Curriculum: Civil Engineering and Architecture

Curricular Unit: History of Civil Engineering and Architecture

Instructional Unit: A. Make connections between the history of civil engineering and architecture and modern day applications

### Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>SCCLE: EGSA.5.Dd</th>
<th>Knowledge: (CA) 4, 6 (FA) 2 (SS) 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCSS: 9-10.WHST.2; 9-10.WHST.6; 9-10.WHST.10; G-MG.3</td>
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<tr>
<td>NETS: 2a; 3b</td>
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<tr>
<td>Performance: 1.2, 1.10, 2.1, 2.4, 4.6</td>
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### Unit (Section 3)

#### Learning Targets:
- Connect historical architectural and civil engineering achievements to current structural and design applications
- Compare examples of three general categories of structural systems based on historical buildings
- Explain how historical innovations have contributed to the evolution of civil engineering and architecture
- Identify 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 house depicting an architectural style using a variety of materials

#### Instructional Strategies:
- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
- Activities:
  - 1.1.1: History of Civil Engineering and Architecture
  - 1.1.2: Design Principles and Elements
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes
Assessments/Evaluations:

- Formative:
  - Quizzes (teacher-created)
  - Practice problems
- Summative:
  - Projects:
    - 1.1.3: Architectural Styles – students will research a chosen architectural style and create a PowerPoint presentation
    - 1.1.4: Architectural Features – students will create a model to depict a distinct architectural style or feature
  - Unit assessment (teacher-created)

Sample Assessment Questions:

- The buildings shown all have different elements of design incorporated into their exteriors. Which structure best shows the design principle of **FORMAL BALANCE** in its design?
  a. Saint Basil Cathedral (Top Right Building)
  b. Burj Khalifa (Top Left Building)
  c. Sydney Opera House (Bottom Left Building)
  d. Taj Mahal (Bottom Right Building)

- What style of architecture is often characterized by a balanced and symmetrical design, entry porch with columns, low pitched roof, fanlight over front door, double hung windows, and dentil molding, such as Thomas Jefferson’s Monticello?
  a. Victorian
  b. Tudor
  c. Italianate
  d. Federal
### Instructional Resources/Tools:
- Project Lead the Way curriculum – including:
  - PowerPoint presentations
  - Activities
  - Projects
  - Scoring guides
  - Instructions
- Project Lead the Way online Learning Management System (canvas)

### Cross Curricular Connections:
- History: Investigate the history of civil engineering and architecture
- Art: Identify prominent design principles and elements of a structure from an image
- Technology: Create presentations using technology
- English: Daily journal/notes kept in an engineering notebook

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: History of Civil Engineering and Architecture

Instructional Unit: B. Explore careers in civil engineering and architecture

**Standard Alignments (Section 2)**

| GLE/CLE: N/A |
| Knowledge: (CA) 4,6 |
| CCSS: 11-12.SL.4; 9-10.WHST.2; 9-10.WHST.6; 9-10.WHST.10 |
| NETS: 2a,d; 4d |
| Performance: 3.8, 4.1 |

**Unit (Section 3)**

**Learning Targets:**

- Identify with the primary duties and attributes of a civil engineer along with the traditional path for becoming a civil engineer
- Recognize that many specialty fields are associated with civil engineering
- Participate in a charrette to develop innovative solutions to support whole building design

**Instructional Strategies:**

- The teacher will provide classroom discussion enhanced with PowerPoint presentations
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

**Assessments/Evaluations:**

- **Formative:**
  - Quizzes (teacher-created)
  - Practice problems
- **Summative:**
  - Projects:
    - 1.2.1: This is Your Career – students will create and present a short video depicting themselves in a civil engineering or architectural career 10 years from now
    - 1.2.2: Design Charrette – student groups will address a design issue scenario, keep an official record of the meeting, and present the group’s ideas in a persuasive format
  - Unit assessment (teacher-created)
Sample Assessment Questions:

- Match the following terms with their definitions:
  1. charrette                                             A. Legal requirements designed to protect the public by providing guidelines for structural, electrical, plumbing and mechanical areas of structure
  2. stakeholder                                         B. An intensive workshop in which various stakeholders and experts are brought together to address a particular design issue
  3. building code                                      C. One who is involved in or affected by a course of action

Instructional Resources/Tools:

- Project Lead the Way curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)
- Autodesk Revit software

Cross Curricular Connections:

- Technology: Create a video presentation
- ELA:
  - Daily journal/notes kept in an engineering notebook
  - Persuasive paper/presentation

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Residential Design

Instructional Unit: C. Examine residential building design and construction

### Standard Alignments (Section 2)

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<thead>
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<th>GLE/CLE: N/A</th>
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<tr>
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<td>NETS: 2d; 4b; 6a</td>
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<tr>
<td>Performance: 2.1, 3.8, 4.5</td>
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### Unit (Section 3)

#### Learning Targets:
- Identify common components of a residential framing system
- Recognize common 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
- Incorporate green strategies in an existing building design

#### Instructional Strategies:
- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
  - activities:
    - 2.1.1: Wood Frame Systems
    - 2.1.3: Utility Shed Design
- Students will complete:
  - engineering notebook documentation of their work
  - daily journal entries/notes

#### Assessments/Evaluations:
- Formative:
  - Quizzes (teacher-created)
  - Practice problems
- Summative:
  - Project 2.1.2 Roof Systems – students will create and present
  - Unit assessment (teacher-created)
Sample Assessment Questions:

- What is the wood-frame building-component to which the arrow is pointing?
  A) Sill
  B) Top plate
  C) Header
  D) Truss

Instructional Resources/Tools:

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - Activities
  - Projects
  - Scoring guides
  - Instructions
- Project Lead the Way online Learning Management System (canvas)
- Autodesk Revit software

Cross Curricular Connections:

- Science: Green design
- Technology: Use of Autodesk Revit software to design residential structures
- Art: Students create a model of a house with a specific roof type
- Math: Creating a scale model

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Residential Design

Instructional Unit: D. Analyze cost and efficiency of residential structures

**Standard Alignments (Section 2)**

| GLE/CLE: N/A
| Knowledge: (CA) 4, 6 (MA) 1,2 (SC) 8
| CCSS: 1-12.RST.4; N.Q.2; N.Q.3; G.MG.2; G.MG.3
| NETS: 2d; 4b,c
| Performance: 1.4, 1.10, 3.8

**Unit (Section 3)**

Learning Targets:

- 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 break-down
- Understand the relative costs of different parts of a project
- 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 the principles of sustainable design to a small project

Instructional Strategies:

- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
  - activities:
    - 2.2.1: Concrete Pad Estimate
    - 2.2.2: Shed Cost Estimate
    - 2.2.3: Heat Loss and Gain
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

Assessments/Evaluations:

- Formative:
  - Quizzes (teacher-created)
  - Practice problems
- Summative
  - Unit assessment (teacher-created)
### Sample Assessment Questions:

- Draw a floor plan of one level of your home and describe the impact that each window has on the temperature and lighting on that level.

### Instructional Resources/Tools:

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

### Cross Curricular Connections:

- ?

### Depth of Knowledge (Section 5)

| DOK: 4 |
Curriculum: Civil Engineering and Architecture

Curricular Unit: Residential Design

Instructional Unit: E. Design a residential structure

**Standard Alignments (Section 2)**

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<td>Performance: 1.10, 2.1, 4.1</td>
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**Unit (Section 3)**

Learning Targets:

- Classify a building according to occupancy and construction type using the International Building Code
- Apply elements of a good residential design to a basic house to meet the needs of a client
- Recognize the critical nature of codes and why they were created
- Follow specifications and codes during a design process
- Incorporate sustainable building principles and universal design concepts to the design of a house
- Create bubble diagrams and sketch a floor plan
- Given 3D architectural design software, design a residential structure
- Given 3D architectural design software, create appropriate documentation to communicate a residential structure design
- Place a building on a site with favorable orientation considering the site-specific information
- Calculate and plan for the drainage that takes place before and after the development of a site
- Calculate the head loss and estimate the water pressure for a given water supply system
- Estimate the cost of creating a foundation and footing for a residential design
- Create a bubble diagram and preliminary sketch for a specified site
Instructional Strategies:

- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
- Activities:
  - 2.3.2: Green Building and Sustainable Design
  - 2.3.4: Adding Green
  - 2.3.6: Residential Electrical Design
  - 2.3.7: Residential Site Planning
  - 2.3.9: Residential Plumbing
  - 2.3.11: Calculating Property Drainage
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

Assessments/Evaluations:

- Formative
  - Quizzes (teacher-created)
  - Practice problems
- Summative
  - Project 2.3.1: Affordable Housing Design – students will use autodesk revit software to design
  - Unit assessment (teacher-created)

Sample Assessment Questions:

- 

Instructional Resources/Tools:

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

Cross Curricular Connections:

- 

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Applications

Instructional Unit: F. Compare and contrast residential and commercial structures

**Standard Alignments (Section 2)**

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**Unit (Section 3)**

Learning Targets:

- Identify applicable building codes and regulations that apply to a given development
- Classify a building according to its use, occupancy, and construction type using International Building Codes
- 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 principles, 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
- Build a structure out of playing cards to carry a given load. Through testing, redesign the structure to improve its performance
- Calculate the structural efficiency of a structure
- Select appropriate steel bar joists and precast concrete floors/roofs using load-span tables

**Instructional Strategies:**

- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
  - Activity 3.1.4: Commercial Roof Systems
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

**Assessments/Evaluations:**

- Formative:
  - Quizzes (teacher-created)
  - Practice problems
- Summative:
  - Project 3.1.1 Keystone Library Renovation – students will design the renovation of an abandoned industrial brownfield site to house a new public library
  - Unit assessment (teacher-created)

**Sample Assessment Questions:**

- ?

**Instructional Resources/Tools:**

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

**Cross Curricular Connections:**

- ?

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Applications

Instructional Unit: G. Analyze calculations involved in a commercial structure

Standard Alignments (Section 2)

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<td>NETS:</td>
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<td>Performance:</td>
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Unit (Section 3)

Learning Targets:

- Determine the live, dead, and snow loads applied during the design of a structure using load tables and appropriate mathematics
- Determine the tributary width and tributary area of structural elements
- Trace a gravity load imposed on a structure to the ground through all structural elements that contribute to supporting the load
- Analyze simply supported beams to determine maximum shear and bending moment
- Design structural steel floor framing for an elevated floor taking into consideration bending moment, shear and deflection limits
- Research the various foundation types, draw sketches of each one, and describe their use
- Design a spread footing for a given loading condition

Instructional Strategies:

- The teacher will provide activities:
  - 3.2.2: Loads – students determine design loads for the roof of a high school in a suburb of Chicago, Illinois (enrollment 2500) and select appropriate roof joists (beams) based on the loads transferred to the joists
  - 3.2.3: Beam Analysis – Students sketch diagrams and complete calculations for different types of beams in their engineering notebook.
  - 3.2.6: Beam Design - Students design floor framing (beams and girders) for a hotel
  - 3.2.8: Foundation Types and Considerations – Students research foundation types, draw sketches of each one, and describe the conditions under which each might be used
  - 3.2.9: Sizing a Spread Footing – Students use the site-specific soils information to size spread footings for several different buildings
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

Assessments/Evaluations:

- Formative:
  - Quizzes (teacher-created)
  - Practice problems

- Summative:
  - Project 3.1.1: Keystone Library Renovation – students will design the renovation of an abandoned industrial brownfield site to house a new public library
  - Unit assessment (teacher-created)

Sample Assessment Questions:

- ?

Instructional Resources/Tools:

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

- Websites:
  - [http://www.msc.fema.go](http://www.msc.fema.go)
- Software: MD Solids

Cross Curricular Connections:

- ?

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Applications

Instructional Unit: H. Interpret and explain constraints involved with utilities and systems in a commercial structure

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<tr>
<td>Learning Targets:</td>
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<tr>
<td>• Interpret and explain code requirements and constraints as they pertain to the installation of services and utilities</td>
</tr>
<tr>
<td>• Read and understand HVAC, electrical and plumbing construction drawings for a commercial project</td>
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<tr>
<td>• Apply criteria and constraints to layout plumbing, electrical, and HVAC systems for a commercial facility</td>
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<tr>
<td>• Create construction drawings to document plumbing, electrical and HVAC system designs</td>
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<td>• Modify system designs to incorporate energy conservation techniques</td>
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<td>• Analyze site conditions and select an appropriate waste-water management system for the facility</td>
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<td>• The teacher will provide:</td>
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<td>• a classroom discussion enhanced with PowerPoint presentations</td>
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<td>• Activities:</td>
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<td>• 3.3.2: Plumbing</td>
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<td>• 3.3.4: Energy Codes</td>
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<td>• 3.3.5: Electrical Systems</td>
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<td>• Students will complete:</td>
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<td>• Engineering notebook documentation of their work</td>
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Sample Assessment Questions:

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Instructional Resources/Tools:

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

Cross Curricular Connections:

- ?

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Applications

Instructional Unit: I. Analyze a commercial building site to determine a site design that meets code specifications

**Standard Alignments (Section 2)**

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**Unit (Section 3)**

**Learning Targets:**

- Classify a roadway according to its level of use
- Calculate important information needed to document a road design
- Design appropriate pedestrian access, vehicular access and a parking lot for a commercial facility
- 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 reduce the impact of development on the storm water runoff quantity and quality
- Estimate the amount of cut and/or fill necessary to build a structure
- Follow specifications and codes during a design process
- Given 3D architectural design software, document a commercial site design

**Instructional Strategies:**

- The teacher will provide:
  - a classroom discussion enhanced with PowerPoint presentations
  - Activities:
    - 3.4.5: Storm Water Management
    - 3.4.6: Landscaping
- Students will complete:
  - Engineering notebook documentation of their work
  - daily journal entries/notes

**Assessments/Evaluations:**

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**Depth of Knowledge (Section 5)**

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<th>DOK: 4</th>
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Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Building Design

Instructional Unit: J. Explore how to design and document outside elements of a commercial structure to meet building codes and requirements

### Standard Alignments (Section 2)

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### Unit (Section 3)

#### Learning Targets:

- 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
- Use differential leveling to complete a control survey and establish a point of known elevation for a project
- Identify the criteria and constraints and gather information to promote viable decisions regarding the development of their solution
- Analyze a site soil sample to determine the United Soil Classification System designation and therefore soil characteristics important to the design and construction of a building on the site
- 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 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
- Communicate the current common practices utilized in Civil Engineering and Architecture and apply them to develop a viable solution to 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

**Instructional Strategies:**

- ?

**Assessments/Evaluations:**

- ?

**Sample Assessment Questions:**

- ?

**Instructional Resources/Tools:**

- Project Lead the Way Curriculum – including:
  - PowerPoint presentations
  - activities
  - projects
  - scoring guides
  - instructions
- Project Lead the Way online Learning Management System (canvas)

**Cross Curricular Connections:**

- ?

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**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Civil Engineering and Architecture

Curricular Unit: Commercial Building Design

Instructional Unit: K. Design and present a commercial structure to meet specified requirements

**Standard Alignments (Section 2)**

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**Unit (Section 3)**

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<tr>
<td>• Assemble and organize work from the commercial project to showcase the project in an effective and professional manner</td>
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<tr>
<td>• Conduct a presentation that includes appropriate drawings, renderings, models, documentation, and the rationale for choosing the proposal for project development</td>
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<tr>
<td>• Complete a personal evaluation and peer evaluations of team members to assess performance during team project</td>
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<td>• instructions</td>
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<td>• Project Lead the Way online Learning Management System (canvas)</td>
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<th>Cross Curricular Connections:</th>
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