Program Self-Study Report

Civil Engineering

Department of Civil and Environmental Engineering
College of Engineering
Wayne State University

July 1, 2006

Submitted to the

Engineering Accreditation Commission
Accreditation Board for Engineering and Technology, Inc.
111 Market Place, Suite 1050
Baltimore, Maryland 21202-4012
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Introduction

The Bachelor of Science in Civil Engineering degree program was last reviewed by ABET in the year 2000. At that time, the transition to the new ABET accreditation system originally introduced in the mid-1990s was being phased in at institutions throughout the country. Many programs were struggling in their initial efforts to properly define, interpret and implement certain elements of the new system, including revised terminology and “new rules” regarding satisfaction of ABET criteria. In the year 2000, programs were given the option of being evaluated under the old accreditation system or the new system. The Civil Engineering Department at Wayne State University chose to undertake its self-study under the new system and received official six-year accreditation from ABET in 2000.

Recognizing the importance of undertaking and maintaining continuous assessment as mandated by the new ABET 2000 accreditation criteria, the program assessment framework and related activities applied by the Civil and Environmental Engineering Department at Wayne State University have continued to evolve and improve from the last ABET evaluation to this point. As demonstrated in subsequent sections of this self-study report, the Department has worked to develop and implement several assessment initiatives that now provide important and necessary data for determining how effectively the CEE program is meeting its Educational Objectives, the extent to which Program Outcomes are being supported, and ultimately how well the CEE Department and its undergraduate curriculum meet ABET criteria used to accredit its undergraduate program in civil engineering.

For the first few years following the ABET review of the civil engineering program in 2000, assessment activities within our Department were ongoing along the same lines as what was being done prior to the 2000 visit. Although comprehensive and systematic documentation of these activities is somewhat incomplete, the Chair and faculty members spent significant time reviewing the undergraduate program, seeking meaningful input from our constituencies, identifying ways to improve the program when and where necessary, and finally implementing measures to achieve that improvement. In the spring of 2004 the Department held its annual faculty retreat and focused its deliberations on developing a formal plan under which program assessment would proceed in the future. The plan included several important components including: a cycle of specific assessment steps and a schedule for completing each element of the cycle; ways to enhance involvement of program constituencies; mechanisms to generate meaningful assessment data/evidence; formation of an internal assessment committee to evaluate and interpret these data; feedback to faculty and other program constituents regarding the state of the program; development and implementation of measures to enhance the program in the future; and follow-up monitoring to assess the extent to which changes actually improved the undergraduate program. In short, the plan required that recommended program improvements be addressed through specific actions that would be clearly defined, implemented, and monitored over time to assess their overall impact on the program. Examples of this process are provided in subsequent sections of this self-study report.
The position of ABET coordinator for civil engineering was established soon thereafter. The coordinator is responsible for overseeing the Department’s ABET review preparations and assisting the Chair in preparing the self-study report. In the fall of 2004, the CE ABET coordinator attended a special training workshop in Nashville, TN. The workshop, sponsored by ABET, provided an opportunity to become familiar with several aspects of the new framework under which ABET currently reviews undergraduate engineering programs. It also provided a clearer understanding of what assessment tools and data are best-suited to meeting the needs of ABET program reviews, as well as necessary steps to “close the loop” in accordance with new ABET guidelines.

A faculty retreat is now held each spring to address matters pertaining to assessment and program improvement. Discussion between the Chair and faculty at these retreats focuses on the undergraduate program in general, the civil engineering curriculum in particular, important feedback from program constituencies, as well as areas of strength and weakness identified within the context of our assessment plan that could help us improve our program and more effectively achieve our Educational Objectives and Program Outcomes.

Details of the Department’s assessment efforts are documented subsequently in this self-study report. In addition, on-site Exhibit 7 contains copies of relevant emails, memoranda, agendas and minutes of faculty meetings, faculty retreats, CE Advisory Board meetings, as well as other miscellaneous material providing documentation of program assessment activities since the year 2000. Over the last six years, but especially during the past four, the Department has strengthened its efforts to routinely confer with its constituents in regard to program assessment issues. Our Educational Objectives have been reviewed and revised. Faculty retreats have been held each spring dedicated to issues such as undergraduate program assessment, student advising, mentoring, and improving the core curriculum within civil engineering. Graduating students have made technical presentations of integrated capstone design projects before our CE Advisory Board members. Feedback from Board members pertaining to those projects and presentations has been collected and scrutinized. Faculty members have developed specific learning objectives for their respective CE courses and at the end of each semester assess how effectively these objectives have been met. Students have been surveyed regarding how effectively those learning objectives were met. Faculty meetings held during the academic year routinely provide opportunities for discussion of program strengths, weaknesses and future needs. The Department has made a concerted effort to undertake effective assessment in order to improve the overall civil engineering undergraduate program. Efforts to assess and improve our senior capstone design course (CE 4995), presented in subsequent sections of this self-study report, provide strong evidence of that fact. In summary, the CEE Department has now implemented a practical framework to sustain meaningful assessment and improvement of the undergraduate civil engineering program in future years.
1. Background Information

1.1 Degree Titles

Wayne State University awards the degree of Bachelor of Science in Civil Engineering.

1.2 Program Modes

The Bachelor of Science in Civil Engineering is offered as essentially an on-campus day program, with some classes made available in the evening. Co-op opportunities are available as an option for the students. However, no credit is given to co-op work assignments towards meeting the degree requirements.

1.3 Actions to Address Previous Concerns

Institutional Concerns

During the last general review of all undergraduate programs in the College, a number of Institution-level concerns were raised. The steps that have been taken to address these concerns are described in the following paragraphs.

- **Criterion 3: Program Outcomes and Assessment**
  
  It was noted that the programs throughout the College rely on the Wayne State General Education Program to meet the educational outcomes noted in criteria 3h (“the broad education necessary to understand the impact of engineering solutions in a global and societal context”) and 3j (“a knowledge of contemporary issues”). In the 14-day response, it was noted that the University was in the midst of a review of the General Education program that was anticipated to allow a change in the way in which these courses were integrated into the engineering curriculum. Unfortunately, the change in the General Education program was not as wide reaching as had been anticipated. Once this was recognized, the undergraduate programs sought to address these outcomes within courses taught within the College of Engineering or through courses in which a strong working relationship exists between the offering department and the College (e.g. PHI 1100 – Contemporary Moral Issues and ENG 3050 and ENG 3060 – Technical Communication) and which all students are required to complete. Thus, while the General Education curriculum continues to provide a broad education to all engineering students, this is no longer the sole mechanism through which criteria 3h and 3j are taught or assessed.

- **Criterion 7: Institutional Support and Financial Resources**
  
  The review team in 2000 noted that business processes, particularly in terms of purchasing, reimbursement, and student financial support, could use improvement and additional institutional support in order to support educational programs. Since 2000, the following changes in business support processes have been implemented by the University or the College:
All business process, personnel, and student data have been transferred to Banner from previous database systems. This allows for greater integration of the processes that cross these boundaries. Implementation of this software began in 2002, and the University will upgrade to Banner 7 (with new reporting and on-line functionality) in July of 2006. This change has allowed for elimination of much of the paperwork surrounding purchasing, for example, as requisitions are now entered on-line – thus reducing the time to make a purchase.

In 2002, the University also implemented a Purchasing Card system, allowing purchases less than $1000 in most categories to be made instantaneously via credit card. This mechanism has significantly increased the flexibility of the College and the departments in obtaining necessary supplies to support classroom and extracurricular educational experiences.

Acknowledging the challenge associated with tracking requested actions with regard to purchases, personnel appointments, and other business processes, the College developed the Business Office Log System. This on-line system allows faculty and staff to determine the status of any business document (e.g. requisition, personnel appointment, reimbursement request) that has been submitted to the College Business Office.

In 2000, the College was in the process of filling two vacant slots in the central Business Office. At that time, a full staff would have included six individuals. In 2006, the Business Office is comprised of eight full-time positions that are responsible for approving and processing personnel appointments, purchase requisitions, and reimbursement requests for both research and educational programs. This increase in staff has occurred in tandem with the greater efficiencies afforded by the implementation of Banner and purchasing cards.

In 2006, the College has received permission from the central University administration to include a 1% administrative fee on all non-federal grants and contracts. The proceeds from this fee will be used to hire an accountant to improve the monitoring of research accounts. This, in turn, will free up other Business Office staff to more quickly process requests pertaining to educational programs.

Thus, while the efficiency of business processes can always be further improved and continual options for this improvement are discussed among the College’s leadership, changes in University processes, College practices, and an increase in central College staffing have improved business practices in the past six years.

Departmental Concerns
During the previous review of the undergraduate civil engineering program at Wayne State University, ABET identified three specific issues considered to be “concerns” within the program, i.e., concerns which required a formal written response be prepared
and submitted to ABET. Each of these concerns is discussed below in conjunction with the Department’s original response as submitted to ABET back in 2001. A current update regarding each of these concerns is also provided. The update discusses how effectively each concern has now been addressed via measures taken within the Department.

- **Concern 1: Program Outcomes and Assessment.** Data presented in the self-study did not show agreement with the requirement that students are provided with knowledge of contemporary issues in the world and the importance of engaging in life-long learning or continuing education. Examination of available curriculum documents and discussions with faculty showed limited coverage of these criteria, but did not present a systematic approach to ensure meeting these criteria.

**Response:** A concerted effort will be undertaken by the Civil Engineering faculty to identify ways and means for satisfactorily addressing this concern. All faculty will be asked to explore how “knowledge of contemporary issues” and “importance of life-long learning / continuing education” can be incorporated in a meaningful way into individual civil engineering courses and into the civil engineering curriculum in general. Based on faculty recommendations, an implementation plan will be devised and executed. Results will be monitored in a continuous improvement framework.

**Current Update:** This particular concern corresponds to Program Outcomes i) and j) as defined in subsequent sections of this report. With respect to Outcome j), faculty have incorporated new lecture material and provided time for in-class discussions focused on a range of case studies to ensure that students develop an understanding of some important contemporary issues throughout the world. An example of this would be discussions held in CE 4210 emphasizing the global nature of modern environmental pollution problems, e.g., movement of PCBs from original sources to distant locations where the toxicant has never been produced or used; the impact of loss of habitat on the ecosystem and natural environment; introduction of non-indigenous species to the Great Lakes region via canal systems and ship ballast water, as well as the irreversible impacts of these organisms on the ecosystems of this country; the relative significance of nonpoint source pollution and toxic pollution on the global ecosystem. Students learn about the ecosystem approach to environmental management, whereby they develop a sensitivity to critical linkages among the lithosphere and biosphere when formulating solutions to civil engineering problems. Most importantly, students learn about relatively new, environmentally friendly best management practices (BMPs) for achieving storm water runoff control within developing areas (e.g., green roofs, bio-swales, rain gardens). Students demonstrate understanding of these BMPs via web-based research and incorporating one or more within the context of their capstone design projects in CE 4995. Finally, students learn about the critical importance of fostering communication and collaboration among different interest groups in order to develop practical, effective environmental management strategies throughout the world. Examination of student exit survey results presented in Appendix I-E indicates
that students generally leave the program feeling they are aware of important contemporary issues. This opinion is attributable, at least in part, to what students learn within the General Education component of the undergraduate curriculum.

In terms of addressing the concern regarding Program Outcome i), the Department has been successful in making sure students understand and appreciate the importance of life-long learning and continuing education by the time they graduate. Feedback from a survey of recent alumni of the civil engineering program (students graduating between 2000 and 2005) indicates a high fraction actively participate in professional organizations and societies, travel to conferences held by these organizations, subscribe to professional magazines and journals, and attend technical workshops to keep current within their profession. Assessment of student feedback from exit surveys conducted each spring suggests that students feel they leave the program having been taught the importance of life-long learning and continuing education. Our graduates typically understand the need to be actively involved in one or more professional societies or organizations throughout their careers, and they also understand the significance of working to achieve their professional engineering license.

Most recently, the department Chair prepared and delivered to the students a two-hour lecture entitled “Professional Skills for Civil Engineers” which covered several important topics, including: 1) understanding the global and societal impacts of modern engineering projects; 2) knowledge of contemporary issues in the world; and 3) importance of engaging in life-long learning and continuing education. One lecture of the required CE 4410 (Steel Design) class was devoted to this effort, which included student exercises, discussions and information sharing. Students were asked to submit a one-page essay on each topic, which was then evaluated by the Chair to ensure that students demonstrated a good understanding of what was covered in the lecture. This program will be repeated each winter semester in one of the required courses attended by juniors and seniors, so all of the civil engineering students will have the opportunity to participate and have exposure to these issues. The Power Point Presentation and samples of student essays are included as part of the course portfolio material for the Winter 2006 offering of CE 4410 (available on-site).

An additional course in which technology and its societal impact is covered is BE 1200 (Basic Engineering 1: Design in Engineering). In this course students are introduced to the most significant engineering and technological achievements of the 20th and early twenty-first centuries, and are then challenged to consider and discuss both their positive and negative impacts on society. They are also given an assignment to write an essay on this topic. Many contemporary issues such as sustainable development, civil infrastructure systems, nanotechnology applications, etc. are covered in these essays. Samples are provided in the course portfolio material for BE 1200.
• **Concern 2: Professional Component.** Review of general education course materials at the visit provided little justification as to why biology and economics are required of engineering students. Discussion with civil engineering faculty and students did not demonstrate that these two general education courses are consistent with program objectives.

**Response:** The biology and economics courses, which are currently part of the civil engineering curriculum, are in large part imposed on the Department to satisfy the Wayne State University General Education requirements. A university-wide committee is presently studying the effectiveness of the General Education Program, and a representative of the College of Engineering (Dr. Chin-An Tan) has been assigned to this committee. Communications will be established with Dr. Tan to link with the university committee. The matter will also be brought up with the College of Engineering Academic Standards Committee to obtain college-wide input and to capitalize on the interactions of this committee with the home departments in which the courses are offered. Better integration of the General Education Program with the civil engineering curriculum will be a continuing goal for our Department.

It should be noted that biology may be replaced by another life science elective, e.g., psychology, within the current system. This affords students the opportunity to take an alternative basic science course, e.g., geology. Several students have opted for this arrangement in the past, and we will continue to encourage it where feasible until a permanent resolution is established. Further, we will explore the relationship between the economics and engineering economy courses to see if the former should be a prerequisite for the latter. We also will study the possible relevance of biology to the future of civil and environmental engineering in view of the biotechnology revolution currently taking place in our society.

**Current Status:** The biology course BIO 1510 (Basic Life Mechanisms) has now been formally approved by the Academic Operations Committee (AOC) of the College of Engineering as a prerequisite to CE 4210 (Introduction to Environmental Engineering). CE 4210 covers aspects of biological systems for treatment of domestic wastewater, as well as the microbiology of water and wastewater from the standpoint of pathogenic organisms, human health risk, disinfection, and compliance with federal and/or state water and wastewater treatment standards. Students who pass BIO 1510 are better prepared to understand these and other biological aspects of environmental engineering. The General Education requirement in economics seems appropriate in view of the frequent role of civil engineers as company managers at least partially responsible for the economic health of their firms. Civil engineers not only need to understand how to normalize and compare project costs and benefits based on time-value-of-money and expected values of alternative courses of action, but also need to understand more macro-economic principles which define pricing strategies,
optimal levels of production, as well as maximization of net revenue (profit) or net benefit within the context of operating a private company vs. a public agency. Making the micro-economics course (ECON 2010) or the macro-economics course (ECON 2020) a prerequisite for the required CE 4850 course (Engineering Economy) was considered by the faculty. However, although the value of these courses to civil engineering students was well acknowledged by the faculty, communications with other civil engineering departments did not indicate a need to make either of these courses a prerequisite for CE 4850.

• Concern 3: Institutional Support and Financial Resources. One office staff member supports the program faculty and chair in both teaching services and research activities. Computer and lab equipment is maintained by a Department technician. However, stability in this position is poor due to low salary classification. A graduate student possessing expertise in computers and software management currently fills the position. Faculty and graduate teaching assistants not trained for this position provide laboratory upkeep. If the Department is to sustain and increase these activities, attention needs to be given to improvements available to the faculty and students.

Response: The importance of support services for effective functioning of the Department is well acknowledged. This is both a staff size issue and a skills issue. The salary structure at Wayne State University is such that it is difficult to recruit and retain highly-qualified personnel for secretarial and technician positions. Consequently, we rely on faculty and graduate students to do their own word processing and sometimes perform clerical/support functions in the office and labs. This issue is being addressed by the College and the University. The Department itself is also considering a solution by availing its discretionary funds to hire the needed support personnel. It is believed that funding will be needed from the University and the College to ultimately resolve this issue.

Current Status: There have not been any additions to the staff and technician positions in the department; there still is only one office staff (secretary) and one technician to serve the program faculty and chair in teaching, research, and administrative services. The skill level of the office staff is gradually improving thanks to the training opportunities provided by the Wayne State University Human Resources Department. However, the technician position remains a problem because of the transient nature of the personnel and only a half-time appointment being available through College funding. Note also that the main function of the current technician is computer hardware and software support, and the laboratory upkeep is still primarily handled by the faculty and graduate students due to lack of resources to employ a laboratory technician.
1.4 Overview of Developments Since Previous Visit

1.4.1 College Administration
In 2004, Ralph H. Kummer was named Dean of the College of Engineering, having previously served as Interim Dean. Supported by three associate deans (Academic Affairs, Research, and Student Affairs), the College has had a stable leadership team since 2003. This team has worked with the faculty to strengthen both the educational and research programs of the College.

In 2000, a single Development Officer was assigned to the College to assist with fund raising efforts. In 2006, this group has increased to three full-time development officers that work closely with the departments as well as the College as a whole to identify potential donors. The current case study for the College seeks funding to support student scholarships, endowed faculty chairs, student projects, and the construction and outfitting of the Engineering Development Center.

The College has identified several challenges that it faces in meeting the educational needs of its students and of its external constituents, including local industry. As these areas require increased attention, two additional, central academic staff positions have been created to devote time to these challenges.

The Director for Student Development and Industry Relations (SDIR), hired in January 2006, is charged with two disparate responsibilities: development and oversight of student learning communities (e.g., Engineering Bridge, Honors, residential Engineering Learning Community); and interfacing with industry to determine what academic programs can be developed or enhanced to educate the next generation of engineers. The current SDIR is a retired doctoral-level engineer from the automotive industry who has brought a new perspective to the college in these areas.

In May 2006, one of the College’s part-time academic advisor positions was expanded to full-time, with the addition of responsibilities in the area of educational research, assessment methodologies, and development of best teaching practices. While this individual’s title has not yet been determined, the goal is to hire someone with an advanced degree and experience in engineering education methods and assessment. This position is targeted to be filled by August.

The College will continue to examine ways to make optimum use of limited resources, both financial and personnel, to support its educational programs.

1.4.2 Engineering Bridge Program
Faculty in the College have long recognized that a significant number of students entering as freshmen, and some entering as transfer students, do not possess the math and science background necessary to immediately begin the outlined engineering curriculum. This phenomenon stems primarily from the University’s mission as an urban university and an institution of opportunity for students throughout the state of Michigan. The four-year retention rate of these students within Engineering was low, as many changed
majors or left the university all together. The College thus identified two, diverging goals: 1) improving the academic preparedness of students in the pre-professional engineering program (freshman and sophomore years of the curriculum); and 2) maintaining an avenue for underprepared students to enter engineering study after they gain the necessary background. The result was the development of adjusted admissions standards (see section 2.1.1) and the creation of the Engineering Bridge Program.

In the past, all interested students who qualified for University admission were admitted directly to one of the pre-professional engineering programs, irrespective of their specific math and science background. While eligible for academic advising from the College advisors, pre-professional students were expected to take responsibility for initiating the advising meetings unless they received substandard grades or fell into academic probation status. In addition, those students that placed into algebra were not given substantial guidance on a set of courses that would best prepare them for engineering study.

In Fall 2004, the Engineering Bridge Program was implemented. The goals of the program are to: 1) provide the appropriate math and science background to students interested in pursuing engineering study; 2) provide the students with additional skills to improve their chance of success, including technical problem solving and the use of University systems and services; and, 3) assist students with determining if engineering is the appropriate educational path early in their college career. Ultimately, the goal of the program is to improve retention of students both within the College of Engineering and within Wayne State as a whole.

Bridge students complete a one-year course of study that includes the following foundational courses:

- MAT 1050 – Algebra with Trigonometry (after having completed MAT 0993 – Beginning Algebra, if necessary)
- MAT 1800 – Elementary Functions (pre-calculus)
- CHM 1040 – Chemical Skills and Reasoning
- PHY 1020 – Conceptual Physics (with Lab)
- ENG 1010 – Basic Writing

In addition, a set of engineering courses has been developed to provide Bridge students with both fundamental academic skills that many seem to lack and an introduction to the profession of engineering.

- BE 0990 – Skills for Success in Engineering I (required of students who place into MAT 0993)
- BE 0991 – Skills for Success in Engineering II
- BE 1001 – Mentorship Program in Engineering (2 semesters)
- BE 1050 – Introduction to the Engineering Profession
The mentorship program creates small cohorts (up to 12) of Bridge students who meet weekly with an upper division or graduate student from the College of Engineering. These meetings are designed to allow students to develop a peer network, connect them with a more advanced student, and provide an environment in which their questions and concerns can be addressed.

Students who have originally placed into the Bridge Program (see section 2.1.1) must complete the courses listed above\(^1\) with a cumulative grade point average of 3.0 or higher and no grade lower than a C-. Students who have shown evidence of reasonable academic progress, but who have failed to meet this minimum gpa requirement at the end of the Bridge courses, are allowed one opportunity to repeat courses to raise their gpa following a meeting with the Associate Dean for Academic Affairs.

All Bridge students are monitored closely by the Academic Advisors. They are required to meet with an advisor prior to their registration each semester, and a dedicated advisor reviews their records after grades have posted. This close advising allows students who are having academic trouble to be identified early so that early interventions can be made. Students who are struggling are provided with access to the services of both the Academic Success Center and the Career Services Center. In combination with meetings with the Associate Dean for Academic Affairs, these University support offices are employed to encourage a student to evaluate their planned course of study and maximize their performance in their chosen major.

### 1.4.3 Engineering Honors Program and GradStart

The University Honors Program has always been available to students in the College of Engineering. However, it was not designed to meld well with the requirements of the undergraduate engineering programs and students who wished to graduate with University Honors often were required to take additional courses beyond their degree requirements. Working in close cooperation with the University Honors Program, the College of Engineering introduced an Engineering Honors Program in the winter semester of 2005.

Students may concurrently earn Engineering and University Honors by completing 24 credits of honors-designated courses, including:

- HON 42XX – Honors Seminar in an area that satisfies a general education requirement (VP, HS, AI or FC) (3 cr)
- BE 2550 – Basic Engineering IV: Numerical Analysis and Computer Programming, Honors Section (3 cr)
- BE 5999 – Engineering Honors Thesis (4 cr)
- Departmental-designated honors design course (4 cr)
- 10 additional honors credits of the student’s choice; courses selected from Engineering, math, or science courses may satisfy degree requirements

\(^1\) Students whose placement test results qualify then to start in CHM 1225 or ENG 1020 are not required to complete the lower level chemistry or English courses. However, they must complete the remaining course set with a 3.0 or higher gpa.
To qualify for the Honors Program, students must have a 3.5 entering grade point average and must maintain this cumulative gpa throughout their Engineering studies.

In addition to the Honors Program, the College of Engineering has developed a program to support its top students who are interested in pursuing advanced graduate work in Engineering. GradStart accepted its first students in Fall 2005. This program, for incoming freshmen, provides a select number of students with opportunities to develop expanding research capabilities and projects throughout their undergraduate career. By rotating through research labs, students gain exposure to numerous research areas within their major area of study. These students are also promised a graduate assistantship for their first year of doctoral study in the Engineering doctoral program of their choice at Wayne State as long as they maintain a minimum of a 3.5 undergraduate gpa. This program is designed to provide a jump start on the doctoral program for top students while attracting and retaining them in the College of Engineering at Wayne State.

1.4.4 Core Engineering Program

For over 25 years, the undergraduate programs in the College of Engineering have included a common core program in computer programming, materials science, probability and statistics, and numerical methods. It was identified in 2003 that these courses were not continuing to provide a sufficiently developed link to the outcomes of the undergraduate degree programs. Through the Academic Operations Committee (AOC), the faculty of the College began a process to explore the objectives of these courses as they relate to each department’s undergraduate program outcomes.

During the 2003-2004 academic year, the AOC worked to develop lists of common outcomes that all engineering students were expected to demonstrate by the time they graduated. These common outcomes were then used as the basis for development of a revised core engineering program under the Basic Engineering designation. The four course sequence that was developed to provide students with the following experiences:

- **BE 1200 – Basic Engineering I: Introduction to Design in Engineering**
  - Introduction to design
  - Introduction to the development of algorithms
- **BE 1300/1310 – Basic Engineering II: Materials Selection for Engineering Applications and Laboratory**
  - Understanding of the structural basis for material properties
  - Experimental techniques to examine the properties of materials
- **BE 2100 – Basic Engineering III: Probability and Statistics for Engineering Applications**
  - Application of probability and statistics to problems in engineering analysis, design, and manufacturing
The new course formats were first implemented during the Fall 2004 semester, and as of May 2006 had been offered for five consecutive semesters. A committee was established for each course to oversee the annual assessment process, consisting of all faculty whom departments nominate to teach the course as well as departmental faculty representatives from those departments that do not provide a faculty member to that course. A summary of the course objectives and their relationship with general program outcomes (Criteria 3a-k), as well as the assessment processes, are described in the appropriate portion of sections 2.3 and 2.4, below. Detailed information on this process is provided in the course binders for these courses, available on site. The BE course sequence provides foundational skills, knowledge, and experience related to a number of the general program outcomes. However, as they do not relate to any specific discipline, each program’s assessment of its outcomes is typically independent of the assessment processes in these courses.

1.4.5 Engineering Laptop Mandate Program

The computer has become as important a tool for the next generation of engineers as the slide rule was to those practicing engineering prior to the 1970’s and the scientific calculator has been over the past 30 years. Recognizing that continual use of computer-based tools is the best way to improve student comfort and ability, the faculty of the College of Engineering have determined that it is important for every undergraduate student in the engineering programs to have continual access to a computer, both inside and outside of class. Requiring students to have a laptop computer was determined to be the most realistic way to provide this continual access to advanced computer hardware and software.

Once this goal was established, different mechanisms to ensure that all students have access to appropriate computer technology were investigated. A lease program was selected over a student purchase program for two main reasons:

- Ability to ensure that students had up-to-date technology throughout their academic programs, which typically last 5-6 years
- Ability to provide students with software through College licensing agreements

The Laptop Mandate will be phased in beginning in Fall 2006 with the following time table:

- 2006-2007: Students enrolled in BE 1200 and BE 1300/1310

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2 BE 2550 is not required for BSCE students.
- 2007-2008: Students enrolled in BE 1200, BE 1300/1310, BE 2100, and BE 2550
- 2008-2009: Students enrolled in previous list of courses or one of a list of departmental professional-level courses to be selected over the next two years

The College has selected a convertible notebook computer so that students may utilize the system for standard software applications as well as course note taking and design brainstorming. All laptops will be equipped with software packages to be used throughout the undergraduate programs, including MSOffice, MATLAB, an NQC compiler, NX, TeamCenter, MiniTab and analysis packages appropriate to each undergraduate program.

The Engineering Computer Center is working with faculty to develop instructional techniques to fully integrate the tablet and notebook technologies into the classroom. The impact of the laptop program on the undergraduate educational programs will be evaluated through modified assessment tools to be developed during the Fall 2006 semester.

1.4.6 PACE Partnership
On June 1, 2006, the College of Engineering was notified that it had been selected as one of the last two colleges of engineering in the US to join the international PACE Partnership. This program, developed by GM, Unigraphics, EDS, and Sun Microsystems, works with engineering and design programs to integrate product cycle management concepts and tools into the curriculum. Through participation in this partnership, the College faculty plan to develop increased multidisciplinary and project-based educational opportunities over the next few years in order to better prepare graduates for the challenges they will face in the modern, global engineering economy. (Please note that this partnership will not be publicly announced until 2007, following procedures established by GM and PACE.)

1.4.7 Engineering Development Center
Slated for groundbreaking during the Fall of 2006, the University has committed to the construction of a new, 80,000 square foot Engineering Development Center (EDC) to be physically connected to the current Engineering Building. While a significant portion of the three story building will provide additional research space in the areas of smart sensors, nanotechnology, and advanced propulsion, substantial space has also been allocated to support student teaming. This includes the 1650 square foot PACE Center, which will feature teaming workstations to support many project-based classes, and a 5900 square foot student design project space, including student garage, machine shop, and organization offices. The entire EDC and the student spaces of the current Engineering Building will be outfitted with wireless internet access, allowing students to use their laptops to access on-line tools for engineering and research throughout the College.

1.4.8 Civil Engineering Developments
Since the last ABET accreditation visit in 2000, the Department has continued to deliver its undergraduate curriculum to its students with a high commitment to excellence. The chair and the faculty have regularly examined and discussed those matters pertaining to ABET accreditation (e.g., educational objectives, program outcomes, and assessment tools and processes) at faculty meetings and retreats. E-mail communications have been used to solicit input, obtain information and gather assessment data from the faculty. Regularly scheduled meetings with the CEE Advisory Board have complemented these efforts. Feedback has been routinely sought from our students. Necessary adjustments have been identified and corrective measures implemented. Two major curriculum changes were adopted effective in Fall 2004. The first one was the rearrangement of the Basic Engineering component of the curriculum, i.e., the BE courses. This was handled at the College level. BE 1010 (Introduction to Computers in Engineering) and BE 1100 (Introduction to Engineering) were dropped out of the curriculum, while a new required course, BE 1200 (Basic Engineering 1: Design in Engineering) was instituted as a replacement. Changes were also made in other required BE courses, namely BE 1300/1310 (Science of Engineering Materials I and Lab) and BE 3220 (Probability and Statistics in Engineering). The content of BE 1300/1310 course was modified and the title of the course changed to Basic Engineering II: Materials Science for Engineering Applications and Lab. BE 3220 course was revised, renumbered and renamed as BE 2100 (Basic Engineering III: Probability and Statistics in Engineering). Although the CE curriculum was not affected, another BE course was also included in the set of changes made to the BE program. BE 3040 (Numerical Methods) was changed to BE 2550 (Basic Engineering IV: Numerical Modeling and Computer Programming).

The second major curriculum change involved the structural engineering component of the CE curriculum. This change was handled internally by the department. Based on student and instructor feedback, and with the approval of the faculty, the department decided to convert the required three course sequence of CE 4300 (Structures I), CE 4310 (Structures II) and CE 4350 (Design of Steel and Concrete Structures) to a new set of three structures courses: CE 4400 (Structural Analysis), CE 4410 (Steel Design) and CE 4420 (Reinforced Concrete Design). The impetus for this action came from the need to separate the combined steel and concrete design course into two individual and independent design courses. There was consensus amongst the faculty teaching CE 4350, as well as students taking it, that the current format under which both steel design and reinforced concrete design were included in a single four credit hour course was too ambitious, i.e., time constraints limited adequate depth of coverage of both topics. The problem was discussed amongst the structures faculty and information was collected to examine how civil engineering programs at other institutions around the country were handling similar courses in the structures area. After thorough review of the available information, the faculty decided that both determinate and indeterminate structural analysis could be taught more effectively in a single course if appropriate software were available to support coverage of the material. This approach was consistent with that adopted at several other institutions and was considered to be the format best-suited for the CE program at WSU. As a result, a new course emphasizing structural analysis was developed with appropriate supporting software. The course was then integrated into the
curriculum. Since this change, feedback from both students and faculty suggests that both steel design and reinforced concrete design are now covered more effectively than before.

Finally, a relatively minor change to the curriculum occurred when UGE 1000 (Information Power) was eliminated. This decision was made by the Wayne State University General Education Committee. The course was dropped altogether by the University. The impact on the CE curriculum was to reduce the total credits required for the BSCE degree from 133 to 132.

Between the last ABET accreditation visit and the Fall semester of 2005, the department has maintained stability with respect to the continuity of faculty positions and their roles. As we entered the Fall semester of 2005, we received devastating news that Dr. Kagawa was fatally ill. At about the same time Dr. Yesiller resigned her position when her husband accepted a faculty position in the state of California. This created a temporary void in the geotechnical component of our program, which was subsequently filled by Dr. Mahmoud El-Gamal, a part-time faculty. A search was then undertaken to fill one of the vacant positions effective Fall 2006. The search culminated with an offer being extended to an assistant professor candidate in the transportation area. The other position is expected to be filled by the 2007/2008 academic year, with the search process to be initiated in 2006/2007.

The department has continued to grow in size, acquiring new physical space in 2002 dedicated to the educational and research activities of the Transportation Research Group. The department has also developed plans to acquire new laboratory space for traffic simulation and advanced composites testing and evaluation in the Engineering Development Center (EDC) Building. Details are provided in the discussion of Facilities (Section 2.8) later in this report.

1.5 Contact Information

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2. Accreditation Summary

2.1 Students

2.1.1 Admission

All students eligible for admission to the University are also eligible for admission to the College of Engineering. As a result of Wayne State University’s urban mission, one of the governing principles of the university’s admissions process is to be a “university of opportunity” to students from the southeastern Michigan region. Therefore, the university has a rolling admissions policy so that qualified students may be admitted through the beginning of the semester in which they wish to enroll. In addition, minimum admission standards have been set by the university at a level to provide students with the best opportunity to pursue a university-level education. Students must meet one of the following criteria for admission to the university’s undergraduate programs:

- High school grade point average of 2.75 or above
- High school grade point average of 2.0 or above with composite ACT score of at least 21
- Transfer of at least 12 credits of college-level coursework with a college grade point average of 2.0 or above

In order to provide appropriate academic advising, it has been determined by the faculty and administration of the College of Engineering that students interested in engineering should be admitted directly to the College. Thus, all pre-engineering programs are currently housed within the College of Engineering. While recognizing the importance of working within the admissions framework established by the university, the Engineering faculty have also noted that many students who are both eligible for admission and interested in engineering may not be prepared to begin the engineering pre-professional program. As a result, a multi-tiered admissions structure has been established for the College.

Professional Engineering Program: A small number of freshmen and a significant number of transfer students are admitted directly to the professional engineering program of their choice. Requirements for direct admission include:

- Freshmen:
  - 3.5 minimum cumulative high school gpa, overall and in science and math courses
  - Minimum Math ACT score of 26 (SAT Math of 650)
  - Placement into MAT 2010 (calculus 1), CHM 1225 (general chemistry), and ENG 1020 (basic composition) or above
- Transfer students:
  - 3.0 cumulative college gpa, overall and in science and math courses
Completion of equivalent of MAT 2010, 2020, 2030 (calculus 1 to 3); CHM 1225/1230 (general chemistry with lab); PHY 2175, 2185 (general physics); and ENG 1020 (basic composition) with no grade lower than a C

Direct admission to the professional program provides top students with a small amount of added flexibility in the scheduling of their classes and their proficiency exams.

Students who progress through the pre-professional program (see below) must earn a minimum of a 2.5 cumulative grade point average in the pre-professional courses to advance to the professional program of their choice. Students directly admitted to the professional program must maintain their grade point average above the 2.5 level or they will be moved back down to the pre-professional program and will be required to meet the general requirements for advancement to professional status.

Pre-Professional Program: In order to be admitted to the pre-professional engineering program, students must meet one of the following criteria:

- Freshmen:
  - 3.0 minimum cumulative high school GPA, overall and in science and math courses
  - Minimum Math ACT score of 22 (SAT Math score of 550)
  - Placement into MAT 1800 (pre-calculus), CHM 1225 (general chemistry), and ENG 1020 (basic composition) or above

- Transfer students:
  - 2.5 minimum cumulative college GPA overall, 3.0 minimum in science and math courses
  - Placement into MAT 1800 (pre-calculus), CHM 1225 (general chemistry), and ENG 1020 (basic composition) or above based on transfer credit or placement examinations
  - Completion of at least 12 credits at the college-level

Pre-professional students must complete the following sequence of courses, either at Wayne State or through accepted transfer credit, with a minimum grade point average of 2.5 in order to advance to the professional program of their choice:

- Math: MAT 2010, 2020, 2030 (calculus 1 through 3)
- Chemistry: CHM 1225/1230 (general chemistry with lab)
- Physics: PHY 2175, 2185 (general physics – ECE students must also complete PHY 2171, general physics lab)
- English: ENG 1020 (basic composition)
- Basic Engineering: BE 1200 (Introduction to Design), 1300/1310 (materials science with lab)
- Departmental pre-professional courses: CE 2400

3 Students who meet all other requirements for admission to the pre-professional program but who have placed into no more than one lower level course in English (ENG 1010) or chemistry (CHM 1040) will be provided with a waiver to start in the pre-professional program.
In addition to this coursework, students must satisfy the University’s English proficiency and Critical Thinking proficiency requirements (through either examinations or coursework) before advancing to the professional program.

Engineering Bridge Program: Students who are admissible to the University but who do not meet the minimum standards for the Engineering pre-professional program are admitted to the Engineering Bridge Program. These students must complete a one-year program of math (algebra and pre-calculus), science (chemistry and physics), English, and pre-engineering courses with a minimum grade point average of 3.0 in order to progress into the pre-professional program of their choice. This minimum grade point average has been set to be equal to the level expected from students entering directly from high school with these same courses. Students who do not meet these requirements after the completion of the one-year program are counseled to select a program other than engineering in order to meet their professional goals.

2.1.2 Degree Requirements

Successful completion of a BS degree in Civil Engineering requires that students complete the 132 credit-hour curriculum as published in the University Catalog and CE Department website (http://www.eng.wayne.edu/page.php?id=401) with a minimum HPA of 2.0 overall and a minimum HPA of 2.0 in all courses comprising the professional program in civil engineering.

2.1.3 Advising and Monitoring

Academic advising of students takes place at two levels: College and Department. University-level advising of new (freshman) students is very limited and is mainly of a general counseling nature. College-level advising has historically represented the main component of academic advising and is conducted through the centralized Undergraduate Advising Office and under the direction of the Associate Dean for Academic Affairs. Under this arrangement, an undergraduate advisor position has been allocated to the CEE Department. However, the arrangement to date has been such that this individual has shared her duties with Mechanical Engineering, Industrial and Manufacturing Engineering and Electrical Engineering (at different periods). The CEE Department has not experienced continuity in this position. With the exception of a brief period at the end of 2005 and beginning of 2006, the department has not had an advisor since August 2005. All undergraduate advising during this period has been handled by the Department Chair with assistance from the Associate Dean for Academic Affairs and her staff. The CEE Department has been promised a dedicated full-time advisor by the Dean. This person is expected to be hired by Fall 2006.

It is the philosophy of the College advisors to empower students to be aware of the policies and requirements of their program, while providing a support system that is always present to assist students and answer questions. The *College of Engineering Pre-Professional Handbook* has been developed to provide students with more detailed
information on College policies than is provided in the Undergraduate Bulletin. It can also be updated more readily than the two-year revision schedule allows for the Undergraduate Bulletin. The Pre-Professional Handbook is available for download from the College’s web page and is provided to all incoming students who attend Engineering Orientation. Departments have also been encouraged to develop Undergraduate Handbooks that outline the program of study and any department-specific policies.

Under the current system, the designated undergraduate advisor is assigned responsibility for handling student counseling, curriculum monitoring, record keeping, information management, and degree certification for all CE students. It is the responsibility of the undergraduate advisor to review and track the progress of each student in the program, enter transfer credit information in the student records, and to provide advice to students in regard to course load and course sequence in planning for registration during future semesters.

While the advisor reports to the Associate Dean, he/she works closely with the Department Chair. The Chair makes final decisions on several issues, including the transferability of credits for CE courses (in consultation with the CEE faculty and based on available information pertaining to the courses in question), occasional prerequisite waivers for CE courses, and release of academic holds placed on students demonstrating substandard performance. These decisions are made after careful consideration of each student’s progress since the previous semester, academic load proposed for the next semester, and other pertinent factors. Members of the CE faculty are normally not involved in academic advising from the standpoint of curriculum monitoring and record keeping. However, faculty members do contribute considerable curriculum and career counseling on a one-on-one basis with students.

The Department has undertaken steps to dramatically improve advising of its undergraduate students. Advising has been identified as an area of concern within the CE program based on feedback received via the annual senior student exit survey (Appendix I-E and on-site Exhibit 2). Students have expressed concern and frustration over their inability to obtain helpful, accurate advising in a timely manner under the existing system within the CE Department. The Chair established a Civil and Environmental Engineering Advisory Group composed of undergraduate students representing different years of academic standing. Previous feedback obtained from this group indicated that a main advising issue was the personality and performance of the individual assigned as advisor for civil engineering students. As a result of administrative level evaluations, this person was terminated effective August 2005. The decision was largely driven by a need to address the advising issue pointed out by students. The CE Undergraduate Assessment Committee (UPAC) has further discussed this issue and developed a recommendation to address the problem. The recommendation was presented to the entire faculty at a spring 2005 faculty meeting, approved at that meeting, and an attempt was made to implement it in the 2005/2006 academic year. Effective August 2005, all undergraduate CE students who have met College and Departmental academic requirements for advancement to the professional program (upper-division) were assigned a faculty advisor, i.e., a member of the full-time faculty to advise and mentor the student throughout the balance of his/her
undergraduate program. Each student was expected to meet with his/her faculty advisor at least once per year, with additional meetings to be held at the request of either the student or his/her faculty advisor. The first trial of this initiative produced mixed results. The response from students to e-mails sent to them directly by faculty was quite weak. However, those students who did follow up and meet with their faculty advisors/mentors established useful dialogs that provided them with answers to a range of difficult questions, including insights into different aspects of their future careers as civil engineering practitioners. At the same time, faculty members serving as advisors/mentors received valuable feedback from students that could be later shared with the rest of the faculty. Original e-mails documenting specific details of this program are provided in on-site Exhibit 7. We believe that this program has the potential to ultimately become a very beneficial component of our overall undergraduate program from the perspective of both students and the department as a whole. As a result, we will make adjustments to our previous approach based on feedback from student representatives/leaders and then re-launch the mentorship program in Fall 2006.

In addition to the aforementioned efforts to improve advising, the CE Department has also initiated a student – faculty luncheon and Town Hall meeting each academic year. This new activity was held during the second or third week of the winter semester to foster interaction and communication between faculty and students outside the normal classroom environment. The event promoted an enhanced comfort level and sense of belonging for students, helped faculty learn about a range of student opinions and concerns regarding the undergraduate program, and reminded students of the importance of meeting with their academic advisor whenever they have questions, need advice, or simply want to share their thoughts and opinions regarding the program and their own academic progress.

The College of Engineering monitors the academic progress and standing of all students in the Engineering Bridge Program, pre-professional program, as well as students admitted directly into the professional program but who have not yet begun taking CE courses.

At the end of each semester, advisors review student records and contact those students who are on academic probation (gpa < 2.0) or who have received substandard grades (D+ or below) in any of their courses. At this time, the student is reminded of the College policies regarding repeated courses, substandard grades, and multiple semesters on probation. Advisors also provide students with information on resources available to help them succeed academically – including tutoring and the Academic Success Center. Students who are on probation for a second semester or who are at risk of exclusion based on an excessive number of substandard grades are referred to the Associate Dean for Academic Affairs for a meeting.

There are a number of monitoring mechanisms in place to prevent students from straying too far from their intended academic path. First, the College of Engineering is the first unit within the University to implement automatic prerequisite checking through Banner at the time of registration. Students are not allowed to register for the next course until
they have satisfactorily completed (C- or higher) the listed prerequisite courses and any implied prerequisites (a prereq to a prereq). Any student who wishes to receive a waiver on a prerequisite must submit an **Academic Petition** to the department teaching the course, justifying why they feel an exception should be made.

Second, students are prevented from registering for professional-level (3000-level or above) engineering courses until they have advanced to the professional program of their major. This allows advisors to verify the academic progress of all students at a mid-point in their curriculum, including completion of University-required proficiency exams. Students who wish to take professional courses before completing all pre-professional requirements must submit an **Academic Petition** to their home department justifying why they feel an exception should be made.

Finally, all department advisors have selected a professional-level course within their department as a key time point for conducting a degree audit. Typically taken during the junior year, this course provides an additional opportunity for advisors to review a students’ progress towards their degree and determine what requirements remain. **Degree audit forms** have been developed and are available on the College web site ([www.eng.wayne.edu](http://www.eng.wayne.edu)) for students to track their own degree progress as well.

At the time students begin to take CE courses (usually at the outset of their junior year), the College continues to monitor academic progress in coordination with the department chair. Monitoring of each student’s academic program is done via the computer-based Student Tracking Advising Retention System (STARS) database ([https://www.stars.wayne.edu/default.htm](https://www.stars.wayne.edu/default.htm)) in accordance with the CE curriculum as published on the CE web site ([http://www.eng.wayne.edu/page.php?id=401](http://www.eng.wayne.edu/page.php?id=401)). This system grew out of efforts in the College of Engineering to develop a user-friendly interface for obtaining student academic information. STARS allows academic advisors, records officers, and program directors to easily access complete student academic data (grades, transfer credit, General Education completion, test results) and document advising contacts. All requests for policy waivers, whether granted or not, are documented within STARS for future reference. Several reports used for student monitoring and retention are also available through the STARS interface, which is easier to use than Banner and E-Reports.

Letters are sent to students when it is determined that they have skipped one or more semesters or are experiencing academic difficulty. When all curriculum requirements are satisfied, degrees are certified by the undergraduate program advisor with final approval from the Department Chair.

All students who expect to graduate in a given semester must submit an Application for Degree through the University Records Office prior to the end of the 4th week of the semester. The list of degree applicants is provided to the College of Engineering Records Office and forwarded to the academic advisors of each department for review. Once final grades have posted for the semester, each degree applicant’s record is reviewed in detail by the academic advisor to ensure that all degree requirements (university, college, and
department) have been met. Any waivers that have been granted (replacement of courses, transfer waivers, general education waivers, etc.) are confirmed through the STARS contact records for that student. The degree is then certified by the academic advisor and forwarded to the University Records Office or the student is notified of the deficiencies in their record that must be cleared before a degree can be awarded.

2.1.4 Transfer of Credit

The College and the University have a well-established process for the evaluation of transfer credit. The first time a course is presented for evaluation for transfer equivalency, the student is asked to provide the course description, as a minimum, to the Transfer Evaluation Office so that it can be forwarded to the department that teaches that subject at Wayne State. The course description is evaluated for equivalency and, if more information is required, the student may be asked to provide the complete course syllabus. The teaching department may assign an exact equivalent (e.g. MAT 2010) or a general elective equivalent (e.g. HIS 2XXX) for the course. If a course is not found to be of adequate academic rigor to be equivalent to university-level work, a transfer equivalency may not be assigned.

Once a course is evaluated, it is noted in the University’s transfer equivalency tables (www.transfercredit.wayne.edu) for easy evaluation by current and prospective students, advisors, and faculty. Future students who submit transcripts containing these courses will automatically be awarded the appropriate transfer credit. If courses at transferring institutions are found to change with time, the equivalency may be given start and end dates. The University works closely with the surrounding community colleges to keep the transfer equivalencies up to date and accurate.

Transfer credit is awarded to a student only based on an official transcript provided from the institution that taught the course originally. Thus, Wayne State will not accept transfer of transfer credit. Students in the College of Engineering must earn at least a C in any technical course (science, math, engineering, or prerequisite) that they wish to transfer in and apply towards their degree. (As of Fall 2006, this C requirement will also apply to all sociohumanistic courses that students wish to transfer in and apply to their degree requirements.) In general, departments will not accept for transfer any engineering course at the 4000-level or above.

Once an engineering student has matriculated at Wayne State, he must request permission from the College of Engineering to complete any coursework at another institution. This permission must be obtained prior to registering for the course. Except under exceptional circumstances, permission is not granted for technical courses (math, science, engineering, or prerequisite). Such permission must be sought by a student using an Academic Petition that is submitted to the Associate Dean for Academic Affairs (pre-professional and basic engineering courses) or their program’s undergraduate director (departmental courses).
2.1.5 Mentoring

Although mentoring of undergraduate students has historically lacked a systematic framework within the civil engineering program, the Department and its faculty routinely communicate with students outside of the classroom and encourage them to take advantage of an open door policy for discussing any issues or problems they encounter. Responses to our senior exit survey conducted in the spring of 2005 and 2006, summarized in Appendix I-E of this report, indicates that students are very satisfied with the availability of faculty and their willingness to serve as mentors. Nevertheless, in spite of this positive feedback regarding mentoring of students, the Department feels strongly that a more structured system is needed. As a result, the mentoring framework discussed previously in Section 2.1.3 was implemented. The Chair assigns a member of the full-time faculty to mentor each of our undergraduate students once they have entered the professional program in civil engineering (juniors and seniors). The system was initially designed to have each faculty member contact a specific set of students via email for the purpose of scheduling a future mentoring meeting. During that meeting the student has an opportunity to ask questions, request advice, discuss problems or express concerns regarding his/her academic progress, curriculum issues, future employment opportunities, or anything else pertaining to the civil engineering program in general or the civil engineering profession in particular. Unfortunately, the initial student response to this program was weaker than anticipated, perhaps in large part because students frequently ignore their University email accounts in favor of their own personal accounts. As noted previously, we will study the issue after obtaining student feedback and then make another attempt to do it better and more effectively next year (2006/2007).

2.2 Program Mission and Educational Objectives

2.2.1 CE Program Mission Statement

The CE program mission statement, as currently posted on the department web site (http://www.eng.wayne.edu/page.php?id=4410), is as follows:

*The mission of the Civil and Environmental Department is to provide high quality, state-of-the-art educational and research programs. The Department strives for excellence in its academic programs, its research endeavors, and its university, community and professional service activities. The program is designed to prepare our graduates for success in their immediate, as well as long-term, professional careers as practitioners, for obtaining a professional license, and for pursuing advanced studies and life-long learning.*

The CE program mission is consistent with the unique urban mission of Wayne State University and its College of Engineering. The program seeks to recruit, retain and ultimately graduate students reflecting a diverse set of cultural, educational and economic backgrounds. Many of our local students live at home and commute to and from campus. Most students work either part-time or full-time while pursuing their BSCE degree. The CEE Department maintains an awareness and sensitivity to these factors in designing its
academic program, scheduling courses, placing several students in summer internships with local businesses, mentoring students to help them confront and overcome obstacles, and preparing our graduates to understand and meet future challenges as effective civil engineering practitioners.

2.2.2 Constituencies of the Program

The Department’s assessment activities involve regular collection, review and interpretation of feedback from a number of constituencies, including current students, CEE Advisory Board members, alumni, and faculty members themselves. The CE Assessment Plan presented in Section 2.4 describes the involvement of specific constituencies within various phases of the plan. Feedback from constituencies is obtained via the following mechanisms:

- **Students.** Senior student exit surveys (Appendix I-E and on-site Exhibit 2); Student Evaluation of Teaching (SET) results (on-site Exhibit 5); surveys of course learning objectives; annual advising and mentoring meeting with faculty advisor; impromptu meetings with department chair or faculty advisor; meetings between the Department Chair and the Civil and Environmental Engineering Student Advisory Group.

- **Advisory Board Members.** Annual fall and spring meetings; CEE Advisory Board Feedback Survey (Appendix I-D and on-site Exhibit 1). A full membership list is available in Appendix I-C.

- **Alumni.** College survey of alumni for each department (on-site Exhibit 3).

- **Faculty.** Course Assessment Reports (on-site Exhibit 5); annual spring faculty retreat; regular faculty meetings held during the academic year; meetings of the CE Undergraduate Program Assessment Committee (UPAC).

**CEE Advisory Board:** The CEE Department maintains an active advisory board consisting of civil engineering practitioners from a diverse cross-section of companies and agencies located within southeast Michigan. The Department has historically worked closely with the board to foster meaningful exchange and interaction regarding curriculum issues and assessment of student learning, including written and oral communication skills. The Department Chair schedules two meetings of the advisory board each academic year. The fall meeting typically focuses on emerging curriculum issues, faculty research projects and fund-raising. Faculty and board members have the opportunity to discuss a range of important topics, many of which relate to needs, improvements and the future direction of the undergraduate program. At the spring advisory board meeting, graduating seniors make team presentations of their capstone design projects. Members of the CEE Advisory Board and the civil engineering faculty have an opportunity to review and critique the final written design project reports submitted by each team. They also listen to oral presentations from individual members of each design team. After the oral presentations have concluded, board members and
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faculty ask students from each team a series of questions pertaining to the design details of their respective projects. This activity provides valuable insight into how well students are able to comprehend and effectively respond to spontaneous questions from a technical audience, especially practitioners familiar with engineering tools and methods applied in the team projects. At the conclusion of the question and answer period, advisory board members are asked to fill out a survey form reflecting their opinions of how well students demonstrated proficiency in different areas of civil engineering based on the content of their written reports and oral presentations. A summary of this feedback for 2005 and 2006 is presented in Appendix I-D. Specific feedback from the survey is discussed at length in subsequent sections of this report.

2.2.3 Fundamental Terminology

Before pursuing an in-depth discussion of the CE undergraduate program and its ongoing assessment, it is helpful to clearly define the meaning of a few key terms used throughout this self-study report. Following is a set of specific definitions for those terms:

**Educational Objectives** describe the expected accomplishments of graduates from the civil engineering program within the first few years of graduation. They are written, approved and publicized for external constituencies (e.g., prospective students and their parents, graduate programs, employers).

**Program Outcomes** describe what all students are expected to know, do, or think at the time of graduation. Program Outcomes must, at a minimum, embrace ABET 2000 Criterion 3 a) – k) as well as an additional criterion l) specific to a civil engineering undergraduate program.

**Course Learning Objectives** describe what students who complete a specific course should be able to do (explain, calculate, derive, design, etc.). Course learning objectives relate to and support Program Outcomes.

**Assessment Measures** are measures used to collect data/evidence necessary to assess how well Course Learning Objectives and Program Outcomes have been met. For assessing effectiveness in meeting Course Learning Objectives, assessment measures include: answers on exams and quizzes; individual or team projects, reports and presentations; student surveys; faculty observations; or other appropriate sources of information. For assessing how well individual Program Outcomes are met, assessment measures include student exit surveys, alumni surveys, Advisory board feedback, cumulative and integrated results from review and analysis of Instructor Course Assessment Reports, as well as other sources of relevant information that may be identified.

**Benchmarks** are thresholds used to define whether or not course-level Learning Objectives have been satisfied (or how well they are satisfied).
From the standpoint of understanding relationships among these terms as they pertain to overall program assessment, the following explanation is provided. Educational objectives should ultimately be achieved as a result of a student successfully completing the civil engineering undergraduate curriculum. Assessing the extent to which Educational Objectives have been met is based on evidence reflecting student performance as a civil engineering practitioner within a few years of graduation with his/her baccalaureate degree. The curriculum, in turn, is designed to satisfy a set of thirteen Program Outcomes closely linked to ABET criteria a) – j). These Program Outcomes, as defined in Section 2.3.2, each support one or more of the Educational Objectives presented in Section 2.2.4. Therefore a student successfully graduating from the CEE Department will have completed an undergraduate program which satisfies all Program Outcomes and hence ABET criteria a) - j). Satisfaction of Program Outcomes is in large part determined by the degree to which course learning objectives are met within individual courses comprising the undergraduate curriculum. Accordingly, the CE Department’s Assessment Plan emphasizes evaluation of how effectively:

- Individual course learning objectives are achieved by our students
- Program Outcomes are satisfied via successful completion of the curriculum and thus achievement of course learning objectives reflected by the curriculum
- Educational Objectives are achieved as a result of a student’s successful completion of the civil engineering curriculum and all Program Outcomes it effectively supports.

Figure 1 provides a general overview of the assessment framework used by the Department of Civil and Environmental Engineering. The assessment process involves continuous collection of direct, measurable data or evidence from program constituents, as well as other more subjective information that is equally important for judging how effectively the undergraduate program is achieving defined Program Outcomes and hence its Educational Objectives. The department seeks to review the evidence on a routine basis, identify areas that warrant improvement, develop practical strategies for achieving such improvement, and ultimately implement and monitor whether or not these strategies have successfully accomplished their intent. Details of this assessment framework and the overall assessment process for the undergraduate program in civil engineering are discussed in subsequent sections of this report.
2.2.4 Educational Objectives of the Civil Engineering Undergraduate Program

The expected attributes of CE students within the first few years following graduation are reflected in the set of educational objectives for the CE program given below.

Graduates of the Civil and Environmental Engineering Program, within a few years of graduation, will be expected to:

1) apply their knowledge and skills as effective, productive civil engineers within private corporations, consulting engineering firms, municipalities, as well as state and federal agencies dealing with analysis and design of modern civil engineering systems and processes;
2) work and communicate effectively with others on multi-disciplinary teams to develop practical, technically-sound, cost-effective solutions to complex and diverse civil engineering problems;
3) maintain an active program of life-long learning and continuing education while practicing civil engineering in an ethical and professionally responsible manner;
4) seek leadership roles as practitioners and become active members within professional and technical societies.

2.2.5 Process to Establish and Review Educational Objectives

Consistent with guidelines set forth in the CE Department’s Assessment Plan (Section 2.4), once every four years the annual spring faculty retreat affords the opportunity for the chair and full-time faculty members to re-visit the Department’s existing Educational Objectives and to revise them if necessary. During that same year, the Department chair devotes substantial time at the spring CE Advisory Board meeting (held a few weeks earlier) discussing the civil engineering program’s Educational Objectives and soliciting feedback from Board members regarding their opinions and suggested modifications. The spring faculty retreat culminates with a final recommendation regarding the CE program’s statement of Educational Objectives and a draft of the specific language if different from that currently in effect. The CE Undergraduate Program Assessment Committee (UPAC) convenes shortly thereafter, usually in early summer, to develop the final language and distribute the program Educational Objectives to the full faculty for final approval.

2.2.6 Achieving Educational Objectives

The extent to which the Educational Objectives of the civil engineering program are achieved is judged based on demonstrated performance and accomplishments of students after they have graduated from the CE program and have been practicing civil engineering for a few years. Information used to assess how effectively graduates have met these objectives comes from a variety of sources. Presently UPAC solicits and reviews feedback from members of the CEE Advisory Board regarding this important issue. Many of our board members represent companies and organizations that frequently hire graduates of our CE program. They are able to provide a fair and candid opinion of student performance a few years after graduation. Their feedback is discussed in greater detail in Section 2.5 of this report. In addition, the committee also reviews and evaluates feedback from alumni surveys conducted by the office of the Associate Dean for Academic Affairs for the College of Engineering. Alumni surveys are designed to provide information regarding how effectively the Educational Objectives of the program were met, the extent of membership in professional societies, involvement in technical committees, participation in community service activities, as well as advancement to PE status and promotion within the organizations for whom they work. A comprehensive discussion of assessment results regarding program Educational Objectives is presented in Section 2.5 of this report.
2.3 Program Outcomes

2.3.1 Relationship of Program Outcomes to Educational Objectives and ABET Engineering Criteria

Program Outcomes outlined in Section 2.3.2 reflect a foundation of knowledge and skills that, if satisfied, provide graduates of the CE program with the tools needed to successfully achieve the Educational Objectives defined above. Program Outcomes have been designed to ensure ABET 2000 criteria a) - k) are successfully met by the CE program. An additional Program Outcome (Outcome l) has been included to address criteria specific to a civil engineering program and its students. Collectively these outcomes serve as a template for designing and improving the curriculum, providing an undergraduate program that meets all ABET criteria for civil engineering, and maintaining an educational focus that emphasizes competence and future professional success for our graduates.

The twelve Program Outcomes defined below were developed and approved by the faculty during the annual spring CE faculty retreat in 2004. The CE Undergraduate Program Assessment Committee collects, reviews, and interprets information drawn from individual courses at the end of each semester, as well as input from constituencies of the CE program, to prepare an annual program assessment update for the Department. The chair and faculty typically discuss the update during the annual spring retreat. It is at this time that any problems or issues regarding Program Outcomes are identified, deliberations undertaken on potential ways to address these issues, and a strategy developed for implementing solutions and monitoring their subsequent impact.

2.3.2 Definition of Civil Engineering Program Outcomes

Following are the Program Outcomes for the CE undergraduate program.

Program Outcomes: Each graduate from the Civil and Environmental Engineering Department will demonstrate the following skills and attributes at the time of graduation:

a) the ability to apply knowledge of mathematics, science and engineering within the framework of solving civil engineering problems, including the analysis and design of structures, transportation systems, water treatment and supply systems, wastewater collection and treatment systems, as well as the geotechnical aspects of each.

b) the ability to design and conduct experiments, as well as collect and interpret experimental data, pertaining to civil engineering systems.

c) the ability to design a civil engineering system, system component or process which meets specific needs.
d) the ability to collaborate, communicate and work effectively with others on multi-
disciplinary teams.

e) the ability to identify, formulate and solve a range of civil engineering problems.

f) an understanding and appreciation of professional and ethical responsibility in the
practice of civil engineering.

g) the ability to communicate effectively in both written and oral form.

h) a broad educational background which addresses the importance of global and
societal factors as they affect and are affected by civil engineering systems.

i) an understanding of the importance of life-long learning and continuing education.

j) an understanding of important contemporary issues within and outside the civil
engineering profession.

k) the ability to use the techniques, skills and modern engineering tools required for
the practice of civil engineering.

l) an understanding of civil engineering professional practice issues such as:
procurement of work, bidding versus quality-based selection processes, addressing
public safety concerns in project design, how design professionals interact with the
construction profession to construct a project, the importance of professional
licensing and continuing education, and/or other professional practice issues.

UPAC’s assessment of how effectively each of the aforementioned Program Outcomes is
being satisfied is presented in section 2.5.2.

2.3.3 Program Outcomes and Course Learning Objectives

Core Engineering Program
The common program of core (basic engineering) courses provides fundamental skills,
knowledge, and experience in key areas that support the program objectives and are later
applied in more advanced, departmental courses. In particular, the course sequence
supports the general program outcomes (3a-k) as listed below:
<table>
<thead>
<tr>
<th>General Program Objective</th>
<th>BE 1200</th>
<th>BE 1300/1310</th>
<th>BE 2100</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(c) 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 sustainable</td>
<td></td>
<td>*</td>
<td>+</td>
</tr>
<tr>
<td>(d) an ability to function on multi-disciplinary teams</td>
<td></td>
<td>*</td>
<td>+</td>
</tr>
<tr>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(f) an understanding of professional and ethical responsibility</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(g) an ability to communicate effectively</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(i) a recognition of the need for, and ability to engage in, life-long learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(j) a knowledge of contemporary issues</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Mapping of general program outcomes (criterion 3) to core engineering courses. * indicates that the course plays a strong role in the students obtaining the foundational skills, knowledge, and experience necessary to meet the outcomes in future courses. + indicates that the course plays a supporting role in these foundational skills.

The course learning objectives for each of the core, basic engineering courses have been mapped to the general program outcomes (Criterion 3a-k). The specific maps are provided in the course binders and outcome binders, which will be available during the site visit. All four courses include three common learning objectives:

- Identify the ethical issues related to an engineering problem
- Work in multi-disciplinary teams to solve engineering problems
- Identify the societal impact of engineering solutions

The College faculty determined that it was important to interweave these objectives throughout the engineering curriculum, with the core courses being the appropriate place to start.

The basic engineering courses are designed to provide a foundation for many of the general program outcomes, but they are not the sole or final point of assessment for those
outcomes. Therefore, departmental assessment of outcomes is generally independent of
the assessment of the core courses.

Civil Engineering Program
Members of the civil engineering faculty are responsible for preparing a set of learning
objectives for each required civil engineering course within the undergraduate
curriculum. At the conclusion of the semester, each instructor completes a course
assessment report providing a comprehensive description and assessment of how
effectively each learning objective was achieved by students. Course assessment reports
are discussed at greater length in sections 2.4 and 2.5. A complete set of assessment
reports for all core undergraduate civil engineering courses offered during the Fall 2004,
Winter 2005, Fall 2005, and Winter 2006 semesters is provided as on-site Exhibit 5.
Appendix I-F contains the course assessment report for the Winter 2006 offering of CE
4210 (Introduction to Environmental Engineering).

There are two exceptions to the completeness of the set of course assessment reports in
on-site Exhibit 5. The first one is CE 4420 (Reinforced Concrete Design), which was
offered for the first time in Fall 2005 (see Section 1.4 where changes in the structures
component of the undergraduate curriculum are described). The second one is CE 4450
(Civil Engineering Materials) which was offered by a faculty member who resigned and
left the department effective December 2005. It was not possible to obtain a course
assessment report from this faculty member. However, henceforth there should be no
problems in obtaining complete course assessment reports for either of these courses. CE
4420 will now be regularly taught every Fall semester, whereas the new instructor
assigned to teach CE 4450 will be properly trained to perform this task.

Course learning objectives are intended to support one or more of the twelve Program
Outcomes. By mapping individual Course Learning Objectives to the appropriate
Program Outcomes they support, UPAC can determine the extent to which any given
Program Outcome is emphasized within the undergraduate curriculum and identify any
gaps or weaknesses that need to be addressed. Course learning objectives are mapped to
Program Outcomes and results used to identify areas of relative strength and weakness, as
well as to begin the process of developing, implementing, and monitoring strategies
designed to improve the CE program, i.e., “closing the loop”.

2.4 Assessment Plan

The CE Department has implemented an assessment plan to ensure that the
undergraduate program achieves its Educational Objectives and satisfies ABET 2000
criteria. The assessment plan involves collection, review and analysis of data/evidence
reflecting how effectively Program Outcomes are supported by the curriculum. It also
involves identification of program strengths and weaknesses, formulation of strategies to
correct areas of weakness and maintain areas of strength, and finally implementation and
follow-up monitoring of the strategies adopted to improve the program. The assessment
plan relies upon feedback from all program constituencies, including faculty, students, advisory board members, alumni and some employers of our graduates.

2.4.1 Assessment Plan Overview

Core Engineering Program
The assessment process for the basic engineering courses is generally independent of the assessment of the program outcomes. However, as the courses provide a common set of foundation skills, knowledge, and experience, their assessment is equally important. Many of the departmental courses build on the skills and knowledge that should be gained by students in the four-course sequence. All core engineering courses are taught by a team of faculty, typically drawn from multiple departments. It is imperative, however, that the courses address the same learning objectives each semester and in each section so that faculty can have a consistent foundation on which to build in program courses.

Assessment of the core engineering courses is based on a combination of student surveys on learning objectives and instructor course assessment reports. These instruments mirror those used by the individual programs. Each spring, following the completion of the Winter semester, the team for each BE course meets to review the student survey results, discuss the instructor assessments, and determine what adjustments should be made to the course for the upcoming year. This team includes all instructors for the course as well as departmental representatives from each department that does not provide an instructor to the course pool. The course binders, including assessment materials, for each of the basic engineering courses will be available on-site. Two basic tools are applied for the assessment of learning objectives in the BE courses: student surveys and instructor assessment reports.

Each semester, students are asked to complete a survey indicating whether or not they are able to accomplish the listed course objectives. For course specific objectives, they provide a response on a likert scale, with the following options: 1 – no ability, 2 – some ability, 3 – adequate ability, 4 – more than adequate ability, 5 – high ability. For common BE course objectives (ethics, team work, societal impact), students are asked to indicate whether there is any improvement in their ability using the following scale: 1 – No improvement, 2 – minimal improvement, 3 – slight improvement, 4 – reasonable improvement, 5 – tremendous improvement. In Fall 2004, these surveys were administered in class and on paper. Due to the time required to compile the data from paper surveys, an on-line survey system was implemented for Winter 2005. The negative effect of this has been a reduction in the overall response rate from students, as they are left to determine on their own whether or not to respond to the survey. The College’s mandatory laptop program, to be implemented starting with the BE 1200 and BE 1300 courses in Fall 2006, has been identified as a mechanism to improve student response rates to these surveys. In future semesters, instructors will ask students to log on and complete the survey on-line while they are in the classroom, using their laptops.
Instructor assessment reports provide an equally important mechanism for the evaluation of these courses. Each instructor is expected to complete a report for each semester in which they teach the course, using in-class assessments as well as the student survey results to evaluate whether or not course objectives have been met and reflecting on what adjustments should be made to the course in the future to improve these outcomes.

Civil Engineering Program

The major components or activities of the assessment plan are outlined below, along with program constituents typically participating in each activity and the approximate schedule under which each activity is undertaken.

1. Review Educational Objectives

Involved Constituencies: faculty, alumni, employers, students, CEE Advisory Board members

Comments: Educational Objectives are periodically reviewed to ensure they remain relevant for the profession. Alumni surveys and feedback from the CEE advisory board members provide important input to this component of the program assessment process.

Approximate Frequency: once every 4 years

2. Review program outcomes to ensure the CEE undergraduate curriculum is aligned with our educational objectives and that outcomes are consistent with the requirements of Criteria 3 of the ABET Engineering Criteria.

Involved Constituencies: mainly faculty with some input from alumni, employers, current students, and CEE advisory board members

Comments: The CEE program assessment committee reviews feedback from involved constituencies and determines how effectively our educational objectives are being achieved. Program outcomes are also reviewed and opportunities to improve the curriculum are identified. Consistency between the CEE undergraduate curriculum, its program outcomes, and the most current ABET criteria are evaluated. The committee considers potential mechanisms to more effectively solicit meaningful feedback from involved constituencies.

Approximate Frequency: once every 4 years

3. Map program outcomes with course learning objectives to show that satisfaction of our course learning objectives will support and ensure that the more broadly-stated program outcomes have been met.
Involved Constituencies: faculty (CEE program assessment committee)

Comments: The CEE program assessment committee meets to review instructor course assessment reports and to identify how historical changes or modifications to course learning objectives have impacted coverage of our program outcomes. A revised matrix of program outcomes vs. course learning objectives is prepared. Results are discussed at a day-long faculty retreat focusing exclusively on program issues pertaining to ABET.

Approximate Frequency: Once every two years

4. Review matrix of program outcomes vs. course learning objectives. Identify existing information gaps or weaknesses in data/evidence to support assessment of program outcomes and their respective performance criteria. Define additional data/evidence needed to fill these gaps and specific measures for generating the data or evidence in the future.

Involved Constituencies: CEE program assessment committee, CEE Advisory Board

Comments: Based on review of the revised matrix of program outcomes vs. course learning objectives developed in Step 3 above, the CEE program assessment committee shall identify any program outcomes which lack adequate evidence to support assessment. These gaps in assessment evidence will be presented to the full faculty and mechanisms will be explored to generate the necessary information. The most appropriate mechanism(s) will be identified and implemented.

Approximate Frequency: Once every two years

5. Review the Instructor Course Assessment Reports. Analyze results and evaluate their implications to overall program assessment and future improvements to our undergraduate curriculum. Identify instructor-defined course enhancements and evaluate how these enhancements are expected to better support Program Outcomes, ABET Engineering Criteria, and the Educational Objectives as currently stated.

Involved Constituencies: CEE program assessment committee, faculty

Comments:

Approximate Frequency: Annually
6. Collect and review exhibits of student work, results of annual course surveys and exit surveys/interviews, feedback from CEE Advisory Board members regarding the senior design reports and team presentations. Evaluate student impressions of their learning experience with respect to meeting the CEE program outcomes.

Involved Constituencies: faculty, students, CEE program assessment committee, CEE Advisory Board

Comments: Student Evaluation of Teaching (SET) results are reviewed, along with written comments from students, to identify aspects of each course that may require strengthening in the future. Course assessment reports are prepared by individual faculty. Areas of relative strength and weakness are identified and results used to modify courses as deemed necessary by the involved instructor and the undergraduate assessment committee. Student exit surveys/interviews are compiled and reviewed by the CEE program assessment committee. Results are presented to the entire faculty at the day-long CEE ABET retreat and steps are developed to address areas of concern, especially those related to the curriculum and its ability to achieve program outcomes. The CEE Advisory Board Feedback Survey is distributed to board members immediately following the capstone design team presentations at the spring meeting. The feedback is reviewed by the CEE undergraduate program assessment committee to help judge how effectively our graduating students are meeting program outcomes.

Approximate Frequency: Annually

7. Compile, analyze and evaluate feedback from other program constituents.

Involved Constituencies: Employers, alumni, faculty

Comments: When the College provides results of alumni surveys and/or employer surveys, the CEE program assessment committee reviews the information, along with that described in Step 6 above, to assist in identifying areas within the curriculum that require improvement. The committee develops a preliminary set of recommended program modifications/improvements for consideration by the faculty at the CEE ABET retreat.

Approximate Frequency: once every 4 years
8. Identify and implement recommended changes to the curriculum to better support Program Outcomes and achieve Educational Objectives. Monitor impacts to establish whether or not expected improvements have occurred.

Involved Constituencies: Faculty, CEE Advisory Board

Comments: This is the component of the CEE assessment plan in which the loop is closed, i.e., a recommended set of curriculum improvements are identified, implemented, and monitored as to their impact. These modifications are defined and adopted pending final approval of the CEE faculty. Some are program-level changes focused on the curriculum as a whole, while others address changes within individual courses. Program-level changes are also presented to CEE advisory board members for additional feedback prior to final approval.

Approximate Frequency: Implementation of measures to improve the program is a continuous process, occurring at appropriate times within each academic year. All elements of the program and its curriculum are not assessed each year. A staged approach is used in which only a subset of all program elements are assessed in any given year.

2.4.2 Civil Engineering Undergraduate Program Assessment Committee (UPAC)

The Undergraduate Program Assessment Committee (UPAC) is responsible for oversight of all assessment activities undertaken by the Department. The mandate and activities of the committee is reflected through its charter as given below.

CEE Undergraduate Program Assessment Committee Charter

The CEE Undergraduate Program Assessment Committee has been established to undertake systematic assessment of the civil engineering undergraduate program for the purpose of providing students with an education that prepares them for the challenges of a future career in civil engineering while satisfying all requirements of the Accreditation Board for Engineering and Technology (ABET) for program accreditation. The committee shall be comprised of one faculty member from each civil engineering subdiscipline, the department chair, and the department’s designated ABET coordinator. The committee shall meet at least once each semester to review and discuss one or more assessment issues pertaining to the civil engineering curriculum. The committee shall be responsible for the following major tasks:

- Review and evaluate Educational Objectives and Program Outcomes
- Review current ABET accreditation criteria
- Design and implement departmental strategies for collecting appropriate program assessment data
- Solicit assessment feedback from program constituencies
- Review all Instructor Course Assessment Reports and other assessment data
• Identify program strengths and weaknesses as they pertain to student learning and satisfaction of all ABET criteria
• Provide constructive feedback to individual faculty regarding specific courses, including results from the committee’s review of the Instructor Course Assessment Report.
• Formulate realistic strategies to address weaknesses and improve the civil engineering undergraduate program
• Implement program improvement strategies and undertake follow-up monitoring to determine their effectiveness
• Undertake other initiatives as necessary to ensure that students receive a strong, practical educational experience that prepares them to function in the future as effective civil engineering practitioners.

Individual faculty members are appointed to the Department’s Undergraduate Program Assessment Committee for a period of 3 years, with membership ultimately rotating among all individuals in each sub-discipline to ensure everyone is familiar with all ABET assessment needs and protocols. At each spring faculty retreat, the committee will report to the full faculty a summary of all program assessment activities from the previous year, as well as important findings and recommended program improvements for the coming year.

2.4.3 Course Assessment Reports

As noted previously, instructors teaching a required undergraduate CE course are responsible for preparing a course assessment report at the conclusion of each semester. Reports for courses offered during the Fall 2004, Winter 2005, Fall 2005 and Winter 2006 semesters are provided in on-site Exhibit 5. Each report provides the following important information for the overall assessment process:

• A list of all course learning objectives and the specific Program Outcomes each supports;
• A list of the measures (exam questions, quiz, homework, etc.) used to assess how effectively each learning objective was achieved by students;
• An assessment of the extent to which each course learning objective was achieved by students;
• Identification of problems, issues and concerns regarding the course, its learning objectives, and the Program Outcomes it supports;
• Description of any planned improvements to the course based on current assessment results;
• Description of how planned improvements to the course will be implemented and their impact monitored in the future.

A discussion of the review, analysis, interpretation, and eventual use of the feedback from these reports for program improvement is presented in Section 2.5. The Winter 2006 Course Assessment Report for CE 4210 (Introduction to Environmental
Engineering) is presented in Appendix I-F as an example of the information provided by these important assessment instruments.

2.4.4 Assessment Measures

Measures used for ongoing assessment of the civil engineering undergraduate program include the following:

- Student performance on exams, quizzes, homework and projects in individual courses
- Results from instructor course assessment reports
- Student surveys of course learning objectives
- Team-based project reports and presentations in senior capstone design course
- Feedback from CEE Advisory Board members
- Student Evaluation of Teaching (SET) results
- Feedback from the alumni survey administered by the College
- Percentage of graduating civil engineering students passing the Fundamentals of Engineering Examination
- Occasional feedback from employers of department graduates
- Others (e.g., informal communications with the constituencies)

These measures, some direct and some indirect, provide the data and evidence subsequently compiled, reviewed, and analyzed by UPAC to assess the state of the undergraduate program. Specifically, the evidence is used to assess whether each Program Outcome is satisfied. If all Program Outcomes are achieved, then the Educational Objectives of the undergraduate program are also achieved. If not, a strategy to address a specific concern and thereby improve the program is developed and implemented consistent with recommendations of UPAC. Follow-up monitoring of appropriate assessment data or evidence is then undertaken to determine whether or not the strategy has satisfactorily accomplished its purpose.

2.5 Assessment Results

To briefly reiterate what has been stated just above, ongoing assessment of the undergraduate CE program involves a focus on the following issues:

- How effectively the program’s Educational Objectives are met by former students;
- How completely Program Outcomes, and therefore ABET Engineering Criteria, are satisfied via the undergraduate curriculum;
- Areas of concern in the program that are identified through the assessment process;
- Strategies developed and implemented to address the areas of concern;
- Monitoring to evaluate whether or not a strategy has accomplished its purpose and improved the undergraduate program.
Table 1 below shows the different measures used to provide meaningful data and other evidence for assessment. A discussion of assessment results follows.

<table>
<thead>
<tr>
<th>Data Description</th>
<th>Source</th>
<th>Collection Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>student performance on exams, quizzes, other course assignments</td>
<td>course assessment reports</td>
<td>end of each semester</td>
</tr>
<tr>
<td>extent to which individual course learning objectives are met</td>
<td>course assessment reports; student surveys of course learning objectives</td>
<td>end of each semester</td>
</tr>
<tr>
<td>feedback from graduating seniors</td>
<td>student exit survey</td>
<td>end of winter semester</td>
</tr>
<tr>
<td>team-based design; technical writing and oral presentation skills</td>
<td>senior capstone design project reports and oral presentations (spring Advisory Board meeting)</td>
<td>end of winter semester (spring Advisory Board meeting)</td>
</tr>
<tr>
<td>feedback from CE Advisory Board members</td>
<td>CE Advisory Board survey form</td>
<td>end of winter semester (spring Advisory Board meeting)</td>
</tr>
<tr>
<td>feedback from alumni of CE program</td>
<td>college alumni survey</td>
<td>once every 4 years</td>
</tr>
<tr>
<td>performance on Fundamentals of Engineering Exam</td>
<td>National Council of Examiners for Engineering and Surveying</td>
<td>January and April of each year</td>
</tr>
<tr>
<td>student feedback on instructor and course content</td>
<td>Student Evaluation of Teaching (SET) surveys</td>
<td>end of each semester</td>
</tr>
<tr>
<td>feedback from employers of graduates from the CE program</td>
<td>discussions with officials of local companies</td>
<td>no set frequency</td>
</tr>
<tr>
<td>discussions between faculty and civil engineering undergraduate students</td>
<td>student-faculty mentoring meetings</td>
<td>once or twice per academic year</td>
</tr>
</tbody>
</table>

### 2.5.1 Achieving the Educational Objectives of the CE Program

The Department of Civil and Environmental Engineering is fortunate that many of its past and present students accept employment opportunities with a diverse set of companies, agencies and organizations located in southeast Michigan. Many of these organizations routinely contact the department chairman or individual faculty looking for students they might hire for a summer position or a full-time position upon graduation. One of the most commonly heard themes during those conversations is that the firm currently employs or has employed past graduates of the CE program at Wayne State University and these students have proven themselves to be productive, highly competent practitioners in their early years with the firm. Many have gone on to receive their
professional engineering license and are actively involved in technical committees and/or community service activities related to the civil engineering profession. In addition, several of our alumni are involved with various facets of academic programs at Wayne State University, such as the MSPE and ASCE student chapters, the Alumni Association, and the CEE Advisory Board. Our alumni occasionally serve as adjunct faculty and often are guest lecturers in our classes. A large number of our graduates continue their association with the faculty via department visits, telephone and e-mail communications, and interactions at professional gatherings.

Following are a few quotes from advisory board members as written on the spring 2005 CEE Advisory Board Feedback form:

“In my own company, we have employed three recent graduates of the Civil and Environmental Engineering Department at Wayne State University. All three are outstanding workers who have progressed rapidly based on their ability to complete projects, apply engineering concepts and effectively communicate.”

“Our firm has hired eight graduates of the CE program in the last twelve years. We still have five of those students working with us. A few have taken jobs elsewhere. We think WSU is doing an excellent job of preparing them for the real world of engineering.”

“The students that we have hired is a testimonial to this program.”

These statements are indicative of the employers’ appraisal of the quality of our undergraduate program. Employers actively recruit our graduates as future civil engineering practitioners within their own organizations based on the effective performance of many of our previous graduates. Furthermore, feedback obtained from the survey of alumni administered through the office of the Associate Dean of Administrative Affairs for the College of Engineering also provides evidence that the Educational Objectives of the program are being met. Following is a summary of feedback from alumni of the civil engineering program who graduated between 2000 and 2005. Nineteen recent alumni responded to the following statement:

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4 Survey was sent to 16,000 alumni of the College of Engineering for which postal and/or email addresses were on file. Over 1500 responses were received. Undergraduate alumni from 2000 through 2005 were asked to respond to questions regarding program educational objectives.
As a graduate of the Civil Engineering undergraduate program, within a few years of my graduation I had the ability to:

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Response Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) apply my knowledge and skills as an effective, productive civil engineer within a private corporation, consulting engineering firm, municipality, or a state or federal agency dealing with analysis and design of modern civil engineering systems and processes.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>47% (9)</td>
<td>53% (10)</td>
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<tr>
<td>2) work and communicate effectively with others on multi-disciplinary teams to develop practical, technically sound, cost-effective solutions to complex and diverse civil engineering problems.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>47% (9)</td>
<td>53% (10)</td>
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<tr>
<td>3) maintain an active program of life-long learning and continuing education while practicing civil engineering in an ethical and professionally responsible manner.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>58% (11)</td>
<td>42% (8)</td>
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<tr>
<td>4) seek leadership roles as a practitioner and become an active member within professional and technical societies.</td>
<td>0% (0)</td>
<td>5% (1)</td>
<td>74% (14)</td>
<td>21% (4)</td>
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</tbody>
</table>

The responses shown above provide strong evidence that virtually all of our recent alumni either agree or strongly agree that the Educational Objectives of our undergraduate program are being achieved.

Finally, the strongest indicator that the program’s Educational Objectives have been achieved is to clearly demonstrate that all Program Outcomes, which themselves correspond directly to ABET accreditation criteria, have been satisfied. The following section addresses satisfaction of Program Outcomes.

2.5.2 Satisfying Program Outcomes

As noted previously, Program Outcomes a) through k) for the civil engineering undergraduate program correspond directly to ABET Engineering Criteria a) through k). In addition, Program Outcome l) reflects knowledge, expertise and proficiency or skills that a civil engineering student should possess and fully demonstrate by the time they graduate. Success in meeting Program Outcomes is in large part determined by success in achieving the learning objectives of individual courses comprising the professional component of the undergraduate curriculum. Table 2 just below provides a matrix showing undergraduate civil engineering courses currently supporting one or more Program Outcomes.

Assessment of specific course learning objectives is based upon the following system of performance benchmarks:

**Level 1:** A given course learning objective has been fully satisfied if most students demonstrate excellent understanding of a problem/concept/solution as evidenced by essentially correct answers to specific questions appearing on the Mid-Term, Final Exam, or other class assignments.
Level 2: A given course learning objective has been reasonably satisfied if most students demonstrate good understanding of the problem/concept/solution as evidenced by partially correct answers containing no major conceptual errors.

Level 3: A given course learning objective has been partially satisfied if most students demonstrate fair understanding of the material as evidenced by partial progress towards the solution (e.g., generally correct answers to some intermediate stages of the overall solution).

Level 4: A given course learning objective has not been satisfied if most students demonstrate poor understanding of the material. Virtually no partial credit could be given on questions/tasks relevant to the Learning Objective.

Additional evidence germane to the assessment of how well Program Outcomes are satisfied includes student exit survey feedback, feedback from the CE Advisory Board, student responses to surveys of course learning objectives, performance of graduating students on their team-based capstone design projects and presentations, and the percentage of students taking and passing the Fundamentals of Engineering Examination. Following is a detailed discussion of assessment results for each Program Outcome, along with information regarding specific measures used in the assessment.

Program Outcome a): Upon graduation, students will demonstrate the ability to apply knowledge of mathematics, science and engineering to solve civil engineering problems.

To conclude Program Outcome a) is satisfied at the time students graduate from the undergraduate program, students must show they can identify appropriate engineering methods, scientific principles, theories and/or concepts necessary for solving a range of civil engineering problems. They must demonstrate the ability to explain and defend why selected method(s) are appropriate for application to a given problem, and how these principles, theories, concepts and method(s) are applied in solving a range of civil engineering problems.

As evidenced by information provided in Table 2, Program Outcome a) is satisfied via achievement of learning objectives in several civil engineering courses comprising the professional component of the undergraduate curriculum. Each course incorporates one or more learning objectives corresponding to this outcome, thereby providing measurable evidence of coverage in the traditional areas of transportation, geotechnical, structures and environmental engineering. UPAC’s review of course assessment reports for the Fall 2004/Winter 2005 and Fall 2005/Winter 2006 semester cycles indicates that course learning objectives supporting Program Outcome a) were achieved by students at Performance Level 1 or Performance Level 2 in most instances. Students demonstrated
### Table 2
Program Outcomes supported within the CEE Curriculum

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>a)</th>
<th>b)</th>
<th>c)</th>
<th>d)</th>
<th>e)</th>
<th>f)</th>
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<th>k)</th>
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<tbody>
<tr>
<td>CE Course #</td>
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<tr>
<td>CE 3250: Applied Fluid Dynamics</td>
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<td>CE 4210: Introduction to Environmental Engineering</td>
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<td>CE 4400: Structural Analysis</td>
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<td>CE 4410: Reinforced Concrete Design</td>
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<td>CE 4420: Reinforced Concrete Design</td>
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<td>CE 4450: Civil Engineering Materials</td>
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<td>CE 4510: Introduction to Geotechnical Engineering</td>
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<td>CE 4600: Transportation Engineering</td>
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<td>CE 4640: Transportation Design</td>
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<td>CE 4850: Engineering Economy</td>
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<tr>
<td>CE 4995: Senior Design Project</td>
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√  Program outcome supported by course learning objectives

**Program Outcomes**

<table>
<thead>
<tr>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)  apply knowledge of mathematics, science and engineering to solve civil engineering problems</td>
</tr>
<tr>
<td>b)  design and conduct experiments; collect and interpret data</td>
</tr>
<tr>
<td>c)  design a civil engineering system, component or process to meet specific needs</td>
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<tr>
<td>d)  collaborate and communicate on multi-disciplinary teams</td>
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<tr>
<td>e)  identify, formulate and solve civil engineering problems</td>
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<tr>
<td>f)  demonstrate understanding of ethical and professional responsibility of a civil engineer</td>
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<tr>
<td>g)  communicate effectively in oral and written form</td>
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<tr>
<td>h)  demonstrate understanding of global and societal issues as they pertain to civil engineering</td>
</tr>
<tr>
<td>i)  understand importance of life-long learning and continuing education</td>
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<tr>
<td>j)  demonstrate knowledge of contemporary issues</td>
</tr>
<tr>
<td>k)  demonstrate proficiency in using modern engineering tools in the practice of civil engineering</td>
</tr>
<tr>
<td>l)  understand professional practice issues germane to the civil engineering profession</td>
</tr>
</tbody>
</table>

**Undergraduate Courses**

| CE 3250: Applied Fluid Dynamics                                                | CE 4210: Introduction to Environmental Engineering |
| CE 4400: Structural Analysis                                                    | CE 4410: Steel Design                              |
| CE 4420: Reinforced Concrete Design                                             | CE 4450: Civil Engineering Materials               |
| CE 4510: Introduction to Geotechnical Engineering                              | CE 4600: Transportation Engineering                |
| CE 4640: Transportation Design                                                  | CE 4640: Transportation Design                     |
| CE 4850: Engineering Economy                                                    | CE 4995: Senior Design Project                     |
the ability to identify appropriate engineering methods, scientific principles, theories and/or concepts necessary for solving a range of civil engineering problems. Students were able to explain why a particular engineering method was appropriate for application to a given problem and demonstrated how important scientific principles, theories, engineering concepts and methods are applied to solve a range of civil engineering problems. Additional details of specific course learning objectives supporting Program Outcome a), along with assessment of student performance regarding those learning objectives, may be found in the individual course assessment reports provided in Exhibit 5 to be available on-site in fall 2006.

Further evidence that the undergraduate program is satisfying Program Outcome a) is found in the summary of responses of CE Advisory Board members to the 2005 and 2006 surveys conducted at the spring board meeting (Appendix I-D). In 2005, thirteen of thirteen board members either agreed or strongly agreed that graduating students from the Civil and Environmental Engineering Department at Wayne State University leave the program with the ability to apply knowledge of mathematics, science and engineering to solve a range of practical problems expected of a new entry-level civil engineer. In 2006, eight of eight board members responded similarly.

Program Outcome b): Students will possess and demonstrate the ability to design and conduct experiments, as well as collect and interpret experimental data, pertaining to civil engineering systems.

The performance criteria used in judging the extent to which this program outcome is satisfied by students at the time of graduation include the following: students must demonstrate they can conduct a fundamental experimental procedure in civil engineering, use laboratory materials properly and safely, record appropriate data and observations in a notebook, and describe the procedures clearly for others; students must show they can analyze experimental data for the purposes of understanding and explaining the results; they must demonstrate the ability to describe empirical data both verbally and visually (via graphs, equations, tables and figures) in a manner that presents an effective overview and accurate depiction of experimental results; students must show they can provide meaningful interpretation of the data by calculating and discussing its statistical attributes (including central values, variability, uncertainty) and using these results to formulate clear and concise conclusions that can be drawn from the experiment.

Program Outcome b) is supported in several courses comprising the professional (i.e., upper division) component of the civil engineering curriculum. Following are examples of how this Program Outcome is currently satisfied within the existing CE curriculum, as well as a description of areas needing improvement and plans to address them.

In CE 3250 (Applied Fluid Mechanics) students perform and document appropriate laboratory methods during several lab sessions focusing on a range of fluids experiments and/or demonstrations. In CE 4450 (Civil Engineering Materials) students participate in extensive laboratory sessions focusing on tests relating to the properties and response of
common materials used in civil engineering applications, such as aggregates, cement, concrete and asphalt. CE 4510 (Introduction to Geotechnical Engineering) includes laboratory sessions and exercises emphasizing identification and testing of soil properties. Among the soils tests to which students are exposed in the laboratory are those pertaining to grain size, plasticity, compaction, permeability, consolidation, and shear strength. Students in CE 4640 (Transportation Engineering) rely upon a practical field investigation as a “real world laboratory experiment” in which students observe a process (traffic patterns), collect data, review and interpret the data, and ultimately prepare and submit a final project report which includes an assessment of observed problems, relationships among key variables, methods of analysis, and recommendations for solving the problems in the future. CE 4210 does not provide students with a hands-on laboratory experience for conducting a range of tests and experiments related to water and wastewater. However, the course covers the laboratory methods and protocols, equipment, reagents, and other details of the most common, fundamentally important tests used in the practice of water and wastewater treatment, including that for alkalinity, hardness, turbidity, coliform organisms, suspended solids, volatile solids, biochemical oxygen demand (BOD), dissolved oxygen, sludge volume index, residual chlorine, and others. Once again, the specific details of student exposure to laboratory tests and methods germane to civil engineering can be found in the individual Instructor Course Assessment Reports provided in on-site Exhibit 5.

Improvement plans: Although students are provided comprehensive exposure to the equipment, experimental procedures and data collection protocols for a wide range of important laboratory tests commonly used in civil engineering, UPAC has identified this Program Outcome as one in need of further improvement. More specifically, the committee has concluded that the curriculum should incorporate greater emphasis on experimental design methods governed by fundamental statistics, including analysis of underlying probability distributions for empirical data, calculation of confidence intervals about descriptors of central values and variability, hypothesis testing, sample size and its effect on reliability of statistical descriptors, as well as other statistical procedures. This particular concern will be addressed by incorporating expanded coverage of principles of design of experiments in future laboratory sessions of CE 4450. Further details of this effort to strengthen the curriculum and thereby improve support of Program Outcome b) can be found in the Instructor Course Assessment Report for CE 4450.

Program Outcome c): Students will possess and demonstrate the ability to design a civil engineering system, system component or process meeting specific needs.

Program Outcome c) is satisfied if graduating students show they understand the major steps involved in the design of a modern civil engineering system, including: the open-ended nature of design problems; the need for specifying clear and concise objectives and constraints at the start of the design process; obtaining and reviewing all appropriate codes, standards and criteria that govern the system under design; the importance of considering cost-effectiveness in choosing from among a range of alternatives for
meeting specified objectives; and the need to identify and communicate all major assumptions underlying the design. This particular outcome is strongly supported within the curriculum as described by the examples given below.

CE 3250 requires that students design a flow management strategy for either total volumetric discharge or instantaneous velocity determination. In CE 4210 students demonstrate the ability to design major components of conventional water and wastewater treatment systems, as well as storm water piping networks. More specifically, students undertake design of sedimentation tanks and determine expected solids removal using Stoke’s Law and particle-size distribution curves, design an activated sludge process based on known values of essential design criteria, and use the rational method to design the flow capacity of storm sewers serving an urbanized area. In CE 4410 students learn how to analyze and design steel members in tension, compression and bending using the LRFD method and AISC code. They also learn how to design bolted and welded connections. In CE 4420 students demonstrate the knowledge and ability to design a small reinforced concrete superstructure, including preparation of detailed drawings and submission of a final design report. In CE 4600, elements of transportation design including geometric design of highways, pavement design, and roadway cross-sections are covered and runway configuration for airports and design of urban rail systems are also discussed, along with various measures of emerging technologies including traffic calming measures for collector and local roadways. The highway design elements are thoroughly incorporated in lectures, homework, exams, and packaged in the final design project. CE 4640 (Transportation Engineering Design) requires that students design optimal timing plans for signalized intersections and learn design standards for signs and pavement markings essential to highway systems. Finally, the senior design course, CE 4995, requires that students complete a comprehensive, team-based capstone design project which incorporates design considerations pertaining to most major areas of civil engineering, including site design, foundations, structural design, traffic and transportation aspects, and environmental considerations. Student teams present their final project reports orally before the faculty and members of the CE Advisory Board at the conclusion of the winter semester. Additional details of these design elements and required student proficiencies can be found in the Instructor Course Assessment Report for CE 4995 contained in on-site Exhibit 5.

The design component of the CE curriculum is strong and integrated throughout the program. The design component culminates with the senior capstone design project. Following are comments from the CE Advisory Board reflecting their impressions of the quality of the team-based design projects and student presentations at the conclusion of CE 4995:

“As a long time member of the CE Advisory Board, I am greatly impressed with the development and substantial improvement in capstone design projects and presentations. Teams have put in a lot of work and shown discipline and teamwork. This is a very worthwhile program that will be of great benefit to students in their careers.”
“The use of live, actual projects with real issues and problems is a great asset to the students. They are getting a good dose of actual problems they will have to deal with in their chosen professional career paths.”

“Each year the capstone design projects seem to get better and better. The students evaluate different design concepts, such as green roofs and bioswales for handling stormwater runoff. They always seem to be in tune with the economic impacts of their projects and make design selections that are fiscally responsible.”

“I believe the Civil and Environmental Engineering Department does an outstanding job of preparing their graduates for success in the field, whether they end up with industrial firms or engineering design firms.”

“I think WSU does an excellent job of introducing undergraduates to the design process, including communication skills, interdisciplinary concerns and the iterative nature of basic designs. I also think WSU does an excellent job of structuring a program to suit the needs of the undergraduates who attend, encouraging co-op work experience to both enhance their education and provide some financial stability, and providing a few courses which focus on urban design/construction considerations.”

“Students did an excellent job in addressing design solutions. They understood the overview requirements of projects as well as the detailed requirements.”

“… provides a real-life training in terms of complete project design and presenting it to strangers.”

“The presentations given today were very professional in every respect, well-planned and executed within the time frame. I was very impressed with the structural analysis of each project. There was much more understanding than what I would expect from college students. Some having experienced the work environment made a considerable contribution to the presentations. Drawings, specs, and reports were all very well done, clear and concise. The recognition of environmental factors was very good.”

“The capstone class presentations were very good this year and the content and organization of the class has obviously improved greatly over the years. I believe the students don’t realize and appreciate what they have learned, but will look back to the capstone experience throughout their career.”

“Overall the students were well versed in structural, design, civil, environmental and transportation”.
Twelve of thirteen board members in 2005 either agreed or strongly agreed with the statement that students graduating from the CE program demonstrate the ability to design a system, system component or process which meets specific needs. Feedback from the advisory board in 2006 revealed that eight of eight respondents either agreed or strongly agreed with the same statement (see Appendix I-D).

In addition to the examples cited above, BE 1200 is highly focused on the introduction and application of design principles to engineering problems through a reverse engineering project or a Lego robotics exercise. Also, CE/ME 2400 has a significant design component (please refer to the course exhibit presented by the Mechanical Engineering Department).

In summary, UPAC’s review of Program Outcome c) indicates that students are demonstrating the skills and knowledge necessary to design a range of civil engineering systems or system components. It is the Committee’s conclusion that this program Outcome is satisfied within the current CE curriculum.

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**Program Outcome d): Students will demonstrate the ability to collaborate, communicate and work effectively with others on multi-disciplinary teams.**

To satisfy this program outcome, students must demonstrate the ability and willingness to work together in a manner simulating team-based collaboration within a real-world engineering team. Students must show respect for diversity of opinion and sensitivity to others while undertaking the design of a modern civil engineering system or process. Students are expected to effectively express their ideas and opinions, deal productively with conflict, and reach general consensus in functioning effectively on a team involved in a multi-disciplinary design project.

BE 1200, as well as several other courses within the CE curriculum, currently utilize a team-based approach to problem solving emphasizing collaboration and communication among students. However, the senior design course (CE 4995) represents the main program component within which this outcome is assessed. In CE 4995, students are divided into teams consisting of three to five members. Each team is assigned a unique design project involving elements of structural, geotechnical, transportation and environmental engineering. Teams meet on a weekly basis throughout the semester to consider project objectives, constraints, alternative design approaches, costs, unique conditions and special needs, as well as challenging problems surrounding their own individual projects. The capstone design projects are intentionally open-ended, allowing student teams flexibility in defining conditions and constraints that are interesting, challenging and practical. Individual CE faculty come to the class during the semester to present focused lectures on topics that facilitate the design process by providing important design criteria, regulations and standards governing various phases of design, discuss new technologies that might be incorporated into the team-based projects, provide advice or guidance for structuring an effective oral presentation of results to a technical audience, and continue the ongoing assessment of student progress.
audience, answer questions and address student concerns pertaining to the projects, as well as offer assistance when needed throughout the semester.

Teams work together to produce a comprehensive final design product that must be presented and defended in front of faculty and members of the CEE Advisory Board at the end of the winter term. Students divide the overall workload into separate but inter-related components, i.e., structural design, soils and foundations, traffic and transportation issues, environmental problems such as stormwater management at a developing site, as well as matters related to field construction and project scheduling. Within any given team, each student is assigned a leadership role for one of these design components. The student teams then rely upon weekly meetings to discuss progress within each design component; discuss emerging problems; share data, information and ideas; plan future design activities and schedule meetings with faculty as needed, and agree as a team how the final report and team presentation will be structured. In addition, each team reaches consensus as to who will assume lead responsibility for different aspects of the final report and oral presentation.

The CE students have demonstrated maturity and professionalism while participating on design teams in the capstone design course. UPAC’s review of responses provided on the 2005 and 2006 spring CEE Advisory Board Feedback Forms, as well as responses from students on the CE Student Exit Survey, indicates that our undergraduate students are demonstrating the ability and skills necessary to conclude that Program Outcome d) is strongly supported and fully satisfied at the time of graduation. All board members attending the spring 2005 meeting (13 out of 13) either agreed or strongly agreed with the statement that graduating students from the CE program demonstrate the ability to collaborate, communicate and work effectively with others on multi-disciplinary teams. In 2006, seven of eight board members responded similarly, with one indicating it was unclear.

Program Outcome e): Students will demonstrate the ability to identify, formulate and solve a range of civil engineering problems.

To satisfy Program Outcome e), students must demonstrate the ability to review facts and conditions surrounding a given civil engineering problem, then identify and correctly apply appropriate engineering methods to solve it. Students must be able to describe the essential information, data, and analytical methods involved (including the important variables, processes and inter-relationships underlying the problem), and list any major regulations or standards governing the solution approach.

Assessment of this particular program outcome indicates that it is broadly supported within the current CE undergraduate curriculum. Inspection of Table 2 shows that every upper division CE course includes one or more learning objectives supporting Program Outcome e). UPAC’s review and evaluation of individual Instructor Course Assessment Reports, together with feedback from CE Advisory Board members and student exit surveys, indicates that most learning objectives were satisfied within individual courses,
and therefore Program Outcome e) itself is satisfied within the curriculum. All advisory board members (13 out of 13) in attendance at the 2005 spring meeting responded that they either agreed or strongly agreed with the statement that graduates of the CE program leave with the ability to identify, formulate and solve a range of civil engineering problems. Seven of eight board members responded similarly in 2006, with one indicating it was unclear.

**Program Outcome f): Students will demonstrate an understanding and appreciation of professional and ethical responsibility in the practice of civil engineering.**

To satisfy Program Outcome f), students must show they can identify appropriate behaviors and reach decisions reflecting an awareness of ethical responsibility within the context of a civil engineering design project. More specifically, students must identify ethical issues pertinent to a given engineering project, discuss ethical criteria influencing proper and improper decisions and courses of action, and incorporate those criteria within all phases of the project. Students must be willing and able to identify and discuss ethical issues in appropriate courses, and with other team members as part of the senior capstone design project.

All engineering curricula, including civil engineering, require a course in professional ethics taught by the Philosophy Department of Wayne State University (PHI 1100: Contemporary Moral Issues - Professional Ethics). This course is specifically designed for and offered to engineering students. BE 1200 (Basic Engineering 1: Design in Engineering) is another course taken by all engineering students which covers professionalism and ethics in some depth. In addition to these courses, over the past five years the CE Department has undertaken several steps to broaden student exposure to ethical issues within the civil engineering profession. Most of our upper division civil engineering courses now devote one or more lectures to matters of ethical behavior. Typically the instructor presents students with one or more case studies involving a set of conditions, choices or decisions having ethical implications. Students learn about and discuss the meaning or interpretation of ethical behavior using documented guidelines from a number of sources which address rules governing ethical conduct in the practice of engineering, e.g., ASCE’s Engineering Code of Ethics and other rules. They then apply this guidance within the context of a given case study to help them arrive at a course of action that is technically sound, economically prudent and ethically responsible.

As shown in Table 2, five courses within the professional component of the undergraduate curriculum incorporate one or more course learning objectives emphasizing ethics and professional conduct within civil engineering. UPAC’s review of course assessment reports indicates that this Program Outcome is broadly supported and effectively satisfied within the current curriculum. Feedback from the student exit survey shows that students agree that the curriculum has provided them with an understanding of professional and ethical responsibility, and comments from CE Advisory Board members during the spring 2005 and 2006 meeting suggest that students demonstrate professional conduct and an awareness of professional expectations as part of their capstone design
projects and presentations. In terms of professionalism, students understand the importance of continuing education, membership and active participation in professional societies and their committees, and career advancement via licensure as a professional engineer.

Future Improvements: Although students have demonstrated an awareness of the importance and meaning of ethical responsibility, ethical conduct and professionalism in the practice of civil engineering, UPAC has concluded that the curriculum would benefit from expanded coverage in this area.

Current strategies to address this need are as follows:

- In winter 2006, the Wayne State University ASCE Student Chapter organized a panel discussion focusing on the subject of professional ethics and ethical conduct in engineering with particular emphasis in the area of civil engineering. This special seminar is one of the enhancements implemented as a result of ongoing program assessment indicating a need for more structured programs to educate students on the subject of ethics and ethical conduct.

- A current civil engineering practitioner, licensed professional engineer and upper-level manager in a local civil engineering consulting firm will be invited to deliver a lecture at the outset of the senior capstone design course (CE 4995) in the Winter 2007 semester and each offering of the course thereafter. This lecture will emphasize how issues of ethics and professionalism are perceived and managed within a company working on real-world, modern civil engineering projects.

- Students will be asked to incorporate an example of a problem or issue involving ethics and professionalism within the framework of their final capstone design reports and presentations. Each team will need to carefully identify the issue, define important aspects of the issue, and describe how their engineering design team successfully addressed the issue. We expect to introduce this new element of CE 4995 effective Winter 2007.

Given the current level of emphasis on ethics and professionalism provided within the curriculum, combined with planned implementation of additional measures described above, UPAC concludes that Program Outcome f) is currently strongly supported and will be strengthened even more in the future. As further evidence of success in meeting this program outcome, twelve of thirteen CE Advisory Board members in attendance at the 2005 spring meeting, as well as six of eight members attending the 2006 meeting, either agreed or strongly agreed that graduating students understand and appreciate the importance of professional and ethical responsibility in the practice of civil engineering. The other board members indicated it was unclear based on evidence available to them.
Program Outcome g): **Students will demonstrate the ability to communicate effectively in both written and oral form.**

This outcome is met when students exhibit the ability to effectively communicate with other team members within the context of a comprehensive capstone design project. Communication skills may be demonstrated in a variety of ways, including verbal discussions during routine team meetings, written technical memoranda to other team members, as well as emails informing others of progress, important schedules, existing or anticipated design problems, as well as project needs. Students will submit a comprehensive, grammatically correct, well-organized final team design report and deliver a clear, concise technical presentation of their final capstone design project to faculty and CE Advisory Board members. Students also must demonstrate the effective use of computer software packages (e.g., PowerPoint, relevant CAD software) within the context of their capstone design team presentation.

UPAC has concluded that Program Outcome g) is satisfied within the current curriculum. Evidence in support of this conclusion rests largely with feedback from faculty, CE Advisory Board members and comments from other students following the formal presentations of capstone design projects at the spring Advisory Board meeting. In responding to the 2005 CE Advisory Board Survey, all board members in attendance (13 out of 13) responded that they either agreed or strongly agreed with the following statement:

> “Based on my familiarity with past graduates of the program, together with evidence demonstrated via the senior capstone design project and team presentations, students graduating from the CEE Department at Wayne State University leave the program with the ability to communicate effectively in both written and oral form.”

Seven of eight board members responded similarly in 2006.

Future Improvements: The CEE faculty is of the opinion that this particular program outcome is especially important to the success and future advancement of a graduating civil engineering student. The assessment committee’s review of available information regarding this program outcome indicates that students would benefit from expanded coverage of oral and written communication skills within the curriculum, including guidance for making more effective use of visual aids, writing clear and concise summaries of information (technical memoranda; emails; executive summaries for written reports; concisely articulating and communicating major findings, conclusions and recommendations from an engineering design project), as well as understanding protocols for making effective presentations of project results to technical and non-technical audiences. In order to meet this need, the ASCE Student Chapter will be working with faculty and the CE Advisory Board during the 2006/2007 academic year to organize a special seminar focusing exclusively on this topic. In addition, future offerings of the senior capstone design course CE 4995 will include a lecture emphasizing effective communication skills and tools for civil engineers.
Program Outcome h): Students will receive a broad educational background addressing the importance of global and societal factors as they affect and are affected by civil engineering systems.

For Program Outcome h) to be satisfied, graduating students will have received an education at Wayne State University that provides them with an appreciation of and sensitivity to the importance of global and societal factors as they relate to real-world civil engineering problems and their solutions.

UPAC has struggled in its assessment of the degree to which Program Outcome h) is satisfied. Review of individual Course Assessment Reports indicates that five of our CE courses include one or more learning objectives supporting Program Outcome h). CE 4210 (Introduction to Environmental Engineering) addresses global and societal factors by discussing the impact of land development and the generation of chemical wastes on the ecosystem. Students learn that ecosystem components (land, air, water and living organisms) are all inter-connected throughout the world. Activities in one part of the world can have an impact in locations far away, e.g., the migration of PCBs from original sources via volatilization and movement within the atmosphere.

The Department is home to a diverse faculty having experience and familiarity with engineering projects in countries throughout the world. In teaching courses within the professional (upper division) component of the curriculum, individual instructors seek opportunities and examples to facilitate discussion of the ever-increasing interdependence of global economies and how societal issues in other countries impact the civil engineering profession.

Improvement Plan: The assessment committee has concluded that Program Outcome h) needs greater emphasis, documentation and measurable evidence within the CE curriculum. Although some CE courses do address global and societal issues as they pertain to the civil engineering profession, coverage is not considered sufficiently strong to support and satisfy this important program outcome. As a remedy, it was decided that the Department Chair, Dr. Usmen, will prepare and deliver a lecture in a required senior-level course on the topic of societal impact of technology, contemporary issues affecting civil engineering, and life long learning. This was implemented in the winter of 2006 by allocating one lecture of CE 4410 (Steel Design) to this initiative. Details of the presentation, entitled Professional Skills for Civil Engineers, have been provided in Section 1.3 of this report.

Program Outcome i): Students will demonstrate an understanding of the importance of life-long learning and continuing education.

To satisfy Program Outcome i), students must demonstrate an awareness of the need to practice independent learning and continuing education throughout their professional
careers, including the use of internet resources, engineering journals, publications of professional societies, handbooks of relevant codes and standards, as well as attendance and participation at regional, national, and international conferences. Students must be aware of the importance to maintain membership and meaningful involvement in one or more professional societies (e.g., ASCE) that keep members informed of the newest technologies, state-of-the-art software, existing and proposed legislation, important meetings and publications, as well as emerging issues within the civil engineering profession.

Improvement Plan: UPAC feels it may be necessary to add one or more assessment tools providing more direct and measurable evidence that students meet this Program Outcome at the time of graduation. Although faculty members routinely stress the importance of lifelong learning and continuing education throughout the career of a civil engineer, strong evidence to subsequently assess student comprehension of this outcome is limited. As shown in Table 2, only two of our eleven upper division CE courses currently incorporate course learning objectives in support of Program Outcome i). Nevertheless, responses from graduating seniors on the exit surveys conducted each year suggest that students generally agree or strongly agree that the civil engineering program taught them the importance of engaging in life-long learning and continuing education. In addition, feedback from alumni who graduated from the civil engineering program between 2000 and 2005 (obtained via the College of Engineering’s recent Alumni Survey administered through the office of the Associate Dean of Academic Affairs) reveals that almost 80% of respondents subscribe to professional magazines, two-thirds of respondents attend technical workshops, and more than one-third of respondents subscribe to professional journals, attend professional society conferences, and either have or are pursuing an advanced degree in their field.

In conjunction with a planned seminar during the upcoming academic year emphasizing written and oral communication skills for civil engineers, the CE Department will be working with its ASCE Student Chapter to schedule a guest speaker from a local firm to address the importance of life-long learning and continuing education, and how these two needs may be effectively met by civil engineering practitioners. Examples or case studies demonstrating how some engineering firms and their employees have successfully dealt with this issue will be presented. In addition, Dr. Usmen will continue to offer the presentation on Professional Skills for Civil Engineers, as described above, in a required upper division CE course on an annual basis, so this issue will be addressed and the requirement satisfied on a continuing basis.

Program Outcome j): Students must demonstrate knowledge of important contemporary issues in the world within and outside the context of civil engineering.

To satisfy Program Outcome j), students must take and pass a representative set of general education courses within the undergraduate curriculum, including humanities, arts and social sciences. Several of these courses present coverage of important contemporary issues.
UPAC finds Program Outcome j) is supported and satisfied via content of select general education courses as well as achievement of learning objectives in six CE courses (CE 3250, CE 4210, CE 4400, CE 4410, CE 4420 and CE 4600). Faculty members consistently present real-world examples and case studies to provide a meaningful context to engineering methods and tools taught in their respective courses. For example, students learn about the history of environmental contamination and remediation strategies within the Great Lakes region, ranging from longstanding problems with eutrophication of the lower Great Lakes to the more contemporary problems of persistent, bioaccumulative toxicants, nonpoint source pollution, habitat loss, and the impact of introducing non-indigenous species (zebra mussels, sea lampreys, other plants and organisms) on the Great Lakes ecosystem. As noted earlier in this report, students also learn about the migration of certain toxicants throughout the world via atmospheric transport and rainfall, as well as contemporary strategies for managing existing problems and minimizing the risks of future problems.

Responses from graduating seniors to the annual exit survey indicate that students either feel neutral or agree that the civil engineering program provided them with knowledge of contemporary issues in the world.

Program Outcome k): Students shall demonstrate the ability to use techniques, skills and modern engineering tools required for the practice of civil engineering.

Program Outcome k) is satisfied when students demonstrate proficiency in the application of a wide range of modern engineering tools often needed in solving civil engineering problems, designing and analyzing civil engineering systems and processes, preparing technical memoranda and project reports, and delivering effective presentations before technical and non-technical audiences. Examples of such tools are: word processing packages, PowerPoint, internet searches and email, MATLAB, state-of-the-art software in environmental, transportation, structures, and geotechnical engineering, GIS, EXCEL, and a variety of CAD packages.

UPAC feels the content of the current CE curriculum effectively supports and satisfies Program Outcome k). Inspection of Table 2 shows eight CE courses currently contain learning objectives that, if achieved, provide students with the knowledge and skills to satisfy this outcome. The committee’s review of course assessment reports indicates that the relevant learning objectives from these courses were achieved at Level 1 or Level 2. In addition, students are required to use many of these analysis tools in completing their team-based senior capstone design projects. Students demonstrate knowledge of and proficiency with these tools in preparing their final project reports (including technical drawings) and delivering their oral presentations before the faculty and CE Advisory Board. All advisory board members attending the spring 2005 meeting responded that they either agreed or strongly agreed that students demonstrated the techniques, skills and modern engineering tools required for the practice of civil engineering. Seven of eight board members responded similarly in 2006. Finally, feedback from the student exit
surveys conducted between 2000 and 2006 indicates that the CE curriculum provides students with the techniques, skills and modern tools necessary for civil engineering.

Program Outcome l): Students must demonstrate an understanding of civil engineering professional practice issues, including: procurement of work, bidding versus quality-based selection processes, addressing public safety concerns in project design, how design professionals interact with the construction profession to construct a project, the importance of professional licensing and continuing education, and/or other professional practice issues.

To satisfy Program Outcome l), students must develop an understanding of how civil engineering firms work in terms of business development in a competitive market, design project initiation and implementation, and the relationship between design and construction in the context of various project delivery systems. Students also must develop an appreciation of the need for and the value of professional licensure, be familiar with its requirements (including continuing professional development through lifelong learning), and show a willingness to start the process by preparing for the Fundamentals of Engineering Exam. Students need to be exposed to a variety of professional practice issues to help them become better leaders and managers in their careers.

Students are introduced to many engineering professional practice issues in BE 1200 and CE 4995. BE 1200 emphasizes the topics of professionalism and ethics, and teaches students about the importance of professional licensure (P.E. registration). Students learn the steps needed to become a P.E. They also learn about different career paths for engineers within industry, government and academia. Students are familiarized with project management principles, methods and tools (e.g. project meetings with agendas and minutes, Ghannt charts and CPM techniques for scheduling), and apply them to the management of their reverse engineering projects. Emphasis is also placed on understanding the relationship between design and construction/manufacturing in the context of real world applications. The topics of project management and project delivery systems have also become a part of the CE 4995 Senior Design experience. Based on discussions between the course instructor (Dr. Katsikas) and the Department Chair (Dr. Usmen) during the annual year-end course review and evaluation of CE 4995, it was decided that students could benefit from learning more about project management issues and applying this knowledge to the execution of their design projects. To this end, Dr. Usmen presented a two-hour lecture to the CE 4995 students in Winter 2006 and then engaged the students in group discussions and student exercises. This teaching approach helped students better understand linkages between the ideas and methods formally presented in class and the practical application of these ideas and methods to their own senior design projects. Student feedback on the merit of adding this element to the course was very positive and it will be repeated in future years.

Outside specific curricular efforts, the assessment committee has reviewed comparative statistics regarding the percentage of students graduating from the civil engineering
undergraduate program at Wayne State University who take and successfully pass the Fundamentals of Engineering (FE) Exam administered by National Council of Examiners for Engineering and Surveying. Based on performance relative to CE students from other accredited programs in the state of Michigan as well as nationally, WSU students generally do as well or better than other students on the FE Exam. UPAC feels relative success in passing the FE exam is a strong indicator and direct assessment measure for concluding that the undergraduate program in civil engineering is effectively meeting this important Program Outcome. Further discussion of student performance on the FE exam is presented later in this self-study report.

Table 3 provides a summary of UPAC’s review of course assessment reports submitted for the Winter 2005 semester.

<table>
<thead>
<tr>
<th>Course</th>
<th>3250</th>
<th>4210</th>
<th>4400</th>
<th>4410</th>
<th>4420</th>
<th>4450</th>
<th>4510</th>
<th>4600</th>
<th>4640</th>
<th>4850</th>
<th>4995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were learning objectives generally satisfied overall?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of learning objectives satisfied</td>
<td>10/10</td>
<td>9/9</td>
<td>7/9</td>
<td>6/6</td>
<td>7/7</td>
<td>5/8</td>
<td>7/9</td>
<td>8/8</td>
<td>14/15</td>
<td>13/15</td>
<td>6/10</td>
</tr>
<tr>
<td>Number of Program Outcomes supported</td>
<td>7/12</td>
<td>9/12</td>
<td>7/12</td>
<td>10/12</td>
<td>7/12</td>
<td>7/12</td>
<td>4/12</td>
<td>12/12</td>
<td>8/12</td>
<td>6/12</td>
<td>8/12</td>
</tr>
<tr>
<td>Are major changes planned for the next offering?</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Will any new learning objectives be added or existing objectives dropped?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Is a plan in place to implement and monitor changes or improvements?</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

See individual Course Assessment Report (Fall 2004 or Winter 2005) for details
2.5.3 Assessment and Program Improvements

Core Engineering Program

The core engineering courses are taken early in a student’s engineering career, and many students enrolled in these courses choose to change to a major outside of the College prior to graduation. As a result, performance goals for the course learning objectives are set with this fact in mind. A BE course has been determined to successfully address a learning objective if 75% of the students are determined to meet the objective. For student surveys, this is documented through at least 75% of students indicating that they had an adequate ability (3), more than adequate ability (4), or high ability (5) in a delineated course outcome. Histogram analysis of student results was selected as the performance metric in this area to reduce the effect of small groups of students who are not successful in one of these core courses and, as result should not be indicating that they are able to demonstrate an adequate ability in these areas.

In BE 1200 – Basic Engineering I: Design in Engineering, student surveys indicate that all course objectives are being achieved by 75% or more of the students in the past three semesters (W05 through F05). The exception is in the area of development of simple algorithms, which had an overall response rate of 72.5% of adequate ability or above. The Reverse Engineering section (one of four sections) offered had the lowest response rate on this learning objective (57.1%). Instructors in the Reverse Engineering section use Excel and MATLAB to teach students to develop simple algorithms for their design projects, while the Lego Robotics sections utilize NQC programming language. The possibility that students are not receiving sufficient experience in this area, and that they may not associate the work done in Excel and MATLAB with algorithm development, was discussed this past May and adjustments will be made to the courses for the Fall 2006 semester.

BE 1300/1310 – Basic Engineering II: Materials Science for Engineering Applications and Lab is transitioning from a traditional, introductory materials science course to one that focuses more on building an understanding of materials that can be later applied in engineering design. During the past five semesters, the rate of achievement of the learning objectives has in general increased from semester to semester – with the majority of the learning objectives now being met with at least adequate ability by 75% or more students. The course-specific areas that are not yet meeting this threshold are the ability of students to discuss the relationship between macro, micro, and nano-scale properties of materials (F05: 65.5%) and to identify sources of variability within materials (F05: 72.4%). There has been substantial improvement in these areas since Fall 2004 (40% and 46.7%, respectively), and the instructors and course team will continue to investigate ways to improve student abilities in these areas.

In BE 2100 – Basic Engineering III: Probability and Statistics for Engineering Applications, the Fall 2005 semester showed an improvement in achievement of course learning objectives, in particular in the areas of using the basic features of statistical software packages and developing numerical models to describe data. One area that slipped, perhaps as more time was devoted to other objectives, was the students’ ability to
describe the robustness of engineering designs and the means by which to assess this statistically (65%). The BE 2100 course team has identified a problem in the amount of material that is expected to be covered within the semester. The availability of MiniTab on student laptops in Fall 2008, it may be possible to shift the time currently spent in small groups in the computer lab towards other identified objectives so that students are able to improve their ability in all areas.

While students in all BE courses indicate at least a minimal increased ability in the areas of ethics, teamwork, and recognition of societal impact, instructors were often surprised by these response rates as they did not feel that they had devoted significant time to these subjects (with the exception of multidisciplinary teamwork in BE 1200 and BE 1310). The instructor teams are working to develop course “tool boxes” of exercises and case studies that can be used to bring these topics increased attention in the classes in future semesters.

Civil Engineering Program
Since the previous ABET accreditation in Fall 2000, the Department of Civil and Environmental Engineering has undertaken routine assessment of the undergraduate program. This ongoing assessment has resulted in important changes that have significantly improved the curriculum and/or the educational experience received by our students. Following are a few of the more notable changes made between 2000 and 2006.

♦ Revamping Basic Engineering (BE) Courses: The effectiveness of the BE program and individual BE courses has undergone continuing assessment based on student feedback received through SET evaluations, solicitation of direct feedback from students, as well as regularly scheduled meetings of instructors teaching BE courses. Discussions in the aforementioned meetings, held under the leadership of the Associate Dean for Academic Affairs, indicated that BE courses were generally not well received by students largely due to inconsistencies in the content of similar courses taught by different instructors. Some of the better students expressed the opinion that course content in BE 1010 and BE 1100 was not delivered at an appropriate depth. Although engineering design was covered in BE 1100, it was not covered at the desired level for an early design experience within the curriculum. Furthermore, BE 1100 was not required for all of the engineering curricula within the College. The fact that these entry level courses were sometimes taught by instructors other than full-time engineering faculty also raised concerns whether students are getting the best of the College’s resources. Based on these considerations, the College decided to abolish BE 1010 and BE 1100 and establish a new design course, BE 1200, that would be required of all engineering students at an early stage of their education. In addition, improvements were made to other BE courses as described in Section 1.4.

For further details of the rationale behind the changes made to the BE courses and assessment of resulting improvements, please refer to Dr. Grimm’s report.
♦ **Reorganizing the undergraduate structures courses:** Both reinforced concrete and steel design had previously been covered in the same course. Assessment revealed that the two topics should be separated and covered in different courses. After implementing a reorganization of structures courses as described previously in Section 1.4, the issue seems to have been effectively resolved and the curriculum improved as a result. The concerns of both students and faculty have been addressed and there have been no subsequent complaints about the content and delivery of material in structures courses.

♦ **Student – Faculty Mentoring Meetings:** Based on occasional impromptu meetings and feedback obtained from graduating students and past alumni of the civil engineering program, the UPAC believes students welcome opportunities to meet with faculty outside the boundaries of individual courses. Furthermore, the committee feels that students would benefit from occasional discussions with a faculty member to address issues other than those pertaining to the specific course(s) which traditionally bring the professor and student together. In response to this perceived area of need, the Department recently initiated a student – faculty mentoring program, a program designed to provide students with a more direct and rewarding relationship with the Department and its faculty. At least once each academic year every student is invited to meet with a member of the full-time faculty to talk about any problems, concerns or questions that are of interest and importance to the student. Topics can range from academic progress to future employment opportunities to advice regarding job interviews and networking with prospective employers. The program is intended to foster a stronger sense of belonging for the student in terms of his/her relationship with the Department. It also provides an enriching experience helping to breakdown some of the barriers that intimidate many students, thereby preventing them from approaching faculty members for help, advice, and guidance pertaining to issues other than solely academics. This is the first year in which the student – faculty mentoring program has been in place. To date it has met with limited success as previously discussed. We intend to revisit this program in the Fall of 2006 after making some necessary improvements, one of which will be to seek the cooperation of student leaders within the CE Department. After appropriate adjustments have been made to the program, we will then reinstitute the program and assess its impact on civil engineering students. We are hopeful to obtain valuable assessment data regarding the success of the program via an additional question to be added to the student exit survey form.

♦ **The Civil Engineering Conversations Program:** Another new initiative undertaken this year to improve our students’ understanding of professional practice issues is the Civil Engineering Conversations Program. The essence of this program is to bring students, faculty and civil engineering practitioners together in a business setting to exchange information and views about current issues affecting civil engineering, thereby giving students direct exposure to real-life civil engineering practice within a local organization. In addition to interacting with faculty and working engineers, students have an opportunity to observe and learn business etiquette. The ability to feel confident and
comfortable in a business dining setting is important for the future success of students and is not an experience normally available to them.

It was recognized that a program facilitating interactions with members of local civil engineering firms and governmental agencies was a unique and invaluable opportunity for Wayne State University civil engineering students. The Wayne State University chapter of the American Society of Civil Engineers made a presentation to the members of the CEE Advisory Board about the concept and developed their interest in taking this proposal to their respective organizations for support. Specifically, the program was designed to have a participating organization host a lunch or dinner attended by six students, one or two faculty members, one senior field engineer and one recent civil engineering graduate employed by the host organization. An optional format was one in which faculty members and students would visit the local office of a participating engineering firm and then subsequently attend a luncheon with some of the firm’s members. This option would provide students with a different learning experience – observing and interacting with engineers in their work environment. In addition, since many companies and engineering firms undertake projects which are multi-disciplinary in nature, this would provide visiting students with an opportunity to interact with industry professionals possessing an array of expertise applied to diverse engineering projects.

The response from the CEE Advisory Board members was very positive, resulting in three visits to engineering consulting firms and one visit to the offices of the Michigan Department of Transportation during the Winter 2006 semester. Feedback from participating students and faculty, as well as members of the host agencies, was overwhelmingly positive. Students felt they gained increased knowledge about specific disciplines in civil engineering that would greatly assist them in pursuing internship opportunities and in making important curriculum choices. Students also had the opportunity to network with local civil engineering practitioners which could lead to future employment possibilities. Participating industry professionals were able to pass on invaluable advice to the students. Faculty members were able to interact with a large number of students on a more personal level and help guide them toward courses of interest to them. Faculty members, practitioners and students who collaborated in the design of the Civil Engineering Conversations Program felt it would not only prepare graduating students with skills and knowledge better-suited to the needs and expectations of local firms, but would also advance the College of Engineering’s reputation. Finally, the Wayne State University student chapter of the American Society of Civil Engineers (ASCE) promoted this program to the civil engineering students during their annual effort to recruit new members.

Based on its success via a few initial trials with local firms, the Department plans to continue the Civil Engineering Conversations Program in future years. Naturally, more detailed feedback will be sought from all participating parties to make improvements as we move forward.
Senior Design Course Modification (CE 4995): Since the year 2000, no area of the CE undergraduate program and its curriculum has received greater attention in terms of assessment and subsequent attempts at improvement than the senior design course and the team-based capstone design projects. The course is coordinated by Dr. Chris Katsikas, a civil engineering practitioner and professional engineer. Senior students in civil engineering work in teams on multi-faceted projects involving all elements of civil engineering (structures, transportation, environmental and geotechnical). Students collaborate on their designs and prepare a comprehensive final project report formally presented to the CEE Advisory Board at the annual spring meeting in April. Not only are the knowledge, skills and tools taught throughout the curriculum brought to bear on a focused project involving comprehensive analysis and design, but student teams are also required to communicate details of their technical work in a clear and concise manner via their written final reports and oral presentations to members of the faculty and the CEE Advisory Board. Because this is the single most detailed, complex and comprehensive interdisciplinary design project undertaken by students during their undergraduate program, the Department has committed significant time to assessing and improving the course to ensure each student’s academic program culminates with a challenging, practical and rewarding design experience.

Over the past six years, both the format for the course and the individual projects themselves have evolved in response to feedback from program constituencies, including faculty members, members of the CEE Advisory Board, graduating students taking the course, as well as recent alumni of the civil engineering program. Originally each team worked on the same raw project as defined by site location, topography, design criteria, and final design objectives. Each week during the middle part of the semester a member of the CE faculty would come to the class to present a general lecture focusing on one or more aspects of the overall design project. It was then the responsibility of each team to use the information presented in each technical lecture for their design project. After each lecture, the faculty member would confer with each group regarding points of confusion and offer helpful guidance on how to practically apply the material within the framework of the overall project. From that point forward student teams would proceed to integrate these design tools and protocols based on their own internal deliberations. If they needed additional input from the same faculty member at a later date, a team member would contact him/her and set up a meeting for a follow-up discussion later in the semester.

After this approach was in place for a few years, student feedback to UPAC and the course coordinator indicated that it might be more effective if the course format were modified. In lieu of the previous approach, faculty members would now meet independently with individual teams using an “on time” delivery of appropriate design material, methods and advice, i.e., student teams would progress with their design projects until such time team members agreed that coverage of a specific topic or block of material and advice was clearly needed. At that time the team would request a meeting with an appropriate faculty member and the relevant information was presented and discussed as necessary.
This revised course format employing “on time” delivery of design lectures and meetings between faculty and individual design teams was adopted for two years, after which it became clear that the original, more structured approach to design lectures and input from faculty was superior. This assessment and conclusion was based upon strong feedback from students, the course coordinator, as well as individual faculty members actively participating in delivering design lectures and advice to the teams throughout the semester. In addition, the same program constituencies (students, faculty, and advisory board members) felt the course and its learning objectives would be better served if each team of students were presented with a unique design project containing details and conditions different from that of the other teams. Upon review and consideration of this feedback, UPAC recommended that future offerings of CE 4995 should reflect unique design projects for each team. Furthermore, design lectures by individual faculty and follow-up meetings to discuss problems, offer advice and answer questions pertaining to the design project should be scheduled in advance. This approach was to be adopted for the recently concluded Winter 2006.

In response to the aforementioned observation and UPAC recommendation, an invitation was extended to Dr. Katsikas to attend a CEE faculty meeting at the very beginning of the Winter 2006 semester. At this meeting Dr. Katsikas was asked to discuss the range of civil engineering design projects planned for the Winter 2006 semester, including the types and amounts of data to be given to students as a foundation for subsequent analysis and design. Individual members of the faculty were given a chance to add to that data set so that more challenging and complete design work could be undertaken by the students. The final project reports and oral presentations from each design team at the end of the semester revealed that this adjustment was successful and enhanced the overall design experience for the students.

It should be noted that Dr. Usmen and Dr. Katsikas meet annually to discuss the progress of CE 4995. Occasionally a meeting is held at an interim point during the semester in which the capstone design course is delivered. The two are also in routine communication about the course via email. After each winter semester, Dr. Usmen and Dr. Katsikas meet to thoroughly review the course and discuss comments and feedback received from members of the CEE Advisory Board and the CE faculty based on the most recent capstone design presentations by the civil engineering students. They address issues identified from review of student surveys of the course (SET results and surveys of course learning objectives), as well as issues brought up by Dr. Katsikas based on his observations of student performance throughout the semester. Strategies for improvement are developed and implemented on this basis. One recent example of this assessment activity was identifying a need to add a lecture on project management to the course. Dr. Katsikas observed that some student teams did not effectively manage progress on their design projects. As previously described in Section 2.5.2 of this report (see Program Outcome 1), Dr. Usmen prepared and delivered this lecture. It was considered highly effective and helpful to students based on direct student feedback to Dr. Usmen on the day of the project presentations in April 2006. Communications and assessment-related discussions between Dr. Usmen and Dr. Katsikas are documented in on-site Exhibit 7.
Students have expressed strong satisfaction with the current framework for CE 4995. Discussions between the Department Chair, the Department ABET coordinator and members of the CE Advisory Board in attendance at the spring 2006 meeting (at which students made oral presentations of their team-based design projects) indicated that student presentations showed clear and significant improvement from past years. In addition, eight of eight board members in attendance either agreed or strongly agreed that the capstone design projects and oral presentations by students have demonstrated general improvement over the years. Following are a few written comments from board members as taken from the completed 2006 survey forms:

“You are doing a good job of introducing the students to codes and standards.”

“The WSU CE Department is achieving remarkable progress. More injection of current issues may enhance learning. Practitioner participation is very helpful to students.”

“The capstone class presentations were very good this year and the content and organization of the class has obviously improved greatly over the years. I believe the students don’t realize and appreciate what they have learned, but will look back to the capstone experience throughout their career.”

“The capstone design project presentations are very well done. I wish that I would have had a similar opportunity when I was an engineering student. I believe it is a necessary part of the engineer’s development and connection with the real world of engineering.”

“While it is difficult to display an understanding of all the questions generated herein, the presentations provide an indication that the general educational goals are achieved.”

2.5.4 Student Performance on Fundamentals of Engineering (FE) Exam

Recent statistics regarding the performance of civil engineering students on the Fundamentals of Engineering (FE) examination administered by NCEES indicate that graduates from the civil engineering program at WSU have as high or a higher rate of passing the exam as compared to students graduating from programs at other institutions both in the state of Michigan as well as nationally. The number of students graduating from our undergraduate program is relatively small and therefore the sample size may be considered insufficient to draw statistically significant conclusions regarding relative success in passing the exam. Nevertheless, UPAC feels this is important assessment data that should not be ignored or minimized when characterizing the strength of our program in preparing graduates for future success. Following is a brief summary of available NCEES statistics for civil engineering students taking the FE exam in October 2005, April 2005 and October 2003.
For students taking the exam while enrolled in an accredited civil engineering undergraduate program:

<table>
<thead>
<tr>
<th></th>
<th>WSU</th>
<th>State</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examinees Taking</td>
<td>2</td>
<td>93</td>
<td>2204</td>
</tr>
<tr>
<td>Examinees Passing</td>
<td>2</td>
<td>60</td>
<td>1468</td>
</tr>
<tr>
<td>Examinees Passing (%)</td>
<td>100</td>
<td>65</td>
<td>67</td>
</tr>
<tr>
<td>April 2005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examinees Taking</td>
<td>6</td>
<td>126</td>
<td>3045</td>
</tr>
<tr>
<td>Examinees Passing</td>
<td>5</td>
<td>95</td>
<td>2478</td>
</tr>
<tr>
<td>Examinees Passing (%)</td>
<td>83</td>
<td>75</td>
<td>81</td>
</tr>
<tr>
<td>October 2003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examinees Taking</td>
<td>3</td>
<td>63</td>
<td>2204</td>
</tr>
<tr>
<td>Examinees Passing</td>
<td>2</td>
<td>51</td>
<td>1468</td>
</tr>
<tr>
<td>Examinees Passing (%)</td>
<td>67</td>
<td>81</td>
<td>81</td>
</tr>
</tbody>
</table>

For students taking the exam at a time after graduating from an accredited civil engineering program:

<table>
<thead>
<tr>
<th></th>
<th>WSU</th>
<th>State</th>
<th>National</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 2005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examinees Taking</td>
<td>8</td>
<td>52</td>
<td>1171</td>
</tr>
<tr>
<td>Examinees Passing</td>
<td>3</td>
<td>18</td>
<td>336</td>
</tr>
<tr>
<td>Examinees Passing (%)</td>
<td>38</td>
<td>35</td>
<td>29</td>
</tr>
</tbody>
</table>

Again, although the sample size is limited, the data presented just above suggest that the undergraduate curriculum in civil engineering at WSU is preparing students to become licensed professional engineers as well or better than other programs both inside and outside the state of Michigan.

### 2.5.5 Results of Alumni Survey

UPAC has reviewed feedback from the Alumni Survey coordinated through the office of the Associate Dean for Academic Affairs in the College of Engineering. The survey generated feedback from 157 respondents representing alumni of the civil engineering undergraduate program at Wayne State University. Of these 157 respondents, 20 were alumni who graduated since the last ABET accreditation visit. The following overview of alumni responses is limited to the feedback received from those 20 students, thereby ensuring that the assessment process focuses on opinions and impressions from students who graduated between 2000 and 2005. It is important to note that all 20 CE alumni did not necessarily respond to each and every survey question.
Educational Objectives: In terms of meeting the Educational Objectives of the civil engineering program, alumni responded as shown below to the following statement:

As a graduate of the Civil Engineering undergraduate program, within a few years of my graduation I had the ability to:

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
<th>Response Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) apply my knowledge and skills as an effective, productive civil engineer within a private corporation, consulting engineering firm, municipality, or a state or federal agency dealing with analysis and design of modern civil engineering systems and processes.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>47% (9)</td>
<td>53% (10)</td>
<td>3.53</td>
</tr>
<tr>
<td>6) work and communicate effectively with others on multi-disciplinary teams to develop practical, technically sound, cost-effective solutions to complex and diverse civil engineering problems.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>47% (9)</td>
<td>53% (10)</td>
<td>3.53</td>
</tr>
<tr>
<td>7) maintain an active program of life-long learning and continuing education while practicing civil engineering in an ethical and professionally responsible manner.</td>
<td>0% (0)</td>
<td>0% (0)</td>
<td>58% (11)</td>
<td>42% (8)</td>
<td>3.42</td>
</tr>
<tr>
<td>8) seek leadership roles as a practitioner and become an active member within professional and technical societies.</td>
<td>0% (0)</td>
<td>5% (1)</td>
<td>74% (14)</td>
<td>21% (4)</td>
<td>3.16</td>
</tr>
</tbody>
</table>

These responses provide strong evidence that virtually all of our recent alumni either agree or strongly agree that the Educational Objectives of our undergraduate program are being achieved.

Following are a few of the direct comments written on the survey by recent alumni of the CE program. These comments relate to a variety of areas.

1. “The senior design course was very useful. It helped me apply what I learned in earlier courses.”

2. “Courses were geared towards the FE/EIT Exam.”

3. “I would have liked the senior project class to be different. When I took it in 2000, it felt like it was just a bunch of individual homework assignments that ended up being bound together. I would have like to see it take the shape of a real project. It would have been nice to pick the project also. Then it could be a project in the field the student is thinking of going into.”

4. “Have more evening courses available, particularly those for graduating seniors. By the time of nearing completion of the degree, many students are already working full time and finding courses to fit an evening schedule is difficult, particularly those that are required. WSU is a non-traditional university where a good majority of students are working. It’s hard to pursue your degree with such a limitation and many employers are not readily agreeable to allowing employees time off to pursue their degree.”

5. “The college did an excellent job of preparing me for my professional career after graduation. I am pleased that the college continues to adapt and strive to improve for the future.”

6. “I would suggest more student/professor social settings.”

7. “Excellent Professors.”
8. “I enjoyed my time at Wayne State and the education I received so far has been beneficial. If I had to pick one weakness, it would be advising. If students are assigned to a faculty member for advising in the last two years at Wayne, I think it would help that student with their educational path better than someone who is not in the engineering field.”

9. “I feel that my education from the CE department at the COE is one of the best tools I can have for my career. The department and staff are fully supportive of its students and provide enough flexibility in scheduling, course options, research opportunities, and extra-curricular activities to make every student’s education an asset for their future. My education from the CE department is something I am proud to have obtained.”

10. “Provide more stringent academic advising prior to senior year. Have advisers review student’s coursework each year to prevent from learning too late that the student hasn’t earned enough credits or met the requirements for graduation. Make this a mandatory review.”

These comments are typical of views held by our recent alumni. The undergraduate program and the civil engineering curriculum are effectively preparing students to succeed upon graduation. Students possess the skills and knowledge to become licensed professional engineers and advance within their chosen profession. As with every academic program inside or outside the College of Engineering, inside or outside Wayne State University, there are some areas needing improvement. Advising is one area that has been a weakness in the past. The Department is working closely with the College of Engineering to address and improve this problem in a timely manner such that students receive clear and concise advising throughout their undergraduate program.

2.5.6 Summary of Assessment Results

Since the last ABET accreditation visit in 2000, the CEE Department’s assessment process has continued to evolve. The Department’s UPAC has worked to identify, develop and utilize a diverse set of measures to obtain meaningful data and other evidence for ongoing assessment of the civil engineering undergraduate program. Some of these measures have provided direct evidence for assessment (e.g., student performance on exams and design projects; student success rate in passing the Fundamentals of Engineering Exam), while other assessment measures have provided indirect evidence (e.g., feedback from surveys and meetings).

UPAC has undertaken steps to collect, analyze and interpret all available assessment data for the purpose of maintaining our program’s strengths and improving areas that exhibit shortcomings. We have maintained and even improved a longstanding commitment to our program constituencies by seeking new and better ways to solicit their valuable opinions and insights. We have then used that feedback to help the undergraduate program improve.

UPAC feels the civil engineering undergraduate program at Wayne State University is providing its students with a strong, comprehensive education that meets ABET Engineering Criteria and achieves all of its Educational Objectives. Our assessment findings support this conclusion. Students graduate from the program with the knowledge and skills necessary for them to move on to become successful civil engineering
practitioners. The program is meeting its stipulated Program Outcomes and thus graduates leave the program prepared for future success and professional growth in civil engineering. Our assessment findings also support this conclusion. Perhaps as important, students are able to complete their baccalaureate degree in a Department that encourages the exchange of ideas and opinions between students and faculty both inside and outside the classroom.

Following is a brief summary of specific reasons we believe our assessment results show that the civil engineering undergraduate program satisfies ABET criteria and conditions for accreditation, including the Educational Objectives and Program Outcomes defined previously in this self-study report:

1. Graduates of the civil engineering program at WSU who take the Fundamentals of Engineering exam administered by the National Council of Examiners for Engineering and Surveying successfully pass the exam at a rate high or higher than graduates from other civil engineering programs both inside and outside the state of Michigan. Members of the CEE faculty consistently emphasize to students the importance of becoming a licensed professional engineer. Graduates of the program who choose to take the exam are generally successful in achieving this important milestone in their careers.

2. Virtually all alumni graduating from the civil engineering program at WSU between 2000 and 2005 who responded to the College’s recent Alumni Survey indicated that they either agree or strongly agree that the Educational Objectives of the program are achieved.

3. Feedback from the CEE Department’s Advisory Board (Appendix I-D), indicates that graduating students are able to undertake and satisfactorily complete comprehensive capstone design projects. Students are able to prepare technically sound, well-organized final project reports and deliver clear and effective oral presentations of their results.

4. Students are able to demonstrate an ability to effectively work together within a team-based framework to complete a comprehensive, multi-faceted senior design project.

5. Careful review of course assessment reports prepared by members of the faculty at the end of each semester indicates that course learning objectives cumulatively support and satisfy all Program Outcomes as defined previously in this self-study report.

6. All Educational Objectives of the civil engineering undergraduate program are supported by each of the defined Program Outcomes currently in effect. A matrix showing the support of Educational Objectives by all Program Outcomes is presented in Table 4.
7. The CEE Department has in place a plan and schedule of activities that support ongoing assessment of the undergraduate program, including its academic curriculum.

8. The CEE Department actively involves its constituencies in the assessment process, soliciting regular feedback and encouraging communication and the exchange of ideas and opinions.

Table 4
Educational Objectives supported by Program Outcomes

<table>
<thead>
<tr>
<th>Program Outcome</th>
<th>a)</th>
<th>b)</th>
<th>c)</th>
<th>d)</th>
<th>e)</th>
<th>f)</th>
<th>g)</th>
<th>h)</th>
<th>i)</th>
<th>j)</th>
<th>k)</th>
<th>l)</th>
</tr>
</thead>
</table>

- ![checkmark] Educational Objective strongly supported by Program Outcome
- ![checkmark] Educational Objective supported by Program Outcome

Program Outcomes
a) apply knowledge of mathematics, science and engineering to solve civil engineering problems
b) design and conduct experiments; collect and interpret data
c) design a civil engineering system, component or process to meet specific needs
d) collaborate and communicate on multi-disciplinary teams
e) identify, formulate and solve civil engineering problems
f) demonstrate understanding of ethical and professional responsibility of a civil engineer
g) communicate effectively in oral and written form
h) demonstrate understanding of global and societal issues as they pertain to civil engineering
i) understand importance of life-long learning and continuing education
j) demonstrate knowledge of contemporary issues
k) demonstrate proficiency in using modern engineering tools in the practice of civil engineering
l) understand professional practice issues germane to the civil engineering profession
2.6 Professional Component

2.6.1 Basic Curriculum

The Civil Engineering curriculum is designed to prepare students for engineering practice by achieving the Educational Objectives presented in Section 2.2 and the Program Outcomes discussed in Section 2.3. Members of the faculty possess expertise covering a broad range of civil engineering specialties, including structures, transportation, geotechnical, water and environmental and construction. They are interested in and knowledgeable about the civil engineering curriculum and provide their input to its design, evaluation and implementation (delivery).

The design and revision of the curriculum is an ongoing activity in the department, with discussions and evaluations comprising a significant part of the agenda at faculty meetings and retreats. In addition, faculty members serve on various college and university committees from which they convey broader perspective and input to the process. Members of the full-time faculty assume a major role in teaching required undergraduate civil engineering courses. They also work closely with part-time and/or adjunct faculty who teach courses taken by our undergraduates. They participate in outcome assessment efforts and the implementation of improvements based on these assessments. Through these processes, the faculty assures that the curriculum adequately covers each subject area to meet the program Educational Objectives and achieve the Program Outcomes.

As presented in Table I.1 of Appendix I-A, the Civil Engineering curriculum devotes 34 credit hours to college mathematics and basic sciences; 70 credit hours to engineering topics (engineering science, engineering design and other engineering topics), culminating in a capstone design experience; and 28 credit hours to general education topics. The total number of credit hours required for the BSCE degree is 132 as delineated in Table I.1.

Mathematics and Basic Science

The ABET requirement for math and science within the curriculum is the equivalent of one year (1/4 of total required credits). The engineering degree program with the greatest number of required credits is Mechanical Engineering (136 credits), which would thus require students to complete 34 credits of math and science. All students graduating from the Division of Engineering are required to complete the following set of math and science courses (34 credits):
As students are required to complete a Life Science (LS) course to graduate as part of the University’s General Education requirements, students are advised to take BIO 1510 (Basic Life Mechanisms) to concurrently satisfy the University’s and the College’s requirements for science credits. Students who have transferred in science or math credits beyond those listed above may petition to have those classes satisfy the College’s 3 credit science requirement while using a course other than BIO 1510 to satisfy the University’s LS requirement. Such permission is granted only if the course supports the student’s overall educational program (e.g. geology for a student in civil engineering; advanced chemistry for a student in chemical engineering). Students in the BSIE program may elect PSY 1010 (Introduction to Psychology) to satisfy both their college and university science requirements, as the Department of Industrial Engineering has determined that psychology is a science of great importance in the practice of industrial engineering.

**Engineering Topics**

The engineering topics component of the curriculum consists of required engineering science courses (materials science with a lab, applied parts of probability and statistics, statics and strength of materials, and dynamics); required civil engineering core courses (fluid mechanics, environmental engineering, structural analysis, steel design and reinforced concrete design, civil engineering materials, geotechnical engineering, transportation engineering, and transportation design), and a required capstone design course. Additionally, two technical electives (CE or other courses) and two CE design electives are included in this component of the curriculum. The freshman level Basic Engineering I: Design in Engineering course is also an important part of the engineering topics component. As clearly seen in this list, our students receive in-depth exposure to at least four disciplines of civil engineering through the required courses in water and environmental, structures, geotechnical and transportation engineering. Design concepts are first introduced at the freshman level in BE 1200, followed by intermediate design content in CE 2400, CE 4410, CE 4420, CE 4600 and CE 4640. This exposure to design is augmented via the design electives of the curriculum. Emphasis on design culminates with a comprehensive capstone design course which draws upon and integrates previous knowledge gained in the core CE courses. Through the engineering topics component of our curriculum, our students develop proficiency in applying basic math and science, as well as engineering science principles, to the solution of complex engineering problems.
Students develop abilities to design and conduct experiments and analyze and interpret data. They gain experience with design, including the identification and formulation of problems; analysis of alternatives; arriving at cost-effective decisions under a given set of constraints; and how to communicate and function effectively on multi-disciplinary teams. Students also gain an understanding and appreciation of the importance of ethics and professionalism as they relate to the practice of civil engineering.

2.6.2 General Education Requirements

The University’s General Education Program underwent substantial review between 2002 and 2005. During the Winter 2005 semester, the Academic Senate voted to approve a slightly revised set of General Education requirements to take effect for students entering the university in Fall 2005 and later. The University requirements for General Education listed in the following table, with new or revised requirements indicated with an asterisk.

<table>
<thead>
<tr>
<th>Category</th>
<th>Broad Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competencies (Course or Exam Based)</strong></td>
<td></td>
</tr>
<tr>
<td>Math (MC)*</td>
<td>Student demonstrates mastery of mathematical concepts and skills in order to cope with academic subjects in which mathematical formulations comprise an integral part of the subject matter, deal with mathematical manipulations that might be required in their careers, manage their personal finances, and understand mathematical elements relevant to public issues.</td>
</tr>
<tr>
<td>Basic Composition (BC)</td>
<td>Student demonstrates competence in basic English composition.</td>
</tr>
<tr>
<td>Intermediate Composition (IC)</td>
<td>Student demonstrates more advanced competence in English composition and rhetoric.</td>
</tr>
<tr>
<td>Writing Intensive (WI)</td>
<td>Student demonstrates ability to communicate effectively with specialized or professional audiences related to their major field of study.</td>
</tr>
<tr>
<td>Oral Communication (OC)</td>
<td>Student demonstrates comfort in situations that require him/her to make an oral presentation, convince others of a point of view, or make appropriate remarks in an informal setting.</td>
</tr>
<tr>
<td>Computer Competency, Basic – Level I (CL)*</td>
<td>Student demonstrates ability to initiate a file and operate word-processing software, understand how to gain access to the University's main computer system, and command the basic skills needed to perform simple on-line data retrieval and manipulative operations.</td>
</tr>
<tr>
<td>Computer Proficiency – Level II (CP)*</td>
<td>Student demonstrates discipline/major/program-specific computer literacy, including critical evaluation of electronic resources and training in the use of appropriate hardware, software, and scholarly electronic resources.</td>
</tr>
</tbody>
</table>

5 More detailed objectives are available in the supporting documentation provided during the visit.
### Critical and Analytical Thinking (CT)
Student demonstrates the ability to formulate and identify deductively- and inductively-warranted conclusions from available evidence; recognize the structure of arguments; assess the consistency, inconsistency, logical implications, and equivalence among statements; and recognize the explanatory relations among statements.

### Group Requirements (Course Based)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Society and Institutions (AI)</td>
<td>Student demonstrates an understanding of American society from the perspective of pluralism, including the organization of political bodies and the manner in which they function.</td>
</tr>
<tr>
<td>Foreign Culture (FC)</td>
<td>Student demonstrates an ability to place individual cultural assumptions in the context of a wider and diversified worldview.</td>
</tr>
<tr>
<td>Historical Studies (HS)</td>
<td>Student demonstrates an understanding of the methods of historical study as applied to a significant historical period and the ability to compare perspectives.</td>
</tr>
<tr>
<td>Life Sciences (LS)</td>
<td>Student demonstrates an understanding of scientific inquiry as applied to the mechanisms that govern the behavior and function of living organisms.</td>
</tr>
<tr>
<td>Philosophy and Letters (PL)</td>
<td>Student demonstrates the fundamental skills of analysis, interpretation, and evaluation applied to primary philosophical and literary materials.</td>
</tr>
<tr>
<td>Physical Science (PS)</td>
<td>Student demonstrates an understanding of scientific inquiry and mathematical predictability as applied to the physical laws that govern the natural world.</td>
</tr>
<tr>
<td>Social Science (SS)</td>
<td>Student demonstrates an understanding of the significance of theories, models, data collection, analysis, and inference applied to social structures.</td>
</tr>
<tr>
<td>Visual and Performing Arts (VP)</td>
<td>Student demonstrates the fundamental skills of analysis, interpretation, and evaluation applied to primary materials in the visual and performing arts.</td>
</tr>
</tbody>
</table>

### Exposure Areas (Course Based)

<table>
<thead>
<tr>
<th>Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural Diversity (CD)*</td>
<td>Student demonstrates an awareness and appreciation of diversity in the human experience based on the cultural, social, aesthetic, historical, or scientific contributions of diverse groups.</td>
</tr>
<tr>
<td>Ethical Issues in Society (EI)*</td>
<td>Student demonstrates the ability to identify ethical issues in various situations.</td>
</tr>
<tr>
<td>Science, Technology, and Society (ST)*</td>
<td>Students demonstrate an understanding of the interplay between social, scientific, and technological advances and the contemporary issues surrounding the development and application of science and technology.</td>
</tr>
</tbody>
</table>

The faculty of the College of Engineering are required to work within this framework to develop a program of study that provides its graduates with a general education component that complements the technical content of the curriculum and is consistent with the program and institutional objectives.

Engineering students satisfy a number of these general education requirements through completion of their core math, science, and engineering coursework:
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- MC – Completion of advanced mathematics courses (MAT 2010 and above)
- PS – Completion of CHM 1225 with laboratory
- CL – Completion of Basic Engineering I: Introduction to Engineering Design, which includes requirements for report writing, presentations, and algorithm development
- CP – Completion of Basic Engineering IV: Numerical Methods and Computer Applications in Engineering

The English Proficiency (EP) and Critical Thinking (CT) requirements can be satisfied through examination. Engineering students are encouraged to complete these exams as early as possible in their academic careers. They must be satisfactorily completed before a student advances to the professional program of their major. Students who struggle with the examinations can elect coursework to satisfy these requirements.

The written and oral communication competencies (BC, IC, OC, and WI) are satisfied through a progression of courses. In their freshman year, students take ENG 1020 (Basic Composition - BC) to gain fundamental writing skills that can be applied to their sociohumanistic courses as well as their technical courses. In their sophomore or junior year, students complete a two course sequence in technical communication: ENG 3050 (Technical Communication 1 - IC) and ENG 3060 (Technical Communication 2 - OC). This pair of courses, developed in cooperation between the College of Engineering and the Department of English, provides students with experience in developing and presenting technically relevant materials to diverse audiences and in both written and oral formats. Finally, a capstone design course (CHE 4800, CE 4995, ECE 4600, IE 4310, and ME 4500) in each program provides an opportunity for students to satisfy the Writing Intensive component of the curriculum. Students must develop extensive interim and final project reports documenting their designs, bringing together the technological and communications knowledge that they have gained through their curriculum.

The capstone design course for each program also satisfies the Science, Technology, and Society exposure area requirement (ST) for engineering students. The objective of this requirement is to have students examine the interaction of societal needs with technological developments – a key area in engineering design. As the capstone projects address many societal issues in their design (environment, economic constraints, ethics, societal need, etc.), these courses are a model for the rest of the university on how these topics can be integrated in an applied fashion.

Several of the Group Requirements have been selected by the College of Engineering to directly support the educational outcomes of its programs. All students in the College must complete PHI 1100 (Contemporary Moral Issues) to satisfy their Philosophy and Letters (PL) requirement. This course in professional ethics has been developed in cooperation with Dr. John Corvino of the Department of Philosophy. Students learn to evaluate the ethical issues surrounding real-world situations. PHI 1100 supports the discussions of engineering ethics that are woven throughout the engineering curriculum,
providing students with a more rigorous exposure to the theory of ethics. This course also satisfies the Ethical Inquiry exposure area requirement. Most departments in the College require students to take either ECO 2010 (Principals of Microeconomics) or ECO 2020 (Principals of Macroeconomics) to satisfy their social sciences requirement. Through the study of basic theories of economics, students are able to better appreciate the effect these forces have on engineering design, production, and corporate strategy.

As mentioned in section 2.6.1 (Mathematics and Science), students are encouraged to satisfy their Life Science (LS) requirement through BIO 1510 (Basic Life Mechanisms), which also satisfies ABET requirements for a course in science. Students in Industrial Engineering may elect PSY 1010 (Introduction to Psychology) to satisfy both of these requirements, as psychology is a science integral to the human components of industrial engineering.

The remaining group and exposure area requirements are: American Society and Institutions (AI), Foreign Culture (FC), Historical Studies (HS), and Visual and Performing Arts (VP), and Cultural Diversity (CD). Engineering students at Wayne State have very little flexibility in their programs until they reach the level of their technical electives. As a result, the College of Engineering has decided that these four sociohumanistic courses provide an opportunity for flexibility and exploration for the undergraduate engineering students. Students are allowed to select any course from the approved list of classes for each of these group and exposure areas. They are encouraged to explore various areas of the social sciences and humanities through these courses in order to broaden their educational experience.

Several of the Foreign Culture (FC) courses also carry Cultural Diversity (CD) designations, and students are encouraged to select one of these classes so that they may satisfy their university requirements with the minimum number of credits. Students who are fluent in a foreign language or graduated from a foreign (non-English speaking) high school may petition for documentation of their completion of the FC requirement. At this time, no similar mechanism has been established for the CD requirement. The College has proposed to the Associate Vice President for Undergraduate Programs and General Education that study-abroad experiences carry Cultural Diversity designation, even if equivalent courses are not completed at the foreign university. If this is approved, it will provided added opportunity for Engineering students to pursue study abroad without taking a significant number of credits beyond their degree requirements. This proposal will be discussed in upcoming year as the new general education program continues to be implemented.

Through the 2005 to 2006 academic year, the College of Engineering has accepted any passing grade for sociohumanistic courses that are not otherwise prerequisites for engineering classes. Thus, while students were required to earn at least a C- in their math, science, English, and engineering courses, they were allowed to apply grades of poor (D+, D, D-) towards their degree in social science and humanities classes. Beginning with Fall 2006, students must earn no lower than a C in all courses that they plan on applying towards their requirements for a BS in engineering. This change in
policy both simplifies advising and demonstrates to the students that the Engineering faculty place equal value on the broad, liberal arts education that they receive through the General Education program.

2.7 Faculty

The Department of Civil and Environmental Engineering has 10 full-time faculty positions, including the department chairman. At the time this report is being prepared (May 2006), two of the faculty positions are vacant; however, one of them is likely going to be filled if our offer is accepted by the candidate selected. The department is assisted by a number of part-time / adjunct faculty who teach graduate and, to a lesser extent, undergraduate courses. Four graduate teaching assistant (GTA) positions are allocated to the department by the College to provide support for laboratory instruction, problem sessions, homework / project grading, and assisting the students with their questions. One GTA is assigned to each specialty area, namely, structures, geotechnical, transportation and water/environmental. An additional graduate teaching assistant is assigned to the BE courses taught by the CEE faculty; this GTA also covers the construction specialty area.

The Department unexpectedly found itself with two open faculty positions due to the sudden death of a faculty member (Dr. Kagawa) in October 2005, and the resignation and departure of another (Dr. Yesiller) effective the end of December 2005. Both of these faculty members were from the geotechnical engineering discipline. The Dean allowed only one of the positions to be filled for the 2006/2007 academic year. The faculty chose to pursue a candidate specializing in transportation or geotechnical engineering for this position. After the search and screening process concluded, the best candidate identified was a person whose background is in transportation. The decision about the second vacant position will be made next year. Most likely this position will be filled with a person having a strong background in geotechnical engineering.

The names and specialty areas of full-time faculty, including the individuals recently lost, are as follows:

Haluk Aktan, PhD., PE - Structures
Gongkang Fu, PhD., PE - Structures
H.C. Wu, PhD. – Structures

Takaaki Kagawa, PhD., PE – Geotechnical (died in October 2005)
Nazli Yesiller, PhD. – Geotechnical (resigned effective December 31, 2005)

Thomas Heidtke, PhD. - Water and Environmental
Carol Miller, PhD., PE - Water and Environmental

Tapan Datta, PhD., PE - Transportation
Snehmay Khasnabis, PhD., PE – Transportation
Mumtaz Usmen, Ph.D., PE – Geotechnical, Materials and Construction

Dr. Aktan specializes in structural engineering and design and is responsible for the required CE 4420 (Reinforced Concrete Design) and CE 6370 (Adv. Reinforced Concrete Design), which is a design elective.

Dr. Fu specializes in structural engineering and design, and is responsible for CE 4410 (Steel Design) as well as CE 6340 (Bridge Design and Evaluation) and CE 6410 (Adv. Steel Design), both design electives.

Dr. Wu specializes in structural and infrastructure engineering, and is responsible for CE 4400 (Structural Analysis) and CE 6330 (Adv. Structural Analysis), a technical elective. He also teaches BE 1300/1310 (Basic Engineering II: Materials Science for Engineering Applications and Lab).

Dr. Kagawa specialized in geotechnical engineering, and prior to his death, was responsible for CE 5510 (Geotechnical Engineering I) and CE 5520 (Geotechnical Engineering II), both design electives.

Dr. Yesiller specializes in geotechnical engineering and until her departure was responsible for CE 4510 (Introduction to Geotechnical Engineering), and CE 6580 (Geoenvironmental Engineering I). The latter course is a design elective.

Dr. Heidtke specializes in water resources and environmental engineering and is responsible for CE 4210 (Introduction to Environmental Engineering), CE 4850 (Engineering Economy), CE 5230 (Water Supply and Wastewater Engineering) and CE 6150 (Hydrologic Analysis and Design). The latter two courses serve as design electives.

Dr. Miller specializes in hydraulics and environmental engineering. She is responsible for CE 3250 (Applied Fluid Mechanics), CE 6130 (Open Channel Hydraulics) and CE 6190 (Groundwater). Again, the latter two courses serve as design electives within the curriculum. Dr. Miller also teaches BE 1200 (Basic Engineering I: Design in Engineering).

Dr. Datta specializes in transportation engineering and is responsible for CE 4640 (Transportation Design) and CE 5610 (Highway Design) and CE 6660 (Pavement Management Systems), which are both design electives.

Dr. Khasnabis specializes in transportation engineering and is responsible for CE 4600 (Transportation Engineering).

Dr. Usmen specializes in geotechnical engineering, construction materials, and construction management, and is responsible for CE 4450 (Civil Engineering Materials), CE 4510 (Introduction to Geotechnical Engineering), CE 4995 (Senior Design Project). He also teaches BE 1200 (Basic Engineering I: Design in Engineering) and is responsible for all technical electives taught in the construction management specialty
area.

Condensed resumes of the full-time faculty, except for Dr. Kagawa and Dr. Yesiller, are presented in Appendix I-B. Careful review of these resumes clearly shows that our faculty members are accomplished scholars with excellent records of research funding and publications, and participate significantly in university, professional and civic service activities for enrichment. Assessments also indicate that they have also been very dedicated and successful teachers highly respected by the students.

The department has historically not depended on part-time faculty for undergraduate instruction, engaging them mostly for graduate courses. However, in recent years we have been forced to change this approach to some extent due to a number of factors. For one, we have had sabbatical leaves by the full-time faculty forcing us to hire qualified part-time faculty as substitutes to teach the required core undergraduate courses (example- CE 4440 taught by Dr. Wu, who went on a sabbatical leave in Fall 2005). Another factor was that Dr. Khasnabis, who regularly taught two required undergraduate courses (CE 4600 and CE 4850), moved to the Dean’s office as Associate Dean for Research. This change in responsibilities significantly constrained his time available for teaching. We had to bring in part-time faculty to take over some of his responsibilities. In the case of CE 4600, we preferred to engage our senior PhD students rather than hiring from outside. This worked very well for us. In the case of CE 4850, another full-time faculty member, Dr. Heidtke, agreed to assume responsibility for teaching that course. Again, this approach worked very well.

When we assign a course to a part-time faculty, one of our full-time faculty members assumes responsibility for providing guidance to him/her. The full-time faculty member keeps in touch with progress and developments in the course throughout the semester for quality control purposes. This process is especially rigorous with our required courses. Many of our part-time faculty members are relatively recent graduates of our department, so this mentoring relationship has been very successful. In addition, since a majority of our part-time /adjunct faculty are employed by industry, students benefit from the practitioners' perspectives in the classroom. Our full-time faculty keep abreast of important developments within industry and practical applications of engineering theory through continuous interactions with civil engineering practitioners who serve as part-time faculty. Resumes of our part-time / adjunct faculty can be found in Appendix I-B. Based on available SET scores, we have been generally very pleased and satisfied with the teaching effectiveness of our current part-time faculty. If it comes to our attention that a part-time faculty is not effective in teaching, we address the issue vigorously and correct the deficiency quickly, usually within the current semester. If things don’t improve, we seek a qualified replacement.

Interactions between the full-time faculty and industry are obviously not limited to contacts with part-time faculty. Faculty involvement with professional activities gives them significant exposure to industry issues and practices. Many of our faculty members also work with local governments and private firms on research projects, gaining further insights and experience pertaining to professional practice. Frequently, industry
representatives who interact with the faculty visit our campus to present guest lectures. In many cases, these interactions are facilitated by our CEE Advisory Board members. Finally, many practicing engineers are students in our graduate program and are therefore continually interacting with the faculty.

The University, the College, and the Department are fully committed to faculty development and our faculty have taken advantage of the resources offered to them by our institution. The department allocates funds to every faculty for at least one trip per year to a major, domestic, out-of-state conference, short course or workshop. Additional funding is made available for in-state conferences as justified. The College, the Department and the faculty cost share the expenses for international trips. Normally one international trip is supported every two years. University funding for travel support is available for special cases as justified. Besides travel funds, financial support is provided to the faculty for instructional equipment, books and supplies, as well as student assistant support when funding is available.

The Office of Teaching and Learning housed in the Adamany Undergraduate Library is an excellent on-campus resource center for the faculty to attend training courses and workshops on effective teaching, distance learning, web-based instructional delivery, etc. Again, our faculty have taken full advantage of this resource. Furthermore, the College has made training of faculty to improve teaching effectiveness a priority through seminars and distribution of pertinent literature. The department has funded younger faculty to attend short courses and visit other campuses to develop expertise in emerging technical and professional topics.

As is evident from the information provided in Tables I-2, I-3, and I-4 in Appendix I-A, the number and quality of our full-time and part-time faculty are sufficient to effectively cover all curricular areas of our program. Although the department has operated with 10 full-time faculty members, it has been able to offer a very diverse curriculum with the help of the adjunct faculty. After filling the second vacant full-time faculty position next year, we would like to acquire an additional faculty position in the area of water and waste water engineering to better develop our experimental capability in this field. This would expand opportunities for hands-on laboratory experiences for our students. In the longer term, growing student interest in construction management may lead us to consider adding a faculty position in this area of specialization as well.

With few exceptions, the evaluation of teaching by our undergraduate students has generally shown that full-time and part-time faculty are both doing an excellent job. This conclusion is supported by results of SET (Student Evaluation of Teaching) scores available at the end of each semester. The department has enjoyed excellent stability with minimal faculty turnover over the past ten years. It has recently run into an unexpected disruption in continuity as described previously. Nevertheless, we expect this problem will be solved by the end of the 2006/2007 academic year. Senior faculty members have continued to grow professionally and have experienced significant success in their interactions with local industry, professional societies, as well as prominent committees and activities relevant to their areas of expertise. The (relatively) new hires have blended
well with the rest of the faculty. We hope this opportunity to fill two vacant full-time faculty positions will enable us to bring younger talent to the department, thereby placing its future in the hands of the “next generation” as retirements begin to take place in the coming years.

2.8 Facilities

2.8.1 Instructional Labs and Classrooms

The Department of Civil Engineering is equipped with modern, state-of-the-art laboratory facilities, most of which are utilized for hands-on student exercises as part of the undergraduate curriculum. The labs are also equipped with personal computers available for testing control and data acquisition as well as use by students for data analysis, computing, graphics, report preparation and general-purpose work. Almost all of the civil engineering laboratories are used by the faculty for research purposes; a great majority of the laboratories serve a dual purpose and accommodate both research and educational activities. Information on individual labs is provided below.

**Structures and Materials Laboratory:** This laboratory supports the Civil Engineering Materials course (CE 4450). It is equipped with aggregate, cement, asphalt, concrete and steel testing facilities, which can also be adapted for testing other materials such as timber, polymer composites, rock, etc. The aggregate testing equipment encompasses sieve analysis as well as specific gravity and unit weight measurement systems. Cement and asphalt testing apparatus include Vicat, mortar cube, fineness, penetration, Marshall mix-design and voids analysis test systems. We have capability for performing mix-design and performance tests on fresh (plastic) and hardened concrete (slump, air, compressive strength, tensile and flexural strength, and elastic modulus), and a curing tank for curing concrete cylinders is available in this laboratory. In addition, we have a 550,000 pounds capacity MTS Universal Testing Machine for testing specimens of various types and sizes in compression, tension and other modes of loading. Also available is a two directional in-plane load frame with vertical compressive capacity of 229,000 pounds, tensile capacity of 159,000 pounds and horizontal compressive capacity of 146,000 pounds, tensile capacity of 90,000 pounds. The vertical actuator reaction mechanism consists of two roller systems. The rollers prevent transverse moment at the interface of the horizontal actuator. Both actuators have a 20-inch stroke capability and are mounted on a steel frame with adjustable columns to allow for specimens of various sizes up to 20 inches by 36 inches in cross-section. These loading devices are completely computer controlled for load application and data acquisition.

Also housed in this laboratory is a significant nondestructive testing capability. The nondestructive testing equipment for property evaluation, condition assessment and defect evaluation are: infrared thermographic digital camera; boroscope; ultrasonic test system with 50KHz to 1 MHz frequency transducers and two channel acoustic emission system with 150 KHz wide band transducers primarily used for concrete; impact-echo system including instrumented hammers; corrosion monitoring Hall sensors; and eddy
current sensors. Equipment specific forensic inspection of field specimens applicable to hardend concrete tests are an apparatus for rapid chloride ion permeability test and an apparatus for acid soluble chloride content measurement test. These technologies are introduced to the students as part of the Civil Engineering Materials course (CE 4450).

**Infrastructure Materials Laboratory:** This facility complements the Structures and Materials Lab and essentially serves as an advanced composites testing and evaluation laboratory. It houses a universal testing machine (MTS Model 810) with complete digital control and strain gages, and mixing and molding equipment to produce high performance fiber reinforced concrete. Also available in this lab are two environmental chambers for freeze-thaw testing, two high-temperature furnaces, a digital camera and optical microscope, acoustics and other meters, and general tools. In addition, the lab is equipped with networked PC’s, a printer, and a scanner.

**Geotechnical Engineering Laboratory:** This laboratory houses: all the soil classification testing apparatus (sieve analysis, hydrometer analysis, Atterberg Limits); soil preparation and Proctor compaction equipment; permeability (constant and falling head, and triaxial), one-dimensional consolidation, unconfined compression, direct shear, and triaxial shear testing machines. All consolidation and shear testing systems are networked with a computer for automated load control and data acquisition. In addition to this standard equipment, we have dynamic triaxial / resilient modulus, CBR and other specialized testing systems with electronic and computer support for students’ use in this laboratory. This laboratory supports the experimental component of the Introduction to Geotechnical Engineering course (CE 4510).

**Geoenvironmental Laboratory:** This laboratory supplements the Geotechnical Laboratory, as well as the Structures and Materials Laboratory, by providing several pieces of equipment for geosynthetics testing and advanced testing of hydraulic conductivity by a Trautwein flexible-wall permeameter. The two major pieces of equipment in this laboratory are a 100KN capacity Instron Universal Testing Machine for multipurpose uniaxial testing and a large (7ft by 7ft by 7ft) environmental chamber for durability exposure investigations. Additional equipment housed in this laboratory includes nondestructive ultrasonic testing devices with peripherals and several PC’s for data acquisition and analysis.

**Environmental Laboratory:** This laboratory offers somewhat modest testing capabilities for water and waste water characterization and quality assessment. It is equipped with a ventilating hood and several benches. Representative testing equipment housed in this lab include various glassware, Mettler electronic scale, tube aggregate filter, Milton Roy absorption spectrometers, an atomic absorption unit, conductance resistance meter, glass still, gravity oven, muffle furnace, and incubation chambers. There are also several PC’s in this laboratory available for student use.

**Hydraulics Laboratory:** The equipment available in this laboratory supports the experimental needs of our fluid mechanics / hydraulics course (CE 3250), as well as the groundwater hydraulics course (CE 6190) and engineering hydraulics course (CE 6130).
Primary instructional equipment utilized in the hydraulics lab includes a tilting flume (with two pumps and a recirculating flow system), three hydraulic laboratory benches equipped with reservoirs and pumps to perform various bench-top flow and energy loss experiments, a head loss demonstration board, and soil moisture suction testing equipment. This lab is also equipped with PCs for general purpose use, data analysis and graphics. Approximately 60 students receive experimental training in this laboratory each academic year.

Transportation Laboratories: This is a recently established facility housed in the Schaver Building that is dedicated to the Transportation Research Group headed by Dr. Tapan Datta. This group engages a large number of graduate and undergraduate students in sponsored research related to various aspects of traffic engineering and safety. Student responsibilities include activities as varied as: literature review; field data collection; preparation of roadway drawings, graphs, tables and charts; comprehensive analysis using specialized traffic engineering and statistical software; developing recommendations for roadway and traffic operation improvements; and report preparation. Excellent facilities are available at the TRG including a well-stocked library, traffic engineering software on each student’s computer, and a shared driving simulator facility with the Department of Occupational Therapy. The TRG staff is housed on the second and third floors of the Schaver Building with approximately 2500 square feet including 1500 square feet for student offices and a 200 square foot conference room. The remaining square footage houses administrative staff and associated services. The student offices include three large rooms accommodating six students and seven individual offices. The TRG employs between 15 and 25 students, each with a state-of-the-art computer loaded with the most recent traffic engineering software, computer aided drafting software, statistical software and word processing software. Much of this software also is incorporated in the delivery of the CE 4600 and CE 4640 courses.

Computer Labs: Although the department does not have a separate computer laboratory, there are several fully-networked computers (PC’s) installed in each of the aforementioned laboratories which are made available for student use. The Construction and Facilities Management (CFM) Laboratory, located in the Manufacturing Engineering Building, is essentially a computer lab open to students taking the Senior Design course and the Introduction to CAD in Civil Engineering course. At a lower priority, the facility is available to other undergraduate and graduate civil engineering students for general purposes. This lab is equipped with 18 PC’s with internet connection and software comprised of the MS suite, AutoCAD, and project management software, as well as a high speed printer capable of producing larger (13” X 17”) prints. While computer access is limited at the department level, excellent facilities exist for use by students at the College and University level. (For detailed information on library and computer resources, please refer to appropriate sections in Appendix II: Institutional Profile.)

Class Room Facilities: The College holds classes in both general, University classrooms and a small number of classrooms located within College buildings. Most classes that are held in general classrooms are scheduled in Manoogian Hall, State Hall, and Old Main –
all located on the south end of campus in close proximity to the College complex. Multimedia carts, equipped with LCD projectors and DVD players, are available through the University Library system for most general classrooms and can be reserved for specific dates in the class calendar or for the entire semester. The CEE department provides the faculty and students with a laptop and an LCD projector in Manoogian, or in any other classroom on or off campus when needed for PowerPoint presentations.

The College has outfitted three classrooms for regularly scheduled lecture courses. All three classrooms are equipped with wireless and wired Internet access, LCD projector and computer, document camera, and multimedia projection capabilities (e.g. DVD, VHS, etc.). 1500 Engineering, the Engineering Auditorium, holds 150 students in a standard, auditorium configuration. 2409 Engineering is a smaller, seminar-style room capable of holding up to 40 students seated at moveable tables. This room is suitable for both lecture-style courses and discussion or team-based coursework. Both 1500 Engineering and 2409 Engineering are also equipped with T-1 line distance education facilities for 2-way communication with off-campus sites, including the University’s extension centers in Oakland and Macomb counties. The third Engineering classroom is room 1005 in the Manufacturing Engineering Building (MEB). This class is most frequently used by the BE 1200 (Basic Engineering I: Introduction to Design) course as the tables can be easily reconfigured to support team-based work.

Computing Infrastructure
Significant resources are annually invested in the computing systems that support the educational programs of the College, both through General Fund allocations and the share of the University-collected Omnibus fund that is returned to the College. The infrastructure is managed by two departments within the College of Engineering in cooperation with the University’s Division of Computing and Information Technology.

The Advanced Technical Services (ATS) Group provides networking support throughout the College, maintaining and improving both the wired and wireless networks. Significant attention is paid to network security, including firewalls and front-end virus scanning of incoming email messages. This group is also responsible for maintaining the servers that support shared Engineering software, back-up systems, email, and web pages. ATS will also assist departmental technicians with hardware set-up and configuration for educational laboratories and faculty researchers. The three full-time staff members have over 40 years combined experience in network design, management, and systems integration as well as over 40 years of experience in electronics repair. ATS staff are on-call 24 hours a day to provide emergency support in the event of major network or system failures.

The Engineering Computer Center (ECC) has a multi-faceted mandate, including management of College computer classrooms, multimedia support of Engineering classrooms, development and implementation assistance for instructional technology, implementation of the new laptop mandate, web development, and management of the College’s software licenses. This is accomplished with a full-time staff of 5 full-time IT
and multi-media experts supported by four part-time IT experts and 15 student assistants, with the latter drawn from Engineering and Computer Science.

A list of the College’s software and hardware resources, those directed to educational programs, are listed in the tables on the following pages. In addition, Engineering students have access to the University’s computer laboratories, which are described in section A.6.2 of Appendix II.

The computers in 2351 Engineering are slated for upgrade over the summer of 2006, and $50,000 has been budgeted for this upgrade. Participation in the PACE Partnership Program will provide opportunities for the College to obtain hardware and software at no cost or reduced prices this summer and in future years.

### 2.8.2 ASCE Student Chapter Room

The students of the ASCE student chapter at Wayne State University are provided a room by the College. It houses desks, tables, shelves, and chairs, and is equipped with PC’s and a printer for student use. Generally members of our ASCE student chapter are the most active students in the department. Members of our Chi Epsilon student chapter also use this room for a variety of purposes. Primarily, this facility serves as a study room or meeting place for organizational meetings, although it also provides a social environment for students to relax between classes or after an exam. Next year students are planning to purchase various codes and standards for the general use of the ASCE chapter members. The room was just remodeled by the students to improve overall conditions. The room was painted and most of the furniture was recently replaced. The ASCE student chapter also sells various snacks and drinks to raise money for projects or to purchase items for the room.
### COLLEGE OF ENGINEERING – COMPUTER LABORATORIES AND LICENSED SOFTWARE

<table>
<thead>
<tr>
<th>Room</th>
<th>Hours</th>
<th>Number</th>
<th>OS</th>
<th>Hardware Description</th>
<th>Projector</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2359 Engineering</td>
<td>M-F 8am – 10 pm, Sa, Su 8 am – 8 pm</td>
<td>37</td>
<td>Windows 2000</td>
<td>Gateway 1.8 GHz Pentium 4, 512 MB RAM, 80 GB HD, CDRW, 19” display</td>
<td>Yes</td>
<td>Open Lab Reservation</td>
</tr>
<tr>
<td>2351 Engineering</td>
<td>M-F 8 am-10 pm, Sa, Su 8 am – 8 pm</td>
<td>21</td>
<td>Windows 2000</td>
<td>Gateway 700 MHz Pentium 4, 512 MB RAM, 80 GB HD, CDRW, 19” display</td>
<td>Yes</td>
<td>Open Lab Reservation</td>
</tr>
<tr>
<td>1005 Engineering</td>
<td>Class schedule</td>
<td>12</td>
<td>Windows XP</td>
<td>Laptops</td>
<td>Yes</td>
<td>Classroom use only</td>
</tr>
<tr>
<td>2360 Engineering</td>
<td>M-F 8 am-10 pm, Sa, Su 8 am – 8 pm</td>
<td>21</td>
<td>Linux</td>
<td>Spaceball, 2.2 GHz, 1.5 GB RAM, 160 GB HD</td>
<td>Yes</td>
<td>Open Lab Reservation</td>
</tr>
<tr>
<td>Student Laptop Program</td>
<td></td>
<td>NA</td>
<td>Windows XP Tablet</td>
<td>Gateway M285E, 1.5 GHz, 1 MB RAM, 40 GB HD, CDR/W/DVD, 802.11a/b wireless</td>
<td>NA</td>
<td>Student Possession</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Software Title</th>
<th>Purpose</th>
<th>Platform</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abaqus</td>
<td>FE Analysis</td>
<td>Linux, UNIX, Windows XP</td>
<td>2360 Engineering, UGL Advanced Computing Lab, UNIX servers</td>
</tr>
<tr>
<td>Acrobat Reader</td>
<td>Utility</td>
<td>Linux, Windows</td>
<td>All computer labs, Student laptops</td>
</tr>
<tr>
<td>Acrobat Distiller</td>
<td>Utility</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Altair Hypermesh</td>
<td>FE Pre-processing</td>
<td>Windows</td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX servers</td>
</tr>
<tr>
<td>Altair Hyperworks</td>
<td>FE Pre and Post-processing</td>
<td>Linux, Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>AutoCAD 2004</td>
<td>CAD</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Bricx Command Center</td>
<td>NQC Development System</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Cadence</td>
<td>Integrated Circuit Design</td>
<td>Linux</td>
<td>2360 Engineering, UGL Advanced Computing Lab, UNIX servers</td>
</tr>
<tr>
<td>CE 4600 Tools (custom software)</td>
<td>Transportation analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Composite Materials Analysis Program</td>
<td>Material analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Control Station</td>
<td>Controller design</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Cradle SSi</td>
<td>Media processing</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Cute PDFWriter</td>
<td>PDF creation</td>
<td>Windows</td>
<td>Student laptops</td>
</tr>
<tr>
<td>Exceed</td>
<td>PC X server</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
</tbody>
</table>

6 Extended hours can be arranged by a faculty member in support of major classroom projects.
<table>
<thead>
<tr>
<th>Software Title</th>
<th>Purpose</th>
<th>Platform</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>FastForm 3D</td>
<td>Metal forming simulation</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>FEMFAT</td>
<td>FEA and fatigue analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Flowmaster</td>
<td>Computational fluid dynamics</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Fluent</td>
<td>Computational fluid dynamics</td>
<td>Windows, UNIX</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX server</td>
</tr>
<tr>
<td>GNU C Compiler 2.45</td>
<td>Programming</td>
<td>UNIX</td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX server</td>
</tr>
<tr>
<td>GNU Fortran 77 Compiler</td>
<td>Programming</td>
<td>UNIX</td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX server</td>
</tr>
<tr>
<td>Highway Capacity Software</td>
<td>Traffic simulation</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Hyperview Player</td>
<td>FE Post-processing</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Hypersys</td>
<td>Chemical process simulation</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Internet Explorer</td>
<td>Web browser</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Java Runtime SUN</td>
<td></td>
<td>Windows</td>
<td>Student laptops</td>
</tr>
<tr>
<td>Labview</td>
<td>Data acquisition</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>LS-Dyna</td>
<td>FE Analysis</td>
<td>Windows, UNIX, Linux</td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX server</td>
</tr>
<tr>
<td>MADYMO 5.4</td>
<td>Rigid body analysis</td>
<td>UNIX</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>MathCAD 2001i</td>
<td>Numerical analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>MATLAB 6.1</td>
<td>Numerical analysis</td>
<td>Windows, UNIX</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>MaxPlus</td>
<td>Design (legacy)</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Microsoft Front Page</td>
<td>Web design</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Microsoft Office 2000 (Excel, Outlook, PowerPoint, Project, Word)</td>
<td>Office Productivity</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Microsoft OneNote</td>
<td>Tablet Utility</td>
<td>Windows</td>
<td>Student laptops</td>
</tr>
<tr>
<td>Microsoft Visio</td>
<td>Product planning</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Microsoft Visual Studio (Basic, C++, Fox Pro, InterDev, J++)</td>
<td>Programming</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Minitab</td>
<td>Probability and Statistics</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>MixSim 1.7</td>
<td>Simulation of stirred mixing tanks</td>
<td>UNIX</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Software Title</td>
<td>Purpose</td>
<td>Platform</td>
<td>Availability</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Mozilla FireFox</td>
<td>Web Browser</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, Student laptops</td>
</tr>
<tr>
<td>MSC.NASTRAN</td>
<td>FE Analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, UNIX servers</td>
</tr>
<tr>
<td>Net Snippets</td>
<td>Utility</td>
<td>Windows</td>
<td>Student laptops</td>
</tr>
<tr>
<td>Norton Anti Virus</td>
<td>Utility</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, Student laptops</td>
</tr>
<tr>
<td>NQC Compiler</td>
<td>Programming</td>
<td>Windows</td>
<td>Student laptops</td>
</tr>
<tr>
<td>Passer II</td>
<td>Transportation Analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Patran</td>
<td>FE Analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, UNIX servers</td>
</tr>
<tr>
<td>Polymath</td>
<td>Numerical Analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Primavera</td>
<td>Project Management</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>Prolog Project Manager</td>
<td>Project Management</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
</tr>
<tr>
<td>PuTTY</td>
<td>Terminal Emulation</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, Student laptops</td>
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<tr>
<td>QuickTime 5.02</td>
<td>Utility</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, Student laptops</td>
</tr>
<tr>
<td>Risa3D</td>
<td>Structural Analysis and Design</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<td>RiskPro</td>
<td>Risk Management</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<tr>
<td>Sage Dictionary and Thesaurus</td>
<td>Utility</td>
<td>Windows</td>
<td>Student laptops</td>
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<td>SciLab</td>
<td>Numerical Analysis</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<td>Simple OCR</td>
<td>Utility</td>
<td>Windows</td>
<td>Student laptops</td>
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<td>Sketchpad GSP</td>
<td>Mathematical Visualization</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<tr>
<td>StampPlot Lite</td>
<td>Analog and Digital Plotting of Controls</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<tr>
<td>Spybot Search and Destroy</td>
<td>Utility</td>
<td>Windows</td>
<td>Student laptops</td>
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<tr>
<td>Sun compilers (C, C++, Fortran 77, Fortran 90)</td>
<td>Programming</td>
<td>UNIX</td>
<td>2360 Engineering, UGL Advanced Computer Laboratory, UNIX servers</td>
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<td>Tanner EDA</td>
<td>Circuit design</td>
<td>UNIX, Windows</td>
<td>2351 and 2359 Engineering</td>
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<td>Transyt 7F</td>
<td>Traffic Network Simulation</td>
<td>Windows</td>
<td>2351 and 2359 Engineering</td>
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<td>Unigraphics 18</td>
<td>CAD/CAE/CAM</td>
<td>UNIX, Windows</td>
<td>2351 and 2359 Engineering</td>
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<td>WinZip 8.0</td>
<td>Utility</td>
<td>Windows</td>
<td>2351 and 2359 Engineering, Student laptops</td>
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<td>XML Editor</td>
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<td>Windows</td>
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</table>
2.8.3 Future Laboratory Plans

The Department of Civil and Environmental Engineering has participated in the planning, programming and design of a new 28 million dollar facility to be named the Engineering Development Center (EDC). Ground breaking is expected in the spring of 2007. We will acquire about 7,000 square feet of new laboratory space in this new building, which will be dedicated partially to a Traffic Simulation Laboratory and partially to a new Advanced Composites Laboratory. These labs will be equipped with state-of-the-art simulation, testing and evaluation systems and space will be made available to the students for participation in research and related educational activities. A student activities area is also planned for the EDC, which will allow our students to undertake activities related to the concrete canoe, steel bridge, and other competitions organized by ASCE and other civil engineering organizations.

Another important laboratory development currently planned is the establishment of the Bridge Engineering Lab. This lab will be used to support the technical elective course Bridge Design and Evaluation (CE 6340) in addition to other research functions. It will provide opportunities for students to observe and experience bridge engineering practice, including design, management, physical measurement, computer modeling, etc. The lab will maintain: PCs and software for bridge design; bridge management systems Pontis and Carris; computer controlled measurement for strain, displacement, and temperature; an environmental conditioning chamber with control of temperature and humidity; and imaging technology, including high resolution cameras and software for image processing, etc. It is envisioned that the current geoenvironmental and geotechnical laboratories will be combined into a single lab, with some equipment from the geoenvironmental lab moved to the geotechnical lab to make room available for this new facility.

2.9 Institutional Support and Financial Resources

State Appropriations
Due to reductions in appropriations at the state-level, financial resources are tight. With the transfer of the budgetary process to the Provost’s Office in 2003, substantial efforts have been made to protect the academic side of the University enterprise while adjusting the University budget to account for the funding reduction. From 2002 to 2006, the state appropriation to the University was reduced by $40 million, almost 15%. Tuition increases partially compensated for this reduction (while keeping Wayne State undergraduate tuition below the average for public universities in the State of Michigan); however, substantial cuts in administrative positions, hiring freezes for non-faculty positions, and contractual negotiations were required to balance the budget.

WayneFirst Capital Campaign
Recognizing the financial challenges faced through continued reductions in state appropriations, the President identified private philanthropy as one way to replace lost revenue – especially in the area of scholarships, building renovations, and novel programs. The official kick-off to the campaign was in May of 2005, and as of May 2006 over $320 million had been raised by the University. The University has provided three full-time development officers to the College in support of fund raising efforts. Current goals outlined in the College’s case study include building
and equipping the Engineering Development Center, funding endowed chairs in each department, establishing endowed scholarships, and providing a continual source of funding for the Engineering Honors Program, including research stipends for participating students.

**New Sources of Revenue**

Through the rebudgeting process, the College of Engineering lost several non-faculty positions that had been previously supported through General Fund monies. The College has since looked for innovative ways to replace and augment these positions.

In 2003, the Board of Governors approved differential tuition (initially $50/credit hour) at the graduate level for students in the College of Engineering and School of Business Administration. A substantial portion (50% in AY03-04, 75% in AY04-05, 85% in AY05-06) of this revenue is returned directly to the College and is available to support educational and research programs. Common College priorities are first funded through this program (e.g. graduate student recruiting, additional academic advising, national design competition sponsorship), and the remaining funds are distributed to the departments for allocation based on department-level priorities. It has been negotiated with the Provost that these funds do not “expire” at the end of a fiscal year and can be carried over without penalty. This allows for more stable funding and long-term planning.

The University administration has recently approved adding a one percent administrative fee onto all non-federally funded research grants and contracts in the College of Engineering. Proceeds from this administrative fee will be used to support an additional professional staff member within the College Business Office to assist with research grant accounts. While this new staff member will not directly impact educational programs, he or she will cover a portion of the current workload of other staff members, allowing them to direct more time towards educational program needs.

**Budgetary Process – University**

Each summer, the Dean and Business Manager from the College of Engineering prepare a budget request that is submitted to the University Budget Office, under the auspices of the Provost.

**Budgetary Process - College**

Within the College of Engineering, the budgeting process has shifted from historic funding to metric-based funding, beginning with a portion of the allocations in Fiscal Year 2003. The precise metrics and weighting used in budget allocations are discussed and agreed upon within the Deans and Chairs bi-weekly meetings each fiscal year before allocations are made. For Fiscal Year 2006, the following metrics were used:

- **General Fund Unrestricted Operating Budget:** faculty head count
- **Differential Tuition:** credit hour enrollment by departmental graduate students
- **Omnibus Funds:** credit hour enrollment by departmental undergraduate and graduate students
- **Graduate Teaching Assistants:** credit hour enrollment in departmental undergraduate and graduate courses, active PhD headcount, graduate research assistantships funded, participation in teaching of core undergraduate courses
- **Part-Time Faculty Budget**: credit hour enrollment in departmental undergraduate and graduate courses, faculty and GTA head count

With the exception of differential tuition and omnibus fund distribution, allocations are based on multi-year averages of student enrollment in order to reduce their volatility from year to year.

**Departmental Allocations**

For the most part the department has been provided adequate financial support from the College (and the University) to sustain its operations. Each year we receive General Fund allocations to cover all full-time faculty salaries (9-month basis); the chair's salary (12-month basis); salaries of five graduate teaching assistants, and one full-time secretary. The full-time technician position historically allocated to the department was sequestered by the University Administration in 2003; however, the College has allocated a half-time technician position during the past two years to partially compensate for this loss. Over the past six years, an Academic Advisor funded by the College has been assigned to the department; however, this position has been shared with other departments. There has not been an advisor serving the civil engineering department since August, 2005. Although a half-time advisor was hired by the College to assist the department, she resigned after a relatively short period and was unable to provide any sustained, meaningful help. The Chairman has repeatedly urged the Dean’s Office to quickly fill this position, but that has not materialized as of yet. The General Fund allocations also cover part-time faculty salaries, and in general, our allocations have been less than our expenditures in this line.

In addition to personnel funding, we are allocated a modest current expense budget to pay for supplies, copying and printing, travel, telephones, and student assistants (for administrative support). A separate budget for equipment had also been provided annually; however, that line has been absent in the past few years. On the other hand, new funding for equipment has been made available to the department by the University in the form of Omnibus funds (mostly earmarked for IT expenditures) and differential tuition returns.

Besides the General Fund allocations, the department receives additional financial resources from donations (gifts from alumni and friends) and from research overhead returns from the University. The College, the Department, and the Principal Investigator each receive a portion of the research overhead. Matching funds are usually made available to the departments by the University on equipment purchases for new faculty start-ups. We are hoping to benefit from this system with the hiring of two new faculty.

Given this modest level of financial support from the University and the College, the department has been making relatively slow progress in developing its laboratory and computer capabilities. In terms of support services, we see considerable room for improvement there as well. The salary structure continues to be a problem in recruiting highly-qualified personnel for secretarial and technician positions. The secretary, supported by the department’s General Fund, and the hourly-paid technician have fallen short of meeting the department's needs for administrative and faculty support, as well as laboratory and computer infrastructure upkeep. We have needed to hire additional (hourly) student assistants to fill existing gaps. Funding for these positions has come partly from faculty research projects / overhead and partly from the department’s discretionary funds.
Table I - 5 in Appendix I-A summarizes the financial resource allocations to the department (actual expenditures) for the past two fiscal years. The table also includes projected allocations for the current and subsequent fiscal year. Please note that the figures for operations reported in the table are based on the expenditures charged to the General Fund. There are additional unreported expenditures charged to the Indirect Cost Return and Discretionary Fund accounts. The figures reported on other budget items are obtained by summing up expenditures charged to the General Fund account, Indirect Cost Return account, CEE Discretionary Fund account, and CEE’s share of the Omnibus Fund account. Equipment expenditures charged to grants and gifts have been added to those charged to institutional funds listed above to arrive at the total amounts.

Processes and Planning for Facility and Equipment Maintenance

While finding initial funds for educational equipment and facilities is a challenge, maintaining funding for their maintenance and, when necessary replacement, presents a greater budgetary dilemma. General fund money must be spent within the budgeted fiscal year, with any remaining balances “taxed” by the University. It is therefore difficult to use these funds to establish an equipment maintenance account. In addition, as the General Fund allocation to the College has been reduced over the past 5 years in parallel with overall university budget reductions, discretionary funds that have been available in the past for emergency repairs have all but disappeared. Three sources of funds have therefore been targeted for these purposes.

One of the primary planned uses for differential tuition is departmental allocation towards needed educational equipment as well as a share of start-up packages for new faculty. As the department receives a substantial fund each year through this mechanism, which can be carried over between fiscal years, differential tuition can be used to establish a fund for deferred maintenance and investment.

University Omnibus funds, which are charged to all registered students based on credit hour enrollment, are also returned, in part, to the individual schools and colleges. Omnibus funds are specifically targeted towards instructional technology and equipment, as well as personnel support of these systems. After College-wide initiatives are deducted from the annual funds returned to Engineering, the balance is provided to the departments. In past years, Omnibus funds have been used to replace outdated computers in the PC labs, update multimedia equipment in the Engineering classrooms, and purchase a large format printer for use by student groups and faculty.

Finally, the College, departments, and faculty receive a share of collected indirect costs from grants and contracts. These funds are a significant source of revenue to faculty for maintenance of research equipment and to departments and the College for both educational and research equipment.

The College and the departments realize the importance of modern and functional equipment to the educational experience of engineering students. All efforts are made to repair and replace equipment as these needs present themselves.

Support Personnel and Institutional Services
Colleges and faculty can always think of ways to improve and expand research and educational programs if additional funds are available for support personnel. Given the financial constraints within the College of Engineering, efforts are always being made to make the most efficient possible use of funding for support personnel. When an area of critical need is identified, all efforts are made to provide opportunities for funding, including through differential tuition allocations.

**Academic Advising**

Within the College of Engineering, academic advising is organized through a co-management structure. The academic advisors report directly to the Associate Dean for Academic Affairs and meet regularly as a group to discuss policies and processes. This opportunity to share information also allows for cross-coverage of departments when an advisor may be away from the office. The advisors are also expected to work closely with their assigned departments in order to understand departmental program goals, policies, and practices so that they may provide the best service to the students.

Academic advisors are expected to monitor student progress, advise students on course selection, enforce College registration policies, set overrides when students meet established criteria or faculty/departmental permission has been given, certify degrees, and support the departmental undergraduate and graduate program directors. The majority of contact time is with undergraduate students, as graduate students frequently also receive academic advising from their research advisor. Advisors do not review waiver requests, but will direct students to the appropriate individual if a policy waiver is sought.

Through 2005, several of the academic advisors had responsibility for more than one department. Due to the importance of academic advising in student retention and satisfaction, the College has committed to providing one dedicated advisor to each department to support both undergraduate and graduate programs. With the exception of Biomedical Engineering (which has only a graduate program), all advisors positions will be full time.

**Administrative and Business Processes Support**

The College of Engineering has centralized many business processes, including account reporting, purchasing approvals, and personnel appointments. Departmental administrative personnel work with the College staff to submit appropriate documentation to initiate purchasing and personnel processes. Departmental administrative assistants who have appropriate qualifications take a greater role in these processes, which provides added efficiency.

Each department in the College has at least one secretarial or administrative assistant position that is supported at least in part by General Fund monies. Unfortunately, University policy makes it difficult to fill these positions during periods of extended medical leave, which will occasionally leave a department short handed. In this case, the College Business Office, other departmental administrative staff, and faculty will typically be called on to take over some of that individual’s responsibilities in these situations.

**Electronics and Machine Shops**
The Electronics Shop, a component of the Advanced Technical Services group, and the Machine Shop are central units within the College. These units provide support for educational programs (including classes) based only on the cost of materials. Support for research programs is provided at a subsidized hourly rate. Capstone design students and students participating in national design competitions make frequent use of the services provided by these offices.

**College Tutoring Services**
Free tutoring is available to Engineering students through two sources. First, the members of Tau Beta Pi provide tutoring in a range of science, math, and engineering courses as one of their many outreach efforts. Secondly, the Associate Dean for Student Affairs has a small budget through which he is able to pay engineering students to provide tutoring in engineering classes. These tutoring sessions are arranged based on individual requests and the students’ schedules.

### 2.10 Civil Engineering Program Criteria

The ABET Program Criteria for civil engineering requires that the program must demonstrate its graduates have:

- a) proficiency in mathematics through differential equations; probability and statistics; calculus-based physics; and general chemistry;
- b) proficiency in a minimum of four recognized major civil engineering areas;
- c) the ability to conduct laboratory experiments and to critically analyze and interpret data in more than one of the recognized major civil engineering areas;
- d) the ability to perform civil engineering design by means of design experiences integrated throughout the professional component of the curriculum; and
e) 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.”

The civil engineering curriculum is designed and ultimately delivered to fully meet these program criteria. Previous sections of this self-study report have discussed in great depth the manner in which we have assessed the curriculum and demonstrated that the aforementioned criteria have been satisfied as a result of meeting the appropriate Program Outcomes linked to these criteria. In more general terms, our curriculum satisfies each of the aforementioned criteria in the following manner:

(a). Required math, chemistry, physics, biology, and probability / statistics courses are intended to achieve targeted proficiencies in these subjects.

(b). Required courses in structural engineering, geotechnical engineering, transportation engineering, and water resources and environmental engineering develop student proficiencies in the required minimum of four recognized major civil engineering areas.

(c). Three Civil Engineering courses -- CE 3250 (Applied Fluid Mechanics), CE 4450 (Civil Engineering Materials) and CE 4510 (Introduction to Geotechnical Engineering) -- include a laboratory component in which students develop the ability to conduct laboratory experiments and critically analyze and interpret engineering data.

(d). Several required courses in civil engineering include extensive design components that ensure design is integrated throughout the professional component of the curriculum. These courses are: BE 1200 (Basic Engineering I: Design in Engineering), CE 2400 (Statics and Strength of Materials), CE 4410 (Steel Design), CE 4420 (Reinforced Concrete Design), CE 4640 (Transportation Design), and the capstone design course CE 4995 (Senior Design Project). In addition, students must take two design electives, with choices available in structural engineering, transportation engineering, water resources and environmental engineering, and geotechnical engineering. These courses collectively meet the ABET criterion for design within the civil engineering curriculum.

(e). Professional practice issues are covered in each of the CE courses and are integrated with the technical content. Specific and highly focused attention to professional practice issues is presented in BE 1200 (Basic Engineering I: Design in Engineering) and in CE 4995 (Senior Design Project).
2.11 Cooperative Education Criteria

Our program does not have a mandatory co-op requirement. However, a large number of our students take advantage of co-op opportunities in the Detroit area and the state of Michigan. Information on co-op educational objectives, quality improvement processes, and sample student and employer survey results will be provided in On-site Exhibit 7.
Appendix I-A

Basic Curriculum
<table>
<thead>
<tr>
<th>Year; Semester or Quarter</th>
<th>Course (Department, Number, Title)</th>
<th>Category (Credit Hours)</th>
<th>Math &amp; Basic Science</th>
<th>Engineering Topics</th>
<th>General Education</th>
<th>Other</th>
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<tr>
<td><strong>Freshman 1st Semester</strong></td>
<td><strong>MAT 2010 Calculus I</strong> 4 ( )</td>
<td></td>
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<tr>
<td></td>
<td><strong>CHM 1225 General Chemistry I</strong> 3 ( )</td>
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<td><strong>ENG 1020 Introductory College Writing</strong> ( ) 4</td>
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<td><strong>BIO 1510 Basic Life Mechanisms</strong> 3 ( )</td>
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<td><strong>CE 2400 Statistics &amp; Mechanics Materials</strong> 4 (X)</td>
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<td><strong>BE 2100 Basic Eng. III: Probability &amp; Statistics in Eng.</strong> 3 ( )</td>
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<td>Year; Semester or Quarter</td>
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<td>Category (Credit Hours)</td>
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<td>CE 4410 Steel Design</td>
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<td>CE 4510 Introduction to Geotechnical Eng.</td>
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COURSE SYLLABI
Course Description

This course provides an introduction to the profession of engineering, tools for engineering analysis and design, and basic engineering design concepts. Students receive hands-on computer laboratory and project management experience, become familiar with various engineering disciplines, learn teamwork, problem solving, and communications skills, and acquire skills in computer software including MATLAB and MATHCAD. (2 Credit Lecture, 1 Credit Lab)

PREREQUISITES  MAT 1800

CO-REQUISITES  NONE

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE LEARNING OBJECTIVES
At the end of this course, students will be able to:
- Identify simple engineering problems
- Examine goals and constraints associated with engineering problems
- Understand fundamental engineering methods and develop skills in their use.
- Understand the fundamentals and principles of engineering design processes and methodologies, and the characteristics of design products and documents
- Plan and successfully execute a variety of basic engineering projects, including a major reverse engineering design project
- Develop and implement simple algorithms and programs as part of the system design
- Develop skills in the use of important software packages that have wide applications in engineering.
- Initiate improved written and oral communications skills.
- Recognize the importance of communication skills and teamwork.
- Gain an appreciation of soft skills, specifically those pertaining to professionalism and ethics.
- Appreciate societal impacts of engineering projects and importance of life long learning

TOPICS COVERED
1. Discussion of course outline, examination, lesson plan, and course objective
2. Engineering, profession
3. Ethics and professionalism
4. Soft skills in engineering education
5. Total quality and teamwork
6. Project management
7. Success strategies
8. Technical communications
9. Problem solving
10. Engineering design –Reverse engineering
11. Lab Overview + email + WORD
12. EXCEL – Algorithms
13. POWERPOINT
14. MATLAB and MATHCAD
15. Engineering design principles
16. Engineering design tools
17. Engineering design processes
18. Engineering design documents
19. Standards and codes
20. Design integration

CLASS SCHEDULE
Tuesdays and Thursdays, 4:00pm – 6:20pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Provides students with skills needed to develop and implement simple algorithms and programs as part of the project design; examine goals, procedures and constraints associated with engineering design problems

RELATIONSHIP TO PROGRAM OUTCOMES
This course aims to link with the following program outcomes:

A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design a civil engineering system, component or process to meet specific needs
D. Collaborate and communicate on multi-disciplinary teams
E. Identify, formulate and solve civil engineering problems
F. Demonstrate understanding of ethical and professional responsibility of a civil engineer
G. Communicate effectively in oral and written form
H. Demonstrate understanding of global and societal issues as they pertain to civil engineering
I. Understand importance of life-long learning and continuing education
J. Demonstrate knowledge of contemporary issues.

PREPARED BY: MUMTAZ USMEN, PhD, P.E
DATE: JANUARY 10, 2006
ME/CE 2400
Statics and Mechanics of Materials
(Required - 4cr.)

COURSE DESCRIPTION
Application of equations of static equilibrium, geometric compatibility and force-deformation in estimation of load-carrying capability of simple structural or machine elements, and in design of those elements against failure. Forces, moments, couples, equilibrium, free body diagrams, centroids, elastic relationships between external forces acting on deformable bodies and associated stresses and deformations. Behavior of structural and machine elements under axial, torsional, and flexural loading; combined stresses; column buckling. Design projects and reports involving design of simple components against failure.

PRE-REQUISITES
MAT 2020 - Calculus, PHY 2175- General Physics, and ME 2060 - Computer-based Engineering Economics and Problem solving (not a prerequisite for CE 2400)

CO-REQUISITES
BE 1300 - Basic Engineering II: Materials Science for Engineering Applications

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE OBJECTIVES
(Letters in brackets refer to BSME Program Educational Outcomes A - K. Abbreviations in brackets refer to the methods of evaluation, with HW = Homework, QE = Quizzes & Exams, PC = Projects or Competitions, PR = Presentations, and RP = Reports.)

Students who successfully complete ME ME2400 will be able to:

1. understand the basic concepts of forces, moments, couples, free body diagrams, and static equilibrium. [A,B,G; HW, QE, PC]
2. understand the basic concepts of geometric compatibility and force-deformation as applied to simple deformable elements of structures and machines.[ A, B, G; HW, QE, PC]
3. analyze the stresses and deformations of simple deformable structural and machine elements under axial, torsional, shear, and flexural loading.[ A, B, G; HW, QE, PC]
4. analyze statically indeterminant structures. [A, B, G; HW, QE, PC]
5. apply equations of static equilibrium, geometric compatibility and force-deformation to estimate load-carrying capability of given simple structural or machine elements. [A, B, G; HW, QE, PC]
6. apply equations of static equilibrium, geometric compatibility and force-deformation to design simple structural or machine elements against failure. [A, B, C, D, F, G, I; HW, QE, PC]
7. use computers as a tool in the practice of engineering. [D; PC]
8. communicate effectively by writing technical reports. [B; PC, RP]
TOPICS COVERED
- Introduction to concurrent forces and equilibrium
- Introduction to stress-strain-temperature relationships
- Introduction to force and couples, free-body diagrams, equivalent force/couple systems
- Introduction to 2-D and 3-D equilibrium, frames, machines, trusses
- Introduction to torsional loading, shafts
- Flexural loading, shear and bending moment diagrams
- Beam deflections, integration method, singularity functions, superposition
- Statically indeterminate beams
- Combined loading, stresses in oblique planes
- Mohr’s circle
- Design and column buckling

CLASS SCHEDULE
- Monday and Wednesday, 5PM - 7:20PM.

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
- This course contributes 4 credits to the Engineering component of the professional program.

EXPECTED PROGRAM OUTCOMES
- It is expected that by the time of graduation, our BSME students will:

  A. be able to understand scientific principles and apply them to the practice of engineering;
  B. be able to communicate effectively;
  C. possess the problem-solving skills, background, and confidence necessary to educate themselves continually throughout their careers;
  D. be able to apply computers as tools for engineering;
  E. be able to apply the basic principles of measurement, data analysis, and design of experiments, learned through “hands-on” laboratory experience;
  F. be able to practice engineering with ethical standards and a responsibility to society;
  G. be able to develop creative solutions to engineering problems;
  H. be able to work well as part of a team;
  I. be able to apply the design process to engineering problems, including the consideration of different technical alternatives while bearing in mind cost, environmental concerns, safety, and other constraints;
  J. be able, based on their first-hand design experience, to analyze, construct, test, and evaluate an engineering design.
  K. be able to connect engineering solutions and designs with contemporary issues, and consider engineering solutions and designs in a global and societal context.

RELATIONSHIP TO PROGRAM OUTCOMES
Specific Course Objectives for this course are strongly related to Program Outcomes A, C and F, G and J.

Specific Course Objectives for this course are related to Program Outcomes B, D, E, H, I and K.

PREPARED BY: Golam Newaz, Ph.D. DATE: February 27, 2006
Syllabus

CE 3250
Applied Fluid Mechanics
(Required – 4cr.)

Course Description
Introduction to fluid properties, fluid forces, energy applications, fluid measurement, and urban applications of water systems. (4 credit)

Prerequisites MAT 2150 and CE 2400

Co-Requisites ME 3400

Textbook and Other Required Material


Book web site: www.mhhe.com/engcs/civil/finnemore/

Course Objectives
At the end of this course, students will be able to:

- Describe, both qualitatively and quantitatively, the engineering properties of a range of fluids, with particular emphasis on water.
- Apply fundamental fluid properties to the solution of fluid statics problems, providing forces and moments on submerged and floating objects.
- Classify a described flow situation as either laminar, turbulent, or transitional flow.
- Express the governing equations of fluid flow (continuity, momentum, and energy) in both narrative and symbolic form.
- Apply the momentum equation for force calculations in both pressurized and free surface flow systems.
- Apply the Bernoulli equation in pressurized flow and free surface flow applications.
- Graphically demonstrate the hydraulic grade line, energy grade line, and system schematic for a pipeline.
- Design a flow measurement strategy for either total volumetric discharge or instantaneous velocity determination.
- Describe the Detroit’s water distribution system, as well as on-going issues with water distribution and supply.
- Document appropriate laboratory techniques and numerical analysis in the completion of fluid mechanic laboratory sessions.

Topics Covered
1. Fluid Properties
2. Fluid Pressure, Measurement and Presentation
3. Static Fluid Forces – Submerged Planes and Curves
4. Bouyancy
5. Continuity Equation
6. Energy Equation
7. Momentum Equation
8. Energy Losses
9. Grade Lines
10. Hydraulic Jump
11. Piping Systems
12. Three-Reservoir Problem
13. Urban Applications of Engineering Hydraulics

CLASS SCHEDULE
Monday, Wednesday 3:00 – 4:50 PM

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Equips the student with the tools to solve basic hydraulics problems. Prepares the student for upper-level undergraduate and graduate-level hydraulics courses in groundwater, surface water, and closed-conduit flow. Prepares student for Part I of the PE exams.

RELATIONSHIP TO PROGRAM OUTCOMES
The course material promotes the following program outcomes:
A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design and conduct experiments; collect and interpret data
C. Design a civil engineering system, component or process to meet specific needs
E. Identify, formulate and solve civil engineering problems
G. Communicate effectively in oral and written form
J. Demonstrate knowledge of contemporary issues
L. Understand professional practice issues germane to the civil engineering profession

PREPARED BY: Carol J. Miller, Ph.D., P.E. DATE: February 1, 2006
Course Description

Engineering ethics and professionalism; introduction to environmental laws; reaction kinetics; principles of mass balance; hydrology and the rational method; Darcy’s law, groundwater and well analysis; water chemistry; water treatment; wastewater treatment; biochemical oxygen demand, dissolved oxygen and Streeter-Phelps oxygen sag curves. (4 credits)

Prerequisites CE 3250

Co-requisites None

Textbook and Other Required Material


Course Objectives

At the end of this course, students will be able to:

- Understand the importance of ethics and professionalism in civil engineering practice
- List and discuss major elements of prominent water treatment and water pollution legislation
- Solve a range of environmental engineering problems using a mass balance approach
- Develop and apply a unit hydrograph to predict distribution of direct runoff for a given design storm
- Apply the rational method to compute design flows for storm sewers
- Apply principles of groundwater hydraulics for analyzing wells
- List and define important physical, chemical and biological characteristics of water and wastewater
- Describe important operations and processes for treatment of water and wastewater
- Compute values of fundamental design criteria for water and wastewater treatment systems
- Derive a Streeter-Phelps oxygen sag curve for a river or stream

Topics Covered

1. Ethics and professionalism in civil engineering
2. Mass balance principles
3. Hydrology, design storms, and unit hydrographs
4. Groundwater hydraulics
5. Analysis of wells under equilibrium and non-equilibrium conditions
6. Water chemistry
7. Design of water and wastewater treatment systems
8. Streeter-Phelps oxygen-sag curves for streams
CLASS SCHEDULE

Tuesdays and Thursdays, 12:50pm – 2:40pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS

Prepares students to properly apply mathematics and science to solve a range of environmental engineering problems. Provides students with skills needed to design water and wastewater treatment systems and to calculate the environmental impacts associated with pollutant discharges to lakes and streams.

RELATIONSHIP TO PROGRAM OUTCOMES

Allows students to build proficiency with respect to the following general outcomes:
A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design and conduct experiments; collect and interpret data
C. Design a civil engineering system, component or process to meet specific needs
E. Identify, formulate and solve civil engineering problems
F. Demonstrate understanding of ethical and professional responsibility of a civil engineer
G. Communicate effectively in oral and written form
H. Demonstrate understanding of global and societal issues as they pertain to civil engineering
J. Demonstrate knowledge of contemporary issues
K. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering
Syllabus

CE 4400
Structural Analysis
(Required – 4cr.)

COURSE DESCRIPTION
Basic concepts of structural analysis; reactions; forces and stresses in trusses and beams; influence lines; elastic deflections; introduction to stiffness and flexibility methods; introduction to computer application. (4 credit)

PREREQUISITES CE 2400

CO-REQUISITES None

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE OBJECTIVES
At the end of this course, students will be able to:
• Quantify load (tension, compression, shear & bending moment) distribution along the segments
• Calculate member forces and displacements for trusses, beams, and frames.
• Use structural analysis software such as RISA 3D

TOPICS COVERED
Review of Basic Concepts
- Structural systems and structural models
- Loading conditions and load combinations
- Applied and reaction forces
- Boundary conditions
- Free body diagrams

Equilibrium of Structures
- Equations of equilibrium
- Condition equations
- Determinacy and stability of structures

Member Forces in Simple Beams
- Principle of superposition

Stiffness Method – Beams, frames, trusses
Flexibility Method – Beams, frames, trusses
Elastic Deflections of Beams
Influence Lines
CLASS SCHEDULE

M – W 5:30 pm – 7:20 pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS

Students are trained with necessary skills to perform analysis of structures tasks that they come across during their studies and in professional career.

RELATIONSHIP TO PROGRAM OUTCOMES

Allows students to begin to build proficiency in the following program outcomes:

A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design a civil engineering system, component or process to meet specific needs
C. Identify, formulate and solve civil engineering problems
D. Communicate effectively in oral and written form
E. Demonstrate understanding of global and societal issues as they pertain to civil engineering
F. Demonstrate knowledge of contemporary issues
G. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering

PREPARED BY: Upul Attanayake, M.Eng.  DATE: April 17, 2006
SYLLABUS

CE 4410  
Steel Design  
(Required – 4cr.)

COURSE DESCRIPTION

This course is the first one for design of steel structures. Its objective is to introduce the students to the concept, requirements, and fundamental skills for steel building structural design. Upon completion of the course, the student is expected to be able to design typical components of steel building structures according to the current US design specifications. (4 CREDITS)

PREREQUISITES  CE4300

CO-REQUISITE  NONE

TEXTBOOK AND OTHER REQUIRED MATERIAL

“Steel Structures: Design and Behavior” by C.G.Salmon and J.E. Johnson, 4th Ed. 1995

COURSE OBJECTIVES

At the end of this course, students will be able to:

• Understand the process of steel building design.
• Understand the material and geometric properties of structural steel used for buildings.
• Determine the load requirements according to building design codes.
• Understand the Load and Resistance Factor Design (LRFD) method of the AISC code.
• Familiar with the AISC LRFD code
• To analyze and design steel tension members according to the AISC LRFD code. To understand and be able to examine the possible failure modes including slenderness, yielding, and fracture. To be able to use effective net area and gross area for respective failure modes.
• To analyze and design basic steel compression members according to the AISC LRFD code for the buckling limit state. To understand the concepts of strength curve and effective length of compression members. To understand and to be able to determine the radius of gyration and the slenderness ratio of compression members. To understand the phenomena of global and local buckling and their treatment in design
• Analyze and design bending members fully braced laterally, according to the AISC LRFD code. This includes meeting the requirements for the limit states of both strength and serviceability.
• To analyze and design bending members not fully braced laterally, according to the AISC LRFD code. This includes meeting the requirements for the limit states of lateral torsional buckling and serviceability
• To analyze and design bending members with compression, according to the AISC LRFD code. This includes meeting the requirements for the limit states of moment magnification and biaxial bending.
• To analyze and design simple bolted connections according to the AISC LRFD code.
• To analyze and design welded connections according to the AISC LRFD code.
TOPICS COVERED

1. INTRODUCTION
   - Principles of Steel Structure Design
   - Steel Buildings
   - Steel Building Members
   - Loads
   - Design Specifications
   - Design Objectives

2. STEEL MATERIAL PROPERTIES
   - Structural Steels
   - Fastener Steels
   - Weld Electrode and Filler Material
   - Stress-Strain Behavior
   - High Temperature Behavior
   - Low Temperature Behavior
   - Brittle Fracture
   - Fatigue Strength
   - Corrosion Resistance and Weathering Steels

3. TENSION MEMBERS
   - Tensile Strength
   - Net Area and Effective Net Area
   - Design Examples

4. COMPRESSION MEMBERS
   - Buckling of Compression Members
   - Compression Member Strength
   - Code Requirements
   - Design Examples

5. BEAMS
   - Stability of Beams
   - Laterally Supported Beams
   - Bending and Shear
   - Laterally Unsupported Beam (lateral buckling)
   - Bending and Shear
   - Biaxial Bending
   - Code Requirements
   - Design Examples

6. BEAM – COLUMNS
   - Combined Bending and Axial Load
   - Moment Magnification
   - Design Requirements and Procedure
   - Design Examples

7. BOLTING AND WELDING
   - Types of Bolts and Their Installation
   - Nominal Strength of Bolts
   - Bolt Design
   - Types of Joints and Welds
   - Nominal Strength of Welds
   - Weld Design
CLASS SCHEDULE
   Tuesday and Thursday, 3:00pm – 4:50pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
   Prepares students to properly apply mathematics and science to solve a range of environmental engineering problems. Provides students the knowledge and skills to understand the processes of steel building design and be able to design steel buildings.

RELATIONSHIP TO PROGRAM OUTCOMES
   Allows students to build proficiency with respect to the following program outcomes:
   A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
   B. Design a civil engineering system, component or process to meet specific needs
   C. Collaborate and communicate on multi-disciplinary teams
   D. Identify, formulate and solve civil engineering problems
   E. Demonstrate understanding of ethical and professional responsibility of a civil engineer
   F. Communicate effectively in oral and written form
   G. Demonstrate understanding of global and societal issues as they pertain to civil engineering
   H. Understand importance of life-long learning and continuing education
   I. Demonstrate knowledge of contemporary issues
   J. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering

PREPARED BY: DR. GONGKANG FU                      DATE: JANUARY 10, 2006
Syllabus

CE4420
Reinforced Concrete Design
(Required – 4cr.)

Course Description

This is the first course teaching the design of concrete structures. The course objective is to introduce the students to design and analysis of reinforced concrete beams for flexure and shear, bond and anchorage, cracking, beam deflection, and serviceability, design of short and slender columns, and elastic flexural analysis of pre-stressed concrete. Each of the afore-mentioned topics will be addressed with respect to relevant ACI Code requirements, cost concerns, safety, and industry practices. (4 credits)

Prerequisites CE 4400, CE 4450

Co-requirements None

Textbook and Other Required Material

Building Code Requirements for Structural Concrete and Commentary, ACI 318-05

Course Learning Objectives

At the end of this course, students will be able to:

- Analyze RC beams with respect to shear and flexure. Rectangular beams, T-beams, and L-beams will be considered.
- Design the above-mentioned beams, including dimensions, longitudinal reinforcement, and shear reinforcement.
- Include bond, anchorage, development length, and serviceability and deflection criteria in beam design.
- Understand and implement principles of integrated beam design.
- Analyze and design short and slender columns, under conditions of both concentric and eccentric loading.
- Understand the effects of pre-stressing steel reinforcement, and carry out designs using elastic flexural analysis.
- Apply relevant portions of the ACI 318 Code to ensure designs are safe and in compliance.
TOPICS COVERED

1. Introduction:
   a. Concrete
   b. Loads, Serviceability, Safety
   c. Design Basis, ACI code
   d. Fundamental Assumptions
   e. Behavior of RC Member under Axial Load

2. Materials and Properties:
   a. Stress-Strain Relationship
   b. Tensile Strength
   c. Modulus of Elasticity
   d. Creep and Shrinkage
   e. Steel Reinforcement

3. Analyses and Design of Beams:
   a. RC beam behavior
   b. Beams Reinforced on Tension Side
   c. Beams Reinforced on Tension Compression Side
   d. T Beams

4. Shear, Torsion and Diagonal Tension in Beams:
   a. Diagonal Tension
   b. RC Beams without Shear Reinforcement
   c. RC Beams with Web Reinforcement
   d. ACI Code Provisions
   e. Axial Force Effects

5. Bond and Anchorage:
   a. Fundamentals
   b. Development Length for Ultimate Strength
   c. ACI Code for Tension Reinforcement
   d. Anchorage by Hooks
   e. Development Length in Compression
   f. Bundled Bars
   g. Cutoff, Bend Point, Splices, Design Example

6. Cracking and Deflections of Beams:
   a. Cracking in Flexural Members
   b. ACI Code for Crack Control
   c. Deflection Control
   d. Deflection under Sustained Loads
   e. Deflections due to Shrinkage and Temperature Changes
   f. Moment vs. Curvature

7. Short Columns:
   a. Axial Compression
   b. Ties and Spirals
   c. Compressions Plus Bending
   d. Interaction Diagrams
   e. ACI Code
   f. Computer Analysis
   g. Bar Splicing

8. Slender Columns:
   a. Concentrically Loaded Columns
   b. Compression Plus Bending
   c. ACI Criteria and Moment Magnifier
9. Pre-stressed Concrete:
   a. Pre-stressing Effects
   b. Pre-stressing Steels
   c. Elastic Flexural Analysis

CLASS SCHEDULE
   Mondays and Wednesdays, 12:50pm – 2:30pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
   Provides students with information needed to design and analysis of reinforced concrete beams for flexure and shear, bond and anchorage, cracking, beam deflection, and serviceability, design of short and slender columns, and elastic flexural analysis of pre-stressed concrete

RELATIONSHIP TO PROGRAM OUTCOMES
   This course intends to develop the following program outcomes:
   A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
   B. Design and conduct experiments; collect and interpret data
   C. Design a civil engineering system, component or process to meet specific needs
   E. Identify, formulate and solve civil engineering problems
   F. Demonstrate understanding of ethical and professional responsibility of a civil engineer
   G. Communicate effectively in oral and written form
   J. Demonstrate knowledge of contemporary issues

PREPARED BY: DR. HALUK AKTAN          DATE: JANUARY 04, 2006
Course Description

This course is designed to provide fundamental principles related to common civil engineering materials to undergraduate civil engineering students. Fundamentals of mechanical analysis of materials are covered. Properties and behavior of various civil engineering materials are discussed in detail. Selection and design of materials based on their intended use in design and construction are emphasized. Laboratory exercises are included in the course as the testing of materials is common practice used in identification of materials as well as determination of material properties and behavior prior and subsequent to construction of civil engineering structures and facilities (3 Credits; 2 hrs lecture and 3hrs lab)

PREREQUISITES
BE 1300

CO-REQUISITES
NONE

TEXTBOOK AND OTHER REQUIRED MATERIAL

“Materials for Civil and Construction Engineers” by M. S. Mamlouk and J. P. Zaniewski

COURSE OBJECTIVES
At the end of this course, students will be able to:

- Determine index properties of aggregate and classify aggregate.
- Determine index properties of cement and classify cement.
- Determine properties of concrete.
- Perform mix design analysis for concrete.
- Determine index properties and basic behavior of asphalt.
- Perform mix design analysis for asphalt.
- Perform mix design analysis for stabilized soils.
- Use phase relations for solving a variety of problems related to concrete, asphalt, and soils.
- Determine basic properties of steel.
- Understand types and basic properties of geo synthetics.
- Understand types and basic properties of composites.
TOPICS COVERED

LECTURE:
1. Introduction: Materials Engineering Fundamentals
2. Aggregate
3. Cement
4. Concrete
5. Asphalt
6. Geosynthetics
7. Stabilized Soils
8. Masonry

LAB:
1. Introduction; Gradation Analysis (ASTM C136)
2. Specific Gravity and Unit Weight (ASTM C127 & ASTM C128)
3. Setting Time of Cement Paste (Vicat Test) and Mortar Cubes (ASTM C191, ASTM C109, ASTM C150, & ASTM C305)
4. Fresh Concrete Properties (Slump and Air Content), 6x12-in Concrete Cylinder Samples, and 7-Day Compressive Strength of Mortar Cubes (ASTM C143, ASTM C231, & ASTM C31)
5. Hardened Concrete (7-day Compressive Strength and Elasticity Modulus) and 14-day Compressive Strength of Mortar Cubes (ASTM C39)
6. Hardened Concrete (14-day Compressive Strength and Elasticity Modulus)
7. Corrosion Mapping
8. Mortar Cubes (28-day Compressive Strength)
9. Rapid Chloride Test (AASHTO T 260)
10. Hardened Concrete (28-day Compressive Strength and Elasticity Modulus)
11. Eddy Current Rebar Location
12. Concrete Plant Visit
13. Ultrasonic Pulse Velocity Test
14. Voids Analysis (ASTM C642)
15. Tensile Strength of Steel

CLASS SCHEDULE
Lecture: Fridays, 10:40 – 12:30
Lab: Fridays, 12:50 – 3:50

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Provides students with knowledge about fundamental principles related to common civil engineering materials, properties and behavior of various civil engineering materials, and selection and design of materials based on their intended use in design and construction.

RELATIONSHIP TO PROGRAM OUTCOMES
This course promotes the following program outcomes:
A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design and conduct experiments; collect and interpret data
C. Design a civil engineering system, component or process to meet specific needs
D. Collaborate and communicate on multi-disciplinary teams
E. Identify, formulate and solve civil engineering problems
J. Demonstrate knowledge of contemporary issues
K. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering

PREPARED BY: NALI YESILLER, PhD

DATE: DECEMBER 10, 2005
**Syllabus**

**CE 4510**

*Introduction to Geotechnical Engineering*

*(Required – 4cr.)*

**Course Description**

This course is designed to provide the fundamental principles of geotechnical engineering to undergraduate civil engineering students. *(4 credits; 3 hrs lecture and 3 hrs lab)*

**Prerequisites**

Recommended CE 2400/3600 Statics and Strength of Materials and CE 3250 Fluid Mechanics

**Co-Requisites**

None

**Textbook and Other Required Material**

Holtz, R. D. and Kovacs, W. D., *An Introduction to Geotechnical Engineering*

Recommended reading for Soil Mechanics / Geotechnical Engineering

Das, B. M., *Principles of Geotechnical Engineering*

**Course Learning Objectives**

At the end of this course, students will be able to:

- Determine index properties of soils and classify soils
- Use phase relations for solving a variety of problems
- Compare and contrast various clay minerals
- Compare and contrast various compaction methods
- Determine seepage through soils
- Calculate effective stress in soils
- Determine amount and time rate of consolidation
- Draw Mohr’s circle and determine strength of soils
- Determine shear strength of soils
- Identify, compare and contrast various types of soil tests

**Topics Covered**

**Lecture:**

1. Origin of Soil / Phase Relations
2. Index Properties
3. Classification
4. Compaction
5. Capillary, Freezing, Shrinkage
6. Hydraulic Conductivity
7. Seepage / Flow Nets
8. Consolidation / Settlement / Time-Rate
9. Shear Strength / Mohr’s Circle / Triaxial Tests
10. Lateral Earth Pressures
11. Foundation Design
LAB:

1. Introduction & Determination of Index Properties
2. Water Content
3. Specific Gravity
4. Sieve Analysis
5. Hydrometer Analysis
6. Atterberg Limits
7. Constant Head Permeability Test in Sand
8. Falling Head Permeability Test in Clay
9. Standard Proctor Compaction
10. Modified Proctor Compaction
11. Direct Shear Test on Sand
12. Unconfined Compression
13. 1-D Consolidation Test

CLASS SCHEDULE
- Lecture - Mondays 5:00 – 8:00 PM
- Laboratory - Friday 12:00 – 3:00 PM

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Students will be introduced to geotechnical engineering terminology. Theoretical, empirical and practical aspects of classification and determination and significance of engineering properties of soils will be discussed.

RELATIONSHIP TO PROGRAM OUTCOMES
This course intends to produce the following program outcomes:
A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design and conduct experiments; collect and interpret data
D. Collaborate and communicate on multi-disciplinary teams
E. Identify, formulate and solve civil engineering problems

PREPARED BY: Mahmoud El-Gamal, Ph.D., P.E.       DATE: April 21, 2006
SYLLABUS

CE 4600
Transportation Engineering
(Required – 4cr.)

COURSE DESCRIPTION
To present an overview of the multimodal transportation system in the United States including highways, railways & airways, and to demonstrate the application of engineering principles in planning, analysis and design of transportation system components. (4 credits)

PREREQUISITES BE 3220

CO-REQUISITES NONE

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE LEARNING OBJECTIVES
At the end of this course, students will be able to:

- The students will be able to understand the various modes of transportation, the transportation system, and the impacts of economies of scale in transportation.
- The students will be able to identify and understand the basic elements of the highway traffic engineering systems that include the roles of the road user, the vehicle, the roadway and the environment.
- The student will be able to understand how human factors affect driver performance in a highway system in terms of perception-reaction time, dilemma zones, visual acuity and lateral displacement.
- The students will be able to classify highways according to the functions they serve (functional classification), with respect to the entity responsible for their construction, operation, and maintenance.
- The students will be able to identify all elements of a highway cross-section and understand how each element affects highway design.
- The students will be able to design the horizontal alignment of a highway including radius of curvature, superelevation and length of superelevation run-off.
- The students will be able to design the vertical alignment of a highway for crest and sag vertical curves, and to determine the required stopping sight distance, passing sight distance, as well as the length of the vertical curve for symmetrical and non-symmetrical curves.
- The students will have an understanding of types of pavements, their structures, and pavement design procedures as per AASHTO guidelines.
- The students will learn the fundamentals of traffic flow characteristics, the relationship between speed, flow and density and specific flow variables including spacing and concentration, headways and flows, and average or mean speed.
- For a roadway network and specified origin and destination points, the students will be able to determine minimum path, maximum flow and develop a minimum spanning tree.
- The student will understand the four-step transportation planning model and solve problems related to (1) Trip Generation, (2) Trip Distribution, (3) Mode Choice and (4) Traffic Assignment.
- The students will understand the basic concepts of urban rail systems in terms of their planning, design and operation.
- The students will understand the concepts of air transportation, including air traffic control and operation, and runway configuration and length.
- The students will be familiar with emerging technologies in transportation which are technology and application oriented.
COURSE DESCRIPTION
A description of design elements of various system components of transportation; including the driver, vehicle and roadway. Traffic flow design elements including volume, density and speed; intersection design elements including delay, capacity and crash countermeasures and terminal design elements including inflow, outflow and circulation.

PREREQUISITES
CE 3250

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE OBJECTIVES
At the end of this course, students will be able to:
• The students will be able to identify and understand transportation issues as related to traffic safety and congestion. Identifying highway infrastructure deficiencies, crash frequency and severity and traffic crash patterns are a few factors related to safety. Increased travel time, air pollution, noise pollution, and gas consumption are a few factors of concern while dealing with congestion problems.
• The students will be able to identify and understand the basic elements of the highway traffic engineering systems that include the roles of the road user, the vehicle, the roadway and the environment.
• The students will be able to understand the concepts related to speed. This includes understanding the differences of time mean speed and space mean speed, performing spot speed studies and analyzing the data in order to assess the speed characteristics on a roadway. The student will be able to prepare a speed distribution and determine the mean speed, standard deviation, and variance, as well as the mode, median and 85th percentile speeds. Design of speed zones in highways/roadways.
• The students will be able to prepare a condition diagram of intersections and roadway segments that shows all of the important geometric characteristics including traffic signals, traffic control devices, lane designation and width, pavement markings, street signs, location of driveways and surrounding land uses along with the necessary critical dimensions.
• The students will be able to prepare collision diagrams from the data available from crash report forms. The students will also be able to analyze the crash data to perform a pattern analysis, identify safety deficiencies and to design appropriate countermeasures to mitigate traffic crashes.
• The students will learn the design standards for signs and pavement markings. This includes the appropriate color, shape, size and placement of signs and markings with respect to the roadway.
• The students will be able to design the optimal signal timing plans for signalized intersections that include calculating the cycle length, number of required phases, along with the effective green time, yellow and all-red intervals.
• The students will learn how to calculate delay using Webster’s model and will understand the concepts of capacity, delay and level of service and will learn how to use the Highway Capacity Software (HCS) to simulate the expected levels of service (LOS) at signalized intersections.
• The students will be able to use the traffic signal warrants, as outlined in the Michigan Manual of Uniform Control Devices in order to determine if an existing traffic signal is warranted, or if a planned traffic signal should be installed.
• The students will be able to design arterial signal progression using time-space diagrams. The students will be able to design an alternating system or a simultaneous system, and will understand the concepts of bandwidth, offset, semi-actuated and actuated controls, and progression speed.
• The students will be able to use access management concepts including parking facilities for commercial developments using appropriate design standards. These include stall lengths and widths, aisle widths, and design of angle parking.
• The students will be able to solve queuing theory related problems, and will understand the concept of queue length, line length, waiting time and service time. The student will be able to use various mathematical distributions in the design of facilities, which experience queueing phenomenon.
• The students will learn about highway capacity, including free flow versus forced flow, jam density, free speed, level of service, and other factors affecting roadway capacity.
• The students will be able to understand the processes and sub-processes of Risk Management and the Highway Safety Improvement Program.
• The students will be able to identify hazardous locations using the frequency method, crash rate method, frequency rate method, rate quality control method, crash severity method, hazardous index method and the hazardous roadway features inventory. They will be able to identify deficiencies and design countermeasures.
• The students will be able to perform effectiveness evaluations using various methods including: before and after study, before and after study with control site, comparative parallel study, and before, during and after study. They will be able to use such techniques and associated statistical tests in the evaluation of performance of completed highway projects.
• The students will learn the concept and procedures for performing traffic impact studies for various new and added developments including office buildings, commercial building, and others.

Topics Covered

1. Discussion of course outline, examination, lesson plan, and course objective
2. The traffic problem
3. Basic elements of traffic engineering system - Chapter 3
   a. The road user
   b. The vehicle
   c. The roadway and environment
4. Introduction to Traffic Studies - Chapter 5
5. Speed - Volume - Density relationship - Chapter 4
6. Speed studies and design of speed limits - Chapter 7
7. Travel time and delay studies - Chapter 7
8. Volume Studies - Chapter 6
9. Design of Traffic Sign Systems - Handouts from MUTCD
10. Design of Pavement Marking Systems - Handouts from MUTCD
11. Design of Roadside Furniture - Handouts from MUTCD
12. Delineators - Handouts from MUTCD
14. Highway Safety - Introduction - Chapter 8
15. Accident analysis and Countermeasure design - Chapter 8
16. Non-accident measures and its use in Countermeasure design
19. Queuing systems - analysis and design
20. Elements to be considered in highway capacity analysis - Chapters 10, 11
21. Capacity analysis and design - rural highways - Chapters 11, 17
   Computer Applications
22. Capacity analysis and design - urban highways
   Computer Applications
23. Capacity analysis and design - intersections - Chapters 18, 21
   Computer Applications
24. Capacity analysis:
   a. Intersection, Computer Applications
   b. Freeway ramps, Computer Applications
25. Parking study and analysis - Chapter 16 (Reference 1)
26. Design of parking facilities - Chapter 16 (Reference 1)
27. Traffic impact studies
28. Traffic signal systems - Chapter 22
29. Design of isolated signals, Computer Applications - Chapter 18
30. Design of linear progression - Chapter 22

CLASS SCHEDULE
Tuesdays and Thursdays, 12:50pm – 2:40pm

CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Prepares students to properly apply mathematics and science to solve a range of transportation engineering problems. Provides students with skills needed to design transportation.

RELATIONSHIP TO PROGRAM OUTCOMES
The purpose of this course is to accomplish the following general outcomes:
A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design and conduct experiments; collect and interpret data
C. Design a civil engineering system, component or process to meet specific needs
D. Collaborate and communicate on multi-disciplinary teams
E. Identify, formulate and solve civil engineering problems
G. Communicate effectively in oral and written form
H. Demonstrate understanding of global and societal issues as they pertain to civil engineering
K. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering

PREPARED BY: TAPAN K. DATTA, Ph.D.           DATE: SEPTEMBER 6, 2005
COURSE DESCRIPTION

PREREQUISITES
Students must be enrolled in a professional engineering program.

TEXTBOOK AND OTHER REQUIRED MATERIAL

COURSE OBJECTIVES
At the end of this course, students will be able to:
• Prepare and interpret a cash flow diagram
• Understand, calculate and apply nominal and effective interest rates
• Compute the present worth, annual worth and future worth of a cash flow time series
• Evaluate investments based on present worth, annual worth, rate-of-return and benefit-cost ratio
• Calculate depreciation using straight-line, sum-of-the-years-digits and declining balance methods
• Calculate before tax and after tax rate-of-return on investment options
• Calculate and interpret expected values for comparing investments under conditions of uncertainty
• Prepare and apply decision trees for making choices under conditions of uncertainty
• Understand the importance of engineering economy principles to personal financial management

TOPICS COVERED
1. Relationship and implications of engineering economy to personal financial management
2. Interest rates, borrowed money and repayment alternatives
3. Single payments, uniform annual payments, gradient series
4. Present worth, annual worth, future worth
5. Rate of return
6. Benefit-cost ratio
7. Depreciation and income tax impact on investments
8. Expected values and decision trees

CLASS SCHEDULE
Tuesdays and Thursdays, 3:00pm – 4:20pm
CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS
Prepares students to properly apply mathematics and principles of engineering economy in analyzing and solving modern engineering problems. Provides students with skills needed to evaluate the economic implications of investment decisions and engineering design, as well as personal financial management.

RELATIONSHIP TO PROGRAM OUTCOMES
Allows students to build proficiency with respect to the following general outcomes:

B. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
F. Identify, formulate and solve civil engineering problems
I. Communicate effectively in oral and written form
K. Demonstrate knowledge of contemporary issues
L. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering
M. Understand professional practice issues germane to the civil engineering profession

PREPARED BY: THOMAS M. HEIDTKE, Ph.D.  DATE: JANUARY 20, 2006
**SYLLABUS**

CE 4995
Senior Design Project
(Required - 3cr.)

**COURSE DESCRIPTION**
Development of capstone design experience through civil engineering projects.

**PREREQUISITES** Senior Standing in Civil Engineering

**CO-REQUISITES** None

**TEXTBOOK AND OTHER REQUIRED MATERIAL**
The Michigan Building Code, County and City Regulations, AISC and ACI and ASCE design manuals.

**COURSE OBJECTIVES**
The objective of this course is to provide the student an exposure to the design of a specific project and get some experience from participating in the project development. Also, to integrate and strengthen students’ knowledge acquired throughout the curriculum, including that to be obtained in this course.

**TOPICS COVERED AND CLASS SCHEDULE**
1. Course Introduction, Student Survey & Teams (Structure, Objectives and Requirements-Student Survey for Team Forming), Project Requirements, (Owner Requirements, Design Criteria, Code and Regulatory Requirements
3. Project management
4. Foundation design
5. Concrete design
6. Steel design
7. Land development & site design
8. Traffic design
9. Team project work
   a. Progress Review
   b. Foundation Design Review
   c. Structural Design Review
   d. Site Design Review
   e. Traffic Design Review
10. Team presentations

**CLASS SCHEDULE**
Fridays, 4.00 -7:00 pm
CONTRIBUTION TO PROFESSIONAL PROGRAM COMPONENTS

The course builds upon and draws on the previous required CE courses in the curriculum and leads to a culminating multidisciplinary design experience.

RELATIONSHIP TO PROGRAM OUTCOMES

This course aims to verify the following proficiencies relative to program outcomes:

A. Apply knowledge of mathematics, science and engineering to solve civil engineering problems
B. Design a civil engineering system, component or process to meet specific needs
D. Collaborate and communicate on multi-disciplinary teams
E. Identify, formulate and solve civil engineering problems
F. Demonstrate understanding of ethical and professional responsibility of a civil engineer
G. Communicate effectively in oral and written form
K. Demonstrate proficiency in using modern engineering tools in the practice of civil engineering
L. Understand professional practice issues germane to the civil engineering profession

PREPARED BY: Chris A. Katsikas, PE, Ph.D. DATE: January 5, 2006
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title and Credit Hours</th>
<th>No. of Sections offered in Current Year</th>
<th>Average Section Enrollment</th>
<th>Type of Class (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 2400</td>
<td>Statics and Mechanics of Materials. Cr. 4</td>
<td>2</td>
<td>12</td>
<td>Lecture 75</td>
</tr>
<tr>
<td>CE 3010</td>
<td>Introduction to CAD in civil Engineering Cr. 3</td>
<td>1</td>
<td>18</td>
<td>Lab. 50</td>
</tr>
<tr>
<td>CE 3250</td>
<td>Applied Fluid Mechanics Cr. 4</td>
<td>1</td>
<td>24</td>
<td>Recitation 75</td>
</tr>
<tr>
<td>CE 4210</td>
<td>Introduction to Environmental Eng. Cr. 4</td>
<td>1</td>
<td>22</td>
<td>Other 100</td>
</tr>
<tr>
<td>CE 4400</td>
<td>Structure Analysis Cr. 4</td>
<td>1</td>
<td>16</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 4410</td>
<td>Steel Design Cr. 4</td>
<td>1</td>
<td>16</td>
<td>Lab. 75</td>
</tr>
<tr>
<td>CE 4420</td>
<td>Reinforced Concrete Design Cr. 4</td>
<td>1</td>
<td>14</td>
<td>Recitation 75</td>
</tr>
<tr>
<td>CE 4450</td>
<td>Civil Engineering Materials Cr. 3</td>
<td>1</td>
<td>17</td>
<td>Other 25</td>
</tr>
<tr>
<td>CE 4510</td>
<td>Introduction to Geotechnical Engineering Cr. 4</td>
<td>1</td>
<td>22</td>
<td>Lecture 75</td>
</tr>
<tr>
<td>CE 4600</td>
<td>Transportation Engineering Cr. 4</td>
<td>1</td>
<td>29</td>
<td>Lab. 100</td>
</tr>
<tr>
<td>CE 4640</td>
<td>Transportation Design Cr. 4</td>
<td>1</td>
<td>13</td>
<td>Recitation 75</td>
</tr>
<tr>
<td>CE 4850</td>
<td>Engineering Economy Cr. 3</td>
<td>1</td>
<td>33</td>
<td>Other 100</td>
</tr>
</tbody>
</table>
Table I - 2. Course and Section Size Summary
(Civil Engineering)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Title and Credit Hours</th>
<th>No. of Sections offered in Current Year</th>
<th>Average Section Enrollment</th>
<th>Type of Class (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 5350</td>
<td>Introduction to Structural Dynamics. Cr. 4</td>
<td>1</td>
<td>9</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 5370</td>
<td>Finite Element Analysis Fundamentals Cr. 4</td>
<td>1</td>
<td>6</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 5420</td>
<td>Alternative Energy Technologies for Various Transportation Modes Cr. 4</td>
<td>1</td>
<td>18</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 5610</td>
<td>Highway Design Cr. 4</td>
<td>1</td>
<td>12</td>
<td>Lecture 75</td>
</tr>
<tr>
<td>CE 5830</td>
<td>Business of Engineering. Cr. 3</td>
<td>1</td>
<td>13</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 6060</td>
<td>Construction Techniques and Methods. Cr. 3</td>
<td>1</td>
<td>16</td>
<td>Lecture 100</td>
</tr>
<tr>
<td>CE 6130</td>
<td>Open Channel Hydraulics Cr. 4</td>
<td>1</td>
<td>24</td>
<td>Laboratory 100</td>
</tr>
<tr>
<td>CE 6270</td>
<td>Environmental Management and Sustainable Development. Cr. 4</td>
<td>1</td>
<td>17</td>
<td>Recitation 100</td>
</tr>
<tr>
<td>CE 6410</td>
<td>Advanced Steel Design. Cr. 4</td>
<td>1</td>
<td>17</td>
<td>Other 25</td>
</tr>
</tbody>
</table>

1. Enter the appropriate percent for each type of class for each course (e.g., 75% lecture, 25% recitation)
### Table I - 3. Faculty Workload Summary  
(Civil Engineering)

<table>
<thead>
<tr>
<th>Faculty Member (Name)</th>
<th>FT or PT</th>
<th>Classes Taught (Course No./Credit Hours)</th>
<th>Teaching Activity Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Course No./Credit Hours)1</td>
<td>Teaching</td>
</tr>
<tr>
<td>Haluk Aktan</td>
<td>FT</td>
<td>Fall 05: CE 4420 (4), CE 7410 (4) Win 06: CE 5370</td>
<td>60</td>
</tr>
<tr>
<td>Tapan Datta</td>
<td>FT</td>
<td>Fall 05: CE 4640 (4), CE 7640 (4) Win 06: CE 7670 (4)</td>
<td>60</td>
</tr>
<tr>
<td>Gongkang Fu</td>
<td>FT</td>
<td>Fall 05: CE 4410 (4), CE 6410 (4) Win 06: CE 5350 (4)</td>
<td>60</td>
</tr>
<tr>
<td>Thomas Heidtke</td>
<td>FT</td>
<td>Fall 05: CE 4850 (3), Win 06: CE 4210 (4), CE 7100 (4) – Graduate Program Officer</td>
<td>70</td>
</tr>
<tr>
<td>Takaaki Kagawa*</td>
<td>FT</td>
<td>Fall 05: Medical leave Win 06: NA</td>
<td>60</td>
</tr>
<tr>
<td>Shehamay Khasnabis</td>
<td>FT</td>
<td>Fall 05: CE 5420 (4) Win 06: CE 7630 (4) – Associate Dean</td>
<td>50</td>
</tr>
<tr>
<td>Carol Miller</td>
<td>FT</td>
<td>Fall 05: CE 3250 (4), CE 6270 (4) Win 06: CE 6130 (4)</td>
<td>60</td>
</tr>
<tr>
<td>Mumtaz Usmen</td>
<td>FT</td>
<td>Fall 05: CE 7020 (4) Win 06: BE 1200 (3) – Dept. Chair</td>
<td>50</td>
</tr>
<tr>
<td>Huang Chai Wu</td>
<td>FT</td>
<td>Fall 05: On sabbatical leave Win 06: CE 7300 (4), CE 7460 (4)</td>
<td>50</td>
</tr>
<tr>
<td>Nazli Yesiller**</td>
<td>FT</td>
<td>Fall 05: CE 4450 (4), CE 5520 (4) Win 06: NA</td>
<td>45</td>
</tr>
</tbody>
</table>

1. Indicate Term and Year for which data apply  
2. Activity distribution should be in percent of effort. Members’ activities should total 100%  
3. Indicate sabbatical leave, etc., under “Other”; Primarily service in our case  
   * Died in October 2005.  
   ** Resigned in December 2005.
Table I - 3. Faculty Workload Summary  
(Civil Engineering)

| Faculty Member (Name) | FT or PT | Classes Taught (Course No./Credit Hours)
AY 05/06 | Teaching Activity Distribution |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>Ahmed Awad</td>
<td>PT</td>
<td>CE 6060 (3)</td>
<td>NA</td>
</tr>
<tr>
<td>Upul Attanayake</td>
<td>PT</td>
<td>CE 4400 (4)</td>
<td>NA</td>
</tr>
<tr>
<td>Mahmoud El-gamal</td>
<td>PT</td>
<td>CE 4510 (4)</td>
<td>NA</td>
</tr>
<tr>
<td>Hani Emari</td>
<td>PT</td>
<td>CE 3010 (3)</td>
<td>NA</td>
</tr>
<tr>
<td>Chris Katsikas</td>
<td>PT</td>
<td>CE 4995 (3)</td>
<td>NA</td>
</tr>
<tr>
<td>Paul Maxwell</td>
<td>PT</td>
<td>CE 5830 (3)</td>
<td>NA</td>
</tr>
<tr>
<td>Deb McAvoy</td>
<td>PT</td>
<td>CE 4600 (4)</td>
<td>NA</td>
</tr>
<tr>
<td>Prasad Nannapaneni</td>
<td>PT</td>
<td>CE 5610 (4)</td>
<td>NA</td>
</tr>
</tbody>
</table>

4. Indicate Term and Year for which data apply
5. Activity distribution should be in percent of effort. Members’ activities should total 100%
6. Indicate sabbatical leave, etc., under “Other”.
Table I - 4. Faculty Analysis  
(Civil Engineering)

<table>
<thead>
<tr>
<th>(Name)</th>
<th>Age</th>
<th>Rank</th>
<th>FT or PT</th>
<th>Highest Degree</th>
<th>Institution from which Highest Degree Earned &amp; Year</th>
<th>Years of Experience</th>
<th>Professional Registration in (Indicate State)</th>
<th>Level of Activity (high, med, low, none)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haluk Aktan</td>
<td>58</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Michigan, 77</td>
<td>6</td>
<td>MI</td>
<td>Med (1)  High Low</td>
</tr>
<tr>
<td>Tapan Datta</td>
<td>67</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Michigan State, 73</td>
<td>17</td>
<td>PA, MI, OH, FL</td>
<td>Med (1)  High Med</td>
</tr>
<tr>
<td>Gongkang Fu</td>
<td>52</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Case Western, 87</td>
<td>10</td>
<td>NY, MI</td>
<td>High (1)  High Med</td>
</tr>
<tr>
<td>Thomas Heidtke</td>
<td>59</td>
<td>Assoc. Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Michigan, 77</td>
<td>6</td>
<td>None</td>
<td>Med (1)  Med Med</td>
</tr>
<tr>
<td>Takaaki Kagawa*</td>
<td>59</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Berkeley, 78</td>
<td>13</td>
<td>TX</td>
<td>Low (1)  High Med</td>
</tr>
<tr>
<td>Shehamay Khasnabis</td>
<td>67</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>North Carolina State, 73</td>
<td>7</td>
<td>MI</td>
<td>Med (1)  High Low</td>
</tr>
<tr>
<td>Carol Miller</td>
<td>49</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Michigan, 84</td>
<td>6</td>
<td>MI</td>
<td>High (1)  High Med</td>
</tr>
<tr>
<td>Mumtaz Usmen</td>
<td>57</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>West Virginia, 77</td>
<td>5</td>
<td>MI, WV</td>
<td>High (1)  High Med</td>
</tr>
<tr>
<td>Huang Chai Wu</td>
<td>48</td>
<td>Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>MIT, 91</td>
<td>10</td>
<td>None</td>
<td>Med (1)  High Low</td>
</tr>
<tr>
<td>Nazli Yesiller**</td>
<td>38</td>
<td>Assoc. Prof.</td>
<td>FT</td>
<td>PhD</td>
<td>Wisconsin 94</td>
<td>0</td>
<td>None</td>
<td>Med (1)  High Low</td>
</tr>
</tbody>
</table>

Instructions: Complete table for each member of the faculty of the program. Use additional sheets if necessary. Updated information is to be provided at the time of the visit. The level of activity should reflect an average over the current year (year prior to visit) plus the two previous years.

(1) Refer to CV for list of societies

* Died in October 2005.
** Resigned in December 2005.
Table I - 4. Faculty Analysis
(Civil Engineering)

| (Name)         | Age | Rank | FT or PT | Highest Degree | Institution from which Highest Degree Earned & Year | Years of Experience | Professional Registration in (Indicate State) | Level of Activity (high, med, low, none) | Professiona | Research | Consulting/Summer Work in Industry |
|----------------|-----|------|----------|----------------|---------------------------------------------------|---------------------|-----------------------------------------------|------------------------------------------| Society     |          |                                |
| Ahmed Awad     | 42  | NA   | PT       | PhD           | WSU                                               | 20                  | Med (1)                                       | Med                                      | High         | Med      | High                           |
| Upul Attanayake| 35  | NA   | PT       | MS*           | WSU                                               | 1                   | Med (1)                                       | High                                     | Low          | Low      |                                |
| Mahmoud El-Gamal| 42 | NA   | PT       | PhD           | Nevada                                            | 20                  | MI, OH                                        | High (1)                                 | Med          | High     |                                |
| Hani Emari     | 29  | NA   | PT       | MS*           | WSU                                               | 9                   | Med (1)                                       | Med (1)                                 | High         | Med      | High                           |
| Chris Katsikas | 48  | NA   | PT       | PhD           | Michigan                                          | 30                  | MI                                            | Med (1)                                 | Low          | High     |                                |
| Paul Maxwell   | 54  | NA   | PT       | BS            | Lawrence Tech.                                    | 32                  | MI                                            | High (1)                                 | Low          | High     |                                |
| Deb McAvoy     | 35  | NA   | PT       | MS*           | WSU                                               | 14                  | MI                                            | Med (1)                                 | High         | Med      |                                |
| Prasad Nannapaneni | 40 | NA   | PT       | MS            | WSU                                               | 10                  | MI                                            | Med (1)                                 | Med          | Med      |                                |

**Instructions:** Complete table for each member of the faculty of the program. Use additional sheets if necessary. Updated information is to be provided at the time of the visit. The level of activity should reflect an average over the current year (year prior to visit) plus the two previous years.

* PhD in progress
### Table I-5. Support Expenditures

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Expenditure Category</th>
<th>1</th>
<th>2</th>
<th>3*</th>
<th>4*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(prior to previous year)</td>
<td>(previous year)</td>
<td>(current year)</td>
<td>(year of visit)</td>
</tr>
<tr>
<td>2003-2004</td>
<td>Operations (1)</td>
<td>$68,960.66</td>
<td>$78,306.67</td>
<td>$70,000</td>
<td>$75,000</td>
</tr>
<tr>
<td></td>
<td>(not including staff)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004-2005</td>
<td>Travel (2)</td>
<td>$15,575.91</td>
<td>$26,485.96</td>
<td>$10,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>2005-2006</td>
<td>Equipment (3)</td>
<td>$19,137.35</td>
<td>$66,918.82</td>
<td>$28,000</td>
<td>$30,000</td>
</tr>
<tr>
<td></td>
<td>(a) Institutional Funds</td>
<td>$18,680.35</td>
<td>$59,981.15</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td>(b) Grants and Gifts (4)</td>
<td>$457.00</td>
<td>$6,837.67</td>
<td>$8,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>2006-2007</td>
<td>Graduate Teaching Assistants</td>
<td>$77,370.02</td>
<td>$77,464.55</td>
<td>$78,000</td>
<td>$80,000</td>
</tr>
<tr>
<td></td>
<td>Part-time Assistance (5) (other than teaching)</td>
<td>$21,947.54</td>
<td>$25,980.51</td>
<td>$29,000</td>
<td>$30,000</td>
</tr>
</tbody>
</table>

### Instructions:

Report data for the engineering unit(s) and for each engineering program being evaluated. Updated tables are to be provide data the time of the visit.

**Column 1**: Provide the statistics from the audited account for the fiscal year completed 2 years prior to the current fiscal year.

**Column 2**: Provide the statistics from the audited account for the fiscal year completed prior to your current fiscal year.

**Column 3**: This is your current fiscal year (when you will be preparing these statistics). Provide your preliminary estimate of annual expenditures, since your current fiscal year presumably is not over at this point.

**Column 4**: Provide the budgeted amounts for your next fiscal year to cover the fall term when the ABET team will arrive on campus.

### Notes:

1. Categories of general operating expenses to be included here.
2. Institutionally sponsored, excluding special program grants (includes discretionary funds).
3. Major equipment, excluding equipment primarily used for research. Note that the expenditures (a) and (b) under “Equipment” should total the expenditures for Equipment. If they don’t, please explain.
4. Including special (not part of institution’s annual appropriation) non-recurring equipment purchase programs.

Do not include graduate teaching and research-assistant or permanent part-time personnel.

*Current estimates*
Appendix I-B

Faculty Resumes
CURRICULUM VITAE

HALUK M. AKTAN, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering

EDUCATION
1972-1977 Ph.D. Civil Engineering
The University of Michigan, Ann Arbor, Michigan

1969-1970 M.S. Civil Engineering
Middle East Technical University, Ankara, Turkey

1965-1969 B.S. Civil Engineering
Middle East Technical University, Ankara, Turkey

PROFESSIONAL APPOINTMENTS
Professor, Department of Civil and Environmental Engineering, Wayne State University, 1991 – Present
Associate Professor, Department of Civil Engineering, Wayne State University, 1986
Assistant Professor, Department of Civil Engineering, Wayne State University, 1980

PROFESSIONAL REGISTRATION
P.E., Michigan (#29256)

PROFESSIONAL SOCIETY MEMBERSHIP
Structural Engineering Association of Michigan (SEAMi)
Chair, Publications Committee, 1998-2001
Member, Professional Issues SE Registration Committee
American Society of Civil Engineers (ASCE)
Faculty Advisor, Student Chapter at Wayne State University
Transportation Research Board
Earthquake Engineering Research Institute (EERI), 1986-1999

PROFESSIONAL CONSULTING ACTIVITIES
Numerous projects dealing with identifying structural failure causes and related expert reports and testimonies.
Numerous projects on structural assessment and adequacy investigations.

PRINCIPAL PUBLICATIONS (LAST FIVE YEARS)


COURSES TAUGHT

Undergraduate:
CEE 4300 Structures I
CEE 4310 Structures II
CEE 4420 Reinforced and Prestressed Concrete Design

Graduate:
CEE 5370 Introduction to FEA
CEE 6370 Advanced Reinforced Concrete Design
CEE 7350 Advanced Structural Dynamics
CEE 7410 Assessment and Upgrade of Structures in Service
CEE 7450 Non Destructive Testing of Structures

SPONSORED PROJECTS (LAST FIVE YEARS):

“Combining Link-slab, Deck Sliding over Backwall and Revising Bearings,” Michigan Department of Transportation, April 16, 2006– April 15, 2008 (Account No.: 337678, $225,131)

“Condition Assessment and Methods of Abatement of Prestressed Concrete Box-Beam Deterioration (Phase I),” Michigan Department of Transportation, October 1, 2003– June 15, 2005 (Account No.: 337678, $125,890)

“Center for Structural Durability Administration” Principal Investigator, Michigan Department of Transportation, February 15, 2001– October 1, 2006 (Account No.: 337679, $110,500)

“Investigate Causes and Develop Methods to Minimize Early-Age Deck Cracking on Michigan Bridge Decks,” Principal Investigator, Michigan Department of Transportation, January 1, 2002–December 31, 2003 (Account No.: 337074, $158,313) (Co-PI Gongkang Fu 50%)

“Causes and Cures of Cracking of Concrete Bridge Barriers,” Principal Investigator, Michigan Department of Transportation, March 1, 2002–August 31, 2003 (Account No.: 337920, $106,766)

INSTITUTIONAL SERVICE

University, Academic Senate 2001-to date
University, 2006-2011 Strategic Planning Leadership Committee
University, Chair, Academic Senate Research Committee 2004 – to date
University, Public Safety Building Renewal Assessment Committee 2006 – to date
University, Academic Senate Research Committee 2002 – 2004
University, Academic Senate Facilities Committee 2001 - 2002
University, Tenure and Promotion Committee 2000-2001
CURRICULUM VITAE

TAPAN K. DATTA, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering

EDUCATION
Ph.D., Civil Engineering – Transportation, Michigan State University (East Lansing, MI), 1973
M.S., Civil Engineering, Wayne State University (Detroit, MI), 1968
Graduate Diploma, Town and Regional Planning, Bengal Engineering College (Calcutta, India), 1965
B.S., Civil Engineering, Bengal Engineering College (Calcutta, India), 1962

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 33)
Faculty, Department of Civil and Environmental Engineering, 1973 – Present
Professor, Department of Civil & Environmental Engineering, 1979 – Present
Chairman and Professor, Department of Civil and Environmental Engineering, 1979 – 1983
Acting Chairman, Department of Civil and Environmental Engineering, 1978 – 1979
Associate Professor, Department of Civil and Environmental Engineering, 1976 – 1978
Assistant Professor, Department of Civil and Environmental Engineering, 1973 – 1976

PROFESSIONAL REGISTRATION
Registered Professional Engineer – State of Michigan, Reg. No. 19947
Registered Professional Engineer – State of Pennsylvania, Reg. No. PE-040997-R
Registered Professional Engineer – State of Ohio, Reg. No. 56275
Registered Professional Engineer – State of Illinois, Reg. No. 062-049332

PROFESSIONAL SOCIETY MEMBERSHIP
Transportation Research Board – Organization Member
Institute of Transportation Engineers – Fellow, Life Member

HONORS AND AWARDS
Honor Member – Chi Epsilon, National Civil Engineering Honor Society
Member – Tau Beta Pi – National Engineering Honor Society
Member – Sigma Xi
College of Engineering - “Arthur Carr” Professorship Award, 2000
College of Engineering Excellence in Teaching Award from Wayne State University College of Engineering, 2003-2004

FUNDED RESEARCH AND GRANTS (LAST 5 YEARS) – PI unless mentioned otherwise
Evaluation of the Signal Timing/Optimization Project in Oakland County, MDOT, (3-37544), 3/6/02-1/31/03, $145,928
Susan Hardwood Training Grant (Co-Investigator) – OSHA Training Material Development for Highway Construction Work Zones and Traffic Control Hazards, OSHA – U.S. Department of Labor, (3-31708), 10/1/03-9/30/05, $199,648
A Study of the Effectiveness of the Use of Traffic Channelizing Devices (Drums) in Work Zones, MDOT, (3-37718), 5/7/04-5/7/05, $211,796
Trip Generation: Fundamentals and Applications, an ITE Professional Development Course, Institute of Transportation Engineers (ITE), (4-46756), 5/24/04-8/16/04, $10,918
Traffic & Safety Engineering Services to MPOs FY04-05, OHSP, (3-36514), 10/1-9/30/05, $150,000
Evaluation of the May ‘Click It or Ticket’ Mobilization, OHSP, (3-36518), 1/19/05-9/30/05, $76,320
US-2 Safety Audits, OHSP, (3-36520), 3/30/05-9/30/05, $21,385
Rural Sub-Sample Observations of Seat Belt Use for the Click It or Ticket Mobilization in Michigan, Preusser Research Group, (4-46830), 4/15/05-8/15/05, $36,000
Traffic & Safety Engineering Services to MPOs FY05-06, OHSP, (3-36522), 10/1/05-9/30/06, $149,957
Safety Observation Surveys, OHSP, (3-36526), 10/5/05-9/30/06, $140,538
Commercial Motor Vehicle Direct Observation Survey, OHSP, (3-36528), 12/16/05-9/30/06, $62,959

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)

A. BOOK CHAPTER AUTHORED

B. REFEREED JOURNAL PAPERS

C. REFEREED PAPERS IN CONFERENCE PROCEEDINGS

INSTITUTIONAL SERVICE
Department Tenure and Promotion Committee
College Tenure and Promotion Committee
Department of College Salary Committee
Michigan Traffic Signal Summit
Oakland County Traffic Signal Summit
Research and Evaluation Team of the Governors Traffic Safety Advisory Commission
Member of the Traffic Engineering/Enforcement Coordinating Committee (TEECC)
Michigan “Stop on Red” Coalition

NATIONAL SERVICE
University Representative to Transportation Research Board (TRB)
CURRICULUM VITAE

GONGKANG FU, Ph.D., P.E.
Professor and Director, Center For Advanced Bridge Engineering
Department of Civil Engineering and Environmental Engineering

EDUCATION
Ph.D., Civil Engineering, Case Western Reserve University (OH), 1987
M.S., Engineering Mechanics, Tongji University (Shanghai, China), 1981
B.S., Civil Engineering, Tongji University (Shanghai, China), 1979

PROFESSIONAL APPOINTMENTS

00- present  Founding Director, Center for Advanced Bridge Engineering,
              Wayne State University, Detroit, MI
01 - present  Professor, Wayne State University, Detroit, MI
96 - 01  Associate Professor, Wayne State University, Detroit, MI
90 - 96  Head, Structures Research
              New York State Department of Transportation, Albany, NY
/Independent Engineering Consultant

PROFESSIONAL REGISTRATION
Registered Professional Engineer- New York # 68752, Michigan # 44127

PROFESSIONAL SOCIETY MEMBERSHIP

Member - American Academy of Mechanics
Member-at-Large - Structural Stability Research Council:
Member - International Association for Bridge and Structural Engineering
Member - Earthquake Engineering Research Institute
Member - International Association of Civil Engineering Reliability and Risk Analysis

HONORS AND AWARDS

Outstanding Faculty Service Award, Engineering Student Faculty Board, Wayne State University 2006
Excellence in Engineering Award, New York State Department of Transportation, Albany, NY, 1991

PATENTS AWARDED
None

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)

Books:
G.Fu (Editor) “Inspection and Monitoring Techniques for Bridges and Civil Structures” Woodhead
Publishing Ltd., 2005
G.Fu “Nondestructive Testing for Steel Highway Bridges”, Chapter 5, Fatigue and Fracture of Steel
Structures, (Ed.) by Jamshid Mohammadi, American Society of Civil Engineers Press, 2004
G.Fu and A.G.Moosa “Health Monitoring of Structures Using Optical Instrumentation and Probabilistic
Diagnosis”, Chapter 8, Condition Monitoring of Materials and Structures, (Ed.) by Farhad Ansari,
American Society of Civil Engineers Press, 2002

Refereed Journal Papers:
J.Ye, G.Fu, and U.Poudel “High-Accuracy Edge Detection with Blurred Edge Model” Computer Vision,
X.Lu, G.Fu, W.Shi, and W.Lu “Dynamic Similitude for Shake Table Model Testing and Its Application to
Engineering Design”, (accepted) Structural Design of Tall and Special Buildings, 2005

Refereed Proceedings Papers:
J. van de Lindt and G.Fu “Highway Bridge Design Load and Locality of Truck Loads” International Association for Bridge and Structural Engineering Symposium on Metropolitan Habitats and Infrastructure, Shanghai, China, Sept. 2004 (CD)
G.Fu “Vehicle Traffic Loads and Bridge Network Renewal Requirements” International Association for Bridge and Structural Engineering Symposium on Metropolitan Habitats and Infrastructure, Shanghai, China, Sept. 2004 (CD)
G.Fu “Management of Truck Loads and Bridges”, Proc. of Second Golf Conference on Roads, Abu Dhabi, United Arab Emirates, March 14-18, 2004 (CD)

COURSES TAUGHT
Undergraduate:
Bridge Design
Engineering Systems
Steel and Timber Structure Design I, II
Reinforced Concrete Structure Design I, II
Graduate:
Advanced Bridge Engineering
Structural Dynamics
Structural Stability
Earthquake Engineering
Random Vibration
Steel Structure Design II
Prestressed Concrete Design

SPONSORED RESEARCH (LAST 5 YEARS)
Enhancement of Michigan’s Bridge Management System (BMS) using Pontis Software (funded by Michigan Department of Transportation), Principal Investigator, September 2005 – August 2007, $150,245
Condition Assessment of Existing Bridge Structures (funded by Georgia Department of Transportation), Principal Investigator, June 2005 - May 2008, $119,478
Center for Advanced Bridge Engineering, (funded by Federal Highway Administration – US Department of Transportation) Principal Investigator (Founding director), Federal FY 2000-06, $1,000,000
Causes and Cures for Bridge Deck Corner Cracking on Skewed Structures (funded by Michigan Department of Transportation) Principal Investigator, $150,185, July 2004 – June 2006

INSTITUTIONAL SERVICE
Chairman, Faculty Assembly Executive Committee
– College of Engineering, Wayne State University (elected, 2004-06)
Academic Operations Committee
- College of Engineering, Wayne State University (1998-99, 2002-04)
Curriculum Vitae

Thomas M. Heidtke, Ph.D.
Associate Professor
Department of Civil and Environmental Engineering

EDUCATION
Ph.D., Water Resources Engineering, University of Michigan (Ann Arbor, MI), 1976
M.S., Water Resources Engineering, University of Michigan (Ann Arbor, MI), 1972
B.S., Industrial Engineering, University of Michigan (Ann Arbor, MI), 1970

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 25)
Associate Professor, Department of Civil and Environmental Engineering, 1981 – Present
Interim Chair, Department of Civil and Environmental Engineering, 1988 – 1989

PROFESSIONAL REGISTRATION
None

PROFESSIONAL SOCIETY MEMBERSHIP
American Society of Civil Engineers
Engineering Society of Detroit

PROFESSIONAL CONSULTING ACTIVITIES
Consultant in the area of Great Lakes water quality management. Occasional consulting projects with Limno-Tech, Inc. in Ann Arbor, MI.

HONORS AND AWARDS
2005 College of Engineering Excellence in Teaching Award
2005 Engineering Student-Faculty Board Outstanding Faculty Award
2004 Engineering Student-Faculty Board Outstanding Faculty Award
2001 Engineering Student-Faculty Board Outstanding Faculty Award
2000 Engineering Student-Faculty Board Outstanding Faculty Award
1998 Engineering Student-Faculty Board Outstanding Faculty Award
1997 Engineering Student-Faculty Board Outstanding Faculty Teaching Award
1996 College of Engineering Excellence in Teaching Award
1996 Engineering Student-Faculty Board Outstanding Faculty Teaching Award
1996 William F. Shepard Award, Michigan Water Environment Association
1995 President’s Award for Excellence in Teaching
1994 Engineering Student-Faculty Board Outstanding Faculty Teaching Award

PATENTS AWARDED
None

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)


**Institutional Service (Last 5 Years)**
- ABET coordinator, Department of Civil and Environmental Engineering, 2004 – present
- Faculty Assembly Executive Committee, 2005 - present
- Graduate Program Officer, Department of Civil and Environmental Engineering, 1998 – 2005
- ASCE Student Chapter Faculty Advisor, 2001 – 2005
- Teaching Workshop Moderator for WSU Graduate School’s training and orientation of incoming GTAs, 2001- 2002.

**Professional Service (Last 5 Years)**

**Professional Development Activities (Last 5 Years)**
- ABET Training Workshop, October 26-27th 2004, Nashville, TN.
CURRICULUM VITAE
Snehamay Khasnabis, PhD
Professor
Department of Civil and Environmental Engineering

EDUCATION
BE Civil Engineering, University of Calcutta, India, 1962
MCE Civil Engineering, N.C. State University Raleigh, N.C., USA, 1970
Ph.D. Civil Engineering, N.C. State University Raleigh, N.C., USA, 1973

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 31)
AT WSU
Assistant Professor, Department of Civil Engineering, 1975 – 1979
Associate Professor, Department of Civil Engineering, 1979 – 1982
Professor, Department of Civil Engineering, 1982 – present
Acting Chairman, Department of Civil Engineering, 1983 – 1984
Chairman, Department of Civil Engineering, 1984 – 1987
Interim Associate Dean of Research, College of Engineering, 2001 Fall – 2004 Summer
Associate Dean of Research, College of Engineering, Since 2005 Winter

OUTSIDE WSU
Visiting Scholar, Transportation Research Board, National Research Council, 1995 Fall
Fulbright Research Scholar and Visiting Faculty, Department of Civil Engineering,
Indian Institution of Technology, Bombay, India, 2004 Fall

PROFESSIONAL REGISTRATION
Registered Professional Engineer in the State of Michigan: #25684

PROFESSIONAL SOCIETY MEMBERSHIP
Transportation Research Board
American Society for Engineering Education
American Society of Civil Engineers
Institute of Transportation Engineers
Tau Beta Pi
Chi – Epsilon
Sigma Xi

PROFESSIONAL CONSULTING ACTIVITIES
Consultant in the area of Traffic and Transportation Engineering

HONORS AND AWARDS
Recipient of Certificate of Accomplishment of the Institute of Transportation Engineers for
Outstanding Faculty Award by the Engineering Students Faculty Board (ESFB), Wayne State Univ. (1999).
Teaching Excellence Award by the College of Engineering, Wayne State Univ. (1999).
Outstanding Faculty Service Award, by the Engineering Students Faculty Board (ESFB), Wayne State Univ. (2003).
Fulbright Research Scholar, India on “Transferability of Asset Management Strategies to Optimize Transportation Investment in India,” (Fall 2004).
PATENTS AWARDED
None

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)

INSTITUTIONAL SERVICE (LAST 5 YEARS)
Graduate Program Officer: Department of Civil Engineering
Member: ABET Assessment Committee, Department of Civil Engineering
Chair: Olbrot Graduate Student Travel Award Committee, College of Engineering
Member: Wayne State University Transportation Committee

PROFESSIONAL SERVICE (LAST 5 YEARS)
Appointed Member of the Transportation Advisory Committee, Southeastern Michigan Council of Governments (SEMCOG).
Taught refresher’s course for Professional Engineers Exam for the Engineering Society of Detroit (ESD) and Michigan Society of Professional Engineers (MSPE).
Member, Executive Committee, Council of University Transportation Center (CUTC), 1998 – 2001.
Member of the Board: Michigan Intelligent Transportation Society (MITS).
Member of Four Group, Transportation Application of Restricted Use Technologies (TARUT). Study sponsored by USDOT and MDOT, conducted by Altarum Institute, Ann Arbor
Reviewer: Journals of the American Society of Civil Engineers, National Research Council, and Institute of Transportation Engineers

PROFESSIONAL DEVELOPMENT ACTIVITIES (LAST 5 YEARS)
Workshop on Transportation Planning Methodologies on Developing Countries (TPMDC), held at the Indian Institute of Technology, Bombay, India, December 2004.
CURRICULUM VITAE

Carol J. Miller, Ph.D., P.E.
Professor
Department of Civil and Environmental Engineering

EDUCATION

B.S.E., Civil Engineering, The University of Michigan (Ann Arbor, MI), 1979
M.S.E., Civil Engineering, The University of Michigan (Ann Arbor, MI), 1980
Ph.D., Civil Engineering, The University of Michigan (Ann Arbor, MI), 1984

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 21)

Professor, Department of Civil and Environmental Engineering, 1998 – Present.
Associate Professor, Department of Civil and Environmental Engineering, 1989 - 1998.
Assistant Professor, Department of Civil and Environmental Engineering, 1984 - 1989.

PROFESSIONAL REGISTRATION

Professional Engineer (Michigan) License #31003

PROFESSIONAL SOCIETY MEMBERSHIP

American Society of Civil Engineers
National Society of Professional Engineers
Environmental Water Resources Institute (EWRI, ASCE)

PROFESSIONAL CONSULTING ACTIVITIES

Consultant in surface water and groundwater hydraulics, 1986 – Present

HONORS AND AWARDS

Rackham Dissertation Fellowship, University of Michigan
H.W. King Hydraulics Fellowship, University of Michigan
1990-91 Career Development Chair Award, WSU
1990 Michigan Society of Professional Engineers, Engineering Educator of the Year
2005 Michigan Society of Professional Engineers, SE Michigan, Engineer of the Year
Tau Beta Pi and Chi Epsilon Inductee

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)


**INSTITUTIONAL SERVICE (LAST 5 YEARS)**

Promotion and Tenure Committee, CEE Department (2000-Present)
Promotion and Tenure Committee, COE (2000-Present)
Academic Operations Committee, 2006
Search Committee, CEE Department, 2006
Search Committee, COE Dean, 2002
Honors College Liaison and Lecturer, 2005
Scholars Day Volunteer, 2005

**PROFESSIONAL SERVICE (LAST 5 YEARS)**

Chi Epsilon Faculty Advisor (2001-2005)
Tau Beta Pi Faculty Advisor (2002-2005)
Keynote speaker and Scientific Committee for Environmental Geotechnology and Global Sustainable Development Conference, Seoul Korea, July 2002.
Invited Panelist for Proposal Funding Selection, National Science Foundation, USDA SBIR Program, and USEPA STAR Program.
Scientific Advisory Committee for GeoEnvironment 2004, Segovia, Spain.
Scientific Advisory Committee for GeoEnvironment 2006, Rhodes, Greece.

**PROFESSIONAL DEVELOPMENT ACTIVITIES (LAST 5 YEARS)**

Board Member, State of Michigan Board of Professional Engineers (1994-2002); Chair (2001-2002).
Worked with the Michigan DEQ, Oakland County, and others in the evaluation of Lake Augmentation Projects in northern Oakland County (2000-Present).
Researched the development and use of flood mapping software and the patent history of same for patent litigation in Dallas, TX (2005-2006).
Evaluated extent of contamination and developed a computer model of the groundwater contamination at a previous copper and brass foundry in Ohio (2001-2002).
CURRICULUM VITAE

MUMTAZ A. USMEN, Ph.D., P.E.
Professor and Chair
Department of Civil and Environmental Engineering

EDUCATION
Ph.D., Civil Engineering, West Virginia University (WV), 1977
M.S., Civil Engineering, California State University (Long Beach, California), 1972
B.S., Civil Engineering, Robert College (Istanbul, Turkey), 1970

PROFESSIONAL APPOINTMENTS
Professor and Chairman, Department of Civil and Environmental Engineering, 1989 – Present
Professor, Department of Civil Engineering, West Virginia University, 1987 – 1989
Associate Professor, Department of Civil Engineering, West Virginia University, 1981 – 1987
Assistant Professor, Department of Civil Engineering, West Virginia University, 1980 – 1981
Interim Department Chair, Department of Civil Engineering, West Virginia University, Aug 1983 – July 1984

PROFESSIONAL REGISTRATION
P.E., West Virginia (#8894); Michigan (#39074)

PROFESSIONAL SOCIETY MEMBERSHIP
• American Society of Civil Engineers (ASCE)
• National Society of Professional Engineers (NSPE)
• Michigan Society of Professional Engineers (MSPE)
• ESD, The Engineering Society of Detroit
• American Society of Engineering Education (ASEE)

PROFESSIONAL CONSULTING ACTIVITIES
Expert witness work on geotechnical and materials engineering, construction project management, and construction safety (numerous)

HONORS AND AWARDS
Faculty Service Award, Alumni Association, Wayne State University, 2005
Selected to the Assembly of Fellows, Michigan Society of Professional Engineers (MSPE), 2004
Distinguished Service Award, Engineering Society of Detroit (ESD), 2002
Engineer of the Year Award, MSPE, 2000
Outstanding Engineer of the Year, MSPE Detroit Chapter, 2000
Selected to College of Fellows, ESD, 1998

PATENTS AWARDED
None

PRINCIPAL PUBLICATIONS (LAST FIVE YEARS)

REFEREED JOURNALS:
Baradan, S. and M.A. Usmen, “Comparative Injury and Fatality Risk Analysis of Building Trades”,
paper accepted for publication in the ASCE Journal of Construction Engineering and Management, 2005


REFEREED CONFERENCE PROCEEDINGS:


SHORT COURSE OFFERINGS (LAST FIVE YEARS)

“Professionalism, Ethics and Leadership”, two-day short course presented at the University of Castilla La Mancha, Ciudad Real, Spain, under a grant from the Rafael del Pino Foundation, October 2005

“Construction and Site Safety”, continuing education seminar presented at the Michigan Society of Professional Engineers Annual Meeting, Belaire, MI, May 2005

COURSES TAUGHT

UNDERGRADUATE:
- Introduction to Engineering Design
- Civil Engineering Materials
- Soil Mechanics
- Foundation Engineering

GRADUATE:
- Earthwork Design
- Advanced Soil Testing
- Pavement Design
- Professional Issues in Engineering
- Construction Organization and Management
- Construction Safety

JOURNAL / ARTICLE REVIEWER

Transportation Research Record, Journal of the Transportation Research Board, National Academy of Engineering
ASCE Journal of Aerospace Engineering
ASCE Journal of Geotechnical and Geoenvironmental Engineering
ASCE Journal of Materials Engineering
ASCE Journal of Construction Engineering and Management
ASCE Practice Periodical on Structural Design and Construction
ASTM Journal of Testing and Evaluation

INSTITUTIONAL SERVICE
IMR Advisory Committee
ELI Review Committee
WSU Delegate to Midwest Universities Energy Consortium (MUEC)
Wayne State University

HWAIC-HUNG WU, Ph.D.
Associate Professor
Department of Civil & Environmental Engineering

EDUCATION
Ph.D., Materials Science & Engineering, Massachusetts Institute of Technology (Cambridge, MA), 1990
M.S., Mechanical Engineering, Auburn University (Auburn, AL), 1985
B.S., Civil Engineering, National Taiwan University (Taiwan), 1981

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 8)
Associate Professor, Department of Civil & Environmental Engineering, 2003 – Present
Assistant Professor, Department of Civil & Environmental Engineering, 1998 – 2003

PROFESSIONAL REGISTRATION
None

PROFESSIONAL SOCIETY MEMBERSHIP
American Society of Civil Engineers
American Society for Composites
Sigma Xi
AAAS

PROFESSIONAL CONSULTING ACTIVITIES
Consultant in the area of mechanics and materials aspects of advanced construction materials, 1996 - Present

HONORS AND AWARDS
Visiting Associate Professor, Hong Kong University of Science and Technology, Oct 2005-Jan 2006
Visiting Associate Professor, Sataima University, Japan, June –Aug 2005
Career Development Chair Award, WSU, 2004
Japan Technology Management Program faculty fellowship, U-M, 1996
AAAS
Sigma Xi

PATENTS AWARDED
One US patent (5,788,760)

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)


**INSTITUTIONAL SERVICE (LAST 5 YEARS)**

Faculty advisor, Student Concrete Bowling Competition, 1st Place, the ASCE North Central Regional Conference, April 5, 2003, Detroit, MI

The Wingerter Award Committee, College of Engineering, member, March 2003

The Engineering Alumni Association Award, College of Engineering, member, March 2003

Scholarship Committee, CEE, Chair, 09/00- present


Academic Operations Committee, College of Engineering, member, 09/00 – present


Faculty advisor, ACI Student Concrete Egg Protection Device Competition, 4th place, March 2001

Faculty advisor, ASCE, WSU Chapter, Aug. 1999- Aug. 2000

**PROFESSIONAL SERVICE (LAST 5 YEARS)**

Program committee member, session co-chair, SPIE’s 11th Inter. Symp. on Smart NDE and Health Monitoring of Structural and Biological Systems, San Diego, CA, March, 2006

Member of International Organization Committee and Session Chair, International Symp. On Bond Behavior of FRP in Structures, Dec. 7-9, 2005; Hong Kong, China.


Program committee member, session co-chair, SPIE’s 10th Inter. Symp. on Smart NDE and Health Monitoring of Structural and Biological Systems, San Diego, CA, March, 2005


Program committee member, session co-chair, SPIE’s 9th Inter. Symp. on Smart NDE and Health Monitoring of Structural and Biological Systems, San Diego, CA, March, 2004

Program committee member, session co-chair, SPIE’s 8th Inter. Symp. on Smart NDE and Health Monitoring of Structural and Biological Systems, San Diego, CA, March, 2003

Organization committee member, SPIE’s 7th Inter. Symp. on NDE for Health Monitoring and Diagnostics, San Diego, CA, 2002

Session Co-chair, SPIE’s 7th Inter. Symp. on NDE for Health Monitoring and Diagnostics, San Diego, CA, 2002


CURRICULUM VITAE

UPUL B ATTANAYAKE
Graduate Teaching Assistant
Department of Civil & Environmental Engineering

EDUCATION
Ph.D., (Candidate), Structural Engineering, Wayne State University (Detroit, MI), 2006
M.Eng., Structural Engineering, Asian Institute of Technology, Bangkok, Thailand, 2001
B.Sc.(Eng.), Civil Engineering, University of Peradeniya, Sri Lanka, 1998

PROFESSIONAL APPOINTMENTS (YEARS OF SERVICE AT WAYNE STATE: 5)
Graduate Teaching Assistant, Department of Civil & Environmental Engineering, Sep. 2004 – Present
Graduate Research Assistant, Department of Civil & Environmental Engineering, Sep. 2001 – Aug. 2004

PROFESSIONAL REGISTRATION
Engineer in Training (EIT)

PROFESSIONAL SOCIETY MEMBERSHIP
American Society of Civil Engineers (Student Member)
American Concrete Institute (Michigan Chapter – Student Member)
Structural Engineering Association – Michigan (SEAMi) (Student Member)

PROFESSIONAL CONSULTING ACTIVITIES
None

HONORS AND AWARDS
Outstanding Teaching Assistant Service Award, April 2006, Wayne State University, Detroit, MI 48202
Dissertation Fellowship: June 2005 – August 2005, Wayne State University, Detroit, MI 48202
Norway Government Scholarship: September 1999 – April 2001, Asian Institute of Technology, Bangkok, Thailand

PATENTS AWARDED
None

PRINCIPAL PUBLICATIONS (LAST 5 YEARS)


**INSTITUTIONAL SERVICE (LAST 5 YEARS)**

None

**PROFESSIONAL SERVICE (LAST 5 YEARS)**

None

**PROFESSIONAL DEVELOPMENT ACTIVITIES (LAST 5 YEARS)**

85th Transportation Research Board (TRB) Annual Meeting, January 22-26, 2006

84th Transportation Research Board (TRB) Annual Meeting, January 09-13, 2005

83rd Transportation Research Board (TRB) Annual Meeting, January 11-15, 2004

ACI Convention Fall 2004, San Francisco, California, October 24-28, 2004


82nd Transportation Research Board (TRB) Annual Meeting, January 12-16, 2003

American Concrete Institute (ACI) Concrete Site Paving Seminar, Grand Rapids, Michigan, May 22, 2002

American Concrete Institute (ACI) Spring Convention, Detroit, Michigan, April 21-25, 2002

How to Design Masonry Structures – Seminar by the Masonry Society and the American Concrete Institute (ACI), Novi, Michigan, December 2001.
CURRICULUM VITAE

Ahmed M. Awad, P.E., P.T.O.E
Part Time Faculty
Department of Civil & Environmental Engineering

EDUCATION
PhD, Civil Engineering/Construction Management, Wayne State University (Detroit, MI)
M.S, Civil Engineering/Construction Management, Wayne State University (Detroit, MI)
M.S, Civil Engineering, Cairo University (Cairo, Egypt)
B.S, Civil Engineering, Cairo University (Cairo, Egypt)

PROFESSIONAL APPOINTMENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Position</th>
<th>Company/Office</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/1996 - 07/2004</td>
<td>Construction Manager, Resident Engineer, Project Control Engineer, and Scheduler</td>
<td>Sigma Associates, Inc., Detroit, MI</td>
</tr>
<tr>
<td>02/1986 - 08/1995</td>
<td>Senior Project Scheduler</td>
<td>Project Management Consultancy Office, Cairo, Egypt</td>
</tr>
</tbody>
</table>

PROFESSIONAL REGISTRATION

“Project Management Professional” (PMP), Project Management Institute.

COURSES TAUGHT AT WSU

CE 6050 – CONSTRUCTION ESTIMATING
CE 6060 - CONSTRUCTION TECHNIQUES AND METHODS.

SELECTED PROJECT EXPERIENCES

4. DWSD CS-1382: Department-Wide As-Needed Information Systems Technical Support, Training and Knowledge Transfer, Detroit, MI
5. Contract PC-744 – Program Management for Detroit Wastewater Treatment Plant – Rehabilitation and Upgrading, Detroit MI
6. Combined Sewer Overflow (CSO) Control Project (Basin, and Pump Station), City of River Rouge, MI.

7. Detroit Water and Sewerage Department, Reservoir Exterior Inspection, Detroit MI.

8. Detroit Metropolitan Airport, Rogell Drive Connector, South Access Drive, Romulus, MI.

9. County of Wayne, Sibley Yard Maintenance Facility, Plymouth Township, MI

10. General Dynamic, Factory 200 Equipment Installation, Cairo, Egypt.


Dr. Awad has twenty (20) years of experience in Project and Construction Management as an expert at scheduling, resource loading, and cost controlling. Experienced in cost estimating, inspection, and oversight services, contract administration, and management. and proficient in the use of Primavera Enterprise, Primavera P3, Microsoft Project, Expedition, Prolog, Maximo, Documentum, and Timberline estimating. He has served as Project Manager, Project Control Engineer, Scheduler, Cost Engineer, Financial Analyst, Office Engineer, and Cost Estimator for several large municipal, automotive, residential, and commercial design/construction projects. Expert at using the scheduling/tracking software applications to develop project baseline schedules, and update project progress schedules. I have an extensive experience in change order, and claim negotiations and resolutions.

PROFESSIONAL SOCIETY MEMBERSHIP

AMERICAN SOCIETY OF CIVIL ENGINEERS
ENGINEERING SOCIETY OF DETROIT
PROJECT MANAGEMENT INSTITUTE

PUBLICATION

CURRICULUM VITAE

MAHMOUD EL-GAMAL, Ph.D., P.E.
Part Time Faculty
Department of Civil & Environmental Engineering

EDUCATION
Ph.D. (Honors), Civil Engineering, University of Nevada (Reno, NV), Dec 1996
M.S. (Honors), Civil Engineering, University of Nevada (Reno, NV), May 1992
B.S., Civil Engineering, El-Mansoura University (Egypt), May 1986

PROFESSIONAL APPOINTMENTS
Adjunct Faculty Member, Wayne State University, College of Engineering, 2006
Adjunct Faculty Member, Lawrence Technological University, 2000 - present

PROFESSIONAL REGISTRATION
Registered Professional Engineer – State of Ohio, State of Michigan

PROFESSIONAL CONSULTING ACTIVITIES
Consultant in the area of seismic and geotechnical earthquake engineering, 1986 - Present

HONORS AND AWARDS
Professional Engineer in Education of the Year, State of Michigan, 2003
Member of Strathmore’s Who’s Who, 2001
Winner of EERI Research Paper Competition, 1996
Outstanding International Students and Scholars Honors (Nevada World Trade Council), 1996
Phi Kappa Phi, Inducted 1992

COURSES TAUGHT AT WSU
CE 4510- Introduction to Geotechnical Engineering

PRINCIPAL PUBLICATIONS


RESEARCH PROJECTS


PROFESSIONAL SOCIETY MEMBERSHIP

American Society of Civil Engineering (ASCE)
National Society of Professional Engineers (NSPE)
Earthquake Engineering Research Institute (EERI)
Phi Kappa Phi (Engineering Honor Society)
CURRICULUM VITAE

MEDHAT M. GHABRIAL, P.Eng., P.E., B.Sc., M.Sc., Ph.D.
Part-Time Faculty
Department of Civil and Environmental Engineering

EDUCATION
Ph.D., Civil Engineering, University of Windsor, 1977
M.Sc., Civil Engineering, University of Cairo, 1974
B.Sc., Civil Engineering, University of Cairo, 1970

PROFESSIONAL APPOINTMENTS
Lecturer (part-time), Department of Civil Engineering University of Windsor, 1977 - 1979
Lecturer (part-time), Department of Civil Engineering University of Windsor, 1979 - 1993
Lecturer (part-time), Department of Civil Engineering, Wayne State University, 2001 to Present

PROFESSIONAL REGISTRATION
Registered Professional Engineer, Province of Ontario since 1978
Designated Consulting Engineer, Province of Ontario since 1984
Registered Professional Engineer, State of Michigan since 1986
Registered Professional Engineer, State of Florida since 1986
Registered Professional Engineer, State of Ohio since 1991
Registered Professional Engineer, Commonwealth of Pennsylvania, since 1990

PROFESSIONAL SOCIETY MEMBERSHIP
- Professional Member: The Precast Concrete Institute (PCI)
- Professional Member: The Canadian Precast Concrete Institute (PCI)
- CSA A23.4 (Precast Concrete Code of Canada) Committee Associate Member
- CPCI – Technical Activity Committee - Member and Design Manual Co-Editor

PROFESSIONAL CONSULTING ACTIVITIES
Consulting: 1979 - Present
Dr. Ghabrial is Vice President of the firms HGS Limited, Windsor, Ontario and Hanna, Ghabrial and Associates Inc., Southfield, Michigan. These firms have been involved in the past twenty-seven years in virtually every type of structural engineering in Canada and U.S. in additional to overseas projects. A central part of this practice is devoted to the analysis, design of precast concrete structures. Dr. Ghabrial has been personally responsible of designing thousands of completed projects in those 27 years of practice.

PATENTS AWARDED
None

COURSES TAUGHT AT WSU:
- CE 6370 - Reinforced Concrete Design
- CE 7995 - Prestressed Concrete

PRINCIPAL PUBLICATIONS
“Use of Structural Precast Concrete in Large Scale Institutional Projects; A case Study: The New Greater Pittsburgh International Airport”. Proceedings of the Fifth International Colloquium on Concrete in Developing Countries. Cairo, Egypt, January 1994.


RESEARCH:
1983 - 1985 Joint research with Dr. G. A. Sayed of the University of Windsor on the analysis and stability of soil steel structures.

1978 - 1980 Research for Ontario Ministry of Transportation and Communication, “Prestressed Waffle slab skew bridges” with Dr. J. B. Kennedy, University of Windsor.

CURRICULUM VITAE

CHRIS KATSIKAS, P. E., Ph.D.
Part Time Faculty
Department of Civil & Environmental Engineering

EDUCATION

Ph.D., Structural / Soil Dynamics, University of Michigan, Ann Arbor
M.S., Civil Engineering, University of Cincinnati
B.S., Structural Engineering, National Technical University Athens, Greece

PROFESSIONAL APPOINTMENTS

Dr. Chris Katsikas is Vice President and Director of Operations at BEI Associates, Inc. a Detroit based architecture and engineering firm. BEI offers complete building design for institutional, commercial and industrial facilities. BEI is an ISO 9001 registered firm and Dr. Katsikas is the acting Quality Director and the Director for Civil and Structural Engineering. Adjunct Professor at the University of Michigan, Ann Arbor campus and Wayne State University.

PROFESSIONAL REGISTRATION

Professional Engineer in the State of Michigan

PATENTS AWARDED

None

COURSES TAUGHT AT WSU

CE 4995 – Senior Design

PRINCIPAL PUBLICATIONS


PARTIAL LIST OF PROJECTS:

DaimlerChrysler Corporation, CTC, Auburn Hills, MI
Managed the structural and noise and vibration control design of the 4,000,000+ square foot automotive technology center which includes the NVH, Squeak and Rattle, environmental, electromagnetic, power train, wind tunnel, component development test and certification and other automotive development labs.

General Motors Corporation, Buick/Oldsmobile/Cadillac Group, Lansing, MI
Managed the design of 40,000+ square foot emissions laboratory addition with vehicle test cells, controlled environmental rooms, and high hazard fueling areas.
Ford Motor Company, Squeak and Rattle Facility, Dearborn, MI
Structural, acoustical and vibration control design of road test simulators facility. The design included the test cells, the hydraulic power unit room, the control room and equipment rooms.

Toyota Motor Corporation, Manufacturing Facility, Georgetown, KY
Structural design and process foundations for the 1,000,000+ square foot stamping, welding, paint and assembly areas. Managed the structural, acoustical, noise and vibration control, design of the 300,000+ square foot of the automotive testing, training and administration centers. Structural design, vibration and noise control for the 200,000+ square foot engine plant.

Nippondenso Sales, Inc., Technical Center, Southfield, MI
Structural design, building acoustical design, special foundations and noise and vibration control of test cells, including an anechoic chamber, engine test cells, high and low temperature chambers.

Amoco Company, APPI Center, Atlanta, GA
Managed the structural design and vibration control of the 200,000+ square foot new research and development facility. Pilot plant equipment acoustical treatment.

IBM Corporation, East Fishkill, NY
Comparison study and vibration design concepts for semiconductor facilities. Vibration measurements and evaluation of the performance of four state of the art semiconductor facilities. Ambient ground vibration study and vibration isolation concepts for the Device Manufacturing Facility. Vibration criteria development and structural design of the process floor Building 350. Noise and vibration control and foundation design of the GTA, MLC, and Crystal Grower Laboratories. Noise and vibration control design of 800,000+ square foot of office, manufacturing, and utility buildings. Environmental Impact Statements for 100,000 square foot of research and development facilities.

US Department of Energy, Tokamak Fusion Test Reactor, Princeton, New Jersey
Investigation of the structural integrity of the Motor Generator Building.

PPG Industries Research Center, Alison Park, Pennsylvania
Structural design of office areas. Structural design of the Training Center.

EXPERIENCE:

Mr. Katsikas has over 30 years of experience in the structural engineering field. He has served as Department Director, Project Manager, and Project Engineer responsible for the design of automotive test cells, industrial, institutional and commercial facilities. His expertise is in concrete and steel structural design, building rehabilitation, acoustical design for buildings, vibration and noise control design for buildings and equipment. He has participated in all aspects of project development, from concept design to construction and supervision. He has directed multi-discipline design teams working on proposals, design drawings and specifications, cost estimates, construction coordination and field inspection of projects.

PROFESSIONAL SOCIETIES:

American Concrete Institute, Member
American Society of Civil Engineers, Member
Institute of Noise Control Engineering, Member
CURRICULUM VITAE

DEBORAH S. MCAVOY, P.E., PTOE
Research Engineer
Department of Civil and Environmental Engineering

EDUCATION
Ph.D., Civil Engineering (Transportation), Wayne State University (Detroit, MI), Expected 2007
M.S., Civil Engineering (Transportation), Wayne State University (Detroit, MI), 2004
B.S., Civil Engineering, summa cum laude, University of Detroit, (Detroit, MI), 1994

PROFESSIONAL APPOINTMENTS
Research Engineer, Wayne State University – Transportation Research Group, 2004 – Present

PROFESSIONAL REGISTRATION
Professional Engineer, Michigan, 2000
Professional Traffic Operations Engineer, 2005

PROFESSIONAL SOCIETY MEMBERSHIP
Institute of Transportation Engineers (ITE), National and Michigan Section
Chi Epsilon – National Civil Engineering Honor Society
Tau Beta Pi – National Engineering Honor Society
American Society of Civil Engineer

PROFESSIONAL CONSULTING ACTIVITIES
Project Manager, Tetra Tech MPS, 2000 - 2004
Project Manager/Project Engineer, Washtenaw Engineering, 1997 – 2000
Project Engineer/Assistant Project Manager, Albert Kahn Associates, 1994 - 1997

HONORS AND AWARDS
Outstanding Client Service Award, Tyrone Township, 2004
Outstanding Client Service Award, Genoa Township, 2003
Eliu Geer Scholastic Achievement Award, 1994
Engineering Student of the Year, 1994

PATENTS AWARDED

PUBLICATIONS AND CONFERENCE PROCEEDINGS


CURRICULUM VITAE

PAUL A. MAXWELL, P.E.
Part Time Faculty
Department of Civil and Environmental Engineering

EDUCATION

B.S., Business Administration, Lawrence Institute of Technology (LTU), 1983
B.S., Civil Engineering, University of Michigan, 1974

PROFESSIONAL APPOINTMENTS

Maxwell Solutions, LLC

Currently 2005: Founder, Managing Member and C.O.O.

- Maxwell Solutions provides project and program management services and consultation for design and construction projects, including planning, scheduling, estimating, project controls, commissioning, and claims analysis functions. Additionally, training and educational programs are provided for these services.

Albert Kahn Associates, Inc.

Responsibilities: Senior Vice President and Director of Project Management – Participation on the Executive Leadership Team with the specific responsibility of advising the President on contract and legal matters associated with projects; Responsible for recruitment, training, assignment, evaluation, coaching, and general management of the AKA Project Management staff; Act as Principal on selected AKA projects; Prepare proposals and make presentation to prospective clients as required; Actively cultivate client contacts through business development initiatives; Serve in the various roles, committees, and task groups in support of AKA’s overall continuous improvement.

2004 Senior Vice President and Director of Project Management
President of Kahn Program Management
AKA Corporate Secretary
Member of Board of Directors
Ford Account Executive
Legal Affairs Liaison
Member of Pension and Profit Sharing Committee
Operations Manual Policy and Procedures Author
Training and Professional Development Committee Chairman
Initial Ford Q1 Committee Member and Co-author of AKA Operations Manual

1994 - 2001 Member of Michigan Barrier Free Design Board (Appointment by Governor John Engler)

Ford Motor Company
Corporate Plant Engineering Office
1978 - 1980 Resident Engineer

McLouth Steel Corporation
1974 - 1978 Civil Engineer

Adjunct Professor
2005 Eastern Michigan Univ.: Planning and Scheduling
2005-2006 Eastern Michigan Univ.: Construction Project Controls
2004-2005 Wayne State Univ.: The Business of Engineering

PROFESSIONAL REGISTRATION
Licensed Engineer in Michigan since 1978
Licensed Builder in Michigan since 1999

COURSES TAUGHT AT WSU
CE 5830 – BUSINESS OF ENGINEERING

PROFESSIONAL SOCIETY MEMBERSHIP
American Arbitration Association

National Society of Professional Engineers

Michigan Society of Professional Engineers
1999 - 2000 Vice President of MSPE Mid-Michigan Region
1995 - 1997 State Director for Ann Arbor Chapter
1994 - 1995 President of Ann Arbor Chapter

Author of MPE Articles:
“Electronic Transfer of Documents”
“AE Errors and Omissions as a Measurable”

American Council of Engineering Companies (ACEC)
Past Director on the Board of Directors of ACEC/MI

Engineering Society of Detroit

Automotive Industry Action Group: Past Member
Member of the Construction Industry Action Group
Continuous Improvement Initiatives Sub-Committee Secretary
Participant in A-E Errors and Omissions Task Group

Association for Project Managers
Author of APM Articles:
“Project Management System”
“ISO Certification”

American Society of Civil Engineers

PUBLIC PRESENTATIONS
2005 ACEC National Fall Conference: “Design Errors and Omissions”
2005 ACEC/MSPE Annual Conference: The Business of Engineering
2005 American Society of Professional Estimators: AIA Documents
2004 PSMJ Resources: Project Management Bootcamps
2004 Wayne State Univ.: Guest Lecturer on “Risk Management”
2003 AIC: Panel Presenter on “Ethics in Construction Industry”
2003 Univ. of Michigan: Panel Presenter on “Engineers in Private Practice”
2001 American Society of Professional Estimators: AIA Documents
2001 ACEC: Executive Roundtable presenter: “Managing a Firm in a Tough Economy”
2001 AGC/ACEC: Panel Presenter on “The Innovative Use of Technology”
CURRICULUM VITAE

PRASAD L.V. NANNAPANENI, P.E., P.T.O.E
Part Time Faculty
Department of Civil & Environmental Engineering

EDUCATION

M.S., Civil Engineering (Transportation), Wayne State University (Detroit, MI), 1994
M.Tech, Transportation, Regional Engineering College (Warangal, India), 1992
B.S., Civil Engineering, Bapatla Engineering College (Bapatla, India), 1988

PROFESSIONAL APPOINTMENTS

Transportation Project Specialist responsible for preparing transportation studies, impact studies for land developments, accident analysis, traffic operations, and safety studies. Also, responsible for preparing traffic control and detours plans, traffic sign design and layout plans. Member of Institute of Transportation Engineers (ITE). Member of ASCE. Member of ITS America. Part-time Faculty at Wayne State University and teaches Highway Design in Winter Semester.

PROFESSIONAL REGISTRATION

P.E., State of Michigan, Reg. No. 51397
P.T.O.E., Transportation Professional Certification Board, Reg. No. 1396

HONORS AND AWARDS

Graduate Teaching Assistant from 1996 to 1997
Graduate Research Assistant from 1992 to 1995
Included in National Dean’s list for academic years 1992-93 and 1993-94.
Recipient of Best Student of the Year Award from ITE Michigan Chapter, 1994.
Recipient of Rama Watmul Scholarship for the Fall 1994. Engineering Student Faculty Board Excellence in Teaching Award, Wayne State University, 1993

COURSES TAUGHT AT WSU

CE 5610 – HIGHWAY DESIGN

PRINCIPAL PUBLICATIONS


Certification/Volunteering:

Certified by MDOT to “Train the Trainer” in Access Management.
Volunteer for reviewing the technical papers from ITE Traffic Engineering Council (TENC)
Volunteer for the ITE proposed Transportation Safety Council Website - Manager for the ITS page.
CURRICULUM VITAE

JAMES R. SEARS
Part Time Faculty
Department of Civil & Environmental Engineering

EDUCATION

M.S., Construction Project Management, Worcester Polytechnic Institute, (Worcester, Massachusetts), 1995
B.S., Management Engineering, Worcester Polytechnic Institute (Worcester, Massachusetts), 1979

PROFESSIONAL APPOINTMENTS

WAYNE STATE UNIVERSITY, Detroit, Michigan
Associate Vice President for Facilities Planning and Management (July 2000 to Present)
Following eight months of interim service, promoted to position of senior facilities officer providing
leadership to 22 professional and 355 staff members from eight collective bargaining units.
Responsible for planning, developing and directing Design and Construction Services, Building
Engineers, Trades, Custodial and Grounds Services, Utilities and Business Services. Operations
include 120 buildings, 11,500,000-sq. ft., and 200+ acres.
Director of Design Services (February 1997 to July 2002)
Directed design and construction project management services from concept through use and
occupancy. Responsibilities included management of project programming, design and construction
phase activities, A/E and contractor selection, contract administration, commissioning, start-up, and
transitioning to O&M phase. Additional services included facilities and capital planning, space
inventory management and cost estimating.
NORTHFIELD MOUNT HERMON SCHOOL, Northfield, Massachusetts
Director of Plant Facilities (June 1991 - February 1997)
Directed staff of 110 providing building maintenance, design and construction, custodial, grounds,
utility, laundry, environmental safety and security, fleet maintenance, postal services, and work
control. Operations included two campuses, 250 +/- buildings, 1,200,000-sq. ft., 3,500 acres, and a
nine-hole golf course.
WESTFIELD STATE COLLEGE, Westfield, Massachusetts
Director of Physical Plant Services (May 1988 through May 1991)
Directed unionized staff of power plant engineers/firemen and custodians. Managed trades and grounds
crew on project work. Coordinated facilities planning, engineering, construction and energy management.
Operations included 17 buildings, 1,100,000 sq. ft., and 227 acres.
NORTON COMPANY, Worcester, Massachusetts
Supervisor of Manufacturing Engineering (June 1987 - April 1988)
Supervisor of Projects/Industrial Engineering (January 1985 - May 1987)
Supervisor of Technical Services (January 1984 - January 1985)
Plant Engineer (September 1980 - December 1983)
Industrial Engineer (July 1979 - September 1980)

COURSES TAUGHT AT WSU

CE 6010 – Introduction to Construction Management
CE 7840 – Facilities Management
CE 7995 – Building Systems
INVITED CONFERENCES

- Speaker: Engineering Society of Detroit, March 2003, Contractual Risk Management and Dispute Resolution
- Speaker: SCUP October 2002 Midwest Conference, Space Inventory Management Systems
- Speaker: Agile Planner Conference at Harvard University – University Housing, October 2001
- Speaker: MiAPPA Winter 2000 Conference, Construction Delivery Systems
- Panelist: Michigan Construction Users Council, October 97 Conference
- Speaker: Eastern Region of APPA, Construction Delivery Systems, 1996 Annual Meeting

PROFESSIONAL SOCIETY MEMBERSHIP

- Adjunct Faculty, Wayne State University College of Engineering, M.S. program in Construction Management
  - Facilities Management - Winter 2004
  - Construction Organization and Management – Winter 2005
  - Building Systems – Winter 2006
- Michigan Chapter of The Association of Higher Education Facilities Officers (MiAPPA): President 2001-2004
Appendix I-C

CEE Advisory Board Membership
### CIVIL AND ENVIRONMENTAL ENGINEERING ADVISORY BOARD, WAYNE STATE UNIVERSITY

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
<th>ADDRESS</th>
<th>PHONE &amp; FAX</th>
<th>E-MAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr. John Banicki</td>
<td>Founder</td>
<td>Testing Engineers &amp; Consultants, Inc. 1333 Rochester Road P.O. Box 249</td>
<td>Ph: 248-588-6200</td>
<td>banickilrectest.com</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Troy, MI 48099</td>
<td>Fx: 238-588-6232</td>
<td></td>
</tr>
<tr>
<td>Mr. Patrick M. Doher</td>
<td>Vice President</td>
<td>Smith Group JJR 110 Miler Ann Arbor, MI 48104</td>
<td>Ph: 734-669-2766</td>
<td><a href="mailto:pdoher@aa.smithgroup.com">pdoher@aa.smithgroup.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fx: 734-662-7520</td>
<td></td>
</tr>
<tr>
<td>Mr. Neal Gehring</td>
<td>Senior Project Consultant</td>
<td>NTH Consultants 480 Ford Field 2000 Brush Street Detroit, MI 48226</td>
<td>Ph: 313-237-3915</td>
<td><a href="mailto:ngehring@nthconsultants.com">ngehring@nthconsultants.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fx: 313-237-2900</td>
<td></td>
</tr>
<tr>
<td>Mr. Russell A. Gronevelt</td>
<td>President</td>
<td>Orchard Hiltz &amp; McCliment Inc. 34935 Schoolcraft Livonia, MI 48150</td>
<td>Ph: 734-522-6711</td>
<td><a href="mailto:russ.gronevelt@ohm-eng.com">russ.gronevelt@ohm-eng.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fx: 734-522-6427</td>
<td></td>
</tr>
<tr>
<td>Ms. Elham Jabiru-Shayota</td>
<td>President &amp; CEO</td>
<td>SIGMA Associates, Inc. 535 Griswold Avenue Suite 1700 Detroit, MI 48226</td>
<td>Ph: 313-963-9700</td>
<td><a href="mailto:eshayto@signaassociates.com">eshayto@signaassociates.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fx: 313-963-7626</td>
<td></td>
</tr>
<tr>
<td>Mr. Fred Levantrosser</td>
<td>Wayne State University</td>
<td>21901 Willoway Road Dearborn, MI 48124-1135</td>
<td>Ph: 313-278-6764</td>
<td><a href="mailto:fredlevantrosser@hotmail.com">fredlevantrosser@hotmail.com</a></td>
</tr>
<tr>
<td></td>
<td>Alumni Association</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mr. Larry E. Powlus</td>
<td>Chief of Design Branch</td>
<td>U.S. Army Corps of Engineers 477 Michigan Avenue Detroit, MI 48226</td>
<td>Ph: 313-225-6756</td>
<td><a href="mailto:Larry.Powlus@ire02.usace.army.mil">Larry.Powlus@ire02.usace.army.mil</a></td>
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<td>Fx: 313-225-3096</td>
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<tr>
<td>Mr. Awni Qaqish</td>
<td>Vice President</td>
<td>Tucker, Young, Jackson &amp; Tull, Inc. 2925 Exmoor Rd Ann Arbor, MI 48104</td>
<td>Ph: 734-971-2546</td>
<td><a href="mailto:qaqish@tyji.com">qaqish@tyji.com</a></td>
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<td>President</td>
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<td>Vice President Corporate Director</td>
<td>Albert Kahn Associates, Inc.</td>
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<td>Mr. Jay Shah</td>
<td>President</td>
<td>Spalding DeDecker Associates, Inc.</td>
<td>248-844-5400</td>
<td>248-844-5404</td>
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<td>Dr. Maria Staab</td>
<td>Environmental Programs Specialist / 6-sigma Black Belt</td>
<td>Ford Motor Land Development Corp.</td>
<td>313-621-6983</td>
<td>313-323-7821</td>
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<tr>
<td>Mr. Raymond J. Tessier</td>
<td>Group Director Environmental Services Worldwide Facilities Group</td>
<td>General Motors Corp. PCC-Motors Central Mail Code 483-520-194 2000 Centerpoint Parkway Pontiac, MI 48341-3147</td>
<td>248-753-5681</td>
<td>248-753-5831</td>
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<tr>
<td>Mr. Larry Tibbits</td>
<td>Chief of Design Branch</td>
<td>Michigan Department of Transp. 425 W. Ottawa P.O. Box 30050 Lansing, MI 48909</td>
<td>517-373-4656</td>
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<td>Mr. Paul Tucker, Jr.</td>
<td>President</td>
<td>Tucker, Young, Jackson &amp; Tull, Inc. 2925 Exmoor Rd Ann Arbor, MI 48104</td>
<td>734-971-2546</td>
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Appendix I-D

Summary of CEE Advisory Board Feedback
(Spring 2005 and Spring 2006)
I. Advisory Board - Department Interactions (Please indicate your response by checking the appropriate box):


1. The CEE Department facilitates regular, meaningful interaction and feedback from the CEE Advisory Board regarding its academic programs.

   Response: 1 2 3 4 5
   Number: 10 2 --- --- --- (CK abstained)

2. The Educational Goals and Program Outcomes for the CEE undergraduate program are clear and appropriate as stated.

   Response: 1 2 3 4 5
   Number: 4 9 --- --- ---

3. The CEE Department provides an undergraduate curriculum that satisfactorily covers the profession of civil engineering in terms of breadth and depth of knowledge.

   Response: 1 2 3 4 5
   Number: 8 5 --- --- ---

II. Based on my familiarity with past graduates of the program, together with evidence demonstrated via the senior capstone design project and team presentations, students graduating from the CEE Department at Wayne State University leave the program with:

1. the ability to apply knowledge of mathematics, science and engineering to solve a range of practical civil engineering problems expected of new entry-level civil engineers.

   Response: 1 2 3 4 5
   Number: 9 4 --- --- ---
2. the ability to design a civil engineering system, system component or process which meets specific needs.

   Response:  1  2  3  4  5  
   Number:  5  7  1  ---  ---

3. the ability to collaborate, communicate and work effectively with others on multi-disciplinary teams.

   Response:  1  2  3  4  5  
   Number:  7  6  ---  ---  ---

4. the ability to identify, formulate and solve a range of civil engineering problems.

   Response:  1  2  3  4  5  
   Number:  3  10  ---  ---  ---

5. the ability to understand and appreciate the importance of professional and ethical responsibility in the practice of civil engineering.

   Response:  1  2  3  4  5  
   Number:  8  4  1  ---  ---

6. the ability to communicate effectively in both written and oral form.

   Response:  1  2  3  4  5  
   Number:  6  7  ---  ---  ---

7. a broad educational background which addresses the importance of global and societal factors as they affect and are affected by civil engineering systems.

   Response:  1  2  3  4  5  
   Number:  3  8  2  ---  ---

8. an understanding of the importance of life-long learning and continuing education.

   Response:  1  2  3  4  5  
   Number:  6  2  5  ---  ---
9. knowledge of important contemporary issues within and outside the context of civil engineering.

Response: 1 2 3 4 5
Number: 3 5 5 --- ---

10. the ability to use the techniques, skills, and modern engineering tools required for the practice of civil engineering.

Response: 1 2 3 4 5
Number: 6 7 --- --- ---

11. an understanding of civil engineering professional practice issues such as: procurement of work, bidding versus quality-based selection processes, public safety concerns in project design, interactions with the construction profession, the importance of professional licensing and other professional practice issues.

Response: 1 2 3 4 5
Number: 2 7 4 --- ---

III. Additional feedback on written reports and oral presentations of capstone design project by student teams.

1. Student project reports were typically well-organized and thorough, demonstrating strong technical content, good grammar, and an understanding of important civil engineering methods and their appropriate applications.

Response: 1 2 3 4 5
Number: 10 3 --- --- ---

2. Student reports and presentations reflected a sensitivity to the importance of examining alternative designs and identifying an optimum approach based on important design criteria, including costs.

Response: 1 2 3 4 5
Number: 7 6 --- --- ---
3. During team presentations, students demonstrated professionalism and effective communication skills in terms of clarity of their discussion, attire, conduct and enthusiasm, ability to project clearly to the audience, as well as their use of effective visual aids and/or other communication aids.

   Response: 1 2 3 4 5
   Number:   12 1 --- --- ---

4. Student teams understood the need to complete their design in compliance with fundamental codes and standards which govern different elements of the overall design project.

   Response: 1 2 3 4 5
   Number:   13 --- --- --- ---

5. The capstone design project addressed issues and analytical methods covering a range of civil engineering areas, including structures, transportation and environmental concerns.

   Response: 1 2 3 4 5
   Number:   8 5 --- --- ---

---

Written Comments and Feedback from Advisory Board Members

“The presentations given today were very professional in every respect, well-planned and executed within the time frame. I was very impressed with the structural analysis of each project. There was much more understanding than what I would expect from college students. Some having experienced the work environment made a considered contribution to the presentations. Drawings, specs and reports were all very well done, clear and concise. The recognition of environmental factors was very good.”

“Overall, presentations were delivered well. If criteria is based on presentation to a client, then costs need to be addressed. Need to make sure slides can be read. Some presentations had drawings too small to read. Excellent opportunity for students to deliver a professional presentation.”

“Provides real life training in terms of complete project design and subsequent presentation to strangers.”
“Students did an excellent job in addressing design solutions. They understood the overview requirements of the project as well as the detailed requirements.”

“I think WSU does an excellent job of introducing undergraduates to the design process, including communication skills, interdisciplinary concerns and the iterative nature of basic design.”

“Each year the capstone design projects seem to get better and better. The students evaluate different design concepts, such as green roofs and bio-swales for handling stormwater runoff. They always seem to be in tune with the economic impacts of their projects and make design selections that are fiscally responsible. In my own company, we have employed three recent graduates of the CEE Department. All three are outstanding workers who have progressed rapidly based on their ability to complete projects, apply engineering concepts and effectively communicate. I believe the Civil and Environmental Engineering Department does an outstanding job of preparing their graduates for success in the field, whether they end up with industrial firms or engineering design firms.”

“As a long time member of the CEE Advisory Board, I am greatly impressed with the development and substantial improvement in the capstone design project and presentations. Teams have put in a lot of work and have shown discipline and teamwork. This is a very worthwhile program that will be of great benefit to students in their careers. The undergraduate program at WSU in civil engineering has demonstrated a great improvement over the past several years. The students that we have hired is a testimonial to this program. The chairman, Mumtaz Usmen, has demonstrated dedication and commitment to civil engineering education.”

“Presentations by the students need to show more interaction and awareness with other disciplines to be more prepared for the real world. I commend the Department on all their efforts and dedication.”

“Over the years I have had the opportunity to witness some very good students go through the program. Our firm has hired eight of the students in the last twelve years. We still have five of the students working with us. A few have taken jobs elsewhere. We think WSU is doing an excellent job of preparing them for the real world of engineering.”
Wayne State University
Department of Civil and Environmental Engineering

Summary of CEE Advisory Board Feedback
May 2006

IV. Advisory Board - Department Interactions (Please indicate your response by checking the appropriate box):


1. The CEE Department facilitates regular, meaningful interaction and feedback from the CEE Advisory Board regarding its academic programs.

Response: 1 2 3 4 5
Number: 6 2 --- --- ---

2. The Educational Goals and Program Outcomes for the CEE undergraduate program are clear and appropriate as stated.

Response: 1 2 3 4 5
Number: 4 4 --- --- ---

3. The CEE Department provides an undergraduate curriculum that satisfactorily covers the profession of civil engineering in terms of breadth and depth of knowledge.

Response: 1 2 3 4 5
Number: 3 5 --- --- ---

V. Based on my familiarity with past graduates of the program, together with evidence demonstrated via the senior capstone design project and team presentations, students graduating from the CEE Department at Wayne State University leave the program with:

1. the ability to apply knowledge of mathematics, science and engineering to solve a range of practical civil engineering problems expected of new entry-level civil engineers.

Response: 1 2 3 4 5
Number: 5 3 --- --- ---
2. the ability to design a civil engineering system, system component or process which meets specific needs.

   Response: 1 2 3 4 5
   Number: 4 4 --- --- ---

3. the ability to collaborate, communicate and work effectively with others on multi-disciplinary teams.

   Response: 1 2 3 4 5
   Number: 3 4 1 --- ---

4. the ability to identify, formulate and solve a range of civil engineering problems.

   Response: 1 2 3 4 5
   Number: 3 4 1 --- ---

5. the ability to understand and appreciate the importance of professional and ethical responsibility in the practice of civil engineering.

   Response: 1 2 3 4 5
   Number: 1 5 2 --- ---

6. the ability to communicate effectively in both written and oral form.

   Response: 1 2 3 4 5
   Number: 2 5 1 --- ---

7. a broad educational background which addresses the importance of global and societal factors as they affect and are affected by civil engineering systems.

   Response: 1 2 3 4 5
   Number: 3 1 4 --- ---

8. an understanding of the importance of life-long learning and continuing education.

   Response: 1 2 3 4 5
   Number: 1 4 3 --- ---
9. knowledge of important contemporary issues within and outside the context of civil engineering.

Response: 1 2 3 4 5
Number: 2 1 5 --- ---

10. the ability to use the techniques, skills, and modern engineering tools required for the practice of civil engineering.

Response: 1 2 3 4 5
Number: 4 3 1 --- ---

11. an understanding of civil engineering professional practice issues such as: procurement of work, bidding versus quality-based selection processes, public safety concerns in project design, interactions with the construction profession, the importance of professional licensing and other professional practice issues.

Response: 1 2 3 4 5
Number: --- 1 7 --- ---

VI. Additional feedback on written reports and oral presentations of capstone design project by student teams.

6. Student project reports were typically well-organized and thorough, demonstrating strong technical content, good grammar, and an understanding of important civil engineering methods and their appropriate applications.

Response: 1 2 3 4 5
Number: 3 5 --- --- ---

7. Student reports and presentations reflected a sensitivity to the importance of examining alternative designs and identifying an optimum approach based on important design criteria, including costs.

Response: 1 2 3 4 5
Number: 2 5 1 --- ---

8. During team presentations, students demonstrated professionalism and effective communication skills in terms of clarity of their discussion, attire, conduct and
enthusiasm, ability to project clearly to the audience, as well as their use of effective visual aids and/or other communication aids.

Response: 1 2 3 4 5  
Number: 3 5 --- --- ---

9. Student teams understood the need to complete their design in compliance with fundamental codes and standards which govern different elements of the overall design project.

Response: 1 2 3 4 5  
Number: 5 2 1 --- ---

10. The capstone design project addressed issues and analytical methods covering a range of civil engineering areas, including structures, transportation and environmental concerns.

Response: 1 2 3 4 5  
Number: 5 3 --- --- ---

11. It is my opinion that the capstone design projects and team presentations made by graduating civil engineering students at the annual spring meeting of the CEE Advisory Board have demonstrated general improvement over the years. This conclusion is based upon my assessment of the design projects in terms of their organization, technical content, as well as effectiveness of student teams in communicating project results both in writing and in oral form.

Response: 1 2 3 4 5  
Number: 5 3 --- --- ---
Written Comments and Feedback from Advisory Board Members

“The capstone class presentations were very good this year and the content and organization of the class has obviously improved greatly over the years. I believe the students don’t realize and appreciate what they have learned, but will look back to the capstone experience throughout their career.”

“You are doing a good job of introducing the students to codes and standards.”
“The WSU CE Department is achieving remarkable progress. More injection of current issues may enhance learning. Practitioner participation is very helpful to students.”

“The capstone program provides an opportunity for developing communication skills much needed in CE practice.”

“The capstone design project presentations are very well done. I wish that I would have had a similar opportunity when I was an engineering student. I believe it is a necessary part of the engineer’s development and connection with the real world of engineering.”

“While it is difficult to display an understanding of all the questions generated herein, the presentations provide an indication that the general educational goals are achieved.”

“Overall the students were well versed in structural, design, civil, environmental and transportation”. 
Appendix I-E

Summary of Student Exit Surveys
# Student Exit Survey Summary

Graduates of the Civil and Environmental Engineering Department (AY 2000/01 - 2005/06)

Key: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

## Assessment of Engineering Curriculum

The education that I received at Wayne State University:

1. provided me with the ability to apply my knowledge of science, math and engineering.

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2. provided me with the ability to design and conduct experiments as well as analyze and interpret data.

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3. provided me with the ability to design a system, component or process to meet a specified need.

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4. provided me with the ability to function on multidisciplinary teams.

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5. provided me with the ability to identify, formulate and solve engineering problems.

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6. provided me with an understanding of professional and ethical responsibility.

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7. provided me with the ability to communicate effectively.

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8. provided me with a broad education that allows an understanding of the impact of engineering solutions in a global and societal context.

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9. provided me with a knowledge of contemporary issues in the world.

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10. taught me the importance of engaging in life-long learning or continuing education.

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11. provided me with the ability to use techniques, skills, and modern tools necessary for engineering.

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**Assessment of the College faculty and facilities:**

12. The College had well designed and adequately equipped laboratories.

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13. The faculty were very competent and knowledgeable.

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14. The faculty were fair and respected me as a student.

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15. The faculty were dedicated to my education.

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16. Advising in the College was readily available to me.

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17. The advising that I received was accurate and helpful.

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18. The computing resources of the College were adequate and available.

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Assessment of the Civil Engineering Program:
The Civil Engineering undergraduate degree program offered at Wayne State University:

19. had a meaningful design component taught by qualified faculty.

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</table>
20. equipped me with an understanding of professional issues.

<table>
<thead>
<tr>
<th>Class</th>
<th>Mean</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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<td>9</td>
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21. provided me with an ability to conduct laboratory experiments and to critically analyze and interpret data in more than one civil engineering specialty area (e.g., materials, soils, fluids, etc.)

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<thead>
<tr>
<th>Class</th>
<th>Mean</th>
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<tr>
<td>2000/01</td>
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<td>0</td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

22. The civil engineering faculty were available and willing to serve as mentors, providing guidance to help me successfully understand, confront and overcome problems I encountered during my undergraduate academic program.

<table>
<thead>
<tr>
<th>Class</th>
<th>Mean</th>
<th>1</th>
<th>2</th>
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<tr>
<td>2004/05</td>
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<td>0</td>
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<td>12</td>
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Appendix I-F

Sample Instructor Course Assessment Report

CE 4210: Introduction to Environmental Engineering
Winter 2006
Wayne State University

Instructor Course Assessment Report

Course Number and Title: CE 4210  Introduction to Environmental Engineering

Instructor: Prof. Tom Heidtke
Semester: Winter 2006

Section 1: Goal and Course Learning Objectives

Course Goal: The purpose of this course is to provide students with an understanding of engineering approaches, quantitative problem-solving methods, important legislation, ethical considerations, and other current issues pertaining to environmental engineering problems. Students will learn to apply fundamental theories, engineering methods and mass balance approaches for solving a range of practical environmental problems in the areas of hydrology, groundwater, water and wastewater treatment, and water quality.

Course Learning Objectives:

1. Students will be able to list and describe prominent national legislation governing the treatment of water and wastewater, air and water quality, as well as the disposal and containment of solid and hazardous wastes.

Measures:
- Individual student responses to impromptu in-class questions
- Feedback from student survey of course learning objectives

Program Outcomes supported: f, h (see Table XX of Self-Study Report)

Assessment Overview: Exam 1 and/or the Final Exam lacked a question on this topic. Students were instructed that they must know the definition and meaning of key acronyms (e.g., NPDES, SWQA, CWA, etc.) pertaining to important environmental engineering legislation. However, they were not asked to answer an exam question or homework on the subject. Students were asked impromptu questions in class to test their knowledge in this area. This is a course weakness and will be addressed when CE 4210 is next offered in Winter 2007. A question testing students’ awareness of the titles and main directives of key environmental legislation will be added on Exam 1, the Final Exam, or both.
2. Students will be able to interpret given information, data and facts pertaining to an environmental problem, formulate the problem for solution using a mass balance approach, and execute the necessary calculations to solve.

**Measures:**
- Answers to Questions 2 on Exam #1
- Answers to Homework #2 and #3
- Feedback from student survey of course learning objectives

**Program Outcomes supported:** a, e

**Assessment Overview:** Most students demonstrated a good understanding of mass balance principles and the importance of these principles in solving a range of environmental engineering problems. Answers on exam questions, homework and responses to impromptu in-class questions indicate that students are effectively achieving this particular learning objective.

3. Students will be able to list typical sources of hydrologic data, as well as conventional statistical and graphical methods for describing the data. Students will analyze rainfall-runoff data, develop a design storm hyetograph, and derive a unit hydrograph. Students will apply unit hydrograph methods to calculate the expected distribution of direct runoff resulting from the design storm. Students will apply the rational method to determine design flows in a network of storm sewers.

**Measures:**
- Answers to in-class questions;
- Answers to questions on Homework #3;
- Answers to Questions 3 and 4 on Exam #1.
- Feedback from student survey of course learning objectives

**Program Outcomes supported:** a, e,

**Assessment Overview:** Over 80% of students demonstrated a strong fundamental understanding of the rational method and how to correctly apply it. Roughly 70% of students demonstrated adequate proficiency in terms of understanding unit hydrographs and how they are to be applied for estimating the magnitude and distribution of direct runoff resulting from a given design storm. Students have historically struggled with this latter topic. I need to consider more effective approaches, e.g. examples, to improve student understanding and competency in regard to unit hydrographs and their application in civil engineering.
4. Students will be able to apply fundamental groundwater hydraulics based on Darcy’s Law to analyze and solve well problems as they relate to ordinary and artesian aquifers under equilibrium and non-equilibrium conditions.

Measures:
- Answers to Questions 1 on Exam #2
- Answers to Homework #4
- Feedback from student survey of course learning objectives

Program Outcomes supported: a, b, e

Assessment Overview: This course learning objective was achieved, with more than 75% of students demonstrating knowledge of the correct equations and an understanding of how to apply them under a given set of conditions and available data. Students were able to correctly demonstrate application of Darcy’s Law for the purpose of estimating flow in an aquifer and estimating time-of-travel over a specific linear distance. The TA for the course presented two lectures covering material on equilibrium and non-equilibrium well problems. Exam #2 and the Final Exam did not ask questions covering the topic with the exception of two definitions on the Final Exam.

5. Students will be able to list and define important physical, chemical and biological parameters used to characterize water quality and the efficiency of water and wastewater treatment processes, and describe laboratory methods used to measure these parameters.

Measures:
- Answers to impromptu in-class questions
- Answers to Questions 4, 5, and 6 on Exam #2 as well as Questions 1, 3, 4, 5, 6, 7, and 8 on the Final Exam
- Answers to Homework #5, #6 and #7
- Feedback from student survey of course learning objectives

Program Outcomes supported: b

Assessment Overview: By the end of the course more than 90% of all students understood the meaning and importance of key water characteristics, including BOD, suspended solids, alkalinity, water hardness, pH, fecal coliforms, E. coli, turbidity and a number of others. Almost all students were able to describe laboratory procedures used to determine the levels of many of these characteristics. More than 75% of students understood how to test for turbidity, alkalinity, water hardness, BOD, suspended solids, and fecal coliform bacteria.
6. Students will be able to describe unit operations and processes used in the treatment of municipal water supplies, including water softening, coagulation and sedimentation, filtration and disinfection. Students will be able to list the types and values of typical design criteria and apply these criteria to solve relevant questions pertaining to the design and operation of a water treatment facility.

**Measures:**
- Answers to Questions 2 and 3 on Exam #2 and Questions 1, 2, 8 and 9 on the Final Exam
- Answers to Homework #5
- Feedback from student survey of course learning objectives

**Program Outcomes supported:** a, c, e

**Assessment Overview:** More than 80% of students understood the sequence of steps involved in a conventional water treatment system, as well as the primary equipment and functions for each. Student’s demonstrated the ability to design a conventional water clarification tank based on a range of critical design criteria, including detention time, surface loading rate (overflow rate), horizontal velocity of flow, tank length to width ratio, as well as other considerations. Students were able to apply Stoke’s Law to determine the settling velocities of specific particles and to estimate the overall removal of incoming particles to a sedimentation tank.

7. Students will be able to describe conventional unit operations and processes used in the treatment of domestic wastewater, including primary, secondary and tertiary treatment. Students will be able to list the types and values of typical design criteria for each stage of treatment, with emphasis on the activated sludge process, as well as apply these criteria using appropriate engineering methods to solve relevant questions pertaining to the design and operation of a modern wastewater treatment facility.

**Measures:**
- Answers to Question 9 on the Final Exam
- Answers to Homework #7
- Answers to impromptu questions in class
- Feedback from student survey of course learning objectives

**Program Outcomes supported:** a, c, e

**Assessment Overview:** More than 75% of students demonstrated fundamental understanding of the sequence of unit operations involved in the design and operation of a conventional wastewater treatment facility. Students also demonstrated knowledge of the important functions and objectives at each stage of treatment, along with an understanding of typical concentrations of SS and
BOD for raw untreated domestic sewage vs. the final effluent from a conventional secondary treatment plant.

8. Students will be able to **analyze and discuss** the significance of waste discharges on dissolved oxygen concentration in rivers and streams. Students will be able to **calculate** a temperature-adjusted deoxygenation rate and apply the adjusted value to calculate BOD concentration. Students will **compute** critical dissolved oxygen concentrations as a function of time and distance using the Streeter-Phelps equation, and **interpret** results in terms of water quality management implications.

**Measures:**
- Answers to Questions 4, 5, 6, 7 and 8 on the Final Exam
- Answers to Homework #7
- Answers to impromptu in-class questions
- Feedback from student survey of course learning objectives

**Program Outcomes supported:** a, b, e

**Assessment Overview:** Students demonstrated a good understanding of the importance of water quality models and their use by managers and regulators to monitor conditions and evaluate compliance with water quality standards in rivers and streams. More than 50% of students understood the formulation and appropriate application of the Streeter-Phelps equation for estimating dissolved oxygen concentrations and deficits as a function of time, temperature and BOD loadings from a variety of sources along a given stream reach. Almost all students demonstrated the ability to calculate temperature-adjusted deoxygenation and reaeration rate constants for application in the Streeter-Phelps equation. Additional in-class lecture time and a more comprehensive homework assignment is needed to improve student learning of this material. The subsequent offering of CE 4210 needs to add this additional coverage.

9. Students will undertake a web-based **search and review** of ethical issues in engineering and prepare their own example or case study pertaining to an environmental engineering problem. Students will **write** a brief summary of the facts and conditions surrounding their case study, identify alternative courses of action, discuss their interpretation of how ethical considerations factor into the final outcome, and provide their recommendation as to the proper course of action.

**Measures:**
- Answers to Homework #1
- Written summary and interpretation of findings from web search
• In-class discussions
• Feedback from student survey of course learning objectives

Assessment Overview: This learning objective was not adequately satisfied when the course was offered in Winter 2005. To address this weakness, Homework #1 was developed and administered in this Winter 2006 offering of CE 4210. Review and assessment of student performance on this assignment indicated students were able to demonstrate a strong understanding of ethical issues and standards of professionalism as they pertain to the civil engineer. This web-based research assignment provided students with exposure to a range of information sources from which they could construct a vision of realistic challenges and appropriate responses when confronted by a complex set of circumstances involving ethical and professional behavior. Assessment of student feedback on the end-of-semester survey of course learning objectives strongly suggests most all students satisfied this particular learning objective. Roughly 90% of respondents indicated they either strongly or generally agreed they had achieved an understanding and sensitivity to the manner in which ethical considerations factor into a proper course of action for an engineer and could now use that knowledge as a guide in making a final decision which is ethically and professionally sound. This learning objective has now been satisfied as a result of implementing the aforementioned web-based assignment during the Winter 2006 semester.

10. Students will develop knowledge and skills necessary to help them effectively answer questions pertaining to environmental engineering that might appear on the FE exam should they decide to pursue a professional engineering license.

Measures:
• Answers to Homework #1
• Written summary and interpretation of findings from web search
• In-class discussions
• Feedback from student survey of course learning objectives

Assessment Overview: Based on careful review and consideration of overall performance on exams and other activities in the course, most students appear to be satisfactorily prepared to answer most environmental engineering questions likely to be encountered on the FE exam. Approximately 95% of students responding to the end-of-semester survey of course learning objectives indicated they strongly agreed or agreed with this conclusion.
Section 2: Performance Benchmarks

Level 1: The course learning objective has been **fully satisfied** if most students demonstrate **excellent understanding** of a problem/concept/solution as evidenced by essentially correct answers to specific questions appearing on the Mid-Term, Final Exam, or other class assignments.

Level 2: The course learning objective has been **reasonably satisfied** if most students demonstrate **good understanding** of the problem/concept/solution as evidenced by partially correct answers containing no major conceptual errors.

Level 3: The learning objective has been **partially satisfied** if most students demonstrate **fair understanding** of the material as evidenced by partial progress towards the solution (e.g., generally correct answers to some intermediate stages of the overall solution).

Level 4: The learning objective has **not been satisfied** if most students demonstrate **poor understanding** of the material. Virtually no partial credit could be given on questions/tasks relevant to the Learning Objective.

Results for the current semester:

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<thead>
<tr>
<th>Course Learning Objective</th>
<th>Degree of Satisfaction</th>
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<tr>
<td>1. List and describe legislation</td>
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</tr>
<tr>
<td>2. Mass balance formulations</td>
<td>Level 2</td>
</tr>
<tr>
<td>3. Hydrology</td>
<td>Level 2</td>
</tr>
<tr>
<td>4. Groundwater hydraulics and well equations</td>
<td>Level 2</td>
</tr>
<tr>
<td>5. Water quality characteristics and laboratory methods</td>
<td>Level 1</td>
</tr>
<tr>
<td>6. Water treatment unit operations and design</td>
<td>Level 2</td>
</tr>
<tr>
<td>7. Wastewater treatment unit operations and design</td>
<td>Level 2</td>
</tr>
<tr>
<td>8. BOD/DO relationships and the Streeter-Phelps equation</td>
<td>Level 2</td>
</tr>
<tr>
<td>9. Ethical issues in environmental engineering</td>
<td>Level 2</td>
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</table>
Section 3: Course Assessment Discussion

List the Course Learning Objectives that you feel were not met to your satisfaction this semester. Base your response on review and comparison of data/evidence generated by the measures you have adopted for each Learning Objective, your personal judgment, or any other factors you feel are appropriate.

Learning Objective 1: List and describe prominent environmental legislation.

Although I believe students leave the course aware of the names and general content/focus of prominent environmental legislation, there is no measurable data or evidence to support this conclusion based on answers to exam questions. However, feedback from the newly-designed student survey of course learning objectives administered at the end of the course showed that 95% of students either strongly agreed or generally agreed that this learning objective had been satisfied.

Learning Objective 2: Interpret, formulate and solve problems using a mass balance approach.

This objective is currently satisfied under the present course structure.

Learning Objective 3: Hydrologic data sources, IDF curves, unit hydrograph derivation and application.

Significant time is now spent on this learning objective. Students receive clear, in-depth examples of how to construct and interpret a rainfall intensity-duration-frequency (IDF) curve, how to derive and interpret a unit hydrograph (UH), and how to apply a UH to predict the distribution of direct runoff resulting from a design rainfall event. Nevertheless, students always seem to struggle on this particular subject. Just over 75% of students responding to the end-of-semester course survey either strongly agreed or generally agreed that this learning objective had been satisfied.

Learning Objective 4: Apply principles of groundwater hydraulics for analyzing and solving well problems under equilibrium and non-equilibrium conditions.

This objective is currently satisfied under the current course structure.

Learning Objective 5: List and define physical, chemical and biological characteristics of water and wastewater, as well as related laboratory testing procedures.

This objective is currently satisfied under the current course structure.
Learning Objective 6: List, describe and design basic unit operations and processes for water treatment systems.

This objective is currently satisfied under the present course structure.

Learning Objective 7: List, describe and design basic unit operations and processes for wastewater treatment systems.

Insufficient time is spent on this objective. Students need greater exposure to in-depth design considerations for secondary treatment systems. I still feel the subject is covered too quickly, thereby hindering student understanding and retention of material presented in class and covered in select sections of the text. Improvement is needed here, but students do understand the sequence of treatment steps and their specific functions by the end of the course. Approximately 90% of students responding to the end-of-semester course survey either strongly agreed or generally agreed that this learning objective had been satisfied.

Learning Objective 8: Formulate and solve the Streeter-Phelps oxygen-sag equation for calculating dissolved oxygen deficit in a river or stream.

This objective is strongly emphasized in the course due to its importance in understanding water quality models and their application for setting permit limits and implementing water quality standards. Students achieved a strong understanding of the model structure, including the variables and parameters involved. The material is reinforced via homework, in-class handouts and classroom discussion. Although the objective is generally satisfied overall, further improvement is needed. Just over 80% of students responding to the end-of-semester course survey either strongly agreed or generally agreed that this learning objective had been satisfied.

Learning Objective 9: Search, review and discuss case studies involving interpretation of professional ethics in the civil engineering profession.

This objective was satisfied via homework assignment #1. Approximately 90% of students responding to the end-of-semester course survey either strongly agreed or generally agreed that this learning objective had been satisfied.

Learning Objective 10: I believe this course has prepared me with the knowledge and tools to help me effectively answer questions pertaining to environmental engineering that might appear on the FE exam should I decide to pursue a professional engineering license. Note: This is a new course learning objective that was added to the student survey.

Approximately 95% of students responding to the end-of-semester course survey either strongly agreed or generally agreed that this learning objective had been satisfied.
List future improvements you plan to implement in this course as a result of your current assessment.

Learning Objective 1: List and describe prominent environmental legislation.

I plan to include a question on Exam #1 and/or Final Exam which requires students to specifically demonstrate that this course learning objective is satisfied. Impromptu classroom questions and discussion is insufficient to establish that the objective is met. Next year an exam question will be added which asks students to define and briefly discuss the Clean Water Act, the Safe Drinking Water Act, the Surface Water Treatment Rule, NPDES permits and water quality standards, TMDLs, as well as other important national, regional and state legislation.

Learning Objective 3: Hydrologic data sources, IDF curves, unit hydrograph derivation and application.

I need to find a way to extend or improve the classroom discussion, or provide an additional assignment that achieves better overall comprehension of IDF curves and unit hydrographs. Next time I plan to divide the students into 3-person teams and have each team discuss and solve a well-conceived example problem in class. This material is very important. More needs to be done to ensure a higher percentage of students achieve a strong understanding of fundamental hydrologic concepts in civil engineering.

Learning Objective 7: Unit operations and processes for wastewater treatment systems.

I plan to re-organize course content such that I have time to present one additional lecture on the design and operation of modern wastewater treatment systems, including expanded coverage of disinfection methods. I believe too much is covered too quickly at present.

Learning Objective 8: Streeter-Phelps oxygen-sag equation for calculating dissolved oxygen deficit in a river or stream.

A team-based assignment will be developed to better achieve this course learning objective. Students will be asked to use a spreadsheet approach to solve the equation given a set of pollutant loading and in-stream conditions, and each team will prepare and submit a concise discussion/interpretation of their results.

Learning Objective 9: Professional ethics in the civil engineering profession.

This learning objective was significantly strengthened in Winter 2006. A web-based search, review, and discussion of ethical and professional issues in civil engineering was assigned. Results demonstrated that students had developed a strong understanding and appreciation of difficult problems, complexities, personal challenges and fundamental principles surrounding the issue of ethics and professionalism in civil engineering.
List and comment on any changes you plan to make in the Course Learning Objectives based on your current assessment.

No changes in the course learning objectives are currently planned for the next offering of CE 4210. Changes will focus on improvements to the current course learning objectives as described previously in this report.

List and comment on any changes/modifications in Measures and/or Performance Benchmarks you implemented or plan to implement as a result of your recent assessment of this course.

I designed an end-of-semester survey of students to provide information and measurable evidence regarding their opinions as to whether or not the learning objectives of the course had been satisfied. This survey was first administered in Winter 2006. A summary of results is attached at the end of this report. Specific results for each learning objective have been discussed in previous sections of this report.

Section 4: Additional Information and Miscellaneous Comments

During the Winter 2006 semester Mr. Jack Hilfiker, Director of the Michigan Concrete Pipe Association and coordinator of its academic outreach program, was again invited to our CE 4210 class to present a special seminar on sewer pipe design methods, construction practices, as well as state-of-the-art software packages which facilitate and support the overall design and construction process. In addition to the informative 90-minute presentation, each student received a copy of the American Concrete Pipe Association’s Concrete Pipe Handbook, two CDs containing user-friendly design software, as well as a notebook of material and information in support of Mr. Hilfiker’s presentation. Feedback from students once again provided strong evidence that the presentation is very popular, offering valuable insight into the practical side of modern civil engineering projects. Students really enjoy the seminar, learn a great deal, and appreciate the useful resource material provided to them.
CE 4210: Introduction to Environmental Engineering

[Student Survey of Course Learning Objectives]
Summary of Results
Winter 2006

At the beginning of the semester you were given a set of course learning objectives. The following revised set of learning objectives is based upon that original list, but has been modified slightly to reflect how the course was taught and material presented during this current semester. Please read each one and place an “X” in the box that best describes your opinion of how effectively that objective was met for you personally.

COURSE LEARNING OBJECTIVES

1. I am able to list and describe the name and general purpose of prominent environmental legislation pertaining to water and wastewater treatment, as well as water pollution control.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
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<tr>
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<td>11</td>
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2. I am able to interpret given information, data and facts pertaining to an environmental problem, formulate the problem for solution using a mass balance approach, and execute the necessary calculations to solve.

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<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
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<td>14</td>
<td>6</td>
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3. I am able to list typical sources of hydrologic data, as well as conventional statistical and graphical methods for describing the data. I am able to analyze rainfall-runoff data, develop a design storm hyetograph, and derive a unit hydrograph. Students will apply unit hydrograph methods to calculate the expected distribution of direct runoff resulting from the design storm. I feel I can apply the rational method to determine design flows in a network of storm sewers.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
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<td>15</td>
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4. I am able to apply fundamental groundwater hydraulics based on Darcy’s Law to analyze and solve well problems as they relate to ordinary and artesian aquifers under equilibrium and non-equilibrium conditions.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
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<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>7</td>
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5. I am able to list and define important physical, chemical and biological characteristics used to represent water quality and the efficiency of water and wastewater treatment processes. I am familiar with and able to describe basic laboratory methods used to measure these characteristics.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>12</td>
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6. I am able to describe unit operations and processes used in the treatment of municipal water supplies, including water softening, coagulation and sedimentation, filtration and disinfection. I am able to list the types and values of typical design criteria and apply these criteria to solve relevant questions pertaining to the design and operation of a water treatment facility.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
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<td>14</td>
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</tbody>
</table>

7. I am able to describe conventional unit operations and processes used in the treatment of domestic wastewater, including primary, secondary and tertiary treatment. I am able to list the types and values of typical design criteria for each stage of treatment, with emphasis on the activated sludge process. I am able to apply these criteria using appropriate engineering methods to solve relevant questions pertaining to the design and operation of a modern wastewater treatment facility.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>12</td>
<td>3</td>
<td>0</td>
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</table>
8. I am able to analyze and discuss the significance of waste discharges on dissolved oxygen concentration in rivers and streams. I am able to calculate a temperature-adjusted deoxygenation rate and apply the adjusted value to calculate BOD concentration. I can compute critical dissolved oxygen concentrations as a function of time and distance using the Streeter-Phelps equation, and interpret results in terms of water quality management implications.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Generally Agree</th>
<th>Generally Disagree</th>
<th>Strongly Disagree</th>
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</thead>
<tbody>
<tr>
<td>9</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

9. I am able to undertake a web-based search and review of ethical issues in engineering and prepare a written example or case study pertaining to an environmental engineering problem. I can prepare a brief summary of the facts and conditions surrounding that case study and identify alternative courses of action. I have an understanding and sensitivity to the manner in which ethical considerations factor into a proper course of action for an engineer, and can use that knowledge as a guide in making a final decision which is ethically and professionally sound.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
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<th>Generally Disagree</th>
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<tbody>
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</table>

**Additional Course Learning Objective not identified previously:**

10. I believe this course has prepared me with the knowledge and tools to help me effectively answer questions pertaining to environmental engineering that might appear on the Fundamentals of Engineering Examination should I decide to pursue a professional engineering license.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
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<th>Strongly Disagree</th>
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<tbody>
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