ARCHITECTURAL DIVERSITY THROUGH CLIMATE RESPONSIVE DESIGN

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"The nature of a place must be explored. You don't plunk a building somewhere without the influence of what is around it. A building is the character of the place, the nature of it."

Louis I. Kahn, 1970.

ABSTRACT

During the past ten years, students in the third year of the School of Architecture of the New Jersey Institute of Technology, have been asked to address both the most technical and philosophical aspects of climate responsive architectural design. They have considered energy consumption, visual and thermal comfort, and ventilation in the context of various architectural studio design projects. Through the use of a microcomputer program, students engage in repetitive cycles of thermal analysis and architectural design. Most importantly, the computer is beginning to permit and encourage experimentation, testing of solutions and preconcept ions, as wel I as refining individual design approaches to reduce overall energy consumption and increase thermal and visual comfort.

INTRODUCTION

Rather than focus upon the extreme conditions of climate for HVAC design, the speed and accessability of the micrcomputer allows each student to study their design under a wide variety specific environmental conditions, including clear, cloudy and average skies, seasonal variations, daily weather patterns, and changes in human activity. This study of environmental diveristy challenges each student to appropriately respond with a dynamic architecture, which develops morning-afternoon-evening, and winter-spring-summer-fall building characteristics. Architecture is then seen as a changing filter which modifies the effects of climate for the comfort of man. The influence of shading devices, insulation systems, openess and enclosure, etc. has as great an affect upon the development of architectural form and the basic concepts of the design, as it does in testing the non-physical characters of a building such as visual/thermal comfort. Students seek to provide cool, shaded, pleasant place in summer, rahter than solely focussing upon reducing energy consumption or maximum loads.

Because of the complexity of energy analysis, the computer becomes the vital link in the design/analysis relationship. It acts as an expert consultant through which the student gains an understanding, possibly even intutition, of the implications of many architectural choices in complex environmental situations. It is the quick and interactive access, to precise information about the students own design, which ultimately permits the student to ask the more fundamental questions about architectural quality, comfort, and energy consumption: What is the most pleasant space to sit in during a summers rain ? What kind of place is most comfortable in a winters cold, sunny afternoon ? Must a North elevation be differentiatied from the South elevation ? To what degree are East and West elevations different ?

ANALYSIS AND DESIGN

The computer permits the immediate application of knowledge to design. The traditional sequence of developing basic principles, leading to applied knowledge in the early design stages and eventually to detailed considerations, are challenged by the application of the capabilities of the small computer. Given access to many types of information, the designer

can respond in a more wholistic fashion, i.e. considering many influences, obtaining a sense of the whole, and developing intuition as well as technical understanding. Expanding, manipulating and testing more information sooner ultimately permits a clearer understanding of problem, and greater desire for experimentation.

The process of reflection and experimentation is an essential part of all design. When dealing with the uncertain, always unique and multifacted considerations of architecture, the computer provides a vehicle for the generation of design alternatives. Ideally the microcomputer provides an insight into the problem that will result in alternatives that would otherwise not be seen, or for which the constraints of time and graphic representation does not permit adequate study. Computer programs must ultimately improve the quality of the physical environment if it is to find a place in the mainstream of architectural theory and practice.

Beyond the complexity associated with energy analysis, it is a field which has been assumed to have few physical manifistations. Unlike structural systems, which can be seen in abstraction, drawn, tested and understood in the context of architectural design, energy has few visual counterparts. Because the microcomputer can deal with vaste ammounts of visual information, it may the vehicle through which a visual vocabulary for energy analysis and physical design is created.

PRESENTATION

The students projects, previously published by the Association of Collegiate Schools of Architecture as part of their Energy and Design Competition, will be presented. They focus upon a discrete set of environmental forces and building functions which lead to unique architectural solutions. The first, "The Wintergarden," illustrates the influences of a high mass construction for the limiting of climatic variations. Numerous interior spaces are developed to precisely meet the needs of varying plant systems. Although the design exhibits a highly structured and unified formal organization, variations of materials, colors, orientation, etc., at the scale of a room, result in an environment of extraordinary diveristy, from arrid to tropical conditions.

The second project, "A Woodworkers Shop" focusses upon the requirements of highly controlled daylight, the need for natural ventilation and temperature control. Daylighting models were developed to evaluate the luminous environment, while hourly thermal analysis tested the thermal performance of the design.

The final project, "A Country Club," approaches climate responsiveness through basic decisions about functional zoning, site access and circulation. The fundamental characteristrics of the building change for a distinctive winter and summer facade. The activites of the building tu from inward oriented in the winter, to outward or ed in the summer, occurring along the interior nd exterior edge of the building.

The architectural choices for climate responsive design are many and varried. Focussing upon the dynamics of climate, results in more opportunities for different architectural approaches, which are more diverse, interesting, experimental and as well as more technically developed.

DESIGN SYSTEMS

There is simply no microcomputer model which assists in the development of the initial and basic approaches to architectural form. In the beginning when the designer is seeking the larger answers, more generalized concepts, and is dealing with conflicitng situations, current energy software cuts the building into many small pieces; daylight, heating, cooling, heat storage, shading, etc. Existing computer models can not generalize, express basic concepts or provide alternative physical models.

A fundamental characteristic of the architect is that they work with graphic (visual) diagrams to examine, develop and ultimately express ideas. It is the early, most abstract "doodle" drawings which are the main influence in the development of the final buildings design. Tied to these "doodles" are all the traditional factors which determine architecture. The microcomputer may eventually provide design guidance through the graphic representation of alternative approaches to precedont, siting, structural systems, spatial organization, etc. The larger issues, in the beginning of the design process (siting, room arrangement, etc) can rarely be reconsidered in the middle or end of the design process. Unless computer applications can be made part of the beginning stages of design, any subsequent information provided by the microcomputer later on can be devalued by earlier committments to a particular set of design choices.

A question which is often overlooked is, "To what degree can the architect or engineer take raw data, and transform it into meaningful form, in a way that improves our physical environment?" Most of the current software provides only raw data, although graphically pleasing, it is oriented toward mid-design analysis. Regretably current programs do not provide information about the relative importance of the many design and technical choices available to the architect or engineer in the early design stage. Most analysis models utilize the microcomputer to facilitate the processing of large amounts of numeric data, and do not take advatnage of the graphic capabilities of the small computer. Although a few manual design-based systems exist, such as "Climate Graphics"": Loftness, or "Climatic Patterning": Brown and Notiski, there is no comprehensive model which is suitable throughout the design process. Design based systems must be developed to permit increased levels of sophistication, choices in the technical variables being considered, provide detailed information about various climatic events, changing comfort conditions, short and long term energy analysis, and assistance in the development of physical design strategies.