CIVIL ENGINEERING AND ARCHITECTURE
Course Syllabus

Course Number: ST00019
OHLAP Credit: No
OCAS Code: 8713
Course Length: 120 Hours
Career Cluster: Science, Technology, Engineering and Mathematics
Career Pathway: Engineering and Technology
Career Major(s): PLTW Pre-Engineering (Comprehensive High Schools), PLTW Pre-Engineering

Pre-requisite(s):
This course provides an overview of the fields of Civil Engineering and Architecture, while emphasizing the interrelationship and dependence of both fields on each other. Students use state of the art software to solve real world problems and communicate solutions to hands-on projects and activities. This course covers topics such as: the history of Civil Engineering and Architecture, residential design for sustainability and cost efficiency, commercial structures, site design, and commercial building design.

Textbooks:
Project Lead The Way Civil Engineering and Architecture Curriculum – August 2010

Course Objectives:
Unit 1: Overview of Civil Engineering and Architecture

Lesson 1.1: History of Civil Engineering and Architecture
Performance Objectives Addressed In Lesson:
It is expected that students will:

· Connect modern structural and architectural designs to historical architectural and civil engineering achievements.
· Identify three general categories of structural systems used in historical buildings.
· Explain how historical innovations have contributed to the evolution of civil engineering and architecture.
· Identify and explain the application of principles and elements of design to architectural buildings.
· Determine architectural style through identification of building features, components, and materials.
· Create a mock-up model depicting an architectural style or feature using a variety of materials.

Lesson 1.2: Careers in Civil Engineering and Architecture
Performance Objectives Addressed In Lesson
It is expected that students will:

· Identify the primary duties, and attributes of a civil engineer and an architect
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along with the traditional path for becoming a civil engineer or architect.

- Identify various specialty disciplines associated with civil engineering.
- Participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.
- Understand the relationship among the stakeholders involved in the design and construction of a building project.

Unit 2: Residential Design

Lesson 2.1: Building Design and Construction

Performance Objectives Addressed In Lesson

* It is expected that students will:

  - Identify typical components of a residential framing system.
  - Recognize conventional residential roof designs.
  - Model a common residential roof design and detail advantages and disadvantages of that style.
  - Use 3D architectural software to create a small building.

Lesson 2.2: Cost and Efficiency Analysis

Performance Objectives Addressed In Lesson

* It is expected that students will:

  - Apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.
  - Create a cost estimate for a small construction project, including a detailed cost breakdown.
  - Calculate the heat loss through one wall of a conditioned building.
  - Calculate the heat loss for a building envelope with given conditions appropriate for the project.
  - Apply principles of sustainable design to a small project.

Lesson 2.3: Residential Design

Performance Objectives Addressed In Lesson

* It is expected that students will:

  - Apply elements of good residential design to the design of a basic house to meet the needs of a client.
  - Design a home design that complies with applicable codes and requirements.
  - Incorporate sustainable building principles and universal design concepts into a residential design.
  - Create bubble diagrams and sketch a floor plan.
  - Identify residential foundation types and choose an appropriate foundation for a residential application.
  - Calculate the head loss and estimate the water pressure for a given water supply.
system.
· Create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that comply with applicable codes.
· Design an appropriate sewer lateral for wastewater management for a building that complies with applicable codes.
· Create a site opportunities map and sketch a project site.
· Choose an appropriate building location on a site based on orientation and other site-specific information.
· Calculate the storm water runoff from a site before and after development.
· Document the design of a home using 3D architectural design software and construction drawings.

Unit 3: Commercial Applications

Lesson 3.1: Commercial Building Systems

Performance Objectives Addressed In Lesson

It is expected that students will:
· Identify applicable building codes and regulations that apply to a given development.
· Classify a building according to its use, occupancy, and construction type using the International Building Code.
· Research Land Use regulations to identify zoning designations and allowable uses of property.
· Comply with specifications, regulations, and codes during a design process.
· Compare a variety of commercial wall systems and select an appropriate system for a given commercial application based on materials, strength, aesthetics, durability, and cost.
· Compare a variety of commercial low-slope roof systems and select an appropriate system for a given commercial application based on materials, strength, durability, and cost.
· Incorporate sustainable building practices, especially a green roof, into the design of a commercial building.
· Use 3D architectural design software to incorporate revisions for the redesign of a building.
· Use 3D architectural design software to create appropriate documentation to communicate a commercial building design.
· Calculate the structural efficiency of a structure.
· Use load-span tables to design structural elements.

Lesson 3.2: Structures

Performance Objectives Addressed In Lesson

It is expected that students will:
Identify the work of a structural engineer.

- Use building codes and other resources to calculate roof loading to a structure and select appropriate roof beams to safely carry the load.
- Analyze a simply supported beam subjected to a given loading condition to determine reaction forces, sketch shear and moment diagrams, and determine the maximum moment resulting in the beam.
- Use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
- Use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
- Calculate the deflection of a simply supported beam subjected to a given loading condition.
- Use building codes and other resources to determine the required floor loading and design a structural steel floor framing system (beams and girders) for a given building occupancy.
- Identify and describe the typical usage of foundation systems commonly used in commercial construction.
- Determine the loads transferred from a steel framed structure to the ground through a foundation.
- Size a spread footing for a given loading condition.
- Check structural calculations created by others for correctness.

Lesson 3.3: Services and Utilities

Performance Objectives Addressed In Lesson

It is expected that students will:

- Interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
- Read and understand HVAC construction drawings for a commercial project.
- Apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
- Modify system designs to incorporate energy conservation techniques.

Lesson 3.4: Site Considerations

Performance Objectives Addressed In Lesson

It is expected that students will:

- Use differential leveling to complete a control survey to establish a point of known elevation for a project.
- Design appropriate pedestrian access, vehicular access and a parking lot for a commercial facility.
- Analyze a site soil sample to determine the United Soil Classification System designation and predict soil characteristics important to the design and construction of a building on the site.
Estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.

· Apply Low Impact Development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.

· Follow specifications and codes during a design process.

· Given 3D architectural design software, document a commercial site design.

Unit 4: Commercial Building Design

Lesson 4.1: Commercial Building Design Problem

Performance Objectives Addressed In Lesson

It is expected that students will:

· Work individually and in groups to produce a solution to a team project.

· Research codes, zoning ordinances and regulations to determine the applicable requirements for a project.

· Identify the boundaries of a property based on its legal description.

· Perform research and visit a site to gather information pertinent to the viability of a project on the site.

· Identify the criteria and constraints, and gather information to promote viable decisions regarding the development of their solution.

· Create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.

· Communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.

· Investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.

· Apply current common practices utilized in Civil Engineering and Architecture to develop a viable solution in their project.

· Develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.

Lesson 4.2: Commercial Building Design Presentation

Performance Objectives Addressed In Lesson

It is expected that students will:

· Assemble and organize work from a commercial project to showcase the project in an effective and professional manner.

· Create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development.

· Conduct an oral presentation to present a proposal for the design and development of a commercial building project.
Teaching Methods: The class will primarily be taught by the lecture and demonstration method and supported by various media materials to address various learning styles. There will be question and answer sessions over material covered in lecture and media presentations. Supervised lab time is provided for students to complete required projects.

Grading Procedures:
1. Students are graded on theory and lab practice and performance. Each course must be passed with seventy (70%) percent or better.
2. Grading scale: A=90-100%, B=80-89%, C=70-79%, D=60-69%, F=50-59%.

Description of Classroom, Laboratories, and Equipment:
Tulsa Technology Center campuses are owned and operated by Tulsa Technology Center School District No. 18. All programs provide students the opportunity to work with professionally certified instructors in modern, well-equipped facilities.

Available Certifications/College Credit:
The student may be eligible to take state, national or industry exam after completion of the program. Students will take the national PLTW final exam after completion of the program; and may earn college credit from Rochester Institute of Technology if they achieve a 70% on this final along with an 85% course grade average. College credit may also be issued from Oklahoma State University-Okmulgee or Tulsa Community College. See program counselor for additional information.

College Credit Eligibility: The student must maintain a grade point average of 2.0 or better. Please delete. A grade of 70% on the national final exam and a course average of at least 85% is required to obtain credit from RIT. OSU-IT credit requirements include concurrent college enrollment and a passing course grade.