DISCUSSION PAPER

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Is Surveying Really Part of Civil Engineering?

Earl F. Burkholder[1] M.ASCE

Abstract

Surveying has been taught in departments of civil engineering and surveying practice has been associated with civil engineering for many years. In the past 30 years the number of surveying courses and credit hours required in most undergraduate civil engineering curricula has been significantly reduced and in some cases, eliminated entirely. This paper looks at the historical interaction between surveying and engineering and raises questions about impacts of the current trend in areas of accreditation, registration and professional practice.

Introduction

The terms "surveying" and "civil engineering" carry with them certain mental images which differ according to ones background and experience. Without attempting to define either one exclusively, it is noted that surveying as a measurement science has changed dramatically in the recent past through application of new technologies including; photogrammetry, remote sensing, electronic distance measurement, inertial positioning, satellite positioning, and the silicon chip (computers). Surveying as an information science (knowing what to measure as determined by evidence, historical fact and legal principle) has also come to be recognized for its contribution to development of a multi-purpose cadastre and managing spatial attributes of a Land Information System (LIS). In general, the interaction between surveying and civil engineering has been in the measurement science arena and "land surveying" has been associated with land boundaries and property line surveying.

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1 Geodetic Engineer, Oregon Institute of Technology, 3201 Campus Drive, Klamth Falls, Oregon 97601-8801

A broad definition of surveying could cover both perspectives in which surveying falls under the broad umbrella of civil engineering. However, arguments were offered for separate status (registration) because specific differences are important to land surveyors who feel a civil engineer lacks sufficient knowledge and background in legal aspects to perform property surveys. Society, acting through state legislatures, laws and registration boards, accepted those arguments and separate registration is a fact in most states.

If surveying is truly under the umbrella of civil engineering, then the separate registration might have been a specialty certification (meaning a person would qualify for and receive engineering registration before becoming eligible for the added distinction of "land surveyor"). But, that is not the case as most (if not all) registration boards will grant a "land surveyor" license to one who would not otherwise qualify for engineering registration. The result is a double standard for registration. Does registration as an engineer qualify one to practice "land surveying"? Or, does registration as a surveyor qualify one to perform engineering surveys? These questions are too narrow because registration (even though widely used) is not a reliable indicator of professional competence. Of greater importance is the knowledge (education) and judgement (experience) one brings to a given task. As evidenced, in part, by persons registered in both catagories, there is a significant overlap between the professions and questions of academic preparation need to be discussed by both.

When discussing similarities of and differences between surveying and civil engineering, the issue is often clouded by a failure to distinguish the catgory in which comparisons are being made.

Research: Research activities which explore frontiers of knowledge and promote development of new technologies are conducted at universities, in both state and federal agencies and by private enterprise.

Management: Managers at all levels, both government and private, make informed decisions about allocation of technical, capital, and human resources to meet organizational missions or corporate (and business) objectives.

Application: Responsible professionals analyze existing technology and make judgements between alternatives in planning how given objectives or missions will be met.

Implementation: Persons knowledgeable about technical principles and concepts are responsible for getting the work done in a prudent manner.

The foregoing catagories are not meant to suggest that an individual is restricted to one or the other. In reality, some individuals may function in all catagories. Two points to be made are: 1) it is not fair to compare surveying in one catagory with engineering activities in another and, 2) educational curricula are often designed to prepare a person for one of the catagories; graduate school for research, business courses for management, engineering/surveying programs for applications and technology degrees for implementation. These catagories are neither complete nor exclusive.

Historical Interaction:

The historical interaction between surveying and civil engineering should be considered in trying to answer, "Should Surveying be Included in Civil Engineering Education?" Activities related to or called "surveying" have been part of civilization throughout recorded history. From construction of the Egyptian pyramids to Roman aquaducts to seagoing ships (and maps) to machines of the industrial age. From conquest of the seven seas and the uncharted continents to the fringes of space by landing on the moon, surveying and civil engineering professionals have worked together in a quest for a better life for all mankind. Specifically, surveyors and engineers both contributed in significant ways to settlement of the United States. Kreisle (1988) describes development of surveying engineering in the US, White (1983) chronicles the role of surveying in establishment of the U.S. Public Land System and Wilford (1981) traces the progress of the mappers (engineers, surveyors, cartographers and others) in exploring and charting vast territories of the western United States.

Since the early 1900's surveying has been part of the civil engineering curriculum in most universities in the USA. However, as other specialties in civil engineering (structures, transportation, planning, hydraulics, water supply & treatment, materials, geotechnical, environmental studies and others) have risen to prominence, other topics such as surveying have been reduced or eliminated entirely. Marks & Weeden (1985) did an extensive study of surveying course offering in civil engineering programs and found no program required more than two courses in surveying. Twenty three percent do not require any courses in surveying and ten percent don't offer any surveying instruction in the undergraduate curriculum. A follow-up study should be conducted.

With surveying instruction being squeezed out of civil engineering programs, the slack has been taken up by establishment of separate programs in surveying. In 1951 the Oregon Institute of Technology began offering a 2 year associate degree in surveying and in 1966 offered the first 4-year surveying program in the USA. Purdue University followed with a Land Surveying degree in 1971 and others have been established since then. Today, there are several very high quality university research based surveying programs in the USA offering both graduate and undergraduate degrees. There are also several professional level 4-year degree programs and numerous technical and associate degree programs available for the person who wishes to study surveying.

Definition of Issues:

Within the Surveying Engineering Division of ASCE, there is a Committee on Education and Professional Practice. At a committee meeting in April, 1989 the committee discussed the apparent decline of surveying instruction within civil engineering and identified five issues deserving study and consideration:

1. Should civil engineering programs offering courses in design and construction offer at least one course in surveying?

2. To what extent should surveying engineering (location, grades, drainage, etc) be included in transportation, site design, and facilities engineering programs?

3. Given the purpose of licensing is to protect public safety and welfare, is it necessary for an individual to be licensed as a surveyor in addition to his/her engineering registration in order to provide surveying engineering services?

4. At what point does specialty certification become necessary for one who has only an engineering registration or the person who has only a surveyor's license to provide services that are considered to overlap the other profession?

5. The licensing process should be flexible enough to accomodate an engineering or surveying degree from either profession as meeting minimum requirements for registration. Does it (or should it) work both ways?

It is hoped feedback from this forum on education and continuing development for the civil engineer will provide the basis for additional committee deliberation.

Areas of Impact

With due regard to the level (or catagory) of comparison and past interaction between surveying and civil engineering, the complex issues raised by the Education and Professional Practice Committee need to be discussed in light of:

A. Accreditation - EAC, RAC and TAC

B. Registration - NCEE and individual state boards

C. Professional Practice - Overlap of professions

The Accreditation Board of Engineering & Technology (ABET) is the accrediting agency for civil (and other) engineering and surveying programs in the USA. Three accreditation commissions include:

EAC: Engineering Accreditation Commission
TAC: Technology Accreditation Commission
RAC: Related Accreditation Commission

The EAC accredits professional level engineering programs, including those surveying programs which meet EAC criteria. The TAC accredits engineering technology programs which includes some surveying programs, both at the associate and baccalaureate degree levels. The RAC was established in 1983 to accredit programs which are closely allied with engineering, but whose specific program content departs from traditional engineering programs. It was intended by those who established RAC criteria for surveying programs that the rigor would equal that of EAC progams.

EAC criteria do not require any surveying to be included in a civil engineering degree. TAC program criteria for both an associate and baccalaureate degree in civil engineering technology (submitted to ABET by ASCE) do require topics in surveying. The implication is that technical operations of surveying are important for technicians. Somehow, professionals either don't need it or are expected to get it on their own? Is (or has) ASCE going to abdicate its role in professional surveying? ASCE participates with the American Congress on Surveying & Mapping (ACSM) in submitting criteria for EAC Surveying and TAC Surveying Technology programs.

Additional evidence of the continuing growth and emergence of surveying as a separate profession is the name change approved August, 1989, at the annual meeting of the National Council of Engineering Examiners (NCEE). The new name is the National Council of Examiners for Engineers & Surveyors.

If surveying has its own (equal) accreditation criteria and enjoys equal stature in the registration process, then maybe civil engineers should abandon attempts to include surveying as part of civil engineering. However, in spite of the changes being made, some surveying engineers feel civil engineering should not abdicate its role in surveying.

NCEE is made up of registration boards (both engineering and surveying) from various states and composes and grades the examinations used by most boards as the basis for granting registration to both surveyors and engineers. Content for the surveyors exam is based upon a "task analysis" of activities of practicing surveyors and carefully analyzed by a hired psychometrician to assure validity of the testing process. Observations of the process are that many practicing surveyors do not have a college degree and perform many "surveying" tasks for which a college degree is not required. In addition, few states require a college degree of surveying registration applicants. Therefore, the testing process could be biased against improving the qualifications of those entering the surveying profession. A resolution passed at the 11th National Surveying Teachers' Conference (Fresno, CA, 1984) requested that NCEE base passing scores for the surveying exams on the performance of those examinees having a college degree. Unless and until that is done, the double standard for registration will be perpetuated.

In the area of professional practice, there is a significant difference between public perception of the surveyor and the civil engineer. Part of the perception is that many surveyors work directly for the lay public and most of their fees come directly from the consumer. Engineers tend to work for governmental or corporate clients. Added to that perception is the fact that surveyors are seen standing behind the tripod and the public fails to see or understand the planning and research which goes into surveying activities. The engineer is viewed as the person in a suit and hard hat with a roll of plans laid out on the hood of a pick-up on the construction site. Unwittingly, a surveying technician is compared to an engineering professional resulting in an inaccurate conclusion.

Admitting an element of truth in the aforementioned stereotype, it is not a correct picture. In an ASCE Workshop on Civil Engineering in the 21st Century, Dr. Wong (1988) described surveying and mapping activities beyond 2000 and pointed out that civil engineers have a vested interest in two areas of current research; real time surveying (positioning) systems and geographic data bases. Each of those surveying activities does and will have an impact on the scope of civil engineering activities. Civil engineers

need significant training (more than a 2 credit hour course) in modern surveying methods and techniques.

Surveying as a measurement science is changing dramatically and those changes have a direct impact on civil engineering practice. Bro. B. Austin Barry (1987) focused specifically on that point in his presentation to the 12th National Surveying Teachers' Conference when he described "What Civil Engineers Should be Taught About Surveying." He was brave enough to suggest civil engineers should not waste time learning taping corrections and angles by repetition. Effort should be spent instead on three dimensional coordinate systems, EDM resections, stereoscopy, satellite positioning, computers and others.

Conclusion

In this writers opinion, there is a legitimate overlap of interest and practice between surveying and civil engieering, but two points need to be made: 1.) There is much more to surveying than a civil engineer can learn in one or two courses. The civil engineer who wants to "sign-off" on engineering surveys should obtain a surveying license.
2. The examination process for surveyors should be expanded to include modern measurement science at a level which promotes parity with other professionals.

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