Editorial

Building and Environmental Performance Simulation: Current State and Future Issues

Computer-based modelling and simulation is becoming more and more important for the prediction of future energy and environmental performance of buildings and the systems that service them. Modelling and simulation can and should play a very important role in building and systems design, commissioning, operation and management.

Although most practitioners will be aware of the emerging building simulation technologies, few as yet are able to claim expertise in its application. This situation will soon be improved due to developments and activities such as:

- Introduction of performance-based (EU) standards — as opposed to prescriptive standards — in areas such as energy consumption, quality of the indoor environment, etc.
- Establishment of societies dedicated to promotion and the effective deployment of simulation such as the International Building Performance Simulation Association (IBPSA),
- Growth in small-to-medium-sized practices offering simulation-based services.
- Appropriate training, continuing education, and incorporation in the regular curricula of (higher) educational institutes.

IBPSA was founded in 1986 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. IBPSA’s biannual international Building Simulation conferences in Vancouver, Canada (1989), Nice, France (1991), Adelaide, Australia (1993), Madison, United States (1995), Prague, Czech Republic (1997) and most recently in Kyoto, Japan (1999) have all contributed to this goal. (We expect the next one — Building Simulation ’01 in Rio de Janeiro, to do the same.)

IBPSA covers broad areas of building environmental and building services engineering. Example topics are modelling and simulation of:

- building physics including heat, air and moisture flow, heating and cooling loads, 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 such as lighting systems, sound/vibration control systems, fire/smoke and emergency control systems, cold/hot water supply systems, sewerage systems;
- advances and recent developments in modelling and simulation technology including coupling with CAD, product modelling, software interoperability, user interface issues, validation and calibration techniques.

All these topics may be addressed:

- at different levels of resolution; from urban scale to microscopic scale;
- 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. (Fig. 1)

The proceedings of Building Simulation ’99 comprise a total of 183 papers from all over the world, and are available as three printed volumes and on CD-ROM.

A number of Building Simulation ‘99 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.

The first two papers are of a general nature. In the first paper by Donn the issue of quality assurance in modelling and simulation is discussed. The second paper by Soebarto and Williamson concerns theory and implementation of designer orientated multi-criteria assessment of building performance.

The next four papers are all concerned with indoor environment quality but in different ways. The paper by Huizenga et al. describes an improved multi-node model of human thermo-physiology and thermal comfort. The following paper by Murakami et al. describes the use of modelling and simulation for designing indoor climate so as to attain a given PMV. The paper by Kumar and Mahdavi concerns a combined analytic and case-based reasoning approach to thermal comfort prediction in buildings. The fourth paper by Hayashi et al. describes modelling and simulation of ventilation and indoor air quality in Japanese houses using average daily occupancy schedules.

The next group of four papers each describe a specific building modelling issues. The paper by Matsumoto et al. is about how to model freezing and thawing processes in building materials. The next paper by Wallenten concerns convective heat transfer coefficients in a room with and without furniture. Rees and Haves describe how to model displacement ventilation and chilled ceiling systems in office spaces based on a nodal network approach. In the next paper, Igawa and Nakamura describe a sky luminance distribution model for simulation of daylit interior building spaces.

The last three papers each concerns building and system performance issues. The paper by Sakai et al. concerns simulation of an underground heat storage system that uses nighttime electric power. Karagiozis and Salonvaara describe in their paper the integrated hygrothermal performance of building envelopes and systems. In the final paper, Mahdavi describes the integration of contextual forces into building systems control using modelling and simulation.

It is our hope that this special issue provides a good overview of the current state of building simulation. It is important to realize, however, that the current state represents only a point on our path towards truly powerful, and easy-to-use, design tools for building and systems design. As has been noted before, hopefully today's state-of-the-art can become the foundation of tomorrow's promise.

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J.L.M. Hensen,
\textsuperscript{a}Centre for Building and Systems,
Technische Universiteit Eindhoven,
TNO-TU/e,
P.O. Box 513, 5600 MB Eindhoven,
The Netherlands
E-mail address: jahe@jago.bwk.tue.nl

N. Nakahara
\textsuperscript{b}
\textsuperscript{b}Nakahara Laboratory,
Prof. Emer., Nagoya University,
20-48-2 Harusatocho,
Chikusaku,
Nagoya 464-0038,
Japan