Department of Education | College, Career and Technical Education

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Architectural & Engineering Design III

Primary Career Cluster:	Architecture & Construction
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C17H10
Prerequisite(s):	*Architectural & Engineering Design II* (C17H14), *Geometry* (G02X03, G02H11)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11-12
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 third 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/content/tn/education/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/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/career-and-technical-education/career-clusters/cte-cluster-architecture-construction.html Best for All Central: https://bestforall.tnedu.gov/

Approved Jan. 30, 2015; Amended Jan. 31, 2018, Nov. 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 2.1-2.8** | Integrated project with a design professional.
- **Standards 3.1-3.5 |** Integrated project with a mechanical professional.
- **Standards 4.1-5.3** | Do a project useful to a local employer and have the manager help evaluate it.
- **Standards 6.1-6.3** | Ask an industry manager to talk about project management on the job.

Course Description

Architectural & Engineering Design III is the third course in the *Architectural & Engineering Design* program of study. In this advanced course, students will apply technical drawing and design skills developed in the previous courses to specific architectural and mechanical design projects and contexts. In the process, students will expand their problem-solving and critical-thinking skills by assessing the requirements of a project alongside the available resources in order to accomplish realistic planning. Upon completion of this course, proficient students will be able to employ methods of data collection and analysis to provide others with appropriate information for projects and to develop their own designs. Students will also be able to engage with industry-specific technology to create visual representations of project outcomes. 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.

Recommended Credit

If all standards in the course are covered, the course is recommended for two credits. If only one credit is to be offered, the following two options are recommended:

1 Credit- Option A

Content	Standards
Safety	1.1, 1.2
Architectural Design	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8
Research Project	4.1
Design Project	5.1, 5.2, 5.3
Project Management	6.1, 6.2, 6.3
Portfolio	7.1

1 Credit- Option B

Content	Standards
Safety	1.1, 1.2
Mechanical Design	3.1, 3.2, 3.3, 3.4, 3.5
Research Project	4.1
Design Project	5.1, 5.2, 5.3
Project Management	6.1, 6.2, 6.3
Portfolio	7.1

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. Architectural Design

2.1 Civil Drawings: Interpret **civil drawings used to describe a site**, including recognizing **symbols** used to describe topography. For example, in teams, interpret a topographic survey drawing to construct a model (physical or virtual) of a building site. Use the model to influence **the design of the building** and the **building's placement** on the site.

2.2 Site Analysis: Perform a **site analysis** to make **design decisions for a building plan**, including interpreting existing site conditions and evaluating site surroundings. Determine the impact **environmental factors** such as climate, wind patterns, and the movement of the sun have on the design and site placement of the building. Summarize site analysis findings with drawings and supporting text.

2.3 Design Constraints: Synthesize the various **constraints affecting a building's design** to make and justify **design decisions.** Items to consider should include:

a. Evaluating the building's program based on client need. For example, appraise the requirements of the client such as total square footage and list of desired features (number of bedrooms, bathrooms, etc.).
b. Accommodating the needs of people of all ages and physical abilities in compliance with the Americans with Disabilities Act (ADA).
c. Interpreting applicable building codes based on the project type. For example, determine the minimum number and spacing of exit doors for a given building occupancy size.

2.4 Planning and Diagramming Techniques: Research **planning and diagramming techniques** used by designers. Implement planning and diagramming techniques such **as bubble diagrams** and **traffic flow patterns** to design a **schematic site plan and floor plan** for a given building program.

2.5 Building Model: Create a **properly scaled model of a building** (physical or virtual) and study the model **in the context of the site layout**. Present the model along with supporting sketches and diagrams to an audience (such as the instructor and peers), explaining and **justifying design ideas** in a logical, coherent narrative. Gather feedback and use it to **refine the design.**

2.6 Comprehensive Set of Drawings: Incorporate **schematic design sketches, models, and peer feedback** to further develop **a building's design**. Communicate details of the design through appropriate drawing types, utilizing industry-standard drawing conventions and software. Create a **comprehensive set of drawings** including the following drawing types:

a. Site plan
b. Floor plan
c. Interior and exterior building elevations
d. Foundation plan
e. Roof plan
f. Building system plans (such as an electrical plan)

g. Door and window schedules
h. Three-dimensional renderings (interior and exterior)

2.7 Sustainable Design: Research **sustainable design solutions and practices;** then provide **sustainable design recommendations** for a given design. Calculate a rating for **energy responsiveness** using a **sustainable building guideline**.

2.8 Wall Section: Examine a **wall section drawing** for a specific building. Identify, define, and explain the **function and purpose of each component**, including wall insulation, flashing, and the structure of the cornice.

3. Mechanical Design

3.1 Three-Dimensional Models: Create **three-dimensional models of machine parts** of increasing complexity utilizing **parametric modeling software**. Perform software operations including:
a. Utilizing basic software tools such as extruding and cutting, and navigating around the object.
b. Applying and modifying geometric constraints and dimensions to capture and alter the design geometry of a part.
c. Creating drawing layouts with dimensioned views of parametric solids, arranging a drawing sheet according to industry standards.
d. Printing drawing layouts at appropriate scales.
e. Preparing multi-sheet working drawings and assembly drawings according to industry standards.

3.2 Field Measurements: Modify **drawings based on field measurements**. Building on techniques practiced in prior courses, continue to **measure, record, and use field measurements** to create **drawings of increasingly complex objects and layouts**.

3.3 Assembly Model: Compile **parametric models of individual machine parts** to create a **model of a simple assembly**. Perform **advanced software operations** such as animating the model to illustrate **how the assembly operates**.

3.4 Schematic Design: Utilize the **design process** to create **a schematic design solution for a mechanical design problem**. Identify the criteria and constraints and produce a virtual or physical model of the solution, utilizing software tools where appropriate. Test and evaluate the solution by performing **an analysis of the model and gathering feedback from peers**.

3.5 Schematic Design: Incorporate **schematic design models, peer feedback, and test results** to further develop a design. Communicate **details of the design** through **appropriate drawing types**, utilizing **industry standard drawing conventions and software**. Derive working drawings (**detail and assembly drawings including parts lists**) from the three-dimensional models created using parametric modeling software. Attend to details when explaining the design, including:

a. Specifying and depicting threads, fasteners, and other hardware involved in a mechanical assembly.
b. Applying appropriate geometric dimensioning and tolerancing based on industry standards, including understanding tolerance relationships between mating parts, interpreting geometric tolerancing symbols in a drawing, and using tolerancing in drawings.
c. Selecting and creating appropriate section drawings, noting tolerances, hidden surfaces, and other mechanical details.

4. Research Project

4.1 Research Project: Employ basic methods of **data collection and analysis** to compile information for projects. Use available **research methods** when **project planning** and **problem solving**. Synthesize research to present **appropriate precedents for development of a project** and articulate logical rational for the use of chosen precedents.

5. Design Project

5.1 Schematic Designs for Project: Use the **design process** to create **schematic designs employing discipline-appropriate representational media** (such as sketches, technical drawings, and preliminary models) for a given **problem set**. Prepare and present schematic designs to peers and others, citing research to justify design solutions. **Note constructive feedback** received and use it to **refine the design**.

5.2 Drawings, Models and Presentation Boards: Drawing on results from the schematic design phase, create **discipline-appropriate drawings** based on **industry standards, a three-dimensional model of the design, and presentation boards**. Present **final design conclusions** to members of the profession as well as peers; employ **design decision justifications** as would an architect or engineer delivering a pitch to a prospective client.

5.3 Comprehensive Set: Compile **working drawings in a comprehensive set,** including a bill of materials with allowable material alternatives. Demonstrate the ability to properly select the drawing scale, select the views, lay out drawings, and organize the drawing set according to industry standards.

6. Project Management

6.1 Project Management: Examine how architects and engineers conduct **project management processes**, including but not limited to setting interim goals, tracking progress, and

coordinating with construction professionals and clients. Compare and contrast **components of project management models** gathered from textbooks, online resources, and actual case studies of major or local design professionals.

6.2 Project Management Strategies: Utilize **project management strategies** to create and implement **a work plan to complete projects according to schedule.**

6.3 Report: Apply **the basic steps of traditional project delivery**, outlining who and what is involved in each step. Compare texts to describe **alternatives to traditional project delivery methods**, such as the design-build method used in construction.

7. Portfolio

7.1 Portfolio: **Update the portfolio** to reflect the cumulative total of all projects undertaken across the program of study. 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.