The University of Texas at Tyler

Department of Civil and Construction Engineering and Management

CONE 4325 / CENG 4350 / CENG 5350 – Horizontal and Vertical Construction Techniques

Course Syllabus (Fall 2025)

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Office Hours: By appointment (please schedule via email)
Course Modality: 100% Online (Canvas LMS)
Meeting Times: Asynchronous – no set class meetings (individual Zoom consultations scheduled as needed)
Course Duration: 7-Week Accelerated Session (Fully Online, Asynchronous)
Credits: 3 semester credit hours
Prerequisites/Corequisites: Co-requisite CENG 4412; junior/senior standing or instructor approval.

Course Description

Discusses topics related to the construction of buildings, roadways, and bridges. Topics include: soil investigation, soil improvement methods, concrete placement criteria, trench work, shoring design, field welding and bolting requirements, right-of-way, traffic management planning, and quality control and quality assurance. This course compares **horizontal construction** (infrastructure such as roads and bridges) versus **vertical construction** (buildings and other structures), examining the unique techniques, materials, and management practices required for each. Students will learn field-ready practices for planning and executing both types of projects in a safe, efficient, and quality-driven manner.

Learning Objectives

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

- **Differentiate Horizontal vs. Vertical Construction:** Describe the characteristics of horizontal infrastructure projects versus vertical building projects, including their unique challenges and project delivery considerations.
- **Site Investigation & Soil Methods:** Explain how to perform site/soil investigations and identify soil improvement techniques to prepare project sites (for foundations, roadbeds, etc.) based on subsurface conditions.
- **Construction Techniques (Vertical):** Describe methods for constructing vertical structures, including concrete construction techniques (formwork, placement, curing) and structural steel erection (field bolting and welding requirements).

- **Excavation and Trenching:** Apply safe excavation practices for foundations and utility trench work, including shoring design principles to prevent collapses and compliance with OSHA trench safety standards.
- **Project Logistics & Traffic Management:** Identify key project logistics considerations such as securing right-of-way for projects and developing traffic management plans to minimize disruptions during road/bridge construction.
- **Materials & Techniques (Horizontal):** Discuss the fundamental materials and techniques used in highway construction, including soil/aggregate basics for roadways, asphalt pavement construction processes and equipment, and Portland Cement Concrete (PCC) pavement materials and practices.
- **Quality Assurance and Quality Control:** Distinguish between quality control and quality assurance (QC/QA) in construction, and outline how proper QC/QA practices contribute to pavement performance, long-term durability, and overall project success.
- **Safety, Ethics, and Management:** Understand the importance of construction safety regulations, ethical standards, and project management principles, and evaluate how these considerations influence decision-making on construction sites.

Course Format and Delivery

This course is delivered **fully online in an asynchronous format**. There are no scheduled class meetings or live lectures. Instead, each week a module will be provided on Canvas with curated learning resources (such as reading assignments, technical articles, industry videos, and case studies) covering the week's topics. Students are expected to engage with these materials independently and make timely progress each week. Active learning is reinforced through weekly discussions and quizzes:

- **Curated Resources:** Each module contains selected readings (e.g. textbook chapters, instructor notes, or published articles) and multimedia content illustrating construction techniques. *There is no required textbook;* all essential materials will be available via Canvas or UT Tyler Library links.
- **Discussion Boards:** Weekly discussion prompts will require students to reflect on the content, share insights or experiences, and engage in constructive dialogue with classmates. **Participation is required** – students should post at least one substantive original response and at least one meaningful reply to a peer each week. This replaces in-class discussion and is vital for understanding topics in depth.
- **No Recorded Lectures:** The instructor will not provide formal video lectures. However, narrated presentations or demonstration videos from external sources may be included. Students should take notes from these resources as they would from a live lecture.
- **Instructor Interaction:** The instructor will actively monitor discussions, provide feedback on assignments, and be available for questions. Virtual office hours or consultations can be arranged by appointment (via Zoom or phone) to support students as needed.
- **Time Commitment:** This accelerated 7-week course covers a full semester's content, so expect to dedicate **approximately 15+ hours per week** to coursework (reviewing materials, completing assignments, participating in discussions, etc.). Staying on schedule is critical to succeed in the compressed timeframe.

Course Schedule and Topics

The course is organized into **7 weekly modules**. Each week's module opens on Monday and concludes Sunday night (11:59 PM CST) with all assignments due by then unless otherwise noted. Below is the planned schedule of topics, activities, and major due dates (tentative subject to change):

Week 1: **Introduction to Horizontal vs. Vertical Construction**

- **Topics:** Course overview and expectations; definitions of horizontal vs. vertical construction. Comparison of project types (buildings vs. infrastructure) and their unique challenges in management and coordination. Overview of construction sectors (commercial building, highway, bridge) and examples of each. Introduction to construction safety and ethical responsibility as overarching themes.

Week 2: **Site Investigation, Earthwork, and Soil Improvement**

- **Topics:** Geotechnical site investigation methods (soil borings, standard penetration tests, sampling and lab testing for soil properties). Soil bearing capacity and its impact on design. Soil improvement techniques for weak soils: compaction, dewatering, soil stabilization (e.g. lime/cement stabilization), use of geotextiles or other ground improvement methods. Basics of earthwork operations: clearing, grubbing, cut-and-fill. **Excavation and Trench Work:** planning and executing safe excavations for foundations and utility trenches. Introduction to shoring design for deep excavations or trench support (trench boxes, sheet piling) and OSHA trench safety requirements.

Week 3: **Vertical Construction Techniques – Concrete & Steel**

- **Topics: Concrete Construction:** Formwork design considerations, concrete mix placement criteria (proper pouring techniques, vibration, avoiding cold joints), and curing methods to achieve desired strength. On-site concrete quality tests (slump test, cylinder breaks) as part of QC. **Structural Steel Construction:** Overview of steel frame erection for buildings/bridges – sequencing of steel erection, use of cranes and lifts. Field bolting and welding requirements and inspection – understanding high-strength bolted connections (torquing, bolt grades) and welding standards (welder qualifications, weld inspections). Coordination of multiple trades in vertical builds (e.g., integrating concrete and steel work with mechanical/electrical).

Week 4: **Project Logistics & Horizontal Construction Fundamentals**

- **Topics: Right-of-Way (ROW) and Project Planning:** Understanding how horizontal projects (roadways, utilities) require securing ROW and coordinating with property owners and agencies. Steps in ROW acquisition and the impact on project timelines. **Traffic Management Planning:** Developing Maintenance of Traffic (MOT) plans for construction zones – detours, lane closures, safety signage, and minimizing public disruption during road/bridge construction. **Highway Materials Introduction:** Overview of materials used in roadway construction – soil subgrade, aggregates for base and subbase layers, asphalt, and PCC (Portland Cement Concrete) for pavements. **Soil and Aggregate Fundamentals for Highways:** Properties of subgrade soils and aggregates (gradation, compaction, moisture-density relationships). Importance of proper subgrade preparation and base course compaction for pavement longevity. Introduction to specifications and tests for roadbed materials (Proctor compaction test, CBR, Limerock bearing ratio, etc.).

Week 5: **Asphalt Pavement Construction and Equipment**

- **Topics: Asphalt Materials:** Composition of Hot Mix Asphalt (HMA) – asphalt binder and aggregate, basic asphalt mix types. Handling and preparation of HMA at the asphalt plant (overview of batching and mixing, transport to site). **Pavement Construction Techniques:** Laying asphalt pavement layers – use of paving equipment such as asphalt pavers, material transfer vehicles, and rollers/compactors. Best practices for asphalt placement (temperature management, lift thickness, achieving proper compaction to meet density specs). **Equipment and Crew Operations:** Roles of the paving crew (paver operator, dump truck driver, laborers for raking), and key equipment like tandem rollers, pneumatic tire rollers for compaction. Discussion of typical productivity rates and challenges (weather effects, night paving,

traffic control during paving). Introduction to asphalt quality control tests (density tests, asphalt content, core samples for thickness).

Week 6: **Concrete Pavement Construction Practices**

- **Topics: PCC Pavement Materials:** Characteristics of concrete mixes for pavements vs. building structures (importance of workability, setting time, durability factors like air entrainment). Role of aggregates and admixtures in pavement concrete. **Concrete Pavement Types:** Introduction to Jointed Plain Concrete Pavement (JPCP) and Continuously Reinforced Concrete Pavement (CRCP) used in highways. **Pavement Construction Methods:** Setting up formwork or slip-form paving machines for concrete pavements. Process of paving concrete roads: subbase preparation, placing and spreading concrete (e.g. via slip-form paver), inserting dowel bars or tie bars, texturing and curing the pavement. Forming joints (saw cutting) to control cracking in JPCP, versus managing crack development in CRCP. **Construction Equipment:** Overview of concrete paving equipment (mixers, slip-form pavers, cure sprayers) and ancillary equipment (dowel bar inserters, joint saws). Emphasis on timing and weather considerations (temperature, wind, rain effects on fresh concrete).

Week 7: **Quality, Performance, and Project Integration**

- **Topics: Quality Control & Quality Assurance (QC/QA):** Comprehensive look at construction quality programs – contractor's QC procedures (e.g. on-site material testing, inspections, documentation) versus owner's or third-party QA oversight (independent testing, audits). How QC/QA is implemented in both building construction and road projects (e.g. concrete strength tests, asphalt density tests, weld inspections). Discussion of how quality during construction impacts long-term performance of structures and pavements. **Pavement Performance and Maintenance:** Common pavement distresses in asphalt and concrete (cracking, rutting, spalling) and how construction quality or material selection can lead to or prevent these issues. Introduction to maintenance strategies (sealcoating, overlays for asphalt; slab replacement, diamond grinding for concrete) and the concept of designing for maintainability. **Construction Safety & Ethics:** A capstone discussion on maintaining a safe construction site (OSHA regulations, personal protective equipment, hazard communication) and the ethical responsibilities of construction professionals (accurate reporting, adherence to codes/standards, environmental stewardship). **Project Management Considerations:** Integrating knowledge from the course – how to plan and execute projects that balance cost, time, quality, and safety. Basics of scheduling and risk management as they pertain to coordinating horizontal and vertical construction activities.

Note: The above schedule is subject to adjustment. Any changes to topics or due dates will be communicated in advance via Canvas announcements. All assignments (quizzes, exams, homework, discussions, project deliverables) are due by 11:59 PM on the Sunday of the corresponding week unless specified otherwise.

Assessment and Grading

Course grades will be based on the following components. **Undergraduate and graduate students have different grading breakdowns**, as graduate students are assigned an additional project. All students are held to high standards of academic integrity and effort.

Undergraduate (CONE 4325 / CENG 4350) Grading

- **Weekly Quizzes – 40%:** Approximately 6–7 quizzes administered weekly via *LockDown Browser*. Quizzes test understanding of that week's content and are typically 30–40 questions (multiple-choice/short answer). Quizzes are **closed-book, timed assessments** to be completed individually. *Note:* The lowest quiz grade may be dropped (at instructor's discretion) to accommodate one missed/poor performance.

- **Exams (2) – 30%:** Two proctored online exams (mid-term and final, each roughly 15%). These exams cover multiple weeks of material and consist of problem-solving questions, short essays, and applied scenarios. Exams must be taken with **Respondus LockDown Browser + Webcam** (see policies below) during the scheduled exam window.
- **Homework Assignments – 20%:** Four (4) homework assignments throughout the term (~5% each). These may include problem sets, case-study analyses, or short writing assignments to reinforce practical application of the concepts. Students may use course materials to complete homework, but must work independently and submit original work.
- **Discussion Boards – 10%:** Participation in weekly discussions. Full credit is earned by posting thoughtful, timely responses to the prompt and engaging with classmates (e.g. replying with substantive feedback or questions). Posts are graded on relevance, insight, and professionalism. Consistent participation is expected in at least **6 of 7** weeks (one week's discussion may be missed without penalty if overall engagement is strong).

Undergraduate Grade Scale: A = 90–100%; B = 80–89%; C = 70–79%; D = 60–69%; F = <60%.

Graduate (CENG 5350) Grading

- **Weekly Quizzes – 30%:** Same quizzes as undergraduates, but counted for 30% of the grade. (*Note:* Graduate students are expected to demonstrate a deeper understanding in their quiz and exam responses.)
- **Exams (2) – 20%:** Two exams (mid-term and final, ~10% each) as described above. Graduate-level evaluation may include additional or more advanced questions on exams.
- **Homework Assignments – 20%:** Same homework assignments as undergrads (with potential extra questions or higher expectations for analysis).
- **Discussion Boards – 10%:** Same participation requirements as undergrads, with an expectation for leadership in discussions (e.g. providing additional scholarly insight, guiding conversation).
- **Graduate Project – 20%:** A semester project tailored for graduate students (see below), replacing a portion of quiz/exam weight. This project allows demonstration of advanced competency in a specific construction topic.

Graduate Grade Scale: A = 90–100%; B = 80–89%; C = 70–79%; *Below 70% is considered failing at the graduate level.*

Graduate Project (CENG 5350 only)

Graduate students will complete an independent project exploring a **construction-focused topic** beyond the scope of regular assignments. This is a **non-design-based** project – instead of structural design calculations, the emphasis should be on methods, management, or materials in construction practice. Possible project types include: a research paper on an emerging construction technique, a case study analysis of a major construction project (examining its logistics, QA/QC program, safety record, etc.), or an evaluation of new technology or policy in horizontal/vertical construction. Students are encouraged to choose a topic aligning with their interests or work experience, **subject to instructor approval**.

Project Guidelines:
- **Proposal (Week 2):** Submit a brief proposal (approx. one page) outlining the chosen topic, its relevance to horizontal/vertical construction techniques, and the intended scope (what you plan to investigate or analyze). The instructor will review and must approve the topic to ensure it is appropriate and achievable within the course timeline.
- **Progress Check (Week 4):** Provide an outline or summary of progress (key points gathered, preliminary findings, any challenges) to get feedback. This is informal but required to keep you on track.

- **Final Report:** Develop a written report (~30–50 pages, single-spaced) that includes an introduction to the topic, background research or literature review, analysis/discussion, and conclusions or recommendations. The report should demonstrate ***graduate-level critical thinking*** and link to course concepts (e.g. discuss how the findings relate to quality, safety, or project management in construction). Proper citations in APA style should be used for any external references.
- **Presentation:** Prepare a short presentation (about 10–15 minutes, using PowerPoint or video) summarizing your project for the class. This can be a narrated slides ***with*** video or recorded talk via Zoom or other tool available to you. It should cover the problem or question you addressed, methodology (if any), key findings, and lessons for construction practice. This presentation must be posted by the due date in Week 7 so that **classmates and the instructor can view it**.
- **Evaluation:** The project will be graded on depth of research, quality of analysis, clarity of writing, and how well it ties into course themes. The presentation component will be graded on clarity and engagement. This project accounts for 20% of the graduate grade, so a *high standard of effort is expected*.

Course Policies

Academic Integrity: All students are expected to uphold UT Tyler's standards of academic honesty. Cheating, plagiarism, and any form of academic misconduct will not be tolerated. This means **all work submitted must be your own**. Do not share quiz or exam content with others. For written assignments, properly cite any sources used. Suspected violations will be referred to the Office of Academic Integrity and may result in a zero on the assignment, course failure, or further disciplinary action. When in doubt, ask the instructor if a certain form of collaboration or resource is permitted. Remember that the goal is to learn and demonstrate your own understanding of construction techniques.

Artificial Intelligence Tools Use: UT Tyler is committed to exploring and using artificial intelligence (AI) tools as appropriate for the discipline and task undertaken. We encourage discussing AI tools' ethical, societal, philosophical, and disciplinary implications. All uses of AI should be acknowledged as this aligns with our commitment to honor and integrity, as noted in UT Tyler's Honor Code. Faculty and students must not use protected information, data, or copyrighted materials when using any AI tool. Additionally, users should be aware that AI tools rely on predictive models to generate content that may appear correct but is sometimes shown to be incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research. You are ultimately responsible for the quality and content of the information you submit. Misusing AI tools that violate the guidelines specified for this course (see below) is considered a breach of academic integrity. The student will be subject to disciplinary actions as outlined in UT Tyler's Academic Integrity Policy. ***For this course***, the work submitted by students in this course will be generated by themselves. This includes all process work, drafts, brainstorming artifacts, editing, and final products. This extends to group assignments where students must create collaboratively create the project. Any instance of the following constitutes a violation of UT Tyler's Honor Code: a student has another person/entity do any portion of a graded assignment, which includes purchasing work from a company, hiring a person or company to complete an assignment or exam, using a previously submitted assignment and/or using AI tools (such as ChatGPT).

LockDown Browser + Webcam Requirement: *Quizzes and exams in this course require the use of Respondus LockDown Browser with a webcam.* This software will prevent browsing other websites or accessing notes during the test, and the webcam will record you to ensure a closed-book, independent testing environment. Before the first quiz, students must download and install LockDown Browser and test their equipment. Guidelines:
- Choose a quiet, distraction-free environment for taking quizzes/exams. Your face, ID, and workspace may be recorded per UT Tyler online testing policies.
- No external resources (books, notes, phones, other devices) are allowed during quizzes/exams. All hats, headphones, and smart watches should be removed.

- If an issue arises during a test (e.g. technical glitch or interruption), notify the instructor **immediately** with details and screenshots if possible. Any attempts to bypass or cheat the LockDown system will be considered *academic misconduct*.

Late Work and Make-up Policy: Due to the short duration of the course, staying on schedule is crucial. Assignments are due on the dates specified. Late submissions will be penalized **10% per day** up to a maximum of 3 days late, after which the grade may be a zero. Quizzes and exams must be taken within their availability window – *make-up quizzes/exams are only allowed in documented emergency situations*. If you anticipate an issue meeting a deadline (illness, personal emergency), inform the instructor **in advance** if possible to discuss alternative arrangements. It is the student's responsibility to keep track of due dates and manage time accordingly in the accelerated format.

Communication & Netiquette: Professional and respectful communication is expected in all course interactions. On discussion boards and emails:
- Keep your tone courteous and constructive. It is fine to disagree or critique ideas, but do so respectfully without personal attacks.
- Follow standard writing conventions (complete sentences, no texting slang) and be concise.
- Review what you wrote before posting/sending – ensure it is clear and free of inflammatory language that could be misinterpreted.
- Use the university email to contact the instructor. Allow 24 hours for a response on weekdays. When asking questions, be specific and include relevant context so the instructor can assist you best.
- For urgent issues, you may mark your email as high priority. Always include your course number in the subject line for clarity.

Technical Requirements: Ensure you have reliable access to Canvas and a stable internet connection, especially for quizzes and exams. A computer (Windows or Mac) capable of running LockDown Browser and viewing multimedia content is required. Familiarize yourself with Canvas and upload/download functions. If you face technical difficulties, contact UT Tyler IT support or Canvas Support immediately. Lack of technical preparation is not an acceptable excuse for missing work. It is recommended to **not wait until the last minute** for quizzes/exams in case of technical problems.

Disability Accommodations: If you have a documented disability that may require accommodations, please contact the Office of Student Accessibility and Resources (SAR) as soon as possible. The university will work with you and the instructor to provide appropriate accommodations to ensure equitable access to the course. All discussions will remain confidential. Arrangements such as extended time on quizzes/exams or alternative formats for materials must be made through official channels. It is the student's responsibility to initiate this process early in the term.

Collaboration Policy: You are encouraged to study together and discuss course concepts with peers, but all submitted work (homework answers, quiz attempts, exam responses, project report, etc.) must be your individual effort. Group discussion should never result in identical write-ups. Do not share your written solutions or take-home answers. For the graduate project, while you may consult external experts or references, the analysis and writing should be your own. Always cite sources for any ideas, data, or text that are not originally yours.

Instructor Feedback and Grading Timeline: Quizzes are auto-graded and scores will be available immediately upon submission (feedback on answers may be released after the due date). Exams and homework will be graded by the instructor within one week of submission when possible. Discussion board participation will be evaluated weekly, with feedback or highlights posted by the instructor to the class. For the graduate project, feedback on the proposal will be given within a few days of submission, and the final project grade will

be posted along with course final grades. If you have questions about a grade or feedback, please contact the instructor—appointments can be made to review your work.

Course Changes: This syllabus is a guiding document and is subject to refinement. The instructor reserves the right to adjust the schedule, topics, or assignments as needed to enhance learning or accommodate unforeseen circumstances (for example, adjusting workload or substituting equivalent assignments). Students will be notified of any changes through Canvas announcements and an updated syllabus will be provided if significant changes occur. All students are responsible for staying informed of updates.