



# Architectural & Engineering Design II

<b>Primary Career Cluster:</b>	Architecture & Construction
<b>Course Contact:</b>	<a href="mailto:CTE.Standards@tn.gov">CTE.Standards@tn.gov</a>
<b>Course Code(s):</b>	C17H14
<b>Prerequisite(s):</b>	<i>Architectural &amp; Engineering Design I</i> (C17H13), <i>Algebra I</i> (G02X02, G02H00)
<b>Credit:</b>	1
<b>Grade Level:</b>	10
<b>Elective Focus - Graduation Requirements:</b>	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
<b>POS Concentrator:</b>	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.
<b>Programs of Study and Sequence:</b>	This is the second course in the <i>Architectural &amp; Engineering Design</i> program of study.
<b>Aligned Student Organization(s):</b>	SkillsUSA: <a href="http://www.skillsusatn.org/">http://www.skillsusatn.org/</a> Technology Student Association (TSA): <a href="http://www.tntsa.org">http://www.tntsa.org</a>
<b>Coordinating Work-Based Learning:</b>	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit <a href="https://www.tn.gov/content/tn/education/career-and-technical-education/work-based-learning.html">https://www.tn.gov/content/tn/education/career-and-technical-education/work-based-learning.html</a> .
<b>Promoted Tennessee Student Industry Credentials:</b>	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 <a href="https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html">https://www.tn.gov/education/career-and-technical-education/student-industry-certification.html</a>
<b>Teacher Endorsement(s):</b>	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
<b>Required Teacher Certifications/Training:</b>	ADDA Certified Drafter or Autodesk Certified Professional
<b>Teacher Resources:</b>	<a href="https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-architecture-construction.html">https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-architecture-construction.html</a> Best for All Central: <a href="https://bestforall.tnedu.gov/">https://bestforall.tnedu.gov/</a>

## 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.

- **Standard 2.1** | Guest speaker.
- **Standards 3.1-3.8** | Ask an industry rep to discuss the importance of technical drawing on the job.
- **Standard 5.1** | Guest speaker.
- **Standards 6.1-6.4** | Integrated project with a professional.
- **Standards 8.1-8.2** | Do a project that is useful to a local employer or can be evaluated by the manager.

## Course Description

*Architectural & Engineering Design II* is the second course in the *Architectural & Engineering Design* program of study. Students in this course build their skills in developing and representing design ideas using technical drawing and modeling techniques, and apply the design process to solve design problems. Upon completion of this course, proficient students will be able to use computer-aided drafting (CAD) software to create multi-view, sectional view, auxiliary view, and three-dimensional drawings using industry standard dimensioning and notation. Students will connect drawings with actual physical layouts by building models based on drawings, creating drawings based on objects and other physical layouts, and using software to create basic three-dimensional models. In addition, students will continue 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. Career Exploration

- 2.1. Postsecondary Options: Research **postsecondary institutions** (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer architecture or engineering programs. Evaluate the tentative career plan developed in the introductory course and **update the career plan** to reflect any new discoveries, citing evidence from the research.

### 3. Advanced Technical Drawing

- 3.1. Two-Dimensional Drawings: Use **computer-aided drafting (CAD) software** to create **two-dimensional drawings** of advancing complexity, accurately incorporating symbols, notes, dimensioning, and line types to design drawings. Perform **software operations** such as utilizing sheets/layouts for printing, scaling viewports in sheets/layouts for printing, printing drawings to proper scale, outputting drawings to electronic and paper media, and overlaying drawings on externally-referenced drawings.

- 3.2. Multi-View Drawings: Use **CAD software** to create accurate **multi-view drawings** of objects of advancing complexity using **orthographic projection**, incorporating symbols, notes, dimensions, and line type (such as hidden lines to show internal or hidden features).
- 3.3. Pictorial Drawings: Use CAD software to create **pictorial drawings** of advancing complexity, such as **isometric, oblique, and perspective** drawings. Attend to detail by using proper angles and ensuring holes, cylinders, prisms, and other features are in proper alignment and relationship to each other. Incorporate **symbols, notes, dimensions, and line type** according to industry standards.
- 3.4. Sectional View Drawings: Create accurate **sectional view drawings** of advancing complexity (such as full, half, offset, broken-out, removed, and revolved sections), incorporating **symbols, notes, and dimensions**, using **appropriate layout** within title blocks, and **appropriate drawing composition** (including line weight and line type).
- 3.5. Auxiliary View Drawings: Create accurate **auxiliary view drawings** of advancing complexity including depth, height, or width auxiliary views; partial auxiliary views; and auxiliary section views.
- 3.6. Drawings of Threads and Fasteners: Draw **detailed, schematic, and simplified drawings** of various **types of threads and fasteners**, including unified, square, and acme threads. Demonstrate the ability to accurately interpret **industry-standard thread notes** to calculate the **thread pitch** as well as layout and construct the drawing.
- 3.7. Set of Project Drawings: Produce a **complete set of project drawings** including a **completed assembly drawing** and an **exploded assembly drawing**. Supplement assembly drawings with appropriate representations of individual components and a **bill of materials** as needed for the project type. Fully describe the design by selecting the most **appropriate drawing type** for the given component, including **plan, section, and three-dimensional drawings**.
- 3.8. Refine Drawings: Demonstrate the ability to **refine drawings based on critique** from peers, instructors, and self-evaluation. Drawing on evidence from textbooks and other resources, evaluate the **effectiveness of a drawing** based on industry standards for technical drawing. Interpret and incorporate feedback when refining drawings.

#### 4. Dimensioning

- 4.1. Annotate Drawings: Interpret **industry standards** to accurately apply **dimensions, notes, and symbols on CAD drawings**, including arranging dimensions, using various dimension styles and symbols, and avoiding redundancy. Demonstrate the ability to adjust **annotation styles and sizes** based on the drawing type and scale. Define **tolerance** and give examples of general **methods for noting tolerances** on drawings.

4.2. American National Standards Institute: Research the **American National Standards Institute** (ANSI) and describe the **goals of the organization** and the **impact it has on technical drawing**, particularly for dimensioning a drawing.

## 5. Introduction to Three-Dimensional Modeling

5.1. Three-Dimensional Modeling: Use **three-dimensional modeling software** to create a **simple three-dimensional model**. Interpret **instructional materials** to perform basic operations using three-dimensional modeling software. Instructional materials may include textbooks, instructional manuals, websites, video tutorials, and more.

## 6. Applications of Technical Drawing

6.1. Physical Model: Interpret **technical drawings** to build a **physical model** of a design. Select and use the **appropriate materials and tools** to safely measure components and construct the model. Upon completion, use the **technical drawings** to check the model for accuracy.

6.2. Use Field Measurements: Building on **techniques practiced in the introductory course**, continue to measure, record, and use field measurements to create **drawings of increasingly complex objects and layouts**. For example, create an accurate half section drawing of an actual mechanical gear by measuring and examining the physical object to visualize and draw the section.

6.3. Three-Dimensional Model: Create **two-dimensional plans for a simple three-dimensional object** utilizing **drawing techniques** learned in the course, such as auxiliary drawing. Use the plans to build a **rough study model of the object**. Evaluate the model and revise the design on the basis of collected test data. For example, create a two-dimensional drawing of three-dimensional sheet metal design or package design as if the object were unfolded. Print the drawing on paper and construct a paper model of the object. Evaluate the model for inaccuracies and **identify opportunities to improve** efficiency of materials or construction. Use these conclusions to **refine the design**.

6.4. Drawing and Model Comparisons: Understand **how designs are communicated** through different types of **two-dimensional** and **three-dimensional drawings, physical models, and virtual three-dimensional models** within various disciplines, such as architectural, civil, mechanical, electrical, and industrial design. Interpret symbols and notations within the context of each type.

## 7. Technology

- 7.1. Troubleshooting: Identify and demonstrate **basic troubleshooting strategies related to fundamental hardware and software problems**. Evaluate electronic media to diagnose and fix hardware and software problems encountered during the coursework. For example, consult software forums, tutorial videos, and other instructional materials to diagnose and correct a drawing that prints on paper differently than intended.
- 7.2. Impact of Technology: Explain **how technology has changed design** throughout history, and identify **current transitions occurring in design media, technique, and focus**.

## 8. Projects

- 8.1. Project Plan: Develop a **project plan** and use the design process to create a solution for **moderately complex problem sets**, utilizing both simple three-dimensional modeling techniques and detailed technical two-dimensional and three-dimensional scale drawings.
- 8.2. Alternate Designs: Choose between **alternate design solutions for a given design problem** and justify the choices. Demonstrate the ability to **pitch the idea** to the client in a presentation, defending the design by pointing to specific features that meet the client's specifications.
- 8.3. Portfolio: Update **materials from coursework to add to the portfolio** begun in the introductory course. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of drawing types and learning outcomes.

## 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.