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EDUCATING THE DESIGN PROFESSIONAL

ENERGY-CONSCIOUS DESIGN FOR COMMERCIAL BUILDINGS

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EDUCATING THE DESIGN PROFESSIONAL: ENERGY-CONSCIOUS DESIGN FOR COMMERCIAL BUILDINGS

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ABSTRACT

To date, much emphasis has been placed on developing educational programs and written information about applying energy conservation and renewable energy to residences. Less emphasis has been placed on energy-conscious design and the use of renewable energy resources in commercial buildings (defined here as nonresidential buildings). The energy problem in a residence is substantially different from that in a commercial building; therefore, the approach to using renewable resources in a commercial building differs from that in a residence. For this reason, educational materials, seminars, and workshops developed to teach architects and engineers basic design principles to integrate renewable energy into commercial buildings must differ from that developed for residential building designers. The purpose of this paper is to identify some of the differences in approach between residential and commercial solar design, discuss what the Solar Energy Research Institute (SERI) Commercial Buildings Group has learned about educating commercial building design professionals through experience, and describe the American Institute of Architects (AIA) national effort to educate architects about energy-conscious design.

1. INTRODUCTION

Buildings account for 37% of our nation's energy use. Of this amount, approximately 10.4 quads of energy are used in commercial buildings, and 16 quads are used in residential buildings.

To date, using energy conservation and renewable energy in residences has generated much publicity. The U.S. government has emphasized residential solar demonstration and education programs. Most local bookstores carry many books on residential energy conservation and solar design. It is estimated that over 400,000 residences in the United States use solar energy for heating, cooling, or hot water.

In contrast probably less than 500 commercial buildings in the United States can be cited as good examples of energy-conscious design (defined as the appropriate use of both energy conservation and renewable energy resources available at the site), and generally bookstores do not carry books on energy conscious design for commercial buildings.

Energy-conscious design can be used successfully in commercial buildings. Based on preliminary data gathered under the Department of Energy's (DOE) Passive Commercial Buildings Program, an energy-conserving conventional building (one which is well insulated with a very efficient HVAC system) requires about 50% of the energy used by a typical commercial building, and a climate-adapted commercial building (one that optimizes the use of renewable energy resources found at the site) can reduce a building's conventional fuel usage 70%-80%.

2. DEFINING THE DIFFERENCES: RESIDENTIAL VS. COMMERCIAL

As building design professionals, who are familiar with energy conscious design, know the approach to developing an energy conscious design for a residence differs substantially from that used for a commercial building. Thus, information developed to teach design professionals about energy-conscious design for commercial buildings differs from that being generated about residential.

In a residence, where heat generally is the dominant energy use, energy requirements are typically determined by the heat loss or gain through the building's envelope walls. Obviously, this is not true in most commercial buildings where the type of energy required generally is a function of the buildings internal loads; i.e., lights, people, and equipment. A building designer who assumes that heating is the dominant energy requirement in a commercial building may develop a design that solves the wrong problem. In a commercial building, determing how energy will be

used and determining an appropriate solution to the energy problem is more complex than in a residence. This is because of the dynamic interrelationship of the heat being generated from lights, people, and equipment; the relationship between heating and lighting; and the relationship between air conditioning and lighting.

Of course, the range of possible energy conscious design solutions is greater for a commercial building than a residence. In residences most solutions involve heating strategies. In commercial buildings, solutions must address several problems simultaneously; i.e., various combinations of lighting, heating, and cooling levels.

Energy-conscious designs can not be generalized for commercial buildings. The energy design solution must address the predicted energy pattern of a particular building on a given site. For this reason, emphasis must be placed on understanding how the proposed building will use energy; and, based on this analysis, appropriate design strategies must be developed and analyzed to reduce the building's energy requirements.

3. THE SERI COMMERCIAL BUILDINGS GROUP'S EDUCATION PROGRAM

Under the sponsorship of the Solar Federal Buildings Program, the SERI Commercial Buildings Group has sponsored week-long and 2-1/2 day short courses on energy-conscious design for commercial buildings during the past two years. Courses were taught to architects and engineers primarily employed by federal agencies. One agenda was used for both engineers and architects because when energy is a key factor in the design of a building, both the architect and engineer need to be involved in the design process from day one. This way architects learn about engineers' energy issues and concerns and vice versa.

The 5-day course covered the following topics:

Day 1

- Introduction to Solar Design
- Solar Fundamentals
- Passive Solar Techniques
- Active Systems
- Industrial Process Heat

Day 2

- Active System Components
- Building Energy Requirements
- Active Subsystem Components
- Design/Sizing Techniques for Passive Systems

Day 3

- Design/Sizing Techniques for Active Systems (with example)
- Tour of Solar Buildings

Day 4

- Energy Conservation in Buildings
- Case Study
- Daylighting
- The Solar Design Process
- Architectural/Engineering Concerns and Construction Documents
- Case Study

Day 5

- Solar Economics
- Costing
- Instrumentation and Monitoring
- Summary and Wrap-up

A comprehensive Solar Design Workbook prepared by SERI accompanied the course.

Based on approximately 300 evaluations received from 1980 course participants, we learned that approximately 60% were engineers and 30% were architects. Forty-two percent of the participants use computers in their job. Approximately 32% of the participants had no professional experience with solar energy while 48% had had some experience with up to five projects using solar energy. Seventy percent said they preferred the five-day course format over a shorter format. The presentations participants enjoyed the most included passive and active solar system design and sizing, the solar design process, architectural and engineering concerns, and daylighting. Ninety-five percent rated the course as good to excellent, and the two major complaints were that too much information was presented in a short period of time and participants would have liked more information on design details and less emphasis on theory.

Several things were learned in the process of conducting the courses. Much of the material presented was very dry, yet very important. Therefore, to hold the participants' attention and interest, the course format was varied as much as possible. The majority of the presentations were lectures accompanied by slides. The session on active design and sizing, which almost everyone enjoyed, was a hands-on session in which participants used programmable calculators to solve problems. The course included a tour of solar installations that provided participants with a chance to see and critique solar installations in the area.

Short breaks between sessions were also very important. The participants really seemed to appreciate the workbook and handouts provided to accompany the lectures.

We are revising the material in the Solar Design Workbook and integrating it with material being developed by the SERI Design Group on the design of passive commercial buildings. We then will be able to develop comprehensive documents that cover the following topics on Designing Energy Responsive Buildings:

Volume I. Fundamentals

Solar Basics
Energy Technologies
Analysis Tools
Economics

Volume II. Design and Analysis

Basis for Design (Historical Transition)
Characterizing the Energy Need
Characterizing the Appropriate Response
Integration (Renewable Resources/Conventional HVAC Systems)

Volume III. Constuction and Evaluation

Legal Considerations
Construction Documents
Operation
Evaluation
Cost Consideration

Volume IV. Case Studies

We plan to arrange the agenda for our upcoming series of summer short courses to parallel the new format for the workbooks.

4. NATIONAL EDUCATIONAL EFFORTS FOR DESIGNERS

In 1981, one of the major goals of the American Institute of Architects, an organization of approximately 40,000 members, is "to raise the knowledge level and credibility in the energy field of every AIA member."(1) To achieve this goal, AIA has developed a comprehensive program to provide their membership with the skills necessary to integrate energy considerations into the design process. SERI has assisted with the development of this program. The AIA program is divided into four learning levels:

- Level 1 provides a complete overview of energy conscious design - what it is, why it is necessary, what is involved.
- Level 2 is designed to convey technical skills to provide the knowledge base to move into the full spectrum of energy-conscious design.
- Level 3 teaches technical skills required to understand and practice energy conscious design.
- Level 4 teaches skills for specialists in specific areas of energy design.

Material developed for Level 1 includes a slide/tape presentation, a booklet, and articles to appear in the media and is designed for building design professionals and their clients to make them aware of our country's energy problem. Level 2 training consists of a series of workshops that began at the AIA National Conventional held in May 1981, in Minneapolis. In August, a session will be held to train faculty to conduct workshops on energy-conscious design on a regional basis around the country. Level 3 and 4 workshops will also be initiated later in 1981. AIA's goal is to teach 8,000 building designers about energy over the next two years. SERI intends to provide appropriate technical assitance in this process.

5. CONCLUSIONS

As fuel costs continue to escalate, building designers are becoming aware of the importance of learning more about energy-conscious design. The current level of knowledge varies greatly through the profession. In the coming years, the SERI Commercial Buildings Group plans to continue supporting efforts to assist the building industry to develope programs to educate designers on energy use in commercial buildings.

6. REFERENCES

(1) Vosbeck, Randall, AIA President. "Energy to be a Major Theme of Incoming President's Year." AIA Journal/January 1981.