

CIVIL ENGINEERING AND ARCHITECTURE

Civil Engineering and Architecture introduces students to the fundamental design and development aspects of civil engineering and architectural planning activities. Application and design principles will be used in conjunction with mathematical and scientific knowledge. Computer software programs should allow students opportunities to design, simulate, and evaluate the construction of buildings and communities. During the planning and design phases, instructional emphasis should be placed on related transportation, water resource, and environmental issues. Activities should include the preparation of cost estimates as well as a review of regulatory procedures that would affect the project design. **NOTE: Use of the PLTW Course number is limited to schools that have agreed to be part of the Project Lead the Way network and follow all training and data collection requirements.**

- DOE Code: 4820
- Recommended Grade Level: 11-12
- Required Prerequisites: Introduction to Engineering Design and Principles of Engineering
- Credits: 2 semester course, 2 semesters required, 1 credit per semester, maximum of 2 credits
- Fulfills a Directed Elective or Elective requirement for all diploma types
- Qualifies as a Quantitative Reasoning course

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

Content Standards

Domain – History in Architecture and Civil Engineering

Core Standard 1 Students evaluate historical structures to understand the evolution of design elements, structural components and material used.

Standards

- CEA-1.1 Identify and describe the different architectural styles
- CEA-1.2 Analyze the influence technology innovations have had on the design and construction of structures.
- CEA-1.3 Analyze the impact of innovations in tools and materials on architecture and civil engineering and design.
- CEA-1.4 Explain the design concept of form and function
- CEA-1.5 Identify engineering achievements through history and how those innovations have changed the way structures are designed.
- CEA-1.6 Compare modern structural and architectural design to historical designs.

Domain – Careers in Architecture and Civil Engineering

Core Standard 2 Students analyze the various facets of architectural and civil engineering careers to integrate into design projects.

Standards

- CEA-2.1 Identify work ethics and behaviors that are important for career success in civil and architecture engineering.
- CEA-2.2 Research college/technical schools for class requirements for a civil and architectural engineering career major.
- CEA-2.3 Describe connections between engineering and other disciplines to see how they work together.
- CEA-2.4 Evaluate job outlook information on various civil and architecture engineering careers.

Domain – Architectural Design, Cost & Efficiency

Core Standard 3 Students assess architectural design to incorporate the use of spatial relationships, building layout, and costs into a design project.

Standards

- CEA-3.1 Describe the importance of focusing on detail when executing the design Process.
- CEA-3.2 Demonstrate the principles and elements of design and incorporate them in design solutions.
- CEA-3.3 Apply the steps of the design process to solve a variety of architectural design problems.
- CEA-3.4 Adapt and apply math skills to calculate material costs
- CEA-3.5 Use cost estimation processes
- CEA-3.6 Calculate heat loss of projects
- CEA-3.7 Identify and describe materials used in construction of a building or residential structure.
- CEA-3.8 Identify accessibility requirements and the cost impact.
- CEA-3.9 Incorporation sustainable building practices into the designs

Domain – Residential Building Design

Core Standard 4 Students establish a base knowledge of residential design concepts to develop a set of construction documents.

Standards

- CEA-4.1 Identify family needs that should be considered when planning a dwelling.
- CEA-4.2 Apply planning rules and techniques for the sleeping, living, and service areas of a residence.
- CEA-4.3 Draw a plot plan or site plan for a residence considering drainage, property improvements, utilities and dwelling footprint.
- CEA-4.4 Design footings and foundations for a residential structure.
- CEA-4.5 Design and draw to scale a residential floor plan using the accepted symbols and annotation and drawing techniques.
- CEA-4.6 Verify home construction costs using the cost per square foot and identify cost per type of construction, affordability, and the cost of amenities.
- CEA-4.7 Demonstrate layout techniques of exterior and interior elevations and detail drawings.

- CEA-4.8 Select appropriate materials to be used in residential construction in accordance to geographical location, building codes, and style of dwelling.
- CEA-4.9 Analyze building codes and zoning codes for use in constructing a residential structure.
- CEA-4.10 Identify components of residential framing systems
- CEA-4.11 Distinguish advantages and disadvantages between different residential roof designs.
- CEA-4.12 Analyze structures to identify how residential/commercial structures are assembled, current construction practices, and impact on the environment.

Domain – Commercial Building Design

Core Standard 5 Students establish a base knowledge to identify commercial building materials, building codes, and design concepts to develop a set of construction documents.

Standards

- CEA-5.1 Compare commercial and residential building systems
- CEA-5.2 Analyze building codes and regulations used in constructing a commercial structure
- CEA-5.3 Evaluate zoning regulations for the allowable use of property
- CEA-5.4 Choose appropriate commercial wall systems for structures
- CEA-5.5 Determine appropriate materials for structures

Domain – Structural Components and Design

Core Standard 6 Students connect through terminology and mathematics the structural components of commercial and residential design to apply loads on a structure including beams, girders, columns and footings.

Standards

- CEA-6.1 Select appropriate roof beams to carry the calculated load
- CEA-6.2 Analyze load conditions of supported beams
- CEA-6.3 Graphically demonstrate the structural analysis of supported beams
- CEA-6.4 Determine required floor loading
- CEA-6.5 Identify and describe usage of commercial foundation systems
- CEA-6.6 Determine loads transferred from the structure to the ground
- CEA-6.7 Design appropriate structural floor framing systems

Domain – Building Systems

Core Standard 8 Students integrate building systems including fire, plumbing, HVAC, and electrical, to properly size and appropriately serve a building project while conserving natural resources.

Standards

- CEA-8.1 Apply code requirements for the installation of services and utilities
- CEA-8.2 Interpret HVAC construction drawings
- CEA-8.3 Analyze the need for an architect to understand how electrical, plumbing, and HVAC systems are designed and constructed
- CEA-8.4 Identify and describe options for the management of wastewater
- CEA-8.5 Examine how the placement of utilities effect design of the structure
- CEA-8.6 Assess systems to incorporate energy conservation techniques

Domain – Surveying & Hydrology

Core Standard 9 Students connect land surveying equipment components and theory to architectural and civil engineering projects to evaluate how land surveying impacts design and construction.

Standards

- CEA-9.1 Analyze a site by surveying
- CEA-9.2 Classify soil samples relevant to structure designs
- CEA-9.3 Create a design for storm water runoff
- CEA-9.4 Compare and contrast site design factors and the impacts on the environment and surrounding properties
- CEA-9.5 Demonstrate site planning with consideration of codes and facility requirements
- CEA-9.6 Analyze drainage patterns, vegetation, and construction materials to determine the impact of design elements and methods to modify the surrounding terrain.

Career and Technical Student Organizations

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as the **Technology Student Association (TSA)**.