

Spring 2022

CE 494-102: Civil Engineering Design I

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New Jersey Institute of Technology

Department of Civil and Environmental Engineering

Course Outline and Requirements

CE 494 – 102

Spring 2022

Civil Engineering Design I

Prepared by:

John Mayo, P.E.

Introduction

The objective of this course is to take the student through the land development design process utilizing an actual site in New Jersey. The course requires the student to use materials, procedures and concepts from earlier courses. The work the student will do will be similar to that of a professional engineer engaged in private practice. The time and effort required to successfully complete the course requirements is demanding and also unlike that to which you have been exposed to in the past. A balanced effort is required throughout the semester since it is impossible to perform the required work in one or two weeks much less a few days. This Course Outline will serve as a checklist for the minimum project requirements. **All work submitted for grading in this class shall include the student's class assigned group number as described later in this document along with the student name, course number and date.**

I. Prerequisites

- A. Senior standing in Civil Engineering.
- B. The NJIT Honor Code will be upheld and any violations will be brought to the immediate attention of the Dean of Students.
- C. Students must agree to any modifications or deviations from the syllabus throughout the course of the semester.
- D. Time extensions will not be given for late work under any circumstances.

II. Course Materials

- A. Site base maps including boundary and topography data (CAD data).
- B. Regulatory code as required.
 1. "Residential Site Improvement Standards", www.nj.gov/dca/divisions/codes/offices/rsis.html
 2. NJ Stormwater Management Rules www.state.nj.us/dep/watershedmgt/rules.htm
 3. Municipal bulk zoning table (CAD data).
 4. NJDEP Stormwater Best Management Practices Manual and Rules www.njstormwater.org/bmp_manual2.htm
- C. Reference Materials
 1. Bergen County Soil Survey <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>
 2. Design software and manuals for stormwater management and sanitary conveyance design.
 3. NJDEP Nonstructural Stormwater Points System (NSPS) <http://www.njstormwater.org/index.html>
 4. Supplementary materials for student review
 5. A technical writing guide.
 6. Additional online data and mapping resources, i.e. Google Earth, Flash Earth, NJ Geoweb, etc.
 7. Textbooks from previous preparatory courses as well as other related references as required.

III. Course and Project Report Requirements

Utilizing the above mentioned material each team (3 students max. per team) will subdivide a parcel of land for single family homes. The project plans and calculations will be submitted in two phases:

Phase I: Preliminary Subdivision Plan and Hydrographs for Detention Basin Size. (50 points) – Group Submittal; see minimum requirements below. No time extensions will be granted.

Phase II: Preliminary Subdivision Plan set, Engineering Report and Oral Presentation (150 points) – See Written Report Format and minimum requirements for final submittal below. No time extensions will be granted. Planning board reports will be included in this grade.

Hydrographs: Existing and proposed preliminary hydrographs shall be submitted for the proposed detention basin design. Hydrographs shall be submitted for each of the NJ design storms for a “Major Development” per the New Jersey Stormwater Rule (NJAC 7:8)

Oral Presentation: For the final oral presentations, each team member will present their work to the class by discipline, i.e., transportation/planning, geotechnical, hydraulics/water resources, and environment. You are expected to dress and present yourself in a professional manner. Presentations shall be direct and comprehensive with regards to existing conditions, project scope and variance/waiver relief requested. Each team will be allotted 15 minutes to present their project to a mock planning board in an attempt to be granted approval by the board.

Local Municipal Planning or Zoning Board Meeting: Students are also required to attend one local planning or zoning board meeting and prepare a summary report. The meeting attended should preferably be in the municipality you live in. The report shall be one to two pages documenting and discussing the student’s findings and opinions on the public hearing and the applications before the board.

Digital Submission Required: All data files created for the project are to be submitted with the phase 2 submission on a USB flash, CD or DVD media. Computer data is your responsibility. Corrupt or lost computer data cannot be used as an excuse for failure to meet deadlines in any professional environment or in this class. Backup your project data each day to a rewritable disc or flash drive when you edit or revise it.

Students are required to use a number of computer applications for the required computations to support their project design. The primary applications are Civil 3D, Autodesk Hydrographs, Autodesk Storm Sewers. Other applications may be required for other aspects of the project design. These will be discussed in detail during the course.

The class will be divided into teams of three. Each team will use a multidisciplinary approach. That means that each team member will assume a discipline-specific role on the project as follows: transportation engineer, planning engineer, geotechnical engineer, water resources engineer and environmental engineer.

You will also designate a team leader. The team leader is the project manager and shall coordinate and manage the project. The team leader will assign discipline-specific roles to team members. Teams are expected to take the project from preliminary design through to the final design report and oral presentation. This discipline-specific approach should not prevent one member of the team from helping out another member of the team. In fact, with four disciplines and three members to a team, all team members will collaborate on at least one of the four disciplines. Each student is responsible for the work in one discipline

and must work with his/her team members on a second discipline. The division of project work among the four disciplines is recommended as follows:

- Transportation and planning – Subdivision and bulk zoning compliance, horizontal and vertical road design, traffic analysis.
- Geotechnical – Lot grading, pavement design and soil erosion control and soil movement (cut/fill) volumes.
- Water resources engineer – storm sewers, water quality devices, detention basin and water distribution.
- Environmental – Project report editor, sanitary sewer system, environmental impact statement and wetland delineation (Transition areas if required).

Technology tasks in CAD programs and other applications should be shared among all groups members. One person should not be the ‘Cad go-to’ teammate. A group member assigned to a design task should do all CAD and computational work for that design.

You are to use the resources in the library, online or whatever resources are available to prepare a quantity takeoff and cost estimate for the public site improvements only (stormwater management system, sanitary sewer system, water distribution system and roadway). You are not to include the improvements proposed for the residential lots.

Finally, you are to insure the project is feasible for development by meeting local bulk zoning, the “New Jersey Residential Site Improvement Standards” (NJAC 5:21), and the "New Jersey Stormwater Rule" (NJAC 7:8). The final report is used to document that the project meets the governing code. All governing code shall be cited in the report to prove to the Board that you comply with the requirements.

Reports shall include appendices that include **all** calculations for the storm water management system, sanitary sewer system, water distribution system, traffic and environmental assessments.

All calculations are to be initialed by the designer and the person who checked the calculations. Credit will not be given for unsigned calculations. All your reports are to be concise, well-thought-out and presented in a professional format. The report should explain what exists, what you are constructing and how you comply with the code requirements. The final plans and report will document the change in land use, residential density and compliance with governing land development rules and regulations (Local Bulk Zoning, RSIS, Stormwater Rule).

Please remember there will be **no extensions granted** so use the semester time wisely. Many students underestimate the time required to learn the software, design, organize, publish and present the subdivision design. Students are asked to consider carefully the time required to learn the design process and all of the software required to publish this data. Make copies of your submission as the projects submitted will not be returned.

III. Course Administration

Students are not to directly contact Township officials. Students are NOT to drive to the site for visual inspection. Periodic checks of each group’s progress will be made on an unannounced basis. All groups are encouraged to bring weekly progress prints/files for informal review. All submittals must be in a professional manner utilizing acceptable standards for plans and reports. Plans will be prepared using Autodesk Civil 3D. There will be no time extensions for any due dates. Except for the individual planning board reports listed above, all submittals are on a group basis.

IV. Grading - 200 total points are assigned to the entire project.

<u>Point Total</u>	<u>Grade</u>
180 +	A
171-179	B+
160-170	B
151-159	C+
130-150	C
120-129	D
Below 120	F

V. Minimum Requirements for All Maps and Reports

All existing and proposed property lines print black with varying widths on all maps.

All streets and properties must be identified/labeled.

All existing ground features (roads, buildings, walls, utilities, etc) print in shades of gray with varying widths.

All existing contours print in gray dashed lines.

All proposed conditions are to print bold black or in color with varying widths.

All contours are to be labeled

1. Unit Precision (P) and Format – All plans

- a. Contours, P=0
- b. Distances, P=0.01
- c. Elevations, P=0.01
- d. Radii, P=0.01
- e. Angles, DMS to one second (N 90d 45' 33" E)
- f. Stations, P=0 for centerline markers at 100', P=0.01 for location
- g. Area, P=0 for square feet, P=0.001 for acres
- h. Volume, P=0 for cubic feet and cubic yards.

2. Phase I Subdivision Plan - 45 Points. Prepare a subdivision plan depicting and dimensioning the following.

- a. 24"x36" or 30"x42" sheets only. Trim all sheets to page size. 36"x48" sheets are not acceptable.
- b. Scale of 1 inch = 40 feet or larger scale
- c. Title Box, north arrow, scale.
- d. Existing lot, block numbers, street names
- e. Existing ground features (pavements and buildings, no utilities, no contours and no elevation data).
- f. Existing and proposed right of ways (ROW), lot lines and protected and/or restricted lands.
- g. Proposed alignment controls such as PI, PC and PT points as well as CL curve radii labeled.
- h. Proposed road names, roadway width and ROW widths.
- i. Proposed parcels numbered with areas reported in acres and square feet, lot lines and curves with meets and bounds labeled.
- j. Locations of proposed buildings with setbacks dimensioned, driveways, water quality devices and detention basins.
- k. Zoning table identifying bulk zoning compliance and any required variance for each lot.
- l. Proposed easements labeled with name, area, meets and bounds.
- m. Call out labels for proposed features. (curbs, walls, easements, etc.)

- n. Hydrographs for detention basin size (3 existing and 3 proposed).

4. Phase II Site Plan Set- 150 Points. Min. Requirements for final submission Minimum Map Requirements For Phase II, Preliminary Subdivision Plans

Note that all printed plan labels shall be legible with the naked eye and shall be submitted in an ordered stapled set. All sheets shall be trimmed to a maximum sheet size of 24"x36" or 30"x42". **No 36"x48" sheets will be accepted.** Minimum mapping requirements follow.

- a. Plans sheets (properly bound and folded). One pdf with all plan sheets, one pdf with the entire report and all supporting calculations.
- b. Scale of 1 inch = 40 feet or larger scale.
- c. All sheets are to be numbered with sheet index supplied on the first sheet.
- d. Proper title blocks with group number, company name, title, date and sheet number.
- e. North arrows, date and bar scales. ALL PLAN SHEETS.
- f. Existing features (building outlines, walls, fences, roads, drives, etc), topography (contours, elevation labels) and property lines. ALL PLAN SHEETS.
- g. Proposed features, existing ground features and property lines. ALL PLAN SHEETS
- h. Existing features, properties and roadways are to be labeled.
- i. All proposed features are to be called-out in plan view, i.e. 'Proposed 4' High Retaining Wall', Proposed Curb", etc.
- j. Minimum sheets required
 - 1. Final Subdivision
 - 2. Roadway Grading and Utility Plan
 - 3. Residential Grading Plan
 - 4. Profiles and cross sections
 - 5. Soil Erosion and Sediment Control Plan
- k. Proposed centerline alignment stationing with PC, PT and radii labeled. (Roadway Grading Plan)
- l. Proposed buildings with first floor elevations. (Residential Grading Plan)
- m. Proposed drives with average slopes labeled for the access and parking area (Residential Grading Plan).
- n. House connections (water and sanitary) and drywells (Residential Grading Plan).
- o. Stormwater management system and sanitary sewers including manhole/inlet with rim/grate elevations and inverts. Pipe material, length, diameter, slope (Roadway Grading and Profile Plans).
- p. Watermain and/or forcemain locations including total pipe length, diameter and material. All fittings are to be depicted and labeled. Forcemain manholes shall be labeled with rim and inverts (Roadway Grading and Profile Plans).
- q. Revised subdivision plan as per Phase I with proposed easements, land restrictions and bulk zoning schedule computed for each lot proposed. All lots and easements shall be clearly labeled.
- r. Residential grading sheets shall also have design point elevations (Building corners, low/high points, floors, swales, berms and walls).
- s. Profile and Cross Section Sheets (attached to plan sheets)
 - 1. All roads and proposed utilities (storm, sanitary and water) must be profiled and labeled as mentioned above for plan.
 - 2. Station designations that match plan sheet roadway stations.
 - 3. Vertical curves labeled with curve length, PVC, PVI PVT stations and elevations. High and low points are to be identified.

4. Proposed road grades.
 5. Labels for the sanitary and storm sewers that match the plan view data.
 6. Average End Area table with 3-5 cross sections and sample lines (please do not use more than ½ of a sheet for soil movement to keep this a bit greener).
- t. Drainage maps
1. Sheets no larger than 11"x17" shall be included in the engineering report.
 2. Detention basin sizing drainage map - Time of concentration travel path. Existing topology and property lines, proposed property lines, surface cover and limit of disturbance.
 3. Pipe capacity drainage map - Existing and proposed topology and property lines, proposed drainage areas to each inlet, time of concentration travel paths and surface cover to document storm sewer sizing.
- u. Soil Erosion and Sediment Control Plan
1. Limit of grading/disturbance.
 2. Inlet filers
 3. Construction access
 4. Stockpile area
 5. Silt fence for grading activities.

5. Quantity Takeoff – Prepare a quantity takeoff and cost estimate for the public site improvements only (curbing, pavements, storm and sanitary sewers, basins, inlets, watermains, valves, hydrants, etc.), do not include residential lot improvements (buildings, driveways, drywells, etc.). NJDOT bid award information can be used for unit prices.

<https://www.state.nj.us/transportation/business/procurement/ConstrServ/awards21.shtm>

Google search terms that may help are, ‘NJDOT 2021 Construction Awards’ or, ‘NJDOT Pay Item List’ to assist in preparing the estimate.

6. Phase II Engineering Reports – All groups are required to submit an engineering report to document the proposed improvements and regulatory compliance. The report should be written as if you were the project engineer applying for a site plan application to the township. It should be addressed to the township in support of your client’s development application to the township. The report should describe the site location, existing conditions, proposed conditions (a.k.a. project scope) and demonstrate compliance with all governing code.

Content and Format

All reports shall be typed and presented as a professional report with a cover sheet, table of contents and letter of transmittal. The group number shall be included on the first page or cover of all documents.

Specific reference to all assigned regulatory code is required in all sections. This course will focus on the class assigned municipal/local bulk zoning code and New Jersey Administrative Codes, NJAC 5:21 (RSIS), NJAC 7:8 (The New Jersey Stormwater Management Rules) and the New Jersey Stormwater Best Management Practices Manual.

Reports shall be written to the governing agencies that will be approving your development application for this subdivision. The report must document how the project design conforms to the regulatory code and defend any variance and/or waiver relief required. All groups must attempt to design without waiver or variance relief. Any request for design relief must be presented to the course instructor for

preliminary approval at least two (2) weeks prior to the final submission date. No design relief will be granted after this date.

The project report narrative will follow the format described below. Remember each member is responsible for their own discipline and shall collaborate on one other discipline. Reports shall document the improvements proposed, compliance with regulatory code and computation methods used to prove compliance. All calculations are to be signed by the person who prepared them. All report sections are to be initialed by the design engineer.

- A. Cover Page: Project title; your company's name; group number, names of team members identified by discipline: transportation/planning engineer, geotechnical engineer, hydraulics/water resources engineer, and environmental engineer; and course/semester information.
- B. Introduction - In the introduction, you are to state the purpose of the report (support for the engineering design and application to the local planning board), provide the project's location (including lot and block number and area), a description of the existing conditions (include drainage pattern, surface cover, existing land use, etc), the project scope (what you are proposing) and list the governing regulations. Identify existing environmental constraints, variance and/or waiver relief requested. Include a general compliance statement regarding the governing codes. This section should not go into detail on these topics.
- C. Planning (principal: transportation/planning engineer) - Under this section, you should detail conformity with the bulk zoning code, provide an explanation for any variances and/or waivers requested. Describe the site layout and how it fits the bulk zoning code and surrounding neighborhood. Discuss any problems and solutions that you had during the planning and design phases with respect to environmental constraints, topographic features and/or bulk zoning. Generally describe the proposed drainage patterns on the site. Provide residential density calculations (dwelling units per acre).
- D. Subsurface Conditions and Grading (principal: geotechnical engineer) - Under this item you should discuss the findings of the site's geologic investigation based upon available published data, e.g., Soil Conversation Survey, Rutgers Soils Maps, NRCS Web Soil Survey (<http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>). Indicate the soils hydrological group. Explain how the soil will affect development and drainage design (hydrological group/infiltration). Provide general recommendations for foundation type based on bearing capacity for proposed structures. The report must include the site's soils map.
- E. Drainage and Storm Water Management (principal: hydraulics/water resources engineer) - Under this item you should detail the methods and formulas used in the drainage design (storm sewers, and detention basin). Discuss the placement of basins, inlets (catch basins) and storm sewer network. Provide a summary comparing the site's pre and post development peak flows and include the detention basin design volume. Demonstrate full compliance with the "NJ Stormwater Rule" for the storm sewer and detention basin designs. Drainage maps are to be submitted to support the detention basin and storm sewer designs. Include calculations for existing and proposed peak flows (hydrographs) and pipe capacity. Provide calculations to support the average number of drywells that will be required for a typical residential lot in this new development. Autodesk Storm Sewers and Autodesk Hydrographs programs are to be used

for all hydraulic and hydrological calculations. Reference all governing code and formulas/methods.

- F. Sanitary Sewer (principal: environmental engineer) - Under this section, discuss the proposed design for the sanitary sewer or low-pressure forcemain (LPFM) proposed (include formulas and methodology); how you intend to service the lots (individual unit connections). Discuss design issues, such as main depths, location in roads or easements, how you overcame them. Discuss how the design meets the “Residential Site Improvement Standards”. Computations shall be included to document the sewer or LPFM size will be adequate for the proposed application. Autodesk Storm Sewers shall be used for sewer capacity. LPFM calculations shall be as discussed in class. Reference all governing code.
- G. Water Distribution (principals: hydraulics/water resources engineer and environmental engineer) - Describe the existing water supply system you will connect to. Describe the improvements to be made for the application and the minimum design requirements. You are to meet and discuss the water requirements (see RSIS Subchapter 5) for domestic water service and fire flow. Determine what total flow (domestic service and fire service) needs to be supplied by the township at street level to meet RSIS 5.3. Also discuss hydrant locations, fittings required, problems/issues encountered in the design and their solutions. Reference all governing code.
- H. Streets and Traffic (principal: transportation/planning engineer) - Under the traffic section you are to discuss the traffic volumes expected to be generated and how they impact the existing traffic volumes for the roadway design with a level of service analysis using HCS (Highway Capacity Software). Parking requirements must be documented and satisfied in the design based on RSIS. Also discuss the road layout including ROW and pavement widths, design of horizontal and vertical alignments and how you met the “Residential Site Improvement Standards”. Provide a design summary for your chosen proposed pavement section as per. Provide the results of the Average End Area method for the soil movement volumes due to the roadway and utility improvements. Reference all governing code.
- I. Environmental Impact (principal: environmental engineer) - Under this section, identify environmental impacts both during and after construction including groundwater recharge (as per the Stormwater Rule, include calculations), required TSS reduction (water quality as per the Stormwater Rule), constrained property (wetlands, riparian buffers, etc.), soil erosion and sediment control, noise control and dust control.

Use a technical writing guide as required to insure that the description, intent and scope of your project is understood by all who read the reports.



DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

CE 494 – 102 - Civil Engineering Design I

Spring 2022

Texts: No new texts. Various online resources and previous CE course books.

Instructor: John Mayo, P.E. contact information: jmayo@boswellengineering.com

Prerequisite: *Senior standing in civil engineering. Simulates the submission and acceptance process normally associated with the initial design phases for a civil engineering project. Familiarizes students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment. Requirements include written submittals and oral presentations in defense of the project.*

Class	Date	Description
1	1/19	First class meeting, project overview and professional expectations. Lecture - Introduction to land development, boundary surveys, topographic mapping. Land use and regulatory code, Environmental constraints and subdivision planning.
2	1/26	No Class – Monday classes meet per academic calendar.
3	2/2	Formation of project teams. Lecture – Engineering estimations and preliminary detention basin design, soil maps, computing peak flows using the Rational Method and Modified Rational Method. Detention basin design. Stormwater runoff and water quality standards.
4	2/9	Phase 1 Materials Due Lecture – Engineering calculations and reporting. Project management, CAD data management. Roadway Design: Alignments, Profiles and Cross Sections.
5	2/16	Lecture - TIN Surfaces – Roadway grading and Civil 3D Corridors
6	2/23	Lecture - Cul-de-sac and intersection design.
7	3/2	Lecture - Stormwater Management, drainage area maps, Sewer Capacity.
8	2/9	Lecture - Stormwater Management: Detention Basins. Using Civil 3D Pipe Networks, Detention Basin Grading.
9	3/16	SPRING BREAK
10	3/23	Lecture - Sanitary and Domestic Water Services. Sewer Capacity and Site Utilities Sanitary System Design, Watermain Layouts. H&H Engineering Applications and Calculators.
11	3/30	Lecture - Earthworks, Cross Sections and the Average End Area Method. Environmental Impact Reports – Environmental constraints (floodplains, wetlands, riparian zones), soil erosion and sediment control
12	4/6	Lecture - Residential grading plans and TIN grading techniques – 2D to 3D
13	4/13	Lecture - Residential grading plans and grading techniques – driveways, walkout basements, retaining walls, swales and berms.
14	4/22	Lecture - Public speaking, oral presentation requirements. - Project Review: Calculations, Reporting, Map Sets, Managing Data and Plot Times. - Informal project review with individual groups. All groups are required to have drafts of all material for review either printed or on your personal computing device.
15	4/27	Presentations, Planning board reports due. Deadline for Submission of Phase II materials.

Grading Scale:

Grading 200 total points are assigned to the entire project

<u>Point Total</u>	<u>Grade</u>
A:	200-180
B+:	179-171
B:	170-160
C+:	159-151
C:	150-130
D:	129-120
F:	Below 120

Withdrawals:

In order to insure consistency and fairness in application of the NJIT policy on withdrawals, student requests for withdrawals after the deadline will not be permitted unless extenuating circumstances (e.g., major family emergency or substantial medical difficulty) are documented. The course Professors and the Dean of Students are the principal points of contact for students considering withdrawals.

NJIT Honor Code:

The NJIT Honor Code will be upheld; any violations will be brought to the immediate attention of the Dean of Students. The Honor Code can be found at (<http://www5.njit.edu/doss/policies/honorcode/index.php>).

CE 494 – Civil Engineering Design I

Description:

Simulates the submission and acceptance process normally associated with the initial design phases for a civil engineering project. Familiarizes students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment. Requirements include written reports and oral presentations in defense of the project.

Prerequisites: Senior standing in Civil Engineering

Textbook(s)/Materials Required:

No new textbooks. Students are expected to utilize the textbooks from preparatory courses as well as other related references.

Course Objectives:

1. Simulate the submission and acceptance process normally associated with the initial design phases for a civil engineering project to familiarize students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment.

Topics: Depends on Site Selected. Typically the following topics are covered:

Introduction to project site, zoning requirement and other constraints

Subdividing Property

Street Design

Grading Plans

Environmental Impact Analyses and Report

Sanitary Sewer Design

Stormwater Management System Design

Soil Program and Sediment Control

Water Supply Layout

Quantities and Cost Estimaes

Schedule: Lecture/Recitation- 3 hour class, once per week

Program Objectives Addressed: 1, 2

Prepared By: John Mayo, PE

Date: Spring 2022

Course Objectives Matrix – CE 494 Civil Engineering Design I

Strategies and Actions	Student Learning Outcomes	Outcomes (a-k)	Prog. Object.	Assessment Methods/Metrics
Course Objective 1: Simulate the submission and acceptance process normally associated with the initial design phases for a civil engineering project. To familiarize students with the preparation of sketch plats, preliminary engineering design, and a related environmental assessment.				
Present an open ended civil engineering practice design problem for solution by teams of students.	Learn how to identify, formulate, and solve open ended civil engineering practice design problems by applying knowledge of mathematics, science, and engineering integrated with CAD.	a, c, d, e, k	1, 2	Final project report and periodic progress reports.
Discuss specific code, performance, cost, time, quality and safety objectives.	Learn how to identify, formulate and solve area specific civil and environmental engineering practice design problems that meet specified code, performance, cost, time, quality and safety objectives.	c, d, e, f, h, i, j	1, 2	Final project report and periodic progress reports.
Work individually and within multi-disciplinary design teams.	Learn how to function and communicate effectively both individually and within multi-disciplinary design teams.	d, g	1, 2	Final project report, periodic progress reports, oral presentation of project.

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our Program Educational Objectives are reflected in the achievements of our recent alumni:

1. **Engineering Practice:** Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward safe, practical, sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.
2. **Professional Growth:** Alumni will advance their technical and interpersonal skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.
3. **Service:** Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.