Graduate Program Performance Review Report

September 2012

Department of Civil & Environmental Engineering
California State University, Fullerton

I. Department/Program Mission, Goals and Environment

A. The primary goal of the Civil and Environmental Engineering department's graduate degree program is to provide students with the educational background and tools required for them to excel in their intended profession in Civil Engineering. The areas of focus at graduate level (also called as tracks) in the Civil Engineering program are structural, geotechnical, environmental and construction engineering. Most course topics are well integrated with computer-aided analysis and design tools.

The following learning goals and learning outcomes have been established for students pursuing a degree in Civil Engineering:

The department has established the following Learning Goals (LG) for the graduate program:

A. Technical Growth: Graduates will be successful in their chosen area (i.e., Structural Engineering, Environmental Engineering, Construction Engineering and Management, Geotechnical Engineering), integrate into the local and global workforce, and contribute to the economy of California and the nation.
B. Professional Skills: Graduates will demonstrate the professional skills necessary to be competent employees, assume leadership roles, and have career success and satisfaction.
C. Professional Attitude and Citizenship: Graduates will become productive citizens with high ethical and professional standards, who make sound engineering or managerial decisions, and have enthusiasm for the profession and professional growth.

The Student Learning Outcomes (LO) for the above goals are as follows:

a. Utilize scientific inquiry and knowledge skills to design and solve and interpret engineering problems.
b. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
c. Collaborate with multi-disciplinary teams.
d. An understanding of professional and ethical responsibility.
e. Communicate effectively.
f. Recognition of the need for, and an ability to engage in life-long learning.
g. Knowledge of contemporary issues.

The university mission, goals and strategies are directly reflected within the mission and goals of the department, especially in the following areas: a) ensure the preeminence of learning, b) provide high quality programs that meet the evolving needs of our students, community and region, c) enhance scholarly and creative activity, d) make collaboration integral to our activities, e) create an environment where all students have the opportunity to succeed.

The Master of Science degree in Civil Engineering is intended to meet the needs of students who wish to prepare for careers in areas such as construction and project management, design and analysis of complex systems (including structures such as tall buildings and bridges), geotechnical engineering, environmental engineering, consulting and research; as well as doctoral studies. The program provides advanced study within the area of civil engineering and allows students to select coursework, with adviser's approval, in the areas of structural engineering, geotechnical engineering, construction engineering and management and environmental engineering.

This is the first Program Review for the department. Therefore, there are no changes in the program since the previous review.

B. The Bureau of Labor predicts a total employment of 345,900 by 2018, approximately 24% higher than the employment in 2008. This makes Civil Engineering fourth fastest growing profession in USA. This is mainly to maintain the aging infrastructure in the country. American Society of Civil Engineers (ASCE) estimates a total of $2.2 trillion in next 5 years to improve the quality of our poorly rated infrastructure. One of the goals of the department is to prepare qualified technical manpower to support the need of the community and the nation in terms of civil engineering workforce. Moreover, obtaining master's degree in civil engineering from an ABET Accredited program such as the Civil Engineering program of CSUF is considered as one year of work experience towards the eligibility for Professional Engineer (P.E.) License application in California. This fact also adds to an increasing demand of the graduate program in civil engineering. Moreover, a specialized knowledge is required if a civil engineer is planning to work in the projects that demand specific skills in certain focus area of civil engineering. The graduate program in civil and environmental engineering provides additional skills to support the students in specialized areas of civil engineering such as structural engineering, geotechnical engineering, construction engineering and management and environmental engineering.

C. The Civil and Environmental Engineering Department will focus in integrating state-of-the-art practice in civil engineering into its graduate curriculum. Priority will be given to integrate the department, college and the university's mission and goals into the graduate courses in civil and environmental engineering. The graduate program will be modified to focus on the employment trend and demand in different areas of civil and environmental engineering. Starting from Fall 2012, a new online master's degree program in environmental engineering is being offered. The department will take a leadership role in developing this online curriculum and in offering new courses to satisfy the intellectual desires of the students,

D. There are no programs currently offered in a Special Session self-support mode.

II. Department/Program Description and Analysis

A. This is the first program performance report for the graduate program in civil engineering. Therefore, there has been no substantial change from the last review.

B. Applicants who have a Bachelor's degree from a regionally accredited institution with a minimum grade-point-average of 2.5 in the last 60 semester units and a good standing at the last institution attended can apply for the graduate program in civil engineering. The applications of students meeting the above requirements will be reviewed for possible admission to the graduate program in Civil Engineering and will be advanced to classified standing immediately after filing an adviser-approved study plan in the Civil and Environmental Engineering Department office. Students not meeting the above requirements may be admitted and will be required to take additional prerequisite coursework. Any student entering the M.S. degree program without a B.S. in Civil Engineering will be required to complete the advisor approved deficiency courses prior to beginning coursework for the master's degree. All deficiency courses must be completed before the final semester of coursework. The list of deficiency courses depends on the undergraduate major of the students. The main objective of these deficiency courses is to prepare the students from non-civil engineering majors to attend the graduate level classes in civil and environmental engineering and to the professional license examination. These deficiency courses are listed below.

Students with Bachelor's degree in		
Engineering but not civil	*Science*	*Non-science/non-engineering*
EGCE 301 EGCE 324 EGCE 325 EGCE 408 EGCE 428 EGCE 430	EGCE 201 EGCE 301 EGCE 324 EGCE 325 EGCE 408 EGCE 428 EGCE 430	Math 150B Math 250A Phys 225 Phys 225L EGCE 201 EGCE 301 EGCE 324 EGCE 325 EGCE 408 EGCE 428 EGCE 430
Total units: 18	Total units: 21	Total units: 33

In order to obtain a master's of science in civil engineering, a student is required to complete 30 semester units of a combination of core and elective courses, approved by the graduate advisor, in addition to the required deficiency courses. A minimum GPA of 3.0 is required for graduation. The core and elective courses in different focus area or concentrations of civil engineering are listed below. The department also offers several approved graduate classes as special courses, which are also considered as either the core or the elective courses. These courses are offered in a regular basis with an intention to approve them as new courses in future depending on the demand. Detailed descriptions of the approved courses are presented in Section VIII.

Specialization Area	*Core Courses**	*Elective Courses**
Structural • 6 unit math oriented • 15 unit minimum from core • 9 unit minimum from elective	EGGN 403** EGCE 501** EGCE 510 EGCE 517 EGCE 533 EGCE 563 EGCE 566	EGCE 493 EGCE 509 EGCE 532 EGCE 544 EGCE 549 EGCE 562 EGCE 597 EGCE 598 EGCE 597
Geotechnical • 6 unit math oriented • 15 unit minimum from core • 9 unit minimum from elective	EGGN 403** EGCE 501** EGCE 544 EGCE 545 EGCE 546 EGCE 547 EGCE 548 EGCE 566	EGCE 493 EGCE 510 EGCE 517 EGCE 532 EGCE 563 EGCE 597 EGCE 598 EGCE 599
Construction Management • 12 unit minimum from core • 12 unit minimum from elective Total 30 units	EGCE 465 EGCE 534 EGCE 538 EGCE 557 EGCE 575 EGCE 592	EGCE 463 EGCE 466 EGCE 501 EGCE 517 EGCE 533 EGCE 539 EGCE 540 EGCE 550 EGCE 566 EGCE 575 EGCE 597 EGCE 598 EGCE 599 Manag 441 Manag 444 Manag 516
Environmental (concentration) • 12 unit minimum from core • 12 unit minimum from elective Total 30 units	EGCE 481 EGCE 482 EGCE 515 EGCE 537 EGCE 546 EGCE 583	EGCE 436 EGCE 463 EGCE 466 EGCE 501 EGCE 533 EGCE 559 EGCE 563

		EGCE 597 EGCE 598 EGCE 599 ES 510 ES 595

*Or classes approved by the graduate advisor **Math-oriented courses

The main objective of offering the elective courses are to provide the students with opportunities in learning some classes within civil engineering, which are important in professional practice but may not be directly related to the area of focus. Some of the elective classes are designed to engage the students in research and creative activities, which will also prepare the students towards doctoral level studies.

C. The trend of application and acceptance in the master's degree in civil engineering is presented below. In the past 6 years, the acceptance rate ranged from 61-74% with an average of 67%, out of which 47-64% with an average of 56%, enrolled into the program. In the past 6 years, the number of applicants has increased by 448%, whereas the enrollment has increased by 460%. Likewise, the graduate headcount and FTES has increased by 300% and 387%, respectively in the past 6 years. This justifies the increasing demand of the program.

Year	Applied	Admitted	% Admitted	Enrolled	% Enrolled	Headcount*	FTES
2005-2006	72	45	63%	21	47%	53.5	15.8
2006-2007	65	45	69%	29	64%	47.5	13.3
2007-2008	117	86	74%	54	63%	72.5	20.7
2008-2009	168	118	70%	61	52%	104.0	31.2
2009-2010	136	87	64%	42	48%	117.5	39.2
2010-2011	287	174	61%	106	61%	161.0	61.2

*Average of fall and spring

According to the records provided by the Office of Institutional Research and Analytical Studies, out of 34 cohort students admitted in 2007, 53% students graduated in 3 years, whereas 29% and 3% students graduated in 2 years and 1 year, respectively.

Data on the number of master's degrees provided by the program in the past 6 years is presented below. The data shows that the number of degree awardees has increased by 328% in the past 6 years.

Year	MS degree awarded
2005-2006	18
2006-2007	18
2007-2008	13
2008-2009	27
2009-2010	40
2010-2011	59

D. Enrollment trend in the program has been described above. Shown below are the enrollment trends in some of the selected graduate courses. As can be observed from the chart, some classes are offered every year whereas the remaining classes are offered once in three semesters or once in two years depending on the availability of faculty resources and enrollment demand. The enrollments in all of these classes are increasing significantly in the past 4 years. At present, the student enrollments in these classes are more than sufficient to offer these classes in a yearly basis. The program is planning to offer more classes in future to reduce the class size to 20.

Year	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
CE 501	13	18	18	48	26	25	
CE 509	10		12		18		
CE 510			8		21		24
CE 515	23		24	18		49	
CE 517		4				33	
CE 532	9	14		5			48
CE 533	12	12	9		58	47	
CE 534	18		16	14			51
CE 537			14	22	32	25	36
CE 538		6		36		48	36
CE 539	12	11		16			
CE 544					49	49	30
CE 546		23	31		35		63
CE 549			7				32
CE 557			21		25	37	
CE 563	12		17	8	23	21	
CE 566		10		17		25	
CE 575	10				36	31	42
CE 583	16	12		39		55	41
CE 592					56	61	33
GN 403		31	32		25		

The number of faculty members and the faculty student ratio in the Civil and Environmental Engineering Department is presented below. The trend shows that the faculty student ratio has doubled in the past 6 years. The department is planning to hire new tenure track faculty in future.

YEAR	Tenured	Tenure Track	Lecturers	FTEF Allocation	FTES Target	Actual FTES	Budget SFR
2005-2006	4	2	1	7.0	115	116.8	16.4
2006-2007	4	3	1	7.0	115	130.8	16.4
2007-2008	4	3	0	8.5	161	160.7	18.9
2008-2009	4	3	0	9.5	194	193.8	20.4
2009-2010	3	5	0	10.5	201	201.2	19.1
2010-2011	4	6	0	10	253	252.9	25.3

E. The department hired 7 tenure track faculty in the past 6 years. Moreover, student enrollment in each focus area has increased significantly. Several courses were offered as special courses. The program has a plan to include these special courses in a list of regular courses in the next 3 years. There will be a change in the list of graduate courses after the inclusion of these courses. As explained earlier, a new online master's degree course in environmental engineering is being offered from fall 2012.

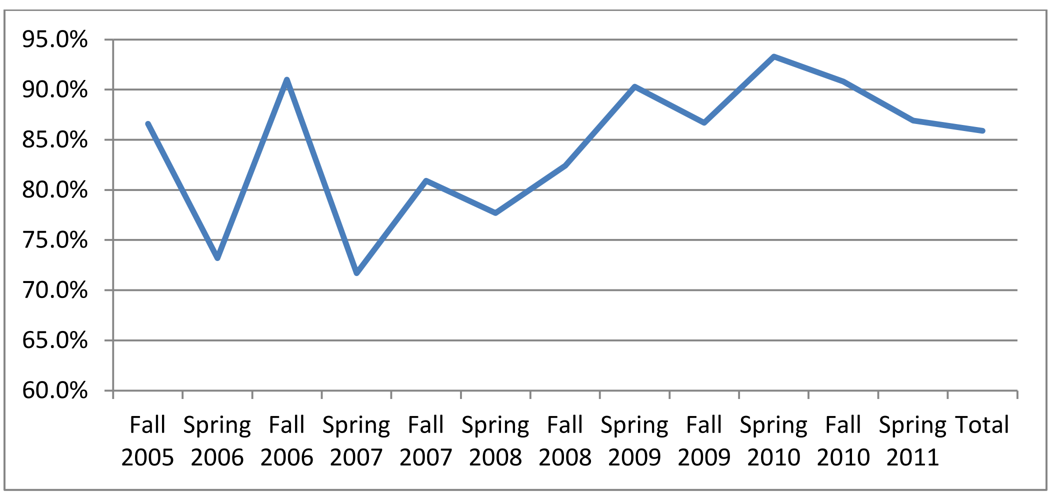
F. There are no special sessions to be offered by the department in future.

III. Documentation of Student Academic Achievement and Assessment of Student Learning Outcomes

A. Student Learning

In order to assess student learning in Civil Engineering courses, the Department used enrollment and student performance data for essentially all aspects of the program during the PPR review period. Overall passing rates during these six years have been increasing from 79.9% in 2005 to 86.9% in 2011. These improving student success rates suggest that instructional effectiveness has exceeded.

Civil Engineering Enrollment Data and Completion Rates Fall 2005 to Spring 2011					
Term	**A+ thru B (Incl. CR)**	**Pct.**	**B- thru F (Incl. WU)**	**Pct.**	**Total No. of Students**
Fall 2005	75	86.6%	12	13.8%	87
Spring 2006	60	73.2%	22	26.8%	82
Fall 2006	61	91.0%	6	9.0%	67
Spring 2007	43	71.7%	17	28.3%	60
Fall 2007	76	80.9%	18	19.1%	94
Spring 2008	94	77.7%	27	22.3%	121
Fall 2008	112	82.4%	24	17.6%	136
Spring 2009	140	90.3%	15	9.7%	155
Fall 2009	163	86.7%	25	13.3%	188
Spring 2010	154	93.3%	11	6.7%	165
Fall 2010	208	90.8%	21	9.2%	229
Spring 2011	206	86.9%	31	13.1%	237
Total	1392	85.9%	229	14.1%	1621



B. Assessment for Student Learning

The program coordinator thoroughly assesses students at the point of their application using GPA, TOEFL scores for non-English speaking foreign students, personal statement, resume, and their engineering backgrounds through interview if necessary. Once students start the program, the common assessment strategies and methods used for assessing student learning and the program's learning goals are as follows:

- Homework assignment, quiz, chapter summary, examination
- Discussion
- Team based project report and presentation
- Individual research/project/survey/case study paper or report and presentation
- Final graduate project report/thesis

Each learning goal is met by one or more courses and is assessed by one or more assessment strategies and methods. The following assessment matrix illustrates how each learning goal is met and assessed.

<table>
<tr><th>Goals</th><th colspan="2">Relevant courses</th><th>Assessment Methods</th></tr>
<tr><td rowspan="4">• Technical Growth

• Professional Skills

• Professional Attitude and Citizenship</td><td>Construction</td><td>EGCE 465
EGCE 534
EGCE 538
EGCE 575
EGCE 557
EGCE 592</td><td rowspan="4">• Homework assignments

• Exams

• Presentations

• Group project</td></tr>
<tr><td>Environmental</td><td>EGCE 435
EGCE 537
EGCE 481
EGCE 482
EGCE 515
EGCE 546
EGCE 583</td></tr>
<tr><td>Geotechnical</td><td>EGCE 547
EGCE 544
EGCE 545
EGCE 547</td></tr>
<tr><td>Structures</td><td>EGCE 430
EGCE 493
EGCE 517
EGCE 532
EGCE 549</td></tr>
</table>

Each instructor is responsible for teaching the course within the defined guideline of the course contents and learning goals. Within the defined guideline, the faculty is free to develop his/her course materials and methodology to deliver the course contents and to assess student learning. Each course uses a multi-modal assessment methodology. Summaries of the course descriptions, learning goals, and assessment strategies for each course offered in the program are presented in section VIII.

C. Changes in Assessment Strategies for the Future

Currently, the department relies on the assessment methods of exams, assignments, class participation and projects. However, we strive to diversify various assessment methods for measuring the utilization of scientific inquiry and knowledge skills, an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability and collaborating with multi-disciplinary teams and effective communication.

D. Modification to Programs to enhance student learning

According to the exit survey collected from current graduate students in the program, the overall student satisfaction for the program in terms of student learning and program quality seems to be very high (See Figures in Appendix). Based on feedback from students, we have no plans to make significant modification of the program. However, we will continue to seek more effective methods and techniques to deliver course materials for better student learning and assessment. Establishing a clear communication channel between student and instructor is the key to avoid any confusion students may have. Creating lecture materials with visual presentation in all of our courses is another improvement we need to make for better student learning.

E. Improvements/Changes due to Assessment Findings

Improvements and changes are implemented by the faculty teaching a course, both individually and collectively. Individual courses set learning goals and assessments and implement changes for upcoming class sessions due to previous student assessment. Additionally, new and special course offerings are proposed if it is determined that there is an area of a Civil Engineering specialty that is not covered by the current courses. New and special courses have been added to the curriculum in the areas of Construction Management, Environmental, Geotechnical and Structural Engineering over the past few years. These changes can include the addition or subtraction of assignments or a change in the material taught. An example of this is the incorporation of a summary of literature reviews/papers from current research articles to satisfy Learning Goal B (Professional Skills), Learning Outcome e (communicate effectively) and Learning Outcome g (knowledge of contemporary issues).

Improvements observed from student assessment results implemented by the Department are also related to the Learning Goals and Learning Outcomes previously outlined. The Department classrooms and laboratories were recently upgraded to provide better facilities to support the technical growth of the students, which satisfies the first learning goal. These facilities can also accommodate a higher number of students. Learning outcome e (communicate effectively) is being addressed by encourage students to present research work they are conducting at on and off campus conferences and competitions. A graduate student from the CEE department won second place under the category “Engineering and Computer Science” in the California State University Student Research Competition 2012. In addition, several students presented their research papers in national and international conferences.

F. Quality Indicators of Departmental Success for Student Learning Assessment

Graduate level students are required to take and pass a Comprehensive Exam during the semester the student is graduating. The comprehensive exam covers topics and courses in the student’s stated discipline (across 4 courses) to ensure that an appropriate amount of knowledge has been obtained during the degree. A passing grade of ‘B’ in each of the four courses is required for graduation.

Students who graduated with a Masters degree from the Civil & Environmental Engineering Department have many avenues open to them for their future careers. Some graduating students continue on into PhD programs. Many graduating students proceed to the private and consulting (industrial) world. Many students stay in the southern California area, however there are students who move outside of the state or the country upon graduation.

G. Student Learning Assessment in Non-Traditional Academic Settings

The Civil & Environmental Engineering Department did not offer online/video conferencing courses or classes at off-site locations during the period covered by this PPR report.

IV. Faculty

A. Changes in the Department FTEF since the Last Program Review

The Department of Civil and Environmental Engineering currently has 10 tenured and tenure-track faculty members and 1 faculty member in the FERP program. Among 10 tenure-track faculty members, 5 are tenured and 5 are tenure-track. There are 3 full professors, 3 associate professors, and 5 assistant professors in the department. Since the number of enrollment is growing in the recent years, the program is expecting to hire one or two tenure-track faculty members in the year 2012 - 13. The areas covered by current faculty members are Structures, Environmental, Geotechnical, Construction Engineering and Management, and Hydraulics and Water Resources. Due to high enrollment of students, the department also hires several lectures to cover any areas that are not taught by the current full time faculty members.

B. Priorities for Additional faculty Hires

The department plans to request approval for hiring a new tenure track faculty position in Construction Engineering and Management. Two new tenure track faculty have joined the department in Fall 2012.

C. Faculty Teaching in the Program

The faculty members in Civil Engineering Program are very active and they have both academic background and professional expertise required in the graduate program. Most courses in the program are currently taught by full-time faculty. A brief biography including educational background and the areas of expertise for each faculty member is listed below:

Chakrabarti, Pinaki

- **Education:** PhD, Rutgers University
- **Related experience:** Chief Engineer, T. Y. Lin Associates; Principal Engineer, A.C. Martin; Principal Engineer, Parsons
- **Area of Expertise:** Pre-stressed Concrete; Static and Seismic Repair & Retrofit of Structures using FRP; Tall Buildings and Building Design

Ghosh, Pratanu

- **Education:** PhD, University of Utah
- **Related experience:** Research Associate, University of Utah; Assistant Engineer, Consulting Engineering Services
- **Area of Expertise:** Concrete Materials; Development of Sustainable Materials; Durability Investigation and Service Life Modeling of Concrete Structures

Hawley, Harmonie

- **Education:** PhD, Rutgers University
- **Related experience:** Post-Doctoral Research Associate, Rutgers University; Consulting Environmental Engineer; published papers related to air and water quality; Supervise and manage environmental research projects.
- **Area of Expertise:** Water and Wastewater Quality; Emerging Contaminants; Air Pollution

Kim, Uksun

- **Education:** PhD, Georgia Institute of Technology
- **Related experience:** Research Scholar, Georgia Institute of Technology; Senior Researcher; Experimental and analytical investigations such as development of high-rise steel framed apartment, development of light-gauged steel frame housing
- **Area of Expertise:** Partially-restrained (PR) Connections, Dynamic Behavior and Design of Steel Joist Girder Structures, Experimental Techniques for Full-scale and Sub-assemblage Structures, Prefabricated Building Systems with Concrete-filled Tube Columns, Seismic Retrofit of Pre-stressed Building Systems

Kuo, Jeff, P.E.

- **Education:** PhD, University of Southern California
- **Related experience:** worked for several major environmental engineering companies and Los Angeles County Sanitation Districts
- **Area of Expertise:** water/wastewater treatment, groundwater and soil remediation, greenhouse gases management, and air pollution control

Mishra, Phoolendra

- **Education:** PhD, University of Arizona
- **Related experience:** Post-Doctoral Research Associate, Los Alamos National Laboratory
- **Area of Expertise:** Modeling Flow and Transport in Subsurface; Well Hydraulics; Coupled Processes Modeling; Contaminant Source Identification; Parameter Estimation; Uncertainty Quantification

Naish, David

- **Education:** PhD, University of California at Los Angeles
- **Related experience**: Seismic design issues related to reinforced concrete structures
- **Area of Expertise:** Structural engineering, reinforced concrete, earthquake engineering

Putcha, Chandra

- **Education:** PhD, Indian Institute of Technology
- **Related experience:** worked for several major engineering companies, Northrop Grumman, Boeing/Rockwell International
- **Area of Expertise:** System Reliability Evaluation; Risk Analysis; Engineering Optimization

Rao, Prasada

- **Education:** Ph.D., Indian Institute of Technology
- **Related experience:** Hydrology consultant
- **Area of Expertise:** Hydrology, Developing parallel models for hydraulic applications

Struckhoff, Garrett

- **Education:** PhD, University of Iowa
- **Related experience:** Post-Doctoral Research Associate, Air Force Institute of Technology
- **Area of Expertise:** Phytoremediation; Bioremediation; Processes that allow wetlands to degrade anthropogenic contaminants

Tiwari, Binod

- **Education:** PhD, Niigata University
- **Related experience:** Post-Doctoral Research Associate, Virginia Polytechnic Institute and State University; Consulting Geotechnical Engineer; Numerous honors and awards in professional services
- **Area of Expertise:** Geotechnical Earthquake Engineering, Slope Stability and Stabilization, Soil and Material Testing, Shear Strength of Soil and Rock, Foundation and Retaining Wall Design, Geo-environmental Engineering, Applied GIS, Dams, Embankments and Levees, Soil Structure interaction, Advanced Soil Testing

D. The department does not offer any courses in the Self support programs.

V. Student Support and Advising

A. The graduate students are typically advised by the department chair. Any specific questions relating to the opportunities in their selected area of interest (i.e., structures, environmental, geotechnical and construction engineering) are answered by the faculty in the respective areas. The Chair develops the study plan for each graduate student and communicates it to the Office of Graduate Studies. Students are informed of all the graduate school policies both at the time of orientation and during the academic year. For students who are on academic probation, Office of Graduate Studies conducts special workshops to walk them through on their options. Graduate students in Civil Engineering have a dedicated room that they use for studying and doing projects**.**

B. Students who are inclined to conduct research are actively engaged by the faculty. Some graduate students are working professionals and can come to the campus only after 5 pm. Hence, they may not be inclined to conduct research. Other students, pursing the graduate program as full time student, are given the opportunity to conduct research for 3 (project) or 6 units (Thesis). For example, the titles of some of the theses submitted in Spring 2012 are listed below.

- Influence of organic pore fluid on geotechnical properties of soil.
- Undrained shear strength characteristics of normally consolidated clays.
- Engineering properties and strength of clay minerals modified with cement.
- Ground motion improvement of loose sand with soil replacement method.

Faculty members who have external research grants partially fund students from their grants. The university provides internal funding to faculty to engage students in research. In 2011-12, the following selected list out of 16 publications resulted from the work of graduate students.

Kuo, J.; Hicks, T. (2011), Disinfection and Antimicrobial Process, *Water Environ. Res.* V. 83(10), pp. 1333-1350.

Nitti, N. and C.S. Putcha (2012), Post Tensioning of wood beams, Texas Section ASCE Fall Conference (in press)

Kim, H. and Anderson, K. (2012), Energy Modeling System Using ifcXML in BIM (Building Information Modeling), ASCE Journal of Computing in Civil Engineering (in press)

Tiwari, B. and Ajmera, B. (2012), New Correlations Equations for Compression Index of Remolded Clays, *Journal of Geotechnical and Geoenvironmental Engineering, 138,6,757-762*.

Tiwari, B. and Lewis, A. (2012), Experimental Modeling of Rainfall and Seismic Activities as Landslide Triggers, *Geotechnical Special Publication 225*, ASCE Press, *471-478*.

Tiwari, B. and Douglas, R. (2012), Application of GIS Tools for Three-Dimensional Slope Stability Analysis of Preexisting Landslides, *Geotechnical Special Publication 225*, ASCE Press, *479-488*.

VI. Resources and Facilities

The information concerning facilities such as classrooms, laboratories, computing and IT infrastructure and their adequacy in meeting the civil engineering instructional and research programs is described below.

1. Classrooms

Most of the classes are held within the premises of the College of Engineering and Computer Science. Sometimes, for very large classes, rooms in colleges are used. The College houses the offices of the faculty, classrooms and computing facilities. The classrooms are equipped with blackboards and erasable whiteboards, computers, overhead projectors and projection screens. These facilities are well maintained. Any additional equipment, such as slide projectors or LCD computer projectors, can be delivered into the classrooms upon request by the distance-learning center of the university. In some of the rooms, large printers are also available for printing drawings related to student projects. Most classrooms are equipped with 'Smart Cabinets" which have full audio and multimedia projection capability.

2. Resources and Support

The Civil and Environmental Engineering Department has one administrative assistant and one half-time student assistant. The department has one and half full-time technician.

The University has an excellent library. The library has a good collection of books pertinent to civil engineering field. Each year, a specific budget is allocated to the Department for the acquisition of new books and periodicals. This effort is coordinated with the main library by one of the faculty members in the department. The CSUF library collection is complemented by the inter-library loan system. The students and faculty have access to the vast selection of books, journals and other information present within the CSU campuses as well as the UC campuses through the inter-library loan. A computerized search is available at the University Library and through the faculty portal. The University Library space has increased significantly with an expansion a few years ago. The library has a computer room. Students and faculty members can use these facilities. They are equipped with major software required by the students. These facilities are heavily used by students and faculty. Each student gets an account number, which can be used to log in to the university system.

The Civil Engineering Department has its own library consisting of books normally not available in the main library. Many of these books are obtained through the donation from professionals and faculty. These books are kept in the bookshelves inside the Civil Engineering Department and the CEE laboratories. Students and faculty can check out books from this library.

2. A. Computing Facilities

All the software listed below as a function of the specific area, are installed in the computers located in room CS 204. Characteristic hardware and software details of the computers located in this room are:

Processor: Intel Quad Core Xeon W3550
Processor speed: 3.0GHz
Memory (RAM): 6 GB
Operating System: Microsoft Windows 7 Professional 64 bit.

Specific Software

Architecture

- AutoCAD 2012
- AutoCAD 2012 Revit Architecture
- SAP2000 v15
- STAAD pro v8i

Structures

- ANSYS 12.1
- Bentley Rail Track V8i
- Etabs 9.7
- Microsoft Visual Studio 2010 w/ C++
- MicroStation V8i
- STAAD pro V8.i
- SAP2000 v15
- RAM Structure
- RAM Connection

Geotechnical

- Dips 5.1
- Examine2D 7.0
- Examine3D 4.0
- Phase2 7.0
- RocFall 4.0
- RockLab 1.0
- Slide 6.0
- Swedge 5.0

Surveying (GPS data analysis and processing)

- ArcGIS 10.1
- GNSS Solution

Hydraulics

- WSPGW
- HEC-RAS

2. B. Laboratory Equipment

At present, the CEE Department is comfortable with the available equipment in the labs. Majority of the equipment has been procured in recent years. However, the department realizes a constant change in the laboratory for several reason reasons, such as - 1) Equipment breaks down and becomes irreparable, 2) Need for new equipment as the old ones become obsolete, 3) demand for more equipment because of increased enrollment, 4) Large expensive equipment never gets replaced because of budget conditions, and 5) Due to a regular change and upgrading of computer hardware and software.

In typical faculty meetings and lab committee meetings, CEE faculty members discuss the needs for new equipment and potential funding source. Plans are prepared and priorities are set accordingly.

Laboratory technicians take care of the maintenance. For large equipment, periodic maintenance contracts are given to outside companies. Detailed list of the equipment are provided in Appendix 2.

2. C. Computer Support Personnel
Mr. Thao Nguyen is the primary computer support person for the CEE Department (1/2 time).

2. D. Laboratory Support Personnel
Mr. LeRoy Sanchez is the primary laboratory support person for the CEE Department.

3. Major Instructional and Laboratory Equipment
The CEE Department has a well-equipped structural engineering laboratory, hydraulics laboratory, geotechnical engineering laboratory, environmental engineering laboratory, surveying laboratory and concrete and pre-stressed concrete laboratory. The structural engineering and geotechnical engineering laboratories are located in E-10. The hydraulics and surveying laboratories are housed in room E-45. The environmental engineering laboratory is located in room E-34.

An inventory of the equipment in the Civil Engineering laboratories is presented in Appendix 2. Some of the major equipment is mentioned below.

* 1 -4ft x 6ft Shake Table for Earthquake simulator
* 1 -30-gpm electro-hydraulic pump
* 1 -200,000 lb. Instron Universal Testing Machine
* 1 -200,000 Ib. Tinus Olsen Servo Hydraulic System
* 1 -large scale (30’-0”) pre-stressed concrete laboratory testing frame (2-D frame)
* 1 -10ft x 10ft Slab testing frame with a water bag loading device (3-D frame)
* 1 -50 ft. and a 16 ft. long hydraulics channel
* 1 -24ft long seepage tank
* 1- 1000 kip compression testing machine.

An assessment of the equipment and instrumentation in each laboratory is presented below.

Structural Engineering Laboratory
The structural engineering laboratory is excellent for teaching EGCE 325 (Structural Analysis Laboratory), EGCE 377 (Civil Engineering Materials Laboratory), EGCE 431L (Advanced Structural Laboratory) and EGCE463 L (Pre-stressed and Reinforced Concrete Laboratory). The Tinus Olsen and MTS have been used for research on concrete beams, beam column joints and corbels, and for other instructional purposes. The new large-scale concrete and pre-stressed

concrete laboratory is particularly useful for advanced undergraduate and graduate students. The structural engineering laboratory is equipped to do the following tests:

* Testing of a 10'-0" x 10'-0" R.C. slab where pressure is created by a water bag (3-D frame).
* Small scale (12’-0”) beam testing frame (for testing light beams).
* Large scale testing of pre-stressed concrete beams and other structural components. (Several 30’-0” long pre-stressed concrete beams have been tested) (2-D frame).
* Fatigue testing of large structures with 6 MTS actuators (2-55 kip capacity) and 2 data acquisition systems.
* 200-kip Capacity Tinus Olsen Machine.
* 200-kip Instron Universal Testing Machine
    - Compression Test
    - Tension Test
    - 3 Point Bending Test
* Shake table and earthquake simulation.
* 1000-kip compression testing machine (in progress)

Geotechnical Engineering Laboratory

The Geotechnical Engineering Laboratory is excellent. Three sets of tri-axial equipment, a set of cyclic triaxial equipment, a set of direct simple shear equipment, a set of surface area measurement equipment, a set of unconfined compression test equipment, and two sets of direct shear equipment are coupled with an automated data acquisition system. Other routine testing equipment is also available to perform the following tests:

* Specific gravity
* Atterberg limits and classification
* Grain size analysis by sieve and hydrometer
* Compaction
* Consolidation
* Unconfined compression
* Direct shear
* Tri-axial
* Mineral mixture characteristics
* 24 feet seepage tank for cofferdam and dam testing
*Permeability
*Miniature compaction
*4 ft long cubic Plexiglas soil model box

The laboratory also provides opportunities for undergraduate and graduate level studies and research. Previous research includes fundamental behavior of clays, improving site class for earthquake loads, modeling unsaturated slopes, simulation of rainfall and earthquake for slope failure, bearing capacity of 2-inch diameter piles, settlement of sand under earthquake loading, a model prediction of the cyclic response of soils and liquefaction tests on tri-axial equipment as well as on the earthquake simulator.

Asphalt Concrete Laboratory (Now combined with Geotechnical Laboratory)
The Asphalt Laboratory is adequate for instructional purposes. It is equipped to perform the following tests:

* Marshall Stability
* California Bearing Ratio
* Saybolt-Furol Viscosity
* Soil/Asphalt Stabilization
* Tensile Strength

Concrete / Pre-stressed Concrete Laboratory
The concrete laboratory is adequate for instructional purposes. Plans are being implemented for pre-stressed concrete instruction and research. Its capability includes:

* Compression Testing
* Slump and Compacting Factor
* Tensile Briquette Tests
* Flexure (3-point bending test)
* Various material testing
* Pre-stressing
* Air-entrainment testing of fresh concrete
* Concrete surface resistivity testing

Surveying Laboratory
The surveying laboratory equipment is also adequate for instructional purposes. Its capability includes:

* Precise measuring of horizontal and vertical angles
* Electronic distance measurement
* Precise leveling
* Various field surveying projects
* Conventional levels, theodolites
* State of the art total stations and GPS data receivers

Hydraulics Laboratory
The hydraulics laboratory is excellent. It is equipped with an open channel 50 feet long and another channel 16 feet long. It is equipped to do the following tests:

* Venturi and Orifice meter
* Rectangular and V-notch weir
* Hydraulic jump
* Sluice gate
* Water surface profiles in channels of various slopes
* Entrance velocity losses
* Pipe flow analysis

Architectural Laboratory (CS-207)
Presently, it is equipped mainly with 50 Intel Quad Core Xeon computers for architectural drafting. The software presently in use are AUTOCAD 2012, AUTOCAD 2012 Architecture, AUTOCAD 2012 MEP, RAM Structure, SAP v15, STAAD Pro V8i and others.

Environmental Engineering Laboratory
The major equipment and instruments available in the environmental engineering laboratory are UV/Visible spectrophotometer, AA/Emission Spectrophotometer, GC with FID and DELCD detectors, Turbidity meter, pH meter, ORP meter, DO meter, Table-top centrifuge, Oven, Electronic balance, and Peristaltic Pump.

Computer Laboratory
The Civil Engineering Computer Laboratory is intended to complement the College's computer laboratories and to respond to the special needs of the CEE Department. The hardware and software that are available on these computers are listed in Appendix.

In addition to the university and college level funding sources, CEE faculty also obtain laboratory equipment through their internal as well as external research grants.

VII. Long-Term Plans

A. Summary of Long-term Plan

In the long-term, the department (a) would like to establish itself as one of the top choices of graduate students in Civil & Environmental Engineering in Orange County and Southern California (b) continue to offer innovative courses that are in line with emerging trends in Civil Engineering (c) consolidate the efforts made towards offering online Environmental Engineering degree program and ensure that the quality of this degree program is maintained (d) recruit more faculty in the department (e) support faculty travel towards their professional development activities (f) explore the option of offering classes on Saturday or in the Irvine campus of CSU, Fullerton (g) support more local and international graduate students by providing them funding or teaching opportunities in the department.

B. Long-term Plan on Implementation of the University's, Department's and Program's Mission and Goals

The long term plans of the department listed above are in line with the University's and Department's mission and goals. The implementation plan for each of them is listed below: (a) The department has seen a considerable growth in student enrollment over the last few years. While this trend is visible across many engineering departments in U.S., the rate of steady growth of our department can be attributed to the consistent effort that the faculty and staff have been putting in to provide quality education over the last few years. The student successes in the department would not have been possible without the active support of the faculty. We would like to maintain this momentum and continue to excel in providing quality education, which will help us to be one of the top choices of the students from Orange County and Southern California. (b) The department has taken the lead in educating students on “High Speed Rail Design”. This was made possible due to the active links that the department has with the local industry. With High Speed Rail close to becoming a reality, our vision will help us to gain more visibility in the state. We have also introduced courses related to Sustainability and Green Building Design. New course in structural engineering, geotechnical engineering and environmental engineering were also offered over the last 3 years. In line with this trend, the department will continue to offer courses that will benefit the students. (c) The department has started a new online MS degree in Environmental Engineering from Fall 2012. We would like to consolidate the effort made in this direction. Since this is the first time, the faculty are teaching courses online, continuous improvements will be made in the teaching paradigms to ensure that quality instruction is provided. This new degree program has been well received by the initial cohort program and we were able to recruit about 50 students in the first year. (d) The department will be working with the administration in recruiting new faculty to the department. We have been recruiting new tenure track faculty at Assistant Professor level, every year for the past four years, even though the budget situation was not very good. We are optimistic of getting approvals for hiring new faculty. (e) The department has been supporting faculty travel to a limited degree. All the new hires have a startup grant that they are at liberty to use for professional travel needs. The travel expenses of other faculty are partly supported. Since this support comes from the department budget, we are optimistic that the new revenue that is generated by the online degree program will aid the department in supporting the professional travel and other needs of the faculty and students to a larger degree. (f) With the growing enrollment comes issues related to space that needs to be addresses. Since all graduate courses are being offered from 5:30PM from Monday to Thursday, finding large size classrooms is proving to be a challenge. We will explore the option of offering classes on Saturday in Fullerton Campus or in the Irvine campus of the university. We will gage the student enthusiasm and their willingness to enroll in these classes, before making any decision. An attempt was made 2 years back when we offered a graduate course (EGCE 436 Engineering Hydrology) on Saturday, and the response (i.e., enrollment) was satisfactory. (g) Supporting full time local and international graduate students by providing them teaching opportunities and out of state fee waivers is a priority to the department. We have been assigning lower level laboratory courses to promising graduate students. This funding is helping them to stay in the campus and assist faculty in their research activities. We have been depending primarily on the number of fee waivers that we are allotted by the graduate school, to provide out of state tuition fee waiver to international graduate students. Over the last few years, we were awarded about 2 fee waivers/year. We will be using some of the funds that the online graduate program generates to support students from all the graduate areas.

C. Potential Evidence in Support of Goals

The Department of Civil and Environmental Engineering is constantly thriving to improve on all fronts. These include implementing new approaches to teaching, enhancing ways and means for accomplishing its goals and objectives, updating curriculum, software and laboratory equipment to reflect the industry requirements and get help from industry leaders.

Through the following evidences, the level of achievement can be assessed.

The evidence of increased enrollment will be an increased number of students applied and enrolled in the program as shown in Table 5.1 (Appendix).

The program satisfaction from students can be found in Figs. 4.1 – 4.4 (Appendix).

D. Long-term Budget Plan

The primary source of funding for the department is the University. The university has been giving one-time money to the department which is being used to enhance the laboratory infrastructure and the classrooms. Although it is difficult to quantify how much of these enhancements are being used for graduate students, a visible improvement for the graduate students is a dedicated study room that evolved using these funds. This graduate study room has been equipped with several computers and printers as well as all required CEE software. Prior to this, the Civil Engineering graduate students had no dedicated room which caused hardships to them. The current room is full of activity round the clock. Enhancements to Structural Engineering, Geotechnical Engineering, Environmental Engineering and Hydraulics Laboratories have contributed to enhanced learning to those students who are making use of the facilities. As mentioned earlier, a sizable number of the CEE graduate students are part time students with full time jobs. They are more inclined to complete the MS degree by taking 10 courses. Full time students, on the other hand, are inclined to engage themselves in research and experimental works.

Internal budget allocations are just sufficient to handle the operational expenses and support faculty travel and professional development activities. The new online Environmental Engineering degree program will bring in additional $33/unit to the department. This money will be used to strengthen all the labs and also to support faculty/students in the department.

Depending upon the enrollment trend, the department will be requesting additional resources to support students by giving them fee waivers and sending them to conferences. At the faculty level, the department will request approval for hiring two new tenure track faculty.

VIII. Appendices

1. Selected Courses in the Department of Civil and Environmental Engineering

1.1. Structural Engineering

1.1.1 EGCE 493: Structural Systems Design - Emphasis on High Rise Structures

Course Description
Structural concepts and systems for buildings and complex structures and their behavior under loads. Roof, floor, wall systems. Characteristics and design concepts of complex structures and highrise buildings. Design project. Latest building codes and computer application. Sustainability and green building.

Learning Goals
- Understand the advantages and disadvantages of various structural systems
- Learn special design requirements that apply to buildings that classify as "tall"
- Calculate demand on buildings due to gravity, earthquake, and wind loading
- Work as a team to assess a site for potential development, layout a preliminary design, and develop a structural design for a tall building

Assessment Strategies
- 5 homework assignments
- 2 exams
- 1 group design project with presentation

Learning Goals linked to Program Goals
- System Design; Problem Solving
- Teamwork
- Professional Practice
- Contemporary Issues
- Communication

1.1.2 EGCE 517: Theory of Elasticity

Course Description
Stress and strain. Equations of elasticity. Extension, torsion, and flexure of beams. Two-dimensional elastostatic problems. Variational methods and energy theorems. Elementary three-dimensional elastostatic problems. Introduction to thermoelasticity and wave propagation.

Learning Goals
- Develop conceptual understanding of background equations of elasto-static and elasto-dynamic theory
- Understand simplifying assumptions of bar, beam, and plate theories
- Solve problems using vector and tensor mathematics
- Learn underlying mechanics behind stress-strain constitutive laws

Assessment Strategies
- 11 homework assignments
- 3 exams

Learning Goals linked to Program Goals
- Problem Solving

1.1.3. EGCE 532 Earthquake Engineering

Course description
This course integrates information from various engineering and scientific disciplines in order to provide a rational basis for the design of earthquake-resistant structures. As such, the course touches upon pertinent information from engineering seismology, geotechnical engineering, economics, risk and reliability theory and architecture in addition to advanced topics related to the dynamics and the analysis and design of structures. The focus of the course is on buildings, bridges, industrial facilities and other types of structures that may in the event of a major earthquake be allowed to respond in the inelastic range. The course emphasizes a theoretical understanding of the fundamental factors influencing and controlling the responses of these structures, and on the development of effective, but simplified, design procedures capable of achieving specified performance goals.

Assessment Strategies
- Evaluations: 2 exams,
- 4 homework assignments
- 1 team project

1.2. Environmental Engineering

1.2.1 EGCE 435: Design of Hydraulic Structures

Course Description
(Prerequisite EGCE 428: Engineering Hydraulics). Applications of hydraulic principles to design of various structures, including spillways, energy dissipaters, outlet works, storm drains, culverts and water distribution systems. Use of computers in design process. Units (3).

Learning Goals
- Design hydraulic structures
- Understand the fundamental concepts for design

Assessment Strategies
- 3 Exams
- 1 Group Project (2-3 students; computer model)
- 1 Graduate Project
- Homework Assignments

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills

1.2.2 EGCE 481: Solid Waste Technology and Management

Course Description:

Process dynamics; reactions and kinetics; reactor engineering and process design; pretreatment operations and physical, chemical and biological treatment operations; residual management and treatment process train selection.

Assessment Strategies:

- 3 Exams:
- Homework Assignments

1.2.3 EGCE 482: Liquid Waste Technology and Management

Course Description:

Process dynamics; reactions and kinetics; reactor engineering and process design; pretreatment operations and physical, chemical and biological treatment operations; residual management and treatment process train selection.

Assessment Strategies:

- 3 Exams:
- Homework Assignments

1.2.4 EGCE 515: Geo-Environmental Engineering

Course Description:

Geo-environmental properties and soil action related to problems encountered in waste management engineering; physico-chemical soil properties, shear strength as applied to landfill design and lateral earth pressures on braced excavation; contaminant migration and partitioning in unsaturated soils.

Assessment Strategies:

- 3 Exams:
- Homework Assignments

1.2.5 EGCE 537: Groundwater and Seepage

Course Description:

Equations governing flow of liquid in porous media. Seepage through dams and under structures, flow in confined and unconfined aquifers, steady and unsteady flow, well fields, flow nets, computer solutions, sea water intrusion, recharge, groundwater pollution. Units (3).

Learning Goals:

- Understand the methods by which water flows through subsurface
- Understand basic groundwater characteristics
- Master calculations related to the movement of water

Assessment Strategies:

- 3 Exams:
- Homework Assignments

Learning Goals Linked to Program Goals:

- Technical Growth
- Professional Skills
- Professional Attitude and Citizenship

1.2.6 EGCE 546: Ocean Pollution Engineering

Course Description:

Introduce theories and engineering applications in coastal engineering, coastal hydrodynamics, coastal development, planning of ports, and conceptual engineering design, tide, wave, wind, currents, littoral drift, beach erosion and sedimentation, coastal geomorphology. Port planning, location, design factors and engineering features. Preparation of construction, dredging, anchoring and dewatering.

Assessment Strategies:

- 3 Exams:
- Homework Assignments

1.2.7 EGCE 583: Air Pollution Control Engineering

Course Description:

Introduction to Environmental Engineering, or equivalent. Fundamental topics with regard to the formation and control of air pollutants are studied. This course intends to provide a strong foundation for design and development of engineering solutions, devices and systems for industrial air pollution prevention and control.

Assessment Strategies:

- 3 Exams:
- Homework Assignments

1.3 Geotechnical Engineering

1.3.1. EGCE 544 (Advanced Foundation Engineering)

Course Description

Design of foundation for earthquake loading; design of foundation for problematic soils; design of piles and caissons, ground surface subsidence, slope stability and stabilization; design of anchored bulkheads and dam sections.

Learning Goals

This course will provide the students with theory and experience-based knowledge necessary to analyze and design civil engineering structures such as retaining walls, excavation bracing systems, and shallow and deep foundations. Upon completion of this course the students will be able to:

- Investigate and evaluate subsurface soil conditions using techniques of geotechnical engineering, structural engineering, and construction engineering.

- Estimate soil properties from sources of information such as boring logs, visual descriptions, and index test results, in combination with textbooks and engineering manuals.
- Evaluate bearing capacity and settlement failure condition for shallow and deep foundations.
- Select the most suitable type of foundation for given site condition and design.
- Estimate total and effective horizontal earth pressures.
- Design retaining walls, sheet piles, and braced excavation supports.

Assessment Criteria

The effect of this course on student's learning ability will be assessed according to the following criteria:

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to design a system, component, or process to meet desired needs.
- An ability to engage in lifelong learning.

Learning Goals Linked to Program Goals

The educational objectives of the program are as follows:

- Technical Growth: Graduates will be successful in modern engineering practice, integrate into the local and global work force, and contribute to the economy of California and nation.
- Professional Skills: Graduates will continue to demonstrate the professional skills necessary to be competent employees, assume leadership roles and have career success and satisfaction

1.3.2. EGCE 545 (Slope Stability and Retaining Structure)

Course Description

Static and seismic stability analysis of slopes; calculation of earth pressures in retaining structures; design of retaining wall, sheet pile, and braced excavation system for static and seismic loading.

Learning Goals

At the completion of the course students will have gained the following knowledge and skills:

- Methods of slope stability analysis for static and seismic loading conditions.
- Methods of earth pressure calculations in earth and water retaining structures.
- Design of retaining structures such as retaining walls, sheet piles, and braced excavation systems for static and seismic loading conditions

Assessment Criteria

The effect of this course on student's learning ability will be assessed according to the following criteria:

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to identify, formulate and solve engineering problems.

Learning Goals Linked to Program Goals

The educational objectives of the program are as follows:

- Technical Growth: Graduates will be successful in modern engineering practice, integrate into the local and global work force, and contribute to the economy of California and nation.

1.3.3. EGCE 547 (Advanced Soil Mechanics)

Course Description

Behavior of soil on fully and partially saturated conditions, Consolidation of soil, Shear strength of Soil for fully and partially saturated conditions, Shear strength of soil for earthquake loading.

Learning Goals

At the completion of the course students will have gained the following knowledge and skills:

- Define the fundamentals of stress and Mohr-Coulomb failure criteria in geotechnical application.
- Evaluate the consolidation behavior of saturated clays both theoretically and experimentally.
- Evaluate the shear strength of saturated soil for static and cyclic loading both theoretically and experimentally.
- Understand the behavior of soil for partially saturated conditions.

Assessment Criteria

The effect of this course on student's learning ability will be assessed according to the following criteria:

- An ability to apply knowledge of mathematics, science, and engineering.
- An ability to engage in lifelong learning.

Learning Goals Linked to Program Goals

The educational objectives of the program are as follows:

- Technical Growth: Graduates will be successful in modern engineering practice, integrate into the local and global work force, and contribute to the economy of California and nation.
- Professional Skills: Graduates will continue to demonstrate the professional skills necessary to be competent employees, assume leadership roles and have career success and satisfaction

1.4 Construction Engineering and Management

1.4.1. EGCE 465 Plan & Control of Project

Course Description

The purpose of this course is to give the student an understanding of Project Control, and to provide practical guidance and tools to enable the student to perform Project Control in the "real world". Project Control is an important component of Project Management, and the success of any project relies on the ability to control the project. Project Control focuses on project scope, schedule and budget, and how to determine when the project is "off-course" in these areas, and how to get back on track. This course will review the overall process of construction project management and deal with construction scheduling fundamentals such as bar charts, CPM PERT.

Learning Goals

After the completion of the course, students are expected to accomplish the following:

- How to control project & schedule, and costs based on project budgets and cost estimation.
- How to balance between cost and time
- How to conduct cash flow analysis

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills
- Professional Attitude and Citizenship

1.4.2. EGCE 534 Advanced Construction Methods and Techniques

Course Description

Construction activities require a complex, significant, and rewarding process. The process begins with an idea and culminates in a structure that may serve its occupants for several decades, even centuries. Like the manufacturing of products, construction process requires an ordered and planned assembly of materials. It is, however, far more complicated than product manufacturing. Construction facilities are assembled outdoors on all types of sites and are subject to all kinds of weather and also much bigger in size than any other products in manufacturing.

Learning Goals

After the completion of the course, students are expected to accomplish the following:

- How to utilize different construction methods and techniques
- Conduct various construction methods and techniques based on knowledge students earned in class
- Evaluate different methods and techniques and select the most optimal method in a given situation

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills

1.4.3. EGCE 538 Construction Methods and Equipment for Heavy Construction

Course Description

The main objective of this course is to make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities. At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.

Learning Goals

After the completion of the course, students are expected to accomplish the following:

- Understand various construction methods and equipment for heavy construction
- Get familiar with different types of construction equipment
- Determine how to minimize the equipment costs and maximize the performance of a project

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills

1.4.4. EGCE 557 Cost Estimating and Bidding Strategy

Course Description

This class will provide a framework for the construction projects and estimating process. This course will include conceptual/detailed estimating, bidding strategy, project budgeting and cost control. The goal of this class is for students to understand estimating techniques, material, labor, equipment costs, and progress payment reports.

Learning Goals
After the completion of the course, students are expected to accomplish the following:

- Understand the process of quantity take-offs, cost estimating and bidding
- Understand the decision making process in cost estimating
- Differentiate different meanings of normal costs and project costs, overheads.

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills

1.4.5. EGCE 575 Data Mining In Sustainability

Course Description
This course will discuss data mining (DM) and knowledge discovery in databases (KDD). The class will involve lectures, lab sessions, class discussions, homework assignments, group projects, and student presentations.

Learning Goals
After the completion of the course, students are expected to accomplish the following:

- Understand the fundamentals of data mining and knowledge discovery in databases.
- Understand energy modeling and learn about its patterns.
- Demonstrate how knowledge discovery in databases can be used to support Green Construction.
- Apply DM/KDD techniques for data classification, prediction, and mining association rules.
- Recognize the Green Design, Construction and implementation issues for DM/KDD techniques.
- Analyze, evaluate, and recommend DM/KDD systems for construction owners, contractors, and/or project managers.

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills

1.4.6. EGCE 592 Green Building Design and Construction

Course Description

The environmental impact of the building design, construction, and operations industry is enormous. Buildings annually consume more than 30% of the total energy and more than 60% of the electricity used in the United States. In 2006, the commercial building sector produced more than 1 billion metric tons of carbon dioxide, an increase of more than 30% over 1990 levels. Green building practices can substantially reduce or eliminate negative environmental impacts through high-performance, market-leading design, construction, and operations practices. As an added benefit, green operations and management reduce operating costs, enhance building marketability, increase productivity, and reduce liability resulting from indoor air quality problems.

Learning Goals

After the completion of the course, students are expected to accomplish the following:

- Understand the significance of green building design and construction
- Apply the knowledge gained in class to real world situations
- Learn how to measure the degree of green building based on LEED certification process

Assessment Criteria

- Exams
- Homework assignments
- Group Project
- Presentation

Learning Goals Linked to Program Goals

- Technical Growth
- Professional Skills
- Professional Attitude and Citizenship

2. Equipment

Table 2.1: Inventory of Laboratory Equipment

Item	Year Purchased	Original Price $
Structures Lab		
Tinius Olsen 200,000 LB. Dynamic Test Machine	1972	90,000
Teaching Polariscope	1971	14,020
3-Strain Gage Switch & Balance Units, Vishay	1972	2,600
MTS 1,000 LB. Dynamic Testing Machine and Single Axis Shake Table	1973	51,050
Arch, Frame and Bridge Experiment Tecquipment	1973	1,869
2 Digital Strain Indicator, Vishay V/E 20	1978	2,598
Sony Camera and Monitor	1988	1,672
1-10'-0" X 10'-0" X 10'-0" Steel 3-D-Test Frame	1990	26,491
1-9' X 9" X 6" Inflatable Bladder	1990	10,000
1-Fas Cut FS-100 Rebar Fabricator	1990	3,352
2-MTS 244.21A-05 Kip Actuators	1990	17,900
1-MTS 242102.KIP Actuator	1990	6,310
2-Firestone Air Bags with Air Hydraulic Booster	1998	1,918
Sony Mavica Digital Camera	1999	700
2-Gardner System Program Generation & 2-Data Acquisition System	1999	18,425
2-Griffin 5 KIP Capacity Grips	1999	3,286
6 Unimeasure Linear Position XDCR	2000	2,200
8 Accelerometers	2001	3,927
1 64 Channel Garner Data Acquisition System	2001	14,515
1-Lebow 200 KIP Load Cell	2001	5,392
15 Schaevitz Linear Variable Differential XDCR's Transducers	1987-2001	14,700
LCD Video Projector	2002	3,334
COMPUTER/LCD Cart	2002	149
LeBow model 3187-10k load cell	2002	4,719
Model A 20 grips, 20 kip capacity	2002	3,736
110 volt Chain Hoist, 10' lift	2002	5,517
RH-102 10 Ton Hydraulic Jack	2002	1,741
3/8" Positive Shut Off Needle Valve	2002	257
3/8" closed nipple	2002	19
Model A-60 grips, 60 kip capacity, 2" wide	2002	5,016
Model A-60-17, jaws for A-60 grips	2002	734
Model A-60-18, jaws for A-60 grips	2002	734
Model A-60-21, jaws for A-60 grips	2002	819
Model A-60-22, jaws for A-60 grips	2002	819
MTS Model 244.21 20 Kip, Actuator	2002	13,311
2" Nylon Tow Straps x 15'	2003	318
Steel needle roller bearings & cage assy	2003	89
Jatco 6"x12" Plastic Mold with Lid	2003	105
Gardner Control System For 2D Frame	2005	23,705
3-3144-10k Load Cell	2005	2,295

Compressometer 37-5625	2005	803
Service Repair of Tinius Olsen Machine	2005	1,508
Extensometer for Tinius Olsen Machine	2005	13,598
2-P3 Strain Indicator & Recorder	2005	2,715
STR1 Structures Test Frame	2006	1,804
STR1A Digital Force Display	2006	1,069
STR2000 Data Acquisition Unit	2006	2,846
STR3 Shear Force in a Beam	2006	3,214
STR2 Bending Moment in a Beam	2006	3,008
STR5 Bending Stress in a Beam	2006	8,011
SR Display Retrofiing system 2	2006	5,862
Signal Conditioner Interface for Series	2006	1,174
LVDT External Signal Conditioner for Series	2006	1,121
Navigator STANPAC Software Package	2006	2,694
High Pressure Bladder for 3D Frame	2006	19,277
SRVTOR-Installation and Service for Retrofits	2006	2,748
Model2000 Degital Multimeter	2006	1,895
Padded Carrying Case	2006	580
5-ft Shielded RS-232 Cable	2006	95
3-year Factory Warranty Extended to 5-year	2006	129
HUSKY PRO Tool Set	2006	183
Black & Decker Drill Set	2006	22
1/2" Cordless Drill	2006	194
MAKITA 4" Angel Grinder	2006	54
HUSKY 50' Retractable Air Hose	2006	139
Wire Brush	2006	18
4" Grinding Wheels	2006	25
Aluminum Plate 5/8" X 2' X 2'	2006	209
20' Steel Flat Bar 1/4" X 1-1/2"	2006	16
20' Aluminum Round Bar, 1" Diameter	2006	33
12' Aluminum Flat Bar 1-1/2" X 1-1/2"	2006	135
12' Aluminum Flat Bar 3/8" X 2-1/2"	2006	56
12' Aluminum Flat Bar 3/8" X 1-1/2"	2006	33
12' Aluminum Round Bar 1" X 1"	2006	45
Pro-Value Steel Ruler (24"L, 1"W)	2006	809
Pro-Value Steel Ruler (12"L, 1"W)	2006	396
DF Plywood AC Exterior (5' X 9' X 23/32)	2006	416
1210AF-10K Load Cell	2006	2,028
Mating Connector	2006	143
30" X 60" Table with Painted Tilt Base	2007	2,450
42" X 72" Reversible Low-Glare Marker Board	2007	672
All-in-one Workstation without Electric	2007	377
Lasting Comfort Seating (KCS-3M3-DF)	2007	2,020
Folding Platform Truck with 900 lb Weight Limit	2007	231
2-Way Convertible Truck	2007	100
Shipping	2007	974
Compression Test Frame (Junior Steel)	2007	35,599
Load Cell & Jack (1000 Kips) - NASA	2007	35,207
20-Storage Cabinet	2008	6,788
2-Outdoor Steel Container	2008	7,793

Shake Table Upgrade (new MTS controller and software)	2008	95,698
Instron 200000 LB Universal Testing Machine	2010	144,595
8 Sets of Brass Sieves	2011	3450
Ro-Tap Sieve Shaker	2011	1916
8 Slump Cones/Tamping Rods	2011	357
2 Cylinder Cappers and Sulfur Warming Pots	2011	1852
General Purpose Bend Fixture	2011	5106
2 I-Series Conditioner Cards for Instron UTM	2011	2508
Rebar Extensometer	2011	7521
2 K-Slump Testers	2011	304
2 Precision Air-Entrainment Meters	2011	1337
2 Compressometers	2011	1831

Geotechnical Lab

2 Ovens, Soil Test	1973	650
Tri-axial Apparatus, Soil Test	1973	3,778
Direct Shear Apparatus, Soil Test	1973	1,210
2 Tri-axial Apparatus, in House Manufactured	1984	950
2 Tri-axial Cells	1986	4716
3 Schaevitz Pressure Transducers	1988	2,105
7 Ohous Digital Electronic Bench Scales	1999	5,848
1 Non-contacting Radial Deformation XDCR	1999	9,700
2 Consolidation Apparatus, Soil Test	2000	3,480
Soil test 10 KIP Load Frame	2000	6,958
2 Aggregate Shaker, Gibson	2001	12,825
1 Rototap Soil Shaker, Soil Test	2001	1,625
1-MTS Clip on Displacement Gage	2001	1,038
Pneumatic Consolidation Apparatus	2002	4,194
Fixed Ring Consolidometer 2.5" Dial	2002	1,823
Dial Indicator 0.4" range x 0.0001"	2002	1,246
Neutronics Inc. Pressure Transducer	2003	440
Undrained Tri-ax Shear Strength Program	2005	2,316
CU/CD Tri-axial Shear Strength Program	2005	2,316
Consolidation Program	2005	2,316
Axial Strain Transducer 0-2" range	2005	882
Tri-Flex 2 Master Control Panel	2005	1,734
ADU-Data Acquisition Unit	2005	4,865
De-Airing Tank	2005	346
Pressure Transducer 145 PSI	2005	1,754
Various assorted equipment for soils lab	2005	1,037
2.8" Dia. Tri-axial Membranes	2006	91
ELE Training	2006	808
Brass Sieve #4	2006	68
Brass Sieve #10	2006	68
Brass Seive #50	2006	68
Brass Seive #100	2006	70
Brass Seive #200	2006	98
Brass Pan	2006	28
Brass Cover Less Ring	2006	19
Mechanical Analysis	2006	324

Hydrometer ASTM 152H-5 to 60 Grams	2006	24
Hydrometer Jar	2006	218
Hydrometer ASTM 152H	2006	24
Sodium Hexametaphosphate	2006	14
Beaker, Glass 600 ml	2006	19
Pyncometer Top - Jar	2006	75
ASTM Liquid Limit Set	2006	748
Plastic Limit Set	2006	199
Shrinkage Limit Set	2006	165
Modified Compaction Hammer (10 lbs, 18" drop)	2006	152
Compaction Straightedge (12" X 1-1/4" X 1/8")	2006	15
Sand Density Cone, 6" (152 mm)	2006	54
Field Density Plate 6-1/2" (165 mm)	2006	32
Density Sand, 50 lb	2006	16
Sample Can, 1 Gal	2006	4
Volumeasure 1/20 cu ft. capacity	2006	413
Volumeasure Pressure Gauge	2006	25
Volumeasure Balloons Pack of 12	2006	19
100 mm Square Shear Box Assembly	2006	1,785
Weight Set-A: Four 1kg, five 4 kg, four 16 kg	2006	1,682
8 Channel Expansion Analog Input Module	2006	1,007
Vertical Displacement Transducer, 0-0.3999"	2006	1,139
Horizontal Displacement Transducer, 0-0.3999"	2006	1,109
2000 LBF (8.9 kN) S-Type Load Cell	2006	676
Corps of Engineers Cone Penetrometer	2006	611
Axial Strain Transducer 0-2.0" range	2006	1,505
2000 LB (8.9 kN) S-Type Load Cell	2006	1,015
2.8" Pedestal	2006	141
2.8 Specimen Cap	2006	175
2.8" Porous Stones Pack of 2	2006	51
2.8 Membrane Sealing Rings, Pack of 10	2006	11
2.8" Glass Fiber Filter Paper, Pack of 100	2006	19
2.8" Tri-axial Membranes, 10" long, Pack of 12	2006	41
2.8 O-Ring Placing Tool	2006	35
Modified Compacition Mold, 1/13.33 cu ft.	2006	256
1.4" Porous Stones, Pack of 2	2006	43
1.4 Membrane Sealing Rings, Pack of 10	2006	8
1.4" Tri-axial Membranes, 8" long, Pack of 12	2006	39
1.4 - 1.5 O-Ring Packing Tool	2006	18
1.4" Pedestal	2006	207
1.4 Specimen Cap for 2" - 3" Tri-axial Cells	2006	177
Hydrometer Jar Bath 110V 50/60 Hz 1Ph	2006	2,255
Constant and Falling Head	2006	1,109
Direct and Residual Shear Strength Program	2006	849
DIG Direct/Residl Shear w/ 115V Cord	2006	11,900
Pressure Transducer 145 psi	2006	2,847
Volume Change Transducer	2006	4,313
Tri-Flex 2 Auxiliary Control Panel	2006	5,073
Tri-axial Cell for 3" Diameter Samples	2006	2,725
Shear Trac II Modified Base Unit	2006	14,098

GEO-NET (Network/Comm Card)	2006	341
500 lb Load Cell	2006	684
DIR Simple Shear Module (SHEAR.DSS)	2006	3673
Direct Simple Shear Module (DSS-II)	2006	14,292
SET-DSS Shear Rings 2.50 in Dia	2006	1,452
DOZ-LATEX MEMB 63.5 mm Dia X 0.015 mm	2006	67
Shipping and Handling	2006	500
DIG TRITEST 50 Load Frame w/ 115V Cord	2006	15,066
Dell Dim 9200C Intel core computer	2007	1,073
Transducer extension cable 10'	2007	339
Piston restraint clamp	2007	200
1.4" Porous Stones	2007	50
Soil Sample Trimmer 1" to 3"	2007	366
Top Platen F/1.4" Trimmer	2007	38
Top Platen F/2.8" Trimmer	2007	56
Cyclic Triaxial Device	2008	
Simple Shear Device	2008	
Miniature Compaction Device	2010	
Surface Area Measurement System	2010	

Computer Labs (CS-204 & CS-207)

2 HP LaserJet 4250 DTN Printers	2007	4,000
1 HP Design Jet T-770 Plotter	2009	3,000
40 Dell Precision T-3500Computers/w 24" Flat panel	2011	72,000
1 Teacher Multimedia Lectern including computer, Video projector and Document camera	2011	15,000
AUTOCAD 2012 Academic Bundle (College Site license)	2011	5,500
Ansys University Intermediate (50 User)	2011	2,300
Rocscience Education (50 User)	2011	500
SAP2000 v.15 (50 User network license)	2011	3,500
1 HP LaserJet 4200N Printers	2006	1,500
50 Dell Precision T-3500Computers/w 24" Flat panel	2011	90,000
1 Teacher Multimedia Lectern including computer, Video projector and Document camera	2011	15,000

Concrete Lab / Pre-stressed Concrete Lab

4 Gantry and Hoists	1967	3,886
Concrete Beam Tester, Soil Test	1973	1,195
Concrete Cylinder Dual Console Tester, Soil Test	1973	3,112
Concrete Briquette Testing Machine, Soil Test	1973	1,609
Crown Lift Truck	1974	782
Abrasive cut-off Machine	1975	558
2 Hobart Lab Mixers	1979	1,660
Vibrating Table, Soil Test	1981	729
Pre-stressing Jack	1986	5,310
2 Schaevitz Inclinometers	1986	2,233
500 KIP Concrete Cylinder Tester	1998	14,084
2 Concrete Mixers	1999	860

12 Lebow Load Cells	2000	21,600
1-16' x 8' x 8' Concrete Curing Room	2000	2,316
4-2 yard Capacity Aggregate Storage Bin	2000	3,916
6-Interface 50 KIP Load Cells with Readouts	2001	7,628
6-30 Ton Hydraulic Jacks	2001	4,565
10 Hydraulic Jacks	1986-2001	6,500
Resipod-Concrete surface resistivity meter	2012	2786
2 wooden rack	2012	118
2 3/8 inch tamping rod	2012	20
1 5/8 inch tamping rod	2012	13
2 trowels	2012	16
Precision diameter tape	2012	89
4 Scoops	2012	29

Hydraulics Lab

18 ft. Demonstration Channel	1972	6,019
Differential Manometer, 2 Tube, 5 ft.	1974	828
50 ft. Water Flume, Manufactured in-House	1975	21,357
Fluor meter, Turner	1978	3,498
20 ft. Wave Tank, Manufactured in-House	1980	1,895
18 ft. Demonstration Channel (to be repaired)	2007-2008	10,000
Fluid Friction Measurements Unit	2007-2008	31,212

Surveying Lab

4 Theodolites with Tripods	1977-82	12,400
4 Automatic Levels with Tripods	1977-82	2,236
Lietz Electronic Distance Measure	1988	5,619
Z-Max Rover	2006	15,206
ALLEGRO Field Terminal Kit (GPS Module)	2006	4,800
PROMARK2-Three Receiver Kit	2006	7,012
Thumb Release Bipod for PROMARK3 Unit	2006	815
Fixed Height GPS Rover Rod	2006	369
Tribrach with Optical Plummet	2006	369
Rotating Tribrach Adapter	2006	81
PROMARK3-Three Receiver Set	2006	10,124
Two Full Days of Training	2006	1,293
Soth NTS-325 Total Station Survey Instrument	2007	3,260
Total Stations with prism and tripod	2008	
Electronic Theodolites with tripod and rods	2008	
GPS with accessories	2008	
Measuring Tapes, Odometer and other routine test sets	2008	

Environmental Engineering Lab

1-Atomic Absorption Spectroscopy	1997	13,778
1-Gas Chromatograph	1997	17,955
UV/Visible Spectrophotometer	1997	12,645

Misc Laboratory Test Equipment	1997	20,451
Hach DR2800 Spectrophotometer	2007-2008	3,000
Lab Programmable Stirrer (Jar Test Machine)	2007-2008	2,700
BOD Measurement System	2007-2008	2,000
Muffle Furnace	2007-2008	2,400
Millipore Direct-Q 3 Water Purification System	2007-2008	4,100
Hach DR5000 UV-Vis Spectrophotometer	2010-2011	7,000
Miscellaneous Glassware/Equipment	2010-2011	7,000
Additional pH meters	2010-2011	5,000
Analytical Balance	2010-2011	4,000
Lighthouse Handheld Air Quality Meter	2010-2011	10,000

3. Photographs of CEE labs

Photo 3.1: 2-D Structural Test Frame (Structures Laboratory)

Photo 3.2: 3-D Structural Test Frame (Structures Laboratory)

Photo 3.3: 1000-kips Compression Test Frame and 200k Universal Testing Machine Beyond (Structures Laboratory)

Photo3.4: Seismic Shake Table (Structures Laboratory)

Photo 3.5: Overview (Geotechnical Laboratory)

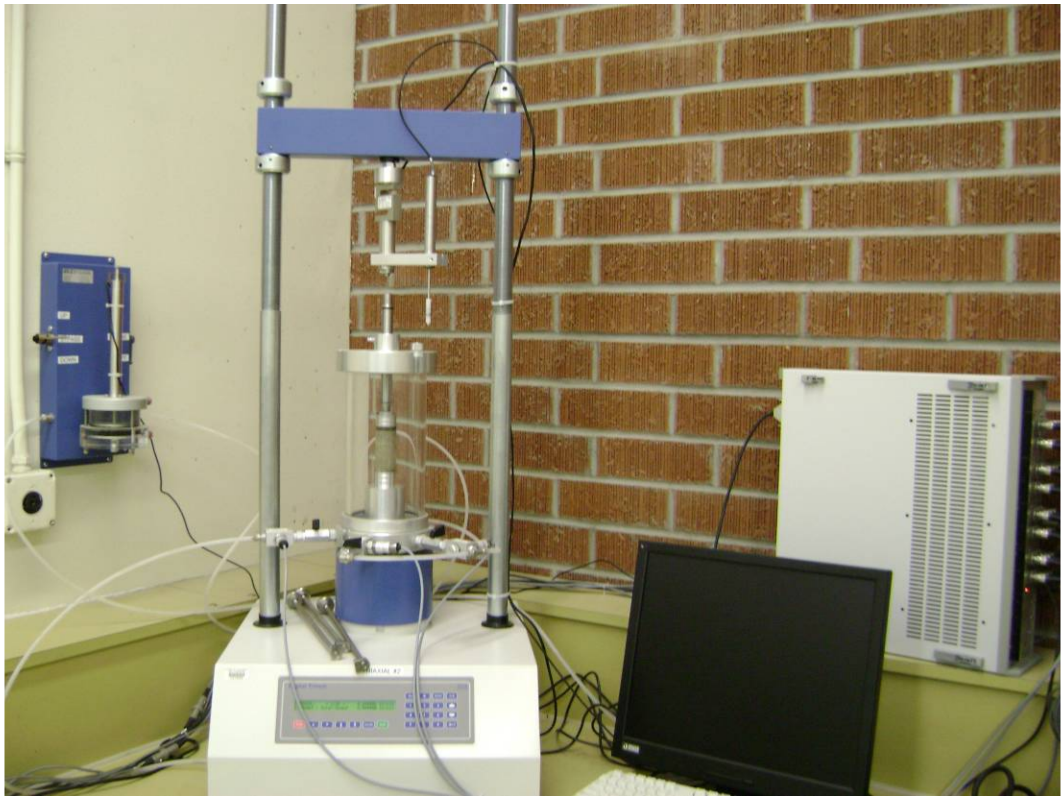


Photo 3.6: Tri-axial Test Apparatus (Geotechnical Laboratory)

Photo 3.7: Overview (Hydraulics Laboratory)

Photo 3.8: 50ft. Hydraulic Channel (Hydraulics Laboratory)

Photo 3.9: Overview (Environmental Laboratory)

Photo 3.10: Laboratory Devices and Equipment (Environmental Laboratory)

4. Survey Results for Program Assessment

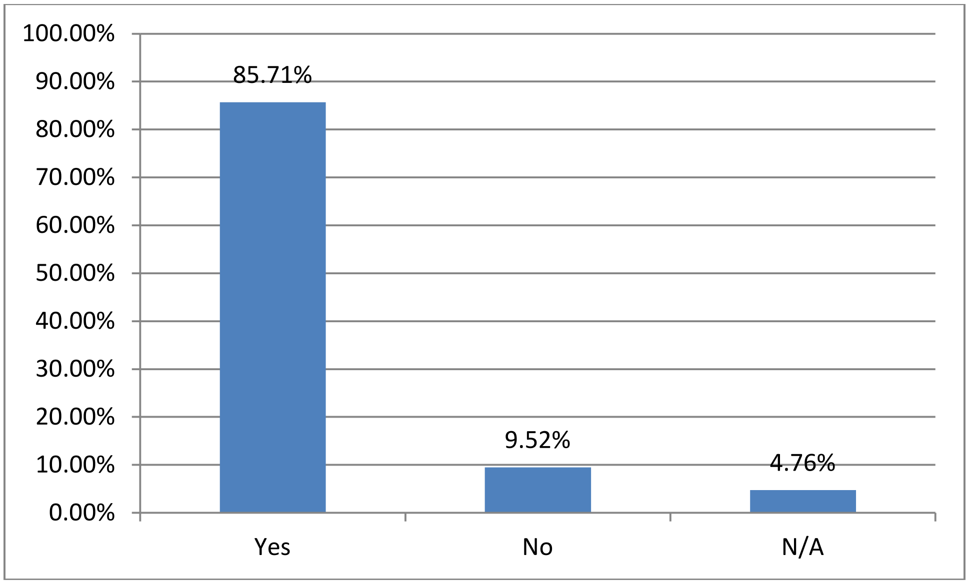


Figure 4.1: Student Expectation rate (21 respondents in total, survey taken in fall 2011)

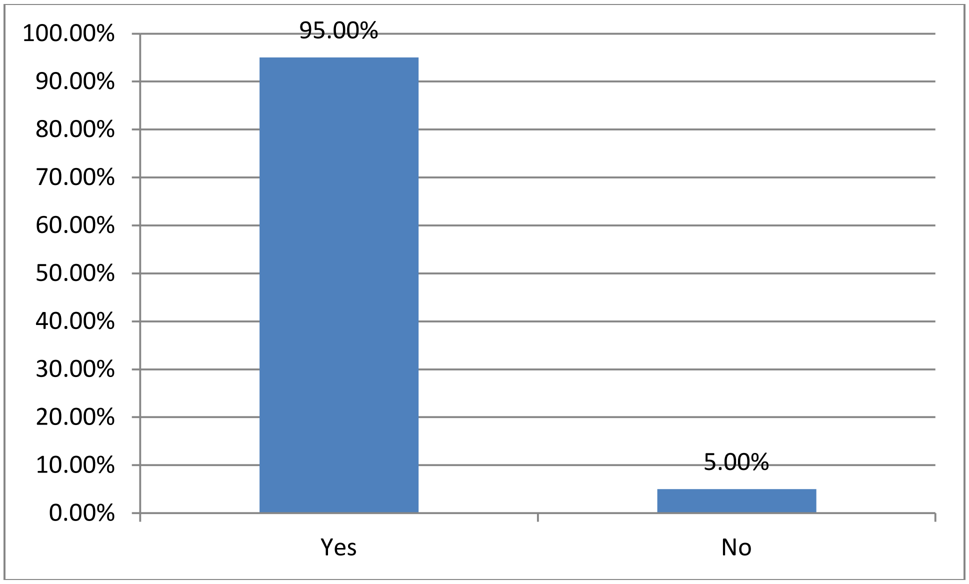


Figure 4.2: Usefulness of the subjects and knowledge learned throughout the program in his/her career rate (21 respondents in total, survey taken in fall 2011)

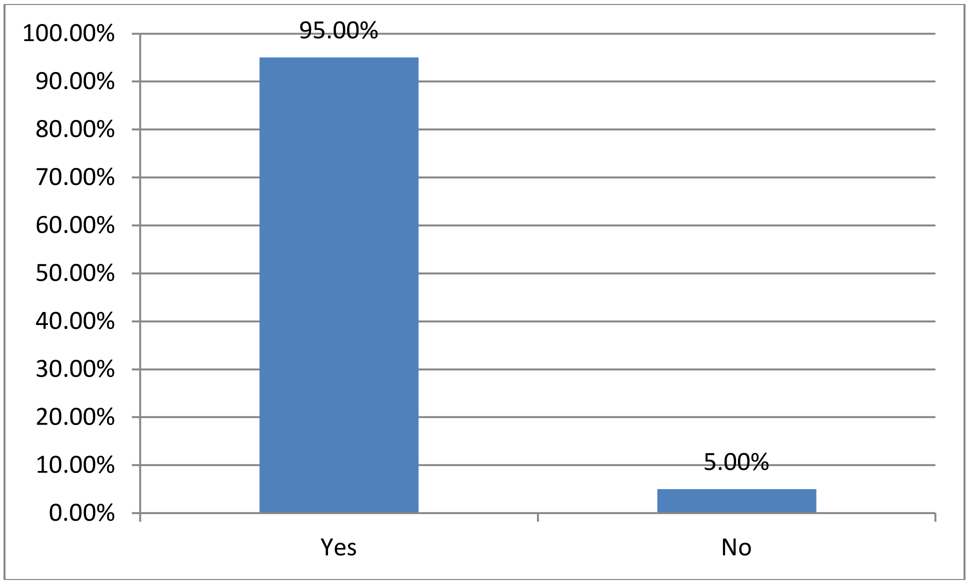


Figure 4.3: Student satisfaction rate (21 respondents in total, survey taken in fall 2011)

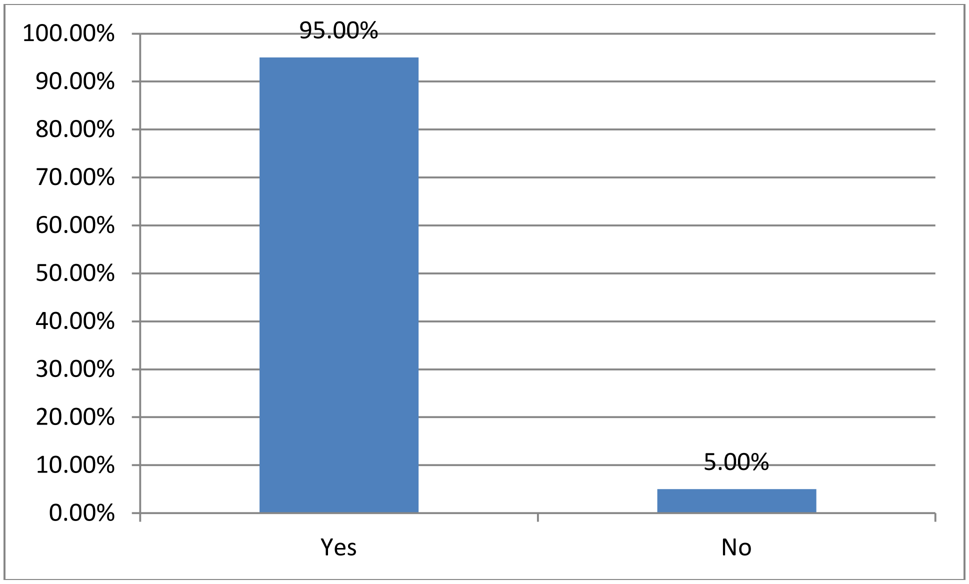


Figure 4.4: The Program Recommended for Other People rate (21 respondents in total, survey taken in fall 2011)

5. Supplemental Tables

Table 5.1. Graduate Program Applications, Admissions, and Enrollments

Academic Year	# Applied	# Admitted	% Admitted	# Enrolled	% Enrolled
2007-2008	117	86	74%	54	63%
2008-2009	168	118	70%	61	52%
2009-2010	136	87	64%	42	48%
2010-2011	287	174	61%	106	61%
2011-2012	287	174	61%	84	48%

Table 5.2 Graduate Program Enrollment in FTES

Academic Year	Enrollments in FTES
2007-2008	20.7
2008-2009	31.2
2009-2010	39.2
2010-2011	61.2
2011-2012	59.9

Table 5.3 Graduate Program Enrollment in Headcount

Academic Year	Headcount major	
	Master's	FTES per Headcount
2007-2008	72.5	37.3
2008-2009	104.0	55.9
2009-2010	117.5	64.3
2010-2011	161.0	87.8
2011-2012	163.0	88.5

Table 5.4. Graduation Rates for Master's-Seeking Students

All Master's Enrolled in:	**Headcount**	**% Graduate within 3 years**	**% Graduated in 4 years**	**% Graduated in 5 years**	**% Graduated in 6 years plus 7 year persistence**
Fall 2002	17	64.7%	82.4%	82.4%	82.4%
Fall 2003	18	66.7%	72.2%	72.2%	72.2%
Fall 2004	12	58.3%	75.0%	75.0%	75.0%
Fall 2005	16	43.8%	56.3%	56.3%	56.3%
Fall 2006	12	50.0%	58.3%	58.3%	

Table 5.5. Master's Degree Awarded

Academic Year	**Degrees Awarded**
2006-2007	18
2007-2008	13
2008-2009	27
2009-2010	40
2010-2011	59

Table 5.6. Faculty Composition

YEAR	Tenured	Tenure Track	Sabbat-icals at 0.5	FERP at 0.5	Lecturers	FTEF Allocation	FTES Target	Actual FTES	Budget SFR
2006-2007	4	3		0	1	7.0	115	130.8	16.4
2007-2008	4	3		0	0	8.5	161	160.7	18.9
2008-2009	4	3		0	0	9.5	194	193.8	20.4
2009-2010	3	5		0	0	10.5	201	201.2	19.1
2010-2011	4	6		0	0	10.0	253	252.9	25.3

Table 5.7. Department funding allocation amounts

AY	**OE&E Allocation**	**Misc Course Fees**	**Spec Equip / Lab**	**Lottery funds**	**UEE**	**Total ($)**
2007-08	18,697	16,933	118,465	18,865	5,899	178,859
2008-09	27,651	20,332	103,888	2,540	6,397	160,808
2009-10	22,125	21,741	-	-	19,662	63,528
2010-11	37,000	27,387	445,000	-	16,365	525,752
2011-12	12,500	34,382	17,700	-	11,443	76,025