Chapter 9
New Challenges to Teaching Technical Disciplines in Architecture Schools:
From Energy Simulation to Online Tools

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ABSTRACT

The goal of teaching zero energy building design in architecture schools has to be tackled by different approaches, from design disciplines to building science, combining traditional and new teaching methods. Current curricula at architecture schools are trying to introduce design courses according to the so-called integrated energy design. This chapter studies current building science and technology teaching strategies, examples of student work at Keene State College in New Hampshire (US), the competencies acquired in each course, and the impact of the technical disciplines on design studios. Finally, the impact of building information modeling (BIM) and building performance simulation (BPS) on the teaching of technical disciplines in architecture programs are evaluated. The essential goal of this chapter is to determine and establish some techniques for using BIM and BPS as adequate tools to teach sustainable building design and construction.

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INTRODUCTION

The low cost of personal computers, which were, just decades ago, accessible to a few institutions and companies, has now replaced the desktop calculator. However, a computer is more than a calculator, as it serves as an audio-visual and communication medium. Thus, the same device used to process the calculations serves as access to a vast amount of information on the Internet. The ease of exchanging, copying, and transporting information also creates difficulties in developing certain types of computer programs. The information itself currently lacks value, whereas knowing what to do with it does not. The development of complex, task-specific programs is usually done under the direction of a software company. Its content is normally kept private to increase productivity and thus the company's competitiveness. Students beginning their architecture program in 2022 will start their careers when buildings with almost zero energy consumption are the required standard. Those high energy-efficient buildings need to be designed appropriately, using Building Information Modeling (BIM) standard software combined with energy simulation software. Current curricula at architecture schools are making an effort to teach design courses according to the BIM standard and elements of the so-called integrated energy design. O'Donnell et al (2013) stated that the challenge of designing buildings with high energy efficiency has to be tackled by different approaches, from design disciplines to building science, combining traditional and new teaching methods. The theoretical classes are supplemented by the design studios and the simulation workshops. This chapter presents examples of teaching methods, and experiences in educating future architects. It includes state of the art in teaching building science and building technology. It shows examples of student work and analyzes the impact of technical disciplines in design studios. Examples of student work at Keene State College in New Hampshire (US), the competencies acquired in each course, and the impact of the technical disciplines on Design studios are analyzed. Finally, the impact of the introduction of Building Information Modeling (BIM) and Building Performance Simulation (BPS) on the teaching of technical disciplines in architecture programs are evaluated. The essential goal of this chapter is to determine and establish some techniques for using BIM and BPS as adequate tools to teach sustainable building design and construction.

Background

Programs such as DOE2 (US) emerged due to the slow but steady investment of the American administration since 1970. Around the same time, the Building Loads Analysis and System Thermodynamics (BLAST) was commissioned by NIST (USA). The development of simulation software began with FORTRAN, which has evolved into C++ or JAVA, which are more object-oriented. Other programs, such as the Transient Simulation of Systems (TRNSYS) of the University of Wisconsin-Madison (USA), were not initially oriented toward productivity or industry because of their university origin. However, applications have recently been developed to generate D-models with greater ease and productivity (SimCAD). Finally, the best of DOE2 and BLAST came together in a new Energy-Plus simulation engine.

For the time being, Europe does not have a pan-European organization that centralizes and brings together the effort to develop this type of software in the American way. Several programs exist with different approaches, such as commercial, free or open-source developed autonomously by some member states. For example, the Danish Institute for Building Research developed BSIM, and the University of Strathclyde in Glasgow developed Environmental Systems Performance - Research ESP-r. IDA-ICE, a commercial program with a standard simulation engine, was launched in Sweden with various ap-