Spring 2020

CE 494-104: Civil Engineering Design I

Joseph Baladi

JOHN A. REIF, JR. DEPARTMENT OF
CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

CE 494 - 104 Civil Engineering Design I – Spring 2020

Texts: No Textbook. Handout Materials Only.

Instructor: Joseph Baladi, P.E, P.P, CME, CPWM.

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Class 9:00 AM-811:50 AM **Saturday** Colton Hall Room 416. Jan 21 – May 14, 2020

Prerequisites: CE 210, CE 260, CE 320, CE 321, CE 350, CE 341 , CE 341A and senior standing
engineering. Simulates the submission and acceptance process normally associated with the initial
phases for a civil engineering project. Familiarizes students with the preparation of sketch plats,
preliminary engineering design, and a related environmental assessment. Requirements include wı
submittals and oral presentations in defense of the project.

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the university. Cheating is strictly prohibited and devalues the degree that you are working on. As
member of the NJIT community, it is your responsibility to protect your educational investment by
knowing and following the academic code of integrity policy that is found at:
http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf.*

Please note that it is my professional obligation and responsibility to report any academic misconc
the Dean of Students Office. **Any student found in violation of the code by cheating, plagiarizi
using any online software inappropriately will result in disciplinary action. This may include
failing grade of F, and/or suspension or dismissal from the university.** If you have any questio
about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

Date	Topic
Session 1	First class meeting, formation of teams & project overview. Lecture - Introduction to Land Development, Cad Data Management, Boundary Surveys and Topographic Maps. Project Management.
Session 2	Lecture - Subdivisions, Matching Existing Grade (Designing Parcels and Roadways to Minimize Grading), Editing CAD designs. NJDOT Design Standards. Handout.
Session 3	Subdivision boundary analysis and area computations may be submitted for informal review. Lecture Roadway Design: Alignments, Profiles and Cross Sections.
Session 4	Submittal deadline for Phase I Conceptual Subdivision Plan. Lecture - Roadway Design: Cul-de-sac and Intersection Design. Roadway Widening. RFP.
Session 5	Lecture - Soil Maps, Stormwater Management: Detention Basins and

	Water Quality Devices. FEMA MAPS & Procedures.
Session 6	Review of Conceptual Plans with each team. Lecture – Stormwater Management: Drainage Area Maps, Sizing Detention Basins and Storm Sewers. Review Check list
Session 7	Review of Conceptual Plans with each team. Lecture –. Sanitary and Domestic Water Services. Incorporate Signal Layout and Handout.
Session 8	Lecture – Handout: Site Grading. GIS Incorporation.
Session 9	Discussion on Environmental Impact Report and Wetland analysis. Lecture - Planning Board Report Requirements, Soil Erosion and Sediment Control Plans
Session 10	Planning Board Reports Due. Lecture - Residential Grading: Driveways Profiles, Cost Estimate, Management and I
Session 11	Lecture- Permits. Agencies Coordination. Project Award & Inspection.
Session 12	Lecture - Lecture-Public Speaking, Oral Presentation Requirements. Subdivision Plan sets, Sheet indexes and plan creation.
Session 13	Project Presentations.
Session 14	Deadline for Submission of Phase II Materials - Project Presentations.
Session 15	Final

*Students are required to attend all lectures. Class recordings are not permitted without instructor permission.

CE 494 - Section 104 - 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 Estimate

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

Program Objectives Addressed: 1, 2

Outcomes Course Matrix – CE 494 Civil Engineering Design I

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Apply a simulated submission and acceptance process normally associated with the initial design phases for a civil engineering project. Prepare 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.	1, 2, 3, 5, 7	1, 2	Final project report and periodic progress reports.
Discuss specific code, performance, cost, time, quality and safety objectives.	2	1, 2	Final project report and periodic progress reports.
Work individually and within multi-disciplinary design teams.	1, 2, 5, 7	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 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 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

Revised: 2/13/18

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 IMap, 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 or midrise condominium. The project plans will be submitted in two phases:

Phase I: Preliminary Subdivision Plan and Aerial Photo Map (50 points) – Group Submittal; see minimum requirements below. No time extensions will be granted.

Phase II: Preliminary Subdivision Plan set 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.

11"x17" Aerial Photo Map: These maps should be prepared using project data and free online aerial photo sites (i.e. www.flashearth.com or Google Earth). This map shall depict the site in the aerial photo and the site's contours and property lines are to be superimposed onto it. This map will serve as a visual reference in the Project Report and as an aid for your design and presentation. A one page report is to be submitted with this map. This report will be a description of the property's existing conditions and a summary of the development plan. A discussion on any problems and solutions that you anticipate shall be included. This report will also serve as material for your final project report.

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. 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.

Students are also required to attend one local planning or zoning board meeting and prepare a summary report. This shall be one to two pages documenting and discussing the student's findings and opinions on the public meeting and the applications before the board.

Students are required to use available computer applications for required computations in support of the information shown on the plans, profiles and in the reports. Several applications will be available at the NJIT computer facility and outside sources may be used. All data files are to be submitted with the phase 2 submission on 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.

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 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 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, cost estimate, sanitary sewer system, environmental impact statement and wetland delineation (Transition areas if required).

You are to use the resources in the library, online or whatever resources are available and prepare a cost estimate of the public site improvements only (stormwater management system, sanitary sewer system, water distribution system and roadway. You are not to include the cost of developing 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", and the "New Jersey Stormwater Rule". The final report is used to document that the project meets the governing code. All governing code shall be referenced in the report.

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 you are constructing, Where you are constructing it and how these new improvements meet the governing codes. The final report shall 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.

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

Grading policy will be based on completeness, and accuracy of the design, details and specifications for required design construction set and reports will be handed out in class. Students should not miss the final presentation however makeup will be handled on case by case issue.

V. Minimum Requirements for Maps and Reports

All existing and proposed property line print black with varying widths.
All existing features and contours print in shades of gray with varying widths.
All proposed conditions are to print bold black or in color with varying widths.

1. Unit Precision 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 Aerial Photo Map - 5 Points. Map shall contain an aerial photo of the site with the existing contours and property lines. A one to two page report shall be submitted with the map describing the existing conditions and land development challenges. Map shall print on an 11"x17" sheet.

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

a. Title Box, north arrow, scale.
b. Existing ground features. No contours or elevation data.
c. Existing and proposed right of way (R.O.W.), lot lines and protected or restricted lands.
d. Alignment controls such as PI, PC and PT points as well as CL curve radii labeled.
e. Proposed road names and widths.
f. Proposed parcels numbered with areas reported in acres and square feet, lot lines and curves with meets and bounds labeled.
g. Locations of proposed buildings with setbacks dimensioned, driveways, water quality devices and detention basins.
h. Zoning table identifying bulk zoning compliance and any required variance for each lot.
i. Proposed easements labeled with name, area and meets and bounds.
j. Calculations for detention basin size.
k. Call out labels

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. Trimmed to a maximum sheet size of 30"x42". No 36"x48" sheets will be accepted. The following shall appear on all maps.

a. Plans sheets (properly bound and folded).
b. Scale of 1 inch = 40 feet or larger scale (must be legible).
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, topography and property lines. ALL PLAN SHEETS
h. All proposed features are to be called-out in plan view, i.e. ‘Proposed 4’ High Retaining Wall’.
i. Minimum sheets required
    1. Final Subdivision
    2. Proposed Siteplan Layout
    3. Construction Drawing: shows work proposed, quantities
    4. Roadway Grading and Utility Plan
    5. Signing & Striping Plans
    6. Profiles and cross sections
    7. Soil Erosion and Sediment Control Plan
    8. Detail Sheet
j. Proposed centerline alignment stationing with PC, PT and radii labeled. (Roadway Grading Plan)
k. Proposed buildings with first floor elevations. (Residential Grading Plan)
l. Proposed drives with average slopes labeled for the access and parking area (Residential Grading Plan).
m. House connections (water and sanitary) and drywells (Residential Grading Plan).
n. 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).
o. 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).
p. 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.
q. Residential grading sheets shall also have driveway grades and critical point spot elevations (low/high points, floors, swales, berms and walls).
r. 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).

s. Drainage maps
1. Sheets no larger than 11"x17"
2. Roadway Construction 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 and surface cover to document storm sewer sizing.

t. 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. Cost Estimate - Public site improvements only (roads, sewers, basins, inlets, watermains, valves, hydrants, etc.), do not include residential lot improvements (buildings, driveways, pools, etc.). Use appropriate reference manuals for cost data.

6. **Phase II Engineering Reports** – All groups are required to submit an engineering report to document the proposed improvements and regulatory compliance.

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 document how the project design conforms to the 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 discuss the project's location, a description of the existing conditions, the project scope and governing regulations.

C. Planning (principal: transportation/planning engineer) - Under this section, you should discuss conformity with the bulk zoning code, the site layout and planning of the project in accordance with the governing code and site restrictions. Discuss any problems and solutions that you had during the planning phase. Explain the roadway layout and how the drainage and grading work on the site. Provide density

calculations (dwelling units per acre) and discuss how property restrictions have limited or enhanced the design.

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 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. Provide a design summary for your chosen proposed pavement section as per RSIS and the soil survey. Provide the results of the Average End Area method for the soil movement volumes due to the roadway and utility improvements. The report must include the soils map.

E. Drainage and Storm Water Management (principal: hydraulics/water resources engineer) - Under this item you should discuss the method and formulas behind 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 and explain non compliance with the "Residential Site Improvement Standards" and the NJ Stormwater Rule for the entire stormwater management system (storm sewers and detention basin). Drainage maps are to be submitted in support of drainage areas derived for detention basin size and storm sewer sizing. Include all calculations.

F. Water Distribution (principals: hydraulics/water resources engineer and environmental engineer) - Describe the existing water supply system. Describe the improvements to be made and 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 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.

G. 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. Parking requirements must be documented and satisfied in the design. 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".

H. 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 the project is understood by all who read the reports.

VI Honors Classes

In addition to Sections I through V above honors classes are required to:

1. Phase I - Compose written legal descriptions for all proposed parcels and easements.
2. Phase II – Design an outlet control structure and provide a final detention basin design. Construction details are to be provided for the detention basin and outlet control structure.

Additional Notes*:

-Attendance will be taken at the beginning of the class and may affect your final grade.
In case of any student misses a class, or fail to submit assignment or presentation on time, the Office of the Dean of Students is the only entity that would determine the legitimacy of the absence or the situation via a written email addressed to the course instructor.
-It is the student's responsibility to contact the office mentioned above and make his/her case with proper documentations.
-Students within the same group, may get different grade based on class & group participation.
-Planning Board attendance, and summary report is mandatory as part of the project

*JB 01/02/2020