Assessment of Student Learning;
The Civil Engineering Program Experience

Prof. Hiram González
University of Puerto Rico
Ponce Campus
March 13, 2003
Will answer questions in any of these 22 languages

- English
- Spanish
- British
- Australian
- Cuban
- Dominican
- Mexican
- Panamanian
- Honduran
- Guatemalan
- Nicaraguan
- Salvadoran
- Costa Rican
- Colombian
- Venezuelan
- Peruvian
- Chilean
- Argentinean
- Paraguayan
- Uruguayan
- Bolivian
- Ecuadorian
- Bolivian
- Uruguayan
Sequence of Presentation

- ABET’s Outcomes Assessment Criteria
- Early Actions/Challenges in the CoE
- Implementation in Civil Engineering
- Assessment Processes, Tools, and Strategies
- Samples of Data Collection
- Samples of Summary Results & Reporting
- Final Hints/Recommendations
- Questions & Closure
ABET

Accreditation Board for Engineering and Technology

• Primary organization responsible for the monitoring, evaluating, and certifying the quality of engineering, engineering technology, and applied science education in the United States.

• Federation of 31 technical and professional societies representing over 1.8 million practicing professionals.
“ABET Engineering Criteria 2000 is based upon what students learn in the course of their program of studies as opposed to what they are presented in a curriculum. Consequently, institutions are required to have educational objectives and to employ outcomes assessment techniques to determine the degree to which program goals and objectives are being attained. The assessment, in turn, is used in an ongoing process of improving student learning through enhancements to the program.”
“The implementation of **ABET EC2000** has been a major step in trying to direct the **outcomes of the educational process** towards the needs of the workplace. To meet these needs, companies like **Boeing** must engage with educational institutions on a global basis.”

Robert E. Spitzer  
VP, External Affiliations  
Boeing
Outcomes Emphasis
(ABET & Middle States)

• Continuous Quality Improvement (CQI):
  The systemic pursuit of excellence and satisfaction of the needs of constituents in a dynamic & competitive environment

• Continuous collaboration with constituencies

• Requires:
  - Proof of students knowledge and skills
  - Institutionalization of assessment (CQI) process to guarantee improvement
  - Dissemination of results and documentation of decision-making to improve education process
Basic Level Accreditation Criteria

1. Students
2. Program Educational Objectives
3. Program Outcomes and Assessment
4. Professional Component
5. Faculty
6. Facilities
7. Institutional Support & Financial Resources
8. Program Criteria
ABET EC2000 Criterion 3
Program (a-k) Outcomes

a. an ability to apply knowledge of mathematics, science, and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to meet desired needs
d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global and societal context
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
1. Curriculum

The program must demonstrate that graduates have: proficiency in mathematics through differential equations; probability and statistics; calculus-based physics; and general chemistry; proficiency in a minimum of four (4) recognized major civil engineering areas; the ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas; the ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum; an understanding of professional practice issues such as: procurement of work; bidding versus quality based selection processes; how the design professionals and the construction professions interact to construct a project; the importance of professional licensure and continuing education; and/or other professional practice issues.

2. Faculty

The program must demonstrate that faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The program must demonstrate that it is not critically dependent on one individual.
Establishment of an Assessment Process

"... an ongoing process aimed at understanding and improving student learning."

Thomas Angelo
Director, Assessment Forum
AAHE
Institutional Curiosity
An Internal Motivator

- Track students' educational experiences
- What they learn?
- How well they learn?
- When they learn?
Success: When we can show value added

Skill A - Value Added Chart

Year 1  Year 2  Year 3  Year 4  Year 5  Year 6  Employer

average assessment data point
“If we keep doing what we’re doing, we’re going to keep getting what we’re getting.”

The 7 Habits of Highly Effective People
Stephen Covey
The Five Stages of Grief

- Denial
- Anger
- Bargaining
- Depression
- Acceptance

On Death and Dying
Elizabeth Kubler-Ross
College of Engineering
UPRM

How & When Did It All Start

Civil Engineering Program
University of Puerto Rico – Mayagüez
Early Actions - 1998

- **Oct 13:** Strategic Plan of the College of Engineering Approved
- **Oct 16-17:** Best Assessment Processes in Engineering Education II Symposium (at Rose-Hulman Institute of Technology)
- **Nov 2:** Faculty ABET Team formed
Development of Logos

System for the Evaluation of Education SEED

Civil Engineering Program
University of Puerto Rico – Mayagüez
http://uprm.edu
Civil Engineering Program
University of Puerto Rico – Mayagüez

http://ing.uprm.edu
Civil Engineering Program
University of Puerto Rico – Mayagüez

http://www.abet.uprm.edu
Developing an Assessment Tool Box Workshop

Rosa Buxeda
(r_buxeda@rumac.uprm.edu)
Lueny Morell
(lueny@ece.uprm.edu)
Milestones - 2002

• Aug 1: Special Lab Assignment: $500K
• Sep 20-22: Mock Visit II
  (Raytheon, Hamilton Sundstrand, Microsoft, Boeing, Abbott, Eli Lilly, Merck-Sharpe & Dohme)
• Oct 25-26: SUCCEED Coalition Workshops
• Nov 19-21: ABET’s EC2000 Accreditation Visit
... and in Civil Engineering ...

(Since Sep 2000)
Our Initial Reaction

HOSTILE !!!

Civil Engineering Program
University of Puerto Rico – Mayagüez
Subsequent Actions

• ...Calm down !!!
• Review of Lessons Learned
• Designation of SEED Office & Committee
• Research on criteria, philosophy, priorities, etc.
• Research on how others do it; various Self-Studies
• Definition of terms, requirements & process to follow
• Transmission to faculty ... without generating the same hostility !!!
• Must “win the faculty into the process”
Common Obstacles

- Resistance to change
- Perception of increased workload
- Overwhelming sensation
- Lack of Resources
- Apathy from some faculty
Overcoming Obstacles

- **Keep it simple !!!**
  - Filter requirements to faculty; give them the tools; do the initial work at department/committee level
  - Train the faculty on the new process & philosophy (workshops, retreats, etc.)
  - Discuss progress & concerns at all Department Meetings; put it on the agenda.
  - Remind faculty of upcoming assessment times or opportunities
  - Seek faculty consensus
Lessons Learned

• **Successful Programs Have Two Common Characteristics:**

  - A faculty member who is highly committed to developing and guiding implementation
  
  - A sincere involvement of all faculty members

Civil Engineering Program
University of Puerto Rico – Mayagüez
The System for Evaluation of Education (SEED)

- Assist in accreditation strategies
- Repository of assessment strategies & tools
- Coordinate professional development activities

**Planning/Coordination Office**

**System for the Evaluation of Education (SEED)**

- Dept.
- Faculty
- ABET 2000 Committee
- Campus IR Office

Civil Engineering Program
University of Puerto Rico – Mayagüez
SEED/ABET Committee

1. Prof. Hiram González - Department’s ABET Coordinator
2. Prof. Ismael Pagán Trinidad - Department’s Director
3. Dr. Raul Zapata - Associate Dean of Academic Affairs, UPRM
4. Dr. Benjamín Colucci
5. Dr. Arsenio Cáceres
6. Dr. Roque Román Seda
7. Dr. Jorge Rivera Santos
8. Dr. José F. Lluch
9. Dr. Ricardo Lopez
10. Dr. Ricardo Ramos
11. Prof. Julio Ríos
12. Prof. Linda Vélez
13. Mrs. Taty Fortunet - Academic Counselor
14. Miss Ivonne Domínguez - Professional Counselor
15. Mrs. Damarys Zapata - SEED/ABET Secretary
16. Miss Rita Rodríguez - ABET Student Representative
Concrete Requirements

- Definition of Major Constituencies
- Clear Mission Statement
- Clear Program Educational Objectives
- Clear Program Outcomes (Course & Program level)
- Design & Implementation of Assessment Process
  
  (Continuous Quality Improvement - CQI)
- Development of Assessment Strategies, Tools, and Metrics Criteria (to measure success & failure)
- Data Collection & Analysis
- Decisions & Implementation of Changes

Civil Engineering Program
University of Puerto Rico - Mayagüez
Major Constituents

Students  Faculty  Alumni  Employers
Advisory Board Members

1. Eng. Carl Soderberg - Director, EPA Region II (Puerto Rico)
2. Dr. David Pittman - Director, Geotechnical & Structures Laboratory, ERDC (WES), US Army Corps of Engineers
3. Dr. Robert Whalin - Director, Army Research Laboratory
4. Dr. Leandro Rodríguez - Former Dean of Engineering, UPR-Mayaguez, Retired Faculty, Member of the Academy of Sciences of Puerto Rico
5. Agrim. Israel Otero - President CIAPR, Former State Legislator
6. Dr. Samuel Díaz - Faculty UPR-Bayamon, Consultant to the Government of Puerto Rico
7. Dr. Rafael Bras - Former Chairman of MIT's Civil Engineering Department (Massachusetts Institute of Technology)
8. Dr. Fernando Fagundo - Secretary of Transportation and Public Works (DTOP) of Puerto Rico
9. Lcdo. Hector Jimenez Juarbe - Executive Director, Puerto Rico Industrial Development Company (PRIDCO)
Vision Statement

We provide society with people-serving, problem-solving professionals in civil engineering and surveying.

Slogan

CES = (PS)^2

Civil Engineers and Surveyors (equal) People-Serving Problem-Solvers
Mission Statement

Provide our society with high quality professionals having a strong education in civil engineering and/or land surveying; with rich cultural, ethical, environmental, and social sensitivities; capacity for critical thinking; and the entrepreneurial skills to solve civil infrastructure problems.

Search for and disseminate new knowledge.

Provide services to solve engineering problems as members of interdisciplinary teams.
Program Educational Objectives

During the first few years after graduation, our Civil Engineering graduates will ...

1. Address the challenges that they will face in their careers.
2. Pursue life-long learning and continue to develop their problem-solving skills.
3. Exhibit leadership and team-building skills in a bilingual setting.
4. Provide quality service to the profession, to our government, and to our society.
5. Function as effective members of interdisciplinary teams.
6. Apply emerging engineering technologies and criteria.
Program Specific Outcomes

By their graduation time, our students will develop:

1. **Ability to understand and apply fundamental knowledge of mathematics through differential equations, probability and statistics; science (calculus based physics and general chemistry); and engineering sciences.**

2. **Proficiency in a minimum of four (4) recognized major civil engineering areas, such as: construction management, environmental, geotechnical, structural, and transportation.**

3. **Ability to conduct experiments and to critically analyze and interpret data in more than one of the major civil engineering areas.**

4. **Ability to perform civil engineering integrated design of systems, components, or processes by means of practical experiences throughout the professional component of the curriculum.**

5. **Ability to identify, formulate, and solve civil engineering problems using modern engineering tools, techniques, and skills.**

Civil Engineering Program
University of Puerto Rico – Mayagüez
**Program Specific Outcomes (cont'd)**

6. **Ability to play an effective role in multidisciplinary professional work groups solving engineering problems.**

7. **Ability to communicate effectively in English and Spanish.**

8. **An understanding of the importance of compliance with professional practice and ethical issues, such as: bidding; procurement; professional interaction; and professional licensure, among others.**

9. **The broad education necessary to understand the impact of civil engineering solutions on health, general welfare, safety, environmental quality and economy in a global context.**

10. **A commitment to engage in lifelong learning.**

11. **An awareness of contemporary social, cultural, economic, artistic, aesthetic, environmental and engineering issues.**
Department's Web Page
(http://www.civil.uprm.edu)
Department's Web Page (cont'd)

Undergraduate Programs

The College of Engineering offers a five-year degree of Bachelor of Science in Civil Engineering which is administered by the Department of Civil Engineering and Surveying. The program was initiated in 1913 with the fundamental purpose of supplying our island with quality civil engineers in order to satisfy the immediate and future technological demands of the Puerto Rican society. Currently (Fall term, 2002), 988 undergraduate, 57 graduate, and 13 PhD students are enrolled. This enrollment is one of the largest of the Engineering programs at the Mayaguez Campus. This program is fully accredited by ABET, the Accreditation Board for Engineering and Technology. For available information, please click any of the topics listed below:

- Vision
- Mission
- Slogan
- Program Educational Objectives
- Program Outcomes
- Curriculum for the five year Bachelor degree
- Definition of Courses
- List of Courses
- SEED Committee
- ABET Accreditation
- Professional Ethics
Professional Component Curriculum Data

BSCE

- **5-Yr. program** *(10 semesters)*
- **179 semester credit-hours** *(under revision)*
- **Components:**
  - Math/Basic Sciences: **39 hrs.** *(vs. ABET min of 32)*
  - Engineering Topics: **85 hrs.** *(vs. ABET min of 48)*
  - General Education: **36 hrs.**
  - Others: **19 hrs.**
DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF PUERTO RICO - MAYAGÜEZ

SYLLABUS OUTLINE1 (ABET)

Course number & title: INCI 4019 – Civil Engineering Seminar
Required Course (•) Elective Course ( )

Course catalog description: Presentation and discussion of topics on Civil Engineering by students, faculty members or guest speakers.
Prerequisites: 5th year student.
Textbook: Does not apply.

Course objectives and student learning outcomes: By the end of this course, students will be able to:
- Compose, develop and write proposals to study technical subjects related to civil engineering.
- Research a technical subject with little or no supervision.
- Compose, develop, write and perform computer assisted oral presentations and written engineering reports.

Topics covered:

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<tr>
<th>TOPIC</th>
<th>TEACHING / LEARNING STRATEGIES</th>
<th>ASSESSMENT TOOLS STRATEGY</th>
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<tr>
<td>Preparation and evaluation of technical proposals. (1 period)</td>
<td>Lecture and format of proposals.</td>
<td>Written student assignment and interactive evaluation of student proposals.</td>
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<td>Guides for making oral and written presentations. (2 periods)</td>
<td>Lectures by invited speakers from the English and Spanish departments on oral and written technical communications.</td>
<td>Required student assistance to lectures.</td>
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<tr>
<td>Student oral and written presentations. (12 periods)</td>
<td>Format guidelines for oral and written presentations.</td>
<td>Evaluation of oral presentations and written engineering reports.</td>
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Grading Plan (course evaluation metrics):

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<th>Partial Exam</th>
<th>Final Exam</th>
<th>Proposal</th>
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Important Note: A final grade of at least “C” (≥ 70%) is required in order to pass the course (move to next level).

Class/laboratory schedule: One credit. One hour meeting per week.

Relationship of course to ABET Criterion 3 (a-k Outcomes):

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Relationship of course to Program Educational Objectives:

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Person(s) who prepared this description and date of preparation: Roque A. Ramírez Seda, Professor of Civil Engineering, August 25, 2001

1 This is only an ABET Outline. A fully completed detailed Syllabus, with other accreditation agencies’ requirements and additional information of interest to students and professors is available for inspection at the Department of Civil Engineering.

System for the Evaluation of Education SEED

Civil Engineering Program
University of Puerto Rico - Mayagüez
### REQUIRED CIVIL ENGINEERING “CORE” COURSES

**vs.**

### PROGRAM EDUCATIONAL OBJECTIVES AND OUTCOMES

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Program (a-k) Outcomes

Engineering Criteria ABET 2000 (Criterion 3)

Program Educational Objectives

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**Civil Engineering Program**

**University of Puerto Rico – Mayagüez**
Civil Engineering Program
University of Puerto Rico – Mayagüez

Continuous Quality Improvement Process

System for the Evaluation of Education
SEED

Department Director
Implement

Once every three years
One Day Faculty Retreat

Academic Affairs Committee
SEED Committee

SEED Continuous Improvement Report

Recommendations and Survey Results

Data Analysis

Faculty
Students
Alumni
Employers

Main Constituents

Educational Objectives

Annual Loop

SEED Continuous Improvement Report

Program Outcomes

Pre-engineering
CE Undergraduate Program
Curriculum
Facilities
Faculty
Staff
Administration

Post-graduate
Along the 5-Yr Program

Surveys & Assessment Tools

Department Director
Implement

Every Three Years Loop

Individual Retreats or Surveys every 3 Yrs.

Annual Loop

Continuous Quality Improvement Process

Every Three Years Loop

SEED Continuous Improvement Report

Educational Objectives

Program Outcomes

SEED Continuous Improvement Report

Educational Objectives

Program Outcomes

Individual Retreats or Surveys every 3 Yrs.

Data Analysis

Faculty
Students
Alumni
Employers

Main Constituents
Civil Engineering Program
University of Puerto Rico – Mayagüez

Assessment Cycle

- Data Gathering
  - Civil Engineering Undergraduate Program
    - Students
    - Faculty & Staff
    - Facilities
    - The Campus, etc.

- Data Analysis
  - Analyzed data & tendencies

- Faculty Meetings & Retreats
  - Decisions & Action Plan

- Implement
  - Department Director

- Raw Data

System for the Evaluation of Education
SEED

Civil Engineering Program
University of Puerto Rico – Mayagüez
Data Gathering Mechanisms

Data Gathering Process

- Pre-engineering
- Along the program
- At graduation
- Post graduation

Raw Data

Data Gathering Mechanisms

- FE Exam Stats
- Advisory Board
- Alumni Surveys
- Employer Surveys
- Exit Surveys
- Faculty Evaluation
- Student Record Monitoring
- Course/Skills Assessments
- Admission Index (IGS)
- Freshman Surveys

Implement

Department Director

Action Plan

Civil Engineering Program
University of Puerto Rico – Mayagüez
Outcomes Assessment Tools

**Pre-Engineering**
- Freshman Orientation Questionnaire
- Ethics Integration Assessment Form

**Course Assessment**
- Laboratory Reports *(copies of)*
- Exams, Quizzes, Home works *(copies of)*
- EIT Exam Statistical Report
- Written Report Evaluation
- Oral Presentation Assessment
- Teamwork Assessment Form (I)
- Teamwork Assessment Form (II)
- Peer Evaluation Form
- Undergrad Research Exp Assessm. Form
- Course/Project Skills Assessment Form
- Student Evaluation of Teaching (SET)
- Video of Presentations

**Program Assessment**
- Ethics Integration Assessment Form
- Graduating Student Exit Survey (Part I)
- Graduating Student Exit Survey (Part II)
- Internship Assessment Form *(Student)*
- Internship Assessment Form *(Mentor)*
- COOP Supervisory Evaluation Form
- COOP Student Evaluation Form
- Student Resume *(Special Format)*

**Post Graduation**
- Alumni Survey
- Employers Survey
- FE Exam Stats
- Advisory Board

Civil Engineering Program
University of Puerto Rico - Mayagüez
## OUTCOMES ASSESSMENT MATRIX

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</table>
Outcomes Assessment Strategies

a. Maintain regular correspondence with graduates and their employers to know their needs and to evaluate whether modifications to the program are necessary and appropriate.

b. Establish an annual process in which a faculty/student committee reviews course and senior design projects to evaluate how well students in the capstone design course are applying material throughout the curriculum.

c. Draw upon students' co-op/intern/undergraduate research experiences as a source for interdisciplinary experiences, for class problems, and information to other students.

d. Require students to prepare written reports and oral presentations targeted to different audiences and topics.

e. Make use of available resources to present case studies of actual examples in which the consequences of ethical and safety-related decisions were not properly considered.

f. A large number of civil engineering courses have at least one major writing assignment.

g. In team settings, students will be required to evaluate peer performance.
Outcomes Assessment Strategies (cont’d)

h. Official Department policies on sexual harassment and academic and ethical misconduct have been documented and made available to all students, faculty, and staff.

i. Faculty design research projects appropriate for undergraduate students.

j. Establish seminar series for undergraduates to present their research work results.

k. Promote the use of programming, spreadsheets, and the most modern hardware and software tools at all levels in the curriculum.

l. Faculty will make greater use of informational sources beyond the course textbook.

m. Strongly promote student participation in the local student chapter of ASCE and support activities sponsored by this organization. Encourage and provide funds for student participation in local and regional events sponsored by professional and civic organizations.
## ASSESSMENT STRATEGIES MATRIX

### Utilization Strategy – Timing – Responsibility

<table>
<thead>
<tr>
<th>Assessment Tools</th>
<th>Pre-Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman Orientation Questionnaire</td>
<td>at UNIV-0004 Freshman Orientation Course (by Departmental Counselor)</td>
</tr>
<tr>
<td>Ethics Integration Assessment Form</td>
<td>at UNIV-0004 Freshman Orientation Course (by Departmental Counselor)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessment Tools</th>
<th>Course Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Reports (copies of)</td>
<td>at all Laboratory Courses (by Lab Instructors)</td>
</tr>
<tr>
<td>Exams, Quizzes, Homeworks (copies of)</td>
<td>retain examples of these tools (by all Professors/Instructors)</td>
</tr>
<tr>
<td>EIT Exam Statistical Report</td>
<td>obtain annually from Examining Board (by Department)</td>
</tr>
<tr>
<td>Written Report Evaluation</td>
<td>anytime written reports are required (labs, etc) (by all Professors/Instructors)</td>
</tr>
<tr>
<td>Oral Presentation Assessment</td>
<td>at all student oral presentations (by all Professors/Instructors)</td>
</tr>
<tr>
<td>Teamwork Assessment Form (I)</td>
<td>at end of any semester where work done in groups  (Professors/Instructors)</td>
</tr>
<tr>
<td>Teamwork Assessment Form (II)</td>
<td>at end of any semester where work done in groups  (Professors/Instructors)</td>
</tr>
<tr>
<td>Peer Evaluation Form</td>
<td>at end of any semester where work done in groups  (Professors/Instructors)</td>
</tr>
<tr>
<td>Undergrad Research Exp Assessm. Form</td>
<td>at end of any such experience (by Mentors)</td>
</tr>
<tr>
<td>Course/Project Skills Assessment Form</td>
<td>at end of every course (by all Professors/Instructors)</td>
</tr>
<tr>
<td>Student Evaluation of Teaching (SET)</td>
<td>At end of every course (by all students)</td>
</tr>
<tr>
<td>Video of Presentations</td>
<td>at Design/Project Presentations (by all Professors/Instructors)</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Assessment Tools</th>
<th>Program Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethics Integration Assessment Form</td>
<td>at end of CAPSTONE Courses (by CAPSTONE Professors)</td>
</tr>
<tr>
<td>Graduating Student Exit Survey (Part I)</td>
<td>at end of CAPSTONE Courses (by CAPSTONE Professors)</td>
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<td>Graduating Student Exit Survey (Part II)</td>
<td>at Graduation time (by Department)</td>
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<td>Internship Assessment Form (Student)</td>
<td>at completion of all Internships (by Mentors)</td>
</tr>
<tr>
<td>Internship Assessment Form (Mentor)</td>
<td>at completion of all Internships (by Mentors)</td>
</tr>
<tr>
<td>COOP Supervisory Evaluation Form</td>
<td>at completion of COOP terms (by Mentors)</td>
</tr>
<tr>
<td>COOP Student Evaluation Form</td>
<td>at completion of COOP terms (by Mentors)</td>
</tr>
<tr>
<td>Student Resume (Special Format)**</td>
<td>start at UNIV-0004 Course; maintain up-to-date thru college years</td>
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</table>

<table>
<thead>
<tr>
<th>Assessment Tools</th>
<th>Post Graduation</th>
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</thead>
<tbody>
<tr>
<td>Alumni Survey</td>
<td>mail to alumni, every 3 years (by Department)</td>
</tr>
<tr>
<td>Employers Survey</td>
<td>mail to employers, every 3 years (by Department)</td>
</tr>
<tr>
<td>PE Exam Statistical Report</td>
<td>obtain annually from Examining Board (by Department)</td>
</tr>
</tbody>
</table>
COURSE / PROJECT EVALUATION
and
ASSESSMENT of SKILLS and KNOWLEDGE

Course: __________________________                   Semester_________________________

The purpose of this assessment is:
• to determine your perception of mastery/level of knowledge and skills developed by the students in this course, and
• to establish the effectiveness of lectures and experiences, as well as of the logistics used.

The results of this assessment will help the instructor in charge of the course to better plan and adjust the course’s agenda in the future.

PART I: GENERAL OBJECTIVES AND SKILLS

Directions:
Using the scale below, please evaluate your perception of the mastery of skills and experience you have developed in this course in the areas specified. If not applicable to the course, assess N/A.

1 - no skills; no experience
2 - rudimentary skills; very little experience
3 - variability; some skills & experience developed
4 - functionally adequate skills; some experience
5 - advance skills; extensive experience

<table>
<thead>
<tr>
<th>SKILL/VALUE</th>
<th>ASSESSMENT</th>
</tr>
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<tbody>
<tr>
<td>a. Ability to use math/science/engineering</td>
<td></td>
</tr>
<tr>
<td>b. Ability to conduct experiments</td>
<td></td>
</tr>
<tr>
<td>c. Engineering design</td>
<td></td>
</tr>
<tr>
<td>d. Teamwork</td>
<td></td>
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<tr>
<td>e. Problem solving</td>
<td></td>
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<tr>
<td>f. Professionalism and ethics</td>
<td></td>
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<tr>
<td>g. Oral and written communication skills</td>
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<tr>
<td>h. Broad education and global awareness/impact</td>
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<tr>
<td>i. Ability to learn by him/herself (lifelong learning)</td>
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<tr>
<td>j. Contemporary issues</td>
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<tr>
<td>k. Modern tools and techniques</td>
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Civil Engineering Program
University of Puerto Rico - Mayagüez
### Value-Added Summary Chart

#### Course Assessment of Skills / Outcomes

<table>
<thead>
<tr>
<th>SKILLS / OUTCOMES</th>
<th>Series</th>
<th>ASSESSMENT PERIOD (Sem / SY)</th>
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<tbody>
<tr>
<td>a. Ability to use math/science/engineering</td>
<td>1</td>
<td>3.15 3.25 2.00 2.00 3.00 4.00 3.00 5.00 2.00 3.00 4.00 5.00</td>
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<tr>
<td>b. Ability to conduct experiments</td>
<td>2</td>
<td>3.10 3.15 3.00 3.10 3.15 3.10 3.10 3.15 3.10 3.10 3.15</td>
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<tr>
<td>c. Engineering design</td>
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<td>d. Teamwork</td>
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<td>e. Problem solving</td>
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<td>f. Professionalism</td>
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<td>4.35 4.70 1.00 4.35 4.70 4.35 4.35 4.70 4.70 4.35 4.35</td>
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<td>g. Oral and written communication</td>
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<tr>
<td>h. Broad education</td>
<td>8</td>
<td>4.35 4.70 1.00 4.35 4.70 4.35 4.35 4.70 4.70 4.35 4.35</td>
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<tr>
<td>i. Ability to learn by him/herself (lifelong learning)</td>
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<td>4.25 4.50 2.00 4.25 4.50 4.25 4.25 4.50 4.50 4.25 4.25</td>
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<td>j. Contemporary issues</td>
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<td>k. Modern tools and techniques</td>
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</table>

**Sample Hypothetical Data**
Fundamentals of Engineering Examination

Number of All Examinees vs. Average Number of UPRM Civil Eng Graduates Per Semester

FE Exam Stats (by Area)

Fundamentals of Engineering Examination-General AM Subjects
Examinees Currently Enrolled in School (Civil Engineering)

Chemistry
- Average Percent Correct

Computers
- Average Percent Correct

Dynamics
- Average Percent Correct

Electrical Circuits
- Average Percent Correct

Civil Engineering Program
University of Puerto Rico - Mayagüez
# Outcomes Assessments Summary Chart

**Year 2002**

## CRITERION 3 (a-k) OUTCOMES

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>ASSESSMENT TOOLS (Surveys) &amp; CONSTITUENCY AUDIENCE</th>
<th>OUTCOME</th>
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<td><strong>CRITERION 3 (a-k) OUTCOMES</strong></td>
<td>Courses</td>
<td>Alumni</td>
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<td>a. Ability to use math/science/engineering</td>
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<tr>
<td>b. Ability to conduct experiments</td>
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<td>c. Engineering design</td>
<td>c</td>
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<td>d. Teamwork</td>
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<td>e. Problem solving</td>
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<td>4.61</td>
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<tr>
<td>f. Professionalism and ethics</td>
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<td>4.49</td>
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<td>g. Oral and written communication skills</td>
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<td>h. Broad education and global awareness/impact</td>
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<td>i. Ability to learn by him/herself (lifelong learning)</td>
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<td>k. Modern tools and techniques</td>
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**Outcome Assessments Summary Chart**

**CRITERION 3 (a-k) OUTCOMES AVERAGES FROM ALL SURVEY ASSESSMENT TOOLS**

- **a**: 3.97
- **b**: 3.61
- **c**: 3.68
- **d**: 3.20
- **e**: 3.89
- **f**: 4.11
- **g**: 4.11
- **h**: 4.41
- **i**: 4.11
- **j**: 4.12
- **k**: 3.36

---

**Average Value**

- **1.00**
- **2.00**
- **3.00**
- **4.00**
- **5.00**

---

**Outcomes**

- **a**
- **b**
- **c**
- **d**
- **e**
- **f**
- **g**
- **h**
- **i**
- **j**
- **k**

---

**STATUS**

- **SAT**

---

**University of Puerto Rico – Mayagüez**

**Civil Engineering Program**

**System for the Evaluation of Education**

**SEED**
Skills/Quality Assessments Summary Chart
Year 2002

<table>
<thead>
<tr>
<th>SKILLS &amp; QUALITY INDEXES</th>
<th>ASSESSMENT TOOLS (Surveys) &amp; CONSTITUENCY AUDIENCE</th>
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<th></th>
<th>AGGREGATE Avg.</th>
<th>Benchmark % = 3.00</th>
<th>Cum Freq. ≥ 3.00</th>
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<tr>
<td>1. Managerial &amp; Entrepreneurial skills to solve CE problems</td>
<td>Alumni: 4.03</td>
<td>Employers: 3.33</td>
<td>Exit (Grads): 4.00</td>
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<td>75.0</td>
<td>94.3</td>
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<tr>
<td>2. Overall satisfaction with the education at UPRM</td>
<td>Alumni: 4.44</td>
<td>Employers: 3.67</td>
<td>Exit (Grads): 4.70</td>
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<td>94.3</td>
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<tr>
<td>3. Satisfaction with the quality of teaching at UPRM</td>
<td>Alumni: 4.32</td>
<td>Employers: 3.83</td>
<td>Exit (Grads): 4.15</td>
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<td>99.3</td>
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<tr>
<td>4. Would recommend UPRM’s CE Program to others</td>
<td>Alumni: 4.63</td>
<td>Employers: 4.40</td>
<td>Exit (Grads): 4.44</td>
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<td>75.0</td>
<td>99.3</td>
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<tr>
<td>5. Would continue to hire UPRM’s CE Program graduates</td>
<td>Alumni: N/A</td>
<td>Employers: 4.17</td>
<td>Exit (Grads): N/A</td>
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<td>75.0</td>
<td>100.0</td>
<td>SAT</td>
</tr>
<tr>
<td>6. Overall performance of UPRM’s CE Program graduates</td>
<td>Alumni: N/A</td>
<td>Employers: 4.00</td>
<td>Exit (Grads): N/A</td>
<td>4.00</td>
<td>75.0</td>
<td>100.0</td>
<td>SAT</td>
</tr>
<tr>
<td>7. Satisfaction with CE Department’s facilities</td>
<td>Alumni: N/A</td>
<td>Employers: N/A</td>
<td>Exit (Grads): 3.59</td>
<td>3.59</td>
<td>75.0</td>
<td>99.3</td>
<td>SAT</td>
</tr>
<tr>
<td>8. Satisfaction with UPRM’s campus environment</td>
<td>Alumni: N/A</td>
<td>Employers: N/A</td>
<td>Exit (Grads): 4.15</td>
<td>4.15</td>
<td>75.0</td>
<td>100.0</td>
<td>SAT</td>
</tr>
</tbody>
</table>

Skills & Quality Assessment Summary Chart
Averages from all survey assessment tools
Achievement of Program Specific Outcomes Year 2002

ACHIEVEMENT OF PROGRAM-SPECIFIC OUTCOMES

Table B3.1 of the Self-Study includes a listing of our program-specific outcomes (which include/consider Program Criteria requirements), reflecting their relationship with ABET's Criterion 3 (a-k Outcomes). The table shows that there are multiple links between our program-specific outcomes and ABET's Criterion 3 (a-k) outcomes.

The Outcomes Assessments Summary Table (2002) – attached - reflects the results of the statistical analysis on the degree of satisfaction/achievement of ABET's Criterion 3 (a-k) Outcomes. It shows that all outcomes were achieved based on the metrics and success criteria established by faculty consensus for the assessment time period ending May 2002.

Achievement of our PROGRAM-SPECIFIC OUTCOMES, and therefore compliance the with Program Criteria set forth by ASCE, is demonstrated by virtue of the achievement of all Criterion 3 (a-k) OUTCOMES linked to the individual PROGRAM-SPECIFIC OUTCOME, as shown on the modified version of Table B3.1:
# Achievement of Program Specific Outcomes  
## Year 2002

## Table B3.1
**Program-Specific Outcomes**  
*(What we expect to develop in our students by time of their graduation)*

<table>
<thead>
<tr>
<th>Program Outcomes</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. math/science/engineering</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. conduct experiments</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. engineering design</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. multi-disciplinary team work</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. problem solving</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. professionalism &amp; ethics</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. communication skills</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. broad education &amp; global impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i. lifelong learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>j. contemporary issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k. modern tools &amp; techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Program-Specific Outcome Achievement</strong></td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td>SAT</td>
<td></td>
</tr>
</tbody>
</table>

### Legend:
- **SATISFACTORY**
- **UNSATISFACTORY**
- **DOES NOT APPLY**
Achievement of Program Educational Objectives
Year 2002

**ACHIEVEMENT OF PROGRAM EDUCATIONAL OBJECTIVES**

*Table B2.1* of the Self-Study includes a listing of our program educational objectives, reflecting their relationship with ABET’s Criterion 3 (a-k Outcomes). The table shows that there are multiple links between our objectives and ABET’s Criterion 3 (a-k) outcomes.

The Outcomes Assessments Summary Table (2002) – attached - reflects the results of the statistical analyses on the degree of satisfaction/achievement of ABET’s Criterion 3 (a-k) Outcomes. It shows that all outcomes were achieved based on the metrics and success criteria established by faculty consensus for the assessment time period ending May 2002.

Achievement of PROGRAM EDUCATIONAL OBJECTIVES is demonstrated by virtue of the achievement of all OUTCOMES linked to the individual OBJECTIVES, as shown on the modified version of Table B2.1:
Achievement of Program Educational Objectives
Year 2002

TABLE B2.1
PROGRAM EDUCATIONAL OBJECTIVES

Our Civil Engineering graduates will...

1. Address the challenges that they will face in their careers.
2. Pursue life-long learning and continue to develop their problem-solving skills.
3. Exhibit leadership and team-building skills in a bilingual setting.
4. Provide quality service to the profession, to our government, and to our society.
5. Function as effective members of interdisciplinary teams.
6. Apply current and innovative engineering technologies and criteria.

<table>
<thead>
<tr>
<th>Criterion 3 (a-k Outcomes)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. math/science/engineering</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>b. conduct experiments</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>c. engineering design</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>d. multi-disciplinary teamwork</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. problem solving</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>f. professionalism &amp; ethics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>g. communication skills</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>h. broad educ &amp; global impact</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
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<td>i. lifelong learning</td>
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<td>X</td>
</tr>
<tr>
<td>j. contemporary issues</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>k. modern tools &amp; techniques</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

OBJECTIVE ACHIEVEMENT: SAT SAT SAT SAT SAT SAT

Legend:

<table>
<thead>
<tr>
<th>SATISFACTORY</th>
<th>UNSATISFACTORY</th>
<th>DOES NOT APPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAT</td>
<td>UNSAT</td>
<td></td>
</tr>
</tbody>
</table>

Civil Engineering Program
University of Puerto Rico - Mayagüez
### Alumni Survey 2002

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number</th>
<th>% from Total</th>
<th>% from Pursuers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning for Grad School</td>
<td>47</td>
<td>74.6%</td>
<td>N/A</td>
</tr>
<tr>
<td>Accepted into a Grad School</td>
<td>28</td>
<td>44.4%</td>
<td>59.6%</td>
</tr>
<tr>
<td>Applied for Employment</td>
<td>63</td>
<td>100.0%</td>
<td>N/A</td>
</tr>
<tr>
<td>Already Employed</td>
<td>48</td>
<td>76.2%</td>
<td>76.2%</td>
</tr>
<tr>
<td>Took FE (EIT) Exam</td>
<td>53</td>
<td>84.1%</td>
<td>N/A</td>
</tr>
<tr>
<td>Approved FE (EIT) Exam</td>
<td>47</td>
<td>74.6%</td>
<td>88.7%</td>
</tr>
<tr>
<td>Took PE Exam (based on all respondents)</td>
<td>21</td>
<td>33.3%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Passed PE Exam (based on those who took it)</td>
<td>10</td>
<td>47.6%</td>
<td>47.6%</td>
</tr>
<tr>
<td>Applied for Engineering License</td>
<td>33</td>
<td>52.4%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

#### Alumni Graduate School Experience (%)

- Planning for Grad School: 74.6%
- Accepted into a Grad School: 44.4%

#### Alumni Employment Experience (%)

- Applied for Employment: 100%
- Already Employed: 76.2%

#### Alumni FE (EIT) Exam Experience (%)

- Took FE (EIT) Exam: 84.1%
- Approved FE (EIT) Exam: 74.6%

#### Alumni PE Exam Experience (%)

- Took PE Exam (based on all respondents): 33.3%
- Passed PE Exam (based on those who took it): 47.6%

---

**Civil Engineering Program**  
**University of Puerto Rico - Mayagüez**
Assessment Results (so far)

a. The alumni are leading successful careers or graduate studies, have overall favorable opinions of the department, and have a continued interest in it.

b. Undergraduate civil engineering education at UPR-Mayaguez provides a good foundation for a career in industry or for graduate school; it is a broad curriculum that covers all areas of Civil Engineering.

c. Many graduates consider their undergraduate civil engineering education to have been somewhat theoretical; need more practice on various areas, particularly construction management, blueprints preparation, and CAD work.

d. The department is perceived as very effective in teaching, with high quality education and experienced, knowledgeable and supportive faculty.

e. There is a need to address safety, ethics, labor relations, political realities, and environmental considerations, among others, more effectively.

f. Physics, basic mathematics, and technical writing in both English & Spanish, as well as conversational English are considered the most valuable courses outside the Civil Engineering Program.

g. Some continue to perceive the program as too long; others see this as a strength.

h. Course/Program Assessments (to date): Good to Excellent, and confirming correlation to Outcomes and Objectives.
Civil Engineering Program
University of Puerto Rico – Mayagüez

"Self-Study" Document

Program Self-Study Report
Main Body & Appendix I (Program Data)

Bachelor of Science in Civil Engineering

Submitted to
Engineering Accreditation Commission
Accreditation Board for Engineering and Technology
111 Market Place, Suite 1050
Baltimore, MD 21202-4012
June 2002

System for the Evaluation of Education
SEED

University of Puerto Rico at Mayaguez
College of Engineering
http://eng.uprm.edu
Department of Civil Engineering & Surveying
http://civil.uprm.edu

Civil Engineering Program
University of Puerto Rico – Mayagüez
Recurring Actions

1. **Alumni Survey**: to 400 alumni from 2000/2001/2002 *(Labels from Registrar)*
2. **Employer Survey**: to 80 companies/agencies *(List from Placement Office)*
3. **Faculty**:
   - Constantly Reviewing/Updating Curriculum Vitaes
   - Constantly Reviewing Course' Syllabus *(revisiting selection of “X’s” vs. Outcomes)*
   - Assessing per strategies; maintaining Course Binders *(with evidence of assessment)*
   - Addressing ABET with Students *(discussion, bonus questions on exams/quizzes, etc.)*
   - Revisiting CAPSTONE Course concept
   - Participating in Curriculum Revision *(already in consensus of philosophical framework)*
4. **Students**:
   - Individual ABET Info Packages *(each student signs list provided by Registrar)*
   - ABET Info Posters *(posted in ALL classrooms, areas, hallways, etc.)*
   - Discussions in class and Bonus questions in exams, quizzes, etc.
   - ABET/Program Info on School Catalog
   - ABET/Program Info on INCI’s Web Page
   - Mass Orientations *(sponsored by the 6 student organizations)*
   - Participating in different assessment strategies
5. **Department Meetings**: **Monthly**, with ABET/CQI on the Agenda

Civil Engineering Program
University of Puerto Rico - Mayagüez
# Level of Implementation Status

## Level of Implementation - Engineering Criteria 2000

**Institution:** University of Puerto Rico - Mayagüez  
**Program:** Bachelor of Science in Civil Engineering  
**Date Prepared:** 14 September 2002

<table>
<thead>
<tr>
<th>Implementation Factor</th>
<th>Score (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Educational Objectives</td>
<td>4</td>
</tr>
<tr>
<td>b. Constituents</td>
<td>4</td>
</tr>
<tr>
<td>c. Processes</td>
<td>4</td>
</tr>
<tr>
<td>d. Outcomes Assessment</td>
<td>4</td>
</tr>
<tr>
<td>e. Results</td>
<td>4</td>
</tr>
<tr>
<td>f. Systems</td>
<td>4</td>
</tr>
</tbody>
</table>

---

1 Based on Level of Implementation Matrix Scoring System

Civil Engineering Program  
University of Puerto Rico - Mayagüez
New Impression of EC2000 Outcomes Assessment Criteria

- Not as difficult as initially perceived
- Not many operational changes required
- Assess & document what we are doing now
- Some processes are new;

BUT ...

- Most are simply formalizations of procedures we have followed for many years
Final Hints

• All faculty needs to be involved!!
  - **Know terminology**
    - Outcomes, assessment, etc.
  - **Be aware that there are desired student learning outcomes**
    - It is your duty to develop these in your courses & learning activities
    - Important to document
      - Learning objectives & outcomes *(syllabus)*
      - Provide evidence of outcomes *(assessment tools)*
  - **Be aware that there is a process of continuous improvement**
    - Decisions made on assessment results
    - Document results and decisions!

• **Outcomes assessment is:**
  - a continuous & on-going process that is here to stay forever
  - A way to enhance education and student learning
... and AGAIN ...

Keep it simple !!!

Civil Engineering Program
University of Puerto Rico - Mayagüez
“If you don’t know where you are going, you might end up some place else.”

Yogi Berra
QUESTIONS
Thank You ...

For more information:
Hiram González, P.E.
Associate Professor
Accreditation Coordinator
Ph. (787)832-4040 Ext. 2172
Email: hiram@ce.uprm.edu

Civil Engineering Program
University of Puerto Rico - Mayagüez