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A view of energy and building performance simulation at the start of the 3rd millennium

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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.

IBPSA² (the International Building Performance Simulation Association) 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.

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² IBPSA details are available at <http://www.ibpsa.org>

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, 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. The next one will be Building Simulation '03 in Eindhoven, The Netherlands. (See <http://www.ibpsa.org>)



View of Copacabana beach from the conference venue

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 Energy and Buildings 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 twelve papers give a good overview of recent developments, current research interests and future issues.

There are four papers that address advanced techniques and developments in terms of building air flow modeling. These are the papers by Beausoleil-Morrison, Dorer et al., Von Grabe et al. and Van Treeck et al.

The papers by Ehrlich et al., Lahrech et al., Clarke et al. and Wright and Loosemore focus on various aspects and developments in building control modeling and simulation.

Quality assurance is obviously of utmost importance in building performance simulation. This is the core subject of the papers by Neymark et al. and De Wit and Augenbroe.

Finally the papers by Karola et al. and Zimmermann have to do with new-generation building performance simulation software in terms of tool interoperability and automatic code generation 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.

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