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# Western Michigan University

## Department of Civil and Construction Engineering

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### Construction Engineering Outcomes and Assessment Plan 2010-11

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#### **The Department**

The Department of Civil and Construction Engineering offers undergraduate degree programs in civil engineering and construction engineering, and a master's degree program in civil engineering. The undergraduate degree program in construction engineering was accredited by ABET/EAC in 1999 and again in 2005. The undergraduate degree program in civil engineering was inaugurated in fall 2003, and accredited by ABET/EAC in 2005.

The undergraduate civil engineering and construction engineering curriculum is based on the "Body of Knowledge for Professional Practice in Civil Engineering" developed by the American Society of Civil Engineers. This body of knowledge contains all the educational objectives of ABET and four additional objectives addressing necessary skills and attitudes for professional practice, as well as additional technical depth. The undergraduate construction engineering program is modeled on similar principles. The two undergraduate curricula are common through the fifth semester.

#### **Departmental Strategic Plan**

The departmental strategic plan, and the departmental mission and vision, was developed by the faculty members following a strategic planning retreat in fall 2002. That strategic plan has guided the allocation of departmental resources since then. The

departmental mission, vision, and strategic plan are aligned with that of the College and of the University.

#### **The Assessment Plan**

This assessment plan was developed collectively by the department faculty members. This plan is used to annually evaluate and in some years incorporate changes for improving the academic degree programs. It embodies the strategic objectives for the department's educational programs. Central to the assessment plan is the objective to maintain ABET/EAC accredited undergraduate degree programs and to educate engineers with the understanding of practice as well as theory and fundamentals of design. Comments and recommendations of the alumni and the Industrial Advisory Board are continually being incorporated into the assessment plan.

#### **Use of the Assessment Plan**

The assessment plan is used as the basis for evaluating the effectiveness of the department's academic programs. Each spring, the faculty members of the department convene and review all assessment data that have been collected during the academic year. That data is analyzed for each educational outcome in the context of metrics described in the assessment plan. Results of the review can be: a) the program is achieving the outcome and no change is necessary; b) the program is achieving the outcome but change is required

due to changing industry needs; c) achievement of the program outcome appears to be marginal, but no change in the program is recommended now; and d) the program outcome is not being achieved and curricular change is required.

Decisions regarding curriculum, curriculum assessment, and strategic planning are made by the entire department faculty membership. The faculty members meet often to discuss the assessment issues and procedures.

#### **Review of the Assessment Plan**

The departmental assessment plan will be reviewed annually to ensure: a) that it is still pertinent to changes that may have occurred in the department, and b) that the data being collected and the metrics established provide appropriate information regarding the knowledge acquired by the graduates. Changes in the assessment plan will be implemented by the faculty members when necessary.



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#### Program Outcomes

The program goal is to prepare graduates who contribute to the profession and are ready to join the workforce.

It is expected that our graduates upon graduation will have:

- A. Understanding of and are able to apply knowledge of traditional mathematics, science, and engineering skills.
- B. Able to design and conduct experiments, as well as analyze and interpret data in more than one Construction Engineering discipline.
- C. Can design systems, components, and processes to meet desired needs.
- D. Can work in design teams.
- E. Able to identify, formulate, and solve engineering problems.
- F. Understand professional and ethical responsibility.
- G. Able to communicate effectively.
- H. Understand the impact of engineering on society.
- I. Understand and embrace the need for life-long learning.
- J. Have knowledge of contemporary issues.
- K. Can use the techniques, skills, and modern engineering tools necessary for engineering.
- L. Understand and are able to apply management topics such as economics, business, accounting, law, statistics, ethics, leadership, decision and optimization methods, process analysis and design, engineering economics, engineering management, safety, and cost engineering.



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#### Assessment Philosophy

The department faculty members view the curriculum as an engineered system designed to achieve particular educational outcomes and educational objectives. The curriculum is not simply an assemblage of a group of independent courses. Rather, it is a complex system composed of highly inter-related components (courses, seminars, conferences, internships and co-op placements, *etcetera*.) As a whole the curriculum is designed to attain the stated outcomes and objectives.

As such, the assessment plan has been developed to evaluate the performance of that system and provide data such that the faculty members can formulate the necessary feedback to improve the system function. To the greatest extent possible, quantitative measures have been used in the assessment process. Following is a brief discussion of the assessment means and the associated reasons.

#### Fundamentals of Engineering

**Examination.** This exam is the only nationally normalized assessment

appropriate to evaluate student's performance. The examination is a program requirement for all students prior to graduation and is administered during their senior year. As such, the performance of our students on this examination, on average, is used as a measure to assess achievement of program outcomes.

**Senior Exit Interviews.** The interview process provides the students with a structured but informal setting to collect their comments about the curriculum and the department as well as parameters that affected their success. Although, these comments do not necessarily provide quantitative information regarding achievement of the program outcomes, they represent the student's perception of the achievement of the outcomes.

**Capstone Design Jury.** The final design projects are the culmination of all that knowledge acquired by the student including their ability to work as part of a team and their skills in communicating the knowledge. The jury reviewing the final projects is composed of the civil and construction faculty members and

practicing engineers from the community. The capstone jury review provides a measure of the achievement level of program outcomes.

#### College Seminar Series and Special Class Events throughout the Curricula.

Selected college and departmental seminars are utilized to support the program outcomes. Special events sponsored by professional associations are also used to assess the program outcomes.

**Student Participation in Regional Society Meetings and Events** Student participation in student professional activities and regional professional society events are used in the curricula and as a measure of the achievement of the program outcomes.

**Program outcome A: Graduates have an understanding of and the ability to apply knowledge of traditional mathematics, differential equations, calculus-based physics, science, and engineering**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates have proficiency in traditional mathematics, differential equations, probability and statistics, calculus-based physics, and general chemistry.	Fundamentals of Engineering Exam	Average of the department is at or above the national average.	A	Faculty
	CCE 4310 PERT Assignment	75% of teams achieve 70% or better on the assignment.	A	Faculty
	CCE 3300 Traffic Analysis Assignment	75% of students achieve 70% or better on the assignment.	A	Faculty
	CCE 3860 Deflection Calculation Assignment	At least 75% of students achieve 70% or better on the assignment.	A	Faculty
2. Graduates can apply knowledge of mathematics, science, and engineering.	CCE 4850 Senior Project	75% students complete the design project with 70% or better.	A	Faculty
	CCE 4850 Senior Project - Jury	At least 75% of all respondents agree with this statement.	A	Faculty

**Program outcome B: Graduates are able to design and conduct experiments, as well as analyze and interpret data in more than one Civil Engineering discipline. (ABET Criterion B).**

Program outcome	Assessment Means	Metric	Frequency (A-Ann., B-Biann.)	Responsibility
1. Graduates can design and conduct experiments, as well as analyze and interpret data in at least two of the major Civil Engineering disciplines	CCE 3080 Mix Design Lab Exercise	75% of teams achieve 70% or better on lab report.	A	Faculty
	CCE 2360 Lab. Team Project	75% of teams achieve 70% or better on lab team project.	A	Faculty
	CCE 3360 Lab. Exam	75% of teams achieve 70% or better on the exam.	A	Faculty
	CCE 4380 Equipment Assignment	At least 75% of teams achieve 70% or better on the assignment.	A	Faculty

**Program outcome C: Graduates can design systems, components, and processes to meet**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates can design systems, components, and processes to meet desired needs.	CCE 4850 Senior Project - Jury	At least 85% of the project jurors agree with this statement.	A	Faculty
	CCE 2360 Lab Project	75% of students receive at least a 70% on end-of-semester team lab project.	A	Faculty
	CCE 3860 Team Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 4400 Design Project	75% of students receive at least a 70% on end-of-semester design project.	A	Faculty
	CCE 4310/CCE 4360 Team Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 4300 Team Project	75% students receive at least a 70% on end-of-semester team project in each of these courses.	A	Faculty

**Program outcome D: Graduates can work in design teams. (ABET Criterion D)**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates can work as part of a design teams.	CCE 4850 Senior Project	All students will work as part of design teams	A	Faculty
	Exit interview	At least 80% of the students agree that all members of the team contributed to the final project	A	Faculty
	CCE 2360 Lab Project	At least 90% students work as part of design teams	A	Faculty
	CCE 3860 Team Project	At least 90% students work as part of design teams	A	Faculty
	CCE 4400 Design Project	At least 90% students work as part of design teams	A	Faculty
	CCE 4310/4360 Team Project	At least 90% students work as part of design teams		
	CCE 4300 Team Project	At least 90% students work as part of design teams	A	Faculty

**Program outcome E: Graduates are able to identify, formulate, and solve engineering problems.**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Civil Engineering graduates can identify, formulate, and solve engineering problems.	CCE 2360 Lab Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 3860 Team Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 4400 Design Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 4310/4360 Team Project	75% of students receive at least a 70% on end-of-semester team project in each of these courses.	A	Faculty

**Program outcome F: Graduates understand professional and ethical responsibility. (ABET)**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates have knowledge of engineering ethics and ethical responsibility.	CCE 4830 Ethics Paper	75% students earn a 70% or better from the Ethics Paper.	A	Faculty
	College Seminar and/or CCE 4830 Speaker/Video	100% of CCE 4830 students attend at least one college seminar and/or course speaker/video on ethics.	A	Faculty
2. Graduates have an understanding of the importance of professional registration.	CCE 4850 FE Sign-up or FE Result	75% of graduating seniors have completed the FE Exam or are registered to take it.	A	Faculty
	Exit interview	75% of graduating seniors indicate their intent to pursue PE registration.	A	Faculty
	CCE 4830 Paper	75% of students earn a 70% or better on the PE registration paper.	A	Faculty
	CCE 3330 Legal Issue Assignment	75% of students earn a 70% or better on the assignment.	A	Faculty

**Program outcome G: Graduates are able to communicate effectively. (ABET Criterion G)**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates demonstrate effective oral communication skills.	CCE 4850 Senior Project - Jury	At least 75% of the jurors agree with this statement.	A	Faculty
	CCE 4310/4360 Team Project	75% students earn a 70% or better on the course team project.	A	Faculty
	CCE 3080 Team Paper	75% students earn a 70% or better on the course team paper.	A	Faculty
2. Graduates demonstrate effective illustrative communication skills.	CCE 4850 Senior Project - Jury	At least 75% of the jurors agree with this statement.	A	Faculty
	CCE 4400 Design Team Project	75% students earn a 70% or better on the course design project.	A	Faculty
	CCE 4310 Team Project	75% students earn a 70% or better on the course team project.	A	Faculty

Construction Program Outcome Assessment 2010-2011

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3. Graduates demonstrate effective written communication skills.	CCE 4850 Senior Project	At least 75% students earn a 70% or better on the senior design project.	A	Faculty
	CCE 4830 Proposal	75% students earn a 70% or better on the senior design project proposal.	A	Faculty
	CCE 4400 Design Team Project	75% students earn a 70% or better on the course design project.	A	Faculty
	CCE 4310/4360 Team Project	75% students earn a 70% or better on the course team project.	A	Faculty
	CCE 3080 Team Paper	75% students earn a 70% or better on the course team paper.	A	Faculty

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**Program outcome H: Graduates understand the impact of engineering on society. (ABET Criterion**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates understand the impact of engineering on society.	College Seminar Series and/or CCE 4830 Speakers	All CCE 4830 students participate in at least one seminar related to Impact of Engineering Solutions on Society.	A	Faculty
	CCE 4830 Impact Paper	75% students earn a 70% or better in CCE 483 Impact of Engineering Solutions paper.	A	Faculty

**Program outcome I: Graduates understand and embrace the need for life-long learning. (ABET**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates understand and embrace the need for life-long learning.	Student Chapter Activities	At least 25% of the students in CCE 4830 participate in at least one ASCE chapter meeting.	A	Faculty
	Regional Professional Society Meetings	At least 15% of the students in CCE 4830 participate in one regional ASCE activity.	A	Faculty
	College Seminar Series	All CCE 4830 students participate in at least 4 college-wide seminars.	A	Faculty

**Program outcome J: Graduates have knowledge of contemporary issues. (ABET Criterion J)**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates have knowledge of contemporary issues.	College Seminar Series or CCE 4830 Speakers	All CCE 4830 students attend in at least one seminar on a contemporary issue.	A	Faculty
	CCE 4830 Contemporary Issues Paper	75% of CCE 4830 students earn a 70% or better on the Contemporary Issue Paper.	A	Faculty

**Program outcome K: Graduates can use the techniques, skills, and modern engineering tools**

Program outcome	Assessment Means	Metric	Frequency (A-Ann., B-Biann.)	Responsibility
1. Graduates can use techniques, skills, and modern engineering tools necessary for engineering practice.	CCE 4850 Senior Project	75% of students complete senior design project with a 70% or better.	A	Faculty
	CCE 2360 Lab Project	75% of students receive at least a 70% on end-of-semester lab team project.	A	Faculty
	CCE 3860 Team Project	75% of students receive at least a 70% on end-of-semester team project.	A	Faculty
	CCE 4400 Design Project	75% of students receive at least a 70% on end-of-semester lab team project.	A	Faculty
	CCE 4310/4360 Team Project	75% of students receive at least a 70% on end-of-semester team project in each of these courses.	A	Faculty

**Program outcome L: Graduates understand and are able to apply management topics such as economics, business, accounting, law, statistics, ethics, leadership, decision and optimization methods, process analysis and design, engineering economics, engineering**

<b>Program outcome</b>	<b>Assessment Means</b>	<b>Metric</b>	<b>Frequency (A-Ann., B-Biann.)</b>	<b>Responsibility</b>
1. Graduates have knowledge of engineering management.	CCE 4310 Time Management Paper	75% of students receive at least a 70% or better on the Time Management Paper.	A	Faculty
	CCE 4360 Cost Management Case Study	75% of students receive at least a 70% or better on the Case Study.	A	Faculty
	CCE 4380 Engineering Management Assignment	75% of students earn a 70% or better on the Management Assignment.	A	Faculty
2. Graduates can apply the concepts of leadership.	CCE4380 Leadership Paper	75% of students receive at least a 70% or better on the Leadership Paper.	A	Faculty
3. Graduates have an understanding of business related issues.	CCE 3330 Bonding Assignment	75% of students receive at least a 70% or better on the Bonding Assignment.	A	Faculty
	CCE 4380 Insurance Paper	75% of students receive at least a 70% or better on the Insurance Paper.	A	Faculty

Construction Program Outcome Assessment 2010-2011

4. Graduates are able to explain basic concepts in economics.	CCE 4380 Replacement Decision Analysis Assignment	75% of students receive at least a 70% or better on the Replacement Decision Analysis Assignment.	A	Faculty
	CCE 4380 Economic Assignment	75% of students receive at least a 70% or better on the Economic Assignment.	A	Faculty
	CCE 4360 Balance Sheet Assignment	75% of students receive at least a 70% or better on the Balance Sheet Assignment.	A	Faculty
5. Graduates have an understanding of the importance of the law.	CCE 3330 Lawful Case Study Report	75% of students earn a 70% or better in the Case Study Report.	A	Faculty
6. Graduates can meet desired process analysis and design.	CCE 4360 Cost Estimating Assignment	75% of students earn a 70% or better on the assignment.	A	Faculty
	CCE 4310 Planning and Scheduling Assignment	75% of students earn a 70% or better on the assignment.	A	Faculty
7. Graduate can apply the knowledge of decision and optimization methods.	CCE 4310 PERT Assignment	75% of students earn a 70% or better on the assignment.	A	Faculty
	CCE 4850 Senior Design Project	75% of students complete Senior Design Project with a 70% or better.	A	Faculty