DEVELOPMENT OF A DESIGN ASSISTANCE PROGRAM: A CASE STUDY

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INTRODUCTION

This paper describes observations made during the process of forming and guiding a "design assistance team." This effort represents one part of a larger project aimed at developing a program which enables the transfer of energy efficient design technology to architects, engineers, and developers making decisions critical to the energy performance of buildings in Minnesota. The overall goal of this project is to develop a design assistance approach for the architects and engineers of mid-size office buildings. Specifically, it aims to develop an understanding among its participants of the design procedures used to determine the type of envelope, lighting, and HVAC technology that create energy efficient and cost effective design strategies.

BACKGROUND

Office buildings have been selected as the subject for a series of pilot studies because they comprise a large and growing portion of Minnesota's non-residential construction, and because office buildings offer excellent potential for energy saving through design. Several programs like the one at Minnesota currently exist in New England and the Pacific Northwest. Among their shared characteristics is the formation a "design assistance team" with special expertise in energy efficient design. This team is assigned to a "building design team" if it meets program guidelines. These programs also generate and evaluate alternative demand and energy-saving strategies by using a computer simulation program (DOE-2). From their efforts recommendations are made for the inclusion of energy conserving strategies based on pre-established performance guidelines or on a cost/benefit analysis. In some cases, recommended capitol improvements are paid for by a granting agency; in others the choice is left to the developer.

In order to develop a pilot design assistance program for Minnesota a two year plan has been developed and divided into two phases of activity. Phase I of the plan calls for the development of procedures and information necessary to the design assistance program. Phase I began in June 1989 and will conclude in July of 1990. The second phase calls for testing the strategies developed during Phase I in 4-6 field tests. Phase II is tentatively scheduled to commence in July 1990 and to run for one year. Following the successful completion of Phase II, the program will be made available to the design community.

PHASE I PROJECT DESCRIPTION

The goal of Phase I is to develop the procedures and information necessary for the implementation of a design assistance program. First, a development team made up of interested, technically-informed design professionals from the local community was assembled. This initial team consisted of three architects (who functioned as designer, DOE-2 modeler, and daylighting consultant), a mechanical engineer and an electrical engineer/lighting designer, and cost estimator. Ideally, this team will eventually become the 'starter' from which the design assistance program will grow.

In order to fully understand the issues of this approach, this team was given the task of redesigning an existing 68,000 s.f. office building with the requirement that they achieve a 30% energy savings over the existing building. It was important to the project that the team begin with an existing building in order to establish a base from which to analyze the impact of various technologies on overall energy use. The building was chosen because it represented the typical speculative office building currently being built in the Minneapolis-St. Paul metropolitan area. It was field-studied, documented, and analyzed by the team. The data was then used to calibrate the DOE-2 model which would serve as the analytical to test energy savings in the project. Based upon this analysis, three prototypical building designs representing a range of climatic response alternatives to the existing structure were developed.

At a later date, another architect was engaged to design three additional energy efficient speculative office buildings, only now with the design assistance of the initial development group. This new architect, who is at first a beneficiary of design assistance, will later become a member of the design assistance team. The student goes on to be teacher. This idea is the driving philosophy of the program.

THE CASE STUDY

The case study is an attempt to follow the process of design in order to understand how professionals learn new technologies, and to understand what is required to be better teachers. The goal of this study is not to attempt conclusions, but to establish a framework for discussion and debate. The proposition is that energy conserving technology is not being effectively integrated into conventional building designs even though it is valued by the design community. The project, through the process of direct observation and systematic interviewing and documentation, must examine how design professionals learn about energy-conserving technology and then how they incorporate that in their design process. Through the subsequent evaluation, we hope to find evidence indicating the real needs of the design professional.

The general questions which the case study will attempt to answer are:

- Is enough time being allotted for exploration and integration early enough in the design process to bring the building systems issues into play?
- Are there the means now to integrate building systems into the design process from the conceptual design on, regardless of time?
- Is the language used by various disciplines making communication difficult at any phase of design?
- Is the current knowledge not making its way into the established design communities?
- Do mechanical and electrical engineers need to be involved early in the process in order for the systems to be well integrated?

When the study began, our preconceptions held that the problem of integrating energy-conserving technology into the design process lies partially in the amount of time professionals have budgeted to deal with the unknowns. If more time was allotted in the early stages of design, technologies could be better integrated. Another preconception held that, if the technical information could make its way into the early phases of design, the design strategies would be fundamentally more efficient. It was a popular notion that all disciplines should be involved at the inception of the project.

The questions which were asked during observation and interviews were designed to get at the type of information utilized by the design professionals in their process, the way in which new information was accessed, the type of information, the sources of information, and how that new information is managed in their design process.

EVALUATION

Through the course of observation issues began to emerge. The team's architects very quickly began looking for ways to organize the problem and the necessary information. The engineers, on the other hand, offered their expert advice but did not attempt to develop any organizational framework. For example, one problem confronted very early on concerned the use of the DOE-2 model to evaluate building design. The model was very useful to conduct elimination parametrics or multiple testing of single variables but it required significant time to prepare input files for whole buildings.

One group from the initial team, consisting of the three architects, devised a scheme to look at one single building bay in order to test what seemed a very large number of combinations of technology bundles in an attempt to identify synergies in these bundles. This bay analysis allowed a fairly extensive analysis of 'bundles' consisting of various building sections (envelope type, bay depths, floor to floor heights, and glass areas). The information on lighting and mechanical systems was provided by the engineers in the from of lists of best available energy efficient systems. At this early stage of the analysis, the engineers did not consider their systems critical. It was advised that engineering systems must be whole building systems in order to take advantage of load-shifting strategies. The fairly large amount of information from the resultant DOE-2 runs was organized into lists which were then to become reference for future exploration. The teams utilized very few information-management tools. Primarily used were the architectural standards of section and elevation, graphs of elimination parametrics, and lists of cases and the tested variables.

This situation posed some difficulties when the lists did not become more broadly applicable strategies. Instead, decisions were made on a case by case basis with the design assistance team members operating more as consultants than collaborators. In fact, the more information that was generated by the team, the more frustrated the members became by the difficulty of managing the information.

One possible information management tool may have been a matrix or morphological approach. By making a matrix of categories and placing the evidence within such categories, it is possible to use what we know in order to find out what we don't know. This approach was suggested only very recently in the study and was not well-considered by the team's engineers.

CONCLUSION

This study has been an exploration into the design process. Some issues have emerged which could possibly have an effect on the development of the educational aspects of the program. It will be difficult to judge whether or not this exploration has been successful until the educational package is developed and tested.

There have been some variations in the program definition which have come to light, depending upon the perspective of the different actors. Some of the initial team members realized in the course of the study that their intent was to become better informed of current technological advances. However, they saw their involvement in design assistance as one of passing on information--in other words, as consultants. The role of teacher is not yet understood.

Team leadership came from the group of architects which is typical of the management of a building design project. The group which tried various information management strategies was also represented by the architects. Whether the engineers simply do not see conceptual organization of information a necessary task for the integration of systems, or if they do not have the tools and training to do that, is the current state of that issue in the study.

REFERENCE

LaVine, L., M. Fagerson, J. Ubbelohde, K. Hornstein. 1988. "Case Study of the Decision-making Process for Systems Impacting Energy Expenditures in an Office Building", *Proceedings of the 1988 ACEEE Summer Study on Energy Efficiency in Buildings*, Volume 3.