# ibpsaNEWS

## volume 10 number 1





The journal of the International Building Performance Simulation Association



## Contents

President's message	2
Building Simulation '99	3
Building simulation in Japan	7
Introduction	7
Research on building environmental performance and system simulationThermal issuesAirflow issuesLighting issuesAcoustic issuesPhysiological and psychological issuesFire safety issuesSanitary and water issuesEnergy and HVAC system issuesRecent work on building thermal simulation and design toolsA logical framework to mediate between building simulation and CADEnvironment simulation and thermal data in architectural designA calculation method for radiant heating and cooling system designDevelopment of a dynamic building simulation program, TASP++Environmental analysis and design based on rapid prototypingSimulation of underground space within insulated foundation wallsA numerical evaluation of thermal bridging in steel-framed housesExergy analysis on the built environment conditioned by passive coolingDevelopment of a thermal and air flow simulation program, NETSPreparation of input data for LESCOM using Visual BasicThermal environment and energy simulation of buildings using EESLISMOptimizing operation of a thermal storage tank by simulation	7 8 9 9 10 11 12 12 12 14 15 15 16 17 18 18 19 20 20 21 21
<b>IBPSA France: activities in 1998 and 1999</b>	23
The first IBPSA France conference	25
News from IBPSA USA	26
News from IBPSA Slovakia	27
Other news	28



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, operations and maintenance of new and existing buildings worldwide.

#### President

Larry O. Degelman Texas A&M University, U.S.A larry@archone.tamu.edu

> Vice-President Roger Pelletret CSTB, France pelletret@cstb.fr

Secretary Terry Williamson University of Adelaide, Australia twilliamson@arch.adelaide.edu.au

#### Treasurer

Edward F. Sowell Ayres Sowell Assoc Inc, U.S.A sowell@fullerton.edu

Membership Services Jeff Haberl Texas A&M University, U.S.A jhaberl@esl.tamu.edu

Webmaster Jeff Spitler Oklahoma State University, U.S.A spitler@okstate.edu

Conference Liaison Jan Hensen University of Strathclyde, U.K. jan@esru.strath.ac.uk

## President's message

The past year has been rich in activity for IBPSA – the affiliates have been busy; we've added two affiliates and new members; we've implemented new member services; and we've been busy getting ready for BS'99.

Yes, IBPSA is growing. In 1997, we had 7 regional affiliates (Australasia, Canada, Czech Republic, France, Greece, U.K., and U.S.A). In this past year we have added Slovakia and Ireland, and the new worldwide membership rosters are nearing an estimated 500 members. We extend our hearty welcome to the new regions and the new members. I encourage everyone to read the affiliate reports and announcements in this issue to get a sense of what is happening in simulation from a worldwide perspective.

We've formally designated a membership services officer as a standing member on the IBPSA Board. This is currently filled by Jeff Haberl who, along with his staff, is organizing a worldwide membership directory, issuing membership cards, and filling orders for conference proceedings and back issues of the IBPSA News. This is an important service that is helping us inform non-members about IBPSA and its mission and activities. Another standing position on the board is that of conference liaison. This is currently filled by Jan Hensen. As a member of the BS'99 organizing committee, he has had an extremely busy year advising, collaborating and assisting the conference organizers. The IBPSA web site (http://www.ibpsa.org) continues to improve in content, usefulness, and appearance, thanks to Jeff Spitler, the webmaster at Oklahoma State University. We are deeply indebted to these volunteer individuals who have devoted their efforts to provide these valuable services to the society. Inside this issue, you will find information that will help you access these people and/or their services.

Lastly, I would like to remark on the upcoming BS'99 conference. In our last issue of IBPSA News, President Joe Clarke summarized the activities that had just been concluded from the very successful BS'97 conference held in Prague. It was the largest Building Simulation conference that IBPSA had held to that date. This year, as we approach the BS'99 conference, to be held in Kyoto from 13-15 September, we anticipate an even larger participation with more than 240 delegates expected. The entire BS'99 organizing committee, chaired by Dr. Nakahara, has displayed outstanding diligence in preparing for the conference, and the BS'99 Secretariat has done an equally effective job of keeping us informed as to the conference venue, reviewing the multitude of technical papers, and keeping a web page current with important notices. I'm sure that all of you share my high expectations that BS'99 will be a high point in IBPSA's history, and I want to extend my sincere thanks to the organizers. In this issue you will find detailed information about the conference as well as the vigorous level of simulation activity that is taking place in Japan today. I encourage you to participate in the conference and gain some first-hand knowledge about this activity and about some of the amenities that Japan has to offer.

Larry Degelman, President, IBPSA



# **Building Simulation '99**

Sixth International IBPSA Conference Kyoto, Japan 13-15 September 1999

#### Aims

Using computer based models (programs) has become important in the design, operation, and management of the building and building service systems. This is not yet widely recognized, and sometimes programs are hard to use. There is a need to improve the capabilities and usability of programs if they are to be more widely used. Researchers as well as architects and engineers in Asian countries have long developed and applied computer based models to the design of buildings and building service systems. Given the above, it was decided that Building Simulation '99 will be in Kyoto, Japan.

#### Scope of the conference

The conference scope incorporates all aspects of modeling and simulation of the built environment including building service systems. Specific topics include:

- Simulations of building physics
- Modeling and simulations of energy systems
- HVAC simulation
- Human factors
- Various building services systems' simulation
- Control and management
- Simulation environments
- Various subjects

#### Program

The technical program comprises a combination of plenary session, parallel oral sessions, poster introduction/presentation, and software introduction and demonstration. In the plenary session, keynote speeches, plenary speeches, and introductions to the current situation on using simulation in each country will be presented.



Approximately 200 papers ( 80 from Japan and 120 from other countries) were submitted and are now under review.



#### Venue

Kyoto is a place of great scenic beauty. Since Kyoto was the nation's capital from 794 until 1868, it has played an important role in the cultural and scientific life of Japan. Kyoto is a famous university city and convention location, much visited by tourists. Kyoto Research Park was established in 1987 to provide facilities for research and development, new businesses and conferences. It is situated very near to the Kyoto railway station.

#### **Social programs**

The social program consists of a welcome reception and banquet. The Conference Banquet will be held in the superb aesthetic and scenic environment of the Heian Jingu Shrine La Garden banquet hall on 14 September (day 2). Japanese traditional cuisine will be served.

Technical tours and tours for accompanying persons will be held during and after the conference. Planned technical tours are:

- Kyoto Station Building
- Simulation technologies of Sekisui House R/D center
- Osaka Municipal Central Gymnasium

#### Exhibition

There will be an exhibition for promoting commercial products and services. Exhibition space is available in booths approximately 2m x 2m costing ¥100,000.

#### **Registration fees**

Registration fees (after 1 July 1999) are:	IBPSA member	¥50,000
	Non-member	¥55,000
	Full time students	¥20,000
	Accompanying persons:	¥10,000

The participant's fee includes conference attendance, proceedings, breaks, banquet and welcome party. Lunch is excluded. The accompanying person's registration fee excludes conference attendance and proceedings.

Registration forms are included at the back of this *ibpsa*NEWS, or can be downloaded from the BS'99 Homepage at http://www.users.kudpc.kyoto-u.ac.jp/~j45827/. Fax or post your completed registration to the BS'99 Registration Secretariat at:

c/o Congress Corporation, Nagoya Office Hirokoji YMD Building, 1-20-25, Naka-ku, Nagoya 460 JAPAN Fax +81-52-222-4187

#### Accommodation

The Kyoto Tokyu Hotel and the Rihga Royal Hotel Kyoto have agreed to provide special discounts to the participants of Building Simulation '99. Both are convenient for the conference venue and for public transport.

Rooms are equipped with two beds for single person use, but they can be shared by two participants if desired. Further information (in English) about the facilities can be obtained from the hotel home pages http://www.j-hotel.or.jp/member/kyoto/ KYOTO\_TOKYU\_HOTEL/welcome-e.html and http://www.j-hotel.or.jp/member/kyoto/ RIHGA\_ROYAL\_HOTEL\_KYOTO/welcome-e.html. The rates shown below are valid until 31 July 1999, and include tax and service charges. Breakfast is excluded. Only a limited number of rooms are available at the special BS'99 rates, so early booking is recommended.

Participants are advised to contact hotels of their choice directly and make reservations personally, using the hotel reservation form which is included at the back of this *ibpsa*NEWS, or can be downloaded from the BS'99 Homepage. Inquiries about room availability and reservations should be made directly to the hotels by fax. We regret that the Building Simulation '99 secretariat cannot help make hotel reservations.

Kyoto Tokyu Hotel		Rihga Royal Hotel Kyoto		
Fax +81-(0)75-34	1-2488	Fax +81-(0)75-341-3073		
single room	(8,000 ¥/night)	single roo	om (8,	300 ¥/night)
shared room	(15,000 ¥/night)	shared ro	oom (1	4,600 ¥/night)

#### Travel

Kyoto is easily accessible from Tokyo International, Osaka and Kansai International airports:





#### **Organizing committee**

Nobuo Nakahara (Chairman, Kanagawa University, Japan) Mamoru Matsumoto (Vice Chairman, Osaka Sangyo University, Japan) Jan Hensen (IBPSA LiaisonOfficer, Chairman of Scientific Committee, University of Strathclyde, United Kingdom) Hitoshi Yamazaki (Chairman of Scientific Committee, Oita University, Japan) Ken-ichi Kimura (Waseda University, Japan) Yoh Matsuo (Meiji University, Japan) Shuzo Murakami (Tokyo University, Japan) Harunori Yoshida (Kyoto University, Japan) Mitsuhiro Udagawa (Kogakuin University, Japan)

The science committee includes 84 Japanese reviewers and 44 reviewers from other countries for reviewing approximately 200 papers.

#### **BS'99 Secretariat**

```
Masaya Okumiya
Center for Integrated Research in Science and Engineering (CIRSE)
Nagoya University
Furo-cho, Chikusa-ku, Nagoya 464-8603 Japan
E-mail BS99@archi.kyoto-u.ac.jp
Fax +81-52-789-5318
```

#### Latest news

The latest news about the conference is available at the BS'99 Homepage. This also includes further information on Conference themes, Calendar, Technical program, Social events and tours, Venue, Accommodation, Organization of BS'99 and Other information - about Kyoto, for example.



## **Building simulation in Japan**

A selection of recent work

#### Introduction

'Japanese researchers and engineers have been active in building simulation for several decades ... application examples can be found in many projects' Japanese researchers and engineers have been active in the field of building simulation for several decades and application examples can be found in many projects. This is why Japan decided to raise hands to host Building Simulation '99. To showcase Japanese simulation work, two members of the BS'99 organising committee - Nobuo Nakahara, Professor of Kanagawa University, Professor Emeritus of Nagoya University and Chairman of the BS'99 Organizing Committee, and Dr. Harunori Yoshida, Associate Professor in the Department of Global Environment Engineering, Kyoto University agreed to compile summaries of recent research, based on contributions by individual researchers. Professor Yoshida was assisted by Sanjay Kumar. Professor Nakahara's selection focuses on research on building environmental performance and system simulation and Professor Yoshida's on recent work on building thermal simulation and design tools.

## **I** Research on building environmental performance and system simulation

#### **I.I** Thermal issues Professor Suichi Hokoi, Kyoto University

Current themes in research on thermal issues include:

- *Energy related problems:* field survey of energy consumption, utilization of natural energy, symbiotic (green) buildings, thermal storage, insulation and airtightness.
- Global, regional and urban environments: thermal environment in urban areas, heat islands, and district heating and cooling.
- Indoor environment: air quality, survey of environmental consciousness, human health.

Most of these issues are

- complicated and highly interrelated
- diversified in their scales
- require professional knowledge from other fields and
- need comprehensive evaluation.

The formaldehyde & VOC emission problem is typical of these problems. Solutions require knowledge from a variety of fields such as chemistry and medical science. Also, the amount of VOC emission from building materials depends on the grade of building elements, and thus on the cost. Furthermore, air-tightness introduced for energy conservation is one of the main causes of this problem. All these factors must be taken into account in obtaining the best solution.

One of the key issues is the the rate at which VOCs are generated, so analysis of the diffusion and phase change processes in building materials using the theory developed in moisture problems seems promising.

Computer simulation is quite powerful in solving these complicated and interconnected problems, and thus makes it possible to integrate, evaluate and optimize the system under consideration. With the increasing importance of numerical simulations, a major effort is needed to generalize the calculated results into simple design principles. At the same time, fundamental researches such as measurement of material properties, modeling of meteorological data, improvement of insulation methods, etc. must be done continuously and steadily. This kind of effort will be rewarded when opening the Japanese market.

#### **1.2** Airflow issues Professor Shinsuke Kato, University of Tokyo

Airflow has an important role in many of the environmental problems concerning building science today, notably HVAC design in a room. It conveys heat, contaminants, fresh air, etc in the room. The airflow is usually three-dimensional and turbulent. It is often difficult to theoretically predict the behavior of airflow and resulting temperature and contaminant distributions in the room. CFD, or computational fluid dynamics, based on turbulence models is now getting a good reputation for analysis of such flow fields. Flow fields with complex geometry can be easily analyzed with CFD and their accuracy is well validated both theoretically and practically. In Japan, there are many commercial CFD codes in wide use by designers. They are used for validating the HVAC design in a room before the building is constructed.

With CFD analysis, it is easy to examine the distribution of ventilation effectiveness in a room. Many indices of ventilation effectiveness, such as the mean age of inflow air, the residual lifetime of air in a certain point and so on, can be estimated by CFD. With a detailed understanding of issues like this, designers can locate supply and exhaust openings etc to achieve rational designs and comfortable and energy-efficient environments.

The latest trend is for CFD tools to be used to optimize HVAC design. In the past, designers have typically carried out only one CFD simulation with fixed boundary conditions, with the aim of checking for serious faults in the HVAC design. Today, designers typically use repeated CFD simulations with various boundary conditions to find the most suitable solution for the HVAC systems in the room.

'In Japan, there are many commercial CFD codes in wide use by designers'

#### **1.3 Lighting issues** Dr Mitsuru Saito, Ohbayashi Corporation

Recent work has made extensive use of Monte Carlo methods in simulation, studying a variety of issues such as:

- the fundamentals of shadow characteristics under task/ambient lighting
- the fundamental evaluation of color distribution in the visual environment
- the distribution of spatial illuminance, spatial illumination vector and color at the observers' eye position
- calculation methods for detecting light source position
- the spatial distribution of scattered daylight in the presence of atmospheric particles, using the Monte Carlo method to simulate sky luminance and daylight illuminance.

Many computer simulation technologies have been applied to predict the characteristics of the luminous environment in interiors and exteriors. Examples include:

- computer graphical simulation of the appearance of taxiway edge and centerline lights in Narita airport
- point brilliance distribution on pilots' eyes caused by aeronautical ground lights under low visibility
- a study on the artificial lighting in a dome stadium based on the visibility of a flying ball
- the computer simulation of coloring of exterior surfaces of buildings that takes luminous environment and color reproduction performance into account.

Today many computer graphic programs are used to simulate the luminous environment of many kinds of building and assist the design of natural and artificial lighting. Research continues on calculation methods. For example, a recent study has looked at the equivalent reflectance of the desk top surface of a room with arranged desks, using simulation to calculate the indirect and total illuminance on the desk top surface.

A working group studying methods for simulating the luminous environment was organized by the Architectural Institute of Japan in 1999. Its aim is to develop simulation tools to predict the luminous environment in interiors.

#### **1.4** Acoustic issues Professor Michihito Terao, Kanagawa University

Work on acoustical simulations in Japan related to buildings appears primarily in the publications and at meetings of the Acoustic Society of Japan, the Institute of Noise Control Engineering of Japan, the Architectural Institute of Japan, and the Society of Heating, Air-conditioning and Sanitary Engineers of Japan, or SHASE.

Fields with a high level of activity among Japanese researchers include:

• Acoustics in large spaces such as music halls, theaters, arenas and conference rooms. To check the performances of the reflectors, diffusers and absorbent surfaces of the interiors and public address systems, computer simulations by the ray tracing method and image source method are widely used.

'many computer graphic programs are used to ... assist the design of natural and artificial lighting' Recently some researches have been validating virtual reality evaluations by taking convolutions of dry sources of music and speech tapes to the inputs sound response between sources and seats given by measurements in 1/10 and 1/20 scale models. Some groups began to make comparisons between the evaluation of professional music performers and the evaluation descriptors of acoustic simulations. Several researchers are doing fundamental work to realize wave theory such as the DEM, FEM and BEM approaches. HVAC duct sound simulations by BEM are already of practical use.

- Noise reduction in noise-sensitive locations such as residences, hotels and healthcare facilities. Simulation robots of the structure-borne sounds by footsteps and child jump-downs are being investigated extensively and have led to international conferences. To study structure-borne sounds from machinery including appliances and equipment, road and railways, several groups are conducting FEM computer simulations for sound transmissions in structures and the radiation impedance of walls.
- Abatement of transportation noise. There is currently a lively debate on ways to predict roadway noise in assessments required by new regulations in Japan.
   BEM simulations are being carried out on new types of sound barriers and active noise control systems.

#### 1.5 Physiological and psychological issues Professor Satoru Kuno, Nagoya University

Recent work in Japan on the treatment of human factors in building simulation has focused on indoor thermal comfort. Fanger's PMV and PPD and Gagge's SET\* have been in use here for around 10 years. Various simulation programs have been developed to enable architects and building services engineers to visualise thermal conditions across rooms. Recent developments in CFD and other computational techniques have enabled much more precise prediction of temperature, humidity, air movement and radiation. These are now being used for actual building automation control and planning of energy saving.

Daylighting design is also being extensively studied. A new way of evaluating glare from wide windows has recently been developed in Japan to replace conventional methods based on point sources. Its aim is an optimal control of natural lighting, the prevention of glare, and energy saving. A simulation tool based on this method is now under development and will soon be available for designers to use.

Work is also in progress on the prediction of human reactions to the acoustic environment in concert halls. Visitors previously know their own preference type in a test room, and choose a seat. Such a concert hall has actually been constructed in Japan. To improve the acoustic environment in large spaces, active controls on reverberation time etc are being used increasingly often. These are simulated, of course, at the design stage.

'A new way of evaluating glare from a wide windows has recently been developed in Japan' Finally, many basic studies on IAQ, vibration, human movement, human perception of indoor spaces etc are being conducted with future application to architectural design in mind.

#### **1.6** Fire safety issues Professor Makoto Tsujimoto, Nagoya University

Research on fire safety in Japan is at a turning point, because the prescriptive approach to fire safety in the Building Standard Law is being replaced by a performancebased approach. The performance-based approach was first introduced in an amendment to the Building Standard Law passed in the Diet in 1998, and successive new codes will be announced by April 2000, to be enforced by June 2000. The change to a performance-based code has been based largely on research carried out by the Building Research Institute of the Ministry of Construction, which organized an integrated research project called "SO-PRO" *(1982-87,1993-98) for performance-based fire code*<sup>1,2</sup>.

The change will involve a new approach to fire safety design based on simulation. A model fire<sup>3</sup> is used to predict the rate at which a fire will develop, taking into account occupancy and geometrical conditions such as openings and room height, and the results provide input data for the assessment method used in the performance-based code.

In the next stage, it is proposed that simulation programs should be used to calculate the stability of structures<sup>4</sup> and smoke movement<sup>5</sup> using the combustion rate given by the model fire, and an evacuation program<sup>6</sup> should be used to calculate the action time for evacuation. Together, these simulations will provide a basis for an integrated assessment of fire safety<sup>7</sup>.

The program to predict the smoke movement is based on a two layer zone model, but many researches<sup>8</sup> are now using field models (CFD) as well.

- <sup>1</sup> Development of fire safety design methods for building (1982-87)
- <sup>2</sup> Development of assessment methods for fire safety performance (1993-98)
- <sup>3</sup> Worst-credible design heat release rate for use in engineering fire safety design of buildings, Ohmiya, Y., Harada, K., Tanaka, T., Hosozawa, T., Tokita, T., Wakamatsu, T., 14th US- Japan Joint Panel on Natural Resources (UJNR) Panel on Fire Research, (Tsukuba), 1998
- <sup>4</sup> Rational framework for fire resistance requirement based on relative risk concept, Harada, K., Tanaka, T., Morita T., Proceedings of the 2nd International Seminar on Fire and Explosion Hazard of Substances, Venting of Deflagrations (Aug., 1997, Moscow), pp. 365- 376, 1998
- <sup>5</sup> A model of multi-room fire spread, Tanaka.T., NBSIR 83-2718, 1983
- <sup>6</sup> *Fire safety engineering tools for evacuation*, Hagiwara, I., Summaries of technical papers of annual meeting, Part A-2, Architectural Institute of Japan, 1999 (to be published)

'Research on fire safety in Japan is at a turning point ... the prescriptive approach to fire safety in the Building Standard Law is being replaced by a performance-based approach'

- <sup>7</sup> Performance evaluation methods for fire safety issues in the building standards law of Japan, Tsujimoto, M., Hagiwara, I, Harada, K, et al., Kasai Vol. 49, Japan Association for Fire Science and Engineering, 1999
- <sup>8</sup> New k-E model including effects due to buoyancy: Study on numerical simulation of room airflow in thermallystratified condition (Part2), T.Chikamoto, S.Murakami and S.Kato, Journal of Architecture, Planning and Environmental Engineering, Transaction of AIJ, pp.67-74, 1996.3

#### 1.7 Sanitary and water issues Professor Akihiko Iio, Nihon Women's University

Sanitary system and water environment researches in Japan are mainly carried out at the research committee works in SHASE. The principal topics for current research are:

Water and hot-water supply systems

- Investigation of water consumption in various buildings, dwelling houses, multiple apartment, office building, hospital and school, etc
- Investigation of water and hot-water usage
- Investigation and simulation of plumbing fixture requirement for various buildings, multipurpose stadium, railway station and school, etc
- System evaluation by event analysis
- Analysis of instant velocity and the biggest load for pipe sizing
- Prediction of water consumption using neural network

Development of advanced system design and control

- New hot-water supply system
- Simulation and annual precipitation and rain utilization amount
- Operation control with load characteristics of building
- Plan for a wastewater reuse system
- Experiment of pipe-end fittings
- Experimental study on plumbing system for ground food waste recycling

#### Drainage systems

- Estimation of waste water
- Design method of drainage system in apartment house
- Development of testing device for trap performance

#### Water environment

- Investigation of public awareness and evaluation for river environment
- Analysis of human behavior in amenity water facilities

#### **1.8** Energy and HVAC system issues

Professor Nobuo Nakahara, Kanagawa University

Energy consumption in buildings arises mainly in HVAC and energy generating systems, so HVAC systems are the principal subject for current research on energy simulation. Work is also under way on comfort quality analysis and system fault detection and diagnosis analysis.

Static HVAC simulations are used mainly to estimate energy consumption and contribute to optimal design for energy conservation. The basic program is HASP/ACSS, which is comparable with DOE-2 or BLAST in U.S.A. This has been extensively modified to increase its functionality and its usability, with options to include various new HVAC and energy systems. For example, one modification is BECS/CEC/AC for Windows, developed by IBEC, Institute for Building Energy Conservation; this calculates an index of HVAC energy performance called CEC/AC, which is regulated by the Energy Conservation Law of Japan.

Research on dynamic system simulation is limited but is gradually drawing attention to enable analysis of the dynamic behavior of the room environment and component movement. A Japanese version of HVACSIM+, which originated in the U.S.A, has recently been modified to allow it to simulate Japanese-style building structures, building elements and HVAC systems.

Work done under IEA Annex-25 andAnnex-34 has motivated research on fault detection and diagnosis at the committees in IBEC and in SHASE. The reproducibility of the program has been verified for two kinds of systems, a simple CAV system and a multi-zone VAV system. It is going to be used as a tool for accumulating a knowledge data base for commissioning.

An urgent need to control summer electricity demand in Japan has led to research being planned on the design, control and operation of thermal storage systems using water and ice. Thermal storage will be analyzed dynamically in order to maximise system capacity. Comparative analysis will also be carried out to assess the energy efficiency and economics of water or ice storage. Several kinds of simulation technologies have been developed and modified into Window 95 based programs.

Co-generation (or CHP, Combined Heat and Power) can provide decentralized power supplies that help energy conservation, electric load leveling and energy security. Energy recovery, which utilizes urban and industrial exhaust energy and thermal energy from various kinds of natural environment where temperature differences exist, is expected to make it possible to the raise the energy performance of district cooling and heating systems significantly. Simulation technologies for design, control and operation for these systems have been developed.

'(there is) an urgent need to control summer electricity demand in Japan'

#### 2 Recent work on building thermal simulation and design tools

Professor Yoshida's compilation is based on synopses of papers presented at a symposium held in Tokyo in December 1998 to promote Building Simulation '99. The papers originate from four working groups of the Architectural Institute of Japan: the Three dimensional thermal conduction WG, Thermal data structure WG, Exergy/Entropy WG and Boundary issues of thermal conduction WG.

#### 2.1 A logical framework to mediate between building simulation and CAD

#### Haruyuki Fujii, Tokyo Institute of Technology

Many diverse types of symbol systems are employed to represent a building in architectural design. Each of them corresponds with a particular discipline within which the contents to be represented are highlighted. The author proposes a framework to organize such symbol systems on the basis of philosophy of language and computational linguistics. The framework is composed of three classes of symbol systems, namely, surface language, universal language, and domain independent structure. Surface language is a class of conventional symbol systems that architects and engineers use to represent a building or to manipulate the representation. Universal language is a class of symbol systems that represent the intentional meaning of the surface language representations as well as the states and transitions in domain independent structure. Universal language also describes the domain specific theories that compose the common ground of the disciplines used in the domain. A domain independent structure is a model of universal language descriptions. A symbol system for building simulation applications and a symbol system for CAD systems are regarded as instances of surface language. They are mediated by providing an instance of universal language. A domain independent structure corresponds to the database of architectural projects.



#### 2.2 Environment simulation and thermal data in architectural design

Tatsuo Inooka, Nikken Sekkei Ltd

Building environment simulation has to address a wide range of scales from micro to macro, as the illustration below shows. Building design, on the other hand, proceeds in sequence from Conceptual Planning/Master Planning, Preliminary Design Stage, Working Design Stage. However, the quantity/quality of the data to be used and its expected accuracy at each stage vary.

When considering simulation as a design tool, one must always keep in mind who needs to use it, when, and for what purpose.

This paper introduces the 'Simplified Annual Load Calculation' as a compact design tool, the 'Air-conditioning System Simulation' as a detail analysis, and the 'Dynamic Ventilation as well as Thermal Load Simulation' as a comprehensive analysis.



Space scales in building environment simulation

#### 2.3 A calculation method for radiant heating and cooling system design

Hisaya Ishino, Tokyo Metropolitan University

Recently, the advantages of radiant heating and cooling systems have been recognized again and these systems have been applied to various buildings.

In the first part of this paper, the advantages and disadvantages of radiant heating principally for warming up performance are discussed. In a hot water floor heating system, steady state heat transfer rate from the floor is estimated by Kollmar-Liese's method. However, the recently-proposed Kilkis method may also be used.

In the second section of the paper, an effort is made to develop a new simplified method for estimating the heat transfer rate from the heated floor by refining the treatment of replacing tubes in the floor by plate finned tubes. By this method, heat transfer rates can be obtained with high accuracy. Furthermore, a simplified method of estimating the step response of heat rate from the floor was proposed, based on analysis of step responses of heat rate from the floor simulated by two-dimensional heat transfer calculation. Thermal load calculation using space operative temperature has been recognized as extremely important for spaces using radiant heating and cooling systems but its method has not been developed yet. This is also important for air conditioned spaces.

It is obvious that operative temperature is a more proper index of thermal sensation than air temperature. Operative temperature can be obtained from the thermal load calculation under the given space air temperature condition, but under the given space operative temperature condition, there has been no method of thermal load calculation. This is one of the most important problems, especially in radiant heating and cooling load calculation. In the third section, the author proposes a calculation method for steady state design thermal load under given space operative temperature conditions.

#### 2.4 Development of a dynamic building simulation program, TASP++

#### Shin-ichi Matsumoto, Tohoku University

A dynamic building energy simulation program named TASP++ with user friendly graphical interfaces has been developed using C++. The building model is entirely object-oriented to bring clarity in model data structure and to make data input easy. The program runs under Windows 95/98/NT4.0 operating systems and looks like a standard office application. A sample of graphical user interface is shown below. The author has another simulation program working on a super computer, but prefers to use this newly developed program because of its ease of use and its graphical displays of calculated results. This paper describes the scheme of the program and discusses the precision of the calculated hourly heating/cooling loads and air temperature fluctuations, as well as the merits and demerits of the object-oriented method for dynamic energy simulation programming. A dynamic simulation program with careful data structures will soon become a familiar tool for designers/engineers. Additionally, the object-oriented thinking must be helpful for generalized modeling of building components.



One of dialog windows to display the calculation results, designed for TASP++.

#### 2.5 Environmental analysis and design based on rapid prototyping

Yasushige Morikawa, Taisei Corporation and Koji Ono, Taisei Corporation

In environmental analysis, various "frames" can be considered to meet different purposes. The setting of any "frame" not sticking to the restriction of conventional experimental facilities and software is important, and the analysis based on such setting will be effective. This paper outlines the Rapid Prototyping method of fluid analysis as a method to obtain success in this aspect. In addition, an analysis method to set urban districts and building indoor environments connecting outdoor and indoor being set on the Rapid as an application example is shown, and an example of unsteady state thermal analysis is also introduced for energy saving buildings in future.



Integrated flow of reproducing scale adapted with Rapid Prototyping method (Application example for thermal environment in urban district)



Time histories of indoor temperature by air conditioning system control (Unsteady state thermal analysis example)

#### 2.6 Simulation of underground space within insulated foundation walls

Akihiro Nagata, Tokyo Metropolitan University, Yuzo Sakamoto, University of Tokyo, Hirotaka Suzuki, Hokkaido Prefectural Cold Region Housing and Urban Research Institute and Yoshinori Honma, Hokkaido Prefectural Cold Region Housing and Urban Research Institute

The ventilation rate between underground space and outside air is usually very small in a detached house with insulated foundation walls. Therefore, its underground environment remains quite sensitive to both the upper floor environment and the heat capacity of the ground and moisture capacity of thje materials which compose the underground structure. A three-dimensional finite difference (backward time) program has been developed to address the coupled heat and moisture effect in and around underground spaces. It is, however, necessary for the program to calculate hour by hour behavior for several years because of the large heat capacity of the ground, so the program needs to be efficient. The water flow problem in the ground is neglected and only vapor diffusion is dealt with, assuming hygroscopic conditions. In addition, temperature is determined by using a gradient of the moisture content in the previous step. Humidity is determined afterwards. This is a practical approach to take into account both the heat capacity of the ground and the moisture capacity of building materials. The data calculated by the program is also compared with the measured data.

#### 2.7 A numerical evaluation of thermal bridging in steel-framed houses

Hideyo Nimiya, Nagaoka Institute of Design, Hiroshi Akasaka, Kagoshima University and Satoshi Obara, Miyakonojo National College of Technology

In steel-framed houses, wood frames of 2x4 construction are replaced by thin steel frames. However, as the steel has high thermal conductivity, it must be insulated properly to avoid heat conduction and condensation on the surface and inside the exterior walls. In this study, the temperature distribution and the possibility of occurrence of condensation in the exterior walls of steel framed houses is simulated. A three-dimensional finite difference computer program named TB3D/FDM has been developed and used for the simulation. The accuracy of the TB3D/FDM is also compared with the bench mark in ISO 10211. In three-dimensional computation, preparing input data is the most time-consuming work. To make it easier, we developed a tool to construct the three-dimensional input data using two-dimensional CAD. The computations were undertaken at the positions where steel members penetrated the insulation materials such as terraces. At these positions, the temperature at the indoor side of steel members becomes low. Therefore, the possibility of occurrence of condensation on the positions where the influence of the three-dimensional heat flow seemed large, is further examined.

#### 2.8 Exergy analysis on the built environment conditioned by passive cooling

Ryoji Nishikawa, Science University of Tokyo and Masanori Shukuya, Musashi Institute of technology

It is necessary to consider the law of entropy generation for better understanding of the built environment, since the conventional theory for calculating room air temperature variation and cooling/heating loads is based only on the law of energy conservation. An exergy theory is developed based upon system entropy to evaluate passive cooling design. The concept of exergy enables us to show explicitly the cooling potential of a substance that is colder than its ambient. The terminology "cool exergy" and "warm exergy" is used for cooling and heating potential respectively. The value of either cool or warm exergy is positive without exception. A case study on the exergy concept is undertaken to examine the combined effects of shading and natural ventilation to utilize the heat capacity of concrete walls for passive cooling in a better way during off sunshine hours in Tokyo. The amount of cool and warm exergies stored by the building envelopes and the variation of their rate of storage were examined by numerical computations. The results show that the cool exergy could be obtained from the concrete walls even during the daytime of a hot day in summer, provided that an appropriate combination of shading, natural ventilation, and heat capacity is designed.



Exergy balance within a room space during the daytime of a hot day in summer in Tokyo

#### 2.9 Development of a thermal and air flow simulation program, NETS

Hiroyasu Okuyama, Institute of Technology, Shimizu corp.

NETS is a versatile program suitable for use in research, development and design of passive and low energy architecture. Preparation of NETS input data is complicated, so the pre-processing system NETSGEN has been developed to enable users to construct the models easily, like drawing a picture. It allows the user to construct a model freely, even if the object being modeled is a newly invented architectural device. The graphic interface program greatly reduces both labor and the possibility of error compared with the usual approach to data input. A program for post-processing results for viewing, NETSOUT, has also been developed. The Ministry of International Trade and Industry supports the development of these programs, so wide trials and feedback on NETSGEN are recommended. We are now distributing the trial version to educational institutions, expecting comments for the next fiscal year's improvements.



Input dialog box for nodal relation between airflow network model and thermal network model

#### 2.10 Preparation of input data for LESCOM using Visual Basic

Hitoshi Takeda, Science University of Tokyo

Preparation of input data is one of the most difficult and troublesome aspects of heat load computations. LESCOM, Life Energy Saving Computer program, has been developed to facilitate multi-room, unsteady heat flow calculations. It can also compute living room, hallway, attic and under the floor temperatures accurately, taking into account heat storage by walls, etc. An interface has been written in Visual Basic to enable input data for LESCOM to be prepared on a personal computer.

#### 2.11 Thermal environment and energy simulation of buildings using EESLISM

Mitsuhiro Udagawa, Kogakuin University

EESLISM is a tool to simulate the whole energy system, including the building itself, the HVAC system and domestic hot water supply. EESLISM has been developed, used and modified since 1990 using C language on UNIX environment.

Although the algorithm is based on the heat balance model consisting of a set of heat and moisture balance equations of all the components used in the system to be simulated, it is designed to reduce the size of the simultaneous equations to increase computational efficiency and simplicity. The methodology uses simulation of imaginary components without detailed descriptions of the heating and cooling components. Further, the imaginary components for simulation of the heating and cooling systems are prepared to examine the heating or cooling capacity of the air-conditioner or heating and cooling equipment. Results show that it is better to use the simulation results for the components. While this paper describes the application of EESLISM especially to residential houses, the simulation model and the tool can be used to simulate both residential and non-residential buildings.

#### **2.12** Optimizing operation of a thermal storage tank by simulation

Harunori Yoshida, Dept. of Global Environment Engineering, Kyoto University, Yoshihito Gotou, Nikken Sekkei Ltd and Hiromasa Yamaguti, Department of Global Environment Engineering, Kyoto University

Thermal storage systems used in building HVAC system are increasingly considered to be an important technology for energy conservation and  $CO_2$  emission reduction - a major component of global warming. However, it is reported that energy conservation targets are often not achieved because systems are not operated optimally. Many studies about cooling load prediction are reported. However, studies about the way to operate thermal storage systems using predicted weather data are quite limited. In this paper, an algorithm is developed for optimal operation of a thermal storage tank by minimizing a non-linear cost function on the premise that cooling load prediction is available. Optimization is achieved by minimizing total power consumption in the system as the objective function. In this algorithm, the model is simulated with the help of MATLAB SIMULINK software.

Three ways of operation are examined and illustrative calculations are done using real load data:

- *midnight operation:* the chiller starts up at the beginning of the night time tariff and stops when the heat storage meets the demand
- *early morning operation:* the operating mode of the chiller is the same as in the previous case. However, the timing is set so that its operation ends at the beginning of the air conditioning operation.
- *early morning optimal operation:* this operation is similar to the early morning

operation. However, the set point temperature of the outlet chilled water is optimized in order to increase the chiller's COP.

It is concluded that early morning optimal operation is the most efficient among the three, with energy consumption reduced by 8.6%, 17.0% and 26.8% in periodically stationary heavy, medium, and light load conditions respectively as compared to consumption in normal operation. Nevertheless, in random load condition also, energy consumption reduces almost in the same manner. The results show the effectiveness of the algorithm.



### TOSHIBA

## Resource Circulating Power Generation System by Livestock Waste

畜産糞尿利用循環型発電システム(燃料電池)

### Why not use natural resources from livestock more effectively?

"The Resource Circulating Power Generation System by Livestock Waste" From TOSHIBA

Along with compost processing and clean waste-water treatment, which have become widespread nowadays, power generation from waste is also possible, making for an even more advanced society in terms of natural resource recycling.



#### **TOSHIBA CORPORATION**

INTERNATIONAL OPERATIONS-INFORMATION & COMMUNICATION SYSTEMS AND INDUSTRIAL PLANT. 1-1, SHIBAURA 1-CHOME, MINATO-KU, TOKYO 105-8001, JAPAN PHONE : +81-3-3457-4130 FACSIMILE : +81-3-5444-9268

# IBPSA France: activities in 1998 and 1999

#### Roger Pelletret, President of IBPSA France

CSTB<sup>1</sup> has been a member of IBPSA since the early days of the Association. When the regionalization initiative was decided, CSTB initiated IBPSA France. EDF<sup>2</sup>, GDF<sup>3</sup> and Ademe<sup>4</sup> supported the idea and IBPSA France was officially created in mid-1997.

In 1998, the year following start-up, IBPSA France's main activities have been focused on:

- developing an IBPSA France Web site, http://ibpsa-france.cstb.fr/
- organizing an IBPSA Board meeting in Paris
- organizing the first French IBPSA conference: IBPSA
   France '98
- making the number of memberships grow.

The first IBPSA France conference (a 2-day conference) was held in Sophia Antipolis (Nice) and attracted 44 participants. About 30 papers and 10 software demonstrations were presented in parallel sessions. The main topics were "Modeling" and "Practical Use of Dynamic Simulation Software". The proceedings are still available on CD-ROM. (See Gilles Lefebvre's article, next in this issue of *ibpsa*NEWS.)

The IBPSA France Web site provides information on:

- building performance simulation tools and techniques, especially for achieving optimal building thermal performance design, air quality, interior comfort and transport of pollutants, acoustic performance, etc
- R & D projects relevant to subjects discussed by IBPSA France
- **u**published articles covering different areas of interest of IBPSA France.

The public part of the IBPSA France Web site is also in English and we invite the IBPSA members Worldwide to take a look at the information on this site. On the other

- <sup>1</sup> Centre Scientifique et Technique du Bâtiment.
- <sup>2</sup> Électricité de France
- <sup>3</sup> Gaz de France
- <sup>4</sup> Agence de l'environnement et de la maîtrise de l'énergie



hand we will be very pleased to add any useful information provided by any IBPSA member. The "Members only" part of the site embeds facilities for workgroups discussions and ftp sites. Currently, six workgroups have been defined (User requirements, Model servers, Information management, Modeling languages, Virtual reality, Validation). In addition, the IBPSA France members get access to free downloading of articles, and, of course, the membership list and various e-mail repertoires facilitating communication between IBPSA France members.







71 people are now registered as members of IBPSA France, representing 32 different enterprises (Research centers, Consulting Companies, Utilities, etc.). Their principal fields of activity are analysed in the pie chart on the left.

The number of consulting companies is already greater than half of the number of Research centers. IBPSA's main objective is to achieve a certain balance between these two groups by involving more users, in line with one of IBPSA France's principal aims: "transferring advanced simulation tools to practitioners".

In 1999, IBPSA France's activities mainly consist in:

- launching a new set of IBPSA France reports, starting with a study about the use of dynamic simulation for Building Thermal Performance Design (available end of 99);
- maintaining and further developing the IBPSA France web site;
- preparing IBPSA France'2000, the second French conference organized by IBPSA France.

IBPSA France is open to anyone who would like to join this group and any IBPSA member can propose information to be displayed on the IBPSA France web site.



Conférence IBPSA France'98

Modéliser pour améliorer les performances des bâtiments

Sophia -Antipolis 10 et 11 décembre 1998

Programme de la conférence

http://ibpsa-france.cstb.tr

# The first IBPSA France conference

Gilles Lefebvre, IBPSA France representative on the IBPSA Board

The initial intention was to organise a French speaking IBPSA conference every two years, alternating with the international Building Simulation conferences.

The first IBPSA France conference took place in Sophia Antipolis, near Nice in the south of France, on 10 and 11 December 1998, where facilities where available both from CSTB<sup>1</sup> and Ademe<sup>2</sup>. The scientific committee was composed of 10 academic people and practitioners. The general rules used for the International IBPSA Conferences have been applied. The proposed communications were selected after reviewing abstracts and, secondly, after reviewing the full papers; reviews were performed by at least two members of the scientific comittee. About 50 abstracts and papers were submitted; about 30 papers were accepted after amendment. The full proceedings have been published in a printed version and in PDF format on CD-ROM.

Two kinds of contribution were accepted: full papers, including a lecture presenting scientific results, some synthesis, or technique, and short papers presenting tools (such as software) as an introduction to a demonstration session. Authors had 20 minutes to present full papers, but only 10 minutes to introduce the software. 8-page written contributions were accepted for both.

Presentations were organised in five dedicated sessions:

- Software presentations
- Using software in practice; practitioners needs and solutions
- Modelling and models
- Building, environment and health
- Validation, optimisation, sensitivity studies using models

The covered topics were rather large, but nevertheless IBPSA France succeeded in organising the Conference in only about 10 months. Some modifications will be made for the next Conference; for example, we will try to invite keynote speaker(s) and to dedicate more time for discussions. The next conference will take place in Sophia Antipolis again and is scheduled for November 2000.

- <sup>1</sup> Centre Scientifique et Technique du Bâtiment (Building Scientific and Technical Center)
- <sup>2</sup> Agence de l'Environnement et de la Maîtrise de l'Energie (French Agency for Environment and Energy Management)

## **News from IBPSA USA**

#### **IBPSA USA activities**

Jeff Spitler, IBPSA USA representative on the IBPSA Board

IBPSA-USA completed its formal organization process in January of 1998, when officers were elected. Current officers are Curt Pedersen, President; Chip Barnaby Vice-President; Barrett Flake, Treasurer; Mike Witte, Secretary; and Jeff Spitler, IBPSA Board Representative. At present, we have approximately 30 members.

Since then, we have had a series of highly successful software expositions and dinner meetings in Toronto (co-organized with IBPSA-Canada), Chicago, and Seattle. In Seattle, the software exposition had about 12 exhibitors demonstrating a range of simulation software to 40 participants. The software exposition was followed by a delightful dinner at the General Petroleum Museum, where Robert Sonderegger gave a thought-provoking talk on "The Future of Energy Analysis in Buildings".

The next meeting of IBPSA-USA will be held on February 5, 2000 in Dallas, Texas. This coincides with the ASHRAE winter meeting. Contact Curt Pedersen (cpederse@uiuc.edu) or Jeff Spitler (spitler@okstate.edu) for more information. International visitors are welcome!

## **News from IBPSA Slovakia**

#### Milan Janak

IBPSA Slovakia was established in June 1998 and now has 33 members. Building simulation is already well established in Slovakian universities as a result of three years EC funding through a TEMPUS project, 'Introducing IT based simulation courses into the Slovakian higher education'.

From the start, IBPSA Slovakia has benefited from affiliation with the Slovakian Society for Environmental Technology and access to their activities. These have included simulation sections in national conferences and workshops with a special focus on building energy efficiency, indoor environment, heating, ventilation and airconditioning – four events in all. In this way, IBPSA Slovakia hopes to provide a forum for discussion among experts and a platform for promoting this new technology and its application into the Slovkian building industry.

IBPSA Slovakia is also taking an active role in organising simulation training. An ESPr training course has already been held in collaboration with ESRU (University of Strathclyde, UK) and the Slovak Technical University.

IBPSA Slovakia plans to continue playing an active role in organising simulation sessions in relevant national conferences, and simulation training workshops.

## Other news

#### Call for papers: ASHRAE Symposium on experience with weather data for simulation and design Minneapolis, 24-28 June 2000

#### Geoff Levermore, UMIST, U.K.

Test reference years, WYECs and TMYs have been around for some years now and simulation is a valuable tool in examining a building's thermal response and energy consumption. But there is little guidance or feedback yet on near extreme weather data for design by simulation. ASHRAE has 1,3,5 and 7-day periods and in Europe there are design summers for natural ventilation assessment. How useful are these and how do they perform? Are other methods, such as repeating a design day or near extreme days better? Papers on experiences using simulation for design and the weather data used, and the selection of the weather data are requested. It is hoped to have a number of papers from a number of countries.

The Symposium is being organized by TC 4.2 and TC 4.7 in collaboration with CIB Task Group 21 Climatic Data for Building Services and will be held at the ASHRAE Annual Meeting 2000 in Minneapolis.

Send abstracts to either Geoff Levermore (geoff.levermore@umist.ac.uk) or Dru Crawley (drury.crawley@hq.doe.gov) by 15th September 1999. The deadline for submitting full papers is 30th October 1999.

#### **BLD-SIM** - a new mailing list for simulation users

#### Michael Witte and Jason Glazer, GARD Analytics

BLDG-SIM is a new e-mail based mailing list for users of building energy simulation programs. Building energy simulation programs allow users to estimate the energy use and operating cost of residential, commercial and other types of buildings. This allows engineers, architects and others in the building design trade to compare alternative designs and select the design that is cost justified. Since the users of building energy simulation programs are spread across the world, this mailing list is

an attempt to foster the development of a community of those users. Examples of building simulation programs include DOE-2, Trace-600, HAP, Blast, ESP, SERIRES, TRNSYS, TASE, Energy-10. Experienced and inexperienced users of all building energy simulation programs are welcome and are expected to share their questions and insights about these programs.

The BLDG-SIM list has about 5-10 messages per week and currently has about 200 members. Since its start in early March it has helped people find:

- sources of international weather files,
- exterior shading algorithms,
- hospital end-use disaggregation,
- atrium chimney effect modeling,
- the best user interfaces for DOE-2

and several other topics.

The BLDG-SIM mailing list is made possible by GARD Analytics in Illinois, U.S.A. For more information, see GARD's Web site http://www.gard.com/ml/bldg-sim.htm. To subscribe to the list, send a blank message to bldg-sim-subscribe@gard.com. The list administrator is Jason Glazer (jglazer@gard.com).

This edition of ibpsaNEWS was designed and produced by David Bartholomew Associates, U.K., dba@compuserve.com

© International Building Performance Simulation Association 1999

### **Conference Registration Form**

Please complete and return this fo	orm to:	Secretariat	use only	
BS'99 Conference Registration S	Secretariat	Date receiv	ed:	
c/o Congress Corporation, Nago Hirokoji YMD Bldg., 1-20-25, Na Facsimile: +81-52-222-4187	ya Office aka-ku, Nagoya 460 –0003 JAPAN	Registration No.		
Notes: Each participant must m Please type or write in bl This maistration form co	ake a separate application and keep copy follock letters, and check appropriate boxes be	or yourself. low.		
1.Name	Prof. Dr. Mr	. 🗌 Ms.)		
	Family Name	First Name	 Middle Initials	
2.Affiliation				
(University, Company, etc.)				
3.Position				
4.Mailing Address				
( Home Office )			Country	
	Phone		Fax	
	e-mail			
5.Accompanying				
Person (Mr.  _ Ms. )	Family Name	First Name	Middle Initials	
	Family Name	First Name	Middle Initials	
	Family Name	First Name	Middle Initials	
6.Registration Fees	Participant Before/on 30 June 1999			
	Member of IBPSA	JPY40,000-	ЈРҮ	
	Non-member	JPY44,000-	JPY	
	Student	JPY20,000-	JPY	
	<u>After 1 July 1999</u>			
	Member of IBPSA	JPY50,000-	ЈРҮ	
	Non-member	JPY55,000-	ЈРҮ	
	Student	JPY20,000-	JPY	
	Accompanying Person(s)			
	Number of Accompanying Fee for accompanying per	; person(s) son(s)		
JPY10,000- x Nur		umber of accompar	nying person(s)	
Total JPY				
Total JPY				

7.Method of Payment			
<ul> <li>A Bank transfer</li> <li>I have remitted the above total of JPY on (date)</li> <li>through (bank name)</li> <li>(Please attach a copy of the remittance receipt to avoid any problems that may arise with the bank transfer)</li> </ul>			
B       Credit Card ( VISA Master Card American Express)         Card No.:			
Signature :			
8.Paricipant Survey         To help the organizers estimate how many will participate in each event, please indicate below which event you or your accompanying person(s) plan to attend.         Welcome party       Number of attendance(s)         Banquet       Number of attendance(s)         Technical Tour       Tour A. Kyoto Station Building         Number of attendonges of Sekisui House R/D center       Number of attendance(s)         Tour B. Simulation technologies of Sekisui House R/D center       Number of attendance(s)         Tour C Osaka Municipal Central Gymnasium       Number of attendance(s)         Tour for accompanying person       Number of attendance(s)			
N.B. Reservation Form for Tours will be transferred separately in near future. If you are author (including co-author) of the paper presented in Building Simulation '99, please put your paper			
number below. My (our) paper number is <u>BS99-</u> / <u>BS99-</u> / <u>BS99-</u> / <u>BS99-</u> /			



Affiliation:	instituti	on or company name		position or title
Mailing Address		postbox, street and number	r	address of D institution / company, D home
		postal code, city		country
		phone	fax	e-mail
Name of Acc	compai	nying Person(s):	family name	first name

#### HOTEL BOOKING

The conference secretariat is pleased to convey that two hotels have agreed to provide special room rates to the participants of Building Simulation '99. Participants are advised to contact hotels of their choice directly mentioning the dates of arrival and departure. The rooms are equipped with two beds which can be shared by two participants if desired. However, the rates vary if shared. Due to limited number of rooms for the special offer, early booking is recommended. Both the hotels are convenient for the conference venue and public transportation. However, slight difference exists. The detailed information is available on their home page. Inquiries related to facilities etc. can be made directly to the hotels by FAX as the Building Simulation '99 secretariat will not be responsible for hotel reservation and will not entertain related inquiries. Please print out, complete, and fax the form to the hotel of your choice.

Hotel Name (The rates include tax and service charges but exclude breakfast. Kindly tick the appropriate boxes)

C Kyoto Standard Twin Superior Twin	Tokyu HotelFax : +8Image: single person(8,000)Yen / nightImage: single person(9,000)Yen / night	81-(0)75-341-2488         nt)       Two persons (13,000 Yen / night)         nt)       Two persons (16,000 Yen / night)
□ Righa □	<b>Royal Hotel Kyoto</b> single room (8,300 Yen / night)	Fax: +81-(0)75-341-3073
Date and Time of Date a	of arrival:	
Sharing accomn	nodation :  Yes No	
II Yes, an	family name	first name
Signature:		Date :

Due to its popularity, Kyoto has accommodation available to suit every taste, from very economic to world-class. Please contact the Conference Secretariat or have a look at our Web pages in case you want information about alternative accommodation.