

CE498 - Senior Design - Spring 2009

‘Design-Build’ Project

Course Details

Course Description:

CE 498 Civil Engineering Design Project Sem. 1 and 2. Lab. 9, cr. 3 (8 CE) - This class will provide an integrated, realistic capstone design experience covering the multifaceted aspects of a real-world engineering project (e.g., technical, legal, environmental, ethical, etc.) in a fashion which addresses (as much as possible) all major aspects of the civil engineering profession.

Project Description:

The project will be to develop a design-build proposal for a new Baseball Complex, west of McCormick Road in West Lafayette, Indiana. The project will incorporate principles of Green Building Design. It will be delivered using the Design-Build method of project delivery.

Project Staffing*:

Vincent Drnevich, PE	Email: dnevich@ecn.purdue.edu Office: CIVL G241; Phone: 765-494-5029	- Principal and Senior staff geotechnical engineer
Mark Bowman, P.E.	Email: bowmanmd@purdue.edu Office: 4143 CIVL; Phone: 765-494-2220	- Principal and Senior staff structural engineer
Venkatesh Merwade	Email: vmerwade@purdue.edu Office: 1101G CIVL; Phone: 765-494-2176	- hydrology, hydraulics and drainage engineer
Ming Qu	Email: mqu@purdue.edu Office: 4122 CIVL; Phone: 765-494-9125	- Principal and Senior staff architectural engineer
Ruth Wertz, P.E.	Email: rwertz@purdue.edu Office: G232; Phone: 765-	- Engineering Manager, course administrator and geotechnical engineering
Joshua Deno	Email: jdeno@purdue.edu Office: 2125 CIVL; Phone: 765-	- Engineering Manager and envir, hyd. engineering
Jill Rajek	Email: jrajek@purdue.edu Office: Phone: 765-	- Engineering Manager and structural engineering

Volunteer Professional Support Personnel

Timothy J. Burke	Email: tiburke@purdue.edu Office: Freehafer Hall 401 S. Grant Street West Lafayette, IN 47907-2024	Project Manager Office of the University Architect
Dan Schuster, P.E.	Email: dcschuster@purdue.edu Office: Freehafer Hall 401 S. Grant Street West Lafayette, IN 47907-2024	Project Engineering Group Manager
James Knapp, P.E.	Email: jrknapp@purdue.edu Office: Freehafer Hall 401 S. Grant Street West Lafayette, IN 47907-2024	Civil Engineer, Office of Campus Planning, Purdue
James M. Barker, S.E., P.E.	Email: jmbarker1@comcast.net Office: 1308 McShay CT. West Lafayette, IN 47906	- Structural and construction engineering
Brendan Owens, LEED AP, P.E.	Email: bowens@usgbc.org Office: Director, LEED Technical Development U.S. Green Building Council 1800 Massachusetts Ave., NW, Suite 300 Washington, DC 20036	- LEED Technical Development

**NOTE: ABET accreditation specifically stipulates a university must demonstrate that faculty teaching courses which are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience, and the program must demonstrate that it is not critically dependent on one individual*

Meeting Times:

Official Meeting Times (Mandatory attendance)

- TTh @ 8:30-9:20 CIVL 1144
- TTh @ 9:30-11:20 in CIVL 2107 (Rajek), 2118 (Deno), 2123 (Wertz), & CE 3145 (Olson Lab)

Supplemental Team Meeting Times

- Minimum 3 hrs per week in CE498 Senior Design Lab CIVL 3145 (Olson Lab)

Course Objectives:

By the end of this course, the student will be able to:

1. Integrate the technical sub-disciplines of civil engineering, develop criteria for design and perform trade-off and alternatives analyses to produce cost-effective solutions.
2. Gather relevant data, have discussions with the client, identify and use applicable regulations, codes and other information.
3. Communicate site analyses, work programs and engineering design detail to both technical and non-technical customers.
4. Do integrated project planning, scheduling, and cost analysis for a moderately-sized, civil engineering project.
5. Perform a reasonably detailed design to meet customer requirements using, where appropriate, software and computer techniques to satisfy design objectives and to prepare requested construction documentation.
6. Work more effectively on a multi-disciplinary team.

Accreditation Criteria:

The Accreditation Board for Engineering and Technology (ABET) outcome criteria for accreditation of engineering programs (EC2000) is listed below. Additionally, there are criteria specifically associated with civil engineering programs and they also are listed. This course is designed to address nearly all of the listed elements. Note particularly the Civil Engineering criteria concerning ***apply knowledge of four technical areas appropriate to civil engineering; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.*** (emphasis added).

EC2000 Accreditation Criteria:

Engineering programs must demonstrate that their students attain:

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

Curriculum Requirements for Civil Engineering Programs:

The program must demonstrate that graduates can: apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

Course Focus:

- If this project was being executed in a regular engineering office, the focus would be on the **product**, i.e. the resulting design product and deliverables. Since this project is being executed in a "learning setting," the focus will be on the **process**, i.e. the procedures used to execute a design of a facility.
- The course instructors wish **every student** to obtain a "big picture" perspective of the civil engineering design process and the tools and procedures used by the civil engineer to accomplish a design. **This approach is consistent with the Accreditation Criteria and should provide the student with an exceptionally valuable background for career success.**
- To accomplish this objective, **every student will engage in all aspects of the project**, irrespective of their "subspecialty interests" in civil engineering. While a subset of a team may take the lead on a subspecialty, say structural design, others on the team should be involved in that subspecialty, typically as a checker (see section below on Work Documentation and Checking), as a means of gaining an understanding of that aspect of the design.
- Also, while it is likely that one or two team members may have better CAD and computing skills than others on the team, **all members of the team** are expected to develop credible skills with the use of these design tools.

Texts and References: *(Some are available in Olson Lab...but do not remove from this lab; others available on line)*

- Civil Engineering Handbook, CRC Press, ISBN: 0849309581, 2nd Edition, 2002, pgs. 2904 (*Highly recommended per each team*)
- International Building Code 2006 Ed., Copyright International Code Council, available on-line by IHS under license with ICC Licensee=Purdue University/5923082001, No reproduction or networking permitted without license from HIS, Not for Resale, ISBN-13: 978-1-58001-251-5, January 2006, 679 pages.
- Quality in the Constructed Project, ASCE Press, ISBN: 0784405069, 2nd Edition, 2000, pgs. 288
- Green Building Rating System For New Construction & Major Renovations, Version 2.2, For Public Use and Display, October 2005 (<https://www.usgbc.org/ShowFile.aspx?DocumentID=1095>)
- New Construction & Major Renovation Version 2.2 Reference Guide, 2nd Ed., September 2006, 416 pages (One copy of this text is provided to each team compliments of the U.S. Green Building Council.)
- Land Development Handbook: Planning, Engineering, and Survey, by The Dewberry Companies, 2nd ed., McGraw-Hill, New York, List price \$150.00, Amazon.com price \$123.00
- ASCE Standards and References, Minimum Design Loads for Buildings and Other Structures, ASCE 7-05, 2005 (Will be available shortly in the Olson Lab).
- Guide to Hiring and Retaining Great Civil Engineers, ASCE Manual #103, 2004.
- How to Work Effectively with Consulting Engineers, ASCE Manual #45, 2004.

Autodesk Student and Educator Community

- Autodesk, Inc., the developers of AutoCAD have established the Student Community, and on-line site for students studying engineering design, <http://students3.autodesk.com/?lbon=1>
- Students in this course are encouraged to sign up for membership in this community. It only requires that you use your official Purdue e-mail address to validate that you are a student.
- The latest versions of their software are available for free downloading and use. Students may be especially interested in the Civil 3D and Revit software.

U.S. Green Building Council and LEED Design

- The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices.
- LEED is becoming pervasive and elements of it will be included in this course. More information may be obtained at <https://www.usgbc.org/>

Project Teams

- The class will be subdivided into teams, with each team having 5 or 6 members
- Teams will be identified on the second meeting of the class with all individual team members being assigned by the staff

Relationships among Teams and Staff

During day-to-day operations, all involved personnel (student team members, TA's, and faculty) shall cooperatively pursue the successful completion of this project. The TA's are engineering managers for the design professional teams. Their efforts are to keep the teams on task and minimize wheel spinning. The faculty persons will play the role of Principals of the firm with Dr. Drnevich having the role of Chief Executive Officer (CEO). The Engineering Managers and the Principals constitute the Management Team.

For the **products and presentations** in the course, the situation will be different. For these, it will be assumed that the individual teams represent the entire firm. Some (or all) of the team members would most likely be principals of the firm they are representing in the products and presentations.

Students must submit time sheets for both individual and group work on a weekly basis (NOTE: see handout entitled, Weekly Time Card Use and Submission).

All relationships will be conducted at a professional level. Students within the teams are expected to act as professionals in all aspects of their participation. (See Chapter 5 in the *Quality in the Constructed Project* reference.) This means taking initiatives to plan and execute work that is consistent with the firm's and project's objectives.

Relationships among Teams and External Parties

- Team members are not to contact the Volunteer Professional Support Personnel unless the individual involved specifically invites teams to do so.
- Do not contact any other external organizations (e.g., Tippecanoe Area Planning Commission, City Engineer, etc.). If information from these organizations is needed, it must be obtained through one of the Instructional Staff persons.

Course Web Sites:

Nearly all course materials will be made available electronically and nearly all submissions will be done electronically. The URL for the course Blackboard Vista web site is: <http://www.itap.purdue.edu/tt/blackboard/index.cfm>. This will be the primary source of information on the course operations, grades, etc. This site will be accessible for about one semester after the end of the course. A second, permanent web site has been created with URL: <https://engineering.purdue.edu/Courses/CE498> where general reference materials will be stored and where student teams will post course products including reports, presentations, and spreadsheets. All team members and instructional staff will have access to both of these sites from anywhere they have web access. No access will be available to unauthorized individuals. Details for accessing and maintaining the permanent web site will be provided in the Vista web site for this course.

Team Computer Account:

Each team will have a computer account for its use. The account name and password will be provided to the team in the second week of class. This account can receive e-mail. A special ".forward" command will have to be used to forward e-mail to all of the individuals on the team from this account.

Schedule and Calendar:

The course Web Site contains a Schedule that will list all of the important dates associated with this course. It is available on the home page.

Communications and Office Hours:

Significant use will be made of e-mail **using Purdue e-mail accounts** for the conduct of the course and for addressing questions. All students are requested to check their Purdue e-mail accounts at least daily. (***E-mail will not be sent to non Purdue e-mail accounts.***)

CE498 Lab Access:

The Olson Design Lab is located in room 3154 of the Civil Engineering Building. The hours of operation of this facility are available on line at: <https://engineering.purdue.edu/ECN/Sites/CE/Documents/OlsonLab>

Also, there is a computer lab in 1212 CIVL that is maintained by the School of Civil Engineering that provides access to nearly all of the software that is available in the Olson Lab. It is open 24 hours a day, seven days a week. Computers in this room have access to all of the software available in the Olson Design Lab.

Additionally, the ITaP lab is located next door in 3144 CIVL. This PUCCLab or any other PUCCLab may be used for this course, but not all of the software available in the Olson Design Lab may be available in the PUCCLabs. The hours of operation of the ITaP Lab in 3144 CIVL can be found at the following URL: <http://www.itap.purdue.edu/tt/lab/about.cfm>

Work Documentation and Checking:

Within a professional engineering design setting, errors are unacceptable because of the potential loss of life, property, and money. To ensure that errors are held to a minimum, it is standard practice to utilize a strict system of documentation and checking. Typical office procedures are given below and will be required in the course:

- Every piece of paper associated with the project, including all design calculations, computer output, e-mail and written correspondence, specifications, reports, etc. must have on it the author's name, date, project code, page number, and total pages in the set (**NOTE: in this course, there is no such thing as scratch paper**)
- All assumptions made must be clearly listed as assumptions and the basis for them explained
- All references and other sources of information, especially those for building and design codes, must be clearly defined to allow another engineer to easily access that information independently
- Only validated and documented computer software can be used
- Every sheet of work must be checked by another individual from the one who generated it. Checking involves examining the document, line by line, calculation by calculation, etc. Everything that the checker understands, finds to be properly documented, and agrees with should be highlighted in yellow. Things that the checker cannot understand, are not properly documented, or cannot be validated by the checker must be resolved between the person who generated the document and the checker.
- Only after resolution of items is complete, the checker's name must also be affixed to the document. In most offices, checked documents and design sheets are reviewed additionally by the chief engineer or the engineering manager before they are considered a completed product. Only at this time are documents signed and stamped with the seal of the licensed engineer.

Presentations:

Each team will make two presentations during the course, covering both their Phase I and Phase II reports. Details of the requirements for these presentations will be presented later in the course.

Products and Deliverables:

The products and deliverables will be in response to a Request for Proposals (RFP) show what the facility will look like, what it will cost, schedule for construction, and includes the plans and specifications that are consistent with:

- Local zoning, environmental, and building regulations
- Building codes and standards of design
- Other applicable regulations and codes

Costs of Services Rendered:

Engineering and construction firms are in business to make a profit. Furthermore, there is a high degree of risk associated with design and construction because most facilities are one of kind and/or are at different locations where site and environmental conditions differ. Thus, charges for engineering services include the cost of people's time who work on the project, all materials associated with this work, overhead (that includes rent, utilities, secretarial and clerical services, computing support, travel, insurances, benefits, etc.), and profit.

Every person in the class will be required to keep track of his/her time spent on the project and this time must be reported on a weekly basis. (In many instances in engineering practice, a person will work on more than one project at a time and the time is then reported for each project. In many firms, time must be reported on a daily basis.)

Grading:

Grading will be on both an individual basis and on a team basis. The basis for the grades will be the quality, originality, and accuracy of the products and deliverables and the performance in presentations. Peer evaluations will be conducted for each of the two phases associated with team responses to the Request for Proposals. Each student will provide an evaluation of his/her performance as well as an evaluation of the performance of others on his/her team. These evaluations will be applied to adjusting individual team member grades for the products and deliverables.

Individual Grades:		
	Professionalism, Attitude and Contribution (i.e., internal Staff calibration)	4%
	Oral Presentations	
	RFP Phase 1	6%
	RFP Phase 2	8%
	Attendance	8%
Team Grades:		
	Oral Presentations	
	RFP Phase 1	8%
	RFP Phase 2	12%
	Reports	
	RFP Response Plan and Gantt Chart	4%
	RFP Phase 1*	20%
	RFP Phase 2*	30%
	Total:	100%

* Report Grades for RFP Phases 1 and 2 will be weighted based on results of peer evaluations and work time sheets.

Attendance:

Students are expected to attend all sessions of the course. Attendance will be taken at each class session. Late arrivals will be counted as absences. For legitimate, excused absences (illness, family emergencies, job plant visits, official Purdue travel, etc.) students shall submit a written explanation of the absence electronically. The dated explanation must be submitted by email to the designated Engineering Manager by the student within one week after the absence occurred. The instructor will confirm whether or not the explanation is accepted.

Ethics:

Students are expected to abide by the Purdue University [Student Conduct Code](#). Further, it is assumed that each and every student subscribes to a personal code of ethics based on a value system that adheres to the highest standards of academic integrity. Any breach of academic honesty or disruptive classroom behavior will be handled in accordance with established university procedures. (This Student Code of Honor is analogous to the [CODE OF ETHICS](#) of the American Society of Civil Engineers that guides practicing professional civil engineers. Additional discussion of these issues is available at [Academic Integrity: A Guide for Students](#).)

Emergencies:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Here are ways to get information about changes in this course. Blackboard Vista web page, my email address: drnevich@purdue.edu, my office phone: 494-5029 or my cell phone: 765-418-0961. Other information associated with emergencies at Purdue University is available at: http://www.purdue.edu/emergency_preparedness/