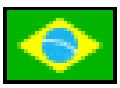

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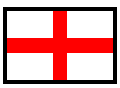

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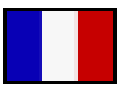

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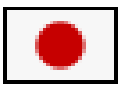

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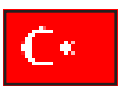

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For additional information about IBPSA, please visit the Association's web site at **www.ibpsa.org**. For information on joining, contact your nearest regional affiliate.

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. ■

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