AC 2007-1066: COMMUNITY SERVICE PROJECTS AS INTEGRATED UNDERGRADUATE LEARNING EXPERIENCES

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Community Service Projects as Integrated Undergraduate Learning Experiences

Abstract

Community-based projects in engineering and engineering technology education have been around for many years in various forms. Recent examples include community-based design projects and partnerships, community outreach for capstone design, capstone design projects for special needs or disabled persons, K-12 community outreach, and international and humanitarian projects.

For obvious reasons, community organizations tend to be very receptive to the assistance afforded through these collaborations. Many community programs, including non-profit organizations, operate on minimal funding and rarely have the in-house expertise to perform technical work. Academic programs, eager to insert students into practice-type experiences make excellent partners for these community organizations.

The authors of this paper have incorporated local and regional community service projects as integrated learning experiences in engineering technology programs. The results benefit both the community and the engineering technology program. Community programs presented in this paper received technical expertise and volunteer hours at no cost while students in the engineering technology program were provided with "real-world" project experience, exposing them to the significance engineering technology can have in society and providing lifelong contacts for volunteer work in the future. Projects are selected which are technical in nature, can be completed in one to two semesters, and meet the societal impact objectives of the program.

In this paper, the authors present two community service projects which were completed by engineering technology students. The first project, "The Magnetic Survey," was developed as a class project for a construction surveying class. The project was provided by the Department of Natural Resources Geodetic Survey Division, and consisted of locating magnetic monuments thought to have been lost for over six decades. The second project, "Soccer Complex Pedestrian Bridge," was provided by the Department of Parks & Recreation. This project required a bridge to be designed and constructed to provide pedestrian and ADA access from a parking lot to the soccer complex.

The paper will cover all aspects of the projects to include selection, course and program relevance, course management, and project assessment. The paper will outline project development, eye-openers for the students, surprises for the sponsor, deliverables and final products, and student and community reactions for each project.

Introduction

The use of community or social projects as capstone experiences is not new to the engineering technology field.[1,2,3,4] However, as in many instances, the resources and impact that a single course can provide to a project are sometimes limited. When choosing projects for capstone

experiences, the instructors must look at the probability for success. To not finish a project on time and budget is not a lesson that should be taught to undergraduate engineering technology students. Therefore, the structure for any given capstone project of course must be tied to the scope of work required of the students. If the students are to take ownership of the project (a requirement for success), the must not feel overwhelmed by the amount of work required. Too often, we as instructors, forget that the time management skills of an undergraduate are often lacking at best. The two projects presented in this paper deal with innovative means to approach a project so that the optimal project experience occurs for both the student and the "customer."[5] By dividing the scope of work into sections for a single course or spread the deliverables over multiple courses, the instructor provides a simpler scope for the student to manage and gives the student a support structure for their deliverables. Furthermore, the students are forced to manage their project effectively due to other teams or classes are relying on their work to complete the next deliverable.

In addition to aiding in student time management, the role the instructor plays must be considered very carefully and is a key to the well-being of the project. The instructor often serves as a mentor; however, the instructor should be well aware that they need to also serve as a safety net and/or offer guidance when appropriate.[5] Timing is everything. The students should first exhaust all possible avenues in seeking their answer, however, not to the point of frustration and giving up on the project.

While a number of projects can be used in this format, the authors chose community based projects to expose students to non-technical clients, develop empathy for social issues, stress the importance of creativity in engineering/construction, and the personal satisfaction from helping the community.[2] Utilizing community or service projects as capstone experiences offers a further benefit to the engineering technology program; they provide the integration of both global and social needs, a requirement of the TAC of ABET criteria.[7]

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North Carolina Magnetic Meridian Monument Project

The North Carolina Geodetic Survey has enacted a project, *"State TresureS,"* [9] to locate the Magnetic Monuments that were placed around the state at the turn of the nineteenth century during the 1890's. The monuments were originally located at each of the county's courthouse and where established based on declination, inclination, and horizontal control. The function for the monuments was to calculate (or calibrate) the declination of the surveyor's compass from "true north." Magnetic declination or variation can be defined as the angle between the true north and south line and the magnetic north and south line as pointed by a compass needle.

For most surveyors participating in the project, the search has been a frustrating experience due to the lack of information on the original surveys. The General Report on the Magnetic Survey of North Carolina in 1899[10] was the last known documentation for the location of the monuments in each of the counties. Unfortunately, over the last century, the monuments have been moved or destroyed in most of the counties and as a consequence, the 1899 report is no longer valid in most instances. The only leads to the newer locations were the Magnetic Records, the official record for the monuments. The Magnetic Record was used to document the changes in true north over the years and the well being of the monuments and was required to remain on file at

the county court houses. However, the Magnetic Record has proved to be just as elusive as the monuments themselves, which in turn, has lead to a lot of dead ends in the search. In an effort to rejuvenate the project and provide some momentum to the participating surveyors, the NCGS contacted a surveying professor at the University of North Carolina at Charlotte in August 2006. The NCGS provided the following scope of work to the university:

1. Locate any remaining monuments in the counties surrounding the university to include: Mecklenburg, Union, Cabarrus, Catawba, Gaston, and Yakin.
2. Recover (re-establish) the monuments that are found providing state plane coordinates for each.
3. Research and report on any information on the Magnetic Survey program to further the *State TreasureS* project.

After an exhaustive search at each of the courthouses, the surveying teams could not locate either the Magnetic Record or any one that had knowledge of the records. Furthermore, the research on the historical data related to the monuments did not turn up any new leads. It was decided by the class to visit the historical societies in the counties as a last effort to generate new information. One team found a reference to the State Geologist Office and the Magnetic Record in surveying notes on record with the Mecklenburg County Library. This relationship proved to be the turning point in the project. During the early 1900's, the State Geologist for North Carolina provided a yearly report to the state. As part of their report, the State Geologist provided a section on the maintenance and progress of the Magnetic Survey. At this point, the reason for the dead ends was quickly discovered, the historical documentation for the Magnetic Monument Project was filed with NOAA not the USGS as many believed. In an effort to accelerate the project for the students, the instructor investigated the historical documentation with NOAA. The result was the discovery of two more magnetic surveys that were performed in 1925 and 1930. Additionally, the instructor also discovered the final State Geologist report documenting the termination of the Magnetic program.

The Magnetic Declination in North Carolina in 1930[11] details the movement of the monuments from their original locations in 1899. The report revealed that a number of the monuments were moved as early as two years after their establishment. Furthermore, it was readily apparent that only the monuments, save one, that resided in their original location were the monuments that have been located. Based on the following information from the Magnetic Survey of 1930, the students began their field investigations.

Mecklenburg County Magnetic Monuments

The original location of the monuments was at the graded school play ground next to the county courthouse. The monuments were moved to an open space on John C. Smith University Campus when the original area was redeveloped. Unfortunately, the monuments were destroyed when the area underwent new building.

Cabarrus County Magnetic Monuments

The Cabarrus County Monuments were located in the back lot of the original county courthouse. Due to the addition of a new courthouse building, the monuments were moved to an adjacent lot at the graded school in Concord, NC. Again, due to new construction of a roadway, the monuments were destroyed.

Union County Magnetic Monuments

The Union County monuments were originally located at the county courthouse; however, they were moved to the private residence of the county surveyor. At the time of the report submission, the monuments have not yet been located, but the search continues.

Gaston County Magnetic Monuments

As of 1930, the monuments in Gaston County were located at their original locations. This has proved to be more of a liability than an advantage. The monuments are no longer at the courthouse which means only the Magnetic Record for Gaston County will provide the monuments fate. The search for these monuments is still active.

Catawba County Magnetic Monuments

The monuments in Catawba County were originally located at the county courthouse grounds. They were moved to the city cemetery at an unknown date between 1900 and 1925. The field investigation for this county proved to be the most successful. Using the bearings provided by the 1930 report, the monuments were relocated by the Surveying II class. Figure 1 shows an elevation of the north monument at the city cemetery. As can be seen in the figure, the monuments were difficult to initially locate due to the resemblance to grave markers. Figures 2 and 3 illustrate the plan view of the monuments. Interestingly, the original monuments were moved instead of new monuments being constructed. In most other counties, new monuments were constructed and the originals destroyed. The monuments measure eight inches by eight inches in plan and protrude approximately eighteen inches out of the ground. Each monument is estimated to weight four hundred pounds.

Yadkin County Magnetic Monuments

The Yadkin County monuments were originally located at the county courthouse where one still resides. Interestingly, only the south monument remains. The north monument was destroyed during the construction of an addition to the county courthouse. Figure 4 illustrates a plan view of the south monument in Yadkin County. The monument measure eight inches by eight inches in plan and protrude approximately four inches out of the ground. The monument is estimated to weight four hundred pounds.

Figure 1. Catawba County Magnetic Monument – Elevation View of North Monument

Figure 2. Catawba County Magnetic Monument – Plan View of South Monument

Figure 3. Catawba County Magnetic Monument – Plan View of North Monument

Figure 4. Yadkin County Magnetic Monument – Plan View of South Monument

During the execution of the project, the students' enthusiasm and work ethic impressed not only the instructor but also the representative from the NCGS. The Surveying II class has taken the State Treasures Project to a new level. The Magnetic Reports of 1925 and 1930 have provided the NCGS with the final locations of all Magnetic Monuments established in North Carolina. The reports were not even known to exist by the NCGS and have been labeled an astonishing find by their representative. This impressive documentation will surely lead to all monuments either being located or definitively deemed destroyed. Furthermore, the State Geologist report provided documentation that the program was terminated due to a lack of funding and new technology in control surveying.

The student reactions at this point are currently anecdotal due to the course evaluations will not be available until late spring semester 2007. However, the direct comments have been very positive and the students' actions have proven to the author that the project made a sincere impact on the students. The students' enthusiasm for the project is evidenced by the number of the students whom have formed an ad-hoc group to continue the search. They are currently searching in Gaston, Stanley and Union counties. The class has provided a digital copy of the Magnetic Report of 1930 and the State Geologist Report to the NCGS. Additionally, the class is submitting a final report on the monuments that have been recovered. The report will include coordinates, declination and inclination of the monuments that will be verified by a Professional Surveyor. The re-establishment of the monuments was performed utilizing GPS surveying techniques.

Pedestrian Access Bridge Project

The Fairmont Soccer Complex is a community supported recreation facility with very limited funding. The construction project was started by members of the community and, due to severe drainage issues, completed by the Army Corps of Engineers. The initial project consisted of six soccer fields and a concession/equipment building. The parking was not addressed by either group. Once the fields were placed into service, the parking problems were quickly realized. In addition to little available space, funds to construct a parking area were not available. The solution was to have a bulldozer and operator donate their time and clear an area on donated land adjacent to the complex. While the solution was very feasible, it presented a problem for handicap access due to a stream crossing from the proposed parking area to the complex. The School of Technology at Fairmont State University was approached to perform a design build on a pedestrian bridge. The students would perform the design of the structure, the community would provide the materials, and together they would build the structure.

The project was rather large for a single class to approach; therefore, it was decided to divide the project into four projects for four courses. The construction surveying class would perform the preliminary site survey, the hydraulics class would perform the open channel analysis for water surface elevations, the structures class would perform the analysis and design, and the civil engineering details class would develop the construction plans. The deliverables for each course were treated as the capstone experience for the course. The students were asked in each course to provide a detailed report along with the deliverable to submit for a grade.

In order to provide some resemblance to a real world experience, each class was divided into teams of three and assigned to another team in each class. The final design group of twelve students would be a three person team from surveying, hydraulics, structures and civil engineering details. The groups were required to work with each other as if working in a design office. If more surveying data was needed for the hydraulic analysis, it was the responsibility of the hydraulic group to communicate with their assigned surveying team to retrieve the required data. Each design group would then present their final plan to the School of Technology and the community for design selection. The selected design was then forwarded to the ASCE student club for construction. The ASCE club provided a construction schedule and a materials take-off so that the community representative could schedule and afford the materials required to build the bridge.

The bridge design that was selected was a timber bridge that is illustrated in Figures 5 and 6. The bridge construction is slated to begin in the spring of 2007. To this date, the representative from the Fairmont Soccer Complex has been impressed with the professionalism of the students, their abilities to generate the deliverables, and the over all experience with the partnership. The students, however, received the full project experience. Their comments from each course evaluation supported a common theme; design build is a challenging experience. The students went through the highs and lows of the project, the long hours to produce deliverables, the importance of effective communication during design (one group had difficulty in expressing the exact data needed for the hydraulic analysis to their surveying group and several field trips were required), and the issues surrounding non-technical clients. However, as evidenced in the student evaluations, the students were very proud of their final product and requested more learning experiences in this format.

Conclusions and Recommendations

Both the single course and multiple course structures produced deliverables that made a significant impact to the constituencies. By dividing the scope appropriately, the students were able to take an in depth approach to their deliverable, and made their project their own. As the projects progressed, the student teams gained confidence and the instructor's role diminished as a mentor. In the end, the instructor was merely serving as a milestone administrator, making sure deadlines were met.

For many students, the importance of solving real world problems, illustrated that not every problem has a definitive conclusion and sometimes not every answer is black and white. As one student remarked on their student evaluation, "in real life, there are no answers in the back of the book."

The community representatives deeply expressed their admiration and gratitude to the students and the students then realized the impact they had made to the community. Lasting partnerships were formed between the community, the students and the programs, where new projects will be proposed. An added benefit not realized at first by the authors, was the positive exposure the program and the students received in the media.

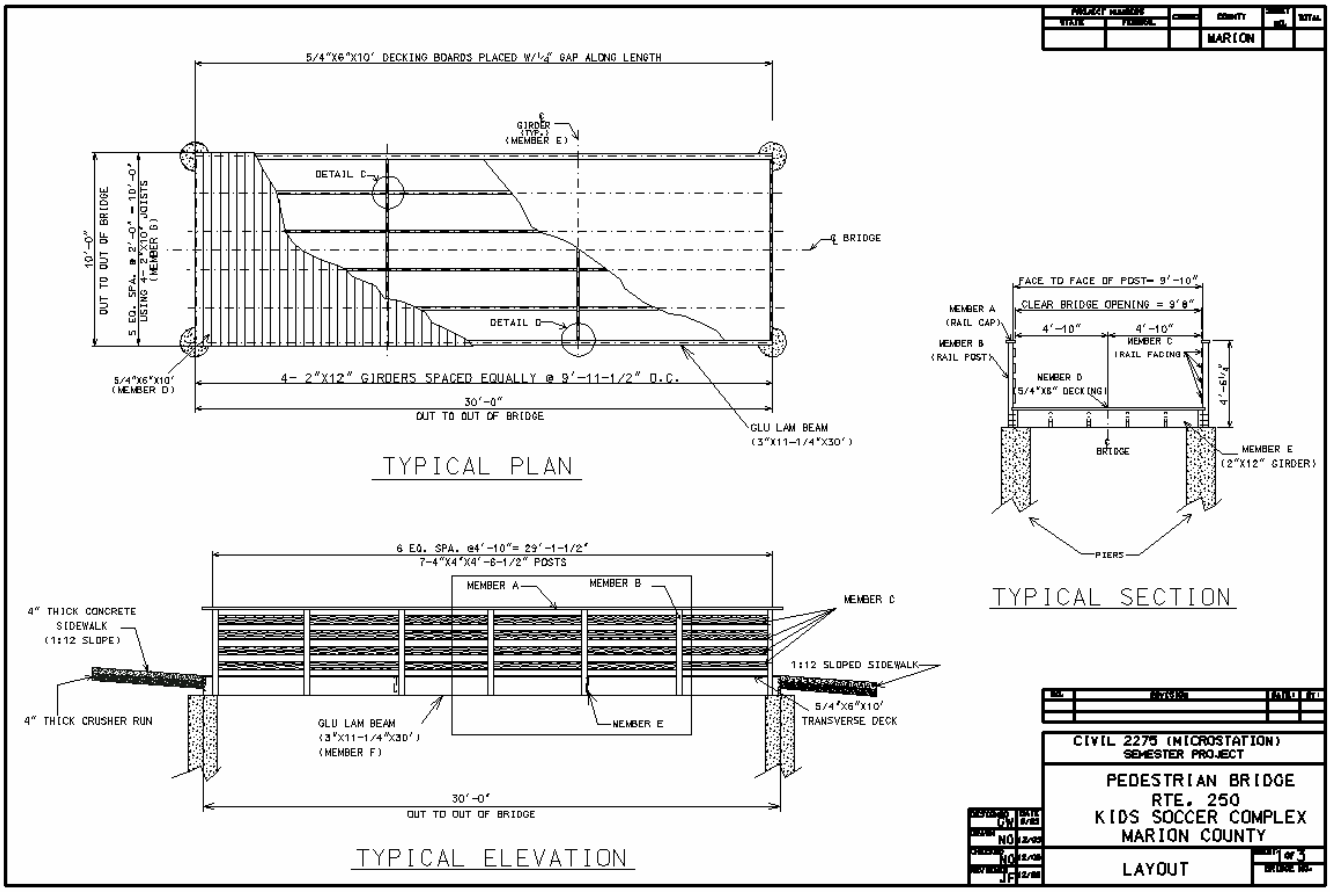

Figure 5. Construction Plans - Layout of Pedestrian Bridge

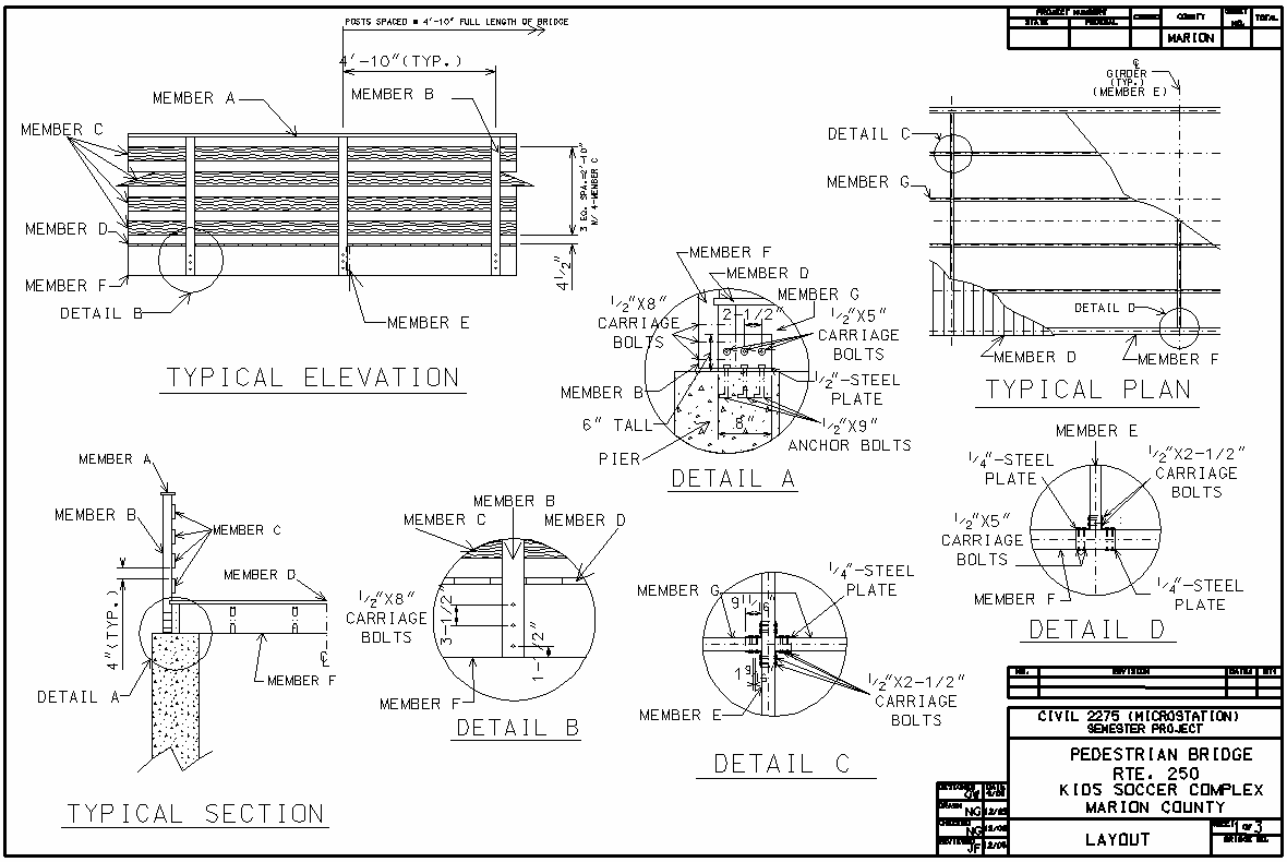

Figure 6. Construction Plans – Detail Sheet for the Pedestrian Bridge

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