

## Inside:

- Major features on predicting the hygrothermal environment in buildings and district level energy management
- Reports on events held earlier this year by IBPSA Canada and IBPSA Netherlands + Flanders, and information on 7 forthcoming events
- Two new IBPSA Affiliates
- ... plus information about other publications and IBPSA activities



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The International Building Performance Simulation Association (IBPSA) exists to advance and promote the science of building performance simulation in order to improve the design, construction, operation and maintenance of new and existing buildings worldwide.

> President Jan Hensen Eindhoven University of Technology, Netherlands j.hensen@tue.nl

Vice-President - Conference Liaison Ian Beausoleil-Morrison Natural Resources Canada, Canada ibeausol@nrcan.gc.ca

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Membership Development Officer Jonathan Wright Loughborough University, UK j.a.wright@lboro.ac.uk

## President's message

IBPSA Members and Friends,

elcome to this issue of IBPSA News, packed with - we hope - interesting news about ongoing and planned activities in and by our Society.

IBPSA comprises members and affiliates. You can read about the privileges and obligations of both on page 11. The essence is that we are in this together. All members are encouraged and entitled to take part in the activities of IBPSA.

We are in the lucky situation that we have many very active individuals amongst our, now more than 2000, members worldwide. You will be able to read about the various activities which take place in the, now 16, regional affiliate organizations. We are happy that recently IBPSA England and IBPSA Switzerland have been established, and that there are proposals for IBPSA affiliate organizations being discussed in another 10 regions. We also benefit from a very enthusiastic and pro-active board. On pages 5 and 6 you can see the current officers, members-at-large and regional affiliate representatives which together make up the board. By the way, all of the work they perform is on a voluntary basis. Thank you all!!

Early September was the annual board meeting; this time hosted by Jonathan Wright and Loughborough University in the UK. We discussed how we divide the board tasks amongst us. (See page 5). Some of the roles may need some explanation. For example, the Membership Development Officer (Jonathan Wright) is concerned with attracting new "sustaining" members, and developing guidelines for general membership benefits. The Affiliate Development Officer (Karel Kabele) focuses on potential new regional affiliate organizations, while the Regional Affiliate Liaison (Drury Crawley) liaises with existing affiliate organizations. You can also read on page 4 that we now have various sub-committees, for example the IBPSA awards and the website. If you would like to get involved, or have any comments, suggestions or ideas, please don't hesitate to contact anyone of us.

There was strong competition for the 2007 IBPSA awards. We plan to announce these in the next issue of IBPSA News and to formally present the awards at Building Simulation 2007. Speaking of awards, the board also made a special recognition award to Jeff Spitler for his outstanding service as President of IBPSA for the last four years. Thanks again, Jeff, for a job well done!

Building Simulation 2007 is shaping up very nicely indeed. The board was impressed by the presentation from the organizers at the board meeting. Initial feedback based on abstract submissions is that there is a lot of interest. Don't miss it! (See www.bs2007.org.cn.)

The board has also decided on the location for Building Simulation 2009. It is going to be held in Glasgow, Scotland. More information will follow in future issues of IBPSA News.

#### President's message



We are starting to look further ahead. If you are interested in hosting Building Simulation 2011 or an international IBPSA conference further in the future, don't hesitate to contact our Conference Location Coordinator, Jeff Spitler.

Apart from a lot of news, this Newsletter contains two scientific articles. Both are about topics which are recently gaining more interest. The first is about heat, air and moisture transfer modeling by Ozaki and Tsujimaru. The second article by Yamaguchi et al. concerns energy modeling on a district level scale.

Finally, I would like to thank all contributors and especially our Newsletter chairman Larry Degelman, and producer Marion Bartholomew for a fantastic job!

Best wishes,

Jan Mensen

Images from the Board Meeting



The diligent board members at work



Past-President Spitler receives his Outstanding Service award from President Jan Hensen



A quirky corner of old Loughborough ... and the new solar-screened Civil & Building Engineering building



## **IBPSA Central contacts**

## Membership Services and Publications

For proceedings of past conferences: Jeff Haberl (IBPSA Membership Services Officer) Texas A&M University, USA Email: jhaberl@esl.tamu.edu

#### **Newsletter Submissions**

To submit Newsletter articles and announcements: Larry Degelman (Newsletter Chair) Texas A&M University, USA Email: larry@taz.tamu.edu

### **Newsletter Editor**

Marion Bartholomew DBA, UK Email: mb@dba-insight.co.uk

### **IBPSA Building Simulation conferences**

For information about IBPSA Building Simulation conferences: Ian Beausoleil-Morrison (Conference Liaison) Natural Resources Canada, Canada Email: ibeausol@nrcan.gc.ca

### IBPSA Website (www.ibpsa.org)

For full information about IBPSA activities and organisation: Fernando Simon Westphal IBPSA-Brazil Email: fernando@labeee.ufsc.br

#### Long-range conference planning

For potential future conference hosting: Jeffrey Spitler (Conference Location Coordinator) Oklahoma State University, USA Email: spitler@okstate.edu

### Honors and Awards sub-committee

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

### Web sub-committee

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

To register yourself on the IBPSA mailing list go to the IBPSA home page www.ibpsa.org and click on Mailing Lists for instructions, or go directly to www.ibpsa.org/m\_lists.asp. For additional information about IBPSA, visit:

- About IBPSA: www.ibpsa.org/m\_about.asp
- Conferences and papers online: www.ibpsa.org/m\_events.asp
- Regional affiliate web sites and contact persons: www.ibpsa.org/m\_affiliates.asp
- Downloads/links: www.ibpsa.org/m\_downloads.asp

For information on joining IBPSA please contact your nearest regional affiliate.



## **IBPSA Board of Directors**

## **Elected Officers and Affiliate Representatives**

#### President

Jan Hensen Technische Universiteit Eindhoven, Netherlands Email: j.hensen@tue.nl

#### **Vice-President**

Conference Liaison Ian Beausoleil-Morrison Natural Resources Canada, Canada Email: ibeausol@nrcan.gc.ca

#### Secretary

Regional Affiliate Liaison Drury Crawley (U.S. Department of Energy, USA) -Email: drury.crawley@ee.doe.gov

#### **Treasurer**

Charles "Chip" Barnaby (Wrightsoft Corporation, USA) Email: cbarnaby@wrightsoft.com

#### **Immediate Past President**

Conference location coordinator Jeffrey Spitler (Oklahoma State University, USA) Email: spitler@okstate.edu

### Member-at-large

Newsletter Chairperson Larry Degelman (Texas A&M University, USA) Email: ldegelman@cox.net

### Member-at-large

Affiliate Development Officer Karel Kabele (Czech Technical Univ. in Prague, Czech Republic) Email: kabele@fsv.cvut.cz

## **Member-at-large** Website Editor

Roberto Lamberts (Universidade Federal de Santa Catarina, Brazil) Email: lamberts@ecv.ufsc.br

#### Member-at-large

Membership Development Officer Jonathan Wright (Loughborough University, UK) Email: j.a.wright@lboro.ac.uk

### **IBPSA-Australasia Representative**

Veronica Soebarto (Department of Architecture, The University of Adelaide, Australia) Email: veronica.soebarto@adelaide.edu.au

### **IBPSA-Brazil Representative**

Nathan Mendes (Laboratório de Sistemas Térmicos, Pontifícia Universidade Católica do Paraná, Curitiba, Brazil) Email: nathan.mendes@pucpr.br

### **IBPSA-Canada Representative**

Ian Beausoleil-Morrison (Natural Resources Canada, Canada) Email: ibeausol@nrcan.gc.ca

### **IBPSA-China Representative**

Da Yan (School of Architecture, Tsinghua University, Beijing, China) Email: yanda@tsinghua.edu.cn

### **IBPSA-Czech Republic Representative**

Frantisek Drkal (Dep. of Environmental Engineering, Czech Technical University in Prague, Czech Republic) Email: drkal@fsid.cvut.cz

(continued on next page)



## **IBPSA Board of Directors (continued)**

#### **IBPSA-England Representative**

Ian Ward (School of Architecture, University of Sheffield, UK) Email: i.ward@sheffield.ac.uk

#### **IBPSA-France Representative**

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#### **IBPSA-Japan Representative**

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### IBPSA-Nederland+Vlaanderen Representative:

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### **IBPSA-Scotland Representative**

Lori McElroy (The Lighthouse Trust, Glasgow, UK) Email: lori.mcelroy@thelighthouse.co.uk

### **IBPSA-Slovakia Representative**

Jozef Hraska (Zlovak University of Technology, Bratislava, Slovak Republic) Email: hraska@svf.stuba.sk

#### **IBPSA-Switzerland Representative**

Gerhard Zweifel (ZIG, Horw, Switzerland) Email: gzweifel@hta.fhz.ch

#### **IBPSA-USA** Representative

Chip Barnaby (Wrightsoft Corp., Lexington, MA, USA) Email: cbarnaby@wrightsoft.com

### Past Presidents of IBPSA:

1987-1991 (5 years) Ed Sowell, USA 1992-1993 (2 years) Dan Seth, Canada 1994-1997 (4 years) Joe Clarke, Scotland 1998-1999 (2 years) Larry Degelman, USA 2000-2001 (2 years) Roger Pelletret, France 2002-2005 (4 years) Jeff Spitler, USA



Sustaining members of IBPSA are those individuals or organizations that provide financial support to IBPSA at the level of US\$500 or more per year. To learn about sustaining membership, please contact one of the IBPSA officers shown in this newsletter.

## **IBPSA Sustaining Members**





# **IBPSA England formed**

After a process that started during the BS'05 Conference in Montreal IBPSA now has an English Affiliate Region. Following a number of informal meetings an initial Board was set up and a Charter was drafted. A formal application to set up IBPSA-England was submitted to the IBPSA World Board in May, with approval being given in August. Like other regional affiliates IBPSA-England's objective is to provide a forum for the exchange of information between researchers, developers and practitioners operating in the area of building performance simulation and related issues.

IBPSA-England was formally launched with a one-day event on Wednesday September 13th at the University of Sheffield. Keynotes were given by Jeff Spitler, past-president of IBPSA, LoriMcElroy of IBPSA Scotland, and Jake Hacker plus Martin Mayfield of Ove Arup, providing an industry view. This was followed by an animated discussion on the future of the fledgling organisation.

Two events are currently in preparation:

- 6 March 2007: Symposium on 'Good practice in building performance simulation', to be held at De Montfort University in Leicester.
- 16 November 2007: Symposium on 'Building Simulation in the South West', to be held at the University of Plymouth.

For the most recent information on IBPSA-England, events, or to register as a member, please visit our website at www.ibpsa-england.org.

Ian Ward, Chair and Affiliate Representative Malcolm Cook, Vice-Chair and 2nd Affiliate Representative Pieter de Wilde, Secretary Jonathan Wright, Board Member Martin Mayfield, Board Member Mike Davies, Board Member Dejan Mumovic, Board Member Simon Rees, Board Member

INTERNATIONAL BUILDING PERFORMANCE SIMULATION ASSOCIATION



## **IBPSA Switzerland formed**

IBPSA Switzerland, abbreviated IBPSA-CH, was officially founded on 1 September 2006 at a meeting held in the School of Engineering and Architecture at the University of Applied Sciences of Central Switzerland in Horw. 20 people attended this first constituting general assembly of the association.

The meeting was preceded by a variety of preparatory work carried out by a team of 6 board members, including writing by-laws, translating them into 3 languages, collecting addresses of potential members, and creating a web site at www.ibpsa.ch in 4 languages (German, English, French and Italian).

IBPSA-CH is a spin-off from brenet, an existing network of Swiss universities and research institutes, which has undertaken to give the association financial and infrastructure support for an initial phase of about 5 years. The majority of the board, including the president and vice president, are brenet member representatives.

Membership is free and includes individual and corporate members. It is expected that the number of registered members will grow towards 50.

Proposed activities include:

- Region-specific workshops to introduce simulation into practice
- (Inter)national conferences to progress development and application of simulation, or dedicated sessions at established conferences
- Software-specific training workshops
- Publishing an IBPSA-CH newsletter
- Maintaining the IBPSA-CH web site to be an evolving resource on:
  - IBPSA-CH events
  - IBPSA-CH documents (eg newsletters)
  - Members / consultants database (should they wish to be identified)
  - Software availability
  - Updated news items

The list will evolve. It is also proposed to establish a research group to strengthen the simulation community's standing with funding bodies.

IBPSA-CH's first event, to be held this autumn, will be a series of half-day presentations at which three software tools for assessing building sustainability will be presented:

Ecobat (http://ecobat.heig-vd.ch): This performs a detailed environmental impact assessment of building construction materials based on a life cycle approach and has a user-friendly GUI



- Ecoentreprise (www.ecoentreprise.ch): A web-based tool for the sustainable management of public and private companies.
- E-Green (www.green-e.ch): Evaluates the environmental impacts of a company including building energy consumption, mobility, product and services, wastes, etc.

These presentations are free and are open to all practitioners from the building industry, including planners, architects and engineers.

IBPSA-CH's board members are:

Gerhard Zweifel, UAS Central Switzerland, Horw, President Stéphane Citherlet, UAS Western Switzerland, Yverdon-les-Bains, Vice president Thomas Afjei, UAS Northwestern Switzerland, Muttenz Daniel Pahud, UAS Southern Switzerland, Canobbio Darren Robinson, Federal Institute of Technology, Lausanne Alois Schälin, AFC Air Flow Consulting, Zuerich



# 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.

## Forthcoming events calendar

Date(s)	Event	Information
2006		
Autumn 2006 (3 half- days, dates tba)	IBPSA Switzerland presentations on software for assessing building sustainability	www.ibpsa.ch
23-25 October 2006	ESM 2006, Toulouse, France	www.eurosis.org
20-21 November 2006	IBPSA Australasia 2006 conference, Adelaide, Australia	www.adelaide.edu.au/ ibpsa2006
22-25 November 2006	<b>ANZAScA annual conference</b> , Adelaide, Australia	www.adelaide.edu.au/ anzasca2006
2007		
6 March 2007	IBPSA England symposium on good practice in building performance simulation, Leicester, UK	www.ibpsa-england.org
10-14 June 2007	Clima 2007, Helsinki, Finland	www.clima2007.org
13-15 June 2007	Roomvent 2007, Helsinki, Finland	www.roomvent2007.org
3-6 September 2007	Building Simulation 2007, Beijing, China	www.bs2007.org.cn
5-7 September 2007	ECOSUD 2007, Coimbra, Portugal	www.wessex.ac.uk/ conferences/2007/ eco2007/1.html
16 November 2007	<b>IBPSA England symposium</b> on building simulation in the South- West, Plymouth, UK	www.ibpsa-england.org

## 23-25 October 2006 Toulouse, France www.eurosis.org

ESM

## ESM 2006 European Simulation and Modelling Conference 2006 EUROSIS

The European Simulation and Modelling Conference is the original European international conference concerned with state of the art technology in modelling and simulation. ESM 2006 aims to provide an overview of academic research in the field of computer simulation. It is sponsored by the European Technology Institute and hosted by LAAS-CNRS (www.laas.fr).

A number of major tracks of simulation research are presented next to specific workshops, which capture the art and science of present-day simulation research.

#### Forthcoming events

ESM 2006 conference themes include:

- Methodology and Tools
- Simulation and AI
- High Performance and Large Scale Computing
- Simulation in Education and Graphics Visualization Simulation
- Simulation in the Environment, Ecology, Biology and Medicine
- Analytical and Numerical Modelling Techniques
- Web Based Simulation
- Agent Based Simulation

For the latest information, visit http://biomath.ugent.be/~eurosis/conf/esm/esm2006/ or www.eurosis.org.

## 20-21 November 2006 Adelaide, South Australia www.adelaide.edu. au/ibpsa2006

IBPSA Australasia

### **IBPSA Australasia 2006 conference**

IBPSA Australasia and The School of Architecture, Landscape Architecture and Urban Design, The University of Adelaide, will hold the IBPSA Australasia 2006 Conference, at The University of Adelaide, South Australia, November 20-21, 2006. The Conference theme is 'Investigating the roles and challenges of building performance simulation in achieving a sustainable built environment' and the conference invites researchers, academics, and practitioners to participate and present their work in addressing the conference theme. More information and registration are available from www.adelaide.edu.au/ibpsa2006.

The University of Adelaide will also host a second conference, the 40th Annual ANZAScA conference immediately afterwards.

22-25 November 2006 Adelaide, South Australia www.adelaide.edu. au/anzasca2006



#### 40th Annual ANZAScA conference

The School of Architecture, Landscape Architecture and Urban Design, together with the Architectural Science Association ANZAScA, will also hold the 40th Annual ANZAScA Conference at The University of Adelaide on 22-25 November, following the IBPSA Australasia Conference. For more information visit www.adelaide.edu.au/anzasca2006.

10-14 June 2007 Helsinki, Finland www.clima2007.org



## Clima 2007 - WellBeing Indoors - the 9th REHVA World Congress

The 9th REHVA World Congress will offer scientists, industry, building owners, end users, consultants, engineers, architects and policy-makers a platform for the exchange of scientific knowledge and technical solutions. The leading international scientific congress in the HVAC area in year 2007, it is being organised jointly by the Finnish Association of HVAC Societies (FINVAC), Finnish Association of Mechanical Building Services Industries (FAMBSI), Finnish Society of Indoor Air Quality and Climate (FiSIAQ) and Helsinki University of Technology (HUT).

The special congress theme is wellbeing of people indoors. The congress will cover all aspects of HVAC technology including building automation in all types of buildings.

The WellBeing Indoors – Clima 2007 congress and web service open a global window to the scientific knowledge and innovative applications of building services. The focus is on improving wellbeing in buildings in a sustainable manner by applying the latest research results and technical innovations into practice.

#### **THEMES AND SCOPE**

The scope of the Congress is HVAC and its applications in creating wellbeing in indoor environments in an environmentally sustainable manner. The conference themes are:

#### Healthy and productive indoor climate

- Energy performance of ventilation
- Modern ventilation technologies
- Maintenance and operation of ventilation systems
- Indoor environment, performance and productivity
- Natural and hybrid ventilation systems
- Developments in regulations and voluntary schemes
- Ventilation technology for special environments

#### Sustainable energy use of buildings

- Sustainable energy systems
  - Energy performance of buildings and HVAC systems
  - Commissioning for better performance of buildings
  - Life-cycle building services (ESCO etc.)
  - Refrigeration and cooling systems
  - Renewable energy sources

#### Intelligent building management

- Building automation and energy performance
- Maximum benefit of building automation systems
- Computer based methods for design, construction and maintenance
- Open building automation systems
- Sensors and methods to control and authenticate indoor environment











#### Comfort and safety by modern piping systems

- Energy efficient heating and cooling systems
- Energy efficient structures
- Water safety by modern piping technology
- Water and waste conservation methods and technologies
- Sprinkler systems and fire safety in homes

#### **CALL FOR PAPERS AND SUBMISSION DEADLINES**

Abstracts submission deadline: 15 October 2006 Full paper submission deadline: 15 March 2007

The full list of topics and subtopics, as well as instructions for abstract submissions (max 300 words), are available at www.clima2007.org.

For further information, contact us via email at info@clima2007.org or by post at FINVAC, Sitratori 5, FIN-00420 Helsinki, Finland.

### Roomvent 2007

13-15 June 2007 Helsinki, Finland www.roomvent2007.org



Climate (FiSIAQ) and Helsinki University of Technology (HUT). The special congress theme is air distribution and control techniques for productive room environments. The conference will cover all aspects of room airconditioning

the Finnish Association of HVAC Societies (FINVAC), Finnish Association of Mechanical Building Services Industries (FAMBSI), Finnish Society of Indoor Air Quality and

The10th Roomvent Conference on Air Distribution in Rooms will offer scientists, industry, consultants, engineers, architects and policy-makers a platform for the exchange of scientific knowledge and technical solutions. Roomvent 2007, the leading event in the area of air distribution in rooms, is a SCANVAC event being organised by

The Roomvent 2007 conference and web service open a global window to the scientific knowledge and innovative applications of room air-conditioning. The focus is on air distribution and control techniques for productive room environments.

#### **THEMES AND SCOPE**

#### Human to room environment interaction

technology in all types of buildings.

- Thermal environment
- Contaminant distribution in rooms
- Acoustical and visual environment Room environment and productivity

#### Forthcoming events







Plenary lecture: Human interaction with indoor climate – scientific background for comfort criteria

#### **Design of room environment**

- Target and design values in specific applications
- Room air conditioning, ventilation and cooling
- Design methods
- Modelling and visualisation
- Validation of designs

Plenary lecture: CFD in design - where are we today?

#### **Control techniques**

- Air diffusion: jets, plumes, terminal devices
- Zonal control techniques
- Demand based control techniques
- Sensors and control devices

#### Plenary lecture: Room air conditioning and control strategies

#### Assessment of room environmental quality

- Commissioning and inspection
- Measurement techniques
- Case studies

Plenary lecture: Assessment of Indoor Climate

#### **CALL FOR PAPERS AND SUBMISSION DEADLINES**

Abstracts submission deadline: 15 October 2006 Full paper submission deadline: 15 March 2007

For further information, contact the organisers via email at info@roomvent2007.org or by post at FINVAC, Sitratori 5, FIN-00420 Helsinki, Finland.

### 3-6 September 2007 Beijing, China www.bs2007.org.cn



### Building Simulation 2007 IBPSA

Building simulation has the potential to improve the design and operation of buildings. Computer simulation can be used to predict future performance at all stages of the building life cycle: design, commissioning, operation and management. The next bi-annual IBPSA (International Building Performance Simulation Association) Building Simulation Conference and Exhibition is Building Simulation 2007, to be held from September 3 to 6, 2007 in Beijing, China. The abstract deadline has passed in September 2006, but further information about the Conference can still be found at the conference website www.bs2007.org.cn.

Additional details may be available from: The Building Simulation 2007 Conference Committee Department of Building Science School of Architecture Tsinghua University Beijing 100084 P. R. China

 Tel:
 86-10-6278-9761

 Fax:
 86-10-6277-0544

 Email:
 bs07@tsinghua.edu.cn

## 5-7 September 2007 Coimbra, Portugal www.wessex.ac.uk/ conferences/2007/ eco2007/1.html



## **ECOSUD 2007**

ECOSUD 2007 is the Sixth International Conference in the well-established series on Ecosystems and Sustainable Development. Organised by the Wessex Institute of Technology, UK, the University of Coimbra, Portugal and the University of Siena, Italy in collaboration with the International Journal of Ecodynamics, the meetings provide a unique forum for the presentation and discussion of recent work on different aspects of ecosystems and sustainable development, including physical sciences and modeling.

The aim of the conference is to encourage and facilitate the interdisciplinary communication between scientists, engineers and professionals working in ecological systems and sustainable development. Emphasis will be given to those areas that will most benefit from the application of scientific methods for sustainable development, including the conservation of natural systems around the world.

Previous ECOSUD conferences have been held in Peniscola, Spain (1997), Lemnos, Greece (1999), Alicante, Spain (2001), Siena, Italy (2003) and Cadiz, Spain (2005).

#### TOPICS

- Thermodynamics and ecology
- Sustainability indicators
- Mathematical and system modeling
- Ecosystems modeling
- Biodiversity
- Sustainability development studies
- Conservation and management of ecological areas
- Socio-Economic factors
- Energy conservation and generation
- Environmental and ecological policies
- Environmental management
- Environmental risk
- Natural resources management
- Recovery of damaged areas
- Biological aspects
- Complexity
- Remote sensing
- Landscapes and forestation issues
- Soil and agricultural issues
- Water resources
- Sustainable waste management
- Air pollution and its effects on ecosystems

Full details are available from the conference website at www.wessex.ac.uk/ conferences/2007/eco2007/1.html.

#### CALL FOR PAPERS AND SUBMISSION DEADLINES

Abstracts submission deadline: as soon as possible Full paper submission deadline: 3 May 2007

Abstracts can be submitted via the conference website at www.wessex.ac.uk/ conferences/2007/eco2007/1.html or by email or fax to Zoey Bluff, Conference Secretariat, email zbluff@wessex.ac.uk, fax + 44 (0) 238 029 2853.

## Software news



## **Building Energy Tools Directory**

Dru Crawley, DOE

The web-based Building Energy Tools Directory at www.energytoolsdirectory.gov contains information on more than 330 building-related software tools from more than 20 countries around the world. Haven't visited lately? Recent additions include Energy Profiler for Commercial Buildings, Commodity Server, Degree Day Forecasts, Energy Usage Forecasts, eDNA, EffTrack, Degree Day Reports, and DesignBuilder.

For each tool in the directory, a short description is provided along with information about technical expertise required, users, audience, input, output, validation, computer platforms, programming language, strengths, weaknesses, technical contact, availability and cost. A link is also provided for directly translating the web pages into more than 8 languages.

If you know of a tool (yours?) that isn't in the directory, send the information shown here: www.energytoolsdirectory.gov/submit.cfm in an email message to Dru Crawley at Drury.Crawley@ee.doe.gov.

## EnergyPlus version 1.4 to be available in October 2006

Dru Crawley, DOE

The next release of the EnergyPlus building energy simulation program, Version 1.4, became available in early October. In addition to many new features, we have updated and extended capabilities throughout the existing building envelope, daylighting, and HVAC equipment and systems portions of the program. The new features include:

#### INPUT

New dataset with performance curves for 162 chillers

#### GEOMETRY/WINDOW/WALLS/SHADING

- More accurate modeling of exterior window screens (Material:WindowScreen)
- Window or door multipliers now allowed in AirFlowNetwork components
- Multipliers on doors and glass doors allowed
- Triangular doors and glass doors now allowed



### **ZONE MODEL**

- New Zone thermostatic control options:
  - Operative Temperature using mix of mean radiant and air temperatures
  - Thermal comfort control using Fanger PMV values as setpoints
- New root finder module significantly increases speed of air loop simulation

#### NATURAL AND MECHANICAL AIR DISTRIBUTION

- New ventilation flow report variables for individual zones
- Interior surface ventilation control can be based on adjacent zone conditions (temperature or enthalpy)

#### HVAC

- New SERIESACTIVE component control type provides improved temperature set point control
- New simple duct leakage model simulates energy impact of supply duct leaks in a VAV system with return plenum and constant static pressure setpoint
- New reformulated version of the DOE 2.1E EIR chiller
- New HVAC system type for Changeover-bypass VAV systems

#### WATER MANAGER (NEW!)

- New water manager to control and report water use throughout the building
- Update of existing HVAC components to calculate and report water consumption or condensate production
- Generalized water end-use objects that allow hot and cold water mixing at the tap, zone latent gains, drainwater heat recovery, and stand-alone or plant loop operation
- Rainwater collectors for harvesting precipitation
- Groundwater wells with pumping
- Water storage tanks for storing and reusing reclaimed water to/from end-uses, HVAC components, rainwater collectors, and groundwater wells

#### **OUTPUT**

- New predefined reports to aid in complying with standards and beyond-code programs such as the new high performance commercial building tax deduction:
  - Input Verification and Results Summary
  - Climate Summary
  - Equipment Summary
  - Envelope Summary

#### UTILITIES

- EP-Launch has new options to support:
  - Converting report variable and meter results to IP units
  - Options centralized in a new Options dialog box
  - Supports new output files including SCREEN, SHD and VRML

#### **DOCUMENTATION AND GUIDES**

- Input/Output Reference and Engineering Reference updated and extended for all new features and updates. Total documentation exceeds 3000 pages.
- And many other enhancements and speed improvements throughout.

More information on these and other new features in this version is available on the EnergyPlus web site, **www.energyplus.gov**.

## Results of the California CEUS (Commercial End-Use Survey)

The California Commercial End-Use Survey (CEUS) project was a massive effort initiated by the California Energy Commission (CEC) to gain detailed knowledge of end-use energy use in commercial buildings in California. The study was implemented by Itron with major support provided by KEMA, ADM Associates, and James J. Hirsch & Assoc. Anticipated applications of the study results were energy forecasting, benchmarking, energy efficiency potential, and quick-response special focused studies and analysis. California's four investor-owned utilities and one large municipal utility participated in the study. The basic approach of the CEUS project was:

- Collect detailed building shell, equipment, and operation information via an onsite survey for 2,790 commercial premises across the state.
- Use that data and an automated system designed by Itron (DrCEUS) to create detailed end-use building simulation models (eQUEST/DOE2.2), and calibrate those models using all available information including monthly billed electric and natural gas consumption, time-of-use logger data for lighting and HVAC fans, and interval metered data.
- Use utility billing data to construct a population frame from which a statistisically valid sample of premises could be drawn, and which could be used to develop representative weights for each surveyed premise.
- Construct segment-level results by aggregating the weighted premise-level results, and make those results available for the various applications.

Results of the study are presented for the four utility service areas and twelve conventional building types: Small Office, Large Office, Restaurant, Retail, Food/ Liquor, Unrefrigerated Warehouse, Refrigerated Warehouse, School, College, Health Care, Lodging (Hotel/Motel), and Miscellaneous. Electric and natural gas energy intensities, end-use intensities, and fuel shares are presented for three HVAC end uses (cooling, heating, ventilation) and 10 nonHVAC end uses (inside lighting, outside lighting, water heating, office, refrigeration, cooking, process, motors, air compressors, miscellaneous). Although premise-level data from the study is not publicly available, the CEUS report and appendices can be downloaded from the CEC website, www. energy.ca.gov/ceus/index.html. Additional information about the study can be obtained by contacting Tom Mayer (tom.mayer@itron.com) or Bob Ramirez (bob. ramirez@itron.com).



## **REHVA Guidebooks**

REHVA, founded in 1963, is a European organization, connecting European professionals in the area of Building Engineering Services. REHVA represents more than 110,000 building engineers from 30 European countries. Its mission is to develop and disseminate economical, energy efficient and healthy technology for mechanical services of building; to serve its members and the field of building engineering (heating, ventilating and air-conditioning).

REHVA has published a number of guidebooks, described below.

1: Displacement Ventilation in Non-Industrial Premises Håkon Skistad (ed) Elisabeth Mundt Peter V. Nielsen Kim Hagström Jorma Railio



Research, development and use of displacement ventilation, mainly confined to Scandinavian countries, is now gaining popularity in other countries as well.

The guidebook serves as a comprehensive and easy-to-understand design manual. The book explains the benefits and limitations of displacement in commercial ventilation and outlines where ventilation should be applied. Case studies for a restaurant, office cubicle, auditorium, meeting room and classroom are included. With displacement ventilation, warm contaminants rise to the ceiling, the contaminated air is extracted and fresh, cool

Principle of displacement ventilation



The air floats along the floor like water and fills the room from below

air is supplied at floor level. Displacement ventilation has two main advantages over traditional mixing systems. First, it ensures improved indoor air quality throughout occupied spaces and removes more contaminants at high level than conventional mixing air distribution systems. Second, as an efficient use of energy due to its capability to remove exhaust air from the room at a higher temperature than that in the occupied zone, this strategy allows a higher inlet temperature for the same internal heat gain/load. Benefits are that less cooling is needed for a given temperature in the occupied spaces, longer periods with free cooling and better air quality in the occupied spaces.

The book also points out the limitations of displacement ventilation. The technique is no marvel that can solve all ventilation problems, but a principle that has definite advantages when applied correctly.

### 2: Ventilation Effectiveness

Elisabeth Mundt (ed) Hans Martin Mathisen Peter V. Nielsen Alfred Moser



Ventilation effectiveness is the common notion for the indices used to characterize the ability of a ventilation system to exchange the air in the room and the ability of a ventilation system to remove air-borne contaminants. Improving the ventilation effectiveness allows the indoor air quality to be significantly enhanced without the need for higher air changes in the building, thereby avoiding the higher capital costs and energy consumption associated with increasing the ventilation rates. This guidebook does not only present the practical research on ventilation effectiveness, but also illustrates its application with case studies.

This guidebook is aimed at practising, consulting and contracting engineers. It provides easy-to-understand descriptions of the indices used to measure the performance of a ventilation system and which indices to use in different cases. It also demonstrates how to measure ventilation effectiveness in practice. Use of tracer gases, measurement equipment and how to perform measurement and calculations are introduced. Eight practical case studies are also presented and discussed.



3: Electrostatic Precipitators for Industrial Applications Kjell Porle (ed) Steve L. Francis Keith M. Bradburn



An Electrostatic Precipitator is a device that collects particles from air or flue gas by electrostatic forces. The ESP's discussed in this book are all for industrial processes. Indoor small units for purification of ambient air are not covered. In the early days ESP's were developed for recovery of precious material, e.g. Cu, Ni and Zn. Environmental aspects are however the main focus today. This guidebook is aimed

at the practising, consulting and contracting engineers. It provides basic knowledge of the physics and power supplies of Electrostatic Precipitators (ESP's), practical aspects of ESP design, and examples of typical applications of ESP's. ESP's are characterised by low-pressure drop and very high capture efficiencies and very low power demand. They can be built for operation at high temperatures, 400 °C and above with help of special steel. Today's



environmental legislation requirements are specified as emissions in terms of e.g. mg/Nm<sup>3</sup> of flue gas rather than collecting efficiency. Extremely low emissions can be guaranteed for most ESP applications today. The future will see even lower emission guarantees and for many applications the ESP will remain as an important device for the removal of particulate from flue gases.



A conditioning tower. The height of the tower is approximately 30m.

The ESP is 15m long and 20m wide.

## 4: Ventilation and Smoking Minimizing the exposure to ETS in buildings Håkon Skistad and Ben Bronsema Editors



The topic of this guidebook on ventilation and environmental tobacco smoke is extremely important in respect of indoor air quality, health and energy consumption. REHVA realises that the best protection against environmental tobacco smoke is to ban smoking indoors. But if smoking is allowed indoors, as it is in many countries, ventilation can be effectively used to reduce exposure to environmental tobacco smoke. The purpose of this guidebook is to present the state-of-the-art technology of controlling environmental tobacco smoke indoors. The guidebook



presents the latest ventilation technology and illustrates the use of the technology with several practical examples for application. The book is intended for designers, installers, architects, restaurants and building owner. With its illustrations it is also an excellent textbook for vocational training.







Multi-storey restaurant

## 5: Chilled Beam Application Guidebook

Maija Virta (ed) David Butler Jonas Gräslund Jaap Hogeling Erik Lund Kristiansen Mika Reinikainen Gunnar Svensson



Chilled beam cooling is a relatively new technology that has rapidly spread all over Europe. Its advantages are in low noise generation, low room velocities and flexibility. High temperature level of cooling media also improves the energy efficiency of mechanical cooling and allows longer periods of free cooling. The guidebook presents theory on the principles of chilled beam cooling and illustrates its practical applications. The chilled beam systems are primarily used for cooling and ventilation in spaces, where good indoor environmental quality and individual space control are appreciated and where the internal moisture loads are moderate. Chilled beam systems are dedicated outdoor air systems. They can also be used for heating. Active chilled beams are connected to the ventilation ductwork, high temperature cold water and when desired low temperature hot water system. The main air-handling unit supplies primary air into the various rooms through the chilled beam. Primary air supply induces room air to be recirculated through the heat exchanger of the chilled beam. In order to cool or heat the room either cold (14–17 °C) or warm (30–50 °C) water is cycled through the heat exchanger. Recirculated room air and primary air mix prior to diffusion in the space.

Room temperature is controlled by regulating the water flow rate of the heat exchanger.



**Active Beam** 



Passive Beam



**Chilled Beams in Ceiling** 

## 6: Indoor Climate and Productivity in Offices How to integrate productivity in life-cycle cost analysis of building services

Pawel Wargocki, Olli Seppänen (editors) Johnny Andersson Atze Boerstra Derek Clements-Croome Klaus Fitzner Sten Olaf Hanssen This REHVA guidebook shows for the first time how to quantify the effects of indoor environment on office work, and also how to include these effects in the calculation of building costs. This is a concerted effort of researchers, engineers and practitioners. Such calculations have not been performed previously, as very little data was available on this issue. In recent years more and more information has become available on this topic. This information has been reviewed during the present work to find out whether there is solid scientific evidence that indoor environmental quality affects office work.

The quantitative relationships presented in this guidebook can be used to calculate the costs and benefits of running and operating the building, as illustrated by several examples. One of the aims of these examples is to emphasize that the costs of running the building are much lower than the benefits from improved office work obtained by reducing temperatures or improving of indoor air quality. This is further presented in the guidebook by comparing the typical costs of wages, and typical energy and operation costs.



The main purpose of the guidebook is to increase the awareness of building owners and practitioners to indoor environmental quality and its importance for office work. This is attempted by showing how large profits can be obtained from fairly small investments. Examples on how to convince the client in practice are given.

Additional REHVA guidebooks will be published soon on:

- Low temperature heating
- CFD calculations in ventilation design
- Clean ventilation system

Orders for all Guidebooks can be made on the order form that can be found on the REHVA web site at www.rehva.com.

#### Job opportunities at Lawrence Berkeley National Lab



Lawrence Berkeley National Laboratory (Berkeley Lab) has been a leader in science and engineering research for more than 70 years. Located on a 200 acre site in the hills above the University of California's Berkeley campus, adjacent to the San Francisco Bay, the Lab is managed by the University of California, operating with an annual budget of more than \$500 million and a staff of about 3,800 employees, including more than 500 students. As a University of California employee, you will enjoy a generous benefits

package, including a choice of several health insurance plans, comprehensive dental coverage, generous leave and retirement benefits, and vacation, sick leave and paid holidays.

#### **Building Science Research Positions**

Join one of the leading international building science teams to develop the next generation of simulation tools for design, analysis and operation of low-energy buildings. Tackle the nation's most pressing energy challenges in collaboration with over 200 other building science researchers and their industry partners to help develop and deploy the next generation of high performance, low-energy building solutions.

#### GROUP LEADER, SIMULATION RESEARCH GROUP Computational Staff Scientist/Program Manager III- Job number 017753

#### **Position summary**

This person will lead the research and development activities of the Simulation Research Group (SRG) within the Building Technologies Department (BTD) of the Environmental Energy Technologies Division (EETD). This building science modeling group is developer or co-developer of several widely-used building energy analysis software tools, including EnergyPlus, DOE-2, SPARK, and GenOpt. This is an opportunity to help define and implement the next generation of advanced energy simulation tools designed to enhance the design and operation of energy efficient buildings. This position will be filled as either a Staff Scientist or a Program Manager.

#### Qualifications

Essential – Advanced degree or equivalent experience in computational science, engineering, architectural engineering or related building science field. Three or more years experience in developing mathematical models for state of the art building energy simulation models, preferably in the HVAC area, and implementing these models in computer code. Demonstrated experience with management of successful software development efforts, including quality assurance and documentation of computer code for building energy analysis. Strong working knowledge of one or more programming languages, preferably Fortran90 and/or C/C++. Demonstrated ability to effectively manage project teams and to coordinate development with diverse technical partners. Demonstrated financial and administrative skills to manage group budgets and subcontracted efforts. Excellent verbal and written communications and presentation skills.

### BUILDING ENERGY SOFTWARE ENGINEER Research Assoclate Senior - Job number 019314

#### **Position summary**

The Simulation Research Group develops simulation tools to analyze building energy performance. Tools developed include DOE-2, Spark, and Genopt with a current focus on the EnergyPlus program. The successful applicant will join the Simulation Research Group to help develop future versions of EnergyPlus and related software. As part of the EnergyPlus development team this is an opportunity to actively develop new software that will enable the design, analysis, and operation of very low energy buildings. The applicant will be expected to become a skilled EnergyPlus and Spark modeler in support of performance analysis of innovative, low energy building designs and related control strategies. The applicant will be expected to modify, enhance, expand LBNL's current hardware-in-the-loop virtual building simulation setup and develop models for use in model-based fault detection and diagnosis.

#### Qualifications

Essential - Advanced degree or equivalent experience in computational science, engineering, architectural engineering or related building science field. Two or more years of experience in developing mathematical models for state of the art building energy simulation models, preferably in the HVAC area, and implementing these models in computer code. Strong working knowledge of one or more programming languages, preferably Fortran90 and/or C/C++. Demonstrated ability in using either whole building energy analysis programs (such as EnergyPlus, DOE-2, ESP, eQuest) or general nonlinear differential/algebraic solvers (Spark, TRNSYS, EES, HVACSIM+, DASSL). Excellent verbal and written communications and presentation skills. Good working knowledge of at least one of the following: HVAC system design and operation; building controls; building operations.

#### **HOW TO APPLY**

For complete job descriptions and information on how to apply, please visit our jobs website at http://jobs.lbl.gov. Berkeley Lab is an Affirmative Action/Equal Opportunity Employer committed to the development of a diverse workforce. For more information about Berkeley Lab and its programs, visit www.lbl.gov and http://btech.lbl.gov/.

## **News from IBPSA affiliates**



### IBPSA Canada eSim 2006, 4-5 May 2006

eSim 2006 represented the fourth Canadian conference on building performance simulation and was hosted by the Faculty of Architecture, Landscape, and Design located within the downtown campus of the University of Toronto. The conference was held in Toronto, Ontario from May 4 to 5, with pre-conference workshops held at Ryerson University on May 3, 2006. The conference was sponsored by the following organizations: Natural Resources Canada, Canadian Mortgage and Housing, Institute for Research in Construction, the University of Toronto, and Ryerson University.

eSim 2006 brought together 66 researchers and practitioners from government labs, universities, utility companies, and private industry. Most participants were from Canada, but people also travelled from the United States, Britain, Ireland, France, Germany, Portugal, Netherlands, Turkey and Singapore to attend the conference.

The event started with a pre-conference workshop on eQuest, which was attended by 24 participants. The two-day bilingual (English and French) conference featured 32 full-length peer-reviewed technical papers. Invited speakers gave presentations on local, national, and global perspectives on the application of simulation, in addition to past and future trends in building simulation.

eSim conferences are designed to break even financially. A web-based survey, similar to the ones performed following the previous eSim conferences, was conducted to solicit feedback from the delegates. These results are posted on the eSim 2006 web site at www.esim.ca/2006/survey\_form.asp. In general, the responses were quite positive with both the conference and presentations rated as very useful by a vast majority of those who completed the survey. The post-conference survey further indicated that the eSim format is still effective and attractive to those who prefer a more intimate conference format with fewer but higher calibre papers.

Hard copies of the conference abstracts were distributed to delegates with a CD of the full papers. Further, PDF versions of all the papers are freely available from the eSim web site at www.esim.ca. This web site also contains the final conference programme, photographs, and further information about the conference.

## IBPSA Netherlands + Flanders Symposium, 14 September 2006

IBPSA-NVL held an international symposium on the very live topic of Building and Installation simulation in the light of climate change on 14 September at the Technical University of Eindhoven. Organized in conjunction with the Technical University of Eindhoven and TVVL, the Dutch technical association for installations in buildings, the symposium included seven presenters and attracted an interested audience of 80 people.

The theme of the symposium was inspired by a recent CIBSE publication *Climate Change and Indoor Environment: impacts and adaptation*. We were therefore very pleased that Professor Michael Holmes, one of the co-authors of this report, came and elucidated the conclusions. He summarized them into four simple and straightforward key words:

- Switch off relating to internal and external loads
- **Spread off** use thermal mass
- Blow away apply (natural) ventilation when possible
- Cool when necessary do not hesitate to include some extra cooling in order to adhere to future climate changes.

These key words very much apply to the 'Trias Energetica', the second theme of the symposium and of course closely linked with the presumed cause for climate change. Trias Energetica is defined as:

- 1 Minimize the energy requirement
- 2 If energy is required, apply renewable energy
- 3 Generate and use energy as efficient as possible

The final question was if and how simulation will play a role in this context of climate change and trias energetica. Atze Boerstra and Professor Dolf van Paassen focused on the boundary conditions for this question. Atze indicated that requirements with respect to the indoor environment tend to the adaptive approach, particularly in 'alpha' type buildings (non-air conditioned, with openable windows). Several standards/ guidelines tend in that direction. For air conditioned buildings little will change, though it remains an open question whether warmer outdoor conditions will result in changed requirements for those buildings as well.



Jan Hensen opens the symposium

Changing outdoor conditions were another issue. Dolf van Paassen presented an overview of applied weather data in the Netherlands over the last 30 years. He started by stating that the importance of outdoor conditions for the building decreases as the performance of the building skin increases, but the internal load requires more attention. He indicated that the 1964/65 weather data, used as a design standard in the Netherlands over the last 20 years, actually had little verification. It was only when problems arose that the standard was re-examined, with several national and international activities being undertaken on the topic. In Dolf van Paassen's opinion, however, the most important aspect of a reference year is to allow comparison of designs, not as an absolute value. Plant sizing required more specific information (hot



period, cold period). Past weather data cannot take into account future developments, the period in which the building will function. He proposed the use of a stochastic weather model to take those changes into account.

Next, Drury Crawley from DOE presented work in using simulated futures derived from four major climate models. Besides presenting the effect of climate change in the energy use of buildings in different regions, Drury indicated that simulation can be used to answer policy questions. Furthermore, he promoted the use of the wealth of detail information that comes available through simulation. He concluded with the remark that it is cheaper to simulate than to build the wrong building.

After the break Marleen Spiekman presented EU developments related to the EPBD (Energy Performance of Building Directive) and the use of simulation in that context. An overview of what can be expected in the near future, shows that this is quite a lot, even for building owners (including dwellings!). Marleen described the tension between subsidiarity (the principle that EU directives only specify general principles, leaving technical implementation to national governments) and harmonization (the aim of a uniform approach) that is present in the EPBD. This resulted in a mandate to CEN (the European committee for the development of standards) to develop standards. Three approaches to simulation are currently being proposed: a month method, a simple hour-method, and detailed building simulations. Most countries appear to favour the first approach, while retaining the option to use a more complex method for more complex buildings. She stressed the fact that these methods are not intended as design tools, but as tools to identify the energy consequences of the most significant improvements in design. The need for the methods to be incorporated into building regulations makes transparency, robustness, reproducibility, cost and efficiency more important than detail and high individual quality. Detailed building simulation presents several difficulties in this respect.

Paul Stoelinga brought the topic back again to design and the application of simulation.

He developed a theory on the design process, describing it as a series of small steps with many possible ways forward at each, and many intermediate steps. Luckily he identified some consistency in these steps at which information is required. This information can be derived with several levels of accuracy, ranging from experience, design rules, steady state calculations to dynamical simulation. Depending on the design question in hand the required level of accuracy can be estimated. Special and innovative designs generally require the highest accuracy level as design rules are not valid. He believes that climate change will increase the application of building simulation, as we will have to deal with a new situation that we haven't encountered yet. This will also require building simulation to be used in the early design phase. Some examples were shown to illustrate that. Interestingly Paul came to the conclusion that the outdoor climate does matter for a building, and will continue to do so, especially when designing such measures as long term energy storage in the soil.

Finally, Joop Westland presented the impact of a so-called reference year on the design and dimensioning of HVAC installation, paying special attention to local cooling. To serve the implementation of the EPBD, CEN developed a method to aggregate a reference year from the latest 10 years of real data. Simulation results for the current 'reference' and the CEN reference year were given. He showed that the new reference years give much higher loads than the commonly used 'standard' 1964/65 year. He suggested that designers should adopt the new reference year as soon as possible. This will lead towards higher capacities. The example Joop presented showed only a marginal increase in energy consumption, but with a much better comfort. Relating his conclusions to the first presenter Michael Holmes, he suggested that if everything has been done to optimize energy use and satisfy indoor requirements, designers should not hesitate to bring in some extra cooling capacity. The extra energy requirement is relatively limited and thermal indoor environmental quality can improve significantly.

The discussion at the end of the symposium focused on the need for large HVAC installations in order to anticipate changes in the climate, especially when considering quality/cost ratio. Another point that arose was the rise in electricity consumption due to cooling in the summer period, which coincided with the time that energy plants are limited in their capacity because of cooling water problems. It is clear that simulation can play an important role to quantify these problems, now and in the future.

The successful symposium was ended with a small buffet.