

CIVIL ENGINEERING PROGRAM

Student Outcome Assessment Plan (SOAP)

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Table of Contents

Mission	1
Educational Objectives	1
Effectiveness of the Instructional Program	2
Student Learning Outcomes	2
1.a Assessment Plan	2
1.b Attainment Measures of Educational Objectives	4
Direct Measures	4
1.c Attainment Measures of Program Outcomes	8
Direct Measures	8
Indirect Measures	11

Mission

The Mission of the Civil Engineering Program is to provide the high- quality education required for the students to fully develop their professional qualities and skills as civil engineers, to enrich the students' lives in a culturally diverse environment, and to develop their personal potential to the greatest extent possible to serve the Central Valley and society at large

Educational Objectives

The Educational Objectives of the Civil Engineering Program were modified recently as a result of the suggestions and feedback provided by the ABET Accreditation Team during their visit in October of 2006 as part of the regular ABET accreditation process. The revised Educational Objectives are currently posted on the CE web page (http://www.csufresno.edu/engineering/departments_programs/civil_geomatic_const/programs/civil/about/index.shtml). The Educational Objectives are as follows:

- a. The graduates of the civil engineering program should be well- rounded to function effectively both as professional civil engineers and as responsible and informed citizens.
- b. The graduates of the civil engineering program should practice the profession of civil engineering proficiently with a well- balanced preparation in engineering fundamentals and practical applications in any of the following four areas of civil engineering: Environmental, Geotechnical, Structural, or Transportation.
- c. The graduates of the civil engineering program should use the technical tools and skills required for effective professional practice and should continue learning in their professional lives to remain abreast of new developments and advances.
- d. The graduates of the civil engineering program should function effectively in multicultural and multidisciplinary groups in their practice of the civil engineering profession, be able to communicate effectively with engineering peers, other professionals and with the public in general.
- e. The graduates of the civil engineering program should practice their profession with an understanding of the social and political implications of their professional engineering work and do so guided by the ASCE Code of Ethics.

Effectiveness of the Instructional Program

1. Student Learning Outcomes

Student Learning Outcomes as Developed in the Program's Student Outcomes Assessment Plan (SOAP).

The Student Learning Outcomes are listed in the 3rd column of the following table. These learning outcomes have been prepared to reflect the CE's Educational Objectives considering the requirements stated in Policy Statement PS 465 of ASCE's Committee on Academic Prerequisites for Professional practice (PS 465, ASCE).

Table 1. Relation between Educational Objectives and Student Learning Outcomes

Educational Objectives	Learning Outcomes, The Civil Engineering students should be able to:	
a, b, c	Q1	Apply Knowledge of math and Science and Engineering
	Q2	Learn standard experimental testing protocols
	Q3	Perform experiments, and reduce, analyze, and interpret data in four recognized Civil Engineering disciplines
	Q4	Provide solutions to engineering problems in four Civil Engineering disciplines.
d	Q5	Work in interdisciplinary teams
	Q6	Work in ethnically diverse, and multicultural environment
b	Q7	Follow the Engineering approach in addressing civil engineering problems
e	Q8	Clearly understand and be sensitive to the ASCE canons and code of ethics
	Q9	Communicate verbally
	Q10	Communicate as a Public speaker
	Q11	Communicate in writing
e	Q12	Communicate graphically
	Q13	Discern the interaction between global and societal issues and Civil Engineering Projects.
c	Q14	Recognize the need for, and ability to pursue continuous personal and professional growth
	Q15	Recognize the need to maintain currency in the laws, regulations, codes, and advances of Engineering science and practice
e	Q16	Understand and be aware of contemporary issues.
c	Q17	The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
d	Q18	Function in ethnically diverse, multicultural environment
a c	Q19	Reason critically so as to form intelligent opinions, make good decisions, determine the best course of action
	Q20	Pursue graduate education in civil engineering

1.a Assessment Plan

The assessment plan of the CE program consists in the collection and evaluation of information pertaining to the performance of the students and alumni before and after graduation, respectively. Several constituents are involved in the assessment process as described in the following paragraphs.

The constituents of the CE program are listed in Table 3 and include employers, alumni, engineering practitioners, advisory board, faculty, and students. The majority of the

constituents reside in California's Central Valley and represent a diverse group of different ethnicities, and economical and educational backgrounds.

Table 2. Civil Engineering Program Constituents

Employers
Alumni
Advisory Board
Students
Faculty

The employers of the CE graduates include a wide range of entities from governmental agencies to private engineering consulting firms. The majority are located in the Central Valley. Employers include engineering design firms, consulting firms, and construction companies and contractors. The engineering firms vary in size from firms with 3 or 4 registered professional engineers to large ones owned by local engineers (some of them alumni of the CE program) and large national and international firms with offices in the Central Valley. Also a large number of local or state agencies employ the graduates of the CE program such as: FHWA, EPA, California Department of Transportation, California Department of Water Resources, Fresno County, City of Fresno, City of Clovis, California Department of Forestry, Fresno metropolitan Flood Control District, and many other.

Traditionally, the majority of the Civil Engineering alumni stay in the Central Valley from where they came originally. The alumni constitute an important part of the professional engineer workforce in the local area with many of them holding positions of relevance and leadership both in the private industry or in local, state, or federal agencies.

The Advisory Board is made of practicing engineers with prominent professional positions in a diverse group of offices in the area. They represent the private and public sectors; they represent small and large entities; some are alumni of the CE program while others graduated from institutions other than CSU, Fresno. Also, they represent different technical specialties within Civil Engineering.

1.b Attainment Measures of Educational Objectives

Direct Measures. The CE program conducts several direct measures of attainment of the educational objectives and the degree of career and professional success enjoyed by its graduates.

Employer Surveys. Graduates of the program who have been in the work force for up to 5 years after graduation are evaluated objectively in their place of work by their immediate supervisor (s). The following information is obtained from the surveys.

- a. *Employer Surveys. Performance Appraisal by Supervisor.* Program alumni are rated by their supervisor(s), on a scale from 1 to 5, regarding their performance on specific questions that reflect the educational objectives of the CE program, such as technical effectiveness in professional practice (*Educational Objectives a and b*) ability to work in multi-disciplinary teams (*Educational Objective d*),

communication skills (*Educational Objective d*), etc. The employer surveys are collected on an on-going basis and the Coordinator of the CE program performs the initial review once a year. The CE faculty as a whole analyzes the results every other year. A rating of 3.0 or better is considered satisfactory and no action is taken. If during the initial review, the rating of an educational objective falls below 3.0, the Coordinator brings it to the attention of the CE faculty as a whole to develop plans for correction. For example, summaries of the evaluation periods of 2000-02 and 2003-06 are shown in the following tables.

Table 3. 2000-02 Summary, Work Performance Appraisal of Graduates of CE Program (from zero to 5 years after graduation)

Problem Solving Skills	3.79
Ability to Conduct Experiments	3.64
Ability to Function in Multi-Disciplinary Teams	3.72
Ability to Work Independently	3.72
Ability to Communicate Effectively	2.76
Ability/Desired Continued Education	3.69
Ability to use Modern Technologies	3.93
Leadership and Supervisory Skills	3.34
Self Confidence and Initiative	3.90
Ethical Behavior	4.52
Planning and Organizational Skills	3.48
Understanding of Global and Contemporary Issues	3.38
Overall Performance	3.95
Mean	3.68
Std. Dev	0.41
%CV	11.09
Total Number of Alumni Rated	40

(Rating: 5.0 = Far Above Average, 1.0= Far Below Average)

Table 4. 2003-06 Summary, Work Performance Appraisal of Graduates of CE Program (from zero to 5 years after graduation)

Problem Solving Skills	3.55
Ability to Conduct Experiments	3.00
Ability to Function in Multi-Disciplinary Teams	3.08
Ability to Work Independently	3.63
Ability to Communicate Effectively	3.13
Ability/Desired Continued Education	3.05
Ability to use Modern Technologies	3.30
Leadership and Supervisory Skills	3.00
Self Confidence and Initiative	3.00
Ethical Behavior	3.32
Planning and Organizational Skills	2.66
Understanding of Global and Contemporary Issues	2.61
Overall Performance	2.97
Mean	3.10
Std. Dev	0.30
%CV	9.57
Total Number of Alumni Rated	78

(Rating: 5.0 = Far Above Average, 1.0= Far Below Average)

- b. *Employer Surveys. Behavioral Observations by Supervisor.* In addition to the numerical ratings, the Employer Surveys allow the opportunity for supervisors/employers to objectively state the strengths and weaknesses of the graduates of the program, in reference to the educational objectives. Supervisors/employers are encouraged and in fact provide candid observations on the professional abilities and skills of the graduates. They also provide feedback on changes in the program and curriculum to achieve the educational objectives.

Alumni Surveys. Employment Condition of Graduates. Information about employment conditions is requested from the graduates themselves and sheds some light on the success of the CE Program's ability to prepare graduates. It also assesses whether the educational objectives are achieved in general. For example, the employment conditions as evaluated from 2000 through 2006 for the CE graduates who have been in the work place for up to 5 years after graduation are summarized as follows:

Table 5. Employment Conditions of CE graduates (0 to 5 years after graduation)

Full-time in CE	91.4%
Grad Student	2.9%
Currently not Employed	5.7%
Working in another field	0%

Table 6. Field of Work of Graduates (0 to 5 years after graduation)

Industry	17.1%
Government	25.7%
Private/Consulting	42.9%
Education	0%
Construction	11.4%
Other	2.9%

Alumni Surveys. Comments on CE Program. Alumni are asked to provide their insightful opinions on the curriculum, laboratories, courses, etc. as to how they have helped or impacted on their professional careers. The relevance of major components of the CE program is then visualized from the feedback of the alumni. Most of the alumni respondents (71%) suggested modifications to the program of study at CSU, Fresno. A summary list of suggestions is given in EXHIBIT D. Some indicated issues are related to institutional support; e.g. have more full-time faculty and to offer more technical electives. Other issues are more programmatically related such as: to introduce students to more professional computer software, replace computer programming class with a one

with practical applications of spreadsheets, and prepare the students to better handle different levels of responsibility, including business and leadership.

The alumni praised very highly the *Senior Project Culminating Experience*.

The issue of full-time faculty has been addressed at the College level. Several faculty searches have been conducted in the last few years to hire FT faculty. These searches resulted in the hiring of Dr. Xiao in the Geotechnical area (Fall 2005), Dr. Attard in the Structures area (Fall 2006), and Dr. Choo, who will start as a tenure-track assistant professor in Structural Mechanics in Fall 07.

More computer software with applications in civil engineering design has been made available to the students in the last few years through the Civil Engineering Computer Laboratory. The CE computer lab has been enhanced with the donation/purchase of new computers. At the same time, new software has been uploaded in these computers. The computer software includes AutoCAD, AutoTurn, Highway Capacity Software (HCS), HCSCinema, SAP, and Haestad methods, in addition to the standard office, drawing, and data management software such as MS Office, AutoCADD, etc.

The course CE 110, *Computer Applications in Civil Engineering* was modified in part in response to the alumni suggestions to cover spreadsheet applications in civil engineering. The course deals with most of the tools in MS Excel that can be used in civil engineering problem solving, including graphic capabilities, spreadsheet calculations, functions, Statistics, matrix applications, financial and engineering economics calculations, and iterative solutions. The CE 110 course may be taken in place of ECE 70, *Engineering Computations with C and Fortran*, and it has been offered every semester (exception of SP 05) since Fall 04. In addition, students are introduced to the MS Excel in the course CE 85 *Introduction to Civil Engineering*, where they are assigned homework problems to be solved with spreadsheets.

Rate of EIT certification. This activity is new to the assessment system and has been implemented beginning in Fall 2007. Survey interviews are conducted on an on-going basis to determine the percentages of graduates who have attained EIT certification post-graduation. Direct communication with alumni is used as instruments to collect the information. The percentage of alumni who have attained EIT certification and their corresponding years post-graduation will be determined. Since this tool has been used in the program in Fall 2007 for the first time, there is no previous extensive reference about the percentages to be targeted. The results shown in FIG. 1 were obtained from a survey conducted for the first time in the Spring 2007.

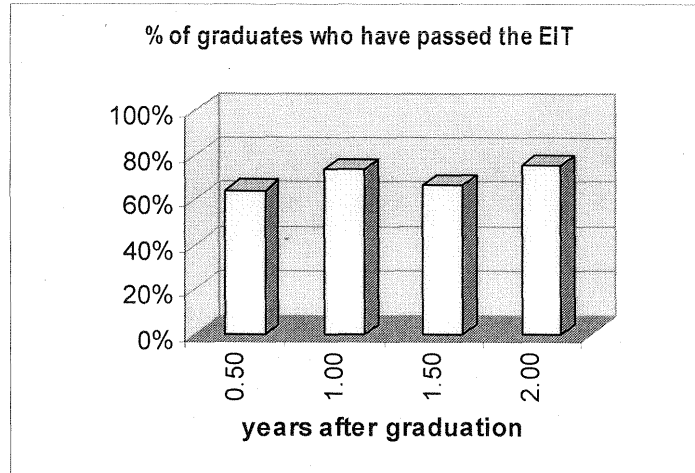


FIG. 1. Rate of graduates of the CE program who have attained EIT certification at a given number of years post-graduation (the sample size varied from 25 to 35 alumni per group).

The target EIT certification rate is initially set at 75% for the cohort of graduates who have been in professional practice for two years after graduation. As more data is collected in the future, this rate of 75% at two years post-graduation will be adjusted accordingly.

PE certification at 5 years post-graduation. The CE program is also planning to implement the PE certification as an assessment of the educational objectives. This rate of attainment of PE licensure has not been used before by the CE program. Initial information started to be collected in Fall 06 using alumni surveys and interviews. Civil Engineering graduates are eligible to take the PE exam in the State of California after achieving EIT certification and after obtaining two-years of engineering experience. Thus, a target year for evaluation has been set at 4 years post-graduation as base line of reference. Once the average and standard deviation of the rate are determined from the preliminary surveys and interviews, a target rate will be selected. The target rate will be selected slightly higher than the one determined initially for the CE program to strive for.

1.c Attainment Measures of Program Outcomes

Direct Measures

The CE program currently conducts several direct measures of attainment of program outcomes throughout the curriculum, especially in the Culminating Experience of the Senior Project. Also, two new measures of student outcomes that has been implemented as a result of the ABET visit of October 2006, namely: (1) determination of rate of EIT certification at the time of graduation, and (2) rate of success of students solving pre-selected key problems given at different levels in the curriculum.

Culminating Experience. Senior project. All CE students have to obtain a passing grade in the two portions of the Culminating Experience (i.e. Senior Project; CE 180A and CE

180B). The Senior Project has been developed to help the students bring together, in a holistic way, the skills and knowledge obtained throughout the curriculum. Although it is not explicitly indicated in the Self-Study Report, the grade results of the Senior Project are not only used to decide if a particular student passes the course, but also for assessment of the CE program outcomes. At the end of each semester and after the Senior Project presentations and Report submittals are completed, the entire CE faculty convenes to evaluate the performance of the Senior Project students individually and as a group. At the same time, an evaluation of the program outcomes is conducted by summarizing the results of the individual students on the various aspects related to the learning outcomes. Additionally, during the final oral presentations of the senior projects, engineering practitioners and representatives of ASCE and CELSOC (Consulting Engineers and Land Surveyors of California) participate in the evaluation of the projects and the evaluation of the individual student members of the project teams. The rubrics used to collect their feedback are the same as those used in the evaluation of the Senior Project class. The feedback provided by the professional engineers is also considered in the assessment of the learning outcomes. and assesses the level of attainment of the program outcomes. The rating of 1 to 5 is used, considering 3.0 and above as adequate and below 3.0 requiring corrective measures.

Rate of EIT certification at the time of graduation. In the State of California, the eligibility requirements to take the EIT exam are 3 years of engineering-related work experience or 3 years of full-time study in an engineering curriculum approved by the State Board. Thus, it is difficult for the CE program to ensure that only those students who have completed all the relevant course work take the EIT exam. Thus it has been difficult in the past to convey to the students the importance of taking the EIT exam at the appropriate time. The following figure shows the passing rates of CE students at CSU, Fresno as compared with the State average.

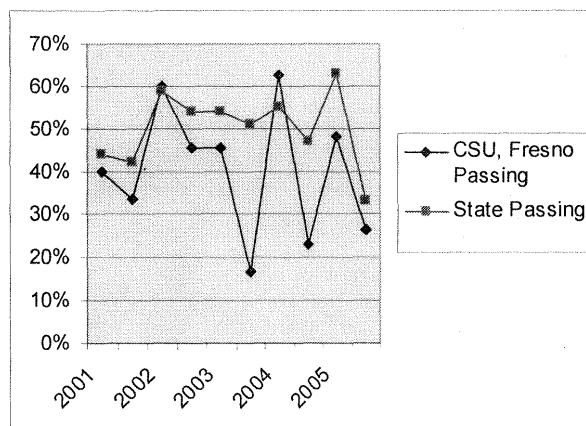


FIG. 2. EIT Passing rates of CE students at CSU, Fresno and California average.

As can be seen in the figure, the passing rates at CSU, Fresno are at or below the State average. Too many students have eagerly attempted to pass the test too early and the CE Program has not been able to do anything about it. A good number of students take the EIT exam too early to earn the possibility of part-time work or to gain a salary increase if

they are already working. Thus, the CE program had not used the EIT certification before as a measure of learning outcomes.

Since it is now possible to enforce effective advising by the use of “Advising Holds”, it is feasible, through advising, to enforce when the students take the EIT exam and to guide them as to when to take it based on their academic progress. Since the rate of EIT certification is going to be used as a measure of attainment of the educational objectives, it will be used also to measure the student outcomes at the time of graduation but measuring it in a more realistic way. The passing rate of only graduating students will be determined for this metric. All graduating students already conduct an “Exit Interview”. The current format of the Exit Interviews, however, will be modified slightly to determine whether the graduating student has passed the EIT exam or not. The graduating class will be divided into three groups: (1) those with EIT certification, (2) those who have taken the EIT exam but not passed it, and (3) those who have not taken it or have taken it but don’t know the result yet. The following figure shows the results of EIT certification of the graduating classes of Spring 06, Fall 06, and Spring 07.

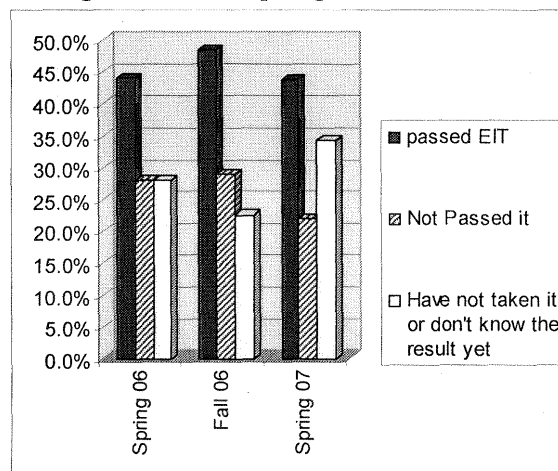


FIG. 3. Percentage of graduating class who have EIT certification.

The percentage of EIT certification of the graduating class is an unbiased assessment of learning outcomes and thus, the CE program has adopted it in its outcomes assessment plan. A preliminary target of the EIT certification will be set initially at 50% and will be revised accordingly as more data is collected in the future.

Student Scores in BOK. A new additional method to assess the learning outcomes will be implemented by the CE program beginning in Fall 07. The idea is to determine how much of the BOK the students learn as they progress through the CE curriculum. The method consists of a series of key questions and problems given to the students at the various levels (Freshman, Junior, etc.) through selected courses in the curriculum. A series of questions prepared for the various student levels will be given to the students in the regular final exams. The right/wrong percentages will be determined for the various student levels taken the aggregate of students of each semester. The questions and problems have been identified by the faculty and reflect the Body of Knowledge (BOK)

as identified by ASCE PS 465. No data has yet been collected at this time. The rates targeted by the CE program will be established after the collection of data for one year.

Indirect Measures

Student Course Evaluations. The procedure for student evaluation of courses was developed in 2000 and then enhanced in 2002. In the enhanced procedure, the full-time faculty developed a vector of indices for each course that maps the objectives and scope of the courses with the Educational Objectives. Then, the CE faculty as a group agreed on an index number to represent the degree to which the course objective is supposed to meet the Educational Objectives. The index number was selected to vary from 1 to 5; where 5 indicates that the course objective directly meets a particular educational objective, while 1 indicates that the course objective somehow addresses an educational objective although it is not specifically intended in the course. In practice the index numbers assigned vary from 3.0 to 5.0. The matrix developed by adding all the course vectors was upgraded gradually to the current one (Spring 2006) shown in table 8.

Table 7. Learning outcomes and their faculty-assigned emphasis in CE courses

CE Course	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Average for Course
20	5.0						4.0	3.0				3.0		3.0				4.0	4.0		3.71
85	4.0			4.0	4.5	4.5	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.5	4.0	4.0		4.5	4.5		4.47
110	5.0			5.0	5.0	5.0	5.0					5.0					5.0		5.0		5.00
121	5.0					4.0	4.0	3.0				3.0		4.0			4.0	4.0	4.0		3.89
121L	5.0	5.0	5.0		4.0		4.0				5.0	5.0		4.0	4.0		5.0	4.0	4.0	4.0	4.46
123	5.0		4.0	4.0		4.0	4.0												4.0		4.17
124	5.0	5.0	5.0		4.0		4.0				5.0	5.0		4.0	4.0		5.0	4.0	4.0	4.0	4.46
125	5.0	5.0		5.0			5.0				5.0	5.0		5.0	5.0		5.0		5.0	5.0	5.00
127	5.0	5.0	5.0		4.0		4.0				5.0	5.0		4.0	4.0		5.0	4.0	4.0	4.0	4.46
128	5.0			5.0		4.0	5.0										5.0	4.0	4.0	4.0	4.50
129	5.0	5.0	5.0	4.0		5.0	4.0		5.0	5.0	5.0	5.0		4.0			4.0	5.0	4.0	4.0	4.60
130	5.0					4.0	4.0	3.0				3.0		4.0	4.0			4.0	4.0		3.89
132	5.0			5.0	3.0	4.0	5.0	4.0				4.0	3.0	5.0	5.0	5.0	3.0	4.0	5.0	5.0	4.33
133	5.0					4.0	4.0	4.0				4.0	4.0	4.0	5.0	5.0	4.0	4.0	4.0	5.0	4.31
136	5.0			5.0	3.0	4.0	5.0	4.0				4.0	3.0	4.0	4.0	5.0	4.0	4.0	4.0	4.0	4.13
137	5.0			4.0	3.0	4.0	4.0	4.0				3.0	3.0	5.0	5.0	4.0	4.0	4.0	5.0	5.0	4.13
141	5.0			5.0	5.0	5.0	5.0					4.0	4.0	4.0		4.0	5.0	5.0	5.0	4.0	4.62
142	5.0	4.0		5.0		4.0	5.0				4.0	4.0	5.0		4.0	5.0	5.0	4.0	5.0	4.0	4.50
142L	5.0	5.0	5.0	4.0		5.0	4.0		5.0	5.0	5.0	5.0		4.0			4.0	5.0	4.0	4.0	4.60
144	5.0			5.0	5.0	5.0	5.0					4.0	4.0	4.0		4.0	4.0	5.0	5.0	4.0	4.54
150	5.0			5.0	4.5	4.5	4.0	4.0			4.5	4.5	4.5				4.5		4.5		4.50
151	5.0	4.0		4.0			4.0				3.0	4.0		4.0	4.0		4.0		4.0	4.0	4.00
152	5.0				4.0	4.0			4.0	4.0	4.0	4.0		4.0			4.0		4.0	4.0	4.09
153	5.0		3.0	3.0			3.0					3.0	3.0	4.0	3.0	3.0	5.0		3.0	3.0	3.42
180A	5.0			5.0	5.0	4.5	4.5	4.5	5.0	5.0	5.0	5.0		4.0	4.0		4.5		4.0		4.64
180B	5.0		5.0	5.0	4.5	4.5	4.5	4.5	5.0	5.0	5.0	5.0		4.0	4.0		4.5		4.0		4.63

In the past all courses taught each semester were evaluated, but because of practical and time constraints, from Fall 06 on only approximately half of the courses are evaluated

each semester. Thus, each course is evaluated at least once every two years, with the exception of the technical elective courses that are offered every two or three years. The course survey instrument is shown in the following figure.

CALIFORNIA STATE UNIVERSITY, FRESNO

Civil Engineering Pr
Course outcomes S

Course: CE XXXX
Semester:XX , YEAR: XX

Based on your experience <u>in this course only</u> , please respond to the following statements:							Comments
		1. Strongly disagree	2. Disagree	3. Neutral	4. Agree	5. Strongly agree	
Q1	I applied my knowledge of math and Science and Engineering						
Q2	I Learned standard experimental testing protocols						
Q3	I perform experiments, reduced, analyzed, and interpreted data in a recognized Civil Engineering discipline						
Q4	I Provided solutions to engineering problems in one or more Civil Engineering discipline						
Q5	I worked on one or more interdisciplinary teams						
Q6	I worked in ethnically diverse, and multicultural environment						
Q7	I followed the Engineering approach in addressing Civil Engineering problems						
Q8	I enhanced my understanding and sensitivity to the ASCE canons and code of ethics						
Q9	I enhanced/used my verbal communication skills						
Q10	I enhanced/used my abilities to communicate as a Public speaker						
Q11	I enhanced/used my abilities to communicate in writing						
Q12	I enhanced/used my abilities to communicate graphically						
Q13	I developed my sensitivity to the interaction between global and societal issues and Civil Engineering Projects.						
Q14	I developed an awareness to the need for, and ability to pursue continuous personal and professional growth						
Q15	I recognized the need to maintain currency in the laws, regulations, codes, and advances of Engineering science and practice						
Q16	I heightened my understanding and awareness of contemporary issues.						
Q17	I was able to use the techniques, skills, and modern engineering tools necessary for engineering practice.						
Q18	I functioned in ethnically diverse, multicultural environment						
Q19	I was able to reason critically so as to form intelligent opinions, make good decisions, determine the best course of action						
Q20	I acquired the necessary knowledge to pursue graduate education in civil engineering						

FIG. 4. Course survey template.

The figure shows the course survey template with all learning outcomes listed in it. The course evaluation for each specific course is then developed from the basic template by tailoring it to the course based on its scope and emphasis as indicated in Table E.7. After collecting the surveys, a data reduction process is followed by which the average response of the students is compared with the expected index level assigned by the faculty. An illustration of this reduction is shown in E.5.

The data reduction shows the differences between the students' perception of the attainment of learning outcomes as compared with the index value expected by the faculty. A positive number in the Deviation of a particular learning outcome indicates that the students perceived that an outcome was achieved up to or better than the faculty expectations. A negative value of the Deviation indicates that the students perceived that outcome was not attained as the faculty expected.

CE 150 Spring 06

	Average Expected by Faculty	Average Student Response	Deviation
Q1	5	4.64	-0.36
Q2			
Q3			
Q4	5	4.64	-0.36
Q5	4.5	4.64	0.14
Q6	4.5	4.64	0.14
Q7	4	4.77	0.77
Q8	4	4.48	0.48
Q9			
Q10			
Q11	4.5	4.41	-0.09
Q12	4.5	4.36	-0.14
Q13	4.5	4.32	-0.18
Q14			
Q15			
Q16			
Q17	4.5	4.36	-0.14
Q18			
Q19	4.5	4.55	0.05
Q20			
average	4.50	4.53	0.03

max dev. = 0.77
min dev. = -0.36

FIG. 5. Illustration of data reduction of student course evaluations.

The most critical values of the deviations for each course are summarized every semester. Attention is given to the identification of patterns or trends in the deviations. If a pattern is identified, in which a particular learning outcome shows a large negative deviation, then corrective actions may be necessary. An arbitrary number of -1.0 was selected as threshold to trigger the need to review the course. Then, a course with a consistent deviation value of -1.0 may need corrections or changes in the scope or emphasis. First, the full-time faculty responsible for the course analyzes the results and determines if changes or corrective actions are necessary. Then, all the CE full-time faculty participate in the decision making process if and when there are changes or actions to be taken. For illustration purposes the learning outcomes survey summary for Spring 2006 is shown in the following figure. The summaries of results from 2003 through 2006 are shown in EXHIBIT A located in the back of this report.

Analysis of Student Assessment of CE Courses						Results of: Spring 2006	
Metric = Average(Expected by Faculty - Student Assessment) <small>criticon</small>							
Course	Average Expected by Faculty	Average Student Response	Average Deviation	Most Negative Deviation	Most Positive Deviation	Outcomes with Negative Deviation of less than -1.0	Outcomes with Positive Deviation of more than 0.0 (Target reached)
CE 020	3.71	4.35	0.64	-0.40	1.50	none	Continuous Personal and Professional Growth
CE 085	4.47	3.86	-0.61	-1.31	0.19	Ability to Communicate Verbally	Maintain Currency in Engineering Practice
CE110	5.00	4.30	-0.70	-1.35	-0.50	Ability to Communicate in Writing	needs analysis
CE 121	3.89	4.26	0.37	-0.64	1.36	none	Ability to Communicate Graphically
CE 121 L	4.46	4.26	-0.20	-0.75	0.31	none	Team work, Engineering Approach
CE 123	4.17	4.84	0.67	-0.07	0.86	none	Ability to Work in Multicultural Environment
CE 123L	4.46	4.80	0.34	-0.25	0.86	none	Ability to Work in Interdisciplinary Teams
CE 124	4.46	4.28	-0.18	-0.78	0.47	none	Ability to Work in Interdisciplinary Teams
CE 125	5.00	4.50	-0.50	-0.82	-0.27	none	needs analysis
CE 127	4.25	4.02	-0.23	-0.60	1.02	none	Perform experiments and analysis
CE 128							
CE 129	4.55	4.28	-0.27	-0.69	0.38	none	Ability to Reason Critically
CE 130	3.89	4.40	0.51	-0.25	1.14	none	Ability to Communicate Graphically
CE 132	4.36	4.07	-0.29	-1.05	1.60	Solution to Engineering Problems	Use of modern tools for engineering practice
CE 133	4.31	4.48	0.17	-0.59	0.68	none	Engineering Approach to CE Problem Solving
CE 134							
CE 136							
CE 137	4.13	4.40	0.27	-0.68	1.11	none	Sensitivity to global issues and civil engineering
CE 141	4.62	3.82	-0.80	-1.25	-0.09	Solutions to engineering problems	needs analysis
CE 142	4.50	4.01	-0.49	-1.12	0.12	Solutions to engineering problems	Ability to Work in Multicultural Environment
CE 142L	4.60	4.29	-0.31	-0.79	0.29	none	Continuous Personal and Professional Growth
CE 150	4.50	4.53	0.03	-0.36	0.77	none	Engineering Approach to CE Problem Solving
CE 151							
CE 180A	4.58	4.50	-0.08	-0.90	0.50	none	Ability to Reason Critically
CE 180B	4.63	4.65	0.02	-0.42	0.85	none	Ability to Reason Critically

FIG. 6. Illustration of End-of-Semester summary of student assessment of CE Courses.

Junior/ Senior Student Surveys. A survey containing all the questions listed in Fig. E.4 is given to Junior and Senior Students at the end of every academic year. The surveys are conducted near the end of the Spring semester in courses with mostly Junior or Senior students, correspondingly. The results of the Spring 06 Junior and Senior surveys are shown in the following figure.

CE Juniors, Spring 06				CE Seniors, Spring 06				Change in Average Student Response from Junior to Senior Student
	Average Expected by Faculty	Average Student Response	Deviation		Average Expected by Faculty	Average Student Response	Deviation	
Q1	5.00	4.18	-0.82	Q1	5.00	4.75	-0.25	0.57
Q2	5.00	4.05	-0.95	Q2	5.00	4.35	-0.65	0.30
Q3	5.00	3.85	-1.15	Q3	5.00	4.55	-0.45	0.70
Q4	5.00	4.15	-0.85	Q4	5.00	4.80	-0.20	0.65
Q5	5.00	4.05	-0.95	Q5	5.00	4.75	-0.25	0.70
Q6	5.00	4.40	-0.60	Q6	5.00	4.70	-0.30	0.30
Q7	5.00	4.11	-0.89	Q7	5.00	4.65	-0.35	0.54
Q8	5.00	3.75	-1.25	Q8	5.00	4.25	-0.75	0.50
Q9	5.00	3.95	-1.05	Q9	5.00	4.70	-0.30	0.75
Q10	5.00	4.25	-0.75	Q10	5.00	4.55	-0.45	0.30
Q11	5.00	4.15	-0.85	Q11	5.00	4.65	-0.35	0.50
Q12	5.00	4.25	-0.75	Q12	5.00	4.65	-0.35	0.40
Q13	5.00	3.85	-1.15	Q13	5.00	4.35	-0.65	0.50
Q14	5.00	4.35	-0.65	Q14	5.00	4.55	-0.45	0.20
Q15	5.00	4.00	-1.00	Q15	5.00	4.45	-0.55	0.45
Q16	5.00	4.20	-0.80	Q16	5.00	4.20	-0.80	0.00
Q17	5.00	4.00	-1.00	Q17	5.00	4.45	-0.55	0.45
Q18	5.00	4.15	-0.85	Q18	5.00	4.70	-0.30	0.55
Q19	5.00	4.25	-0.75	Q19	5.00	4.80	-0.20	0.55
Q20	5.00	4.30	-0.70	Q20	5.00	4.45	-0.55	0.15
average	5.00	4.11	-0.90	average	5.00	4.57	-0.43	0.47

FIG. 7. Illustration of Results of Junior/Senior surveys conducted at end of academic year.

Although these surveys are given to different groups of students, as opposed to administering it two times to the same student at his/her Junior and Senior years, still the survey represents the average perception of the attainment of the *Learning Outcomes* of the Junior and the Senior students. These numbers are, to certain extent, a measure of the satisfaction of the students with the CE program and curriculum. The comparisons of the Juniors' perception with the Seniors' perception conducted simultaneously is an indirect measure of the value added from the Junior year to the Senior year.

Exit Interviews. The graduating students are interviewed at the end of each academic year to obtain an overall impression of their experience through the program to the point of graduation. Initially in 2000, the Senior Course Evaluation was used to obtain feedback from the graduates. However, it was modified to obtain more direct information from the students as well as to obtain spontaneous feedback. The interviews are conducted by the Program Coordinator and take approximately 20 minutes. Initially the same instrument used for Alumni surveys was used for the Exit Interviews. These surveys were conducted at the end of academic years 2003 and 2004. In 2005 the exit surveys were not conducted because the Program Coordinator was on sabbatical leave. At the end of the academic year 2006, a slightly modified instrument was used for the exit interviews.

Exit Interview

**CSU-Fresno
Civil Engineering**

1. When do you graduate from CSU-Fresno?
(month, year) _____

2. Do you have a job offer? _____
Salary (optional) _____
Name and Address (optional) _____

3. Offer from employer: _____

4. In what field do you work?
____ Industry
____ Government
____ Private Practice/consulting
____ Education
____ Construction
____ Other: _____

5. Please rank the overall quality of your **General Education** coursework (arts, humanities, and social science courses).
____ Excellent ____ Good ____ Average ____ Poor

6. Using the following scale, please rate the following items relative to your education that you received in Civil Engineering.

weak ----> strong
1 2 3 4 5

	1	2	3	4	5
Overall quality of your education					
Overall quality of your laboratory coursework					
Support, assistance, and general help from the College					
Support, assistance and general help you received from faculty outside the College					
How confident and prepared you felt in handling professional tasks as you are leaving CSU-Fresno					

7. Using the following scale, please indicate the degree to which your education provided you with the ability to:

weak ----> strong
1 2 3 4 5

	1	2	3	4	5
Apply knowledge of math, science and engineering					
Design and conduct experiments					
Design a system, component or process to meet desired needs					
Function on multi-disciplinary teams					
Identify, formulate, and solve technical problems					
Understand professional and ethical responsibility					
Communicate effectively (written and oral)					
Understand the impact of your practice in a global context					
Continue self-learning and continuing education					
Understand and be aware of contemporary issues					
Use the techniques, skills, and modern technology tools necessary for your practice					
Work independently					

8. Do you think that any aspects of your program of study at CSU-Fresno should be modified?

____ yes ____ no

If yes, explain:

FIG. 8. Exit Interview survey; page 1.

9. What changes do you foresee in your field in the next ten years? How might CSU-Fresno address these changes?

10. Please identify the areas in your program in study that contributed **LEAST** to your professional development. Such areas might include a specific course or specific course content, specific lab or field experience, specific instructional equipment, etc. Please explain.

11. To follow up on question 10, please identify the areas in your program of study that contributed **MOST** to your professional development.

FIG. 9. Exit Interview survey, page 2.

Feedback from Advisory Board. Meetings are conducted in a regular basis with the Advisory Board, two or three times per year. In these meetings advice is sought concerning programmatic and budgetary issues. The educational objectives of the CE

Program as well as the learning outcomes are discussed and surveys are given to the Advisory Board members to request concrete quantitative feedback. For instance, the table shown below shows the summary results of a survey answered by the Advisory Board.

PROGRAM OUTCOMES Scale:1=Unimportant/ Very Weak TO 5 =Very Important/Very Strong		Importance	
Students Should be able to:		Average	Stdev
1	Apply Knowledge of Math, Science, and Engineering	4.7	0.39
2	Learn standard experimental testing protocols	3.5	0.50
3	Perform experiments, and reduce, analyze, and interpret data in four recognized Civil Engineering disciplines	3.6	0.45
4	Provide solutions to engineering problems in four Civil Engineering disciplines.	4.7	0.39
5	Work on interdisciplinary teams	4.4	0.45
6	Work in ethnically diverse, and multicultural environment	2.9	0.48
7	Follow the Engineering approach in addressing civil engineering problems	4.4	0.38
8	Clearly understand and be sensitive to the ASCE canons and code of ethics	4.4	0.45
9	Communicate verbally	4.4	0.38
10	Communicate as a Public speaker	4.0	0.41
11	Communicate in writing	4.6	0.27
12	Communicate graphically	4.7	0.27
13	Discern the interaction between global and societal issues and Civil Engineering Projects.	4.1	0.48
14	Recognize the need for, and ability to pursue continuous personal and professional growth	4.6	0.27
15	Recognize the need to maintain currency in the laws, regulations, codes, and advances of Engineering science and practice	4.6	0.27
16	Understand and be aware of contemporary issues.	3.7	0.39
17	The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	4.9	0.24
18	Function in ethnically diverse, multicultural environment	3.3	0.81
19	Reason critically so as to form intelligent opinions, make good decisions, determine the best course of action	4.4	0.35
20	Pursue graduate education in civil engineering	3.7	0.95

FIG. 10. Summary of Advisory Board survey.

Technical-Elective Needs Surveys. An *Employer Survey* was conducted in Spring and Fall 2004 to request feedback in regards to the *Technical Electives* recommended to be offered on a regular basis. The CE curriculum had been reduced to 124 units and budgetary constraints required to minimize course offerings. Thus, the CE faculty

requested feedback from employers to find out which technical areas and courses would be the most needed for the CE students graduating in the following years. The results of the survey were not very conclusive and there was not clear preference for courses other than the ones that were already being offered. Thus, the approach was to plan for a future increase (as the budget permitted) in the frequency of the courses that have already been offered. The net result was that more *Technical Electives*, although no new ones, were available per semester beginning in 2005.

Summary of Changes that have been made to improve Program

1. Increase the frequency of offerings of *Technical Elective Courses*
2. Include the CE 133 Design of Steel Structures as part of required courses
3. Enhance the *Culminating Experience* of *Senior Project*
4. Enhance the laboratory facilities and equipment
5. Enhance the computer facilities for CE students
6. Allow students to take an improved course in AutoCAD (GM 66)
7. Offer CE 110 for Civil Engineering applications with spreadsheets
8. Offer CE 161 in lieu of IE 160 (discontinued)
9. Increase number of oral presentations, reports and paper submittals
10. Provide more instructions and feedback on oral presentations, reports and submittals