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IISABRE: An Integrated Building Simulation Environment

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An integrated building simulation environment, IISABRE, is introduced. IISABRE consists of CABD, BTP and IISPAM. CABD is an AutoCAD-based building descriptor enabling users to draw a building and define information. Some design tools are built into CABD, and a STEP-based building database can be generated, which provides an open mechanism to share the building database with other programs. BTP is a program for the detailed dynamic simulation of building thermal performance. With a PC 486DX50 (8M RAM) running in MS-Windows 3.11, BTP needs about 40 minutes to calculate the annual hourly energy demand for a building with 20 zones. IISPAM is a knowledge-based system for translating the STEP-based building database into ASCII-based data files for BTP. IISABRE can be widely employed in the field of building environmental engineering in order to improve the energy efficiency of buildings and the thermal comfort of the indoor environment. © 1997 *Elsevier Science Ltd.*

INTRODUCTION

RESEARCH by the BRE (Building Research Establishment, U.K.) and others shows that about 50% of building failures originate from design, while 40% of failures are due to construction. An integrated approach to building design is the key to the improvement of building quality and the reduction of construction, maintenance and operation costs. Despite the increasing use of computer-aided design tools developed during the recent decades inside and outside IEA (International Energy Agency) projects, their integration into global energy analysis in design practice has not been achieved until now. The main barriers to integration are the lack of a common model for describing a building and its components and services, and a method for the exchange of geometrical as well as non-geometrical data between different computer applications [1]. There is a quickly growing gap between what the scientists are offering as calculation and simulation tools and what is really used in current practice.

Simulation should be applied in all stages of the building design process, so that a quick feedback on design implications can be given. IEA Annex 30 "Bringing simulation to application" will focus on the removal of technical and/or nontechnical obstacles in order to put simulation into a practical design process [2]. Good simulation programs should be:

- as correct as possible (by the use of guidelines and rules);
- as appropriate as possible (fit the input requirements of the models to the design practice);
- as easy as possible (through good training and a user interface).

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To encourage designers to use simulation programs self-consciously, an integrated building simulation environment (IBSE) [3] should be provided, which integrates good programs to be used for different purposes at different design stages.

IISABRE (Intelligent Integrated System for the Analysis of the Building theRmal Environment) is such an IBSE developed by the HVAC Division of Tsinghua University [4], which consists of CABD, BTP and IISPAM. CABD is an AutoCAD-based computer-aided building descriptor, which provides users with a graphic interface to draw a building and describe its objective information. Some design tools are built into CABD, such as insulation checking, condensation risk analysis, and design heating/cooling load calculation. In addition, a STEP-based building database can be generated within CABD, which provides an open mechanism with which to share the building database with other simulation programs. BTP [5] is a program for the detailed dynamic simulation of building thermal performance. BTP can generate the building thermal model, and simulate the hourly zone temperature and the annual energy demand of buildings. IISPAM is a knowledge-based system for translating the STEP-based building database into ASCII-based data files required by BTP, simultaneously appending empirical coefficients according to the simulation purpose and knowledge base. The architecture of IISABRE is shown in Fig. 1.

CABD: COMPUTER-AIDED BUILDING DESCRIPTOR

General information

CABD is a computer support environment for architects and HVAC engineers to draw an illustrative view of a building and describe geometrical and thermal infor-