CIVIL ENGINEERING EDUCATION

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The best definition of "Engineering" I believe is that found in the Model Law of 1946. This reads, incidentally, similar to the definition of "Professional Engineers" as defined by our Massachusetts Registration Law.

The Model Law reads as follows:

> "The term 'Practice of Engineering' within the meaning and intent of this Act shall mean any professional service or creative work requiring engineering education, training, and experience and the application of special knowledge of the mathematical, physical, and engineering sciences to such professional services or creative work as consultation, investigation, evaluation, planning, design, and supervision of construction for the purpose of assuring compliance with specifications and design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works or projects."

Perhaps it is needless to point out that the words professional, creative, education, training, experience, and application are the important areas for us to consider at this time.

The Technical Sections of the Boston Society of Civil Engineers and the fifteen Technical Sections in the American Society of Civil Engineers indicate the breadth of the Civil Engineering Profession. To quote from Dr. John B. Wilbur's paper given before the Michigan Conference to which Professor Littleton has referred—"We know that a Civil Engineer is an extraordinarily able fellow, if not a near genius, who uses science "plus," and I emphasize the "plus" as well as the science, to fling gleaming spans across yawning chasms, to carve the countryside with interchanges and with super-highways, to change the very geography of the earth with mammoth dams and the waters they restrain, to rear mighty structures skyward where they stand undaunted through earthquake and through storm."

Professor Wilbur goes on to point out that in addition to our

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awareness of today's rapid tempo of scientific and technological advance we, as Civil Engineers, are aware of further trends of the future, if not actually existing this very moment. These are the population explosion, the rate at which our civilization is plundering its natural resources, and the rate at which our civilization is poisoning and strangling much of the environment in which we live.

Water pollution from industrial and municipal wastes has long been one of our problems on inland waterways, as well as coastal areas, and now we have to contend with the disposal of radioactive waste. The ocean cannot continue to be a disposal area for this radioactive material indefinitely as we are rapidly reaching a danger point in this respect.

The water supply problem is one that is continually growing more acute, especially in the heavily populated areas along the seacoasts and certain inland waterways. This problem involves the quest for new sources of supply, new methods of treatment—possibly a use and reuse type of supply. The U. S. Department of Public Health has embarked upon a campaign to make the public aware of this critical problem.

Air pollution from industrial operations and our ever-growing mass of automobiles have presented smog problems in many areas that require immediate solutions. These air-borne wastes, thought by some to be cancer producing, give every indication to be increasing as our industrial development and Gross National Product inches upward.

Our buildings of today, being "built for eternity," so to speak, could be thought of as restraining the development of our environment. We need but to look around us to observe vast areas of Boston, and other areas, composed of buildings that have become outmoded and inefficient before they have reached an end to their "structural life." New building materials, new structural forms, new construction techniques are a necessity so that our present and future buildings can be more readily and economically altered or replaced as man's needs change.

Although mobility has been classified as one of the basic needs of man it is readily apparent that we are approaching, or perhaps we have arrived at, a transportation crisis. Do we continue to build more expressways into and through our cities; do we continue to expand our tax relief to the railroads and, in the case of Boston,

underwrite a deficit ridden public transportation system—or should we look for new forms of transportation, better co-ordination between various forms of transportation and better control over the space allocated for mobility to increase its efficiency.

The problem outlined by Professor Wilbur points out the following:

(a) They all deal with the fulfillment of human needs on a large scale.
(b) They all deal with the land-water-air environment.
(c) They all deal with the adaption and control of that environment.

It is apparent to many that we consider the scientist as one who creates, the technician as one who applies, but the engineer is one who really is concerned with creative application—they are the innovators, directors and applicators all rolled into one. Engineers are concerned with utility and application; it is their job to decide the merits of a project, whether it is economically justifiable or not, whether it will serve the public in its intended function satisfactorily or not—in short, his is a professional responsibility. Little scientific knowledge would find its way into public usage if it were not for the practical applications given to the knowledge by the engineer.

The problems of the scientist usually lend themselves to a mathematical analysis and are much simpler than the problems of Civil Engineers. The Civil Engineering problems deal, not only with the scientific principles, but also are directly associated with our environment, our emotions, our politics, our rights as citizens, and our dignity.

The condemnation of property in connection with the construction of thoroughfares, the location or relocation of the thoroughfares themselves and the attendant political and environmental consequences, public reactions to the locations of sewage treatment plants, with possible resultant property deterioration such as the famous case of the proposed disposal plant opposite Mount Vernon on the Potomac River, are all examples of the opposition confronting Civil Engineers as they strive to serve man and his needs. Building codes, which may be outmoded as soon as they are printed, cannot be written strictly on a scientific basis due to the human elements involved and the ever-changing technological advances. Civil engineers daily copy with

similar problems and the decisions made certainly have a direct influence on life, health, property, and public welfare.

Dean Williamson, of Penn State University, writes in the November, 1961 Journal of A.S.E.E. "It would be so nice to have a Maxwell's equation, Bernouli's theorem, or a Prandtl's theory to apply, but where human beings are involved, a solution arrived at in an aggregate or mechanics sense fails miserably when applied, since individual, highly vocal units are involved. The rights of citizens and the dignity of human beings have to be considered."

The profession of engineering must be concerned with the human aspect of its solution whereas a scientist, seeking research in his laboratory and a technician working for an engineer are spared this obligation. They will not be barred from practice if they do choose to forget it.

I have no wish to deny that there exists the need for deeper study and understanding of mathematics and physics, and its related engineering sciences of fluid mechanics, mechanics of solids, thermodynamics, etc. Our problem is not only to give broader knowledge and greater depth but to produce a person that is non-superficial. Depth in education can be provided by using specific applications as examples. Our curriculum should not be devoid of professional awareness nor should economics be neglected.

In brief then, shouldn't we teach the engineering approach—getting on top of new situations through self-study of new areas, the instilling of practical curiosity so that no matter how sophisticated and socially acceptable research may appear, there will always be engineers who can bring the research results down to mankind.

Engineering problems are thrust up from the real world, whereas many scientific problems are theoretical and lend themselves to neat solutions due to the methods of analysis available. Could our swing to the science-oriented curriculum be the result of similar thinking? I have found it very difficult to obtain staff members who have their theoretical background blended with good, sound, practical experience. These men may be available, but they are not interested in the education field. Since it is a problem to find engineering instructors, why not solve this problem by doing away with the engineering aspect and give the students more science and math? It is easy enough to defend this solution if administrators and department heads hold educational conferences, press conferences, professional society meet-

ings and the like, and loudly proclaim this "new look in engineering education." Publicity can often sway man's mind into thinking along most any path. The intent of the publicity can pick the pathway—right or wrong.

Such an outlook, that of avoiding real problems, is bound to be popular in the campus environment since this is the locale that glorifies intellectual advance and scholarly profoundness. Schools do not look upon outstanding achievement as a practicing engineer as any qualification for faculty status unless there are publications. These publications, a must in the education field, have little appeal to the practicing engineer, who is more concerned with getting something accomplished than he is in bragging about it. Prospective faculty members, during interviews, are constantly being quizzed as to their research capabilities and how soon can a paper be published—their ability to teach, their willingness to teach, their plans for developing good courses are ignored—evidently these are not considered as necessary to the teaching profession.

I am firmly convinced that our function as enginering educators, especially in the field of Civil Engineering, is to teach ENGINEERING, the art, the economics, the social-humanistics aspects, the design know-how, the technology, and the professional awareness. To be effective, the instructions must be deep and its breadth sufficient only to the extent that it is not considered narrow, bearing in mind always that engineers must produce—not talk about producing.