

BUILDING A BRIDGE: A CASE IN PROJECT SERVICE LEARNING

Kenneth R. Leitch¹, Brett J. Iafigliola², and Kristine Martin³

¹*Assistant Professor, Valparaiso University, Civil Engineering Dept., Valparaiso, IN*

²*Schirmer Construction Company, Cleveland, OH*

³*Master's Candidate, Civil & Environmental Engineering Dept., Marquette University, Milwaukee, WI*

1. INTRODUCTION

1.1 Abstract

An interdisciplinary team of Valparaiso University students led by the student chapter of the American Society of Civil Engineers (ASCE) successfully applied classroom knowledge, management skills, and manual labor to relocate, refurbish, and reconstruct an approximately 150-year-old, 32-foot long, 6-foot wide steel truss bridge on the Valparaiso University campus. Over a period of two years, several dozen students participated in the planning, fund-raising, management, and construction at the bridge's previous site and its new location on campus. In the process, the students gained invaluable knowledge of the construction process while working with local suppliers, campus administration, the faculty, and each other. The Student Bridge Project is the first of a proposed series of service learning projects to improve campus infrastructure and aesthetics while also enhancing civil (and other) engineering students' laboratory and classroom knowledge. The project attracted public attention through several articles in local newspapers and a featured column in the December 2004 issue of the nationally distributed monthly periodical *Modern Steel Construction*, published by the American Institute of Steel Construction (AISC).

In this paper, the student leaders and faculty were asked about their experiences with the Student Bridge Project relating to the challenges, rewards, and lessons learned. Suggestions for future implementation of service learning were solicited from students and faculty.

1.2 The Concept of Service Learning

Service learning is educational instruction in conjunction with community service that serves to enhance pedagogy and fulfill community needs (Gokhale, 2000). Students gain insight into engineering analysis and design that can be difficult to impart within the confines of a classroom with the added benefit of increased student retention and broadening the view of engineering for participants (Oakes, 2004). In recent years, many universities have implemented service learning into instruction. Several engineering programs in the United States have incorporated this concept into undergraduate courses from the freshman through senior levels. ABET actively encourages the utilization of science, mathematics, and engineering skills in the context of multidisciplinary teams.

The concepts of service learning are emphasized in the College of Engineering at Valparaiso University, a Lutheran-affiliated comprehensive university located in northwest Indiana. In addition to the Student Bridge project described in this paper, current key projects involve a multi-year effort to construct a water distribution network in the Turkana district of Kenya by the Engineers Without Borders chapter (Polito, 2005), a joint mechanical-electrical engineering project to construct windmill power systems in Nicaragua, and a civil engineering student team working with a professional mechanical engineer to produce an energy usage improvement study for the university. Each project emphasizes cross-discipline interaction, community service, and sustainable development in a professional and ethical framework in support of goals set forth by ABET (Duffy, 2000).

2. INITIATION OF THE STUDENT BRIDGE PROJECT

The project was initiated in the fall of 2003 by VAULT (Valparaiso Alumni Undergraduate Leadership Team), a campus organization dedicated to preserving school history and pride and connecting alumni to current students. The bridge commonly referred to as the “Student Bridge” or more affectionately as the “Kissing Bridge,” had a very long history with the university. It previously crossed railroad tracks on the oldest part of the Valparaiso University campus from the 1880s until 1969, when it was dismantled and moved approximately two miles to a location over Salt Creek in Valparaiso, Indiana (Figure 1).

Two Valparaiso University student organizations, VAULT and ASCE (American Society of Civil Engineers), took the challenge to move the bridge from the site across Salt Creek back to the Valparaiso University campus. The students developed a plan of action to bring awareness to the project, raise funds, determine how to rehabilitate and move the bridge, and develop a preliminary design for the future bridge site.

A core of committed students and faculty set out to make the bridge relocation possible. Soliciting donations and funds were key for purchasing of supplies and building materials. The students developed planning and design documents, held public meetings, and enlisted campus administration as well as garnered support from their fellow engineering students, other students, faculty and staff, and contractors in order to commence construction. The process was not unlike that used to gain support for construction of civil engineering public works, a concept that can not be fully understood within the confines of a classroom.

3. CONSTRUCTION OF THE STUDENT BRIDGE

The spring 2004 semester was a time of intense planning for the students. Kristine Martin, a key student leader, was also a member of the university’s campus planning committee and helped choose the final site location of the bridge on the Valparaiso University campus. The students presented alternate site locations, ranking them in order of acceptability, incorporating ideas of environmental impact and costs from required courses in transportation (CE 253) and engineering economics (GE 301) courses. With the students’ input, it was decided to locate the bridge near the new main entrance to the campus near the most prominent landmarks on the

campus, the Chapel of the Resurrection and the new Christopher Center for Library and Information Resources.

Students utilized skills developed in coursework from the freshman through senior levels to design and construct the Student Bridge. Site development of the project utilized AutoCAD software and surveying equipment (CE 151). A concrete foundation (CE 322) and concrete abutment wall (CE 417) were designed and built by students in the spring and summer of 2004 for support of the bridge (Figures 2 and 3). The required formwork was designed by principles learned in mechanics (CE 215) and structural analysis (CE 315). All design drawings were reviewed and stamped by a licensed professional engineer registered in the state of Indiana. The bridge was sandblasted, repainted, and repaired according to principles learned in the steel design (CE 316) and materials engineering (CE 212) courses. Relocation of the bridge occurred in late September 2004, attracting the attention of the local media and campus community. An article in the December 2004 edition of nationally distributed *Modern Steel Construction Magazine* highlighted the students' triumph of the successful moving of the bridge (Figure 4).

Fall 2004 and spring 2005 saw the finish of the construction of the wooden bridge deck and railings and earthen ramps. Hundreds of 75-lb masonry blocks were manually carried and placed by hand by student and faculty volunteers and backfilled with earth (Figures 5, 6, and 7). Dedication of the bridge including the ramps with brick wearing surface, attached patio, and native landscaping was held at Valparaiso University's Homecoming in October 2005 (Figure 8).

4. STUDENT AND FACULTY THOUGHTS ON THE STUDENT BRIDGE PROJECT

Key student and faculty leaders who worked on the Student Bridge were solicited for their thoughts on the project. A student from each class (freshman through senior) was selected for their comments and recommendations.

4.1 Senior Student: Brett Iafigliola

Student leader Brett Iafigliola was in his senior year during the project and filled the roles of "project manager, project engineer, architect, superintendent, administration liaison, peacemaker, fundraiser, and changed constantly depending on the challenge of the day." Iafigliola and other students were in class in the morning and in the field with Professors Leitch and Hagenberger in the afternoon. Iafigliola states that working on the bridge "made sense" of core engineering courses (e.g. statics and mechanics of materials) as well as more advanced topics such as timber design (CE elective), foundation design (CE 322), and reinforced concrete design (CE 417). He states that "now I know what that professor was talking about" in reference to concepts that were hard to visualize in a classroom setting but were plainly visible at the construction site.

Iafigliola relates that in the leadership role "the biggest challenge by far was managing people's unique personalities. Everyone brought their unique talents and skills to the table and it was my pleasure to match their abilities with a task they enjoyed. For better or worse, everyone had an opinion on the "right way" to proceed, which almost always conflicted with another person's thoughts. However, the right people always seemed to appear when they were most needed –

when the project could not proceed without their immediate assistance.” His leadership in the project and other previous work experiences led to a job upon graduation with a construction company. He states, “in my experience as a Project Engineer for general contractor construction company, my previous service learning experiences have clearly given me a jump-start in my career. While I still have so much to learn, and try to learn more every day, I draw deeply from my well of knowledge gained on the Student Bridge Project. Countless times I say to myself, ‘Now, when I was running the Bridge Project, what did we do there?’ in order to apply that experience then to my challenges now.”

Iafigliola says that “many of my best friends from college worked on the Student Bridge Project, either because they were recruited or because we became friends through our work together. For that core group of involved students, the bridge project dominated our thoughts, as we constantly were discussing new challenges, strategies, and designs. Together, we all are so proud of the final result, a genuine pride in a job well done, and I thank Valparaiso University for that opportunity.”

4.2 Junior Student: Kristine Martin

Kristine Martin was a junior student when the project started and participated up until the time that she graduated. In her own words, she “was one of the main leaders. There were two of us that took charge of the scheduling and making sure that we were making progress. I worked on things like getting people interested in the project to come work with us, to arranging for materials to be delivered to the site, to scheduling work days.” Kristine was “the AutoCAD expert on the team. I put together the drawings that were sent in for permits and any other drawings that were required.” Using knowledge from course work and from on-the-job training, she was able to design much of the project site layout including the ramps on each end of the bridge. She states that the design of the ramps was “the part [of the project] I am most proud of. Brett [Iafigliola] found a company [Rogers Block and Wall] that was willing to donate Anchor Wall® block to us for the ramps and I became the contact person for that company. I arranged for the blocks to be delivered to campus and was the overseer of construction of the ramps. I also got to run the two concrete pours for the bridge abutments.”

Looking back, Kristine was very positive about what was done on this project. She states that “I got to work on a lot of different aspects of this project. I was able to work on various skills, anything from engineering estimates to communicating with clients and donors.” The construction was particularly challenging because none of the students “had worked on anything like this before, so we were all very green. Construction took a long time because we had to work through mistakes, but I don’t think there is any better way to learn. This inspired one of our coined phrases throughout the project: ‘Next time we move a bridge...’”

Kristine relates that the concept of service learning was rewarding for her and believes that it has a place in engineering education. She says that “I wish that every engineering student could be involved in something such as this. If schools could find a way to incorporate projects like this into their curriculum, it would benefit students immensely. Not only would it give them a chance to put the things they’ve learned in the classroom into practice, but it would allow them to have something that they can look back on and say ‘I was a part of that.’”

4.3 Sophomore Student: Rachel Husfeld

Student leader Rachel Husfeld was in her sophomore and junior years when she worked on the project. Rachel personally set many of the 75-lb concrete masonry Anchor Wall® blocks that compose the retaining walls and spent many hours working on all types of tasks at the project site. She states that the project “was a great experience in hand-on engineering work” and that “it was exciting to team with students, professors, local contractors, and professional engineers” to relocate the bridge. The project was “challenging, and yet a wonderful opportunity for student leadership. Personally, I learned a great deal about leadership, engineering, and team work from the other student leaders of the project (Husfeld, 2006).”

4.4 Freshman Student: Janet Connor

Student participant Janet Connor was a freshman student during the fall 2004 and spring 2005 semesters. In her own words, she, “did general manual labor.. [and] whatever needed to be done.” This included setting the masonry blocks for the retaining wall and building the wooden railings. It was challenging in that “we had a certain time span in which the project needed to be done. This meant we worked afternoons and weekends, in rain and wind, and until dark.” The project helped her “to have an activity to talk about that was directly related to her major” and helped her to get a summer internship, providing “a point of interest and helped my interviews go smoothly.”

The students and faculty working on the project developed a deep camaraderie. Connor states that she “made friends with upperclassmen I otherwise would not have known. They gave me valuable insight about my major and what to expect in my years at Valparaiso University.” (Connor, 2006).

4.5 Faculty Response: Professor Kenneth Leitch

Professors Leitch and Hagenberger spent countless hours working with the students on the project. Professor Leitch states that “I learned as much or more than the students did on this project. Just by the fact that we all had this challenge to convince our university community to sign onto this project to move a 100+ year-old bridge on a shoestring budget *and* transform it into a center piece of the campus *and* that the students did it themselves simply amazes me. The students succeeded beyond our wildest expectations and built a legacy which alumni generations from now will still find exciting. It is a testament to their strong work ethic and sheer determination. I am proud to have worked in the trenches with the students in a literal and figurative sense. Seeing them succeed is a great blessing. Service learning clearly has tremendous potential for engineering education.”

5. LESSONS LEARNED AND FUTURE DIRECTION

Students and faculty were able to successfully plan, design, and construct a complex project on a small budget within a relatively short time frame. Approximately fifty students, faculty, and staff contributed to the project in various ways from planning, design, and management to

manual labor, fundraising, and support services. The participants interviewed expressed positive sentiments related to their roles in the project and how it enhanced their educational and professional goals.

It is anticipated that the Student Bridge Project and other current service learning projects will be used as a catalyst for future projects. In particular, while the Student Bridge Project was very successful, challenges to implementation of such projects remain. Key challenges include liability issues during and after construction, project funding, scheduling time within and outside of classes for design and construction, determination of leadership roles, and commitment levels of student leaders. When several key senior students graduated, although a leadership succession plan was in place, the transition process was an exercise in patience. Careful planning should help to alleviate some of these concerns for future service projects.

6. ACKNOWLEDGEMENTS

The authors relied on a large team of volunteers, campus administrators, and corporate sponsors in the construction of the Student Bridge. In particular, we wish to thank the dedicated student volunteers of Valparaiso University, the faculty of the Civil Engineering Department, the College of Engineering, Valparaiso University's Office of Institutional Advancement for fundraising activities, the Valparaiso University administration, university alumni, and campus administration for helping us to complete the project. Generous corporate sponsors included G.E. Marshall Excavation, Rogers Block and Wall, Ozinga Ready-Mix, the American Institute of Steel Construction, and Cives Steel.

REFERENCES

Connor, J. (2006). Email communication.

Duffy, J., Tsang, E., & Lord, S. (2000). Service-Learning in Engineering: What, Why, and How?, *Proceedings of the ASEE 2000 Annual Conference*, St. Louis, MO, June 2000.

Gokhale, S. & O'Dea, M. (2000). Effectiveness of Community Service in Enhancing Student Learning and Development, *Proceedings of the ASEE 2000 Annual Conference*, St. Louis, MO, June 2000.

Husfeld, R. (2006). Email communication.

Polito, C. & Husfeld, R. (2005). Lessons Learned from an International Service Learning Project, *Proceedings of the ASEE 2005 Annual Conference*, June 2005.

Oakes, W. & Thompson, M. (2004). Integration of Service Learning into a Freshman Engineering Course, *Proceedings of the ASEE 2004 Annual Conference*, Salt Lake City, UT, June 2004.

FIGURES



Figure 1: Student Bridge Over Salt Creek (November 2003)



Figure 2: Foundation Construction (May 2004)

*American Society for Engineering Education
March 31-April 1, 2006 – Indiana University Purdue University Fort Wayne (IPFW)
2006 Illinois – Indiana and North Central Joint Section Conference*



Figure 3: Casting the West Abutment (August 2004)



Figure 4: Moving the Bridge Into Place on Abutments (September 2004)

*American Society for Engineering Education
March 31-April 1, 2006 – Indiana University Purdue University Fort Wayne (IPFW)
2006 Illinois – Indiana and North Central Joint Section Conference*



Figure 5: Placing Masonry Blocks for West Ramp (November 2004)



Figure 6: West Ramp Construction (December 2004)

*American Society for Engineering Education
March 31-April 1, 2006 – Indiana University Purdue University Fort Wayne (IPFW)
2006 Illinois – Indiana and North Central Joint Section Conference*



Figure 7: View of West Ramp, Patio, and Bridge (April 2005)



Figure 8: Student Bridge Dedication (October 2005)

*American Society for Engineering Education
March 31-April 1, 2006 – Indiana University Purdue University Fort Wayne (IPFW)
2006 Illinois – Indiana and North Central Joint Section Conference*