BUILDING SIMULATION IN BRAZIL

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ABSTRACT

This paper describes the building simulation history in Brazil. It started in early eighties, with works on software application and theoretical aspects of building physics. Building Simulation still mainly concentrated in universities with modest application in engineering practice. Some difficulties, motivations and future prospects for the beginning of the 21st century are also discussed.

INTRODUCTION

The 7th IBPSA conference held in Rio de Janeiro, Brazil, the first one in the 3rd Millennium, characterizes the consolidation of a series of initiatives that begun in the early seventies with activities of several research groups looking towards alternative energies and technological innovation in building design. At that time, the world lived the petroleum crises and the scientific community's efforts were addressed to passive and low energy architecture.

Those energy related needs were felt throughout the world and have significantly impelled the development of simulation programs. In the academic scope, several research groups were formed around this need, as well as professional associations, research institutes and departments of Research and Development (R&D) of many companies.

The computer programs developed thenceforward should be able to predict the performance of buildings designed according to energy saving concepts (bioclimatic architecture), and allow the choice of clean energy alternatives such as solar.

The aspects related to energy consumption of large residential and commercial buildings, leaded to the development of computer programs able to analyse complex scenarios. The objective was the reduction and rational use of energy in constructions characterized by many factors that could be taken into account such as geometry, schedules of use, lighting and HVAC systems.

The need to know about detailed behaviours of physical phenomena and the fantastic computer advances conducted many research groups to develop simulation programs in the 70's and 80's such as NBSLD, HVACSIM, DOE-2, BLAST, ESP-r and RADIANCE. More recently with the extraordinary advance of computer hardware and software technology, CFD programs started to be developed and intensely used such as FLUENT, CFX and PHOENICS. The results found by those simulation programs can be directly used for the understanding of building thermal behaviour, providing data such as room air temperature distribution, air speed and pressure fields, humidity and light for environmental comfort analyses.

The development of those building simulation packages and the birth of post-graduate programs in Brazilian universities contributed to promote the formation of building simulation groups in the country working on software application and theoretical aspects of building physics. Genuinely, NBSLD was the first building simulation program to run in the 80's at the Institute of Technological Research (IPT), in São Paulo. At that time, most of the research in Brazil used to be directed towards heat transfer modelling and hygro and thermophysical properties evaluation. In the early nineties, many other computer programs started to be used in the country such as DOE-2, ESP-r, TRNSYS, BLAST, FLUENT, PHOENICS, RADIANCE and HVACSIM.

In the next section, the history of building simulation in Brazil is briefly described. Then the motivations and difficulties for simulating in Brazil are elucidated. At the end, a brief description about the 6-city project, funded by PROCEL, is done to show the great efforts and the fast growth of simulation in different parts of the country.

BRAZIL AND SIMULATION

In the eighties, some research groups in Brazilian universities disquieted with energy crises in the seventies, begun a series of studies on building energy conservation. In the Mechanical Engineering Department of Federal University of Santa Catarina

(UFSC), 2 groups should be mentioned: the Passive Thermal Systems Laboratory (SITERPA) and the Center for Refrigeration, Ventilation and Air Conditioning Research (NRVA). In the Federal University of Rio Grande do Sul (UFRGS), we shall cite the solar energy and the construction groups and in São Paulo, the Institute of Technological Research (IPT), the University of São Paulo and the Federal University of São Carlos among others. As those groups have produced new doctors in Building Simulation and some students went abroad for their PhDs. In the end of the 20th century, new groups have emerged in different places of the country, such as the Laboratory of Thermal Systems (LST) at the Pontifical Catholic University of Paraná (PUCPR), the Federal Center for Technological Education of Paraná (CEFET-PR), the State University of Londrina (UEL) and the State University of Maringá (UEM), among many others that have been exhaustively using building simulation programs.

In order to know about the use and development of building simulation all over the country, a questionnaire was elaborated, which was answered by Brazilian researchers that had submitted abstracts to this 7th IBPSA conference. Most of the consulted researchers work in educational institutions. Actually, this condition is not different from the remaining research areas in Brazil, where there is a higher concentration of people with doctor degree in universities, less in research institutes and, finally, only a few in private companies.

The majority of the Brazilian building simulation community uses well-known simulation tools. There are references to old codes such as NBSLD and HVACSIM, and to more recent programs that are still being developed such as ESP-r, DOE-2, ENERGYPLUS, BLAST, TRNSYS, FLUENT, RADIANCE. When there is a concern to develop the user's own routines, the most used program is TRNSYS, followed by ESP-r. For routines creation in a generic environment, the choice was for MATLAB/SIMULINK.

The development of national simulation tools is relatively small, and we can highlight UMIDUS, for the prediction of heat and mass transfer in building structures, SPTE for building thermal performance and thermal loads prediction using the transfer function method. More recently, an Object Oriented Programming (OOP) simulation code called DOMUS has been developed, focused on investigation of passive cooling strategy alternatives.

Below, we describe most Brazilian groups involved with building simulation studies and we apologize for not mentioning everybody working on the building simulation area in Brazil. More recent work can be found in other papers published in these proceedings.

Federal University of Santa Catarina (UFSC) - SITERPA

In the early eighties, a group of researchers at the Department of Mechanical Engineering of Federal University of Santa Catarina (UFSC), concerned with the second petroleum crisis, begun a series of studies on how could the energy consumption in the built environment be reduced. The use of passive devices and rational architectural design was intended (Philippi et al., 1985; Philippi et al., 1986).

The Passive Thermal Systems Laboratory (SITERPA), as the group was called, grew up with the arriving of graduate students and lecturers from other departments such as Architecture and Civil Engineering. Initial works have been developed on several different aspects of the thermal environment in buildings. Internal radiation field had been one of the first aspect analysed by Pereira's (1984) Master dissertation; other works have followed in this subject (Philippi et al., 1983; Schneider, 1990; Schneider et al., 1990). Other aspects were simultaneous transfer of heat and mass in porous building materials (Souza and Philippi, 1985; Souza, 1985; Silveira Neto, 1985), convection (Biage and Philippi, 1985) and building simulation (Philippi, 1985; Souza and Philippi, 1986; Silveira Neto and Philippi, 1986; Abreu, 1986; Cunha Neto et al., 1988; Nicolau et al., 1988; Schneider et al., 1989; Nicolau and Philippi, 1990).

A code has been written using the transfer function method for the thermal performance simulation of buildings, including radiative exchanges. The code SPTE was used to estimate the cooling loads of a whole training centre of the South Brazil Electricity Company (Eletrosul). The 4000m^2 buildings incorporated ventilated roofs and burried pipes as passive systems and the simulation showed that it would be possible to reduce up to 70 percent the cooling loads when compared to those estimated by conventional air conditioning design procedures and without the use of passive devices.

By that time, a sever lack of data for Brazilian building material properties and climate was detected, which compromised the obtained results of thermal performance simulations. The typical hot and humid climate predominant in most of the Brazilian territory and particular characteristics of local masonry materials used, made the Laboratory turn its attention to the measure and prediction of hygrothermal properties of porous building materials. Several research projects were dedicated to develop instruments, procedures and equipment to thermal properties measurement. (Güths et al., 1990; Schneider et al., 1990; Fernandes et al., 1990a, b). At the same time, the study of heat and mass transport processes, which take place in the microstructure of porous building materials have been undertaken to predict thermal properties, required for thermal simulation, using microstructural description of the porous medium (Perin et al., 1987; Quadri, 1988; Quadri et al., 1988; Quadri and Philippi, 1988; Fernandes et al., 1989, Fernandes et al., 1990a, b, Guths, 1990; Fernandes, 1990).

In the nineties, with the continuous growth of the research domain, the group has been divided in three new laboratories, each one attached to a different University department but still working in cooperation: LMPT- Laboratory of Porous Media and Thermophysical Properties at Mechanical Engineering department, LabEEE - Building Energy Efficiency Laboratory at the Civil Engineering department and LabCon – Environmental Comfort Laboratory at the Architecture department. LMPT (www.lmpt.ufsc.br) has continued in the Mechanical Engineering department and concentrates its research efforts in transport properties of porous materials, including among others, concrete, mortar and wood (Souza et al, 1991; Yunes, 1992; Philippi, 1991, Philippi, 1993). In these works numerical and experimental approach have been used (Cunha Neto and Daian, 1993; Yunes et al., 1994; Bueno, 1994; Guimarães et al., 1995; Philippi and Souza, 1995; Guimarães et al, 1997; Mendes, 1997; Mendes et al., 1999; Mendes et al., 2000c).

Federal University of Santa Catarina (UFSC) – LabEEE

In 1992, DOE-2.1E and ESP-r were brought to Brazil and research on building simulation started for energy analysis all over the country. At that time, it was a great challenge, since there was a sever lack of weather files and also a need to adapt the construction libraries. Goulart´s (1993) M.S. dissertation focused on the treatment of national weather data measured in airports to use on building energy simulations. Using the TRY weather file obtained for the city of Florianópolis, Bulla (1995) carried out parametric simulations on DOE-2.1E to analyse the thermal performance of office buildings in terms of architecture variables. Gómez and Lamberts (1995) also made parametric simulations for building electric energy consumption sensitivity analysis. This research was performed by the energy staff of the Building Research Centre (NPC), at Civil Engineering Department, with participation of the LMPT and LabCon. In 1994, the NPC became the Resource Center of DOE-2.1E in South America. In 1996, the Energy research area of the NPC was consolidated in the Building Energy Efficiency Laboratory (LabEEE – www.labeee.ufsc.br).

At that time, the LabEEE was contracted by Eletrobrás/PROCEL (National Electric Energy Efficiency Program) to design the 6-city project. In this project, two office buildings in each city under analysis would be retrofitted as it is described in the “PROCEL and the 6 city-project” section. The retrofit alternative analyses were simulated by using the software VisualDOE (Lamberts et al., 1998). In that research project, the LabEEE occupied a strategic position, offering the necessary support in Building simulation to other research teams. The difficulty of training new building simulation groups was noticed, given the complexity of the inputs required for good accuracy predictions. This has lead to the development of E2, Windows software to be used in retrofit analysis of commercial buildings.

In November 1997, after the Doctorate thesis of Mendes (1997) the development of a Windows version of the software UMIDUS (Mendes et al. 1999) was started to predict heat and moisture transfer through porous building elements.

Focused on building simulation, Pedrini´s (1997) M.S. dissertation showed different accuracy levels of an office building model calibration by improvement of building constructive variables, chillers efficiency and schedules. Goulart et al. (1997) presented weather data summary oriented to thermal performance analysis of buildings heating and cooling loads calculations. TRY weather files were also developed. Pietrobon´s (1999) Doctorate thesis estimated the energy savings provided by natural external shading in school buildings by using DOE-2.1 E. Signor (1999) in his M.S. dissertation developed a correlation to estimate building electric energy consumption as a function of 10 electric and architectonics variables for 14 Brazilian climates. More than 7000 parametric simulations were carried out and regression analysis was used to obtain simple equations. These equations are one of the starting points to the development of energy efficiency standards for commercial buildings in Brazil. Recently, the LabEEE has been working on the development of a simplified energy simulation tool to support Architects, Engineers and Air-conditioning designers in energy audits and preliminary analysis of building system and construction component alternatives. This tool would take advantage of the public algorithms of EnergyPlus – released in May 16th, 2001. By sensitivity analysis, some EnergyPlus inputs will be defaulted to reduce the interface complexity.

Federal University of Santa Catarina (UFSC) - LabCon

The Laboratory of Environmental Comfort (LabCon – www.arq.ufsc.br/labcon) was created in the department of architecture in 1993. In LabCon, 12 M.S. dissertations and 1 Doctorate thesis were concluded and most of them have used daylight simulation tools such as RADIANCE, LIGHTESCAPE and LUMENMICRO.

LabCon's main focus has been on the Evaluation of the Potential of Daylighting for Improving Spatial Perception, Life Quality and Electric Energy Savings in the Built Environment.

Souza (1995) and Bogo (1996), studied the impact of daylighting on energy consumption using the DOE-2 code for computer simulations. Almeida (1995), Goulart (1997), and Pegas (1998), focused on the visual perception and the interaction between user and space, with Pereira (2001) giving an initial step in the photometric characterization of spatial lighting. Souza (1997), Cabus (1997), Amaral (1999), Zeilmann (1999), and Grazziano Jr. (2000), worked on parametric simulations regarding design variables impact on daylight use. Claro (1998) has developed an innovative approach for implementing radiosity algorithm in a computer code for daylighting calculations.

Federal University of Santa Catarina (UFSC) - NRVA

In 1986, soon after the conclusion of Melo's (1985) PhD thesis, four lectures of the Department of Mechanical Engineering of Federal University of Santa Catarina (UFSC) have joined their efforts to establish a new research group: NRVA (Centre for Refrigeration, Ventilation and Air Conditioning Research – www.nrva.ufsc.br). At the time, work on the modelling of convective heat transfer (Melo, 1986a and 1986b) and air infiltration (Melo, 1987a and 1987b) was conducted. Development of view factors for attics (Hoays and Melo, 1990) and modelling of solar radiation under cloudy conditions (Rzatki and Melo, 1993) were also contributions of NRVA. Since 1990, NRVA has developed research on the simulation of HVAC systems (Marques and Melo, 1990, Marques and Melo, 1993, Negrão and Melo, 1992) and has modelled forced ventilated evaporators (Souza and Melo, 1996). From 1997 to 1999, some papers on the integration of HVAC systems and building thermal simulation were published (Correa, et al., 1997 and Correa et al. 1999). Integration of air flow models of different resolution (Negrão, 1997) and human thermal comfort predictions (Carvalho et al., 1999) were also developed. NBSLD was used in mid eighties, while HVACSIM and ESP-r in the nineties.

Federal University of Santa Catarina (UFSC) - SINMEC

Since 1980, in the Laboratory of heat transfer and fluid mechanics simulation (SINMEC - www.sinmec.ufsc.br), faculty members and a team of graduate and undergraduate students are developing strategies to solve engineering problems that deal with fluid dynamics, heat and mass transfer. They have been working on CFD modeling and simulation involving environmental flow among many other subjects.

Federal University of Rio Grande do Sul

In the Federal University of Rio Grande do Sul, two groups were involved with building simulation: the solar group and the building research group. The solar group has started working with weather files for solar energy analysis with TRNSYS and passive solar architecture (Vielmo, 1981), while the building research group was exclusively working on building physics (Lamberts, 1983) and software development. The software THEDES, based on the BRE (UK) admittance procedure, was developed by Sattler (1986) for building thermal performance evaluation. From the solar group, a thermal science team was formed after the Doctorate of Schneider (1994). This group was involved with software development (Schneider et al., 1994a, Schneider et al., 1994b, Schneider, 1995a, Schneider, 1995b, Schneider, 1995c, Schneider and Kühn, 1997, Peres et al., 2001).

Institute of Technological Research and University of São Paulo

Since 1976, the Institute of Technological Research (IPT) has a group working on building thermal performance evaluation. In 1980, the group started to run the NBSLD program in a mainframe computer. During the 80's this program was used as a tool for thermal performance evaluation of buildings without air conditioning systems. In 1986, the program was adapted to run in a microcomputer and many modifications in the routines were introduced. These modifications include determination of indoor air humidity in unconditioned buildings, improvement in the response factor determination to reduce the calculation time, to determinate the indoor convection heat transfer coefficient as a function of the difference of temperature between the indoor air and the internal surface and variable emissivity of surfaces.

In 1994, IPT started to collaborate with the Department of Mechanical Engineering of the São Paulo University, forming a group of 5 researchers (Tribess et al., 1998, Tribess et al., 1999, Sato, 1983, 1998). The main goal of this new group is the use of simulation programs like ESP-r, DOE 2, BLAST and recently, EnergyPlus. This group is involved with software validation/calibration and some results of their studies are 4 M.S. dissertations and 2 Doctorate thesis.

Also in the state of São Paulo, São Carlos city, we should mention the development of ARQUITROP (Roriz and Basso, 1990), thermal simulation software based on the BRE (UK) admittance procedure and also the work of Jabardo (Jabardo, 1986, Jabardo, et al., 1986, Jabardo, 1987).

Pontifical Catholic University of Paraná (PUCPR) – LST

Mendes (1997) during his Doctorate in collaboration between UFSC/LMPT and the Simulation Research Group at the Lawrence Berkeley National Laboratory (LBNL), in California – USA, developed mathematical models for estimating material properties and predicting heat and moisture transfer through porous building elements and elaborated the DOS version of the UMIDUS program (Mendes, 1997). In 1998, a new laboratory for refrigeration, air conditioning and building simulation research called Laboratory of Thermal Systems (LST, www.pucpr.br/pesquisa/lst) emerged at the Pontifical Catholic University of Paraná (PUCPR), developing in collaboration with LabEEE the software UMIDUS 2.0 for Windows. In collaboration with UFSC/LMPT, a new method to solve highly coupled equations of heat and moisture transfer through porous building materials have been developed (Mendes et al., 2001a).

Since 1999, cooperation was established between LST and LAS (Laboratory of Automation and Systems) with the goal of integrating the areas of building thermophysics and process control by using MATLAB/SIMULINK (Mendes et al. 2000a, 2000b, 2001b; Oliveira et al., 2001).

Also in 1999, a lecturer from PUCPR/LST began a Doctorate program on building simulation at University of La Rochelle – France, developing a zonal model for evaluating simultaneous heat and moisture transfer in conditioned spaces by using SPARK. It also should be mentioned the participation of LST in the 6-city project with the simulation of the Headquarter building of the local telephone company (Mendonça and Mendes, 2001).

More recently, an OOP building simulation program called DOMUS (Mendes et al., 2001c) has been developed at LST, which has been mainly focused on the investigation of passive cooling strategy alternatives and moisture effects on the building hygrothermal performance.

STIMULUS FOR USING SIMULATION PROGRAMS IN BRAZIL

Energy used in buildings is about 48.3% of the total electric energy consumption in Brazil (MME 1999). Figure 1 shows the evolution of the energy consumption in the residential, commercial and public sectors from 1982 to 1998.

The residential sector accounts for half of this consumption and the other half is in the commercial and public sectors. Table 1 presents the annual energy consumption growth per sector. The growth of the commercial sector is generally larger. The residential sector presented the largest growth from 1994 to 1996, mainly due to more houses being connected to the system and the economic stability that resulted in a high consumption of appliances. From 1994 to 1995 the growth was very high, reaching 13.6% in the residential sector and 11.8% in the commercial sector.

Table 1 Annual energy consumption growth per sector.

Years	Residential	Commercial	Public
1990-91	4.9%	2.3%	3.4%
1991-92	1.6%	6.5%	3.9%
1992-93	3.4%	5.7%	5.4%
1993-94	4.3%	5.4%	4.5%
1994-95	13.6%	11.8%	7.5%
1995-96	8.6%	7.7%	4.3%
1996-97	7.3%	9.8%	7.3%
1997-98	7.1%	8.9%	5.5%
1998-99	2.5%	4.8%	1.7%

Figure 1 also shows the growth of the Gross Domestic Product. It is possible to see that the energy consumption growth is linked to the gross internal product growth, showing no improvement of the energy efficiency in general terms. This is different from what was seen in USA and Japan where energy efficiency improvement was on the agenda.

An improvement in energy efficiency should be understood as providing the same service using less energy than before. Building design in Brazil has not been pushed towards energy efficiency due to the lack of standards and lack of professionals trained to act in this interdisciplinary field. A survey by Janda and Busch (1994) about building energy efficiency standards in 57 countries shows that Brazil is one of the 13 without standards. The survey shows that 27 countries have mandatory standards that restrict the energy consumption of new buildings, 11 have voluntary standards and 6 are in the process of developing standards. The only standards in this area in Brazil are NBR 6401 and NBR 5413 but they deal only with the design of air conditioning and lighting systems without any consideration for energy efficiency and the influence of the building design. It should be noted that Brazilian air conditioning standard is very outdated and its application is encouraging over-sizing and inefficiency (Lamberts and Westphal, 2000).

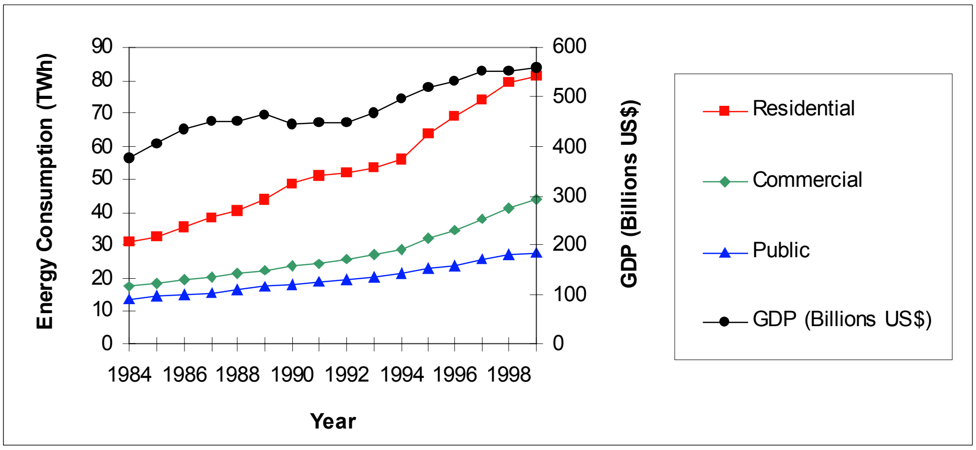


Figure 1. Electric energy consumption in the residential, commercial and public sectors compared to the gross domestic product.

After the oil crisis in the seventies, many countries started to look for different ways of improving building energy efficiency. In the USA and Europe, where the economy was very dependent on oil, great efforts were made through the development of building standards and the results were encouraging.

In Brazil, due to the vast hydroelectric potential (Fig. 1), up to a few years ago the energy scenario was based on supply side management with the economy growth based on cheap and abundant electric energy. Recently, energy efficiency investments became essential due to low rainfall, demand growth and the lack of investments in the supply side.

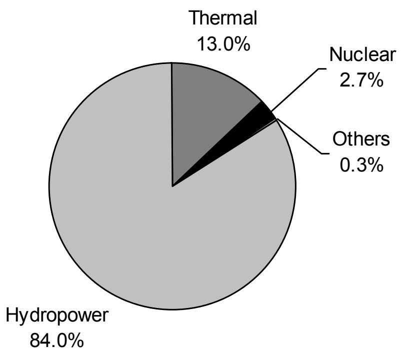
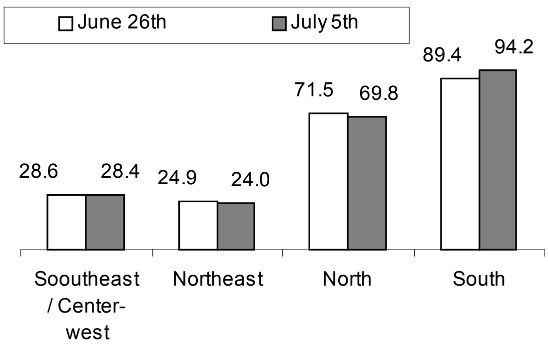


Figure 2: Brazilian electrical energy sources (BEN, 2000).

Fig. 3 shows the percentage of water level in the hydroelectric reservoirs for the 5 Brazilian regions. It can be seen how critical the situation is for the Southeast, Centre-West and Northeast regions, with high risks of blackout problems.

a)



b)

Figure 3a: Percentage of water level of reservoirs for each region (www.ons.org.br). Figure 3b: Brazilian map with its 5 regions.

Due to the low water level of Brazilian hydro plants reservoirs, the government has enforced since June 1st, 2001, the Southeast, Central-West and Northeast regions to reduce at least 20% of their electrical energy consumption when compared to the same period in 2000. This energy crisis situation has brought building energy efficiency to the agenda and energy efficiency building standards should be developed and implemented soon. The use of building energy simulation is expected to increase rapidly with this scenario.

DIFFICULTIES FOR USING SIMULATION PROGRAMS IN BRAZIL

As it was quoted before, a questionnaire was specially created, for this 7th IBPSA conference, and sent to all people who had submitted their abstracts. According to the results of this questionnaire, the researchers manifested that one of their larger difficulties is related to the lack of complete and reliable weather data for different parts of the country. Actually, only in 1997, the first TRY weather file database for 14 Brazilian cities (Porto Alegre, Florianópolis, Curitiba, Belo Horizonte, São Paulo, Rio de Janeiro, Brasília, Vitória, Salvador, Natal, Recife, Fortaleza, Belém and Maceió) was published by Goulart and Lamberts (1997). These data can now be freely downloaded at the LabEEE homepage (www.labeee.ufsc.br). However, these files do not have solar radiation data.

An important comment registered in the questionnaire was the absence of legislation for energy efficiency in new Brazilian buildings. This topic was expressively remarked, because it is from design recommendations and performance prescriptions that the building simulation area will grow up in the country.

Other comments in the same questionnaire were about the appropriateness of existing building simulation programs for the Brazilian reality in terms of climate and local building typology. A big concern is with simulation of naturally ventilated buildings. It was also noticed the lack of interoperability between simulation tools and this is one of the reasons for modest use of building simulation in design practice.

PROCEL AND THE 6-CITY PROJECT

In 1985 the federal government and Eletrobrás (Federal Utility Holding Company responsible for planning for the electricity sector) decided to create the Brazilian Electricity Conservation Program (PROCEL) The role played by PROCEL so far has been strongly oriented to end use efficiency and has failed to see the importance of the building as the depository of all the end uses with high influence on the energy consumption. A report by Lamberts et al. (1996) reviews the state of art of energy efficiency in buildings in Brazil for PROCEL. The past actions of PROCEL related to buildings are discussed and it is possible to see the lack of long time planning and lack of dissemination of results. At the end of the report a list of action were suggested to improve the buildings program inside PROCEL.

In order to help the development of energy efficiency building standard in Brazil, to demonstrate state of art technologies and to encourage the use of hourly building simulation programs, PROCEL started the "6-City Project" in 1997 in collaboration with UFSC/LabEEE. The project was developed in six cities around the country with a standard methodology, which was developed and applied for commercial and public buildings. The six cities chosen were: Florianópolis, Curitiba, Rio de Janeiro, Belo Horizonte, Brasilia and Salvador. Those cities were representative of three different climates (Brazil has six) covering the most densely populated area of the country. A database was created with information on energy consumption intensity and demand intensity in 15 buildings in each city. The database was designed to help the standards development. Among those buildings, in each city, two were selected, one public and one private, for a detailed energy audit. The audit data was used to calibrate a DOE-2.1E simulation model using real weather data files. Simulations were performed and state of art technologies for energy efficiency was tested. Lamberts et al. (1998) present the methodology used, the energy consumption database, techniques used for simulation calibration and the some retrofit studies performed in terms of lighting and HVAC systems. The results from this project are very encouraging and helpful for similar projects in other cities.

During the project, it was observed a high difficulty for software training and a need for appropriated tools for using in the field. It was also noticed that for model calibration, the electric load data available from the electric utility meter could be very useful.

The results demonstrated that the use of simulation is important to reach accuracy in the prediction of retrofit and payback time. The payback time outcome was long and this, associated with economic instability of the country and high interest rates has lead to most of the retrofit suggestions not been implemented.

CONCLUDING REMARKS AND FUTURE TRENDS

Civil and Mechanical Engineers and Architects form the Brazilian building simulation research community. It is not numerous, but it has been expanding in the last years.

Nowadays, the electric power supply problems will certainly instigate once again the development of research and simulation tools adapted to the local users' needs.

Challenges to increase the simulation use in Brazil are: good quality weather data (including solar radiation); appropriate representation of naturally ventilated buildings; energy efficiency in building standards and interoperability between tools.

With the organization of the 7th IBPSA Conference in Rio de Janeiro, the creation of IBPSA-BRAZIL, it is foreseen the number of building simulation program users and developers in Brazil to be significantly increased.

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