A Surveying Course as Summer Experience for

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Bob Pieri is Professor of Mechanical Engineering at NDSU in Fargo, ND. He has many conference publications on engineering education and design. His primary professional interest areas include: Engineering Education, CADD, Design, Fracture Mechanics, Materials Science and Alternative Energy Options. During the 2003 – 2004 academic year, Dr. Pieri spent a sabbatical teaching math & engineering courses at Turtle Mountain Community College on the Turtle Mountain Reservation in North Dakota. Between the fall of 2008 and July of 2011, Dr. Pieri held the position of Coordinator of Tribally Controlled Colleges – NDSU Partnerships under joint appointment to the Equity, Diversity and Global Outreach Division, Extension Service and Mechanical Engineering Department, where he worked to develop authentic partnering opportunities with the TCC's and many disciplines across campus. Currently he is the NDSU PI

for the Pre Engineering Education Collaboration with 4 ND Tribal Colleges to bring Native Americans into engineering. Prior to joining NDSU, he taught for 10 years at the U.S. Air Force Academy. Prior to his time at USAFA, Dr. Pieri was a Research & Development Engineer with the Air Force, studying problems of pollution in the earth's atmosphere.

A Surveying Course as Summer Experience for a Tribal College Pre-Engineering Program

Abstract

A surveying course has been designed and delivered for a tribal college pre-engineering program being developed under the tribal college-university Pre-Engineering Education Collaborative (PEEC) initiative of the National Science Foundation. The collaborative, one of only four in the nation, is established to bring university engineering schools together with tribal colleges to develop pre-engineering programs that would increase the number of Native Americans in engineering. Under the collaborative, students will begin their studies in a pre-engineering program at one of the four participating tribal colleges and then transfer to the collaborative university to complete their studies. The program is in its third year and course development and delivery are in progress. The surveying course is offered as a summer experience over a two-week period during which participating students from the tribal colleges assemble at the university. The course content is equivalent to that of the surveying course offered in a regular semester at the university; an objective of the program being to enhance instruction and support without lowering the bar. Surveying was chosen as the first course to be offered because fieldwork (outdoor activity), integral to the course, is attractive to students and thus helpful to sustain their interest. Because most surveying endeavors require group work, students get a taste of working in teams to complete tasks. The ability to integrate applications of trigonometry, computer aided graphics and spreadsheets into the course is another reason. Surveying fieldwork requiring intense coordination and management of logistics afforded students opportunities to observe how tasks are accomplished. When condensing a 16 week semester schedule to a two-week camp, the major concern was to allow reasonable time for studying, homework and reflection. The schedule was, hence, set so that students were given time overnight before conducting tests and fieldwork on material taught any day. Being a hands-on course, much of the learning happened in the field. Every attempt was made to ensure that students from different tribal colleges will work together in groups, thus increasing interactions among people across tribal reservations. On each fieldwork students were required to maintain a detailed record on a field book that was rigorously graded, and write a reflective journal to emphasize the need to develop into reflective practitioners. Two advanced graduate students assisted the engineering professor in instructing the students on fieldwork and processing field observations using spreadsheets. Beyond that, they took the lead in designing and conducting a series of tutorials making students create survey maps using computer aided graphics, and gain experiences in algebra, trigonometry, numerical methods, statistics and calculus. Further, the two performed yeoman service helping students catch up whenever they fell behind, thus gaining an in-depth knowledge of challenges faced by students. Another activity was demonstration of GPS and GIS technology by two currently active professional surveyors, and introduction to the working environment in their firm. Overall, students gained experience that may stimulate interest to acquire skills towards pursuing a career in engineering. Details of the course and reflections on future improvements will be discussed in the paper.

Introduction to the Context

This paper will focus only on the rationale for the choice of, details, and impact of the surveying course that was offered to the tribal college students as part of the summer camp component of the Pre-Engineering Education Collaborative (PEEC) project. The choice of a surveying course as a summer experience for tribal college students as part of a pre-engineering curriculum development in progress is unique strategically. The objective of this paper is neither to report on the progress of the specific collaborative under the PEEC initiative nor on the effectiveness of the summer camp as a whole on the project. Though brief descriptions of the PEEC program and summer camp are provided, the authors reserve those aspects for developing a future paper.

Pre-Engineering Education Collaborative (PEEC)

A tribal college pre-engineering program is being developed under the tribal college-university collaborative research 'Pre-Engineering Education Collaborative' (PEEC) initiative of the National Science Foundation: 'PEEC: 2+2+2+Infinity: Pipeline for Tribal Pre-Engineering to Society (PTiPS)' (2+2+2 meaning that the efforts go from High School to Tribal College to the university). The collaborative, one of only four in the nation, is established to bring university engineering schools together with tribal colleges to develop pre-engineering programs in the tribal colleges, and perhaps learn something about how to attract more underrepresented people into engineering programs. In this collaborative, four tribal colleges are collaborating with one university with the idea of developing pre-engineering programs in each of the four tribal colleges. Under the collaborative, students will begin their studies in a pre-engineering program at one of the four participating tribal colleges and then transfer to the four-year collaborating university to complete their studies. The program is in its third year. Course development and delivery are in progress. Course sharing is a key component.

Summer camp as an element of PEEC

Built into the PEEC program is an annual two-week summer camp at the university to provide opportunities for the tribal college students to increase their comfort level with the university and urban life style. A good mix of academic and social activities is made available in the summer camp. The mix includes courses for credit, remedial math and AutoCAD courses, and various learning courses to keep the students in an academic mind set.

Students as cohorts take the university courses for credit offered during summer depending on their academic levels. The first level course offered over the two-week summer camp for credit is a surveying course. The course content is equivalent to that of the surveying course offered in a regular semester at the university; an objective of the program being to enhance instruction and support (academic and other) without lowering the bar.

Operation of the PEEC summer camp is not a one man job. Faculty along with Native American student staff (including undergraduates and graduate students) helped keep things moving

smoothly and start the process of building a support cadre. Student support staff were all Native American students successfully pursuing engineering programs at the university, who can shine as good role models to the tribal college students attending the PEEC summer camp.

Education aspects of the camp were over seen by the faulty, and graduate students and undergraduates acted as student support staff. There were two roles that the graduate students filled. The graduate students were essentially teaching assistants of the surveying course at the summer camp. Along with that, they conducted various learning courses to keep the students in an academic mind set. Meaning, outside of the surveying course the graduate students were teaching various session on pertinent math courses to help with the surveying course, statistics, MATLAB, and AutoCAD. Supplement education was just one aspect of the graduate students. The other role of the student support staff, which was not planned but just as important, was in essence to act as camp counselors. The student support staff was in direct contact with the students for more than 9 hours a day. Through this second role the students support staff were able to witness the camp fulfilling the goal and objectives of the program.

The Surveying Course Objectives, Content and Schedule

The catalog description of the surveying course is:

> *An introduction to basic surveying operations, procedures, and equipment required for building construction site organization, layout, alignment, and dimension control. Laboratory topics include: surveying fieldwork, leveling instruments, transit theodolites, total stations, GPS and GIS. Prerequisite: Trigonometry.*

Course schedule is presented in the Appendix to introduce readers to the course content, activities performed, the intensity of activities and coordination at the summer camp. Note the yellow, green, and pink areas on the schedule depicting classwork, fieldwork and homework. Pedagogical objectives of the course are (Specific ABET a-k Program Learning Outcomes are shown in square parenthesis):

- Estimate distances by way of measuring by hand and by pacing.
- Properly record field notes. [g]
- Chain long distances using a tape measure.
- Conduct a basic, small scale triangulated chain survey using only two tapes and three ranging poles.
- Layout the corners of a building using a tape measure using a 3:4:5 triangle and check to be square. [a]
- Transfer the elevation/find the difference in elevation between two points using a leveling instrument and rod. [a]
- Create a topographical map using a leveling instrument and a tape measure. [a]
- Create a topographical map using a laser level and a tape measure. [a]

- Learn the proper way to set up over a point and level a total station. [k]
- Use a total station to:
  - Measure horizontal and vertical angles. [k]
  - Use Electronic Distance Measurement (EDM) function in a total station to measure horizontal, vertical and slope distances. [k]
  - Use above skills to run a traverse and to make a topographical map of an area. [a]
- Determine the horizontal position and height of an inaccessible point by triangulation using a total station. [a], [e]
- Layout points along the centerline of horizontal and vertical curves. [a]
- Understand usage of Global Positioning Systems (GPS) and Geographic Information Systems (GIS) in surveying. [k]
- Choose a location and set control points for a building from benchmark and property corners.
- Set up and use batter boards.
- Become aware of common construction site surveying mistakes and how to avoid them.
- Apply one person surveying techniques.

Where, ABET criteria referred above in square parenthesis are:

[a] an ability to apply knowledge of mathematics, science, and engineering to the field of Construction Engineering.
[e] an ability to identify, formulate, and solve Construction Engineering problems.
[g] an ability to communicate effectively.
[k] an ability to use the techniques, skills, and modern engineering tools necessary for Construction Engineering practice.

In the text of this paper, reference would be regularly made to specific activities of the course, and how they were used to achieve PEEC program objectives in addition to providing technical skills to students. The focus of this paper, however, is not only the surveying content presented to the students, but also the broader preparation to make Native American tribal college students successfully embark on college level engineering programs and eventually become pioneering engineers who would take their communities forward from the present marginalized state in the society (NAE, 2006).

Objective of this Paper

The intent of this paper is not to address the PEEC program as a whole; but to address only the experience with the surveying course and how it helps to meet some of the overall intent of the PEEC program; specifically:

- Why this course is ideal for a first course?
- How it satisfies the PEEC program objectives?

Surveying Course as the First Course in the PEEC Camp

The very first course in the PEEC program should be inspiring in a number of ways as discussed below. Selection of the surveying course satisfied these needs as follows.

Confidence Building

An objective of the two-week summer camp at the university is to provide opportunities for the tribal college students to increase their comfort level with the collaborating university and its urban life style. Being a course with a good balance of fieldwork time (29.5 hours spent outdoors on the campus premises) and 28.5 hours spent in the classroom over 12 days (see the schedule in the Appendix), students get an opportunity to move around many fieldwork locations spread over the campus. This offered them more opportunity to see the campus life unfold before them over the two weeks. This was in addition to many other opportunities of exposure offered by the PEEC camp, which are beyond the focus of this paper.

Another important need is to build confidence that the student can accomplish the challenges of college life. The schedule of the surveying course (and the entire PEEC camp) was set up in a way that would push the students as though the two week camp was to simulate the worst last two weeks of a semester. In going through this schedule, and the toughness of the surveying course stimulated and brought to light the fear that was initially in their minds before coming to camp; students started to open up about their concerns of a four year university career, but with an aggressive support system in place. An objective of the PEEC program being to increase instruction and support without lowering the bar, the undergraduate and graduate students providing support were very attentive, proactive to unearth such concerns and be quick to provide support and assurance. One example of support described by the graduate students is as follows:

> *In one instance, the graduate students noticed that one student started to seem and act disengaged. This being the third day of the camp, the students were new to the environment and were not used to the high stress of the camp schedule. On top of this, the trigonometry review showed that this particular student did not have a good "active knowledge" [student competence in appropriate situations with respect to the quality of cognition (Glaser and Baxter 2000)] of the content important to the surveying course. This resulted in the student being frustrated during one of the math reviews and ultimately left the class room. This person later expressed his frustration to the faculty member and was instructed to talk about these concerns with the trigonometry review instructors, who were the graduate students in this case.*
>
> *The student stated that he was frustrated because the pace of the math instruction was too quick and he felt he was falling behind. Because of the wide range of academic abilities that the students brought to the camp, some students reviewed faster than others. Students that could not keep up ended becoming frustrated, and in the case of this student, becoming completely disengaged.*

It was a benefit to both the instructors and the students that this particular student expressed his concerns. The conversation brought about a compromise for which the student decided to try harder and the instructors would try to slow down the pace of the course work. Being a two week course the pace could only be slowed down so much. This resulted in the instructors taking care to make sure that the students in need got extra attention in times that the pace of the course was fast.

Because of this particular students' decision to stay on and try harder he began to open up about his fears and concerns about transferring to a four year university. During a session of field work this student asked: "How hard are other courses and how do they compare to this course?" This question started a conversation about work ethic and how much effort would be needed to succeed in an engineering curriculum at university. The instructors expressed that it would not come easily and would need a high level of commitment. Also we expressed that there would be set backs and times where they would like to give up; for everyone has times where schooling becomes too much. This being the truth did not deter them but seemed to give them some form of comfort in knowing what to expect.

This particular student, we believe, showed great resolve for deciding to stay and put more effort forward. As the two weeks progressed this student showed more interest in the coursework, produced good work and worked well with his group members.

The reason for providing support of this kind is that Native American Tribal College students are a marginalized ["being outside the mainstream of productive activity and/or social reproductive activity" (Leonard 1984, p.180)] community, often feeling less confident in STEM disciplines. "What typically seems to happen is that the situation of the marginalized persons is portrayed as a result of their own characteristics" (Burton and Kagan, 2004); with support, one could discover one's true capabilities and feel confident to face challenges in STEM disciplines.

Through sweet frustrations, tears, support, assurance and joys of learning new skills such as surveying, every attempt was made to make the tribal college students understand challenges of university education, gain confidence that they can accomplish such, and become inspired to embark on an engineering career. Student support staff being all Native American students successfully pursuing engineering programs at the university acted as role models to give assurance: "like we have accomplished, you too can!" Quality of the student support staff has to be very much credited for the success of the PEEC summer camp.

Integration of Activities, Knowledge and Skills

Surveying was chosen as the first course to be offered because it integrates experiences encompassing:

- fieldwork (challenges pertaining to logistics coordination, weather, safety, etc.)
- group activities (challenges pertaining to interpersonal skills and leadership),

- knowledge and skills of surveying, geometry, trigonometry and computer aided drafting.

Fieldwork (outdoor activity), integral to the course, is attractive to students and thus helpful to sustain their interest. It is designed for hands on learning where much of the content was learnt in the field. Outdoor activities are culturally important to Native American students. One observation the faculty member made during the fieldwork sessions was that Native American students at the PEEC summer camp took lot more time to accomplish the field tasks than the students he often encounters when the course is offered in a regular semester at the university. The former showed more interest in the fieldwork (possibly due to cultural importance attached to such) and motivation to learn by reflecting in depth!

Organizing fieldwork involves challenges pertaining to logistics coordination, which was a valuable experience to everybody. As evident from the schedule, students will move from a class activity, to a field activity, to a quick meal and back to a class activity in quick succession. Support staff has to know many things such as: where the students should be ushered, what instruments are required for the activity, whether we should arrange a field lunch or usher the students to a dining hall, swipe card access, et cetera. If it rains, everything needs to be rescheduled quickly.

Fieldwork, in addition to technicalities of surveying, trains students to be prepared for field conditions. In a construction site, a field engineer who is not suitably prepared for the field conditions will become a liability. Students need to dress suitably to face the field conditions and feel comfortable enough to concentrate on the work, and ensure safety.

Because most surveying endeavors require group work, students get a taste of working in teams to complete tasks, collaborative learning and camaraderie. It sharpened their interpersonal and leadership skills. Every attempt was made to ensure that students from different tribal colleges will work together in groups, thus increasing interactions among people across tribal reservations.

The surveying course required students to use their skills of geometry, trigonometry and computer aided drafting in the process of gaining knowledge and skills of surveying. Triangulated surveys required a sound knowledge of geometry and trigonometry. Students were required to do calculations using MS Excel spreadsheets. Three dimensional maps were drawn using AutoCAD Civil 3D. Geometry, trigonometry and computer aided drafting were studied by students before coming to the PEEC camp. The surveying course thus became an interesting experience where disparate knowledge gained in previous courses came together to complete a practical application.

Exposure to Professionalism

Global Positioning System (GPS) and Geographic Information System (GIS) demonstration was done by a professional engineering firm, Houston Engineering, Inc., where many alumni of this

university are serving. For this demonstration, students and staff of the PEEC camp visited the engineering firm. The session was conducted by two professional engineers having the credentials: 1) Professional Land Surveyor, Project Manager and Survey Coordinator, 2) CAD Manager and Survey Technical Coordinator. GPS and GIS equipment and software, including additional equipment such as robotic total station were demonstrated, and the students were given some hands on time with the GPS rover and the data collector. Then the students were taken on a tour of the facility of their company. The objective of this tour was to introduce the students to the working environment in their firm, further inspiring them to pursue an engineering degree leading to an engineering career.

Rigor, Testing and Evaluation

Quizzes on Theory

When condensing a 16 week semester schedule to a two-week camp, the major concern was to allow reasonable time for studying, homework and reflection. The schedule was, hence, set so that students were given time overnight before conducting tests and fieldwork on material taught any day. The course was hence, run to a strict schedule. As you may observe from the Appendix, when material are presented to students, time was allowed overnight to enable studying, further reading and reflection.

Much of the theory and some practical aspects of surveying were presented by way of MS PowerPoint presentations and the textbook by Crawford (2003). The MS PowerPoint presentations have abundance of photographs and illustrations, and Crawford (2003) is also a heavily illustrated textbook. Students were required to study them and take a quiz before each fieldwork session. The quizzes were typical of what is given in an engineering program, and they were graded to the same standard as the surveying course offered in a regular semester at the university.

Intensive Fieldwork

During a regular semester at the university, students go out surveying in groups of 4 persons. Most surveying tasks need at most 2 persons; however 4 person groups were used (requiring 2 persons to watch while two persons work, then take turns) to manage with available resources such as number of instruments and teaching assistants. With the increased resources in the PEEC camp, we were able to have just two persons per group, thus increasing involvement and learning experienced by each student.

Field Book Evaluation

A field book has to be maintained by each group engaged in fieldwork. Students were required to make a detailed record of each fieldwork on the field book, and that was rigorously graded as per the scheme given in Table 1.

Table 1: Field book grading scheme

Field Book Entry		Grading Method	Weight
Table of Contents		Updated/No	0.25
Legend and Abbreviations		All included/No	0.25
Page Numbers		Yes/No	0.25
Main Titles and Continuation Titles of Surveys		Fraction	0.25
Date/ Time		Yes/No	0.25
Names and Roles		Complete/Incomplete	0.25
Weather Conditions and Adverse Conditions		Complete/Incomplete	0.25
Equipment List		Complete/Incomplete	0.25
Sketch of the Area	Attention to detail	Fraction	0.75
	Labeling of locations	Fraction	0.25
Hubs/ Benchmarks Tied	Half page sketch	Yes/No	0.5
	Three measurements and fourth measurement in the absence of a "well conditioned triangle"	Yes/No	0.5
	Measured distances	Yes/No	0.5
	Notes on exact points measured to, e.g., centre, edge, etc.	Yes/No	0.5
Data	Recording format followed	Yes/No	1
	Completeness/attention to detail	Fraction	1
Calculations	Accuracy	Yes/No	1
	Equations/specimen calculations	Fraction	1
Clarity Neatness and Legibility		Fraction	1
Major failure to follow instructions (negative points)			
Total			**10**

Reflective Thinking

Human kind developed from primitive beginnings to where we are today due to reflective thinking. Reflection on practice (on the hindsight) eventually creates the skill in us to reflect in practice (make split second decisions as events happen) (Schön, 1983); which is a very important skill for professionals. Much emphasis was made that students need to develop into reflective practitioners. To make students reflect on practice (on the hindsight) they were required to write a reflective journal at the end of each fieldwork. It required answering 3 simple questions:

a) Select surveying activity/action done during the fieldwork session (students were required to focus on one particular/small activity/action)
b) Identify Problem(s)/shortcoming(s) in the way the activity/action was done
c) Suggestion(s) as to how the activity/action could be improved for the future

Analytical Reasoning

For students of the PEEC camp, as well as those in the surveying course offered in a regular semester at the university, the greatest challenge was the trigonometry calculations. In a regular semester course also a huge effort had to be made by the faculty member and the teaching assistants to guide the students through such calculations. At the PEEC camp also, the graduate students and the faculty member made such huge effort. Without lowering the bar, to increase instructions, the faculty members from tribal colleges who were attending the PEEC camp also shouldered the burden of guiding the students. Without either prompting or showing any model answers, students were enticed to think deeper and deeper and exercise analytical reasoning until they solved the problems. As a result, lots of extra time was spent with the students.

Future Improvements

The main improvement proposed is to increase students' preparation to handle trigonometry challenges. The faculty members from the tribal colleges who were attending the PEEC camp agreed that they will give trigonometry exposure to students just before the PEEC camp, thus improving their "active knowledge" of trigonometry.

Beyond the above major endeavor, every effort is made to reflect on other details of course content and delivery, logistics in conducting fieldwork, and so on, to continuously improve PEEC camp experiences and learning outcomes to students.

Conclusions

Selection of the surveying course as the first course offered significantly contributed to the success of the PEEC summer camp in the following ways:

- Instead of being confined in a classroom for much of the day, students had the opportunity to move around many fieldwork locations spread over the campus, and in the process see the campus life unfold before them over the two weeks, thus increasing their comfort level with the collaborating university and urban life style
- Students were pushed as though the two week camp was to simulate the worst last two weeks of a semester; thus generating an assurance, "If I got through this, I can get through the rest!"
- Outdoor fieldwork activities were culturally important to Native American students, thus motivated them to learn by reflecting in depth
- Coordinating fieldwork logistics itself was a learning experience to all; also was an experience in preparedness and safety
- Group work at fieldwork sessions served to sharpen skills of collaborative learning, teamwork, interpersonal relations and leadership; further, promoted camaraderie and interactions among people across tribal reservations
- Delivered an interesting experience where disparate knowledge in geometry, trigonometry, computer aided drafting, and computing gained in previous courses came together to complete a practical application
- Gave an exposure to practicing professional engineers and their work environment
- Offered some practice towards developing into reflective practitioners in the future
- Students being enticed to think deeper and deeper and exercise analytical reasoning until they solved problems

Another very significant reason for success was the student support staff being all Native American students successfully pursuing engineering programs at the university acting as role models to give assurance: "like we have accomplished, you too can!" Quality of the student support staff has to be very much credited for the success of the PEEC summer camp.

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The faculty members from tribal colleges who were attending the PEEC camp also shouldered the burden of guiding the students in trigonometry assignments. This greatly helped us achieve the course objectives by increasing instructions without lowering the bar.

Numerous support and administration units and personnel from the North Dakota State University (NDSU) helped us conduct the PEEC summer camp and this course successfully on its crash program. We wish to express our gratitude to them all.

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Appendix – PEEC Program Schedule for the Surveying Course

Week 1

Day / Time	Saturday *July 21*	Sunday *July 22*	Monday *July 23*	Tuesday *July 24*	Wednesday *July 25*	Thursday *July 26*	Friday *July 27*
7.30			Preparation	Preparation	Preparation	Preparation	Preparation
8.00			Cha. Sur. Quiz			Total Station Instructions	Total Stn. Quiz
9.00	The Opening Ceremony		Chain Survey Fieldwork	Leveling Instructions (cntd)	Differential leveling and Profile Leveling Fieldwork	Total Station Familiarization and Traverse Survey Instructions	Triangulation HW Discussion
10.00				Automatic Level Familiarization			
11.00	Trigonometry	Preparation	Leveling Instructions	Bldg. Setout Fieldwork			Tour Microsoft
12.00	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	
1.00	Introduction and Video Quiz	Cha. & Pac. Quiz	Bldg. Setout discussion	Leveling Quiz	Laser Level Fieldwork	Triangulation Homework Assin.	45 min. Lunch at Residence Dining Center
2.00	Chaining and Pacing Instructions	Chaining and Pacing Fieldwork	TA Meeting on Grading and the Next Fieldwork Rehearsal	TA Meeting on Grading and the Next Fieldwork Rehearsal	TA Meeting on Grading and the Next Fieldwork Rehearsal	TA Meeting on Grading and the Next Fieldwork Rehearsal	Traverse Survey Fieldwork
3.00		Chain Surveying Instructions					
4.00	Field Note Keeping Instructions						
5.00	TA Meeting on Grading and the Next Fieldwork Rehearsal	Bldg. Setout HW TA Meeting on Grading and the Next Fieldwork Rehearsal					Grading and Debriefing
6.00			• Draw Chain Survey Map on AutoCAD • Study for Leveling Quiz • Refer textbook pages: 3-25 to 3-32, 7-1 to 7-27 • View 'Leveling.ppt' and the two YouTube videos	• Complete Chain Survey Map on AutoCAD • Refer textbook pages: 7-28 to 7-42, 8-1 to 8-17	• Draw Profile Survey Map on AutoCAD • View 'Triangulation.ppt' • Refer textbook pages: 3-43 to 3-61, 5-1 to 5-23, 6-2 to 6-23	• Complete Profile Survey Map on AutoCAD • Do Triangulation Homework • Study for Total Stn Quiz • View 'Reflections on the Use of Total Station.ppt' and 'EDM.pptx' • Refer textbook pages: 15-1 to 15-42	• Complete Triangulation Homework • View 'Horizontal Curve Ranging.ppt' • Textbook 14-1 to 14-46, 16-1 to 16-53
	• Study for Chaining and Pacing Quiz • View 'Chain Surveying.ppt' • Refer textbook pages: 4-1 to 4-22, 21-7 to 21-9	• Refer textbook pages: 11-1 to 11-39, 19-2 to 19-25 • Building Setout Homework • Study for Chain Surveying Quiz					

Week 2

Day / Time	Saturday *July 28*	Sunday *July 29*	Monday *July 30*	Tuesday *July 31*	Wednesday *August 01*	Thursday *August 02*	Friday *August 03*
7.30	Preparation		Preparation	Preparation	Travel to the Site		
8.00	Traverse Survey Fieldwork (Continued)	Turn in Triangulation Homework	GPS and GIS Instructions	Intro to Transit Theodolite and Vernier Reading Quiz	GPS and GIS Demonstration		
9.00							
10.00	Traverse Survey Closing Error Calc		Horizontal and Vertical Curve Ranging Fieldwork	Transit Theodolite Fieldwork	Measuring by Hand Exercise		
11.00		Preparation			GPS and GIS Quiz		
12.00	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	45 min. Lunch at Residence Dining Center	Theo & OPS Quiz		
1.00	Horizontal Curve Ranging Instr	Hor & Ver Curve Ranging Instr	GPS and GIS Instructions (cntd)	One Person Surveying Instr	Lunch at Residence Dining Center, Closing Ceremony, and Students Depart		
2.00	TA Meeting on Grading and the Next Fieldwork Rehearsal	Triangulation Fieldwork	TA Meeting on Grading and the Next Fieldwork Rehearsal	TA Meeting on Grading and Planning GPS-GIS Demonstration			
3.00							
4.00							
5.00		TA Meeting on Grading and the Next Fieldwork Rehearsal					
	• Draw Traverse Survey Map on AutoCAD • View 'Vertical Curve Ranging.ppt' • Refer textbook pages: 5-24 to 5-31, 6-24 to 6-42, 17-1 to 17-28 • Complete Profile Survey Map on AutoCAD	• Complete Curve Ranging calculations • Calculate Hor & Ver Coordinates of IACC • View 'GPS & GIS.ppt' • Refer textbook pages: 9-1 to 9-18	• Refer textbook pages: • Practice for Measuring by Hand Exercise • Refer textbook pages: 7-43 to 7-56, 19-26 to 19-68, 20-1 to 20-43, 21-1 to 21-25, 22-1 to 22-17 • Practice for Measuring by Hand Exercise	• Study for GPS and GIS Quiz • Study for Transit Theodolite and One Person Surveying Quiz • Focus on the Measuring by Hand Exercise			

Key:

In Class Instruction/Activity Meetings | Fieldwork | Preparation Time for Teaching Assistants | HW Tonight

Textbook: Crawford, Wesley G., (2003), *Construction Surveying and Layout*, 3rd ed., Creative Construction Publishing, Inc., IN.

Before Monday July 21st, students should view 'Chaining and Pacing.ppt' available on the Bb, and refer textbook pages: 1-1 to 1-20, 2-1 to 2-36, 3-2 to 3-24, 3-33 to 3-42, 4-1 to 4-22, 12-1 to 12-18, and 21-7 to 21-9. (For detailed reading requirement refer '*Required Reading - PEEC Program Surveying Course.docx*')