Highway Location—The Computer Vs The Brain

DONALD A. OSTROWER
Vollmer Associates, New York City

•TWO THOUSAND YEARS ago in Rome, a single symbol was used to represent the quantity 1,000, and the Appian Way was built. Today computers require ten symbols to represent this quantity and highways are being built which are too often eyesores.

In many cases, taste and judgment have given way to machines whose complexity surpasses human understanding. Because of this inability to comprehend the machine, powers are ascribed to it that it simply does not have and its product is accepted as gospel. Also, taste and judgment are surrendered to those who require numerical evaluations and who would replace the criterion of beauty with that of the dollar and replace a rationale with a ratio.

Any blame for this rests largely with the administrators and designers who have stood by while that which was meant to be a tool for design has been transformed into a total design procedure, and while the "auditors" set dollar values to intangibles and use a logarithm in place of logic. This paper attempts to take some of the mystery out of the computer and to outline ways in which it is being used and misused in highway location and also to demonstrate the absurdity of using certain dollar value or ratio approaches to the location of highways.

THE COMPUTER AND THE BRAIN

The modern computer (such as the IBM 7090) has more than a million memory storage cores and can perform a hundred thousand additions per second while its electrical impulses travel at the speed of light—186,000 mi/sec.

Although the human brain's electrical impulses travel only 320 ft/sec, it possesses 10,000 times as many storage units as the computer and occupies 0.01 of the space of the computer.

Basically, the computer is a machine which adds only two digits 100,000 times a second. Its versatility stems from the imagination and ingenuity of the human programers who reduce complex problems to what is essentially a series of additions. A complex computer program may require as many as 100,000 consecutive instructions to the machine. Yet, this overgrown arithmetic machine, with a working vocabulary of only two symbols, cannot function unless humans translate problems into a series of additions of these two symbols. Yet it is worshipped and its answers are being substituted for human judgment in areas which cannot be mathematized.

USE AND MISUSE OF COMPUTERS IN HIGHWAY LOCATION

One of the early uses of computer programs in highway location is the Digital Terrain Model. Here, the computer is used to store, in the form of digitized data, a three-dimensional model of a strip of terrain. A designer feeds into the machine a number of different alignment and profiles, and the machine computes the construction cost of each of these. In this fashion it is possible to compare a vast number of possible lines and grades to determine which is the most economical. It would be prohibitively time consuming to estimate the construction costs for this number of alternate alignments by conventional means. On the other hand, the experienced

Paper sponsored by Committee on Roadside Development.

designer, whose mind can store 10,000 times as many bits of information as the computer, could probably discard many of these alternate lines by inspection. Nevertheless, the Digital Terrain Model represents an excellent use of the computer as a tool in highway location. This stems from the fact that the inputs and desired results are mathematical concepts. However, this machine or procedure does not determine which is the "best" location for the highway, which location serves traffic best, which location blends the highway to the terrain, or any one of a number of other factors which the human designer is conscious of in selecting a location.

"Misuse" of the computer occurs when an attempt is made to mathematize all of these many factors. There are actually too many factors which are too complexly interrelated for existing computers and computer programs to handle, and most of these factors influencing highway location cannot be reduced to numbers—which is the only thing which the machine can recognize.

Programs have been attempted which reduce each one of these many factors affecting highway location into numerical concepts and attempt to combine these numbers to produce the "best highway location." One such approach lists the many requirements which a highway must meet, evaluates on a quantitative basis how each point on the terrain meets each of the requirements, decides which requirements are interrelated, uses a computer to determine in which order the requirements are to be combined, and then combines the "solutions" to each of the requirements to produce the location which best satisfies all requirements. This would be fine if it were possible to evaluate numerically certain location requirements and if each requirement were of equal importance. A variation of this technique uses a series of diagrams to express how every point on the terrain meets each requirement and then combines these diagrams by eye in the prescribed order.

One of the computer's strong points is also its basic weakness in highway location. The advantage of the unemotional character of the machine should not be overlooked. Many designers have a pet bias in favor of certain characteristics of alignment and other factors, and it is difficult for the human brain to avoid the pride of authorship in the "location I have come up with." The machine avoids these traps because it is devoid of emotion; however, the spark of creativity, which stems from human emotions, is missing.

Vigilance is necessary to keep these overgrown adding machines from taking over what is essentially a creative field.