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Editorial

# Building performance simulation at the start of the 3rd millennium

This special issue is devoted to simulating physical processes in buildings. Simulating energy and airflows in buildings is perhaps the best-known activity, but simulation of light, smoke, moisture, noise and the quality of the indoor environment are often just as important. This special issue gives different perspectives on the state of the art in building performance simulation at the beginning of the 3rd millennium.

Simulation-based Information has the potential to improve competitiveness, productivity, quality and efficiency in the construction industry as well as facilitating future innovation and technological progress. In that respect, successful implementation of software tools and applications in practice will be crucial for Architecture, Engineering and Construction organizations to gain and maintain a competitive edge in the global construction market.

The use of computer-based models for performance predictions has become almost ubiquitous in the design, operation and management of buildings and the systems that service them.

This special issue bears witness to the fact that the building performance simulation field is rapidly evolving. The techniques and applications of building performance simulation are undergoing rapid change. Dramatic improvements in computing power, algorithms, and physical data make it possible to simulate physical processes at levels of detail and time scales that were not feasible only a few years ago. Applications that were not attainable or practicable some years ago are now commonplace.

The building industry, without a doubt, is one of the most important industrial and economical sectors influencing the quality of life and the environment. And yet, planners and property developers pay very little attention during the design process to the life-cycle cost of owning and operating buildings.

Building performance simulation offers the potential to cope adequately with building performance related concerns, as well as with the construction process. Increasingly, computer-based models (programs) are being employed to aid in the design, operation, or management decision making process. The development, evaluation, use in practice, and standardization, of the models and programs is therefore of growing importance. For building design, construction, operation, maintenance and management activities, there is also an urgent need for the integration of "generally applicable" and "generally accepted" methods and tools, for various applications, each having various levels of complexity and/or various types of end-users. Also important is the technology transfer issue within the building modeling field.

The International Building Performance Simulation Association (IBPSA)[1] was founded in 1986 as a non-profit society of building performance simulation researchers, developers and practitioners, dedicated to improving the built environment. IBPSA is an international organization with regional affiliate organizations around the world.

To maintain its leading role in the promotion and development of building simulation technology, IBPSA provides a forum for researchers, developers and practitioners to review building model developments, facilitate evaluation, encourage the use of software programs, address standardization, accelerate integration and technology transfer. So that:

- members all over the Globe find membership in IBPSA worthwhile and profitable in their area of interest;
- governments, industry, utilities and academic institutions look to IBPSA for guidance in determining policies, areas of research, and application development in building simulation;
- local chapters around the Globe benefit from the body of knowledge and experience available through IBPSA;
- IBPSA acts as a clearing house for software products and services in building simulation; members network with other members and societies through electronic means;
- IBPSA provides a framework for strategic alliances for information and cooperation in R&D and technology transfer.

IBPSA covers broad areas of building environmental and building services engineering. Typical topics include building physics (including heat, air and moisture flow, electric and day lighting, acoustics, smoke transport); heating, ventilation and air-conditioning systems; energy supply systems (including renewable energy systems, thermal storage systems, district heating and cooling, combined heating and power systems); human factors (including health, productivity, thermal comfort, visual comfort, acoustical comfort,

[1] IBPSA details are available at http://www.ibpsa.org.


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Fig. 1. View of Sugar Loaf, icon of Rio de Janeiro, near the conference venue.

indoor air quality); building services; and advancements and developments in modeling and simulation such as coupling with CAD, product modeling, software interoperability, user interface issues, validation and calibration techniques.

All these topics may be addressed at different levels of resolution (from microscopic to the urban scale), and for different stages in the building life cycle (from early sketch design, via detailed design to construction, commissioning, operation, control and maintenance) of new and existing buildings worldwide.

One of IBPSA's main activities is the organization of a series of bi-annual international conferences: Vancouver, Canada (1989), Nice, France (1991), Adelaide, Australia (1993), Madison, USA (1995), Prague, Czech Republic (1997), Kyoto, Japan (1999). The most recent was Building Simulation '01 in Rio de Janeiro, (Fig. 1). The next one will be Building Simulation '03 in Eindhoven, The Netherlands (see http://www.ibpsa.org).

The proceedings of Building Simulation '01 in Rio de Janeiro comprise a total of 175 papers from all over the world, and are available as two printed volumes and on CD-ROM. A number of papers have been selected for this special issue of Building and Environment in order to provide an overview of the "state of the field" in terms of the scope of this journal. The papers, which follow, are expanded and improved versions of the conference papers. The process of selection, plus the opportunities for discussions at the conference, has encouraged the authors to revise their papers. In addition, the journal allows more pages than the conference, which allowed for expansions, clarifications, additional references, figures, etc.

It is of course impossible to cover in depth the whole field of building performance simulation in one special issue. Nevertheless we feel that the following 14 papers give a good overview of recent developments, current research interests and future issues.

The paper by Augenbroe provides an extensive overview of trends in building simulation.

Air flow simulation is an area with enormous research and application interest. There are five papers that address advanced techniques and developments in this field. These are the papers by Beausoleil-Morrison, Beausoleil-Morrison et al., Howell and Potts, Musy et al., and Zhai et al.

The papers by Citherlet and Hand, and by De Wilde et al., focus on various aspects integration of building performance simulation in the design process.

Daylight modeling and simulation is the subject of the papers by Glaser and Ubbelohde and by Miguet and Groleau.

Quality assurance is obviously of utmost importance in building performance simulation. Pedrini et al. address this in their paper.

Finally, the papers by Burnett and Du, Holm and Kunzel, and by Riederer et al., provide an indication of the width of the field by discussing issues as far apart as magnetic fields from building electrical installations, heat and moisture transfer in roofs, and heating, ventilation and air-conditioning control systems, respectively.

It is our hope that this special issue provides an interesting view of the state and research interests in building performance simulation at the beginning of the third millennium. It is important to realize, however, that the current state represents only a point on our path towards truly powerful and easy-to-use tools for building and systems design and operation. As has been noted before, hopefully today's state-of-the-art can become the foundation of tomorrow's promise.

Many individuals and organizations have made substantial contributions towards the success of Building Simulation '01 in Rio de Janeiro. In addition to all reviewers, we also would like to particularly thank Ian Beaulsoleil-Morrison, Joe Clarke, Harunori Yoshida, Jeff Spitler and Terry Williamson for their role in the scientific executive committee and in the selection of the papers for this special issue. Our hope is that the many other contributors, including all authors, will be content with collective thanks.

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