

# SYLLABUS – EGR/EM 517

## FACILITIES ENGINEERING SYSTEMS

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### FALL 2024

Days and Dates: Mondays from August 19 through December 2, 2024  
Time: 3:00 to 5:45 PM with a 15 minute break.

Location: Centennial Campus, Monteith Engineering Research Building , Room 313  
Distance-Ed/EOL students NOTE: the recorded lecture will likely be available no sooner than 9 PM Mondays, Eastern Time.

### INSTRUCTOR

James A. Rispoli, M.S. (Civil Engineering), M.A. Business, P.E.  
Professor of Practice, Department of Industrial and Systems Engineering  
Professor of Practice, Center for Nuclear Energy Facilities and Structures, Department of Civil, Construction and Environmental Engineering, NC State University  
Fitts-Woolard Hall, Room 3210  
(919) 515-7628  
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#### Office Hours:

On Campus Students: Mondays from 1:30 to 2:30 at Fitz-Woolard Hall Room 3210, **by appointment**. Or other days/ times, by phone, FaceTime, Google Duo as pre-arranged.  
Distance-Ed Students: Monday evenings from 7:30 pm to 8:30 pm Eastern Time, by phone, Zoom, FaceTime, Google Duo as pre-arranged.  
For All Students: Times for discussion with individual students can be arranged by email.

### COURSE OVERVIEW

This course is intended to build on a traditional bachelor's degree in an engineering discipline, and introduce the engineer graduate students to a multi-disciplinary approach to engineering and management required in the field of facilities engineering. James Rispoli, the course instructor, is a licensed professional engineer with 15 years experience at installation level: as chief of engineering, chief of facilities planning and programming, director of facilities and public works at a major airport, and director of public works, facilities and environment at a major seaport. Additionally, he was facilities and environmental planning department head for a federal agency, covering installations in a 24 state area. He will bring the practical aspects of facilities engineering and management, along with case studies based on actual situations, to the course material. The students will have the opportunity to evaluate, analyze and propose solutions to facilities engineering challenges presented in assignments and case studies.

### COURSE OBJECTIVES

The owner's facilities engineer has a complex, multi-disciplinary and sometimes overwhelming role. Such engineers include those in positions in a city public works department, a state department of transportation, a regional airport authority, a seaport authority, a university

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facilities management department, a facilities planning department, a military base public works or base civil engineer organization; or, in the private sector, a plant engineer at a refinery or power plant, a utilities high voltage transmission system, or an engineer with responsibility for a physical plant and buildings. Additionally, engineers in firms which have facilities engineering organizations as their clients, would find themselves practitioners in facilities engineering. This course is intended to provide engineers working in these organizations, or aspiring to work in such organizations, with the engineering and the management tools to improve their effectiveness as an engineer leader or manager, or journeyman engineer.

Specifically, the course objectives include the ability to:

1. Understand the principles of and be able to organize, plan, direct, coordinate, and control activities where people, money, and materials are efficiently and economically combined to provide effective engineering, facilities, and infrastructure support services. Implicit is an understanding of the technical and managerial instruments available for proposing and implementing objectives, policies, and programs; policy analysis, program planning, and budgeting; accounting, evaluation, and control; and manpower planning.

2. Apply general knowledge of systems analysis problems solving models, network analysis, cost-benefit analysis, and the role of systems analysis in public works/infrastructure decision making.

These abilities are typically required for engineers involved in **Public Works Engineering (public sector) and Facilities and Infrastructure Engineering (private sector equivalent term)**.

Because of cyber threats, it is increasingly critical for the engineer to have an understanding of cyber security fundamentals as they apply to the nation's critical infrastructure (e.g. power/utility distribution grid control systems) to include knowledge and skills in computer network architecture and operations, an understanding of cyber-attack and exploitation methods, cyber system defense mechanisms, as well vulnerability and risk assessment abilities. **(Cybersecurity of Critical Infrastructure Control Systems)**. This course will discuss the importance and applications of cyber security, and overall approach to protect critical infrastructure control systems; the student desiring more detailed knowledge and application of this subject should enroll in a course specific to this content.

### READINGS

#### Required Text 1

*Public Works Department Management Guide*, Naval Facilities Engineering Command, 2008.

Note: This text will be provided electronically to the students at no cost. It is in the public domain. NB: Although there is a more recent version of this PDF text available, the 2008 version is specifically chosen because of the organization and inclusion of technical aspects.

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### Required Text 2

*The Facility Management Handbook, Fourth Edition*, Professors Kathy O. Roper and Richard P. Payant; AMACOM, 2014. This text is required; the student may purchase in hard copy or electronically, OR use a shared version for the assigned readings. The Moodle site includes links regarding purchase and use of the e-text.

### Other Reading Materials

Supplemental reading on relevant issues from several sources will be required throughout the course. The instructor will provide specific, targeted readings excerpted from the *Facilities Engineering and Management Handbook (Commercial, Industrial, and Institutional Buildings)*, Paul R. Smith, P.E., Anand K. Seth, P.E., Rober P. Wessel, P.E., David L. Stymiest, P.E., William L. Porter, FAIA, and Mark W. Neitlich, B.Ch.E, MBA; McGraw Hill, 2001.

## ASSIGNMENTS

### Readings

Readings, primarily from the two texts, and also from the other sources, will be assigned; these are to be completed *before* the class session that is designated. Reading assignments are shown in this Syllabus and will be augmented with other readings as announced beforehand.

### Homework

Written homework assignments will consist of papers or Power Point presentations such that the student understands the lecture material. There will be four such homework assignments throughout the 16 week semester and each must be submitted according to the dates shown in Table 1 (posted on Moodle). Class Participants will submit Homework assignments electronically to the instructor, and the graded assignments will be returned electronically. There will be a mix of individual assignments (1), and team assignments (3).

### Case Studies

Three of the homework assignments will be a student-team-developed case studies based on real-world, actual instances involving a facilities engineering scenario. The student-groups will develop the scenario to demonstrate understanding, and provide an analytical presentation as to the issue, what went wrong (or right) related to the situation presented. All case studies will be approached from the perspective of the owner's engineer (i.e. the facilities engineer). This will require preparation of a presentation with speaker notes. The groups (teams) will present during a regular class session. **NOTE: Student-groups' presentations on these case studies will be spaced out across several class sessions. Each student-team will develop their presentations so as to not exceed 15 minutes. The student team will be comprised of 3 to 4 individuals each. Distance-ed student teams are required to create an audio/visual recorded presentation so that each team's work will be shared with the entire class.**

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*NOTE: All assignments will be graded on communication skills as well as content. The term “communication skills” is intended to mean the organization and logic of the presentation, ability to follow the thought process put forth by the team, etc. and the graduate-level expectation of a team presentation to a group of peers. In such a professional presentation (for three of the team assignments) the team members should speak at a volume such that all present can clearly hear, and team members should not literally read their talking notes by reading full sentences. The team members are expected to know their part of the presentation.*

### QUIZZES

In order to demonstrate mastery of the course material, there will be a series of three or four quizzes throughout the semester. The material in the course builds upon itself; thus, the student may need to be familiar with material from the earlier quizzes in order to successfully complete material on the next quiz.

Each quiz will be closed book, with no access to notes or the internet. Communication between students, will not be permitted thus no mobile phones will be permitted on the student’s desktop during the quiz.

On-campus students: The exact dates of the quizzes will be announced by the instructor during class times or by posted message to the class participants on the Moodle site. **It is intended that the last class session will include a short quiz, similar to the earlier ones. However, to comply with university policy, any student not wanting to take a short quiz during that class session will be able to take a “final” on the day prescribed by the university, that is Monday December 9 at 3:30 PM. To be clear, it is up to each student to opt for a “final” on Monday December 9, rather than a short quiz during the last class session on December 2. If you take the short quiz, then you are “done” on December 2.**

Distance-education students will have the option to come to the classroom (if they are local to the campus). Alternatively, the instructor will work with the students and the EOL office to arrange for a proctor for each quiz. There will typically be a D-E “window” of two days.

It is important to note that textbooks (including our own) and on-line articles will have differing views of how to approach the various topics in this syllabus. For that reason, class participants are advised that in preparing for quizzes, and in answering quiz questions, the following hierarchy will be expected, and grading will apply:

1. Instructor lecture notes as posted on the Moodle site prior to each class session
2. The lecture itself, including any mark ups of the lecture notes made during the lecture
3. The two primary text books
4. Other materials, such as homework assignments and student presentations made during the periods of the lectures
5. Other sources

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Specifically, because there are differing views on approaches to these topics, an answer on a quiz could be graded as incorrect, even if a source is found on the internet, if and when another source of information in the hierarchy as shown above, provides the correct answer.

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### EGR 517 COURSE GRADES

The overall course numerical grade will be calculated based on a weighted average as follows:

Student attendance and participation	(minus potential only)	up to minus 10%
Individual and/or team homework assignments	(5)	45%
Assignment #1 – individual	(5%)	
Assignments #2-5 - team homework assignments	(10%, 10%, 10%, 10%)	
Quizzes	(4)	55%

The Moodle site grades function will be used to convey grades to each student, for each activity (participation, homework assignments, quizzes (and final exam if opted by the student)).

Final course numerical grades will be rounded to two decimal places for assigning letter grades.

Letter grades assigned will be no lower than:

A+ (97-100)	A (93-96.99)	A- (90-92.99)
B+ (87-89.99)	B (83-86.99)	B- (80-82.99)
C+ (77-79.99)	C (73-76.99)	C- (70-72.99)
D+ (67-69.99)	D (63-66.99)	D- (60-62.99)
F (less than 60)		

### Health and Participation in Class

We are most concerned about your health and the health of your classmates and instructors/TAs.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, you should not attend any hybrid or face-to-face (F2F) classes and work with your instructor on any adjustments necessary; also follow other university guidelines, including self-reporting ([Coronavirus Self Reporting](#)): Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to a F2F class or activity.
- If you are in quarantine, have been notified that you may have been exposed to COVID-19, or have a personal or family situation related to COVID-19 that prevents you from attending this course in person (or synchronously), please connect with your instructor to make alternative plans, as necessary.
- Since this semester's class is being recorded for later viewing, any student experiencing the above circumstances will be provided access to view the class, and thus not miss any of the lecture material.
- If you need to make a request for an academic consideration related to COVID-19, such as a discussion about possible options for remote learning, please talk with your instructor.

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### Health and Well-Being Resources

These are difficult times, and academic and personal stress are natural results. Everyone is encouraged to [take care of themselves](#) and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center ([NCSU Counseling Center](#))
- Student Health Services ([Health Services | Student](#))
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: ([Share a Concern](#)).
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program ([Pack Essentials](#)).

### Community Standards related to COVID-19

We are all responsible for protecting ourselves and our community. Please see the [community standards](#).

### Course Expectations Related to COVID-19:

- **Face Coverings:** All members of the NC State academic community are expected to follow all university policies and guidelines, including the [Personal Safety Rule](#) and [community standards](#), for the use of face coverings. If face coverings are determined as required, then the face covering should be worn to cover the nose and mouth and be close fitting to the face with minimal gaps on the sides.
- **Course Attendance:** NC State attendance policies can be found at: [REG 02.20.03 – Attendance Regulations – Policies, Regulations & Rules](#). Please refer to the course's attendance, absence, and deadline policies for additional details. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation. However, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and participation section above. COVID 19-related absences will be considered excused; documentation need only involve communication with your instructor.
- **Technology Requirements:** This course may require particular technologies to complete coursework. Be sure to review the syllabus for these expectations, and see the [syllabus technical requirements](#) for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: ([Technology Lending](#)).

### Need Help?

If you find yourself in a place where you need help, academically or otherwise, please review these [Step-by-Step Help Topics](#).

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### Other Important Resources

- **Keep Learning:** [Keep Learning](#)
- **Protect the Pack FAQs:** [Frequently Asked Questions | Protect the Pack](#)
- **NC State Protect the Pack Resources for Students:** [Resources for Students | Protect the Pack](#)
- **Academic Success Center** (tutoring, drop in advising, career and wellness advising): [Academic Success Center](#).
- **NC State Keep Learning, tips for students opting to take courses remotely:** [Keep Learning Tips for Remote Learning](#)
- **Introduction to Zoom for students:** <https://youtu.be/5LbPzzPbYEw>
- **Learning with Moodle, a student's guide to using Moodle:** <https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>
- **NC State Libraries** [Technology Lending Program](#)

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### POLICIES AND PROCEDURES

#### Professionalism

Each student is expected to conduct themselves in a professional manner. This includes, but is not limited to, arriving to class on time and staying for the full duration; being respectful of the instructor and other students; participating in group activities and discussions; refraining from the use of laptop computers, cell phones, and text messages. Furthermore, oral and written communication with the instructor and other students is expected to be at a professional level.

#### Late Assignments

Unless agreed upon with the instructor prior to the assignment due date, late assignments will not be accepted without assessment of a penalty for being late.

Most written assignments are due on the Friday prior to the class session when due, as shown in this Syllabus, and on Table 1 (posted on Moodle). Refer to the schedule for assignments that might be due at a different time. If an assignment so due, is submitted during the class or right after the class, or is otherwise late, **a maximum of 50 percent will be earned for that assignment.**

***If it is necessary to submit a late assignment, please discuss the situation with the instructor as soon as possible; the instructor will evaluate each situation on a case-by-case basis.***

#### Re-Grading of Assignments

If the student feels that a portion of an assignment has been unfairly graded by the instructor, the student may re-submit the assignment to be re-evaluated by the instructor within one week after it was originally returned to the student. However, the instructor reserves the right to re-grade the entire assignment and not just the portion that is in question by the student.



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***Thus, it is possible for the student to receive a revised final grade on the assignment that is lower than the grade that was received originally.***

### **Academic Integrity**

It is the instructor's expectation that each student will neither give nor receive unauthorized aid on any assignment. Students may discuss the homework assignments if they wish but each student is expected to submit their own assignment. For the quizzes, use of the text book, course notes, or other material is not allowed unless specified by the instructor. Additional information regarding academic integrity may be found in the NC State University [Code of Student Conduct](#).

While the integration of Artificial Intelligence (AI) in your learning experience is acceptable, there are certain uses of AI that are not permitted in this course:

- **Cheating and Academic Dishonesty:** Using AI to plagiarize or produce work without proper attribution is strictly prohibited. Per the [Code of Student Conduct](#), all work submitted must be your original creation, with appropriate citations when referring to external sources.
- **Unauthorized Assistance:** Do not use AI to access unauthorized materials or solutions during examinations, quizzes, or other assessments. Any form of unauthorized assistance is a violation of academic integrity.
- **Malicious Intent:** [Do not use AI for any activities that may cause harm or compromise security.](#)

With that said, the use of AI to assist in finding and even interpreting issues related to our course material, or assignments, can be useful. When you do so, in any of your assignments, it would be ***important to provide a reference to the source material that AI assisted you to locate.***

### **Students with Disabilities**

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please contact the Disability Services office.

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### **REQUIREMENTS AND SUGGESTIONS FOR A SUCCESSFUL SEMESTER:**

#### Participation:

- On-campus:
  - If you are physically present in the classroom, you don't need to reply to any "participation questions."
  - Your participation will be gauged by classroom attentiveness, interaction (when appropriate such as discussion periods).
- Distance-ed:
  - You will need to respond to any "participation questions" I ask during the lecture. I will clearly state that this is a "participation question."
  - If there is no email response by the start of the next scheduled lecture, there will be a minus 1 recorded.
  - You can make up half of the minus 1 by completing an assignment provided by the instructor.

#### Homework Assignments:

- One short paper, and then four case studies to be done by student-teams.
- Student teams will be four students each, and students form their own teams. Please send me an email just prior to the third class session (that session is after the Labor Day holiday day-off).
  - The team can be all on-campus, all distance-ed, or a mix.
- You are encouraged to use a spell checker for your paper, and also for the PPT "talking notes" for me to read (these are mandatory).
- Include references at the end of your PPT presentations.

#### Things NOT PERMISSIBLE:

- Do not use AI tools to write, or help write, your homework assignments. Spell and grammar check software is OK.
  - If evidence is found of "copy and paste" or AI, a ZERO will be assigned.
- **DO NOT POST LECTURE NOTES OR HOMEWORK ASSIGNMENTS ON AN OPEN WEB SITE, OR ON SOCIAL MEDIA. ALL MY LECTURES ARE "OWNED" BY AND COPYRIGHTED**
  - So you violate the law if you post any of these – these are for class use only.
  - Violations of this constitute a violation of the Academic Integrity Policy and will be reported.
  - If you have a legitimate need to share course materials such as these, ask and "permission" to do so will be considered.

#### Academic Integrity and Course Grade

- When collaboration is allowed, when it is not

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- Team assignments – collaborate
- Quizzes or exams are required as the major contributor to course grade. These are to be done with no collaboration, no sharing of notes, entirely your own work.
- Academic integrity – quizzes and first assignment must be your own work.
- Past experience – was not a positive outcome for several students.
- Grading standards for course grade
  - Syllabus gives the breakout in detail. Quizzes: 15, 15, 15, 10
  - **OR YOU CAN OPT FOR A FINAL EXAM ON THE ASSIGNED DATE.**
- Policy regarding late assignments – max of 50 percent
  - Unless there is a valid reason discussed with the instructor in advance. Valid reasons do not include optional activities, social events, discretionary travel.
  - Valid reasons include things like family emergencies, sickness, unexpected work requirements (especially pertinent for distance-ed students).

#### Specific MEM Guidance:

- **Academic Integrity.**
- Zero tolerance for students who
  - ...receive unauthorized aid from others/internet on graded events.
  - ...give unauthorized aid to others/internet regarding graded events.

...fail to provide proper attribution for help received (plagiarism).

...post course materials online without instructor permission.

All students should read <https://studentconduct.dasa.ncsu.edu/academic-integrity-overview/>

- **Best Practices: (do these things!)**
  1. Ask your instructor what is permissible for each assignment if it is unclear.
  2. When in doubt, disclose any and all assistance received.
  3. Never post course materials to the internet without written permission from the instructor.
  4. Do not share, text, or email course materials with students outside the course without permission from the instructor.
  5. Do not complete a sign-in attendance roster for anyone other than yourself.
- **Amnesty Opportunity:** If you have a CourseHero account and/or you have posted materials to this site, or similar sites, remove all content immediately.

#### Grading for Homework Assignments:

- Follow the instructions given for each. Be sure to cover, that is, include, all the requirements.
- ***Case studies will be graded*** on content, covering and explaining the required components as per the instructions given.

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- And also **INDIVIDUALS will be graded** on their contribution:
  - Presentation of case studies should include all team members.
  - DO NOT READ US ALL THE “TALKING NOTES” – I use these for grading.
  - You know the material – you did the work, so talk about it without reading it.
  - When we watch the recorded lecture, it is important that you are heard!
- Team grading matrix – will not “hurt” anyone, but can help.
  - Examples of past mis-use.
  - Mis-use or not following guidance can result in a “missed assignment” grade.

#### Attendance at Lecture Sessions

- The semester is 16 weeks long; because we meet only Mondays, we will miss TWO 2.5 contact hours of class. This would be like missing two entire weeks of a three time per week class!
- There will be an “optional” visit to the Centennial Central Utility Plant. Those who attend will earn an additional “0.5” towards course grade. This is basically making up for one week of a missed lecture.
  - There will be an option for those who can’t make the scheduled visit.
  - This includes both on-campus and distance-ed students.
- IF YOU ARE SICK, OR THINK YOU MAY BE SICK
  - **PLEASE DO NOT COME TO CLASS**
  - There will be no penalty if you let me know PRIOR to the start of the lecture
    - You will just need to respond to the “participation question(s) in that lecture
- IF YOU MISS A CLASS WITHOUT PRIOR NOTIFICATION
  - There will be a “minus 1.0” participation towards course total
  - You can make up 0.5 point by doing an assignment provided by the instructor – typically a three page paper on a specific subject provided

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### **Class Session One – Course Overview, Organization and Functions**

**Introductions – course instructor and class participants; on-campus participants will introduce themselves. The instructor will ask distance-ed students for brief information so that they can be introduced also. The intent is to do all introductions during the first session so that the participants can “meet” each other and begin thinking about case study teams. Introductions may be done in following class sessions if not completed on the first day.**

#### **Discuss the components of the class sessions:**

- Pre-reading assignments before Class Sessions
- Lectures
- Guest Lecture(s)
- Homework assignments – some will be presented by the student/team to the class
- Student teams to develop a course project as provided by the instructor; these will be presented by the student-groups in class sessions.
- Quizzes (three or four)
- Classroom discussion as may be practical

Opportunities to discuss any questions on assignments are available, either during class time, or during office hours as described above.

#### **Introduction Lecture:**

Discuss Facilities Engineering and Facility Management including a recap of the course syllabus. This course will focus on the “engineering” with the following considerations:

Distinguish between the two and show common elements

Differentiate Facilities Engineering

Organization of the Public Works Department

Variability of functions and responsibilities

Functions of departmental elements

#### **Required Reading for Session One:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

#### **Learning Objectives:**

The student will demonstrate understanding of the basics of facilities engineering and facilities management systems.

The student will be able to articulate typical scope and functions of a public works/facilities engineering department.

The student will be able to discuss, at an introductory level, considerations on planning and executing required work.

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The student should display an understanding of the interrelationship between various in-house staff elements and related manpower/expertise in a facilities engineering department/public works department.

**Assignment #1** due before, or no later than the Friday prior to Class Session 3 on Monday September 9. See the Class Schedule and the Lecture 1 Assignment towards the end of the lecture notes. Unless otherwise stated, all written assignments are due not later than the Friday prior to the “due” lecture period, electronically, not on paper.

### **Class Session 2 – Facilities Engineering Terms and Categories of Work**

#### **Read before Class Session 2:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

#### **Lecture:**

Define and discuss facilities engineering terms to include maintenance, repair, construction, operations. Practical cases will be presented.

#### **Learning Objective:**

The student will be able to articulate the difference between categories of work on physical assets, whether vertical construction, horizontal construction, utilities systems, electrical systems, environmental systems.

### **Class Session 3 – Condition Assessments, Prioritization and Maintenance Program Development**

**Due: Assignment #1 from Class Session One – all written assignments (unless otherwise stated) are due by the Friday prior to the “due” class session. Be prepared to discuss your assignment in the class session, or for distance-ed participants, a Power Point presentation with audio narration by the team members is required (for homework assignments requiring a presentation).**

#### **Read before Class Session 3:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

#### **Lecture:**

Discuss importance of credible condition assessments of facilities, including the terms Annual Inspection Summary, and Facilities Condition Assessment Program. Demonstrate development

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and formulation of a risk-informed prioritization and budget that considers aspects of mechanical engineering, electrical engineering, structural engineering and civil engineering (including environmental engineering and failure consequences) in that prioritization scheme. Discuss and be able to evaluate consequences of failure resulting from a lack of scheduled maintenance, or required repair.

The in-class students, and/or the instructor may (if time permits) present a selection of students' Assignment #1 turned in on Friday prior to today. Not all will necessarily be done this during this class; these may continue into the next Class Session.

#### **Learning Objective:**

The student will demonstrate understanding of a range of methods to perform inspection and assessment of facilities conditions, utilizing in-house technical personnel from the trades, and engineers within the organization. Additionally, the student will be able to articulate how the results of such condition assessments would be used in maintenance program and budget formulation and the role of engineering principles in prioritization across disciplines.

**Introduction of the Case Study approach for future assignments.** The intent is that “real-world” situations derived from credible sources will be assigned to student teams. Each will describe a situation showing a backlog of maintenance and repair, a limited budget, possibly less than ideal facilities engineering and management of resources and workforce, and consideration of a risk-informed approach applied to each situation. **Student-groups' presentations on these case studies will be as shown on the schedule posted on the Moodle site. Each student-team will develop their presentations so as to not exceed eight slides, 15 minutes. The student teams will be comprised of 3 to 4 individuals each. Distance-ed student teams are required to create an audio/visual recorded presentation so that each team's work is able to be shared with the entire class.**

The electronic materials are due to the instructor by **Friday prior to the class session when due**, end of day.

#### **Class Session 4 – Development of Maintenance Program and Budgets founded on Facilities Assessments and Prioritization of Needs**

##### **Read before Class Session 4:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

Plus – please research on-line and read other reports of the July 2016 derailment, accuracy of valid condition assessment of trackage, and consequences. Also, please research on-line and read reports of the January 2015 fire in the DC Metro system.

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### **Lecture:**

Continue discussion of the importance of credible condition assessments of facilities, and introduce real-world examples of failures resulting from not having credible condition assessments.

Discuss the derailment occurring on July 29, 2016. Consider methods to insure QA of maintenance functions.

Discuss the fire occurring on January 12, 2015, what apparently caused the fire, and whether response to the fire, and life-saving requirements, were adequate. Consider the impact of not having a clearly established set of roles and responsibilities between the DC Metro system, and the DC (or any other local/regional government agency) for response to such an incident.

Discuss in what ways inadequate facilities assessment (structural, electrical) could have contributed to these two distinct events.

Introduce the aspect of initial Metro system planning, the configuration of the system, the life-cycle cost and benefit analysis to include future capacity expansion and constraints on maintenance.

Discuss how failure of cybersecurity systems could impact engineered features such as positive train control, crash avoidance systems and control of turnouts.

The in-class students, and/or the instructor may (if time permits) continue with presentations of Assignment #1 student papers turned in previously.

### **Learning Objective:**

The learning objective will be matured by the end of Class Session 6.

### **Assignment #2**

***This assignment is due the Friday before the start of the class session 6.***

**Assignment:** A selection of case studies will be provided during class. In a Power Point presentation, discuss the case assigned to your team. Specifics will be provided at the time the homework is assigned.

**IMPORTANT:** This assignment has as its learning objective, the demonstrated ability to explain the importance of a FCA or targeted inspection, categorize failures as to whether caused by ***engineering issues or operational inadequacies***. Also, be able to determine and explain the root causes of the failures.



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### **Class Session 5 – Categories of Projects and Work; Contract Types to Perform**

#### **Read before Class Session 5:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

#### **Lecture:**

Discuss projects and categories of projects. Explain the difference between maintenance projects, repair projects, and construction projects. Distinguish that, even though construction trades and processes are used for all three, there is a difference between these types of projects. Discuss capital budget projects, and operational budget projects. Discuss the Davis-Bacon Act as it applies to construction trades in Federally-funded projects.

#### **Learning Objective:**

The student will demonstrate an understanding of the difference between construction trades, vs. the types of work that construction trades perform, i.e. construction, repair, and maintenance. Understand applicability of the Davis-Bacon Act. Reinforce (through student presentations) the importance of valid condition assessments.

### **Class Session 6 – Planning, Program Development, Budgeting Intro**

**Assignment #2, the case study presentation assigned in Class Session 4 is due. *This assignment is due the Friday before the start of the class session.***

The student teams will present the case studies.

#### **Learning Objective:**

The student will be able to articulate elements of a facilities assessment program, how the results of that program are used in maintenance planning, and budgeting, and the consequences of inadequate assessments. The student will also be able to explain how engineering principles from various disciplines should be employed to raise the credibility of the assessment program.

### **Class Session 7 – Overview of Environmental Laws and Regulations Applicable to FE**

#### **Read before Class Session 7:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

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### **Lecture:**

Present a compendium of environmental laws and requirements. Explain that since the laws and requirements are “media” specific, a range of engineering skills and knowledge is required to ensure that the facilities’ activities are in compliance with the various laws.

### **Learning Objective:**

The student will demonstrate knowledge of the different laws, what types of activity these laws regulate, and the responsibilities of the facilities engineer in responsible operations and compliance with the laws and regulations.

### **Assignment #3**

Due on the Friday before **Class Session 9**, that is, October 18 by the end of the day.

Assignment: Each student team will conduct on-line research to identify an instance wherein a facilities engineering organization failed to comply with environmental law or regulation, and where ***an individual is being held accountable by either a fine, or a trial in the criminal justice system***. Discuss the circumstances that led to the violation, what the facilities engineer/facilities engineering organization did wrong, and what could have been done to avoid the violation. Develop a Power Point presentation of no more than 8 pages, 15 minutes, to present this case.

## **Class Session 8 – Energy and Utilities**

### **Read before Class Session 8:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

### **Lecture:**

Energy and Utilities will be the topic of today’s class session. The cost of energy and utilities is a major portion of the budget and annual spend for a large number of facilities engineering/public works organizations. Types of programs to reduce consumption and costs will be presented, along with the facilities engineering organization’s management of the utilities function.

### **Learning Outcomes:**

The student will be able to articulate approaches for management of the utilities function, and also discuss methods to manage energy consumption to reduce costs.

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### **Class Session 9 – Cyber Security; Physical Security**

#### **Read before Class Session 9:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

#### **Lecture:**

The topic today includes cyber security, and physical security, to protect our assets and the functions they perform. Cyber security is a “hot topic” given the number of “hacks” into systems that are widely reported. Our focus on cyber security is the subset of control systems for infrastructure and building systems, such as systems that control the operation of HVAC plants, pipelines, electrical utilities, “positive train control” as used in public transportation rail systems, building control systems that often integrate access, security as well as interior environmental systems. As opposed to “information technology” or IT, control systems are considered “operational technology” and are often not as secure as IT systems, because of requirements for accessibility by a number of workers and technicians. In addition, aspects of physical security will also be presented, and these physical security features are often included in the control systems in an integrated fashion. Student teams present Case Study #3.

#### **Learning Objective:**

The student will be able to explain and differentiate among the terms IT, OT, information systems, control systems, integration of systems, and basic aspects of approaches to provide both cyber security and physical security for our assets.

#### **Assignment #4**

Due at end of day on Friday November 22:

This will be a student-team assignment. The instructor will present a case study scenario regarding an actual cybersecurity event or other facilities engineering issue. The student/team will develop a PPT presentation describing what they would direct be done in their (hypothetical) facilities engineering organization to protect against, and counter this type of cyber attack, or address the other facilities engineering issue assigned.

### **Class Session 10 – Sustainability and Resiliency; Emergency Planning**

#### **Read before Class Session 10:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

ASCE 73 – Standard Requirements for Sustainable Infrastructure posted to Moodle site – “Skim” (that is, look it over for familiarization, but take special attention to “Outcomes” in the chapters.

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### **Lecture:**

The focus of the first part of today's lecture will be on sustainability, the economic aspects, practical aspects, and implementation. Included in these considerations are total cost of ownership, budget implications, and communication of the trade-off that may be required on first cost, to attain life-cycle optimization. The second segment of this class session will focus on emergency preparedness. The Emergency Management Plan will be discussed, to include the need for an Emergency Management Officer and an Emergency Operations Center. Depending upon the type of facility and organization, the Emergency Management Officer could be the Public Works Officer/Facilities Engineer, or the PWO/FE could be one of the subordinate leaders. Resilience of facilities and systems, including cyber systems, will be discussed, including readiness, security, minimization of damage, and restoration of services after an event.

### **Learning Objectives:**

The student will understand the overall concepts, objectives, and implementation of sustainability in planning and in operations of facilities. Additionally, the student will become familiar with sources of information on sustainability, and certification programs currently available. The student will be able to discuss the various types of events that could impact the installation's operations, including facilities and transportation operations. An understanding of the role of planning and preparedness, and cybersecurity, will be expected, as well as command-and-control during recovery operations. Finally, the student will appreciate current thinking on resilience and recovery of facilities and systems.

## **Class Session 11 – Safety in the Work Place; Integrated Nature of FE**

### **Read before Class Session 11:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

### **Lecture:**

Today's lecture will be in two parts. The first will be devoted to safety in the workplace. The typical dispersion of the work place for public works personnel involved in facilities engineering, maintenance and repair tasks is a challenge. The type of work and working conditions are not always as controlled as would be desirable from a worker safety perspective. Practical lessons learned and suggested best practices will be discussed. Application of multi-disciplinary engineering in this area will be discussed.

The second half of the lecture will discuss the multi-disciplinary nature of facilities engineering expertise related to work force specialties in wet and dry utilities, both outdoor and within buildings and facilities. The importance of integrated control systems, and of cybersecurity to protect the operational integrity and safety aspects of such systems, is also discussed.

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### **Learning Objective:**

The student will be able to explain work force activities, the types of work the inherent hazards with different types of work, and what the facilities engineering leaders and managers can do to influence the organization of work and the safety of operations to protect the workers. The student will demonstrate knowledge of challenges confronting the facilities engineer and the workers in the PW organization, along with how some best practices can be applied.

### **Class Session 12 – Guest Speaker**

**Lecture:** Guest Speaker – the facilities engineer at a major university in the UNC system will discuss topics critical to the operations of the facilities engineering organization.

### **Learning Objectives:**

The student will gain a first-hand perspective of the challenges and opportunities presented in facilities engineering at a university campus.

### **Class Session 13 – Presentation of Case Study assignments**

**SUGGEST START READING:** Required Reading for Class Session 14

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session. Suggest start reading early as it is long

**Due: Assignment #4 from Class Session 10 due by the prior Friday.**

**The student-teams' presentations on the case study assignment are *due by Friday November 22 end of day*. Each presentation must not exceed 8 slides, and be delivered within 15 minutes, must have a Power Point presentation along with speaker's notes. NOTE: Student-groups' presentations on this case study, and any selected previous case studies not yet presented, will be on November 25 Class Session 13. Distance-ed student teams are required to create an audio/visual recorded presentation so that each team's work will be shared with the entire class.**

### **Learning Objective:**

The students will demonstrate ability to evaluate a scenarios that involve facilities engineering situations such as maintenance and repair, a limited budget, and evaluation of alternatives using a risk-informed approach to prioritize a facilities engineering work plan for the year. The student teams will convey an understanding of such issues common in facilities engineering, and decisions must be made concerning public safety, community concerns and values, and economic aspects to develop an optimized solution to planning, programming, budgeting, and execution of their facilities needs.

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The students will have the opportunity to see and hear their classmates' evaluation of the situations in these cases study scenarios.

#### **Class Session 14 – Program Development Decisions Determine Contract Types and Method of Accomplishments; “Construction Management” by the Owner FE for M, R ,C and Service projects.**

##### **Read before Class Session 14:**

For all required pre-readings, see the course schedule posted on the Moodle site. It is expected that each student will read the listed material ahead of time and be prepared to discuss what is covered in the class session.

##### **Lecture:**

Today's topic will start with a recap of Programming and Project Development, the engineering design process, and how to choose contract formats. All these are precursors to the construction phase and construction management, in particular, the owner's functions to promote successful performance of the project through a contract. Current thinking on construction management for facilities projects (construction, alterations, modifications, repairs, and maintenance (performed by construction trades personnel)) will be presented. Additional inter-relationships between type and form of contract, with the work to be done, will be presented. The various types of contracts will be presented. These will include a discussion of category of work (maintenance, repair, construction, services) and also the “legal” type of contracts available (construction, services). Refer back to Class Session 5, and discuss the Davis-Bacon Act, the Service Contract Act, and the Brooks Act. Discuss possible locations of the contracting function and organizational implications. Also discuss the Federal Acquisition Regulations (FAR) and possible applicability to the situation. Present organizational variants for the facilities engineer to provide oversight of contractor work, and approve payment.

##### **Learning Outcomes:**

The student will be able to discuss and delineate between different contract types, applicability of certain contract laws, and possible chain-of-command for contracting personnel. While not expecting the student to have a grasp of the full range and depth of construction management, the student will be able to articulate broad and high level concepts concerning the requirements of effective management of construction contracts (for C, M, R work) and service contracts.