Keeping Surveying Courses Relevant to Current Practice

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Abstract

The scope of this paper will concentrate on current practice in relationship to land and construction surveying. The field of surveying has changed drastically in recent years and continues to change with technological advances in surveying equipment and computer software. Surveying courses that introduce individuals into the profession and that provide the initial training need to remain relevant to current practice. College professors, who are active in the land surveying profession, will incorporate current standard practice into their courses. Professors who are not engaged in surveying need interaction with practicing professionals to insure that current practice is reflected in their coursework. Professional land surveyors provide a great source of information and expertise and should be used in an advisory capacity to review course content. Surveying courses must provide the fundamental skills and knowledge that are essential to an individual entering into the surveying profession and should reflect the daily practice of professional surveyors engaged in both land and construction surveying. When feasible, professional surveyors should be used to teach the lab sections of surveying courses. Practical applications should be reflected in lab assignments while stressing fundamental concepts and techniques. Field trips to various sites depicting different types of surveys should be an integral part of the surveying lab experience. Students can also benefit in the actual practice of land surveying by being teamed up with local surveying companies through the efforts of the college in co-op and work-study programs. Basic preparation of an individual entering into the surveying profession requires the joint effort between college professors and practicing surveyors.

Introduction

Surveyors require many years of training and experience to fully understand the various aspects of the profession. This knowledge and training is first acquired with a series of college courses followed by an internship. State licensing boards require examinations, experience, and recommendations to prove competency of an individual prior to licensing. The examination used by a state licensing board is a national exam produced by the National Council of Examiners for Engineering and Surveying (NCEES). The first exam covers topics on the fundamentals of surveying and requires four years of experience prior to taking the exam. Partial to full credit of the four years of experience can be awarded if an individual graduates from a university in an appropriate field. Some states mandate a bachelor's degree in surveying or in a related subject prior to taking this first exam. An additional four years of experience is required prior to taking the second exam that covers topics on the principles and practice of land surveying. Some states are considering or already require ten years of experience instead of eight years needed for licensure. To become a professional land surveyor requires competency in both the fundamentals as well as the principles and practice of land surveying.

Input into Surveying Course Content

Surveying courses taught at universities should provide the fundamental skills and knowledge using state-of-the-art equipment and computer software while reflecting practical applications encountered in the daily routine of surveyors. Local professional surveyors are valuable assets for enhancing the quality

of material presented in surveying courses. These individuals are engaged in the daily practice of surveying and know the desired qualifications of individuals who are starting out in the profession. Land surveying companies hire students as part-time help during the academic school year, full time during the summer and they employ graduates seeking full-time careers as professional surveyors. By understanding an employer's needs, insight into surveying course content can be obtained. Professional land surveyors provide a great source of information and expertise and should be used in an advisory capacity to maintain the currency of the program.

Surveying Course Content

An advisory board composed of surveyors and professors was created to review the content of surveying courses. The review process began with gathering information about the basic qualifications of an individual entering into the profession. This list of qualifications and required knowledge formed the basis for course content and was used to generate objectives. Realizing that a surveyor requires numerous years of experience after graduation to fully develop, a university needs to concentrate on the fundamentals of surveying presented with practical applications. Basic field procedures as well as office work should be fully understood and performed competently by the students. These skills and knowledge should be acquired after successful completion of a sequence of surveying courses and labs. Many of these skills will be acquired after the introductory course and lab and later refined during sequential courses. The results from the survey were categorized into four objective areas and are listed below:

General Surveying Objectives

- Staying focused on the job
- Keeping a daily log of surveying activities
- Ability to take good field notes, detailed sketches, and include all pertinent information
- Taping and chaining distances using a steel tape
- Pacing distances
- Magnetic surveys for reconnaissance using a compass
- Locating iron pins in the field using a magnetic detector
- Determine if an instrument is out of adjustment and whether calibration is required
- General maintenance of equipment

Leveling Objectives

- Proper technique to setup and operate an automatic level
- Proper focusing of cross hairs and object lens to eliminate parallax errors
- Ability to manually read a level rod
- Proper technique to hold a level rod and rocking a rod

- Proper notetaking for differential and profile leveling (backsight +S, foresight -S, & HI)
- Proper notetaking for a 3-wire level circuit
- Closing a loop to validate field data and knowing if the data's misclosure is acceptable
- Reducing of a set of leveling field notes with all appropriate column and page checks
- Adjusting the elevations based upon the amount of misclosure

Total Station and Data Collector Objectives

- Proper technique to setup a total station over a point
- Proper focusing of cross hairs and object lens
- Determination of vertical angles and familiarization with terminology (zenith, nadir, horizon)
- Determination of horizontal angles (doubling angles, reverse angles, averaging angles)
- Determination of horizontal, vertical, and sloped distances using EDM
- Field data collection using a prism (prism pole, mini-prism on plumb bob string or on a bracket)
- Notetaking of pertinent information not stored in data collector
- Thorough knowledge and use of data collector
- Understanding raw data, reduced data, and coordinate data files
- Validation of field data from a traverse and knowing if the data's misclosure is acceptable
- Perform all appropriate traverse calculations
- Stakeout points in a field
- Using redundancy to validate data collected in field and when staking out points in field

Advanced Surveying Objectives

- Deed research at the local governmental clerk's office
- Acquisition of pertinent information from utility companies, planning & zoning commission, state department of transportation, property valuation administrator, etc.
- Knowledge of computer-aided drafting CAD programs used to generate drawings
- Knowledge of other software packages that work under the CAD platform and/or stand alone software (ie. generation of topographic maps)
- Writing boundary descriptions

- Basic understanding of drainage design
- Global Positioning System (GPS)
- State plane coordinate system
- Astronomical observations

Geomatics and Advanced Topics

Basic surveying used for boundary and construction applications can be grouped with other forms of spatial information into a discipline known as Geomatics. Geomatics focuses on topics that include surveying, photogrammetry, remote sensing, geodesy, geographic information systems (GIS), land information systems (LIS), global positioning systems (GPS), and computer mapping. Various universities offer courses and degrees in Geomatics Engineering. The University of Florida, Fresno State, and Ohio State are a few of the universities that have developed strong curriculum in Geomatics. Although the scope of this paper concentrates on land and construction surveying, some of these advanced topics have applications in the actual practice of land surveying. With improvements in software and equipment, these topics may become more prevalent in the daily operation of practicing professional land surveyors.

Professional Surveyors Teaching Surveying Lab Sections

Our university is using three practicing professional land surveyors to teach the Surveying I Lab sections during the 2000 Spring Semester. Prior to the start of the semester, they were each given a copy of the syllabus to review. Their comments and suggestions were discussed during an advisory meeting and appropriate modifications were incorporated to enhance the effectiveness of the lab assignments.

These professionals will each have a group of fifteen students to instruct. Each lab is set up to accommodate five survey parties of three members each. The lab meets once a week for a two-hour session during the seventeen-week semester. A faculty member will coordinate the overall effort to ensure continuity between the class and lab. Each surveying lab will have a student worker to assist the instructor since five survey groups in an introductory lab usually require some additional individual instruction. A faculty member will be available to help with the instruction when needed and to verify that essential points are presented to each lab section.

The faculty coordinator will take on a more demanding role during the first part of the year to assist the surveyors in their new environment. Certain surveyors have a knack for teaching; however, some may require a little coaching with their delivery of instruction to students. The coordinator can provide some assistance in training these part-time faculty members in their new roles as educators. Many local land surveyors are quite busy with their daily operations and their time is at a premium. The faculty coordinator of the labs can play an important role in assisting them with some of the basic academic paperwork (handouts, overheads, basic course material, and processing course rolls).

As with most universities, monetary compensation for part-time faculty members is relatively low. Fortunately, some professional surveyors are dedicated to their profession and do not mind giving something back to the profession. They do however receive an added bonus of getting a first-hand look at prospective employees. They will learn which students have the ability to become productive employees as they progress throughout the semester. Training these individuals will be done in an academic environment versus in a company setting and thus eliminate the company cost associated with training.

Practical Applications and Experience

Practical applications of surveying are required by the Accreditation Board of Engineering and Technology (ABET). The professional component criteria states that a student must be prepared for engineering practice throughout the curriculum. ABET requires interaction with professional practitioners and employers prior to graduation.

The students as well as the professor need to get out into the field and experience real life surveying jobs. Keeping faculty members involved in the practice of surveying allows the faculty to remain current. Students get to see the faculty practicing their profession. The faculty member should hire students to work with them on jobs and thus expose them to real-life practical applications in surveying. The facilities management department of a university is another avenue to acquire student projects that will be located on campus. This makes it easy for the faculty member and students to practice surveying in a convenient location with an arrangement that also benefits the university.

Involvement of professional surveyors in the classroom opens the door of opportunity for students to work for surveying companies. Small surveying companies often obtain jobs requiring additional workers. Professional surveyors who teach a lab section have access to a good source of employees from students in their surveying lab. Depending on the time of the semester and what material was already covered, some surveying tasks can be accomplished with these students. The professional surveyor has a good first-hand knowledge on which students will work out well for future employment.

Field trips to job sites provide another avenue for students to experience practical applications of surveying. Usually, there will be various forms of construction surveying within a short distance from campus. Having contacts with professional surveyors and contractors yields opportunities to visit various construction sites in the area. Field trips should be scheduled throughout the semester to witness and observe various forms of construction surveying. These projects will generally include layout of a road, stakeout of a building, and site grading. These field trips will allow the students to observe the practice of surveying and should be an integral part of the surveying lab experience.

Practical applications in surveying can be somewhat duplicated in an academic setting on campus; however, these exercises cannot fully demonstrate the interactions and problems that arise in the daily routine of professional surveyors. Practical applications can be observed through field trips and can be experienced through part-time work under the guidance and leadership of a professional land surveyor. Effectiveness of surveying courses is greatly enhanced when practical applications are incorporated.

Conclusion

Surveying is a field of civil engineering that requires an individual to be proficient using various pieces of equipment, have a good working knowledge of applied mathematics, have good problem solving skills, be able to research deeds and plats, and use their past knowledge and experience to determine accurate measurements of the earth's surface. These qualifications can be obtained through a college education coupled with an internship working for a professional land surveyor. The main objective of college courses in surveying is to provide the students with the fundamental concepts and techniques needed to work in the profession and should compliment the daily practice of professional surveyors. Linking college education with required practical work experience can be accomplished with the assistance of practicing professional surveyors. These professionals can be used in the advisory capacity to critique course content as well as directly teaching courses and labs to ensure that the demands of the profession are met. Professional surveyors can provide input to ensure lab assignments are practical in nature. Unfortunately, these exercises in a controlled environment on campus cannot fully duplicate the situations that arise in real life surveying. It is therefore imperative that efforts be made to expose students to real life surveying problems. Creative ways to get the students exposed to practical

applications of surveying will greatly enhance course content. An effort should be made to get all students involved by teaming them up with local surveyors. This effort will provide training to these individuals and make them more marketable to prospective employers. Surveying courses must provide the fundamental skills and knowledge that are essential to an individual entering into the surveying profession and should reflect the daily practice of professional land surveyors engaged in both land and construction surveying.

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Gregory W. Mills is a full professor in the Department of Engineering Technology at Western Kentucky University. He received a Bachelor's Degree in Civil Engineering from the University of Dayton in 1976 and a Master of Science Degree in Civil Engineering (Structural Engineering Emphasis) from Cleveland State University in 1979. He is a registered professional engineer in the states of Kentucky and Ohio. From 1976 to 1982, he worked as a structural engineer for Davy McKee Corporation in Cleveland, Ohio. From 1982 to 1983, he worked as a structural engineer for Minuteman Technical Services in Boston, Massachusetts. In the fall of 1983, he began his full-time teaching career in the Civil Engineering Technology program at WKU and is currently the coordinator of the program. He is an active member of the Mammoth Cave Chapter of the Kentucky Society of Professional Engineers and was the chapter president from 1993 to 1996. He is currently pursuing licensure as a Professional Land Surveyor in the state of Kentucky and received his Land Surveyor-in-Training status during the summer of 1999. During the summers, he works for the land surveying company of Allnutt and Associates.