

CHINO VALLEY UNIFIED SCHOOL DISTRICT
INSTRUCTIONAL GUIDELINES
CIVIL ENGINEERING AND ARCHITECTURE

Course Number	5889
Department	Project Lead the Way
Prerequisite	Concurrent enrollment in Algebra II or higher math
Length of Course	Two (2) semesters/One (1) year
Grade Level	10-12
Credit	5 units per semester/10 total credits - elective
Repeatable	Not repeatable for credit
UC/CSU	
Board Approved	July 14, 2011

Description of Course – Civil Engineering and Architecture (CEA) is the study of the design and construction of residential and commercial building projects. This course includes an introduction to many of the varied factors involved in building design and construction including building components and systems, structural design, storm water management, site design, utilities and services, cost estimation, energy efficiency, and careers in the design and construction industry. This course is aligned to the Project Lead the Way Program.

Rationale for Course – The major focus of the CEA course is to expose students to the design and construction of residential and commercial building projects, design teams and teamwork, communication methods, engineering standards, and technical documentation. Utilizing the activity project problem based (APPB) teaching and learning pedagogy, students will analyze, design, and build electronic and physical models of residential and commercial facilities. While implementing these designs students will continually hone their interpersonal skills, creative abilities, and understanding of the design process.

Standard 1 – (Fundamentals of Civil Engineering and Architecture) Students understand the principles and elements of design and architectural styles, as well as, explore career paths in civil engineering and architecture.

- 1.1 Objective: Identify visual design principles and elements and how they affect architectural style.
 - 1.1.1 Performance Indicator: Students will connect modern structural and architectural designs to historical architectural and civil engineering achievements.
 - 1.1.2 Performance Indicator: Students will identify three general categories of structural systems used in historical buildings.

- 1.1.3 Performance Indicator: Students will explain how historical innovations have contributed to the evolution of civil engineering and architecture.
- 1.1.4 Performance Indicator: Students will identify and explain the application of principles and elements of design to architectural buildings.
- 1.1.5 Performance Indicator: Students will determine architectural style through identification of building features, components, and materials.
- 1.1.6 Performance Indicator: Students will create a mock-up model depicting an architectural style or feature using a variety of materials.
- 1.2 Objective: Explore careers in civil engineering and architecture and identify the primary duties of each.
 - 1.2.1 Performance Indicator: Students will identify the primary duties and attributes of a civil engineer and an architect along with the traditional path for becoming a civil engineer or architect.
 - 1.2.2 Performance Indicator: Students will identify various specialty disciplines associated with civil engineering.
 - 1.2.3 Performance Indicator: Students will participate in a design charrette and recognize the value of using a charrette to develop innovative solutions to support whole building design.
 - 1.2.4 Performance Indicator: Students will understand the relationship among the stakeholders involved in the design and construction of a building project.

Standard 2 – (Residential Design) Students apply understanding of residential wall, roof, framing systems, heat loss and gain, and cost estimating to design a home.

- 2.1 Objective: Recognize components, advantages, and disadvantages in conventional residential roof designs.
 - 2.1.1 Performance Indicator: Students will identify typical components of a residential framing system.
 - 2.1.2 Performance Indicator: Students will recognize conventional residential roof designs.
 - 2.1.3 Performance Indicator: Students will model a common residential roof design and detail advantages and disadvantages of that style.

- 2.1.4 Performance Indicator: Students will use 3D architectural software to create a small building.
- 2.2 Objective: Create a cost estimate for a small construction project and calculate the heat loss for the building.
 - 2.2.1 Performance Indicator: Students will apply basic math skills to calculate the quantity and cost of concrete needed to pour the pad for a small building.
 - 2.2.2 Performance Indicator: Students will create a cost estimate for a small construction project, including a detailed cost break down.
 - 2.2.3 Performance Indicator: Students will calculate the heat loss through one wall of a conditioned building.
 - 2.2.4 Performance Indicator: Students will calculate the heat loss for a building envelope with given conditions appropriate for the project.
 - 2.2.5 Performance Indicator: Students will apply principles of sustainable design to a small project.
- 2.3 Objective: Design an affordable home for a client using sustainable practices.
 - 2.3.1 Performance Indicator: Students will apply elements of good residential design to the design of a basic house to meet the needs of a client.
 - 2.3.2 Performance Indicator: Students will create a home design that complies with applicable codes and requirements.
 - 2.3.3 Performance Indicator: Students will incorporate sustainable building principles and universal design concepts into a residential design.
 - 2.3.4 Performance Indicator: Students will create bubble diagrams and sketch a floor plan.
 - 2.3.5 Performance Indicator: Students will identify residential foundation types and choose an appropriate foundation for a residential application.
 - 2.3.6 Performance Indicator: Students will calculate the heat loss and estimate the water pressure for a given water supply system.
 - 2.3.7 Performance Indicator: Students will create sketches to document a preliminary plumbing and a preliminary electrical system layout for a residence that complies with applicable codes.

- 2.3.8 Performance Indicator: Students will design an appropriate sewer lateral for waste water management for a building that complies with applicable codes.
- 2.3.9 Performance Indicator: Students will create a site opportunities map and sketch a project site.
- 2.3.10 Performance Indicator: Students will choose an appropriate building location on a site based on orientation and other site-specific information.
- 2.3.11 Performance Indicator: Students will calculate the storm water runoff from a site before and after development.
- 2.3.12 Performance Indicator: Students will document the design of a home using 3D architectural design software and construction drawings.

Standard 3 – (Commercial Applications) Students research and design commercial structural systems, analyze utilities and energy codes, and investigate site considerations such as road design, parking lot design, storm water management, site grading, and low impact development.

- 3.1 Objective: Research land use regulations and identify the differences between residential and commercial structural systems.
 - 3.1.1 Performance Indicator: Students will identify applicable building codes and regulations that apply to a given development.
 - 3.1.2 Performance Indicator: Students will classify a building according to its use, occupancy, and construction type using the International Building Code.
 - 3.1.3 Performance Indicator: Students will research land use regulations to identify zoning designations and allowable uses of property.
 - 3.1.4 Performance Indicator: Students will comply with specifications, regulations, and codes during a design process.
 - 3.1.5 Performance Indicator: Students will 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.
 - 3.1.6 Performance Indicator: Students will 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.

- 3.1.7 Performance Indicator: Students will incorporate sustainable building practices, especially a green roof, into the design of a commercial building.
- 3.1.8 Performance Indicator: Students will use 3D architectural design software to incorporate revisions for the redesign of a building.
- 3.1.9 Performance Indicator: Students will use 3D architectural design software to create appropriate documentation to communicate a commercial building design.
- 3.1.10 Performance Indicator: Students will calculate the structural efficiency of a structure.
- 3.1.11 Performance Indicator: Students will use load span tables to design structural elements.
- 3.2 Objective: Apply the principles of structural engineering to the design and sizing of spread footings.
 - 3.2.1 Performance Indicator: Students will use building codes and other resources to calculate roof loading to a structure and select appropriate roof beams to safely carry the load.
 - 3.2.2 Performance Indicator: Students will 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.
 - 3.2.3 Performance Indicator: Students will use beam formula to calculate end reactions and the maximum moments of a simply supported beam subjected to a given loading condition.
 - 3.2.4 Performance Indicator: Students will use structural analysis software to create shear and moment diagrams of simply supported beams subjected to a given loading condition.
 - 3.2.5 Performance Indicator: Students will calculate the deflection of a simply supported beam subjected to a given loading condition.
 - 3.2.6 Performance Indicator: Students will 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.

- 3.2.7 Performance Indicator: Students will identify and describe the typical usage of foundation systems commonly used in commercial construction.
- 3.2.8 Performance Indicator: Students will determine the loads transferred from a steel framed structure to the ground through a foundation.
- 3.2.9 Performance Indicator: Students will size a spread footing for a given loading condition.
- 3.2.10 Performance Indicator: Students will check structural calculations created by others for correctness.
- 3.3 Objective: Apply building codes and other constraints to common services and utilities such as electricity, natural gas, fresh water, sewage, and other internal systems.
 - 3.3.1 Performance Indicator: Students will interpret and apply code requirements and constraints as they pertain to the installation of services and utilities.
 - 3.3.2 Performance Indicator: Students will read and understand HVAC construction drawings for a commercial project.
 - 3.3.3 Performance Indicator: Students will apply criteria and constraints to size and locate the new utility service connections for a commercial facility.
 - 3.3.4 Performance Indicator: Students will modify system designs to incorporate energy conservation techniques.
- 3.4 Objective: Perform land surveys and soil analyses necessary to design and construct a renovation project.
 - 3.4.1 Performance Indicator: Students will use differential leveling to complete a control survey to establish a point of known elevation for a project.
 - 3.4.2 Performance Indicator: Students will design appropriate pedestrian access, vehicular access, and a parking lot for a commercial facility.
 - 3.4.3 Performance Indicator: Students will 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.
 - 3.4.4 Performance Indicator: Students will estimate the increase in storm water runoff from a commercial site and create a preliminary design for a storm water storage facility.

- 3.4.5 Performance Indicator: Students will apply low impact development techniques to a commercial site design reduce the impact of development on storm water runoff quantity and quality.
- 3.4.6 Performance Indicator: Students will follow specifications and codes during a design process.
- 3.4.7 Performance Indicator: Students will document a commercial site design, given 3D architectural design software.

Standard 4 – (Commercial Building Design) Students investigate the legal, physical, and financial aspects of a project and make recommendations based on their findings.

4.1 Objective: Design a commercial facility for a given site.

- 4.1.1 Performance Indicator: Students will work individually and in groups to produce a solution to a team project.
- 4.1.2 Performance Indicator: Students will research codes, zoning ordinances, and regulations to determine the applicable requirements for a project.
- 4.1.3 Performance Indicator: Students will identify the boundaries of a property based on its legal description.
- 4.1.4 Performance Indicator: Students will perform research and visit a site to gather information pertinent to the viability of a project on the site.
- 4.1.5 Performance Indicator: Students will identify the criteria and constraints and gather information to promote viable decisions regarding the development of their solution.
- 4.1.6 Performance Indicator: Students will create an architectural program, a project organization chart, and a Gantt chart and hold project progress meetings to help manage the team project.
- 4.1.7 Performance Indicator: Students will communicate ideas while developing a project using various drawing methods, sketches, graphics, or other media collected and documented.
- 4.1.8 Performance Indicator: Students will investigate the legal, physical, and financial requirements of a project and consider the needs of the community to determine project viability.
- 4.1.9 Performance Indicator: Students will apply current common practices utilized in civil engineering and architecture to develop a viable solution in their project.

- 4.1.10 Performance Indicator: Students will develop an understanding of how software is used as a tool to aid in the solution and then the communication of a project.
- 4.2 Objective: Prepare and conduct an oral presentation of a project proposal for a commercial building project.
- 4.2.1 Performance Indicator: Students will assemble and organize work from a commercial project to showcase the project in an effective and professional manner.
- 4.2.2 Performance Indicator: Students will create visual aids for a presentation that include the appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development.
- 4.2.3 Performance Indicator: Students will conduct an oral presentation to present a proposal for the design and development of a commercial building project.