Assessment of ASCE/AISC Student Projects

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Abstract

The Accreditation Board for Engineering and Technology (ABET) has adopted a revised set of criteria for accrediting engineering programs. Nevertheless, as in the past, civil (construction) engineering departments will be required to demonstrate proficiency in specific subject areas which are included in the ABET program criteria.

This paper investigates, according to civil engineering and construction related students, the level at which the understanding of various subjects required by ABET has been enhanced by being involved with the steel bridge and concrete canoe projects. In particular, the findings suggest that both students who are directly and also those indirectly involved with project work believe that three areas have been greatly enhanced. They include: structural engineering, project management/ scheduling and estimating, and team work. Understanding of engineering codes and standards, health and safety issues, materials engineering, and manufacturability (constructability) are also perceived to be enhanced.

I. Introduction

The American Society of Civil Engineers (ASCE) believes that the practice of civil engineering is broad and diverse, including numerous disciplines. As a result, the breadth of the professional component of civil engineering education is necessarily broad. This precept is recognized by the ASCE Committee on Curriculum and Accreditation and has been adhered to in the development of the criteria for accreditation[6, 7, 8]. In this regard, numerous students and practitioners believe that being involved with the AISC/ASCE steel bridge and/or concrete canoe projects complements the theoretical concepts developed in class. To further investigate this perception, data was obtained from a survey instrument which was distributed to graduate and undergraduate students enrolled, in part, in construction related courses taught in civil engineering degree programs. Respondents were requested to indicate whether (and at what specific level) various design activities and academic subjects have been enhanced by working on the steel bridge and concrete canoe projects. The subjects chosen are those that have been included in the criteria that has been adopted by the Accreditation Board for Engineering and Technology (ABET) and must be satisfied for a program to be accredited[3]. For comparative purposes, the findings of the investigation could be utilized by other institutions and departments that may wish to study their curriculum.

"Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition

II. Curriculum

Over the years there have been recommendations from employers and various technical and professional organizations to revise the engineering curriculum to ensure that students are prepared for the professional practice of engineering[4, 9]. Practicing engineers and educators have also indicated that they are not completely satisfied with the average engineering program in the United States[10, 11].

One aspect that appears to be missing is the development of leadership skills in students. For this to be accomplished, time for presentations, discussion, and project work must be provided[2]. Some believe that a 5-year program is needed in order to include the knowledge and various skills required for a basic level of competency in engineering[12]. However, county and city engineers believe that a 4-year degree is adequate[5]. Nevertheless, it is reported that students tend to compartmentalize courses, treating each subject in isolation from concepts developed in other courses. The challenge to engineering faculty, therefore, may be to integrate knowledge so that students and graduates can perform in a multidisciplinary and complex environment[1].

III. Students Directly Involved with Projects

As a segment of a continuing review of factors related to the curriculum, a survey instrument was distributed to students enrolled in required senior and typical construction related graduate courses offered by the Civil Engineering Department of Lamar University. The tabulated results of the study form the data base for the investigation. Specifically, the questionnaire listed various ABET civil (construction) engineering program requirements and requested respondents to indicate at which level – high, average, low, or unsure/none – each is enhanced by students involved in the design and construction of the steel bridge and concrete canoe projects. The subject areas chosen are among those listed in a recently adopted set of criteria for accrediting engineering programs, *Engineering Criteria 2000*[3].

Specifically, the findings suggest that the understanding by students of many of the subject areas have been enhanced at a high level. For example, Table 1 illustrates that over 55% of the students involved with the projects believe that five areas are enhanced at a high category level. As shown, they include:

- Materials Engineering
- Structural Engineering
- Project Management/Scheduling and Estimating
- Team Work
- Manufacturability (Constructability)

In addition, the following four subjects are perceived to be considered between 35 – 55% in the high level category:

- Engineering Codes and Standards

Table 1. Perceptions of Students Directly Involved with AISC/ASCE Projects

Academic Areas or Design Considerations	Enhanced Understanding of Theoretical and Design Class Work — Percentage of Respondents				Composite Score*
	High	Avg	Low	Unsure/None	
Academic Subjects					
Materials Engineering	63.2	21.1	5.3	10.5	3.4
Structural Engineering	68.4	21.1	0.0	10.5	3.5
Geotechnical Engineering	10.5	21.1	26.3	42.1	2.0
Environmental Engineering	0.0	31.5	21.1	47.4	1.8
Hydraulics/Hydrology/Water Resources	10.5	42.1	26.3	21.1	2.4
Project Management/ Scheduling and Estimating	57.9	42.1	0.0	0.0	3.6
Design Considerations					
Team Work	89.5	0.0	5.3	5.3	3.7
Engineering Codes and Standards	36.8	47.4	15.8	0.0	3.2
Sustainability	26.3	36.8	21.1	15.8	2.7
Manufacturability (Constructability)	68.4	26.3	5.3	0.0	3.6
Ethical Considerations	42.1	36.8	10.5	10.5	3.1
Health and Safety Issues	47.4	36.8	15.8	0.0	3.3
Social Ramifications	26.3	26.3	26.3	21.1	2.6
Political Factors	36.8	15.8	26.3	21.1	2.7
Legal Issues	10.5	26.3	26.3	36.8	2.1

* Composite Score based upon 4.0 = high; 3.0 = average; 2.0 = low; 1.0 = unsure or none.

- Ethical Considerations
- Health and Safety Issues
- Political Factors

The nine areas listed above are perceived by students to be enhanced at a relatively high level. They include the traditional subjects of materials and structural engineering as well as the concepts of constructability, and engineering codes and standards. These areas are strongly needed in project work. Team work, project management/scheduling and estimating, and health and safety issues are also considered very important. Students appear to recognize that consideration of these practical issues are required for a successful undertaking. Environmental and geotechnical engineering, hydraulics/hydrology/water resources, and legal issues were given a low rating. These areas were not considered vital for the completion of the steel bridge and concrete canoe projects. It is perhaps significant that team work received the highest score. This reinforces *Engineering Criteria 2000* which stresses the concept of team work as an attribute that should be developed in engineering students.

IV. Students Indirectly Involved with Projects

The perceptions of students not directly involved with the steel bridge and concrete canoe projects are shown in Table 2. Here, over 55% of the respondents indicate that the understanding of various subject areas could be enhanced at a high level with project work. They include:

- Team Work
- Health and Safety Issues
- Structural Engineering
- Project Management/Scheduling and Estimating

In addition, the following four subjects are perceived to be between 35 – 55% in the high level category:

- Materials Engineering
- Engineering Codes and Standards
- Hydraulics/Hydrology/Water Resources
- Manufacturability (Constructability)

Uninvolved students perceive that the aforementioned eight areas could be enhanced at a relatively high level. Seven of these are also rated at a high level by students involved with the projects. The subject that is not included is hydraulics/hydrology/water resources. Apparently students not involved with the projects perceive that this subject should be utilized for the design and construction of the concrete canoe. However, in practice this does not appear to be a vital consideration for those involved in the competition.

Table 2. Perceptions of Students Indirectly Involved with AISC/ASCE Projects

Academic Areas or Design Consideration	Enhanced Understanding of Theoretical and Design Class Work — Percentage of Respondents				Composite Score*
	High	Avg	Low	Unsure/None	
Academic Subjects					
Materials Engineering	40.7	40.7	0.0	18.5	3.0
Structural Engineering	55.6	33.3	0.0	11.1	3.3
Geotechnical Engineering	29.6	29.6	3.7	37.0	2.5
Environmental Engineering	29.6	25.9	7.4	37.0	2.5
Hydraulics/Hydrology/Water Resources	40.7	29.6	14.8	14.8	3.0
Project Management/ Scheduling and Estimating	63.0	18.5	3.7	14.8	3.3
Design Consideration					
Team Work	70.3	25.9	0.0	3.7	3.6
Engineering Codes and Standards	51.9	37.0	0.0	11.1	3.3
Sustainability (Life Cycle Costs)	33.3	33.3	3.7	29.6	2.7
Manufacturability (Constructability)	48.1	29.6	0.0	22.2	3.0
Ethical Considerations	14.8	40.7	22.2	22.2	2.5
Health and Safety Issues	59.3	25.9	0.0	14.8	3.3
Social Ramifications	14.8	37.0	18.5	29.6	2.4
Political Factors	14.8	37.0	22.2	25.9	2.4
Legal Issues	29.6	33.3	7.4	29.6	2.6

* Composite score based upon 4.0 = high; 3.0 = average; 2.0 = low; 1.0 = unsure or none.

V. Summary and Conclusions

This paper reviews a number of recent recommendations involving engineering education. In addition, it presents the results of an investigation of the perceptions of a group of engineering students, enrolled, in part, in construction related courses, concerning the level at which various civil engineering accreditation requirements have been enhanced by project work. Data for the study was obtained from a questionnaire which was completed by students enrolled in various civil (construction) engineering degree programs. The findings of the investigation could be utilized, for comparative purposes, by other institutions and departments that may wish to study their curriculum and how it relates to the steel bridge and concrete canoe projects.

In particular, the high percentage category and composite scores suggest that students working on projects believe that their understanding of five areas has been greatly enhanced. They include: structural and materials engineering, project management/scheduling and estimating, team work, and manufacturability (constructability). In addition, the understanding of the following subjects have been enhanced at an above average level: engineering codes and standards, health and safety issues, political factors, and ethical considerations.

Many of these subject areas are required by ABET as criteria that must be satisfied for a program to be accredited. Specifically, they are included in *Engineering Criteria 2000* which was adopted by ABET and will be required by all programs for accreditation purposes in the year 2001-2002. It appears, therefore, that the knowledge and experience gained by students working on steel bridge and concrete canoe projects complements the criteria required for accreditation. In addition, the activities should enhance the skills required by engineering students for a successful career involving the design and management of engineering and construction projects.

Acknowledgment

The author wishes to recognize Mrs. Debbie Graves for her assistance with the production activities involved with the preparation of this paper.

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