

## SECTION VI

# Uses of the computer

Electronic digital computers and the advances in electronic technology devices are somewhat parallel developments, but quite interdependent, and could justifiably be labeled as the new sciences of the decades in the third quarter of the twentieth century. Analog computers are, have been, and will continue to be valuable tools in the control of machinery and solution of engineering problems. The analog computer, however, is a device designed and constructed to address the solution to a specific problem in which the analog circuitry represents the parameters and algorithms which relate to the problem. The digital computer is a good deal different in concept and application. It is like a totally controllable “brain” which lacks an intellect, and the resources of the brain can be put to work on a single given problem at a time. In the context of this discussion, the “computer” includes the central processing unit (CPU) along with the necessary assemblers, compilers, and input-output communication devices which enable us to establish mutual communication between man and machine.

The first chapter in this section addresses a brief chronology of the development of the use of the computer as a tool in the design of building environmental systems. This chapter was written back in 1975, and already the “. . . development of the science” recognized in the chapter is well underway.

The second chapter in this section (also published in 1975) addresses the technology of applying these fantastic machines to the analysis of building systems, how the analyst can determine if the program being used can be accepted as providing reliable data, and a few words relating to the technique of using the programs to accomplish a meaningful result.

At the present time, we are starting to observe a closing circle in the use of computers which will likely have an unprecedented effect upon the building industry, from both the standpoint of systems concepts and present institutional structures. Historically, the building design and construction industry has been a “small business” oriented industry. The reason is quite clear—large business is inherently a large-volume operation, and large volume can most effectively be accomplished by mass production. Anything other than mass production to accomplish large volume must rely on a much higher level of skills on the part of the organization’s employees. We use a typical machinery manufacturer as an example, such as a manufacturer of automobiles or air conditioners. Adequate amounts of engineering talent are provided to design the product and its production line (this is actually a rather small percentage of the finished product cost); the product is then mass produced and sold to the consumer. Once the product is in the hands of the consumer, there is the need to perform preventive maintenance and occasional service or repairs on the machinery. The vast majority of these maintenance and services requirements are performed by small business or even

individual private practitioners. This is true because, although the total cost of maintenance and repairs over the lifetime of the equipment may greatly exceed the original cost of the product, it requires a higher level of skill, than did the manufacture, for each dollar earned.

Successful efforts at mass producing buildings in any area other than very low cost homes ("mobile homes") have been quite limited. The reason is that buildings are probably the highest cost consumer product by several orders of magnitude, they have a long life span, and they must be adapted to a large variety of consumer needs including size, purpose, site, materials availability, energy availability, relationship to adjacent structures, availability of operations, maintenance and service skills, and many others. Thus, if a manufacturer wanted to start to mass produce office buildings he would have to develop a design or design series that would satisfy the combination of all of the requirements better than they are presently being accomplished. Since this is virtually impossible, the design of buildings has been and will likely continue to be provided by skilled individuals in small businesses including the professional firms in architecture, structural engineering, electrical engineering, and mechanical engineering.

This nucleus of professional designers had been developing a new skill during the decade of the seventies which even they did not realize. A combination of the existence of a few systems analysis computer programs and the energy situation has led the buildings engineering profession into the area of computerized systems analysis as a decision-making tool. Thus many decisions previously made on the basis of judgment and experience are now being made on the basis of judgment, experience, and considerable quantitative data furnished through the use of a computerized system analysis.

Although it has not been recognized in the industry, the system designer has for years been the person most knowledgeable in the technical aspects of the system he designed. The consulting engineering profession can be said to have dropped the ball in not recognizing this, and utilizing this knowledge in providing additional (and needed) services to the building owner such as testing, balancing, and start-up of systems, as well as the necessary guidance and assistance in operation, maintenance, and service. The systems designers of the future, skilled in computerized systems analysis, will have a much better understanding of the system dynamics because of the substantial amount of information they will have received from computer programs, and the additional systems studies they will make to avail themselves of the full advantages of the computer capability.

When the system designer thus becomes knowledgeable in digital computer technology it becomes evident that the next responsibility which he will have to pursue is that of programming the building automation systems (see Chapter 29); thus the closing of the circle. It is at this point that we will have taken full advantage of the capabilities of the digital computer in building automation systems, and the computer will have found a new use. Here, instead of receiving input answers from the analyst, and printing output information, the computer is receiving input analog data such as air temperatures, system water temperatures, and outdoor temperature change trends, and outputting electronic signals to operate valves, pumps, chillers, boilers, etc. This closed-circle concept is inevitably where building technology will be in the future. In the interim, the designers and analysts are using the digital computer to improve their decision-making ability and the manufacturers of digital hardware are marketing both hardware and software to automate the system operation. Because of the unique feature of each building system, mandating the need for a software program tailored to

the features conceived by the designer, the present approach cannot succeed unless one of two changes occurs. The designer must either program the building automation system or he must design the system to fit the capabilities of the available BAS programs. The latter alternative would impose an artificial constraint upon the system design which is totally impractical—thus, the inevitable result is that the systems designer will be the agency to program the building automation system.

When the industry arrives at this point it will have reached its second plateau in utilizing the computer. Each building at this point will be controlled to optimize the interaction of the active and passive parameters of comfort, energy, power, maintenance, etc. Properly achieved, this degree of technical sophistication will have removed all “operational” energy waste from building operation. And the first plateau, that of use of the computer for systems selection will have removed the potential energy waste from the basic system design. Thus, of all of the so-called new technologies being explored to assist in the solution of the energy dilemma, the digital computer is already here, with the capability to affect enormous reductions in energy consumptions—it needs but to be properly applied and programmed.

The closing statements of the final chapter in this section touch upon data communications. It has been said that data communications is to the advance of computer technology what the railroad and truck (transportation) were to the industrial revolution. Data communications is the field of communication between computers, between computers and people, and/or between computers and machines. With effective low-cost data communications, every analyst and every building can have immediate access to the highest capacity digital computer.

The potential for the computer in building systems is beyond the scope of imagination. If and when we reach the second plateau, the closed circle between design and operations, perhaps we will be able to see the third plateau.

