TN Department of Education | College, Career and Technical Education

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Architectural & Engineering Design I

Primary Career Cluster:	Architecture & Construction
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C17H13
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Elective Focus -Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
POS Concentrator:	This course satisfies one out of two required courses that meet the Perkins V concentrator definition, when taken in sequence in the approved program of study.
Programs of Study and Sequence:	This is the first course in the *Architectural & Engineering Design* program of study.
Aligned Student Organization(s):	SkillsUSA: http://www.skillsusatn.org/ Technology Student Association (TSA): http://www.tntsa.org
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit https://www.tn.gov/education/educators/career-and-technical-education/work-based-learning.html
Promoted Tennessee Student Industry Credentials:	Credentials are aligned with postsecondary and employment opportunities and with the competencies and skills that students acquire through their selected program of study. For a listing of promoted student industry credentials, visit https://www.tn.gov/education/educators/career-and-technical-education/student-industry-certification.html
Teacher Endorsement(s):	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, 982, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
Required Teacher Certifications/Training:	ADDA Certified Drafter or Autodesk Certified Professional
Teacher Resources:	https://www.tn.gov/education/educators/career-and-technical-education/career-clusters/cte-cluster-architecture-construction.html Best for All Central: https://bestforall.tnedu.gov/

Approved January 30, 2015; Amended Jan. 31, 2018, October 2021

Course-At-A-Glance

CTE courses provide students with an opportunity to develop specific academic, technical, and 21st century skills necessary to be successful in career and in life. In pursuit of ensuring every student in Tennessee achieves this level of success, we begin with rigorous course standards which feed into intentionally designed programs of study.

Students engage in industry relevant content through general education integration and experiences such as career & technical student organizations (CTSO) and work-based learning (WBL). Through these experiences, students are immersed with industry standard content and technology, solve industry-based problems, meaningfully interact with industry professionals and use/produce industry specific, informational texts.

Using a Career and Technical Student Organization (CTSO) in Your Classroom

CTSOs are a great resource to put classroom learning into real-life experiences for your students through classroom, regional, state, and national competitions, and leadership opportunities. Below are CTSO connections for this course, note this is not an exhaustive list.

- Participate in CTSO Fall Leadership Conference to engage with peers by demonstrating logical thought processes and developing industry specific skills that involve teamwork and project management.
- Participate in contests that highlight job skill demonstration. These include Career Pathways Showcase, Job Interview, Architectural Drafting, and Engineering Technology/Design.

Using a Work-based Learning (WB) in Your Classroom

Sustained and coordinated activities that relate to the course content are the key to successful work-based learning. Possible activities for this course include the following. This is not an exhaustive list.

- **Standards 2.1-2.4** | Guest speaker.
- **Standard 3.1 |** Workplace tour.
- **Standards 7.1-7.3** | Ask an industry rep to discuss why measurement and math is so important for the job.
- **Standard 8.1** | Have the students do a project that is useful to a local employer. Ask the manager to help evaluate the projects.

Course Description

Architectural & Engineering Design I is a foundational course in the Architecture & Construction cluster for students interested in a variety of engineering and design professions. Upon completion of this course, proficient students will be able to create technical drawings of increasing complexity, and utilize these skills to complete the design process and communicate project outcomes. Students will build foundational skills in freehand sketching, fundamental technical drawing, and related measurement and math. Standards in this course also include career exploration within the technical design industry, as well as an overview of the history and impact of architecture and engineering. In addition, students will begin compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study.

Course Standards

1. Safety

1.1. Safety Rules: Accurately read, interpret, and demonstrate adherence to **safety rules**, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to **distinguish between the rules and explain why certain rules apply.**

1.2. Safety Equipment: Identify and explain the intended use of **safety equipment** available in the classroom. Demonstrate how to properly inspect, use, and maintain **safe operating procedures** with tools and equipment**.** Incorporate safety procedures and complete safety test with 100 percent accuracy.

2. **Introduction to Architecture & Engineering Design**

2.1. History of Architecture and Engineering: Investigate the **history and evolution of architecture and engineering** across a variety of civilizations. Identify **major innovations**, such as technological advances in materials or construction processes.

2.2. Contributions of Architects or Engineers: Research and summarize the **influences and contributions of a selected architect or engineer** giving **examples of the individual's completed work** to illustrate their impact on society.

2.3. Impact of Architects and Engineers: Investigate the **social, economic, and environmental impact of decisions** made by architects and engineers at the local, national, and global levels. Provide a detailed **description of the impacts of a specific discipline**, citing links to relevant websites to illustrate the ideas presented.

2.4. Sustainable Design: Research the **principles of sustainable design**. Examine an **energy efficient building** and determine whether the principles of sustainable design are illustrated in the design of the building. Assess whether the evidence presented is strong enough to support claims of sustainability.

3. **Career Exploration**

3.1. Professions in Architecture and Engineering: Research the **major professions in architecture and engineering**, such as a civil engineer, mechanical engineer, industrial engineer, electrical engineer, engineering technician, architect, and more. Cite supporting evidence from multiple sources (such as interviews with design professionals retrieved from industry magazines). Analyze career options in architecture and engineering.

3.2. Career Opportunities: Compile and analyze **real-time and projected labor market data** from public sources such as the U.S. Bureau of Labor Statistics to investigate **local and regional occupational opportunities and trends in architectural and engineering careers**. Analyze collected data comparing occupations by job availability, salaries, and benefits.

4. **Design Process**

4.1. Design Process: Research **design processes used by architects and engineers.** Drawing on multiple resources, examine **the steps to the design process**, synthesizing a range of perspectives on the process as practiced in a variety of architectural and engineering disciplines. Explain **why it is an iterative process** and always involves refinement.

4.2. Evaluate a Design: Evaluate an **existing design created by architects and/or engineers** using the design process such as a building, landscape, bridge, or product. Describe how the design team likely **progressed through each step of the design process** citing examples from design magazines and other resources. Examples should include design constraints encountered by the design team and criteria for measuring the effectiveness of the design.

5. **Sketching**

5.1. Use of sketching: Investigate the **use of sketching in the creative design process**. Drawing from resources, **explain the tools and techniques** used and when architects and engineers apply sketching in the design process.

5.2. Freehand Sketches: Create **freehand sketches**, including rough and refined sketches, demonstrating **techniques for sketching freehand lines and circles** while attending to **accurate proportion**. Produce **pictorial sketches** applying shading techniques. Simulate sketching techniques used by engineers and architects on jobsites. Utilize **hand lettering techniques** to neatly add notes to the sketches.

5.3. Sketching Developing Design Concept: Develop **conceptual design ideas** using freehand sketching. For example, for a given design problem, generate, analyze, and refine sketches to develop **design solutions**. Create refined drawings based on sketches of a chosen design.

6. **Fundamental Technical Drawing**

6.1. Geometric Constructions: Interpret a **technical narrative** to understand the steps and tools needed to create **geometric constructions** such as bisecting a line, angle, or arc; using lines, circles, and arcs to draw a polygon such as a pentagon or hexagon; and constructing tangent and perpendicular relationships. Use geometric terms, illustrations, and supporting texts to describe the **steps of creating a geometric construction** with accuracy.

6.2. Single-View Drawings: Create accurate **manual single-view scale drawings** of advancing complexity, incorporating **symbols, notes, and dimensions**, using **appropriate layout** within title blocks, drawing composition (including **line weight and line type**), **geometric construction techniques,** and **lettering techniques.**

6.3. Dimensioning Rules: Interpret and apply **dimensioning rules** to accurately **label dimensions** on drawings including arranging dimensions, using various **dimension styles** (such as aligned and angular), and avoiding redundancy.

6.4. Multi-View Drawings: Create accurate **multi-view scale drawings** of objects of advancing complexity using **orthographic projection**. Incorporate **symbols, notes, dimensions**, and **different types of lines** (such as hidden lines to show internal or hidden features). Demonstrate **procedures to establish a principle view of an object and project** from an existing view to create additional views.

6.5. Isometric Drawings: Building on the **knowledge of a single view and multi-view drawing**, create **simple isometric drawings**, properly using **lines, labels, and dimensioning techniques.**

6.6. Computer-Aided Drawings (CAD): Interpret instructional material to use **CAD software** to create simple two-dimensional drawings, accurately incorporating symbols, dimensioning, and line types. Instructional material may include textbooks, manuals, websites, video tutorials, and more. Perform **basic operations** such as creating files, saving files, opening files, storing files, and printing. Set up the drawing environment by inserting title blocks, applying settings (ortho, snap, etc.), and assigning line weights, line types, and colors.

6.7. Comparing Techniques: Define the **differences in technique** among freehand sketching, manual drafting, and computer-aided drafting (CAD). Describe the **skills required** for each and **how each type is used** in industry, citing specific examples.

6.8. Refine Drawings: Demonstrate the ability to **refine drawings based on critique** from peers, instructors, and self-evaluation.

7. **Measurement & Math**

7.1. Math: Apply **mathematics concepts to create drawings and solve design problems** in this course, distinguishing which principles apply to a given design problem. Concepts should include, but are not limited to:

a. Determining and applying the equivalence between fractions and decimals. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch.
b. Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given construction task. For example, convert a dimension from centimeters to inches.
c. Calculating perimeter, area, volume, and surface areas of objects employing related geometric terminology.
d. Performing proportionate reasoning to estimate quantities, such as determining the appropriate scale for a drawing and a given sheet size.
e. Using basic rules of right triangles, such as the Pythagorean Theorem, to find missing lengths.

7.2. Measurement: Use **customary and metric measurement systems** to complete accurate **field measurements**. Determine the **appropriate units** and record accurate measurements of lengths and angles using **proper tools.** Tools should include, but are not limited to: fractional rule, metric rule, measuring tape, architect's scale, engineer's scale, dial caliper, and protractor.

7.3. Measurement in Drawings: Use **field measurements** to **create a drawing**, accurately representing the **true layout**. For example, create a **scale drawing** of a simple mechanical device by taking field measurements of the device, determining the appropriate scale, and using an engineer's scale to accurately draw the device.

8. **Design Project**

8.1 Create Drawings: Use the design process to create a **solution for a given design problem**, selecting and creating **appropriate drawings to explain the solution**, including sketches and multiple views of two-dimensional scale drawings.

9. **Portfolio**

9.1 Portfolio: Compile materials from coursework to create a portfolio connecting personal career preparation to concepts learned in this course, including written descriptions of drawing types and learning outcomes. Continually review and revise documents, using technology as needed.

Standards Alignment Notes

*References to other standards include:

- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.