

Sustainability and Civil Engineering

Basic Responsibility. The first fundamental canon of the American Society of Civil Engineers (ASCE) states: "Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties."¹ Wishing to make a positive impact on the world, this was a primary factor in my decision to pursue civil engineering. More than halfway through my undergraduate career, the absence of sustainability concepts in the curriculum is alarming. Students in today's undergraduate programs are not lacking in technical information of any sort; one can look up any constant, learn the derivation of any equation, and discover the exception to any rule. However, while the education system pours resources into the mastery of the mechanical and mathematical application of engineering, it is unsettlingly neglectful in instructing students on the matter of sustainability. Textbooks and lecture notes may touch on sustainability, but while individual professors may extol the benefits of a sustainable society, far too large a proportion of the educational system remains apathetic. Firmly establishing sustainability as *essential*, rather than discretionary, is necessary to allow civil engineering, as a field, to fulfill the full responsibilities of its basic canon.

Undergraduate Curriculum. Typical required junior level civil engineering courses include structural engineering, fluids and hydraulics, soil mechanics, materials science, measurements, statistics, and environmental engineering.² Schedule flexibility permits general education courses or an optional course if general education requirements have been fulfilled. At first glance, this curriculum appears reasonable, but upon closer inspection, only environmental engineering specifically integrates sustainability concepts. The fourth year does not require any courses featuring sustainability either, as only professional practice, foundation engineering, and transportation are required to graduate. Unfortunately, this results in many graduates joining a professional organization such as ASCE having only a cursory knowledge of many of the principles to which they must adhere.

Unspoken Understanding. We cannot solely blame upper-level undergraduate curricula instituted in universities across the country. Until very recently, sustainability was not even recognized as a crucial component of civil engineering; it was not until the end of a “contentious two-decade process [that] ASCE was finally able to adopt a sustainable development statement in its code of ethics.”³ Fundamentally, there is an unspoken understanding that sustainability will be addressed only when necessary, rather than completely integrated. To date, the most significant sustainability course I have taken has been an alternative fuels lecture class – a non-major, optional class focused on countering dwindling oil availability with emerging sustainable technologies. There are two fundamental failures at issue. The first is quite obvious: why does an optional class provide more insight into sustainability than all courses in the civil engineering major combined? One’s understanding of sustainability will be refined and enhanced throughout the duration of one’s career; the starting point, however, should exist in one’s major – not an optional class so few will take.

Core Concept. The second issue is equally, if not more, distressing. The current educational system is passive with regard to sustainability. It requires students to digest a great deal of information, under the belief that it can be tucked into a file and recalled only when a situation demands. Passing a class is often determined not by who has the strongest grasp of the material, but who creates the most beneficial formula sheet. There is little emphasis on intrinsically knowing subject matter past the point of passing a class, let alone the specific manner in which the subject relates to sustainability. These issues result in an education that is not unethical, but incomplete, and thus at risk of not meeting the ASCE standard of ethics. To combat this, sustainability needs to be implemented into the degree program as a core concept, perhaps to the point where textbooks are rewritten through a new lens. Additionally, a senior level course in sustainable design would offer undergraduates the opportunity to apply knowledge accumulated in previous classes to real-life situations. To succeed, a student would be required to demonstrate both familiarity with the mathematical theories and an ability to apply

sustainable concepts. Implementing such a plan would give students valuable experience with both technical and practical matters, thus giving the civil engineer a more complete education.

Incentivize Leadership. Altering the core curricula is a positive step, but much more can be done. Professors are lifelong learners; while educating students, they work on the cutting edge of the latest advances in their fields. Professors should look to lead, not follow, in their field of study. Given the flexibility to do so, professors should have the ability to integrate new advances into their courses. Volunteer groups of undergraduates and graduates can be created to help the professor research new technologies and expand current courses to include projects that teach sustainability concepts. Students gain the opportunity to learn, while providing fresh, innovative ideas and questions. Through cooperation, the entire educational system for civil engineers can be improved.

Current Initiatives at UB. Some institutions have already taken steps to increase sustainability awareness. The University at Buffalo's chapter of Engineers for a Sustainable World (ESW)⁴ is responsible for plans to incorporate a rooftop garden and gold LEED⁵ certification into the university's new engineering building. The university already has research positions allocated for undergraduates to assist professors in their fields of study. Additionally, sustainability is the institution's theme for its 2009 Concrete Canoe submittal. There is much work to be done, but the University at Buffalo aims to place itself at the forefront of the future of sustainability.

Untapped Opportunities. General education courses are not only vital to a successful engineering career, but offer opportunities for civil engineering students to suggest incorporating sustainability-based projects, writing, and discussion. Despite the popular myth that these are often filler classes, the information obtained in them can be as critical to a successful civil engineering career as any engineering course. ASCE's first fundamental principle of civil engineering is to "uphold and advance the integrity, honor and dignity of the engineering profession by using their knowledge and skill

for the enhancement of human welfare and the environment.”¹ A wide array of skills is required to sufficiently honor the stated code. In addition to technical expertise, comprehension of politics, communication, and general sciences is essential to effectively promoting a sustainable environment. When designing and constructing a bridge, the effect on the local wildlife needs to be considered. Displacing several species could result in the disruption of the food chain. Similarly, a civil engineer needs to have ample understanding of zoning laws before determining the size and location of a structure. Additionally, situations may arise where it is in the best interest of the community to have multiple engineering firms work on a project. A functioning line of communication between the firms is imperative for compliance with the demands of the community. Neglecting any of these concerns would compromise the integrity of the engineer or the profession, and therefore be considered unethical.

Achieving Balance. As a member of ASCE, one must do his or her utmost to uphold the Code of Ethics. Members must strive to maintain and expand on the good reputation of the civil engineer. This is accomplished not only by using knowledge for the good of the general public, but doing so while being “honest and impartial,” casting engineering in a positive light, and “supporting the professional and technical societies of their disciplines.”¹ Sustainable development – a fundamental goal of the profession, is defined by the Code of Ethics as “... the challenge of meeting human needs for natural resources, industrial product, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base for future development.”¹ There are exceptions to every rule, however, and there are times when sustainability will conflict with the overriding principle of protecting the common good. The divergence between sustainability and ethics is multi-directional; there are times where it would be ethical to be unsustainable, as well as moments where forcing sustainability would be beyond the line of what is ethically advisable. Much of this hinges on the duty of the civil engineer to be forthright and honest,

without any agenda that would compromise his or her morals. Advising the implementation of wind turbines over traditional energy production in exchange for a larger personal share of the profits, for example, would be unethical. On the other hand, a low-income community in desperate need of a waste treatment facility, but unable to cover the supply cost of building the most efficient facility, would call for the design of a less sustainable facility that is affordable. The decision is ethical for the community, even though it may not be the best environmental alternative. The correlation between sustainability and ethics is far from ambiguous, but it is not always as black and white as one may think.

Lifestyle Changes. Even less ambiguous than the association of sustainability and ethics is the present situation of sustainability in conjunction with the American lifestyle. The average American lifestyle mocks the concept of sustainability. We grossly overuse oil, heat, and energy, while producing an embarrassing amount of waste. Civil engineers are devoted to making the environment surrounding them as sustainable as possible. Does this require that they hold themselves to a higher level of sustainable responsibility? In a word, yes. The Code of Ethics requires the application of sustainable principles and development "*in performance of their professional duties.*"¹ However, one is not a civil engineer from 9 to 5 for five days a week. Being a civil engineer requires the utilization of a specific type of thinking, a constant belief that something can be improved to provide a greater benefit to society. It would be hypocritical for a civil engineer to stress the importance of sustainability while not following his own information. We must lead by example, and do whatever is possible to improve the abysmal level of sustainability in the United States. A civil engineer could, for example, make it a goal to achieve a LEED certification of silver or better for all buildings he or she develops, perhaps even one's own home. One could also design a more efficient waste recycling system to minimize the effects of pollution in an area. The American lifestyle is not beyond saving. It would require a fundamental conversion in thought and behavior that is far easier said than done. It would demand large-scale

efforts to drastically cut energy and oil consumption and waste production, at a bare minimum. It is attainable, but would require a desire for change that we do not yet have.

A necessity, not a possibility. Sustainability is one of the core values of civil engineering.

Currently, it is severely underrepresented in educational systems and daily life. Civil engineers strive to comply with sustainable principles, but we cannot do this in a silo. Sustainability must be brought to the forefront of both the civil engineering instructional system and profession in order for us to accomplish our task. By altering the curricula and encouraging collaboration between professors and students, the educational system can begin to flourish. ASCE, as an entity and within its ethical construct, can support and promote this level of cooperation on a global basis; it could increase exponentially the rate at which we improve our sustainable growth. In today's world, it is imperative that ASCE and civil engineers establish sustainability not as a possibility, but as a necessity for the future.

¹ Code of ethics. (2006). *Asce.org*. Retrieved February 23, 2009, from <http://www.asce.org/inside/codeofethics.cfm>

² University at Buffalo - civil, structural, and environmental engineering. (2003). *Buffalo.edu*. Retrieved February 24, 2009, from http://www.csee.buffalo.edu/ugrad_acad_ce_curr.shtml

⁵ Walesh, Stuart G. (2000). *Engineering Your Future*. Upper Saddle River, New Jersey: Prentice-Hall.

⁴ Engineers for a sustainable world. (2008). *Wings.buffalo.edu*. Retrieved February 23, 2009, from <http://wings.buffalo.edu/sa/esw/index.htm/>

⁵ USGBC: LEED rating systems. (2008). *Usgbc.org*. Retrieved February 26, 2009, from <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=222>