

OVER 45 YEARS OF SURVEYING EDUCATION¹

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INTRODUCTION

Surveying education has had a major influence on the growth of the surveying and mapping profession both in Michigan and throughout the country. Early engineering degrees involved a healthy number of surveying courses along with conventional civil engineering topics. As the civil engineering profession expanded, surveying courses were removed from these programs. Over the years civil engineering programs became devoid of any surveying topics.

The importance of surveying education began to grow after World War II and colleges and universities began to add surveying programs. In the early days, educational programs at the associate degree level were developed to provide competent technologists for the industry. As our professional ranks grew and the role of the surveyor became broader in scope there was a higher necessity for graduates who understood the technology and the direction in which the profession was moving. Moreover, there became an even more important need for increased professionalism of the individuals entering the surveying and mapping field. This led to the development of bachelor degree programs. Michigan was a leader in this movement.

There are many pressures placed on educational programs. First, surveying and mapping is a technological dependent industry that requires schools to try to keep abreast of the new tools that the practitioner is using. Second, there are new developments looming on the horizon and it is critical that programs incorporate these into their already full curriculum. Third, schools must be constantly vigilant that the graduates from their programs meet certain outcomes. Unfortunately, the many constituencies that a program serves have different ideas of what these outcomes should be. Finally, there is a constant need to attract highly qualified students into the program. Enrollment is an important element at all educational institutions. Quality without quantity only goes so far.

This paper will look at the Surveying Engineering Degree at Ferris State University in order to let the practitioner know where from where we came, where we are now, and maybe glimpse into the future about where we are moving. Faculty, students and facilities will be discussed.

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THE FERRIS SURVEYING PROGRAM

The surveying program was established at Ferris State University in 1957. At the time, the degree consisted of associate degrees in surveying and highway and heavy equipment. The former degree was developed to meet the needs of the surveying profession during this period of growth in the industry. The highway and heavy equipment degree program offered students a unique educational experience. The program was established to meet the needs of the growing interstate highway construction project being created in Michigan and the nation. Students would alternate between school and internships until finishing their degree. The Associate Degree in Surveying Technology still exists at Ferris, although few students utilize it as their terminal degree goal.

Michigan became the first state in the U.S. to require a baccalaureate degree as a part of the minimum criteria for licensure as a Professional Surveyor. In response to this requirement, faculty at Ferris State University along with a committee of licensed professionals from the Michigan Society of Registered Land Surveyors (now MSPS) met to outline a minimum curriculum to meet the needs of the profession. The result was the Bachelors Degree in Surveying, which was created in 1972. The goal then, as it is now, is to provide highly qualified graduates for the broad surveying and mapping profession.

The basic core to any surveying program involves mathematics and science. Surveying and mapping is, to a large degree, the application of mathematical principles to real-world problems. One of the most exciting aspects of our profession is the fact that we pronounce that no two surveys are the same. In fact, book knowledge only provides an educational foundation to solving problems in the field since no two situations are the same. Because of this, graduates must be adaptable to changing conditions. The mathematics and science courses provide this essential skill.

The foundation of the program is the core technology courses that introduce the student to basic surveying technology. At Ferris, we have identified this core knowledge to include surveying instrumentation (theodolite, level, total station and GPS, see figures 1 and 2), surveying techniques, and field processing (traverse adjustment, level-loop adjustment, state plane coordinates, and CAD). These courses give the student the skills necessary to function in a typical surveying operation. A student with no field experience other than that gained in the laboratory setting at Ferris will not be proficient in these instruments but will have a basic working knowledge of how these tools are used. The fundamental idea is that through a summer internship the student will gain more familiarity.

The last two years of the Surveying Engineering curriculum introduce the student to advanced surveying topics. While not formally developed in this manner, one could look at these advanced courses being comprised of three different tracks. The first track is advanced surveying application, which includes the legal principles of surveying and

geodetic surveying. In the legal courses, students learn about the history of the public land survey system, retracement principles, evaluation of evidence, legal research, description writing, common law pertaining to surveying, and Michigan statute law. The geodetic surveying component consists of the basic principles of geometric, satellite and physical geodesy. Geometric geodesy discusses datum definition, geodetic forward and inverse problem, computation of geodetic lengths and the theory of map projections. Satellite geodesy covers the theory and applications of the global positioning system (GPS) and inertial surveying principles whereas physical geodesy involves looking at the effects of the gravity field upon surveying measurements.



Figure 1. Students being shown how to set up the GPS equipment.



Figure 2. Students learning about the total station on the campus quad.

The second track involves imaging sciences. Central to this track is geographic information systems (GIS). Students take courses not only in GIS but also other

technologies germane to the implementation of GIS. Courses in photogrammetry introduce the student to photogrammetric principles, mapping with photogrammetric stereoplotters, advanced photogrammetric principles for survey control, and mobile mapping concepts including laser altimetry (lidar). A course in remote sensing introduces the student to the utilization of other imaging sources, particularly some of the high-resolution satellite images that are being made available to the public. Cartography describes how maps are created and principles behind map production. The GIS courses utilize these basic concepts and show the student how mapped information can be linked to attribute databases. The power of a GIS is to offer the decision maker with tools that can answer “what if” types of questions. The mathematical principles needed to establish these types of queries are presented to the student and are practiced within the laboratory periods.

The third track is the professional track. One part of this track is mathematical in that students learn about advanced math concepts like linear algebra and statistics. This is capped by a course on least squares. The guiding principle in this course is to provide a foundation from which graduates can correctly perform and analyze adjustments to surveying measurements. Central to this is the statistical treatment of the results of repeated measurements. The other part of the professional track is the introduction of professional practices, ethics, and land development. Students begin to gain an appreciation of the profession, understand what constitutes professional conduct, wrestle with contemporary ethical dilemma, and develop a sense of what it takes to operate a viable business enterprise. Land development explores the principles of subdivision design and also shows the importance of the police powers given to control or direct development within a local jurisdiction (i.e., zoning, master plan, subdivision regulations, etc.).

The core math, science and surveying foundation along with the three basic tracks within the program provides, when coupled with the University’s general education requirements, a well-rounded graduate. It is the philosophy of the department that the graduates need not only to be technologically proficient to enter the job market but must also be adaptable to the changes that will befall our profession. We should agree that the surveying paradigm is in a natural state of flux and we, as educators, need to be vigilant to how this affects our graduates.

A question that should be asked is how do we measure the success of this program. This is done a number of different ways. The first method is to seek out and obtain accreditation from a recognized accrediting organization. The surveying program at Ferris was the first program in the state, and one of the first in the nation, to seek and receive accreditation from ABET (Accreditation Board for Engineering and Technology)². The first two times that the program was accredited was under the Related Accreditation Commission. In the fall of 1990 the program changed the name of the degree to Surveying Engineering and sought out accreditation from ABET through the Engineering Accreditation Commission. In terms of accreditation, the surveying program at Ferris was also the first surveying program in the country to apply for and be granted

² The Surveying Program was first visited by ABET in 1984 with accreditation being granted in 1985.

accreditation using the new outcomes-based criteria. While eligible to seek accreditation using the older criteria, the advisory committee recommended and the faculty concurred that if we were truly a national leader in surveying education then we should be the leader in testing the new accreditation criteria.

ABET accreditation provides the faculty with a number of other measures that we use to ensure a quality program. When we look at the success rate in the NCEES (National Council on Examinations in Engineering and Surveying) Fundamentals of Land Surveying exam, Ferris students consistently rate at, or near, the top of all schools in the country. When we look at scholarships awarded by outside organizations, again, Ferris students excel, not only with respect to other surveying schools in the country but also with engineers within the State of Michigan. Finally, while quite antidotal, we see yearly the success that our students have experienced in the workplace.

FACULTY

There are many factors that contribute to a quality program. One element is a qualified and motivated faculty group. Faculty should be active participants within their profession and contributing members of the university community. Service is almost as important as the lecture they are assigned to present because it shows the student how important it is to give back to their profession and community. The Ferris faculty is committed to giving the best possible education to the students who pass through its halls. There are currently five full-time and one full-time adjunct faculty. The full-time faculty includes Robert Burtch, Yaron Felus, Sayed Hashimi, Carl Shangraw, and Khagendra Thapa. Marvin Myers has served as an adjunct within the program for the last 8 years.

The entire full-time faculty has at least a Masters Degree in surveying or a related field with two, Felus and Thapa, holding Doctorate Degrees. Additionally, five of the faculty are also Professional Surveyors. These include Burtch, Felus (in Israel), Hashimi, Shangraw (who is licensed in both Michigan and Wisconsin), and Myers. All have been active members of their profession. Burtch has served on the Board of Directors of MSPS, Museum of Surveying, mLINX (michigan Land Information Exchange), and the American Society for Photogrammetry and Remote Sensing. Hashimi has served on the Board of Licensing and has been an active participant in the NCEES exam process. Shangraw currently serves on the Licensing Board and the IMAGIN Board of Directors.

There is a long history of distinguished faculty within the surveying program. Emeriti faculty include the following individuals: Dave Henry, Robert Johnson, John Norton, Jack Pierson, and Jens Otto Rick. It was only through the hard work and dedication of this faculty, along with a handful of additional faculty that served within the program over the years, that this program is what it is now. Today, the Surveying Engineering program is the largest program in the Midwest and one of the largest in the country.



Figure 3. Surveying Engineering faculty: Top (left to right) Burtch, Felus, Hashimi; Bottom: Myers, Shangraw, Thapa

STUDENTS

The typical surveying student at Ferris State University represents one of the best students within the university. The curriculum is very demanding and requires the student to work hard to meet their professional objectives. The program attracts very few students right out of high school. The overwhelming majority of students have some experience in surveying and also have completed some college courses before coming to Ferris. In fact, there is a small number of students who come into the program with a baccalaureate degree. Because of this, many of the students are categorized as non-traditional since the average age of the student body in surveying is a little higher than the average at the university. As a result the students are very motivated and career oriented. Surveying students come from all over the state and nation. At this time, about 10% of the students are international students.

What separates our students from others you might find in other surveying programs is their level of professional and community activity. A number of students feel that it is important to give back to their community. To do this they have worked with Big Brothers/Big Sisters, Habitat for Humanity, community breadbaskets, church organizations, and numerous other community endeavors. These are the kinds of activities that many seem to believe that our young men and women are lacking, but it is alive and well among many of the surveying students.

The students are also very active within their professional organization. On campus there are two student groups that students can join: the Burt and Mullett Student Chapter of the

American Congress on Surveying and Mapping (ACSM) and the Lambda Sigma ($\Lambda\Sigma$) Honorary Society. Both the Burt and Mullett Student Chapter and the Lambda Sigma chapter are the second oldest chapters in the nation. The organizations are set up so that officers in one group cannot serve as officers in the other group. This gives ample opportunity for more student participation in these organizations. Ferris and the student chapter have been exhibiting at the MSPS annual conference every year since 1975. Students have assisted the conference committees by helping with lights in the meeting rooms, running the overhead projectors, acting as “runners” for the session moderators, and selling books for MSPS.

Burt and Mullett represents one of the most active student chapters in the nation. It has a long history of inviting speakers to campus to talk to the students. Over the last couple of years, they brought in practitioners from throughout the state to address the students about surveying issues and problems. This meeting is usually held at 11:00 am on Tuesdays with pizza provided to those in attendance. This has been a very successful activity with about 50 students attending these weekly presentations. Moreover, the students have sponsored a number of seminars over the years, bringing to campus national experts on a number of different topics such as GPS, boundary surveying and GIS.

Last year, the student chapter raised money to help defray the cost of sending students to the ACSM/ASPRS/FIG conference in Washington, D.C. While at this conference, the students participated in the Roman Surveying competition put on by ACSM (figure 4). Students were required to research how surveying was undertaken during the Roman period and to design and build instruments that Roman surveyors might have used in their surveys. At the same time, students also participated in helping the session moderators. This was a very educational experience for the students and a once in a lifetime opportunity. It is not too often that students will experience the trials and tribulations that professionals throughout the world experience. It gave them the chance to meet surveyors from overseas and to understand how surveying is defined and practiced in different countries. Being a joint conference with a strong international flavor, they were also able to view exhibits that they would never have envisioned before.

The chapter also has a long history of social activities. Each fall they have their annual picnic with the equally anticipated football game (figure 5). Later in the fall they also hold their Wild Game Dinner. In both cases, the students prepare and cook the meals themselves. The Wild Game Dinner has taken on a life of its own. A speaker is invited to address the students. This year the students brought in Joe Gallo, Vice President of PBS Coals, and Chad Mosteller, Chief Surveyor of PBS Coals (figure 6). They discussed the nature of mining and how surveying is performed in deep mining operations. They also detailed the rescue operations, and the role that surveying had in this effort, during the Quecreek mine disaster. Over 100 students and surveyors from throughout the state attended the dinner. As always, the food was excellently prepared and the speakers were very good.



Figure 4. Ferris students competing in the Roman Surveying competition at the 2002 ACSM Annual Conference.



Figure 5. Sayed Hashimi, Steve Novak, Rick Sauve and Carl Shangraw at the annual Burt and Mullett fall picnic.



Figure 6. Speakers Joe Gallo and Chad Mosteller in the food line at the annual Wild Game Dinner.

The students also have helped make the surveying program better. One of the very time-consuming tasks that they have undertaken was the creation of the campus GPS network (figure 7). From donations from practitioners, points were set throughout campus and GPS observations were referenced to the state CORS network. All points have at least two other intervisible points from which students in the beginning courses can use to practice traversing techniques.

Lambda Sigma is the only national honor society for surveying students. The criteria are very demanding with only the top 25% of the students at the junior and senior level being admitted to this group. Each spring, the group holds its induction ceremonies on campus. The new officers are installed and new students inducted into the organization. Each year a professional surveyor is inducted as an honorary member and they give a short presentation to the student group. Once a member is elected to this elite group they are members for life. The audience include members of Lambda Sigma (both students, graduates and past honorary members) and their families (figure 8). Each fall Lambda Sigma hosts their scholarship night. Here, students are informed of scholarship opportunities available to them, application deadlines, and helpful hints on how to apply for these scholarships. The students invite a representative from the Financial Aid Office to discuss general scholarships available through the University.



Figure 8. Lambda Sigma members at the 2002 induction ceremony.

SCHOLARSHIPS

Through the generosity of the surveying community, students can compete for numerous scholarships offered by professional organizations and surveying professionals. Scholarships can be divided into three groups: University scholarships, awards from professional organizations, and scholarships awarded through the Surveying Engineering Department. These latter awards are provided through the generosity of fellow professional surveyors within Michigan. A number of professional organizations provide scholarships to worthy students. Those organizations in which Ferris students have obtained awards include the American Congress on Surveying and Mapping, Michigan Society of Professional Surveyors, Michigan Society of Professional Engineers and American Council of Engineering Companies/Michigan.

This last year a new scholarship has been established by KEBS, Inc. This award is given to an individual who is a full-time student at Ferris with at least a 3.0 grade point average. The student shall have demonstrated leadership potential. KEBS has three offices in Michigan and specializes in surveying, engineering, wetlands, land planning, GPS/GIS, industrial and commercial development, storm water management, and residential development.

Last year the following students were awarded scholarships:

Student Name	Scholarship	Organization
Nathan VanRaemdonck	ACSM Fellow Scholarship	ACSM Scholarships
Bradley Beal	AAGS Dracup Scholarship	
Timothy DeMumbrum	Nettie Dracup Scholarship	
Jonathon Wildrom	Bernsten Scholarship	
Timothy Wrathell	NSPS Scholarship	
Matthew Dontz	NSPS Scholarship	
Timothy DeMumbrum	TriState Surveying and Photogrammetry Kris M. Kunze Memorial Scholarship	
Bradley Beal	NSPS Board of Governors Scholarship	
Timothy DeMumbrum	MSPS Scholarship	State/Regional Scholarships
Nicholas Dunn	SE Chapter of MSPS Scholarship	
Jonathon Wildrom	SE Chapter of MSPS Scholarship	
Matthew Dontz	WC Chapter of MSPS Scholarship	
Jonathon Wildrom	ACEC/M 1 st Place Award	
Keith Osterhaven	ACEC/M 3 rd Place Award	
Timothy DeMumbrum	Moore and Bruggink Inc. Scholarship	Surveying Engineering Department Scholarships
Bradley Beal	Fenn and Associates Scholarship	
Jonathon Wildrom	Rowe, Inc. Scholarship	
Nathan VanRaemdonck	Urban Land Consultants Scholarship	
Angela Kirby	Mary C. Feindt Surveying Scholarship	
Luke Hansen	Joseph L. Bishop Surveying Scholarship	
Steven Novak	Lewis and Lewis Scholarship	
Kevin Miedema	Richard L. Rought Scholarship	
Shawn Lee	Vijay Mahida Surveying Scholarship	
Keith Osterhaven	Khagendra Thapa Scholarship	
Matthew Dontz	David R. Greer Scholarship	
Timothy Wrathell	Tingley and Associates Scholarship	
Rocco Corsetti	Robert Burtch Geodetic Scholarship	

EQUIPMENT

A major issue in the establishment of any surveying curriculum is the equipment. As those in the private sector realize, it is expensive to equip a single surveying field crew let alone 6-8 crews. This is what is required of educational institutions. Additionally, technology is constantly changing. Unless used for research, academia usually lags behind the technology used in conventional surveying. It is the responsibility of the faculty within each institution to keep their equipment inventory as current and relevant to what the students will find in industry as possible. This is often tempered with very little equipment funds available through the institution. This is an area that the Surveying Engineering faculty have been successful. Due to contacts developed by different faculty members, the surveying program has nurtured important strategic relationships with a number of manufacturers including Leica Geosystems, Trimble, Topcon, Environmental Systems Research Institute (ESRI) and Intergraph.

The surveying program at Ferris represents one of the best equipped programs in the country. This is not to say that the entire inventory is state-of-the-art technology, but when evaluated in its totality, it represents a very sizable equipment inventory. While equipment is important, so is a technician who can take care of the instruments and maintain its inventory. At Ferris, the program has a part-time equipment room clerk, Katy Moore, who dispenses and maintains all of the field surveying equipment. This is a very important asset to any program since it ensures that equipment is properly stored and maintained, that batteries are charged and ready for use, and that equipment is accounted for at all times.

The Surveying Engineering Department has the usual complement of field surveying equipment, including analog and digital theodolites, total stations, automatic and digital levels, and GPS receivers (figure 9). This inventory represents equipment that has been donated, purchased, or consigned to the department. Also, too numerous to mention, are the other equipment and supplies that a field survey crew needs. This includes tripods, traverse kits, range poles, tapes and chains, and many other peripheral devices used in the field.



Figure 9. Students operating the total station at the EDM comparison range in Big Rapids.

The program also has a full computer laboratory with 19 workstations that are networked together (figure 10). A full suite of software resides on this system including GPS data processing, CAD mapping software (both C&G and Eagle Point both running on AutoCAD), GIS and remote sensing software (ArcInfo, ArcView, IDRISI, and ERDAS), MathCad, and miscellaneous additional software for word processing and the like. Students have free use to a laser printer and two plotters. The computers were purchased through the support of professional surveyors throughout the state.



Figure 10. Professor Felus helping a student, Carl Singleton, with a remote sensing project.

Finally, the program is equipped with a large photogrammetry laboratory. The instruments located in this lab represent the full gamut of photogrammetric stereoplotters. The lab is equipped with seven analog stereoplotters (four of which are encoded and use computer-assisted orientation and mapping), two analytical stereoplotters, three digital workstations, and one monocomparator used for analytical photogrammetry. This laboratory is currently being upgraded and over the next year or so and will be completely augmented with digital photogrammetric workstations.

ADVISORY COMMITTEE



Figure 11. Advisory Committee members, faculty and a student representative at the last meeting of the Advisory Committee.

The last critical element to the success of any academic program is a strong and effective advisory committee (figure 11). The Surveying Engineering Advisory Committee consists of the following individuals: Gary Bilow, John Fenn, Mary Feindt, John Kamer, Paul Lapham, John Matonich, and John Nelson. Additionally, there are three ex officio members including the Executive Director of MSPS (Rollie Self), and the presidents of MSPS and MSPE. This committee has been very active in providing insight and advice to the faculty on curricular matters. They bring a wealth of experience that covers a wide spectrum of the profession.

FUTURE

The future of the Surveying Engineering Department looks bright. There are four critical components to a quality program: faculty, students, advisory committee, and support from fellow professionals. So far, each part of this equation is coming together. But, the program must grow to remain viable. The department is looking at a number of different options to broaden the scope of the program without sacrificing an excellent existing program. For example, many of our students come to Ferris with college credits and may have lighter class loads during some of the semesters. Ferris has a Small Business Certificate within the College of Business and the faculty encourage students who have extra time to complete this program in addition to their surveying degree. The faculty believe that graduates who are contemplating entering private practice should be prepared for the business aspects of surveying.

A growing number of our graduates are pursuing advanced degrees and we encourage the students to follow those dreams. Under very incubative discussion is the idea of possibly adding advanced degrees within the department.

The future also has a number of uncertainties, particularly during these trying economic times. Over the next year, higher education can expect a budget decrease. Right now it is very speculative as to the amount, but it will probably be significant. Also, there will be new leadership within the University. A new national search is being conducted right now to find a new president of the University. Once this is done, then the process can begin for the Vice President for Academic Affairs. Whomever takes on these positions can impact how things are being done within the University.

CONCLUSION

The surveying program at Ferris State University has a long and illustrious history. For over 45 years, this institution has been graduating highly competent graduates who have made significant impacts upon their profession. The department has all of the key ingredients into making this program a success. It is able to attract well-qualified students who are motivated and desire to learn about surveying. It has a very capable advisory committee who have helped set the tone for the department and encourage its

faculty to be the best program in the country. It has an engaging and hard-working faculty who have established very high standards for students to strive for. Finally, without the support of the profession this program would fail. The professionals hire the graduates, provide summer employment, visit the campus to talk to students, financially support the department for both special projects and scholarships, and encourage the students to pursue their goal.