

Shaping the Battlefield to Increase Enrollments in Civil Engineering

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Abstract

Similar to many undergraduate institutions around the nation, the United States Military Academy at West Point has experienced a steady decrease in the number of students enrolling in the Civil Engineering Major. To counter this trend, USMA runs several programs and initiatives targeted at three distinct groups: the high school student, the college freshman and the West Point Civil Engineering Program. The battlefield is the mind of the potential civil engineering student. Our strategy to reverse this trend and shape this arena is based on marketing. Our marketing objectives are to create an interest in engineering and to develop a positive department reputation within the student body. This paper addresses outreach practices employed by the Civil Engineering Division at West Point to increase enrollments from the high school student to the faculty role model.

Introduction

In order to judiciously combat the recent decrease in civil engineers majors, we first had to answer the question “Exactly what attracts students to civil engineering in the first place?” To accomplish this, we conducted a short survey of our fifty-six incoming civil majors from the class of 2005. We addressed the survey to the class of 2005 because they have not yet taken a class taught by the Civil Department, and therefore, would generally be unbiased. The survey asked the following seven questions:

- 1) When did you decide to be a civil engineer [high school, plebe (freshman) year, yearling (sophomore) year]?
- 2) What event first generated your interest in civil engineering [science fair, TV special, teacher, etc.]? At what age?
- 3) As a plebe (freshman), did you participate in the West Point Bridge Designer (WPBD) Competition?
- 4) Did any department activity [open house, etc] influence your decision to be a civil engineer?
- 5) In your opinion, what is the Civil Engineer Program’s reputation at West Point [hard, easy, work load, grades, etc.]?
- 6) Do you have a parent or relative who is a civil engineer? If yes, what is their relationship to you?
- 7) What most influenced your decision to choose Civil Engineering as a major?

The results of this survey were very insightful and communicated the fact that our ability to attract and retain our engineering students is based upon three facets:

- 1) High/Junior High School Recruitment. We must reach prospective students while they are in high school or earlier. Slightly over 50 percent of the surveyed cadets revealed they had made the decision to be an engineer prior to coming to West Point.
- 2) College Freshman Recruitment. At the same time we target the 9-12 education levels, we must not neglect the college freshman. Slightly less than 50 percent of our majors did not chose civil engineering until their sophomore year. This is unique to West Point as cadets do not declare their major until first semester sophomore year.
- 3) High Quality Civil Engineering Program. The survey illustrated that our ability to maintain a top-notch program reputation is one of our most powerful recruitment tools. Every cadet survey reported the civil program is the hardest and most difficult at West Point but they still chose this major. Why? Over 40 percent of the surveyed cadets listed the department's reputation as a reason. The survey identified the strength of department is promoted through two avenues:
 - a. Current Civil Majors. Several surveys highlighted our majors as one of our best marketing tools. One cadet wrote, "The civil program has a reputation of being very academically challenging but I haven't talked to anyone who regrets choosing it."
 - b. Faculty. We cannot underestimate the importance of dynamic professors and instructors in attracting cadets to our department. One cadet attributed the ability of the student to cope with the heavy workload was attainable due to the fact "...the instructors in the department are very helpful and excited to teach." Another cadet wrote that our open house for recruitment influenced his decision because "...the department was really "fired up" and extremely motivated for their major. I was impressed because I expected a bunch of quiet, geeky professors who could not speak in front of an audience and relied on PowerPoint slides."

The Civil Engineering Program at West Point currently addresses the three areas above with the following programs.

Invitational Academic Workshop

The Invitational Academic Workshop (IAW) is an annual one-week program that is targeted at the high school student. Every June at West Point, upper class cadets entering their junior year act as mentors and section leaders for the high school student attending the workshop. The program is managed by the Office of the Dean of Academics and encompasses a number of departments at West Point. The authors only have experience with and exposure to the Civil Engineering part of the workshop and therefore, only the civil engineer component of IAW will be discussed in this paper.

The purpose of the civil engineering section of the IAW is to expose the students to what a civil engineer is and the variety of work accomplished by civil engineers. The program is run in a two and a half hour session broken into four modules. There is an AM and a PM session each day with approximately twenty high school students cycling through each session.

The first module is an introduction and a welcome to the department. An eight-minute long department video is shown which depicts different laboratories overseen by the department such as the concrete and turbine labs. The video also recounts recent capstone student projects complete by our graduates.

The second module is an introduction to the West Point Bridge Designer program (which will be discussed later). The basic properties of the program are discussed and a demonstration conducted. The students are then given a simple exercise to completely design a bridge using the West Point Bridge Designer.

The third and most interactive, team building module consists of dividing the students into groups of four to compete in two design competitions, one using the West Point Bridge Designer and one using K'nex. The final module is simply an award presentation to the competition winners, a short survey and clean up in preparation for the next session.

The civil engineering program segment of the Invitational Academic Workshop is successfully increasing the awareness of the civil engineering profession. Student comments as they leave the sessions indicate that their interest in engineering has been sparked and many of the high school students are attracted to the creative thought process required in design. One of our majors from the class of 2005 attended IAW and indicated the program "...interested me (him) significantly," and was influential in his decision to major in civil engineering.

West Point Bridge Designer

The authors have both taught non-engineering majors as part of a required five-course engineering sequence taken by all cadets at West Point. At the end of the semester, many cadets in the class made statements that they would have majored in engineering if they knew how challenging, exciting and fun the discipline is. When asked why they did not major in engineering, their response is they did not know much about civil engineering or the department. So how do we reach students before they choose their major? At West Point, cadets do not choose their major until the first semester of their sophomore year. For other universities, the question is how do we reach students before they choose the college they will attend.

We currently lead two programs that are based around the same product to concentrate on both the college freshman and high school student. In 1995, our current Deputy Department Head, COL Stephen J. Ressler, wrote and developed the West Point Bridge Designer Program to provide a tool to simulate and introduce students to the engineering design process. The program was first introduced into our undergraduate Statics course and has since been expanded.

In 2002, in recognition of the celebration of the West Point's Bicentennial, the first West Point Bridge Designer Contest took place. The purpose of the contest was to provide middle school and high school students a realistic and engaging introduction to engineering. The goals were to provide each contestant with an opportunity to:

- Learn about engineering through a realistic, hands-on problem-solving experience.

- Learn about the engineering design process--the application of math, science, and technology to create devices and systems that meet human needs.
- Learn about truss bridges and how they work.
- Learn how engineers use the computer as a problem-solving tool.

The contest received nation-wide participation with more than 19,000 registered teams entering the competition. The top six finalists traveled to West Point to compete in the final round and scholarships of up to \$15,000 were awarded to the top teams. More importantly, it provided an opportunity to directly interact with students to expose them to engineering. The contest was a great success, resulting in the second annual West Point Bridge Designer Contest taking place in 2003.

Based on the interest and response of the competition across the nation, the same contest with different rewards and incentives was conducted among the freshman class at West Point. The objective was to create a similar interest in the freshman class to provide them exposure to engineering. A common belief among faculty in the department is if an engineer class was part of the required freshman core courses, we would see a direct correlation in the rise in the number engineering majors. Since this is not the case, we use the West Point Bridge Designer competition as a conduit to market our program. Approximately 25 percent of our majors from the class of 2005 participated in the West Point Bridge Designer Competition or experimented with the program.

Academic Individual Advanced Development

In order for our majors to be the greatest advocates for our program, we must focus on activities that target our majors and promote the reputation of our program. The Civil Engineering Division at West Point conducts two voluntary summer programs for cadets entering their junior or senior year in the upcoming fall semester. These programs fall under the umbrella of West Point's Academic Individual Advanced Development (AIAD) program that encompasses all summer academic programs at West Point.

The first program, the Cadet District Engineer Program (CDEP), is an internship type program designed to introduce Civil Engineering majors to the functions of a typical US Army Corps of Engineers District. Cadets assume various activities jobs within the Corps Districts throughout the continental United States and overseas for a 3-5 weeks period. Typical jobs cadets perform in the district are Assistant Project Engineer, Quality Assurance Inspector, Assistant Project Manager, Construction Representative, Field Engineer, and Project Officer.

The second program is the US Air Force Academy's (USAFA) Field Engineering and Readiness Laboratory (FERL) in which cadets receive academic credit for a three-semester hour course. FERL is a hands-on classroom type program that introduces the cadets to the basics of civil engineering practices in three blocks: Surveying, Construction Methods, and Construction Materials. Over a three-week period cadets gain practical experience on the capabilities of construction equipment and achieve an appreciation of operator skills through the building of temporary/permanent facilities, roads, and airfield aprons.

The objectives of the two summer programs are to:

- a. Allow USMA CE cadets to gain practical engineering experience away from the West Point environment.
- b. Introduce cadets to the US Army Corps of Engineers.
- c. Allow USMA cadets the opportunity to participate in the USAFA FERL program, gaining valuable practical construction experience as part of the engineering education.
- d. Have cadets participate on multidisciplinary teams.
- e. Learn the roles and responsibilities of civil engineers and the issues they face in professional practice.
- f. Increase knowledge of contemporary issues.
- g. Understand the impact of engineering solutions in a global and societal context.
- h. Prepare and motivate cadets to pursue continued intellectual and professional growth – both as Army officers and as engineers.

In the summer of 2002, 26 cadets participated in the Cadet District Engineer Program. The cadets went to 12 districts and 13 different locations. Six cadets went outside the continental United States to Germany, Japan, South Korea and Hawaii. The remaining twenty cadets went to engineer districts located at: Baltimore, Boston, Chicago, Eglin Air Force Base, Jacksonville, New Orleans, Patrick Air Force Base, and Seattle. The predominant jobs cadets performed were as Quality Assurance Inspectors and Assistant Project Managers. All the cadets reported a positive experience and an increased interest in civil engineering. Two cadets participated in the USAFA FERL program. Both cadets also had very positive experiences and reported that they are more likely to branch Corps of Engineers based on their experience. They both recommend sending more cadets in the future.

The success of the program is illustrated in the following representative examples of Free-Form comments made by the cadets who participated in the Cadet District Engineer Program (CDEP) during the summer of 2002.

- First and foremost, I gained a greater desire to learn all I can from my classes in the fall semester. I saw a lot of work with concrete and became interested in learning more in the concrete design class I will be taking so that I can understand the mechanics and terminology... The opportunity that I had to see the construction process greatly increased my academic and professional development.
- The most important aspect of the AIAD for me was to actually get out there and see the things that I am learning in the classroom. Getting out to a site and observing a compaction test being done and the importance of it helped me better understand why I did those calculations in Soils class. In addition, observing other things such as the retaining wall provided me with a good visual of what I was studying and its importance... I wasn't sure beforehand, but after my AIAD experience, I am sure that I want to join the Corps of Engineers.
- This program helped me decide that I had made the right choice in taking civil as a major.
- This experience helped me to see how my classes will prepare me to be a civil engineer... I liked seeing that the Corps of Engineers provides great opportunities

after your five-year commitment, whether you are a civilian or active duty.

The following comments are from the two USMA cadets that participated in the US Air Force Academy's Field Engineering and Readiness Laboratory (FERL) program at the USAFA during the summer of 2002.

- The FERL program was definitely beneficial to my major. It shows cadets how much fun civil engineering is when it is put to use. It was mostly a hands-on course with a little classroom instruction. It confirmed that I had chosen the right major for me and it let me see how another academy worked. It's a broad survey course that helped me get a head start on a lot of the courses I have to take now.
- I learned a lot. When I started this summer, I was unsure if I wanted to stay a civil major. After all of the hands on experience, talking with professional engineers, and seeing some of the classes being applied to the real world, I became positive that this is what I want to study. Also, I am a very visual person, and the hands on experiences will give me a lot of scenarios to draw upon when I begin studying those areas.

The summer student programs at West Point are achieving their objectives. The cadets who participate gain a much broader understanding of engineering and are much more likely to stay the course as an engineering major. Additionally, the cadets are more likely to select the Corps of Engineers as their army branch and serve as engineers after graduation. The summer student programs with the variety of stateside and overseas locations serve as a promotional tool to attract more underclassmen to the engineering discipline and at the same time make our current majors are greatest "Go Engineer" champion.

Instructor Summer Workshop

In addition to looking at programs that enhance the students learning and interest in engineering, the faculty at West Point look in the mirror and ask what can we do better as instructors?

Anyone who has ever been a student has taken a class from a professor who stimulated their thinking and motivated them to perform to the best of their abilities. The professor whose class you could not wait to attend. Some argue this is an innate quality that cannot be learned. At West Point, we provide our instructors the tools to be that model professor. Every summer, our new additions to the department are immersed in an intense six-week Instructor Summer Workshop (ISW). The objectives of this program are as follows:

- Explain what constitutes effective teaching.
- Apply Felder's learning styles model to the organization and conduct of a class.
- Use Classroom Assessment Techniques to assess student learning.
- Organize a class.
- Conduct a class.
- Assess a class, from a student's perspective.
- Self-assess your own class.

This has been a very successful program. New instructors enter their first class fully prepared to the extent the students cannot distinguish the first year instructors from those veterans professors.

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The Civil Engineering department is known for top quality instruction and is reflected every year when the department receives student ratings well above the academy average. The ability to provide quality instruction is an essential element in creating excitement in the classroom and an interest in engineering. We as educators are responsible for the excitement of learning. Our incoming majors cited the faculty as one of the top reasons they chose civil engineering as their major.

Conclusion

West Point executes several programs to promote the growth of civil engineering. The programs are aimed at every facet of the education system: the educators, the students and future students. The conglomeration of these programs has allowed us to enjoy many successes. However, we must continue to search for more avenues to increase awareness and interest in engineering as national enrollments in engineering curriculums have continued to decline over the last ten years.

Based on the results of our survey, we conclude we must establish new initiatives to reach the minds of prospective students prior to high school. We must establish that interest early and persist through high school as more than 50 percent of engineering students make the determination of their major in high school.

However, another matter that must be addressed is the issue of retaining civil engineers after they leave the education system. It has been found that less than 2 percent of U.S. high school students earn engineering degrees. Of those who graduate with an engineering degree, only 20 percent remain in the engineering field five years after graduation.¹ The importance of this fact is of the cadets surveyed, 50 percent of our current engineers have a parent or sibling who is an engineer. If over 50 percent of current engineers are a direct result of parental influence, where do we get future engineers as the number of engineers in society decreases?

References

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Biographies

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