

Residential & Commercial Construction II

Primary Career Cluster:	Architecture & Construction
Course Contact:	CTE.Standards@tn.gov
Course Code(s):	C17H25
Prerequisite(s):	<i>Residential & Commercial Construction I</i> (C17H24)
Credit:	1-2 credits (see Recommended Credit below)
Grade Level:	11
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 <i>Residential & Commercial Construction</i> program of study.
Aligned Student Organization(s):	SkillsUSA: https://www.skillsusatn.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):	580 OR a minimum of three of the following endorsements: 522, 523, 524, 527, 598, OR a minimum of three of the following endorsements: 701, 702, 703, 706, 707
Required Teacher Certifications/Training:	None
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/

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, Carpentry, Electrical Wiring, Plumbing, and Masonry.

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 1-3** | Include a safety briefing in a visit to an industry partner/job site.
- **Standards 5-6** | Ask an industry rep to discuss how construction industry principles impact on the job.
- **Standards 7-31** | Do a project that is used by a local industry or evaluated by local industry managers.
- **Standards 32-33** | Ask an industry rep to discuss how drawings and specifications are used on the job.
- **Standards 34-36** | Ask an industry rep to discuss the impact of project management on the job.

Course Description

Residential & Commercial Construction II is the third course in the *Residential & Commercial Construction* program of study intended to prepare students for careers in construction by developing an understanding of the different phases of a construction project from start to finish. Upon completion of this course, proficient students will be able to demonstrate knowledge and skill in the later phases of building construction including roofing systems, exterior finishing, stair framing systems, masonry systems, and plumbing systems. Students will be able to perform masonry work; frame roofs; install shingles on roofs; apply exterior finishes; and install proper piping for plumbing systems while safely employing tools and interpreting construction drawings to complete projects. Emphasis is placed on demonstrating proper measurement and application of mathematical concepts. Standards in this course also include an introduction to heating, ventilation, and air conditioning systems, principles of the construction industry, and business and project management. Students will continue compiling artifacts for inclusion in their portfolios, which they will carry with them throughout the full sequence of courses in this program of study.

Program of Study Application

This is the third course in the *Residential & Commercial Construction* program of study. Flexibility is built in to offer this course for either one or two credits, depending on school capacity and teacher background. Whether offered for one credit or two credits, this course can feed into a fourth-level *Construction Practicum* course in which students can apply the skills learned throughout the program of study toward the completion of an in-depth, semester- or year-long work-based learning (WBL) apprenticeship or internship. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at <https://www.tn.gov/education/career-and-technical-education/career-clusters/cte-cluster-architecture-construction.html>.

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: Exterior

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Roofing Systems	7, 8, 9, 10, 11, 12
Exterior Finishing	13, 14, 15, 16
Basic Stair Framing Systems	17, 18
Introduction to Masonry Systems	19, 20
Construction Drawings & Specifications	32, 33
Business & Project Management	34, 35, 36
Portfolio	37

1 Credit Option B: Interior

Content	Standards
Safety	1, 2, 3
Tools & Equipment	4
Construction Industry Principles	5, 6
Plumbing Systems	21, 22, 23, 24, 25, 26
Principles of Electrical Systems	27, 28, 29
Introduction to HVAC	30, 31
Construction Drawings & Specifications	32, 33
Business & Project Management	34, 35, 36
Portfolio	37

Course Standards

Safety

- 1) Identify safety hazards on a jobsite and demonstrate practices for safe working conditions. Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules pertaining to electrical safety, Occupational Safety and Health Administration (OSHA) guidelines, and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. Recognize and employ universal construction signs and symbols such as colors, flags, stakes, and hand signals that apply to construction workplace situations. Research and evaluate construction company safety plans from local industry. Explain the need for jobsite security to prevent liability. Drawing from examples, create and implement a jobsite safety program in the class to ensure safe practices and procedures including jobsite security procedures.
- 2) Maintain safety records and demonstrate adherence to industry-standard practices regarding general machine safety, tool safety, equipment safety, electrical safety, and fire safety to protect all personnel and equipment. For example, when operating tools and equipment, regularly inspect and carefully employ the appropriate personal protective equipment (PPE), as recommended by Occupational, Safety & Health Administration (OSHA) regulations. Incorporate safety procedures when operating tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment. Complete safety test with 100 percent accuracy.
- 3) Follow procedures to work safely around materials. Adhere to responsibilities for employees in material safety as outlined by the Hazard Communication Standard (HazCom), such as locating and interpreting material safety data sheets (MSDS). For example, obtain an MSDS for a given material from a supplier in the community. Demonstrate safe procedures to move materials by planning the movement, properly lifting, stacking, and storing materials, and selecting proper materials-handling equipment.

Tools & Equipment

- 4) For each of the systems covered in this course, identify and select the proper tools and accessories, critique the readiness of the tools, use the tools to accomplish the desired tasks, and then return the tools and accessories to their proper storage. Research a new technology recently developed for the construction industry. Write persuasively to convince an employer how the use of the technology could benefit the company, citing evidence from resources. For example, describe how a new power tool could improve efficiency and reduce muscle fatigue for a construction team.

Construction Industry Principles

- 5) Locate and assess the Tennessee Contractor's Licensing Board's website and analyze the policies and requirements for construction work in Tennessee. Explain how such policies impact local construction businesses.

- 6) Consult a variety of sources to describe alternatives to traditional project delivery methods, such as the design-build and construction management-related methods, distinguishing among the roles and relationships of various construction personnel in each scenario. Examine the project delivery method of an actual company. Develop a company profile with supporting graphics the company could share with a client describing the services provided and explaining the building delivery method used by the company.

Roofing Systems

- 7) Define and describe the framing components of gable and hip roofs such as the ridgeboard, plates, and types of rafters. For example, create a graphic illustration showing the roles of each component and how they work together in a roof framing system.
- 8) Read and interpret drawings to determine roof framing requirements, such as calculating the length of a rafter based on the desired pitch and estimating the materials needed to frame and sheath a roof. For example, use a speed square to lay out a common rafter on a piece of lumber.
- 9) Work in teams to construct a roof frame assembly by implementing required safety techniques, tools, and equipment to accurately measure, lay out, construct, and sheath a roof frame. For example, frame a gable roof with an opening.
- 10) Compare and contrast different procedures to frame a roof. For example, describe the benefits of using prefabricated trusses in place of framing with rafters on site. Outline the major similarities and differences in each and write persuasively to describe why using either prefabricated trusses or framing with rafters is more beneficial for a specific project.
- 11) Compare and contrast the materials, methods, and procedures for roofing with fiberglass shingles with other roofing materials such as wood shingles, metal roofing, and membrane-type roofing systems. Perform a cost analysis for a client to help the client choose between two roofing materials for a specific project given the site location, project budget, environmental considerations, and other factors.
- 12) Apply the appropriate tools, equipment, and procedures to safely install shingles on a roof including strategies for watertight installation, using quantitative reasoning and geometric formulas where applicable. For example, interpret construction documents to estimate the roofing materials needed to install fiberglass shingles on a gable roof. After preparing the roof with underlayment, flashing, and other preparation materials, install fiberglass shingles.

Exterior Finishing

- 13) Examine a wall section drawing for a specific building. Identify, define, and explain the function of each component including wall insulation, flashing, and the structure of the cornice. Draw from textbooks and other resources to annotate the wall section drawing with notes explaining the purpose of each component.

- 14) Interpret wall section drawings to safely construct a cornice. For example, accurately measure materials, employ tools, and follow procedures to build a box cornice, checking for accuracy in each step.
- 15) Analyze various finish systems used to sheath a building, including but not limited to wood siding, fiber-cement siding, vinyl siding, metal siding, stucco, and masonry veneer finishes. Perform a case study of three different buildings in the community which are sheathed in different ways, hypothesizing why the different materials and methods were selected for each.
- 16) Estimate the siding materials needed to cover a building utilizing mathematical principles such as area formulas and quantitative reasoning. Utilize the appropriate procedures, tools, and materials to install various types of siding. For example, identify three siding methods that are commonly used in the area and demonstrate the ability to plan the installation of and install each.

Basic Stair Framing Systems

- 17) Analyze the components of a stair system. Read and interpret construction drawings to determine stair system requirements such as the total rise, number and size of risers, and number and size of treads. Based on stated requirements, estimate the amount of material needed to frame a stair assembly.
- 18) Apply the appropriate tools, equipment, and procedures to safely build a small stair unit, demonstrating proper procedures for laying out and cutting stringers, risers, and treads.

Introduction to Masonry Systems

- 19) Describe the materials and methods used in modern masonry. Distinguish between masonry units made of clay products (i.e. brick) and masonry units made of concrete (i.e. block), analyzing the composition and structure of common units. Differentiate between the types of masonry construction, such as solid masonry walls, cavity walls, and veneer walls, citing examples of when each is used. Apply the knowledge to examine two different masonry constructions found in the school or community. Create a visual display with supporting text comparing the composition and construction methods of each.
- 20) Describe and demonstrate the procedures and techniques of basic bricklaying, including preparing mortar, laying a mortar bed, and laying bricks. Apply the appropriate tools, equipment, and procedures to safely mix mortar and properly use a trowel to spread and furrow bed joints and butter head joints.

Plumbing Systems

- 21) Study a schematic plan of a typical community sewer system. Citing evidence from a technical description or actual observation of a system, explain how waste moves through a drain, waste, and vent system from the fixture to the environment. Create a graphic illustration to represent the movement of waste from one component to the others in the

system. For example, create a basic diagram of how the waste generated by a clean-up sink in the classroom travels to the local sewage treatment plant.

- 22) Demonstrate understanding of the specific roles of various plumbing components in a drain, waste, and vent system by sketching a system model. Label the components, and include a written description of the function of each. Be able to describe the physical principles involved such as gravity and pressure.
- 23) Analyze the function of a trap by examining a drain, waste, and vent system whose trap has lost its seal. Diagnose and explain the cause and determine the appropriate solution, citing evidence from textbooks or technical manuals in order to justify why the chosen solution is preferable or more effective than another.
- 24) Determine common requirements found in plumbing codes and explain why the codes are necessary; include the importance of proper plumbing on human health. Examine a case in which poor plumbing contributed to the outbreak of disease in a community. Write an explanatory text to illustrate the problem and describe how it could have been prevented with proper plumbing applications.
- 25) Compare and contrast the material properties and uses of the various types of plastic and copper piping, including storing and handling, safety issues, and types of fitting and hanging equipment. Describe the factors influencing the decision to use plastic or copper piping in a residence. Demonstrate the ability to select the correct materials, tools, and PPE to complete both plastic and copper piping projects by creating a list of the items needed for a specific installation. For example, for a residential bathroom sink drain, create a list of the materials, tools, and equipment needed to install the drain.
- 26) Employ tools and procedures to safely measure, cut, ream, and join plastic and copper piping and fittings. For example, accurately measure PVC pipe, use a miter box and handsaw to cut pieces of pipe, ream and chamfer the ends, and join the pipe using solvent cement.

Principles of Electrical Systems

- 27) Evaluate and recommend proper electrical hardware for a residential building. For example, for a residential dwelling with a given floor plan and schedule of major appliances, determine the size of the electrical service by referring to the National Electrical Code to select the service-entrance equipment, such as conductors, panelboard, and protective devices. Steps should include: calculating the load for lighting, small appliances, and large appliances; and determining the number of branch circuits required. Describe the installation rules pertaining to dedicated circuits as applied to various equipment such as ranges, dryers, and HVAC systems.
- 28) Utilize the proper tools, equipment, and procedures to select and safely perform basic installation of device boxes according to drawings, specifications, and code requirements.
- 29) Utilizing test equipment such as a voltmeter, inspect and test an electrical wiring system for compliance according to drawings, specifications, and code requirements.

Introduction to Heating, Ventilation, and Air Conditioning Systems (HVAC)

- 30) Demonstrate understanding of the principles of heating, ventilation and air conditioning systems. Use graphic illustrations and supporting text to describe the structure and function of each system.
- 31) Examine the regulations which impact the work of HVAC technicians, such as the Clean Air Act and EPA guidelines. Create a brochure to inform an individual contemplating beginning an HVAC business of these regulations, explaining key considerations and citing resources. (TN Reading 1, 2, 4; TN Writing 2, 4, 9; NCCER 68114-09)

Construction Drawings & Specifications

- 32) Explain the relationship between construction drawings and specifications. For example, describe how both the construction drawings and specifications provide information about the exterior sheathing indicated for a building. Examine construction drawings and specifications to determine the requirements of the sheathing for a given part of a building, and verify with measurements and other sources as needed.
- 33) Describe processes by which construction professionals obtain clarification from architects regarding construction documents, such as by the use of requests for information (RFI's). Write a request for information (RFI), as would a construction professional to an architect to request clarification for a detail of the construction documents, such as the selection of a product.

Business & Project Management

- 34) Establish and implement specific goals to manage project assignments in a timely manner, including organizing teams to effectively manage assignments, monitoring and reporting on project progress, and evaluating a completed project according to client requirements. For example, inspect and critique a team member's work, providing constructive feedback for improvement. Similarly, respond to constructive feedback from a team member to improve project outcomes and meet project goals.
- 35) Perform estimating and scheduling techniques for a long-term project, including calculating material quantities and cost (including tax) and labor cost to complete a bid sheet; scheduling construction activities using a flow chart; and determining amounts to be charged to the client at various intervals throughout the project.
- 36) Utilize technology to write and share periodical reports (weekly, monthly, etc.) to provide others with information about progress during construction activities as would a project manager to a supervisor. Summarize activities in a narrative form including overall progress in relationship to a previously planned schedule.

Portfolio

- 37) Update materials from coursework to add to the portfolio started in *Fundamentals of Construction* and *Residential & Commercial Construction I*. Continually reflect on coursework experiences and revise and refine the career plan generated in prior courses, using technology where appropriate. Include photographs or illustrations and written descriptions of sequential progress in construction projects.

Standards Alignment Notes

*References to other standards include:

- NCCER Curriculum: [National Center for Construction Education and Research](#)
 - Note: NCCER accreditation is required to offer NCCER credentials to students. Instructors trained through the NCCER Instructor Certification Training Program (ICTP) may use the NCCER curricula to teach the listed standards. By doing so, their students will complete modules working toward a certificate of completion for NCCER Construction Technology and be placed in NCCER's National Registry Database.
- 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.