Sociotechnical Synthesis

Every day, engineers must make critical decisions in material selection for construction projects in a wide range of conditions. Each project will have its own set of unique demands, requiring the use of specific materials to meet those needs. The process of material selection encompasses not only the responsibility of the engineer to provide a practical solution to a given engineering project, but to consider the wider social and environmental impact of their work. The decision to use concrete, for instance, necessitates that the engineer select a concrete mix which meets the physical, financial, and social demands of their work. Sometimes, the social cost of using concrete may outweigh the practical benefits, and an alternative material may be used. My technical project was to construct a concrete canoe, a vessel made from an ecologically harmful material, though a significant design criteria for our team was to minimize the boat's environmental impact. Selection of carbon net zero cement and implementation of waste management practices are potential examples of socially conscious engineering practices. The evaluation of concrete as a structural material encompasses a variety of social theories, such as environmental conservationism and economic stakeholder theory, and demonstrates the need for engineers to be considerate of the broader impact of their work and to adjust the scope of their analysis to societal practices.

The goal of the Concrete Canoe team this year was to produce a canoe made completely from concrete, capable of holding at most four people at a given time and exhibiting high levels of performance on the water. The team split into three primary groups to address the technical problem of designing the canoe: the mix team created a strong, environmentally friendly, lightweight, and affordable concrete mix; the hull team designed a hydrodynamic, maneuverable, and stable hull for the boat; the construction team was responsible for assembly of the final canoe mold, as well as any apparatuses needed for transport or research. The mix team tested a variety of concrete mixes to determine which would most optimally meet the design goals mentioned above, while the hull team researched several commercial canoe designs before settling on a "shallow-vee" ridged hull design. The canoe ended up floating and performing very well in the races at the ASCE Annual Concrete Canoe Competition, and came in second place overall.

The social element of the report focused on how engineers should evaluate the criteria by which they select materials for construction projects. Concrete is notoriously bad for the environment, especially insofar as it contributes to anthropogenic carbon dioxide emissions and general depletion of natural resources. A civil engineer has a financial obligation to provide practical solutions toward whatever project they are assigned to, and a social obligation to protect the public communities who will be impacted by their work. The theory of Environmental Conservationism suggests that natural resources may be used in engineering projects as long as ecological balance is maintained. Stakeholder theory reinforces the idea that civil engineers are beholden to all communities impacted by their work, not only the groups or

individuals with a financial interest in their work. Civil engineers have a social responsibility to serve the public as a whole, which should inform their material selection process.

I contributed to meeting the technical problem set forth by the ASCE in the Concrete Canoe Competition by contributing to the hull design as Co-Captain. I was responsible for generating all of the hull equations used to shape the various cross sections of the canoe, as well as selecting the final design of the hull shape based on research we did as a team. I contributed extensively to structural calculations for the hull design, writing the team's final report, and scripting the presentation the team gave at the Concrete Canoe Symposium. The canoe performed well, placing second in the competition. Next year's team should focus on creating a canoe with greater tensile strength and higher levels of aesthetic value. The STS portion of this study could be improved by providing more practical examples of ecologically friendly construction materials being researched today.

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