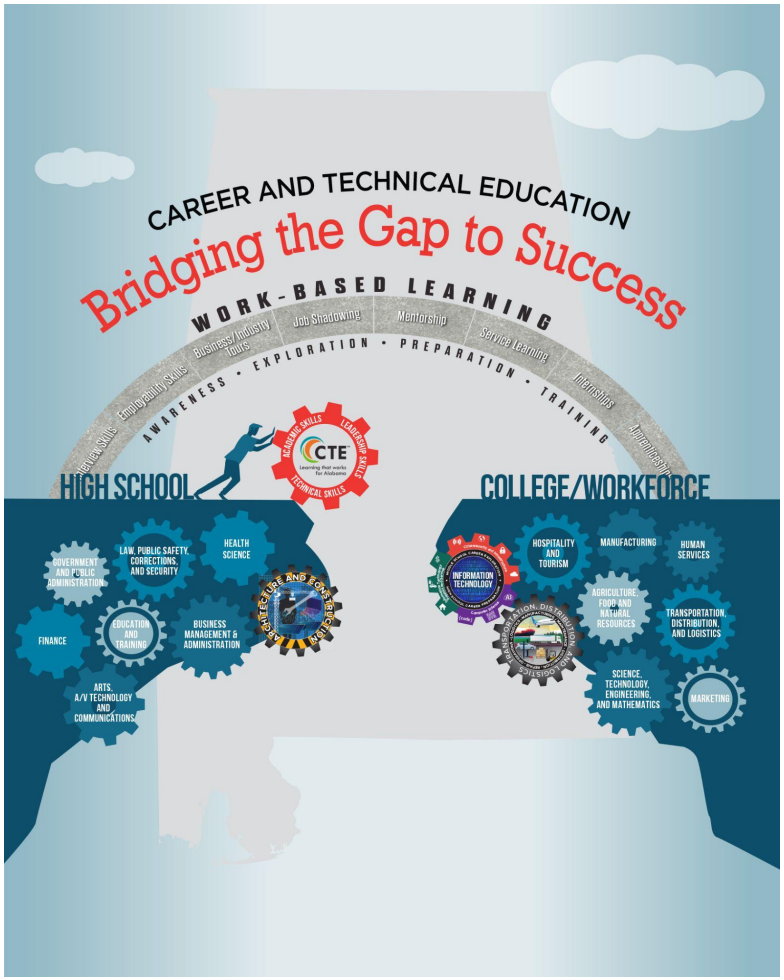
Alabama Course of Study
Career and Technical Education



2022

Eric G. Mackey, State Superintendent of Education
Alabama State Department of Education

For information regarding the
Alabama Course of Study: Career and Technical Education
and other materials, contact:

Alabama State Department of Education
Instructional Services Section
3345 Gordon Persons Building
Montgomery, Alabama

P.O. Box 302101
Montgomery, AL 36130-2101

(334) 694-4768

Alabama Course of Study
Architecture and Construction

Eric G. Mackey
State Superintendent of Education

STATE SUPERINTENDENT OF EDUCATION'S MESSAGE

Dear Alabama Educator:

The 2022 *Alabama Course of Study: Career and Technical Education, Architecture and Construction* presents standards designed to prepare students for the career and technical demands of the future, both in the workplace and in the postsecondary education setting.

This document contains a challenging set of standards designed to promote students' engagement and career interests in Architecture and Construction fields. I encourage each system to use the document in developing local curriculum guides that determine how its students will achieve and even exceed these standards.

The 2022 *Alabama Course of Study: Career and Technical Education, Architecture and Construction* was developed by educators and business and community leaders to provide a foundation for building quality Architecture and Construction programs across the state. Implementing the content of this document through appropriate instruction will promote students' exploration and enhance preparation for further study and careers in a variety of Architecture and Construction fields.

Eric G. Mackey
State Superintendent of Education

MEMBERS of the ALABAMA STATE BOARD OF EDUCATION

Governor Kay Ivey
President of the State Board of Education

District

I. **Jackie Zeigler**

II. **Tracie West**

III. **Stephanie Bell**

IV. **Yvette Richardson, EdD**
Vice President

V. **Tonya S. Chestnut, EdD**

VI. **Cynthia McCarty, PhD**

VII. **Belinda McRae**

VIII. **Wayne Reynolds, EdD**
President Pro Tem

State Superintendent
Eric G. Mackey
Secretary and Executive Officer

Alabama Course of Study
Architecture and Construction
Table of Contents

Alabama Course of Study
Architecture and Construction

PREFACE

The 2022 *Alabama Course of Study: Career and Technical Education, Architecture and Construction* provides the framework for Grades 9-12 Architecture and Construction programs in Alabama's public schools. Architecture and Construction education courses are organized by pathways, which are aligned with national standards. Content standards in this document are minimum and required (*Code of Alabama,* 1975, §16-35-4). They are fundamental and specific, but not exhaustive. When developing local curriculum, school systems may include additional content standards to reflect local needs and philosophies. Systems are encouraged to add implementation guidelines, resources, and activities based upon the content standards in the Architecture and Construction Course of Study.

The 2021 Alabama Career and Technical Education Course of Study Committee and Task Force conducted extensive research during the development of the Architecture and Construction Course of Study, analyzing career and technical education standards and curricula from other states, previous versions of Alabama's career and technical education courses of study, and national standards. The Committee and Task Force also reviewed information from professional journals and Internet sites, listened to and read comments from interested individuals and industry groups throughout the state, considered suggestions from independent reviewers, sought input from advisory councils, and thoroughly discussed each issue and standard among themselves. The Committee and Task Force reached consensus and developed what members believe to be the best Architecture and Construction Course of Study for students in Alabama's public schools.

Alabama Course of Study
Architecture and Construction

ACKNOWLEDGMENTS

This document was developed by the Architecture and Construction Committee and Task Force of the 2021 Alabama Career and Technical Education Course of Study Committee and Task Force, composed of middle school, high school, and college educators appointed by the Alabama State Board of Education and business and professional persons appointed by the Governor (*Code of Alabama*, 1975, §16-35-1). The Committee and Task Force began work in February of 2021 and submitted the document to the Alabama State Board of Education for adoption at the January 2022 meeting.

Architecture and Construction Course of Study Committee and Task Force

Chair: Jennifer Boyd, EdS, Superintendent, Lanett City Schools

Shameka K. Baker, MEd, Principal, Lowndes County Career Technical Center, Lowndes County Public Schools

Nina Bullock, MEd, Arch/ERG/AM Design Drafting Program Coordinator, Calhoun Community College

Richard Burt, PhD, Head, McWhorter School of Building Science, Auburn University

Douglas J. Forsythe, BS, Teacher, Calera High School, Shelby County Schools

Petro L. Johnson, MS, AAA, Career Technical Director, Dallas County Career Tech Center, Dallas County Schools

Scott C. Larson, MS, Teacher, North Baldwin Center for Technology, Baldwin County Public Schools

Kevin R. Lockridge, EdS, Career Technical Director, Calhoun County Career Academy, Calhoun County Schools

Robert T. Peterson, MS, Instructor, Calhoun County Career Academy, Calhoun County Schools

Joshua K. Richter, NCCER & AWS Certified, Instructor, Enterprise High School, Enterprise City Schools

Richard Robinson, MEd, Teacher, MPACT, Montgomery County Schools

Robin Tidwell, ADDA certified with AAS+, Instructor, Walker County Center of Technology, Walker County Schools

William G. Troutman, EdS, Principal, Cullman Area Technology Academy, and Career Tech Director, Cullman County Schools

Wesley D. Yoder, BS equivalent & Ala. Home Builders License, Teacher, Lincoln High School, Talladega County Schools

Appreciation is extended to **Jessica Bowlin,** Building Construction Program Instructor, Auburn High School; **Mary English,** Assistant Professor, School of Architecture, Planning, and Landscape Architecture, Auburn University; **Terrence Marzette**, CD, Academy of Architecture and Construction, Huffman High School; **Joel Owen,** HVAC Training Center Manager, Alabama Power Company; and **Mark P. Pilotte,** Welding Instructor, Huntsville City Schools, who served as content reviewers of this document.

State Department of Education personnel who managed the development process were:

Eric G. Mackey, EdD, State Superintendent of Education
Angela Martin, Deputy State Superintendent, Division of Instruction
Daniel Boyd, PhD, Deputy State Superintendent
Elisabeth Davis, EdD, Assistant State Superintendent, Office of Student Learning
Jimmy Hull, EdD, Assistant State Superintendent, Career and Technical Education
Sean J. Stevens, MEd, Program Coordinator, Instructional Services
Cathy Jones, MS, Executive Secretary, State Courses of Study Committees, Instructional Services
Hailey Ridgeway, MA, Education Administrator, Educational Technology
Lisa Bruce, MEd, Education Administrator, Career and Technical Education
Dawn Morrison, Education Administrator, Career and Technical Education
Jennifer Burt, EdS, Education Administrator, Career and Technical Education
Catherine Wilbourne, MEd, Editor, Courses of Study
Carol Sprayberry, MEd, NBCT, Consultant, Courses of Study

The State Department of Education specialists who assisted the Task Force in developing the document were:

Bryan Upton, **MBA, MEd, NBCT**, Education Specialist, Career and Technical Education
Susanne Estes, MEd, Education Specialist, Educational Technology
Dana Stringer, MEd, Education Specialist II, Career and Technical Education
Niketa Dean, **MS**, Education Specialist II, Career and Technical Education
Amanda Dykes, MEd, Education Specialist, Career and Technical Education, Computer Science
Charles V. Creel, Graphic Arts Specialist, Communications

Alabama Course of Study
Architecture and Construction

GENERAL INTRODUCTION

Alabama's Career and Technical Education programs empower students with the workplace-readiness skills necessary for success in the twenty-first century. As a result, students can become productive citizens who are prepared with the necessary knowledge and skills for postsecondary education and employment. Career and Technical Education provides opportunities for students to combine core academic content with rigorous and relevant technical knowledge and skills.

The *Alabama Course of Study: Career and Technical Education* is intended for all students in Grades 6-12. Alabama's Career and Technical Education programs promote students' career awareness through engaging career exploration and development activities. Career and Technical Education programs focus on providing students with the knowledge and skills that reinforce attainment of academic core content through hands-on experiential learning. These programs are organized into the sixteen national career clusters identified by the United States Department of Education, which arrange instruction into groups of similar occupations. Within the sixteen national career clusters, separate course content standards have been developed for more than fifty career pathways.

Because of the interconnected nature of Career and Technical Education programs, some courses will be utilized in more than one cluster. Shared courses are not reprinted in each course of study, but are indicated in the clusters' program guides, which are the definitive listings of required courses for each cluster. Program guides can be found on the Alabama State Department of Education website.

Alabama's Career and Technical Education programs are designed to keep abreast of the rapid changes in business and industry and be responsive to current and future workforce demands. Rigor in each course of study is derived from both core academic content and industry-specific knowledge and skills required for students to achieve, maintain, and advance in employment in a particular career pathway. The level of academic and workplace rigor determines the degree to which each Alabama Career and Technical Education program prepares students for high-skill, high-wage, and in-demand careers. For each Career and Technical Education program, industry-recognized credentials of value and certifications have been established that validate the rigor of the curriculum to students, parents, and members of business and industry. In addition, articulation agreements are developed in partnership with the Alabama Community College System to allow for a seamless transition for students to further their education.

Alabama's growing economy has created the demand for more highly-skilled workers. Alabama's Career and Technical Education programs, through the implementation of each career cluster's course of study, equip students with the employability skills and technical knowledge necessary to meet current and future workforce demands by preparing them for lifelong learning.

Alabama Course of Study
Architecture and Construction

CONCEPTUAL FRAMEWORK

Alabama Course of Study
Architecture and Construction
CONCEPTUAL FRAMEWORK

The conceptual framework graphic represents the broad scope and numerous opportunities in the Architecture and Construction Career Cluster. The gear interlocks with those of the other career clusters to illustrate the learning opportunities available through Career and Technical Education which enable students to meet their individual career objectives.

The yellow and black stripes behind the cluster name indicate that safety is the top priority in Architecture and Construction, and the images in the center of the diagram represent both the present and the future of the industry. The silhouette of a worker indicates the focus of Career and Technical Education on preparing individuals to meet the occupational demands of a growing economy. The blue and white grid represents traditional blueprints; the crane, tractor bucket, and wrench represent the wide variety of tools used in the field; and the building silhouette represents the end product. The binary code and laptop indicate the growing role of computers in the field and the solar panels represent the emerging "green energy" component of construction.

The Architecture and Construction Cluster provides the foundations for many high-wage and high-demand employment opportunities. Training students to meet this demand is vital to their future well-being and to the economic growth of our state.

POSITION STATEMENTS

Architecture and Construction

The Architecture and Construction Cluster focuses on preparing students for careers in architecture, interior design, industrial design, environmental design, construction management, engineering, technical communication, welding, electrical, utility line work, heating, ventilation, air conditioning, and refrigeration (HVACR), carpentry, cabinetmaking, masonry, surveying, plumbing and pipefitting, and related fields. Certain fundamental understandings which support the Architecture and Construction program must be embraced by schools and school districts in order to provide students with the best possible experiences in the classroom and in the field. These position statements summarize the requirements for an effective Architecture and Construction program.

Classroom and Laboratory Environment

The effective Architecture and Construction classroom should be a safe environment which is fully equipped with current and emerging technologies, supplies, and materials needed for instruction, where students can increase their skills. As in other pathways in Career and Technical Education, Architecture and Construction instruction cannot be confined within the four walls of a traditional classroom. Students and teachers should have access to laboratory environments on campus and in the community where students can experience practical, real-world circumstances in the Architecture and Construction industry.

Technology, Equipment, and Facilities

Classroom technology must be readily available, efficiently maintained, and routinely upgraded according to a regular schedule. Students and teachers utilize equipment to conduct a variety of classroom instruction and learning activities. Using up-to-date technology with as few interruptions as possible enhances the learning environment and prepares students for future career opportunities. In addition, students should have ready access to other classroom supplies and materials (such as textbooks, reference materials, and software) in classroom libraries, research areas, and materials centers to support instruction and industry credentialing. Sufficient funds must be allocated each year to provide and maintain the technology and materials necessary for a superior career and technical education program.

Safety

The safety of students and instructors is a prime consideration in every learning environment. Creating and implementing a written safety plan is an essential part of designing, carrying out, and evaluating each career and technical education program. An effective plan may include federal, state, local, school, and program guidelines. Care must be taken to ensure that students are in safe environments both on and off campus. Safety includes not only physical and emotional well-being but also digital and online security. The importance of safety is underscored by its position as the first foundational standard, which is to be included in every course. Teachers must tailor their safety instruction to meet the demands of each specific area.

Professional Development

Because both instructional methods and technology continue to evolve, it is essential for teachers to participate in professional development and technical training opportunities to stay abreast of innovations pertaining to their content area and to the workplaces in which their students will be employed. Teachers who continually expand their pedagogical knowledge and skills are able to adjust the learning environment to reflect current and emerging trends in teaching methods and to address their students' varied learning styles. Regular program assessment by students, administrators, business and industry personnel, and the educators themselves guides professional development, which in turn enhances the instructional program.

Administrative Support

Full support from district and local administrators is essential in providing the necessary components of an Architecture and Construction program. Administrators should recruit highly qualified teachers who possess appropriate credentials and secure funding for professional development activities and industry certification for those teachers. Administrators must also provide time for professional development and for planning for the integration of academic content areas into the Architecture and Construction Cluster. Administrators should actively promote Architecture and Construction programs within the school and in the community.

Instructional Model

The Architecture and Construction Course of Study is designed to address the challenges of a changing, technological, diverse, and global society in which students must apply knowledge, skills, and ideas to solve problems and make decisions. The Architecture and Construction curriculum designed by each local education agency should be project-based, process-oriented, and work-based so that students can develop their abilities to collaborate, analyze, communicate, manage, and lead.

The content standards contained in this document require students to use innovative critical-thinking skills. Teachers should utilize the course of study to identify the issue or concern addressed in a specific content standard and then use the local curriculum guide to plan appropriate learning experiences. Teachers must understand that there are differences among standards, curriculum, and resources. The Architecture and Construction content standards delineate what students are expected to know or be able to do at the end of each course. A curriculum is a sequence of tasks, activities, and assessments that teachers enact to support students in learning the standards while drawing on a textbook or other resources when appropriate.

Academic core content should be integrated into the Architecture and Construction program. To achieve the solution to a given problem, students must have adequate foundations in reading, writing, speaking, listening, viewing, and presenting; knowledge and skills in mathematics, science, and social studies; and knowledge of current and emerging technologies.

The Architecture and Construction program should also integrate workplace demands and employability skills, incorporating various instructional strategies to accommodate students' learning styles and interests. A variety of assessments should be used to evaluate individual students' interests, aptitudes, and abilities.

When individual needs have been determined for students in special populations, a support service program should be planned cooperatively by Architecture and Construction instructors and other appropriate personnel, because Individual Education Programs are most effective when developed in conjunction with students' career and technical education instructors. Courses and equipment may be tailored to ensure equal access to the full range of learning experiences and skill development in the Architecture and Construction program.

Career and Technical Student Organizations (CTSOs)

Nationally affiliated Career and Technical Student Organizations such as SkillsUSA are an integral part of classroom instruction in each career and technical education program and are essential for the growth and development of a career-ready workforce. In conjunction with coursework completed in each cluster, CTSOs make a positive difference in the lives of students by developing their potential for leadership, personal growth, and career success. The purpose of these organizations is to help students develop an understanding of all aspects of industry and technology while learning teamwork and leadership skills. The importance of CTSOs is indicated by their inclusion in the foundational standards to be taught in every Architecture and Construction course. Goals of student organizations include:

- developing individual potential;
- developing effective leadership and citizenship skills through social, economic, scholastic, and civic activities;

• increasing knowledge and understanding of an ever-changing society.
• assisting in the exploration of occupational choices and the development of essential workplace skills;
• participating in career development events; and
• serving the school and community through community service projects.

Business-Industry-School Relationships

The very nature of Architecture and Construction requires a close relationship between the school and the business community. Some aspects of this relationship are specified by state and federal laws and regulations, while others are determined by the desires, interests, and willingness of school personnel and business leaders in the local community. The relationship between schools and businesses can be immensely beneficial to all parties involved.

Certification

Maintaining relationships with local businesses and industries is vital to the certification process as well as to federal funding through the Carl D. Perkins legislation. Certain elements of program certification require local industries to participate in the Career and Technical Education program's adoption of industry standards. Representatives from local businesses and industries interact with school programs to address the ever-changing needs of the competitive global economy. Through this interaction, the program is reviewed to ensure that needs are being met through lesson plans, instructional techniques, facilities, professional development, technical updates, equipment, and implementation of CTSOs.

Student Work Experience

As students begin to plan careers, they must have opportunities to visit, tour, and work at local industries and businesses. Real-world experiences such as cooperative education, internships, apprenticeships, and job shadowing contribute to the work-based, service-based, and project-based learning that enhances classroom instruction. An additional benefit comes from continuous feedback from students and supervisors, who evaluate the program to facilitate changes that satisfy industry needs.

Advisory Councils and Partnerships

In accordance with Alabama State Department of Education guidelines, each Career and Technical Education program has an advisory council made up of representatives of the local business community that provides professional, real-world input regarding equipment needs, curriculum emphases, technical updates, and problem-solving. This link to business and industry may also provide external support by supplying equipment, resource materials, or qualified speakers. Community partners may provide program sponsors, judges for student career development events, financial support, scholarships, field trip sites, and other program needs.

Community Involvement and Service

There are many ways for Architecture and Construction students and teachers to become involved with community service projects, providing benefits for students and their communities. Local organizations such as civic clubs, professional educational groups, youth organizations, and community adult education programs are valuable resources for Architecture and Construction programs. Open houses, tours, and presentations allow families and other interested citizens to become more informed about Architecture and Construction and more involved in the education environment.

Postsecondary and Higher Education Credit

Postsecondary and higher education articulation is a significant element in a student's career cluster. Secondary and postsecondary instructors must communicate on a regular basis to ensure a smooth transition for students and to make certain that students are aware of articulation opportunities. Articulation may occur through program alignment with postsecondary programs, early college enrollment, or dual enrollment programs.

Students benefit in a variety of ways when cooperation exists between secondary and postsecondary institutions. One of the benefits is the earning of postsecondary credit in conjunction with work completed while the student is still in secondary school. Postsecondary teachers offer additional benefits by serving as guest speakers, donating equipment, sharing expertise through professional development activities, and addressing other needs of the school community.

Dual Enrollment for Dual Credit is an enrichment opportunity allowing eligible high school students to earn high school and college credits for courses taken through an Alabama Community College System (ACCS) institution or an Alabama college or university while still enrolled in high school. Articulated credit is awarded when a student enrolls and satisfactorily completes work in a postsecondary institution that has an articulation agreement with that student's participating school.

DIRECTIONS FOR INTERPRETING STANDARDS

The 2022 *Alabama Course of Study: Career and Technical Education, Architecture and Construction* is organized around the following elements: foundational standards, topics, and content standards.

Foundational standards are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership and take advantage of the opportunities afforded by Career and Technical Student Organizations, and learn and practice essential digital skills.

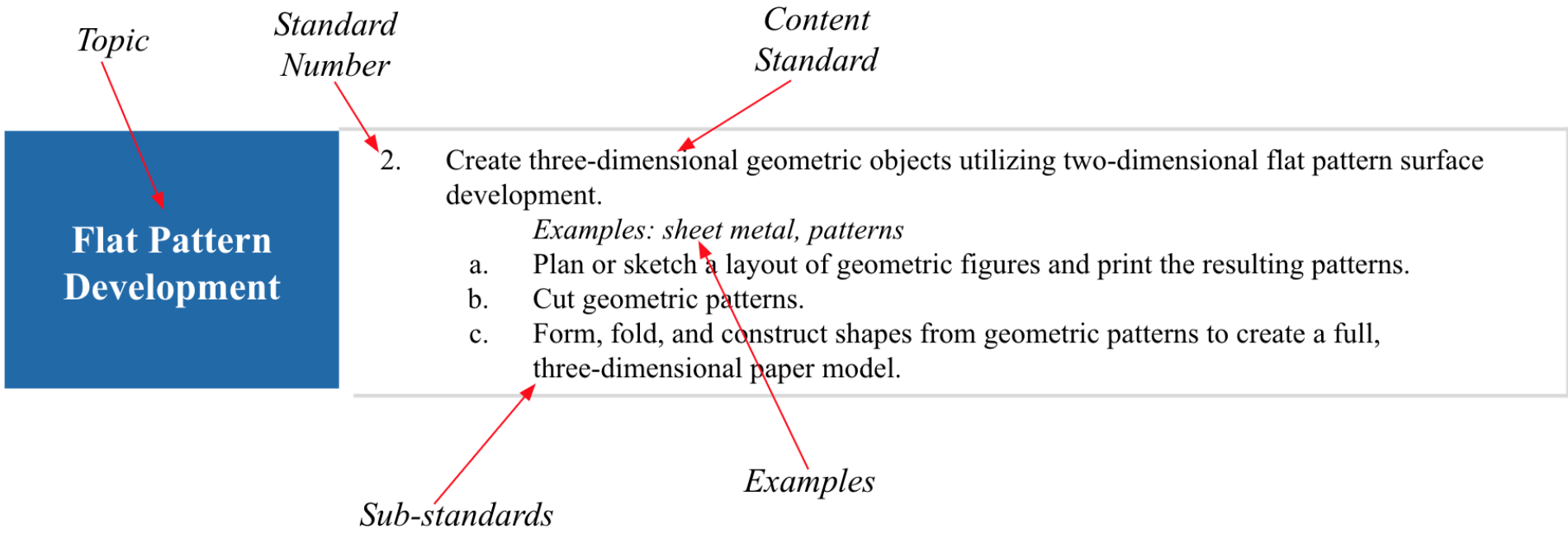
Related content standards are grouped under **Topics**. In the example below, the topic is "Flat Pattern Development" from the Technical Design Communication II course. Standards from different topics may be closely related.

Content Standards contain the minimum required content and define what students should know or be able to do at the conclusion of a course. Some have **sub-standards**, indicated with a, b, c, d…, which are extensions of the content standards and are also required. When "including" appears in standards, it should be construed as "including but not limited to." The items listed must be taught; others may also be included in instruction.

Some standards are followed by italicized **examples**, which present options that might prove useful in instruction of the standard. Examples are not intended to be exhaustive lists and are not required to be taught.

Local education agencies (LEAs) may add standards to meet local needs and incorporate local resources. Each content standard completes the stem *"Students will..."*

The course of study does not dictate curriculum, teaching methods, or sequence; the order in which standards are listed within a course or grade is not intended to convey the order for instruction. Even though one topic may be listed before another, the first topic does not have to be taught before the second. A teacher may choose to teach the second topic before the first, to teach both at the same time to highlight connections, or to select a different topic that leads to students reaching the standards for both topics. Each local education agency should create its own curriculum and pacing guide based on the Course of Study. The standards in each course are to be used as a minimal framework and should encourage innovation.


Topic
Standard Number
Content Standard
Flat Pattern Development
2. Create three-dimensional geometric objects utilizing two-dimensional flat pattern surface development.
Examples: sheet metal, patterns
a. Plan or sketch a layout of geometric figures and print the resulting patterns.
b. Cut geometric patterns.
c. Form, fold, and construct shapes from geometric patterns to create a full, three-dimensional paper model.
Sub-standards
Examples

CLUSTER OVERVIEW

Architecture and Construction

In the Architecture and Construction cluster, students choose one of three pathways—Construction, Design and Preconstruction, or Maintenance and Operations. Coursework within this cluster leads to a plethora of career opportunities in the fields of architecture, interior design, industrial design, environmental design, construction management, engineering, technical communication, welding, electrical, utility line work, heating, ventilation, air conditioning, and refrigeration (HVACR), carpentry, cabinetmaking, masonry, surveying, plumbing, pipefitting, and many more.

Courses are composed of specific content standards which indicate what students should know and be able to do at the end of each course. Course content in this cluster includes significant technical depth and equips students with the knowledge and skills necessary for success across multiple industry-related paths. Every course is designed to help students progress toward earning an industry-recognized credential. In navigating their career paths, students may follow various avenues including employment as an entry-level craft professional, continued study through a technical program within the community college system, a four-year degree program at a university, and/or the military.

Courses encourage critical thinking, integration of technology, development of student leadership skills, and application of knowledge and skills related to practical questions and problems. Safety concepts are integrated into instruction to the maximum extent possible. Students are required to take Architecture and Construction Foundations as the introductory course for programs in this cluster except in the Technical Design program.

Because of the interconnected nature of Career and Technical Education programs, some courses will be utilized in more than one cluster. Shared courses are not reprinted in each course of study, but are indicated in the clusters' program guides, which are the definitive listings of required courses for each cluster. They can be found on the Alabama State Department of Education website.

Students in Grades 9-12 possess varying levels of maturity as well as an array of learning styles. Their backgrounds include diverse family structures and varying social and emotional environments. Throughout these grades, students are adjusting to personal, physical, and emotional changes as well as to social changes taking place in the world around them. Career and Technical Education helps them navigate these personal and social changes and find their places in the world of work.

Students who take courses in the Architecture and Construction cluster are exposed to practical, technical instruction which encourages critical thinking and attention to detail in daily work tasks. The Architecture and Construction cluster provides instruction in basic knowledge and skills within a safe and appropriate setting for student exploration and achievement. Students work together to build a community of learners as their ideas become a source of learning. The active, structured, and stimulating environment simulates the workplace setting and enhances students' ability to adapt to an ever-changing job market.

Career and Technical Student Organizations (CTSO) are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. SkillsUSA is the preferred CTSO for the Architecture and Construction Cluster.

Course of Study standards represent the minimum required content and are not intended to be the course curriculum. LEAs and local schools should use these standards to create a curriculum that utilizes available resources to meet the specific needs and interests of the local community. All Career and Technical Education courses emphasize the application of knowledge and skills to solve practical problems.

Architectural Building Information Modeling (BIM) I

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architectural Design Fundamentals

Architectural Building Information Modeling (BIM) I builds on Architectural Design Fundamentals to present more complex design considerations and construction drawings, including residential floor plans, plumbing plans, HVAC plans, site plans, and stair layout. Topics include design processes and fundamentals; residential construction BIM; sections, details, and schedules; residential site plans, rendering and title sheet; and construction set printing. This course aims to enable students to design and create presentations of residential house plans.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ARCHITECTURAL BUILDING INFORMATION MODELING (BIM) I CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Design Processes	1. Describe the five phases of a design project (schematic design, design development, construction documents, bidding, and construction administration).
Fundamentals	2. Compare and contrast two-dimensional CAD and three-dimensional BIM computer applications. 3. Identify construction components on two-dimensional drawings. *Examples: foundations, walls, windows, doors* a. Identify dimensional attributes of components on two-dimensional drawings. *Examples: length, width, thickness, location (X, Y, Z)*
Residential Construction BIM	4. Using the information from a two-dimensional drawing, create a three-dimensional residential model including views of windows and doors, columns, decks, steps, and railings; elevation level markers; symbols, dimensions, labeling notation, and typical notes. 5. Modify the standard component library to meet the requirements of the specific project. *Examples: Use a standard wall, window, or door type to create a new wall, window, or door.*

Sections, Details, and Schedules	6. Create longitudinal and crosswise building section views for a design project using three-dimensional modeling software. 7. Create typical wall sections and construction details for a design project, using three-dimensional modeling software. 8. Create schedules to identify material for a single-story residential BIM project. *Examples: room finish, doors, windows*
Residential BIM Site Plan	9. Use architectural three-dimensional modeling software to create a residential site plan including site notes, symbols, and dimensions for a given lot, considering building dimensions, lot boundaries, topography, and access to adjoining streets. a. Identify types of site plans, explain terms, and summarize the information included in each type. *Examples: site layout, civil engineering, erosion and sedimentation control, landscaping*
BIM Rendering and Title Sheet	10. Create a single- or multiple-perspective three-dimensional rendering of a design project incorporating site contours, spot levels, and landscaping elements, using three-dimensional modeling software. 11. Create a title sheet which includes the project rendering, sheet index, and project square footage.
Construction Set Printing	12. Set up and print construction documents to scale in hard copy and PDF format, including border, sheets, title block, and required views.

Architectural Building Information Modeling (BIM) II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architectural Building Information Modeling (BIM) I

Architectural Building Information Modeling (BIM) II is designed to increase students' skills and knowledge of drafting design practices and procedures. The course builds on the content of Architectural BIM I, challenging students to illustrate more complex objects using computer-aided drafting (CAD) systems. Topics include residential building information models, virtual design and construction, and client presentations.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ARCHITECTURAL BUILDING INFORMATION MODELING (BIM) II CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Multi-Level Residential Building Information Models

1. Create a basic three-dimensional model of a multi-level residential building with structural components, including foundations, floor system, interior and exterior walls, stairs, and roof, using modeling software.
2. Develop a BIM project for a multi-level residential building, including floor plan, kitchen, exterior elevations, interior elevations, roof plan, stairs, foundation, framing, section details, and rendering camera views.
3. Create schedules to identify materials for a multi-level, residential BIM project utilizing windows, doors, and finishing schedules.
4. Create a schematic ceiling layout plan including light fixtures, ceiling diffusers, and return air grilles for a multi-level residence.
5. Produce two or more design concepts for a specific area using the design option feature in BIM software.
   Examples: two layouts for entries, two layouts for a bathroom, three layouts for furniture
6. Utilize BIM phasing features to create floor plans for each stage of a residential renovation project.
   Examples: existing plan, demolition plan, new plan

Residential Stair Layout and Construction	7. Create a three-dimensional model of a stairway and its components for a multi-level residential dwelling, using modeling software. a. Perform manual calculations of rise, run, and tread dimensions for a residential stairway.
Site Modeling and Rendering	8. Create a basic three-dimensional site model using modeling software, including site access, parking, hardscapes, landscape elements, and elevation changes. a. Create one or more perspective renderings to use in client presentations and as the cover sheet on the set of project drawings, using the BIM rendering features.
HVAC and Plumbing Views	9. Create a basic HVAC three-dimensional model of a multi-level residential building including information on major HVAC components, using modeling software. 10. Create a three-dimensional model of a residential plumbing system including information on plumbing fittings, water supply, and drain, waste, and vent components, using modeling software. a. Explain the importance of clash detection and how this process affects various metrics of a project, including schedule, costs, savings, and quality. *Example: Model the placement of plumbing pipework to avoid structural components.*
Client Presentations	11. Prepare and present a residential design project that addresses potential clients' needs, including floor plan, kitchen, exterior elevations, interior elevations, roof plan, stairs, foundation, framing, sections details, rendering camera views, and title sheet.

Architectural Design Fundamentals

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Technical Design Communications I

Architectural Design Fundamentals introduces students to the foundational terminology, concepts, and principles of the architectural design field. Emphasis is placed on creating basic residential architectural construction drawings including floor plans, electrical plans, foundation plans, wall sections, roof designs, and elevations.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ARCHITECTURAL DESIGN FUNDAMENTALS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Residential Building Elements	1. Describe the elements of a residential building, including building plot, foundation, structure, external and internal walls and doors, windows, external and internal finishes, roof, fixtures, and equipment, using industry terminology. 2. Describe the functions of each element of a residential building, including foundations, structure, external and internal walls and doors, windows, external and internal finishes, roof, fixtures, and equipment. *Examples: structural support, heat or sound transmission, security*
Design Processes	3. Differentiate among common historical residential construction styles. *Examples: cottage, villa, ranch-style, bungalow, mid-century modern* 4. Work with clients to resolve a program and a schematic design for a residential building, grouping spaces by functions and room relationships, in an actual or simulated setting. a. Develop and sketch a residential bubble diagram.
Measurement and Scale	5. Use architectural calculations to produce a sketch of an existing space, utilizing appropriate tools to take precise, accurate measurements and incorporating principles of scale.

Residential CAD Software	6. Create a basic residential floor plan, including symbols, fixture and appliance notations, room names, proper dimensioning techniques, simplified window and door labels, and general floor plan typical notes using CAD software to develop the plan with proper work flow sequence. *Examples: add exterior walls, interior walls, openings (doors and windows), cabinetry equipment, fixtures* 7. Modify plans for an existing single-story dwelling to incorporate minor design changes, using CAD software.
Single Story Dwelling Construction Plans	8. Draw a residential wall section for a single-story dwelling, specifying common building materials and including notes, dimensions, and details. 9. Draw a roof plan for a single-story residence. 10. Create elevations for a single-story dwelling, including notes and markers. 11. Create a residential foundation plan including dimensions and notes. 12. Create a schematic electrical plan using the Residential Building Codes (RBC) for spacing and location requirements.
Printing	13. Print a construction set of plans to hardcopy and PDF.

Architectural Structural Design

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Technical Design Communications II

Architectural Structural Design provides instruction regarding the theory, terminology, design, and practical applications of structural steel components and wood frame buildings used for commercial structures. Students are required to produce a variety of structural engineering plans, sections, and details using the International Building Codes (IBC) or Residential Building Codes (RBC) or the American Institute of Steel Construction (AISC) manual.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ARCHITECTURAL STRUCTURAL DESIGN CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Structure Drawings	1. Describe the types of structural plans required in a set of construction documents. *Examples: foundation, columns and beam, roof, framing* a. Interpret structural wood terminology and symbols found in a set of construction documents. b. Identify and label wood types and classifications required by specifications in a set of structural drawings for given locations and uses. *Examples: tongue-and-groove CDX plywood for subflooring; dry, straight number 2 yellow pine for framing* c. Explain how different types of foundations are indicated on plans. *Examples: crawl space, slab, raised slab*
Structural Loads	2. Calculate structural loads on buildings. *Examples: dead, live, wind, tributary areas* 3. Interpret load requirements for dimensional and pre-engineered lumber based on building spans as outlined in International Building Code (IBC) or Residential Building Code (RBC) charts. *Examples: floor joists, girders, piers, ceiling joist, rafters, trusses*

Wood Structural Plans	4. Create structural plans based on load requirements utilizing dimensional or pre-engineered lumber, including required dimensioning, symbols, and typical foundation notes. *Examples: crawl space foundation plan, ceiling framing plan* a. Create a crawl space foundation plan including dimensions and typical notes. b. Create wood structural details and apply detail markers to identify locations on related plans.
Concrete Foundations	5. Describe different types of structural concrete foundations for low-rise buildings. *Examples: strip footings, isolated footings, slab on grade* a. Create a reinforced concrete slab plan for a structural steel frame.
Structural Steel Drawings	6. Interpret structural steel terminology as it applies to a set of construction documents. *Examples: beam, column, truss, connections, lintels, bracing* 7. Create structural steel construction documents with general notes sheet, details, and dimensional restraints using sketches and architectural plans and the American Institute of Steel Construction (AISC) manual. *Examples: details of columns, base plate connections, structural beams, shop drawings* a. Create a structural steel foundation plan. b. Create a structural steel roof framing plan.
Printing	8. Lay out structural plans on a border sheet. 9. Plot (print) a set of structural plans to hardcopy and to a PDF.

Architecture and Construction Foundations

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Architecture and Construction Foundations is the foundational course for the Architecture and Construction career cluster. It is the first step in any of the three pathways (Construction, Design and Preconstruction, or Maintenance and Operations). Topics include construction mathematics; hand and power tools; construction drawings, specifications, and layout; communication; and material handling.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Identify safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ARCHITECTURE AND CONSTRUCTION FOUNDATIONS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Introduction to Construction Math

1. Prepare a material takeoff and cost estimate for a given project, converting between decimals and percentages as needed.
   Examples: Calculate how many pieces of lumber are required for a construction project, building in a 10% error margin to ensure that sufficient materials are on site when needed. Calculate sales tax.
2. Convert a standard material takeoff to the metric system in accordance with General Services Administration (GSA) regulations for federal renovation and construction projects.
3. Calculate floor and wall areas for a material takeoff, using area formulas, and the amount of concrete for a slab or footing, using volume formulas.
   Examples: carpet, laminated flooring; driveway
4. Describe specialized tools used for measuring and show how they are used to determine dimensions for a given project.
   Examples: speed square, tape measure, framing square, engineering scale, laser measuring system, calipers

Hand and Power Tools	5. Demonstrate the safe use and maintenance of various types of hand and power tools including levels, squares, clamps, hand saws, circular/table/miter saws, routers, drills, and pneumatic staple and nail guns.
Introduction to Construction Drawings, Specifications, and Layout	6. Describe the types of drawings usually included in a set of plans and the information found on each type. *Examples: civil, architectural, structural* a. Use architect's and engineering scales to perform a quantity takeoff for a given set of construction drawings. b. Correlate information from different drawings in a set of plans. 7. Describe the different types of lines used on construction drawings and explain what they represent. *Examples: property, object, hidden, and break lines* 8. Identify architectural symbols commonly used to represent features and materials on plans. *Examples: doors, windows, plumbing fixtures, electrical components* 9. Explain the organization and purpose of written specifications. 10. Create basic drawings and compile specifications for an architecture and construction project, using computers, software, and/or other information technology.
Communication Skills	11. Communicate effectively orally and in writing with various stakeholders as simulated or actual construction projects are carried out.
Introduction to Materials Handling	12. Describe the basic concepts of material handling and common safety precautions. 13. Identify various types of material handling equipment and describe how each type is used.

Cabinetmaking Finishing

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Cabinetmaking Joinery

Cabinetmaking Finishing is designed to provide students with the fundamental knowledge and skills for the final stages of the cabinetmaking process. Topics include cabinet finishing and countertops.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students to develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CABINETMAKING FINISHING CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Cabinet Finishing	1. Sand cabinet boxes and doors with hand tools and power tools. 2. Identify and describe the different types and grit of sandpaper, indicating when it is appropriate to use each one. 3. Explain and demonstrate how to handle and apply sealers. 4. Explain and demonstrate how to match and apply wood fillers. 5. Apply stain and sealer to a cabinet surface. a. Describe the tools and procedures for applying various types of stains and sealer. 6. Compare and contrast the properties of water-based and oil-based stains.
Countertops	7. Summarize the basic process for laminate installation. 8. Demonstrate how to lay out and cut laminates. 9. Apply laminate to a countertop. *Example: Attach laminate to a countertop or a sample-sized piece of material.*

10. Research the advantages and disadvantages of various types of countertops, including laminate, granite, quartz, concrete, wood, and metal, and make recommendations to the customer based on the unit's intended use.
    a. Compare and contrast procurement, processing, manufacture, and environmental impact of natural and manufactured countertops.

11. Determine quantities and pricing of materials for various types of counters and countertops.

Cabinetmaking Joinery

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Cabinetmaking Joinery introduces students to the process of building high-quality finished cabinets, which requires great precision, attention to detail, and the ability to use a variety of specialized tools. The following areas will be covered: types of wood, hardware, layout, joints, and assembly.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students to develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CABINETMAKING JOINERY
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Wood Types

1. Describe and identify different types of solid woods.
2. Identify types of plywood, medium density fiberboard, and particle board and indicate typical applications of each kind.
    a. Explain how cost, durability, finish, appearance, and cabinet location influence the choice of cabinet materials.
    b. Based on a construction drawing and client expectations, select kitchen cabinet materials that satisfy criteria for cost, appearance, and location.
        Example: Using drawing specifications, cabinet detail and elevation drawings, select materials for the cabinet boxes, face frames, doors, and finish for lavatory and kitchen cabinets with a matte cherry finish (stained or natural) that can be built and delivered for $150 or less per foot.

Cabinet Assembly

3. Measure, cut, and assemble a cabinet box based on a construction drawing.
4. Measure, cut, and assemble a face frame based on a construction drawing.
5. Explain when and how to use a pocket hole tool.

Cabinetry Joints

6. Describe the purpose and procedures for using wooden dowels.
7. Identify and describe different types of shapers, indicating when each would be used in constructing cabinet components.
8. Use disc and belt sanders to prepare cabinet components.
9. Use a drill press to bore holes in cabinet components.
10. Describe the safe use of brad nailers.
11. Construct different types of joints used in making cabinet bases, doors, and drawers, including butt joints, miter joints, dado/rabbet joints, and mortise and tenon joints.
    Example: Cut dovetail joints for a cabinet drawer or mortise and tenon joints for cabinet doors.
    a. Calculate the total length of material needed in a given scenario, then measure and cut the material to the proper size.

Cabinet Layout

12. Create cabinet layouts in a variety of configurations, including galley, U-shaped, L-shaped, and island kitchens.
    a. Produce scale drawings of cabinet layouts, indicating measurements and configuration.
13. Identify and describe various types and uses for wall and base cabinets.
14. Select cabinet types and features for various settings.
    Examples: laundry room, office, kitchen
15. Identify and describe various types of cabinet hardware and fasteners, indicating suggested uses of each type.
    a. Install hinges, pulls, and knobs on cabinet doors and drawer faces and drawer tracks on a cabinet, as specified in a construction drawing.

16. Identify and describe types of cabinet shelves and ways of securing them.
    Examples: wood, metal, fixed, adjustable, sliding

17. Interpret symbols on cabinet drawings and layouts.

Career Pathway Project in Architecture and Construction

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Successful completion of any two courses in the Architecture and Construction career cluster.

Career Pathway Project in Architecture and Construction is a capstone course designed for students who have completed two or more Career and Technical Education credits in the Architecture and Construction Career Cluster. This course allows students to utilize the knowledge and skills gained through their secondary coursework in a practical, real-world experience that showcases their learning. It provides an opportunity for a student to choose an area of interest and explore it in depth while demonstrating problem-solving, decision-making, and independent-learning skills. The CPP contributes to an educational plan of challenging courses and practical experiences that prepares students for the workplace or for pursuing further education.

During the CPP, the student works with his or her coordinating teacher, academic teachers, and a product or process mentor who has expertise in the student's field of study. At the conclusion of the CPP, the student presents or demonstrates the knowledge gained to an audience consisting of the coordinating teacher, academic teachers, the mentor, peers, and community and business representatives.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CAREER PATHWAY PROJECT IN ARCHITECTURE AND CONSTRUCTION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Project Proposal	1. Create a formal, narrative proposal that communicates a specific concept, creates a process, or develops a product related to architecture and construction. *Examples: designing a construction project(s), constructing a construction project(s)*
Research	2. Conduct independent research related to the selected architecture and construction project. *Examples: building codes, municipal codes, green energies*

Project Report	3. Write a detailed report on the architecture and construction project, following established conventions for format, grammar, and usage.
Presentation	4. Produce an original multimedia presentation based upon architecture and construction project research and results. *Examples: producing a digital presentation and oral explanation, creating a documentary, presenting a project model and explanation*
Portfolio	5. Design and create a project portfolio that documents all components of the architecture and construction project and demonstrates the validity of the process.

Carpentry: Commercial Framing and Layout

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Carpentry: Commercial Framing and Layout is designed to equip students with fundamental knowledge and skills in the commercial construction industry. Students learn basic theory and practice hands-on application of skills. Topics include commercial drawings, steel framing, exterior finishes, thermal protection, roofing, doors, drywall, suspended ceilings, trim, and commercial cabinet installation.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CARPENTRY: COMMERCIAL FRAMING AND LAYOUT CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Commercial Drawings	1. Set up types and formats of commercial drawings including civil, structural, mechanical, electrical, and plumbing specifications.
Steel Framing	2. Assemble steel framing components. a. List advantages and disadvantages of various types of steel framing systems. 3. Assess hazards involved in constructing steel framing systems and indicate ways to avoid them.
Exterior Finishing	4. Demonstrate and explain installation techniques used with various types of exterior finishing materials. *Examples: vinyl, aluminum, wood*
Thermal Protection	5. Install insulation materials and moisture barriers. a. Explain the importance of insulation and moisture barriers, including their effects on energy consumption. b. Describe health and safety concerns related to various types of insulation and list ways to avoid exposure to hazards when handling and installing it. c. Explain insulation R-values and determine optimal R-values for a given type of building and geographical area.

Roofing	6. Compare and contrast types of roofing systems used in residential and commercial buildings, listing advantages and disadvantages of each type. a. Construct a roofing system, using appropriate tools and fasteners. b. Outline techniques and safety procedures for installing roofing systems in residential and commercial buildings, including tools, fasteners, and materials.
Doors	7. Describe types of doors and hardware used in residential and commercial buildings. *Examples: wood, steel, fiberglass, hollow core, solid core* 8. Create plans to avoid hazards associated with techniques for installing doors and hardware.
Drywall	9. Describe materials, tools, and techniques needed for drywall installation and finishing. *Examples: flat, textured* a. Estimate the quantity and cost of materials needed for drywall installation in a given scenario.
Suspended Ceilings	10. Select the components, tools, and equipment needed to install suspended ceilings. a. Outline procedures for installing suspended ceilings.
Trim	11. Measure, cut, and install trim around doors, windows, floors, and ceilings.
Cabinet Installation	12. Describe types, components, hardware, tools, and layout of commercial cabinetry. a. Select tools needed for installing commercial cabinetry and hardware in given scenarios.

Construction Building Systems

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Construction Building Systems is designed to provide knowledge and skills used with mechanical systems in the finishing phase of a structure. Topics include safety, plumbing, electrical wiring, and HVAC.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CONSTRUCTION BUILDING SYSTEMS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Electrical Safety

1. Identify electrical hazards and their causes and effects.
   Examples: electric shock; faulty wiring, improper grounding, overloaded circuits
   a. Verify that electrical circuits are de-energized.
   b. Explain the hierarchy of risk control, giving examples of how it would be applied in various situations.
2. Explain the purpose and implementation of National Electrical Code (NEC) standards.
3. Demonstrate the safe use of ladders, scaffolds, and lift equipment.
4. Select and demonstrate the use of appropriate fall protection for given situations.
   Examples: guardrails, safety nets, personal fall arrest system (PFAS)

Residential Electrical Services

5. Explain how electricians use the National Electrical Code for residential wiring.
   a. Explain the grounding requirements of a residential electric service and the types and purposes of equipment grounding conductors.
   b. Analyze the electrical requirements of a given single-family dwelling, determine the size of service entrance conductors, and select service-entrance equipment.
   c. Compute branch circuit loads and explain circuit installation requirements.

6. Explain the purpose of ground fault circuit interrupters and tell where they must be installed according to National Electrical Code (NEC) standards.
7. Size outlet boxes and select the proper types for different wiring methods using National Electrical Code (NEC) standards.
8. Describe rules for installing electrical systems around swimming pools, spas, and hot tubs to National Electrical Code (NEC) standards.
9. Explain how wiring devices are selected and installed.
   Examples: receptacles, switches, lighting control devices, lampholders
10. Describe the installation and control of lighting fixtures.

Introduction to HVAC

11. Explain the basic principles of heating, ventilation, and air conditioning.
12. Describe the processes and safety principles that guide HVAC installation and service techniques.
    a. Explain how the standards and guidelines of the Environmental Protection Agency, American Society of Heating, Refrigerating and Air-Conditioning Engineers, and American National Standards Institute affect the HVACR industry.
    b. Gather and share information related to the importance of Leadership in Energy and Environmental Design (LEED) construction and energy management.

Introduction to Drain, Waste, and Vent (DWV) Systems

13. Explain how waste moves from a fixture through the drain system to the septic system or wastewater treatment plant.
    a. Describe the major components of a drainage system and explain their functions.
    b. Identify the different types of traps and their components, explain the importance of traps, and describe ways that traps can lose their seals.
    c. Identify significant code and health issues, violations, and consequences related to drain, waste, and vent systems.

Plastic Pipe and Fittings	14. Compare and contrast the various types of plastic pipe and indicate when each should be used. 15. Identify the types of fittings and valves used with plastic pipe. 16. Describe the techniques used in hanging and supporting plastic pipe. a. Measure, cut, and join plastic pipe to current National Standard Plumbing Code (NSPC) standards.
Copper Pipe and Fittings	17. Explain the materials, schedules, and properties of copper pipe, fittings, and valves. a. Measure, cut, ream, and groove copper pipe to current National Standard Plumbing Code (NSPC) standards. b. Demonstrate how to hang and support copper pipes to current National Standard Plumbing Code (NSPC) standards. 18. Describe the types of valves and fittings used with copper pipes and indicate where each should be used.

Construction Finishing

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Construction Finishing is designed to provide knowledge and skills used in applying a structure's exterior and interior finishes. Topics include exterior finishing, thermal and moisture protection, drywall, trim, stair layout, and cabinetry.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CONSTRUCTION FINISHING CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Exterior Finishing	1. Describe the various types and applications of exterior finish materials including siding material, components, finishes, and flashing. 2. Explain how to install exterior finish materials including surface preparation for wood, fiber-cement, vinyl, and metal siding materials and components. a. Describe how to install selected cornices. b. Describe the installation of three of the most common siding types in their geographical area. c. Calculate the amount of lap or panel siding required for a given structure.
Thermal and Moisture Protection	3. Describe types of insulation, where they are typically used, and their installation methods, including flexible, loose-fill, rigid, semi-rigid, and reflective insulation. a. Install blanket insulation in a wall. b. Install a vapor barrier on a wall. 4. Select the appropriate materials for moisture control, waterproofing, and ventilation for a residential building according to local or International Building Code requirements and describe the installation methods for selected materials. a. Install selected building wraps. b. Describe the estimating procedure for thermal and moisture control projects and create an estimate for a given project.

Drywall Installation	5. Identify components of a drywall assembly including gypsum products, fasteners, and accessories. 6. Describe the installation of gypsum drywall panels on a stud wall and ceiling using nails, screws, and/or adhesives. a. Contrast rated drywall assemblies with non-rated drywall assemblies, including fire protection and sound conductivity. b. Describe how fire-rated interior and exterior walls are constructed. c. Explain procedures for multi-ply drywall applications. 7. Complete a material takeoff for drywall installation in a given scenario.
Interior Trim	8. Identify types of standard moldings and materials, including base, wall, ceiling, window, and door trim. 9. Explain how to install different types of moldings and trim. 10. Estimate the quantities of different trim materials required for selected rooms.
Basic Stair Layout	11. Describe the types of stairways and their components. 12. Compare and contrast residential and commercial stairways. 13. Describe the procedure used to determine the total rise, number and size of risers, and number and size of treads required for a stairway. a. Describe the procedure to lay out and cut stringers, risers, and treads. b. Calculate the total rise, number and size of risers, and number and size of treads required for a given stairway. c. Lay out and cut a stringer.

Cabinet Construction	14. Identify and describe the types of wood commonly used to construct cabinets, including solid wood, plywood, and particleboard. 15. Describe joints and other construction features of cabinet components and their related hardware and fasteners. a. Describe how to assemble, sand, and finish cabinets. b. Describe how to make joints commonly used by cabinetmakers. c. Describe how to build a cabinet from a set of drawings.
Cabinet Installation	16. Describe the different types of cabinets, components, and hardware and their purposes. 17. Explain how to lay out and install a basic set of cabinets. a. Lay out and identify various types of base and wall units following given plans and specifications.

Construction Framing

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Construction Framing is designed to familiarize students with the framing phase of building a structure and with framing components. Topics include floor systems, wall systems, ceiling joist and roof framing, roofing applications, and building envelope systems.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CONSTRUCTION FRAMING
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Floor Systems	1. Read and interpret drawings and specifications to determine floor system requirements. 2. Describe floor system components and their functions. 3. Lay out and construct a floor assembly. a. Verify that a foundation is square using the 3-4-5 rule and diagonal measurement (Pythagorean theorem). b. Lay out sill plates and girders for floor joists. c. Lay out and install floor joists for partitions and floor openings. 4. Estimate the amount of material needed for a given floor assembly.
Wall Systems	5. Compare and contrast platform, balloon, and post and beam framing systems. 6. Describe the framing components of a wall and ceiling assembly and the procedure for laying out a wood frame wall including corner posts, window and door openings, and partition Ts. a. Describe the common materials and procedures for installing sheathing on walls. b. Lay out, assemble, erect, and brace exterior walls for a frame building. c. Lay out and frame an exterior door rough opening and a window rough opening. 7. Compare and contrast wall framing techniques for wood frame, masonry, and metal stud wall framing. 8. Estimate materials required to frame and sheathe walls.

Ceiling Joist and Roof Framing

9. Describe the components of ceiling framing and the function of each part.
   Examples: ceiling joists, tail joists, various beams, headers, joist hangers
   a. Calculate the number of ceiling joists required for a given building.
   b. Lay out, cut, and install ceiling joists on a wood frame building.

10. Identify common types of roofs used in residential construction and their components.

11. Lay out a common rafter using a calculator, speed square, and/or rafter framing square and cut it using a circular saw.

12. Lay out and frame a gable roof.

Roofing Applications

13. Explain the safety requirements for roofing projects, including potential hazards, fall protection, PPE, and hazard control devices.
    a. Describe roofing tools and fasteners, their uses, and safety procedures for using them.

14. Compare and contrast various roofing systems, their associated materials, and their methods of installation.

15. Describe the installation techniques for common roofing systems.
    a. Demonstrate how to install composition shingles on a specified roof and valley.
    b. Demonstrate the method to cut and install a ridge cap using composition shingles.
    c. Lay out, cut, and install a cricket or saddle.
    d. Demonstrate the techniques for installing non-shingle types of roofing materials.

16. Estimate materials for a given roofing project.
    a. Estimate the cost of materials and labor for a given roofing project, using current rates in the geographical area.

Introduction to Building Envelope Systems

17. Identify the components of the building envelope.
    a. Describe ways that air infiltration can be minimized or prevented.
    b. Identify various types of fixed, sliding, and swinging windows.
    c. Identify common types of exterior doors and explain how they are constructed.

18. Outline the procedures for installing various types of windows.

19. Outline the procedures for installing various types of doors and explain the differences between residential and commercial doors.
    a. Install, plumb, shim, and secure an exterior door in a rough opening,
    b. Demonstrate mortising techniques with wood chisels and/or router for a lockset or deadbolt and install in an exterior door.

Construction Site Preparation and Foundations

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Construction Framing

Construction Site Preparation and Foundations is designed to familiarize students with the site preparation phase of construction and the methods and materials used in constructing foundations. The course covers site and foundation plans and how to utilize plans to complete the beginning phases of construction. Topics include concrete properties, placing concrete, masonry terms, and light equipment.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students to develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CONSTRUCTION SITE PREPARATION AND FOUNDATIONS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Site Layout	1. Explain the purpose of site layout and describe the role of a site layout technician in the construction industry. a. Identify and describe the kinds of surveys related to a construction project. *Examples: boundary, location, construction, site planning* b. Set up leveling tools, shoot elevations, and record the data. *Examples: builder's level, transit level, laser level*
Concrete Properties and Quality Control	2. Identify types of cement, concrete aggregates, and admixtures and describe their uses. *Examples: portland cement, pozzolana cement, sand, gravel, vermiculite* 3. Identify factors that affect the curing of concrete and compare and contrast the methods used to achieve proper curing. *Examples: water curing, ponding, membrane curing* 4. Describe concrete testing methods and indicate when each would be used. a. Utilize sampling methods to test concrete. 5. Estimate quantities of concrete needed for given scenarios. *Examples: floating slab, footing and grade beam foundation* 6. Identify types of concrete reinforcement and describe their uses, including bars, bar supports, and welded wire fabrics.

Handling and Placing Concrete	7. Describe factors that contribute to the quality of concrete placement. *Examples: aggregates, water quality, water-to-cement ratio, curing temperature, humidity* 8. Demonstrate methods for placing and consolidating concrete into forms. *Examples: discharging from truck, pumps, conveyors and buggies; vibration, rodding, tamping* a. Use a screed to strike off and level concrete to the proper grade in a form. b. Use tools to place, float, and finish concrete.
Masonry Unit Installation	9. Explain how concrete masonry units (CMU or blocks), clay masonry units (bricks), and stone are used in construction. 10. Explain and demonstrate how to set up, lay out, bond, tool, and clean various concrete masonry units. *Examples: blocks, bricks, stones* 11. Cut concrete masonry units and brick using a masonry hammer, a brick set, a power saw, and a splitter.
Light Equipment	12. Identify and explain the operation and use of various pieces of light equipment, including aerial lifts, skid steer loaders, trenchers, generators, compressors, compactors, forklifts, and backhoes used in site preparation, concrete placement, and masonry.

CTE Lab in Architecture and Construction

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Successful completion of any two courses in the Architecture and Construction career cluster

CTE Lab in Architecture and Construction is designed to enhance the student's general understanding and mastery of the cluster. This course is designed as a learning laboratory to support students' individual interests and goals. This laboratory may take place in a traditional classroom, in an industry setting, or in a virtual learning environment.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

CTE LAB IN ARCHITECTURE AND CONSTRUCTION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Occupational Expertise

1. Demonstrate expertise in a specific occupation within the Architecture and Construction Cluster.
    a. Meet benchmarks selected by the instructor from the appropriate curriculum frameworks, based upon the individual student's assessed needs.

Problem Solving and Critical Thinking

2. Conduct investigative research on a selected topic related to architecture and construction using approved research methodology, interpret findings, and prepare a presentation to defend results.
    a. Select an investigative study based on research, interest, and prior knowledge.
    b. Collect, organize, and analyze data accurately and precisely.
    c. Design procedures to test the research.
    d. Report, display, and defend the results of investigations to audiences that may include professionals and technical experts.
3. Demonstrate higher order critical thinking and reasoning skills appropriate for a career in architecture and construction.
    a. Use mathematical and scientific skills to solve problems encountered in the chosen occupation.
    b. Locate, evaluate, and interpret information related to the chosen occupation, in oral, print, and digital formats.
    c. Analyze and apply data and measurements to solve problems and interpret documents.

Professional Skills

4. Apply enhanced leadership and professional career skills needed in architecture and construction careers.
    a. Develop and deliver a professional presentation offering potential solutions to a current issue.
    b. Practice leadership and career skills in job placement, job shadowing, entrepreneurship, or internship or by obtaining an industry-recognized credential of value.
    c. Participate in leadership development opportunities available through SkillsUSA and/or professional organizations in the architecture and construction field.
    d. Demonstrate written and oral communication skills through presentations, public speaking, live or virtual interviews, and an employment portfolio.

Electrical Fundamentals

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Electrical Fundamentals is designed to provide students with basic knowledge and skills for work in the electrical industry. The course emphasizes safety while addressing basic electrical theory, National Electrical Code (NEC), terminology, conductors, circuit construction, basic alternating current, reactive circuits, and troubleshooting circuits.

Career and Technical Student Organizations are integral, co curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the Electrical industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ELECTRICAL FUNDAMENTALS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Introduction to Electrical Circuits	1. Identify the components of an atom and compare atomic structures of conductors and insulators. a. Describe the role of magnetism in electrical devices. b. Explain the functions of magnetic fields in generating electricity. c. Identify the basic components in a power distribution system and explain their functions. *Examples: generator, switchgear, bus bars, lightning arresters* d. Explain electrical properties of current, voltage, and resistance, and use Ohm's law to calculate the relationship among them.
Electrical Theory	2. Identify resistances in series and parallel circuits. 3. Distinguish between series and parallel circuits. 4. Explain and use Kirchhoff's current and voltage law to analyze circuits and to calculate current.
Introduction to NEC	5. Explain how changes are made to the National Electrical Code (NEC) and identify other organizations that produce electrical standards. a. Explain the layout of the National Electrical Code and use it to find specific installation requirements.

Boxes	6. Identify different types, sizes, and applications of boxes. a. Install outlet and device boxes. b. Size pull and junction boxes.
Wireways, Raceways, and Fittings	7. Identify types of conduit and their applications. a. Install and ground metal conduit boxes. b. Identify raceway supports and installation requirements for various construction methods. c. Select the correct application and install tie wraps, screws, hammer-driven pins and studs, masonry anchors, and hollow-wall anchors.
Conductors and Cables	8. Select wires sizes, conductor materials, and conductor insulation for a residential structure. 9. Select fixture wiring, cable types, and instrumentation control wiring for a specified project. 10. Install conductors using a fish tape.
Residential Wiring	11. Calculate the electric service load and apply demand factors for a given scenario. a. Calculate appliance amperage loads to determine breaker size. b. Determine what size breaker boxes are needed in given scenarios. 12. Size grounding electrodes and main bonding jumper for a given residential building. 13. Identify service drop and panelboard location in a given residence. 14. Select and install electrical cable systems. *Examples: nonmetallic-sheathed cable, metal-clad (MC) cable, underground feeder cable, service-entrance cable* 15. Design and install a branch circuit for a residential building. 16. Select and install receptacles and switches in a residence.

Electrical Installation

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Electrical Fundamentals

Electrical Installation is designed to provide students with the knowledge and skills for the installation of electrical systems. The course emphasizes safety while addressing conduit bending, basic electrical construction drawings, electrical test equipment, alternating current, and conductor installation.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students to develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ELECTRICAL INSTALLATION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Basic Electrical Construction Drawings	1. Interpret information on electrical drawings to determine exact locations for fixtures and fittings. *Example: Locate switch and receptacle boxes on an electrical plan.* 2. Measure items on scale drawings, using an architect's scale to determine the actual dimensions of a given component of a drawing. 3. Integrate specifications with electrical drawings to choose components for an electrical system. *Examples: wiring size, lighting fixtures*
Electrical Test Equipment	4. Identify various types of electrical test equipment and indicate when they are used. 5. Describe meter category ratings and safety requirements. 6. Measure voltage from line to neutral and neutral to ground.
Alternating Current	7. Describe AC waveforms, including nonsinusoidal waveforms, using correct sine wave terminology. a. Explain AC phase relationships. b. Determine unknown values in purely resistive, inductive, capacitive, and combination AC circuits, using Ohm's law. c. Identify various types of transformers and their applications.

	d. Identify the basic components in a transformer and explain how they operate. *Examples: an iron core which serves as a magnetic conductor, a primary winding or coil of wire, a secondary winding or coil of wire* e. Calculate turns and voltage ratios of various transformers.
Conduit Bending and Installation	8. Create conduit bends following National Electric Code (NEC) requirements. a. Summarize the minimum radius bend requirements for various types of conduit. b. Calculate the number of bends per run of conduit. 9. Determine conduit bend distances using equations and circumference of a circle. 10. Select and use hand bending equipment to make 90° bends, back-to-back bends, offsets, and saddle bends. 11. Cut, ream, and thread conduit. 12. Use benders to install conduit to meet installation specifications. *Examples: mechanical, electric, hydraulic* 13. Install PVC conduit, including joints and bends.
Pull and Junction Boxes	14. Size pull and junction boxes for systems under 1000V and systems 1000V or over. a. Select and install fittings for pull and junction boxes. 15. Identify specialty enclosures and indicate when they should be used, including conduit bodies and other cast enclosures. a. Select and install handholes in various materials as required for given scenarios.

Conductor Installations

16. Install cable in conduit systems.
    a. Plan the installation of cable in conduit systems, determining the lengths of cable and conduit and number of brackets needed.
    b. Identify a pulling location and set up the cable reels, raceways, and pull line for cable installation.
    c. Strip cable and attach cable ends to a fish tape in preparation for pulling.

17. Set up equipment and demonstrate high-force cable pulling, including feeding ends, support conductors, and cable trays.

Electrical Technology

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Electrical Installation

Electrical Technology is an advanced study of the design and installation of residential, commercial, and industrial electrical systems. Topics include conductor selection, overcurrent protection, distribution systems, transformers, commercial electrical service, and selection and installation of luminaires for various situations. Precautions for hazardous locations are also stressed.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

ELECTRICAL TECHNOLOGY CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Conductor Selections and Calculations

1. Calculate residential and commercial branch circuit capacity and loads.
   Examples: loads for lighting, receptacles, heating and air conditioning equipment, motors, welders, and commercial kitchens
2. Select conductors for various applications, sizing them based on expected load and voltage drop.
   a. Identify the properties of conductors.
   b. Calculate wire sizes based on resistance, conductor resistance, and voltage drops for various applications.

Hazardous Locations

3. List and explain characteristics of Class I, II, and III hazardous locations.
   a. Summarize requirements for hazardous locations in the most recent version of the National Electric Code (NEC).
   b. Explain and demonstrate methods to prevent ignitions and explosions in hazardous locations.
   c. Identify possible sources of ignition in a given scenario.
   d. Select and install explosion-proof equipment and seals.

Overcurrent Protection	4. Describe overcurrent conditions and their causes, including overloads, short circuits, ground faults, and arc faults. a. Identify types of fuses, their ratings, and their operating characteristics. b. Describe fuse classes and applications. 5. Describe the purpose and operation of circuit breakers. a. Identify circuit breaker classifications, applications, and interrupting capacity ratings. b. Test and troubleshoot circuit breakers and fuses. 6. Size and select overcurrent devices for various applications. a. Apply short circuit calculations based on National Electrical Code (NEC) standards for fuses and overload protectors.
Distribution Systems	7. Identify electrical distribution system components and summarize their installation requirements, including switchboard and switchgear components. a. Explain the operation and applications of medium-voltage limiting (MVL) switches and bolted pressure switches. 8. Describe panelboard arrangements for various applications. a. Research and report on the most recent National Electrical Code (NEC) requirements for distribution equipment. b. Interpret electrical diagrams related to the installation of distribution equipment. 9. Test and maintain switchgear, following general maintenance and testing guidelines.
Transformers	10. Describe the construction and operation of a typical transformer. a. Make transformer connections for various applications, applying the National Electrical Code (NEC) requirements for transformers, capacitors, resistors, and reactors. b. Troubleshoot and maintain transformers.

Commercial Electrical Service	11. Research and report on service components and installation considerations for commercial services, including applicable National Electrical Code (NEC) requirements. a. Install commercial services, including overhead, underground, switchgear, and multi-family service.
Practical Lighting Applications	12. Select luminaires and controls for given indoor and outdoor settings, including dimmer systems, occupancy and photo sensors, and timers. a. Explain how using specialized controls can decrease energy consumption. b. Identify benefits and difficulties associated with various light distribution patterns. c. Categorize luminaires by mounting locations. *Examples: surface-mounted, recessed, suspended, track-mounted* d. Describe characteristics of luminaires for adverse locations. *Examples: underwater lighting, explosion resistant enclosures* e. Describe the characteristics of different types of light sources, including size, efficiency, color, heat generation, power consumption, and infrared emissions. *Examples: halogen, fluorescent, LED*

HVAC Fundamentals

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

HVAC Fundamentals introduces the basic skills and knowledge required in the heating, ventilation, air conditioning, and refrigeration industry, including mathematical skills and the use of specialized tools. Topics include heat, comfort, and psychometrics; equipment; trade math; and electricity.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

HVAC FUNDAMENTALS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Introduction to HVAC

1. Research and report on how legislation and international agreements affect types of refrigerants used in HVAC systems.
   Examples: Clean Air Act, Paris Agreement
2. Explain the HVAC industry's role in global climate change and the regulations designed to combat climate change.

Heat, Comfort, and Psychrometrics

3. Explain how evaporative cooling units reduce air temperature and indicate conditions under which they are most effective.
4. Compare and contrast latent heat and sensible heat, including information about their impacts on the refrigeration cycle.
   a. Determine wet-bulb and dry-bulb temperature, relative humidity, and dew point using an electronic psychrometer.
   b. Predict values for the various properties of air needed to design, adjust, or modify an HVAC system, using a psychrometric chart.

Equipment	5. Explain the underlying scientific and mechanical principles of heating, cooling, refrigeration, and ventilation systems. a. Explain the heat transfer principle and how it applies to modern heating systems. b. Explain the mechanical refrigeration cycle and how it applies to modern cooling systems. c. Describe the methods used to meet Environmental Protection Agency (EPA) indoor air quality standards in modern ventilation systems.
Trade Math	6. Calculate the cubic feet in a cube or rectangular prism to determine the size HVAC unit needed for a given structure. 7. Convert pressures and temperatures using the PT chart to determine and set coil pressure. 8. Solve algebraic equations for designing, adjusting, modifying, or troubleshooting an HVAC system. *Examples: pressure calculations, air flow volume change*
Electricity	9. Explain the fundamentals of electricity and how it is generated. 10. Describe the components of a basic electrical circuit and identify electrical symbols on a schematic diagram, including a compressor, fan motor, and transformer. 11. Apply Ohm's law to troubleshoot electrical issues in an HVAC system. 12. Use the power formula to calculate how much power a device is consuming. 13. Explain the difference between parallel and series circuits and ways they are used. 14. Measure voltage, amperage, and resistance on an electrical circuit. 15. Explain the difference between a ladder diagram and a wiring schematic.

HVAC Installation and Operation

Course Credit	1.0
Grade Levels	10-12
Prerequisites	HVAC Fundamentals

HVAC Installation and Operation introduces students to procedures for installing heating, ventilation, air conditioning, and refrigeration (HVACR) equipment and performing basic preventive maintenance for HVACR systems. Emphasis is placed on interpreting information gathered about the system and using that information to determine whether the system is performing optimally.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.
Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

HVAC INSTALLATION AND OPERATION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Licensing and Certification	1. Explain the importance and purposes of certification, licensing, rules, and regulating agencies in the HVAC industry.
Heating Fundamentals	2. Describe the role of forced air furnaces in residential comfort systems. 3. Explain the differences between a heat pump and a furnace. 4. Explain how a combustion analyzer works. 5. Size flue exhaust pipes and combustion air grilles, using international fuel gas code books. 6. Describe the functions of the components in an electric heat system. 7. Explain the principles of hydronic heating.

Refrigeration Cycle	8. Describe the refrigeration cycle and the changes of state that occur. 9. Explain the law of thermodynamics and the pressure-temperature relationship. 10. Explain the function of a compressor and a metering device in the refrigeration process. 11. Contrast water-cooled condensers and air-cooled condensers. 12. Contrast direct expansion systems and chiller systems.
Air Distribution	13. Explain the importance of airflow in relation to direct expansion and air-cooled HVAC systems. 14. Explain how pressure, velocity, and volume are interrelated in air flow and outline the methods used to measure them. 15. Describe various types of blowers and explain when they would be used. 16. Explain how insulating, sealing, and testing air distribution systems maximize energy efficiency and indicate why these processes are important. a. Explain how common duct materials and fittings affect energy efficiency. 17. Explain the importance of air velocity and how characteristics of common grilles, registers, and dampers affect velocity on both the supply and return sides. 18. Use a ductulator to determine duct sizes for a given size unit and space.
Piping Installation	19. Demonstrate use of pipefitting tools and measurements for fitting refrigerant, fuel gas, and/or water lines. 20. Identify and describe various types of steel pipe and fittings. a. Describe the tools and methods used to cut and thread steel pipe. b. Demonstrate the methods of installing and mechanically joining steel pipe.

Soldering and Brazing

21. Explain the difference between soldering and brazing.
    a. Describe various soldering and brazing alloys, methods, and applications.
22. Describe types of torch equipment utilized by field technicians and explain how and why different torch setups and pressures are used.
23. Explain the use of nitrogen in soldering and brazing.

HVAC Refrigeration Systems

Course Credit	1.0
Grade Levels	10-12
Prerequisites	HVAC Installation and Operations

HVAC Refrigeration Systems introduces students to electrical components and controls for refrigeration systems. Emphasis is placed on advanced problem-solving techniques for electrical components and circuitry. Students utilize flow charts and diagrams and use trouble-shooting procedures to identify defective electrical components and describe operating procedures for components of a refrigeration system. Topics include alternating current, compressors, refrigerating piping design, refrigerants and oils, and basic maintenance.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

HVAC REFRIGERATION SYSTEMS CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Alternating Current	1. Explain how AC power is generated and used. 2. Explain how transformers operate and identify various types of transformers used in HVAC refrigeration systems. 3. Identify the various types of induction motors and explain how they operate. 4. Explain how to test various AC-powered devices. a. Test AC devices.
Compressors	5. Describe the operation of various types of compressors. 6. Explain common causes of compressor failures. 7. Identify and explain the operation of various compressor protection devices.

Refrigerating Piping Design	8. Describe the type of copper used in refrigerating pipes. a. Explain how copper piping is measured and why long radius fittings are used. 9. Explain the difference between plumbing copper and ACR copper and the fittings used with each type.
Refrigerants and Oils	10. Describe the characteristics of various refrigerants and the applications that require these characteristics. 11. Identify various refrigerant classifications and describe their environmental impact. 12. Use pressure-temperature (PT) charts to calculate superheat and subcooling. 13. Identify and describe lubricating oils and issues related to their function. 14. Describe considerations related to refrigerant conversions. *Examples: material compatibility, refrigerant characteristics, lubricant compatibility*
Basic Maintenance	15. Identify and describe common gaskets, packing materials, seals, and bearings. 16. Describe the properties of common lubricants and how they are applied. a. Apply lubricants according to manufacturer's specifications. 17. Identify different types of drive belts and describe how they are installed and adjusted. a. Install and adjust a drive belt. 18. Outline the inspection and/or maintenance requirements for selected equipment.

Industrial Carpentry

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Industrial Site Layout, Formwork, and Concrete

Industrial Carpentry is designed to provide knowledge and skills needed for entry-level carpentry jobs in the commercial construction industry. The training starts with introductory skills for carpenters involving building materials, hand and power tools, rigging, construction drawings, concrete formwork, reinforcement of concrete, placement of concrete, and basic project layout skills.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

INDUSTRIAL CARPENTRY
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Hand and Power Tools	1. Identify and demonstrate the safe use and maintenance of various types of hand and power tools including levels, squares, clamps, hand saws, circular/table/miter saws, routers, drills, and pneumatic staple and nail guns.
Introduction to Construction Drawings, Specifications, and Layout	2. Analyze the types of drawings usually included in a set of plans and the information found on each type. *Examples: civil, architectural, structural plans* a. Explain the different types of lines used on construction drawings and what they represent. *Examples: property, object, hidden, break lines* b. Draw selected architectural symbols commonly used to represent materials on plans. *Examples: doors, windows, plumbing fixtures, electrical components* c. Identify selected electrical, mechanical, and plumbing symbols commonly used on plans. *Examples: switches, junction boxes, temperature sensors, air diffusers, water heater, lavatory* d. Outline the organization and purpose of written specifications.

Building Materials	3. Identify various types of building materials and describe their uses, proper handling, storage, and associated safety precautions, including hardwoods and softwoods, wood sheet materials, engineered lumber, concrete, and metal framing members. 4. Calculate the amount of lumber needed to frame a structure; the number of sheets of plywood required for subflooring, exterior wall sheathing, and roof decking; and the number of drywall panels needed for ceilings and walls, based on a given set of construction drawings or blueprints. a. Calculate the volume of concrete required for given rectangular and cylindrical shapes.
Rigging Equipment	5. Identify common rigging hardware and equipment and describe its use. a. Perform a safety inspection of common rigging hardware and equipment. b. Describe common slings and determine sling capacities for given scenarios, using angle measurements and a load factor chart. 6. Select, inspect, use, and maintain special rigging equipment, including block and tackle (bull rigging), chain hoists, ratchet-lever hoists, jacks, and base-mounted drum hoists (tuggers). 7. Describe types of knots used in rigging and explain when each should be used. a. Select and tie knots in rigging devices.
Rigging Practices	8. Identify and use hand signals to guide a crane operator. 9. Identify site and environmental hazards associated with rigging. *Examples*: *utility poles, bridges, buildings, underground utilities; wind, rain* 10. Determine the center of gravity for a symmetric object and an asymmetric object, using the center of gravity formula CoG = (∑D*W)/∑W. a. Explain the importance of positioning the center of gravity under the suspension point. 11. Identify the pinch points of a load and explain how to avoid them.

	12. Attach rigging hardware for routine lifts and pipe lifts and identify the components of a lift plan. a. Calculate load factor (LAF) for equidistant attachment points in the same horizontal plane using the load factor equation *L (leg length) ÷ H (headroom) = LAF.* b. Determine the share of the load (SOL) for the individual sling legs of equal length using the equation *Load weight ÷ number of legs = share of the load (SOL).* c. Calculate sling tension using the equation *LAF x SOL = Tension.*
Site Layout	13. Describe differential leveling (differences in elevation) between two or more points on a surface.
Reinforcing Concrete	14. Research and share information on the selection and uses of different types of materials for reinforcing concrete.
Trenching and Excavating	15. List safety precautions for digging and working around trenches and excavations.
Slab-on-Grade Foundations	16. Describe basic site layout tools and methods for a slab-on-grade foundation.
Vertical Formwork	17. Describe construction methods for types of forming and form hardware systems for walls, columns, and stairs, as well as slip forms, climbing forms, and shaft forms.
Horizontal Formwork	18. Describe elevated decks and formwork systems and the methods used in their construction.

Handling and Placing Concrete	19. Demonstrate the use of tools, equipment, and procedures for handling, placing, and finishing concrete.
Basic Stair Layout	20. Research and report on the various types of stairs and the common building code requirements related to stairs.

Industrial Site Layout, Formwork, and Concrete

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Industrial Site Layout, Formwork, and Concrete is designed to introduce site layout, excavation, and concrete formwork, reinforcement, and placement. This course aims to prepare students for entry-level jobs in the commercial construction industry.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

INDUSTRIAL SITE LAYOUT, FORMWORK, AND CONCRETE CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Differential Leveling	1. Use a builder's level and differential-leveling procedures to determine site and building elevations, explaining how differential leveling is used to establish point elevations, cross-sections, and control benchmarks. a. Set up and calibrate a leveling instrument. b. Calculate elevations using backsight (BS) and foresight (FS) data from field notes recorded from a differential leveling survey. c. Demonstrate proper handling and storage of tools and equipment associated with differential leveling.
Reinforcing Concrete	2. List applications of reinforced concrete and the general requirements for working with reinforcing steel, including tools, equipment, and fabricating methods. a. Describe methods by which reinforcing bars may be bent and cut in the field and explain the methods for placing reinforcing steel.
Trenching and Excavating	3. Summarize safety guidelines for working in and around foundation excavations and trenches. a. Describe various shoring, shielding, and sloping systems used for trenches and excavations. b. Draft a job hazard/safety analysis for an excavation according to given specifications. 4. Compare and contrast the different types, bearing capacities, and classifications of soils. a. Describe methods of compacting and testing soil.

Foundations and Slab-on-grade	5. Describe how to use control points when establishing formwork locations and elevations. 6. Lay out a foundation for a small building according to given specifications. *Example: Lay out a utility shed.* a. Establish building lines and install batter boards for a small building. 7. Describe the various types of foundations and identify appropriate uses for each. a. Describe how slabs-on-grade are formed and finished.
Vertical Formwork	8. Identify the basic types of concrete wall forms and describe the applications for panel, gang, and patented wall-form systems. 9. Describe the types and applications of various column forms and vertical slipforming. 10. Describe how to construct stair forms.
Horizontal Formwork	11. Compare and contrast various types of structural-concrete floor and roof slabs. 12. Describe different types of form systems including specialty form systems. 13. Describe types of elevated decks and different types of shores and describe applications for each.
Handling and Placing Concrete	14. Describe the methods of moving and handling concrete and the proper methods for placing and consolidating concrete into forms. 15. Describe methods for screeding, leveling, finishing, and curing concrete and creating various joints. a. Explain how various cement types (ASTM C 150 Type I - V) used in the concrete mix affect the minimum curing period corresponding to concrete attaining 70 percent of the specified compressive strength.

Concrete Stair Layout

16. Describe types of concrete stairways and their components.
    a. Compare and contrast residential and commercial concrete stairways.

17. Calculate the total rise, number and size of risers, and number and size of treads required for a concrete stairway and explain the procedures used.
    a. Lay out and cut formwork for concrete stringers, treads, and risers and explain the procedures used.

Masonry Laying Techniques

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Masonry: Mortar, Material, and Installation

Masonry Laying Techniques provides instruction regarding advanced masonry techniques. Topics include laying techniques, temperature and moisture, and quality control.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

MASONRY LAYING TECHNIQUES CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Laying Techniques

1. Identify the structural principles and fundamental uses of solid masonry walls, hollow masonry walls, cavity walls, composite walls, anchored veneer walls, retaining walls, and freestanding walls.
2. Describe the functions of control joints and expansion joints, explaining where they are required and the proper placement and use of each type.
3. Lay out and construct corners and intersections.
   Examples: toothing, corbeling, intersecting walls, angled corners
4. Lay out and construct a cavity wall.
5. Lay out and construct a composite wall with control joints and expansion joints.
6. Lay out and construct a veneer wall.
7. Lay out and construct a retaining wall.
8. Lay out and construct a freestanding wall.

Temperature and Moisture	9. Identify types of insulation used in conjunction with masonry construction, and explain the functions of each type and the techniques for installing them. 10. Outline scenarios in which moisture control is needed in masonry construction. a. Describe the techniques used to eliminate moisture problems in masonry construction. 11. Describe the techniques used to protect masonry being constructed during hot and cold weather.
Quality Control	12. Research industry standards and specifications used to control quality and explain how they are implemented throughout the masonry industry. 13. Build masonry sample panels and prisms to industry standards. 14. Conduct and document field inspections and observations used to ensure quality control.

Masonry: Mortar, Materials, and Installation

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Masonry: Mortar, Materials, and Installation provides instruction regarding mortar work and basic laying of concrete units and brick. Topics include mortar ingredients and types, mixing and disposing of mortar, drawings and codes, concrete and brick cutting, and concrete and brick laying.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

MASONRY: MORTAR, MATERIALS, AND INSTALLATION CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Masonry Fundamentals	1. Research and report on residential and commercial masonry materials and techniques. 2. Summarize the history of the masonry industry. 3. Explain the importance of the masonry industry to the local, state, and national economy. 4. Describe modern masonry and materials.
Tools and Equipment	5. Identify hand and measurement tools, mortar equipment, and power tools and equipment used in masonry, describing the appropriate use of each. 6. Describe how lifting equipment and scaffolding are used in masonry.
Drawings and Codes	7. Identify masonry components on construction drawings. 8. Research and report on building industry specifications, standards, and codes that pertain to masonry, including spacing rules for bricks and concrete masonry modular rules. a. Read a six-foot rule and a mason's rule.

Mortar	9. Identify and describe the types of mortar and their ingredients. *Examples: water, aggregates, portland cement, pre-blended mortars* 10. Describe the properties of plastic and hardened mortar. 11. Identify and solve common problems with mortar application. *Examples: water penetration, disintegration, cracking, blistering, warping* 12. Set up masonry materials and mortar mixing area. a. Mix mortar, set up maintenance of mortar, and dispose of mortar. *Examples: Combine mortar components consisting of 1 part cementitious material to 2 ¼ - 3 ½ parts sand by volume.*
Concrete and Brick Installation	13. Outline procedures and precautions for installing concrete masonry units. 14. Lay brick and block to a marked vertical line. a. Create and mark a true vertical line, using a plumb bob or laser level. b. Maintain proper spacing of head and bed joints when laying brick and block. 15. Cut brick with a hammer, a brick set, and a trowel. 16. Demonstrate how to handle masonry materials to prevent damage. 17. Demonstrate how to install masonry reinforcement and accessories. *Examples: Build wall structure with rebar and rebar positioners.*

Masonry: Residential

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Masonry Laying Techniques

Masonry: Residential focuses on interpreting drawings, estimating materials and costs, mixing and placing grout, reinforcing masonry, and installing masonry openings.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students to develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

MASONRY: RESIDENTIAL CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Residential Masonry Fundamentals	1. Interpret a set of masonry drawings and list the information found on each type of drawing. 2. Estimate material quantities and costs from masonry drawings. 3. Explain the methods for construction of various types of foundations, including spread, raft, and mat foundations. 4. Identify and explain the characteristics, uses, and installation techniques for clay brick and concrete pavers. 5. Lay out and build steps, patios, and decks made from masonry units. 6. Demonstrate how to lay out and build fireplaces and chimneys.
Masonry Reinforcements	7. Name and describe the primary ingredients in grout. a. Demonstrate and explain how grout is prepared. 8. Demonstrate how grout is placed, including low-lift grouting, high-lift grouting, mortaring of joints, and use of mechanical vibrators. 9. Describe how to construct reinforced walls and masonry elements. *Examples: using rebar, bond beams, lintels, piers, pilasters, columns*

Masonry Openings

10. Describe the methods and materials used to install masonry openings.
11. Demonstrate the methods and materials used to tie a single masonry wythe together.
12. Demonstrate the methods and materials used to tie two masonry wythes together.
13. Demonstrate the process of tying masonry wythes to structural elements.
14. Explain the methods and materials used to install masonry wythes using rigid ties and bolts, bearing plates, saddles, and strap ties.

Motor Controls

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Motor Controls introduces students to the calculations and procedures used with conductors and protection devices. A basic understanding of motor operation, components, and circuitry is essential for these tasks. This course provides information on selecting, sizing, and installing motor controllers, as well as control circuit pilot devices and basic relay logic.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

MOTOR CONTROLS
CONTENT STANDARDS

Motor Theory and Applications

1. List characteristics of DC motors and describe how they operate.
2. List characteristics of AC motors and describe how they operate, including single-phase and three-phase induction motors.
3. Differentiate among various adjustable speed loads and braking methods.
4. Categorize types of motor enclosures according to National Electrical Manufacturers Association (NEMA) designations and describe the environment where each type should be used.
   Examples: NEMA 3R, NEMA 4X
   a. Collect information from motor nameplates to determine voltage and current requirements.
5. Summarize National Electrical Code (NEC) installation and motor protection requirements for electrically controlled motors.

Motor Calculations

6. Calculate synchronous speed for various frequencies.
7. Calculate conductor ampacities for a motor control center.
8. Differentiate between overcurrent and overload.

	9. Size equipment grounding conductors to protect motors, starters, and related equipment. *Examples: fuses, grounding connectors, breakers* 10. Install capacitors for power factor correction. *Examples: soft motor starts, stable run speeds, power fluctuation*
Motor Controls	11. Identify electromechanical relays and magnetic contactors and explain their functions. 12. Select magnetic contactors and motor starters for given scenarios according to specifications in NEMA and International Electrotechnical Commission (IEC) codes. 13. Locate control transformers, switches, sensors, and pilot lights, and explain their functions in a motor. 14. Select motor enclosures and installation diagrams for given scenarios and justify the choices. 15. Connect motor controllers for given scenarios. *Example: Make all connections for a magnetic motor controller, pushbutton stations, and computer control.*
Motor Operation and Maintenance	16. Describe the common causes and characteristics of motor failure. 17. Summarize basic maintenance requirements for electric motors, indicating what tools are used for each task. 18. Perform motor insulation testing. 19. Align and adjust electric motors and output shafts. 20. Explain and demonstrate motor startup procedures.

Plumbing and Pipefitting

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Plumbing Systems

Plumbing and Pipefitting provides instruction regarding installation of pipe, drains, fixtures, and fittings using cast iron, copper, and stainless steel pipes. Emphasis is placed on installing and testing water supply and drain lines, supporting pipes, and using fire-resistant materials in plumbing systems.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

PLUMBING AND PIPEFITTING CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Copper Tube and Fittings

1. Identify the types, uses, and properties of copper tubing and fittings.
   Examples: soft and hard type L, K, M, and DMV (used strictly above ground)
2. Use copper tubing cutters of various sizes.
   Examples: half-inch, three-quarter inch, one-inch
   a. Use copper tubing deburring tools and explain why deburring is necessary.
   b. Use a bending spring to bend copper tubing.
3. Describe the methods used to install and test copper tubing.
   Examples: sweating copper (soldering), liquid pressure test

Cast Iron Pipe and Fittings

4. Describe the types, uses, and properties of cast iron pipe.
5. Measure, cut, and join cast iron pipes.
6. Describe methods used to install and test cast iron pipe.
   Examples: hub and spigot, no hub

Steel Pipe and Fittings	7. Describe the types, uses, and properties of steel pipe. *Examples: black steel pipe (gas and compressed air), galvanized pipe (venting applications)* 8. Describe methods for measuring, cutting, and joining steel pipe. 9. Describe methods used to install and test steel pipe. *Examples: threaded, welded, air or fluid under pressure* 10. Explain the properties and uses of corrugated stainless steel tubing (CSST).
Support Systems	11. Describe methods of supporting various types of pipes in horizontal and vertical positions. 12. Demonstrate installation of pipe hangers.
Installation and Testing	13. Install and test water supply and drain lines in actual or simulated environments. 14. Install and test fixtures and valves for actual or simulated trim-out. *Examples: toilets, urinals, faucets, sinks* 15. Install and test appliances in actual or simulated environments. *Examples: dishwasher, garbage disposal, refrigerator ice maker, washing machine*
Drain, Waste, and Vent (DWV) Systems	16. Install cast iron T's, elbows, plugs, and traps for a drain, waste, and vent system. a. Select traps best suited for installation in given scenarios.
Fire-Stopping Materials	17. Research and report on the availability and use of fire-resistant materials in plumbing and drain systems. *Examples: chlorinated polyvinyl chloride (CPVC) pipe, fire-resistant insulation*

Plumbing Systems

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Plumbing Systems provides instruction regarding plumbing materials, tools, supplies, equipment, and methods of installation for plastic pipes. Topics include safety, calculations, drawings, fixtures; drainage, waste, and vent systems; and water distribution systems. This course aims to enable students to join various pipes and fittings; make plumbing repairs; test drain, waste, and vent (DWV) piping; and install plumbing fixtures.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

PLUMBING SYSTEMS
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

History	1. Research and report on the history of the plumbing profession.
Plumbing Safety	2. Describe the impacts of on-the-job accidents on plumbers, clients, and construction schedules. *Example: Determine the cost of missing a day of work due to an accident.* 3. Identify causes of accidents and methods for preventing them in various work areas, including trenches and confined spaces. 4. Demonstrate how to turn off a water supply at the main disconnect and at fixtures.
Plumbing Calculations	5. Explain and demonstrate methods for measuring pipe and indicate when each method would be used. *Examples: end-to-end, end-to-center, center-to-center, end-to-face, face-to-face* 6. Calculate pipe lengths needed for given plumbing projects.

Plumbing Drawings	7. Read and interpret plumbing construction drawings and indicate the purpose of each type. a. Explain the meaning of symbols used on plumbing schematic drawings.
Plumbing Fixtures	8. Identify and describe various plumbing fixtures, including advantages and disadvantages of each type of material used in their construction. *Examples: sinks, faucets, tubs* 9. Describe the types of faucets used in plumbing systems and indicate the advantages and disadvantages of each type. *Examples: ball, cartridge, disc, compression*
Plastic Pipes and Fittings	10. Identify the types, uses, and properties of plastic pipes and fittings. 11. Demonstrate methods for cutting plastic pipes. 12. Demonstrate methods for joining plastic pipes using cleaner, primer, and solvent cement. 13. Describe methods used to support and test plastic pipes.
Drain, Waste, and Vent (DWV) Systems	14. Identify the major components of a drain waste, and vent system and describe their functions. 15. Describe the construction of PVC, iron, and galvanized drain, waste, and vent systems according to plumbing codes. 16. Explain the types, purposes, and construction of traps. *Examples: P trap, S trap, running, vented* 17. Install plastic T's, elbows, and plugs, and traps for a drain, waste, and vent system.

Water Distribution Systems

18. Describe the process by which water is distributed in municipal, residential, and private water systems.

19. Describe the major components of a water distribution system, their functions, and the relationship among them in municipal, residential, and private water systems.
    Examples: source, treatment, storage

20. Gather and share information on sources of water for municipal use, including well-researched predictions regarding future water allocations and possible shortages.
    Examples: lakes, rivers, wells

21. Explain common processes for treating water.

22. Investigate and report on water conservation methods, including reuse of household graywater.

Technical Design Communications I

Course Credit	1.0
Grade Levels	9-12
Prerequisites	

Technical Design Communications I presents a variety of fundamental skills utilized in entry-level computer-aided design (CAD) positions. Students use CAD technology and technical drawing fundamentals to produce various designs, working drawings, charts, forms, and records. This class emphasizes creativity, visualization, critical thinking, and problem-solving. Topics include blueprints, sketching, measurement, basic two-dimensional drawing skills and sheet layout, CAD skills, annotation and dimensioning, and plotting.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

TECHNICAL DESIGN COMMUNICATIONS I
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Blueprints	1. Explain types of drawings required for various kinds of architectural and engineering projects. *Examples: residential, commercial interior design, electrical, electronic, piping, structural, welding mechanical, manufacturing, machining, additive manufacturing, tool design injection CAD/CAM*
Sketching	2. Demonstrate technical sketching techniques. *Examples: the proper technique to hold pencils, aids for drawing lines and geometric shapes*
Communication Skills	3. Set up and utilize an engineering notebook or architectural journal to document and communicate ideas, designs, and projects.
Measurement	4. Use trade-related tools to take and record measurements. *Examples: architectural, engineering, and metric scales; calipers, electronic and manual tape measures*

Basic Two-Dimensional Drawing Skills and Sheet Layout	5. Lay out a drawing sheet that includes a border, standard notes, required symbols, and a title block with necessary information, including material, project name, sheet size, and name of drafter. a. Identify standard symbols used in architectural and engineering plans. b. Determine sheet sizes for layout and printing based on the scale chosen. *Example: Select the proper view needed to represent the part and indicate where the part should be placed on the sheet, along with sheet size and scale.* c. Interpret lines on a technical drawing according to the alphabet of lines and explain line precedence order.
CAD Skills	6. Utilize CAD software to generate and save a multi-view drawing, using file management techniques and CAD and editing commands. a. Construct basic, two-dimensional, multi-view drawings, using orthographic projection and layout techniques to set up required views. b. Explain the difference between first angle projection and third angle projection and apply the correct projection symbol to the title block. 7. Create various section views, utilize cutting planes, and apply section hatches and labels in multi-view drawings. 8. Lay out auxiliary view(s) within a multi-view drawing.
Annotation and Dimensioning	9. Apply dimensioning and tolerating standards to a two-dimensional drawing following the American Institute of Architects (AIA) and American Society of Mechanical Engineers (ASME) standards. a. Apply standard annotations to drawings using AIA and ASME standards.
Plotting	10. Plot (print) construction documents to proper scale, including single-view and multi-view drawings, in hardcopy and in PDF format.

Technical Design Communications II

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Technical Design Communications I

Technical Design Communications II emphasizes detailed parts drawings, bills of materials, and assembly drawings. Students are introduced to basic geometric dimensioning and tolerancing (GD&T) applications. Through intersections and development, students acquire knowledge of basic flat pattern development and creation. Students lay out and form models of geometric figures.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

TECHNICAL DESIGN COMMUNICATIONS II CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Three-Dimensional Solid Model Design	1. Create a three-dimensional model of a mechanical part, utilizing three-dimensional application software. a. Use computer-aided design (CAD) software to produce a two-dimensional drawing showing top, front, and right side of a mechanical part, using a three-dimensional model of the part as reference.
Flat Pattern Development	2. Create three-dimensional geometric objects utilizing two-dimensional flat pattern surface development. *Examples: sheet metal, patterns* a. Plan or sketch a layout of geometric figures and print the resulting patterns. b. Cut geometric patterns. c. Form, fold, and construct shapes from geometric patterns to create a full, three-dimensional paper model.
Fasteners and Springs	3. Use three-dimensional CAD software to insert vendor or pre-created fasteners, threads, springs, and standard connections into a three-dimensional model.
Geometric Tolerancing	4. Produce an advanced drafting design project, utilizing three-dimensional CAD software, applying basic geometric dimensioning and tolerance (GD&T) concepts, and referencing American National Standards Institute (ANSI) dimensioning standards.

Working Drawings	5. Create a complete set of working drawings using three-dimensional modeling software, including all dimensions, notes, and specifications. a. Create assembly drawings including callouts and bill of materials (BOM). b. Create a revision block and note revisions in the block and on the part.
Life Cycle and Stress Analysis	6. Outline the stages of a product's life cycle using a three-dimensional modeling program. a. Gather, evaluate, and share information regarding the sustainability and environmental impacts of a given product, including its manufacture, use, and disposal. 7. Perform a basic stress analysis of a simple part, using three-dimensional software.
Prototype Development	8. Produce a prototype of a simple three-dimensional design part. a. Use prototypes to check a part's form, fit, and function and use results to redesign the part as needed.
Design Development and Presentation	9. Develop and present a design project using the engineering design process including models, assemblies, a written report, and a set of drawings produced by three-dimensional software. a. Prepare and deliver a presentation of a design project in a manner suitable for a professional audience.

Utility Line Worker

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Architecture and Construction Foundations

Utility Line Worker is designed to provide students with fundamental, entry-level knowledge and skills for utility line work. The course emphasizes safety while addressing basic basic electrical circuits and theory, tools of the trade, and climbing wooden poles. This course aims to prepare students to attempt industry-recognized exams.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces.
	2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork.
	3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.
	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
	5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

UTILITY LINE WORKER
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Electrical Circuits	1. Contrast the functions of conductors and insulators. 2. Describe the characteristics of voltage and describe ways in which voltage can be produced. 3. Measure the properties of electricity using industry-standard units of measurement. 4. Compare and contrast the basic characteristics of series and parallel circuits. 5. Use meters to measure voltage, current, and resistance. 6. Identify specialized test instruments used by power line workers.
Electrical Theory	7. Contrast the basic characteristics of series, parallel, and combination (series-parallel) circuits. 8. Using Ohm's law, find the unknown values in series, parallel, and combination (series-parallel) circuits. 9. Explain the purpose of bonding and grounding.
Climbing Wooden Poles	10. Describe the proper use of required and recommended equipment for climbing wooden poles, and assess the condition of equipment prior to climbing. 11. Identify the hazards associated with climbing wooden poles. 12. Inspect a wooden pole for defects prior to climbing. 13. Identify and demonstrate proper climbing ascent, descent, and lateral positioning techniques for climbing wooden poles.

	14. Safely climb over obstructions. 15. Demonstrate the ability to work at heights above 32 feet. 16. Demonstrate the procedures for pole-top rescue with and without the presence of a cross arm.
Tools of the Trade	17. Identify and explain the use of line workers' ladders. 18. Identify and explain the use of line workers' specialty tools, including insulated hand tools. 19. Use line workers' basic tools specified by the instructor.

Utility Line Workers Service Equipment

Course Credit	1.0
Grade Levels	11-12
Prerequisites	Utility Line Worker

Utility Line Workers Service Equipment builds on the Utility Line Worker course to present further knowledge and skills for entry-level utility line work. The course emphasizes safety while addressing utility service equipment, rigging, and setting and pulling poles. This course aims to prepare students to attempt industry-recognized exams.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

UTILITY LINE WORKERS SERVICE EQUIPMENT CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Utility Service Equipment

1. Identify the types of bucket trucks and digger derricks used by power line workers.
2. Summarize the operator safety requirements that must be followed when operating a bucket truck or digger derrick.
3. Explain how to perform a pre-start inspection on a service vehicle.
4. Outline the procedures for setting up a service vehicle at a job site, including safety considerations.
5. Describe the safety considerations and basic operating procedures for using a bucket truck and a digger derrick at a job site.
6. Describe ways that a crew can prepare for and react to an emergency involving a bucket truck or digger derrick.
7. Inspect, set up, and operate utility service equipment.
   Examples: bucket truck, digger derrick, crane truck, aerial lift

Rigging	8. Describe and demonstrate hand signals and other communication methods used in rigging work. 9. Describe hazards and safety practices associated with rigging work. 10. Outline safety procedures associated with the use of cranes in rigging work. 11. Explain how cranes are used to lift and move loads. 12. Tie knots used in rigging. *Examples: square, figure 8, clove hitch, double half hitch, bowline, bowline on a bight, timber hitch, sheetbend, running bowline back splice, sheepshanken* 13. Reeve a set of blocks.
Setting and Pulling Poles	14. Explain and demonstrate how to load and unload wooden poles in preparation for installation. 15. Demonstrate hand signals used when setting a pole and explain their meaning and importance. 16. Explain and demonstrate how to set a wooden utility pole using a digger derrick. 17. Explain and demonstrate how to set a wooden utility pole by hand. 18. Explain and demonstrate how to pull a wood utility pole from the ground.

Welding: GMAW and FCAW

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Welding: GMAW and FCAW introduces metal arc and flux-cored arc welding processes. Emphasis is placed on safe operating practices, handling, and storage of compressed gasses. Process principles, component identification, various welding techniques, and base and filler metal identification are introduced. This course aims to prepare students to perform GMAW and FCAW welds in various positions.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

WELDING: GMAW AND FCAW
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Welding Drawings and Symbols

1. Identify and interpret welding symbols and their placement on blueprints.
2. Describe welding detailed drawings and identify basic drawing elements and features.
    a. Interpret the object views used to depict welding details.
        Examples: plan, elevation, section views
3. Identify and explain how to interpret dimensional information, notes, and a bill of materials in welding detail drawings.

Characteristics and Properties of Metals

4. Describe the composition and classification systems for a variety of ferrous and non-ferrous metals, including low-alloy steel, common-grade steel, and specialty-grade steel.
    a. Describe the physical and mechanical characteristics of metals and how they impact welding methods and procedures.
    b. Explain how to identify base metals in field conditions.
5. Identify the common structural shapes of metal, including structural steel and beam shapes, pipe and tubing types, and rebar.

Heating Metals	6. Identify and describe methods used to preheat metal for welding and the devices and products used to measure temperature of materials during welding. a. Explain interpass temperature control and post heating processes.
Plate Welding	7. Produce basic GMAW and FCAW weld beads. 8. Describe equipment control and welding procedures for GMAW and FCAW. 9. Demonstrate the welding procedures needed to produce fillet welds using FCAW welding techniques.

Welding: SMAW I

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Welding: SMAW I is designed to provide a fundamental understanding of welding safety and basic shielded metal arc welding (SMAW) equipment and procedures. Standards are designed to equip students with knowledge and skills for setting up equipment, preparing surfaces, and performing safe oxy-fuel cutting and welding.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

WELDING: SMAW I
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Oxy-fuel Cutting

1. Set up, leak-test, light, adjust, and shut down oxy-fuel equipment.
2. Distinguish between acceptable and unacceptable cuts, describing conditions and procedures that might have contributed to the quality of the cuts.
    a. Demonstrate techniques for making bevel, gouge, piercing, slot, wash, straight, and square cuts with oxy-fuel cutting machines.

Base Metal Prep

3. Clean and prepare base metals for welding.
    a. Describe the basic types and properties of carbon steel, and explain how these characteristics determine procedures for preparing metals for welding.
        Examples: mild steel, ultra high carbon steel
4. Prepare joints for welding both mechanically and thermally.

Weld Quality

5. Identify and describe basic weld joint designs and types, indicating characteristics of high-quality welds.
    a. Outline the types of information included in a welding procedure specification (WPS).
6. Identify and describe weld defects and their causes, including those related to porosity, inclusions, joint penetration, fusion, and undercutting.
    a. Identify and describe discontinuities that result in cracking.
    b. Distinguish between acceptable and unacceptable weld profiles.

SMAW Equipment and Set-up	7. Explain how voltage, amperage, and polarity apply to SMAW. 8. Identify components of SMAW equipment including cables and connectors and describe their functions. 9. Set up, operate, and maintain SMAW equipment.
SMAW Electrodes	10. Explain the classification system for SMAW electrodes and the meaning of electrode symbols. a. Explain the American Welding Society's filler metal specification system. b. Describe the characteristics of the four main electrode groups (iron powder, rutile, cellulose, and low-hydrogen). 11. Select electrodes for various situations and describe their proper storage, care, and handling. a. Strike an arc and respond to arc blow.
SMAW Beads and Fillet Welds	12. Explain how to complete various types of beads and fillet welds when welding in flat, horizontal, vertical, and overhead positions. a. Demonstrate how to start, terminate, and restart a weld pass. b. Demonstrate the proper technique required to produce stringer beads and weave beads.

Welding: SMAW II

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Welding: SMAW I

Welding: SMAW II presents information and skills needed to weld pipes and plates of various kinds. Topics include SMAW open-root pipe welds, plate welding, and stainless steel and carbon steel welding. The course also incorporates information about gas tungsten arc (tungsten inert gas) welding.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

	4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway. 5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

WELDING: SMAW II
CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

SMAW Open-Root Pipe Welds	1. Explain the basic concepts of open-root shielded metal arc welding (SMAW) of pipe. a. Prepare the area, materials, and equipment for shielded metal arc welding. 2. Produce SMAW weld profiles in all open-root pipe welding positions.
SMAW Plate Welds	3. State the basic concepts of open-root shielded metal arc welding (SMAW) of plate. 4. Prepare the area, base metal, equipment, and materials for SMAW of plate with backing strip and open groove. 5. Demonstrate open-root V-groove plate welding positions and SMAW plate-welding techniques. a. Complete root and fill passes using SMAW techniques.
SMAW – Carbon Steel Pipe	6. Describe the basic concepts of open-root SMAW of carbon-steel pipe. a. Prepare the area, materials, and equipment for SMAW carbon-steel pipe welding.

GTAW Welds for Low Alloy and Stainless Steel Pipe	7. Describe how to prepare the area, materials, and equipment for low alloy and stainless steel pipe welding using the gas tungsten arc welding process. 8. Describe open-root V-groove pipe welding positions and GTAW pipe-welding techniques. a. Describe the techniques used to apply GTAW to low alloy and stainless steel pipe. b. Explain how to make the root pass with a gas backing. c. Describe the techniques required to produce open-root GTAW low alloy and stainless steel pipe welds in various positions.
SMAW Welds for Stainless Steel Plate and Pipe Grooves	9. Describe special considerations for shielded metal arc welding (SMAW) of various types of stainless steel and identify electrodes to be used for each type. a. Explain principles of stainless steel metallurgy. b. Describe methods for controlling carbide precipitation. c. Describe the selection and storage of stainless steel electrodes. 10. State the basic concepts of SMAW of stainless steel. a. Explain how to prepare the area, materials, and equipment for SMAW of stainless steel. 11. Describe open-root V-groove plate and pipe welding positions and SMAW stainless steel welding techniques. a. State general considerations for handling electrodes for SMAW of stainless steel. b. Describe how to make the root pass. c. Describe the techniques required to produce open-root V-groove SMAW stainless steel plate welds in 1G, 2G, 3G, and 4G positions. d. Describe the techniques required to produce open-root V-groove SMAW stainless steel pipe welds in 1G-ROTATED, 2G, 5G, and 6G positions.

Wood Technology: Two-Dimensional Design

Course Credit	1.0
Grade Levels	9-12
Prerequisites	Architecture and Construction Foundations

Wood Technology: Two-Dimensional Design is designed to develop skills and knowledge of wood technology manufacturing processes and the use of Computerized Numerical Control (CNC) equipment. Topics include computer skills, CNC routing programming characteristics, CNC programming, and design and production of a two-dimensional product.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing.

4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.
5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

WOOD TECHNOLOGY: TWO-DIMENSIONAL DESIGN CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

Computer Skills

1. Utilize CAD/CAM software to create specified two-dimensional designs and toolpaths.
   Examples: sign, cabinet component
2. Differentiate among the applications of various methods of programming.
   Examples: Rhino, MasterCam, Vetrics, G code, M code
   a. Demonstrate methods for storage and retrieval of program information.

CNC Routing Programming Characteristics

3. Demonstrate the procedure to start a CNC routing program, using various controller functions to set parameters.
4. Demonstrate the process involved in setting part zero, using X, Y, and Z axes.
5. Calculate the correct speeds and feeds for a given CNC routing operation, using speed and feed formulas.
6. Explain the use of directional vectors in a CNC routing operation.
   a. Use vectors to create a design for a CNC router.

CNC Programming	7. Replicate design vectors and dimensions from selected prints into a simple CNC routing program. 8. Use scale factors or proportional reasoning to calculate and program dimensions in a simple CNC routing program. 9. Select and justify the appropriate tooling/cutting tools for a given CNC routing program. *Example: Choose bits to create a V-carve or engraved design on a tabletop.* 10. Select and justify the appropriate work-holding devices for a given CNC routing operation. 11. Describe the necessary setup documentation for a given CNC routing operation and explain how to create it.
Design and Production	12. Create an original two-dimensional design for prototyping or production. *Examples: sign, cabinet, flat pack furniture* 13. Select materials, work-holding devices, and tooling needed for production of an original two-dimensional design. 14. Create toolpaths and run a simulation for an original two-dimensional design, and troubleshoot as needed. 15. Document CNC routing operation, including part zero, offsets, feeds and speeds, and tooling, for a two-dimensional design. a. Research and report on documentation needed for copyright. 16. Produce an original two-dimensional product and prepare a written evaluation of the project. a. Describe any challenges encountered in the design or production phases of the two-dimensional project and the steps taken to reach decisions or resolve issues.

Wood Technology: Three-Dimensional Design

Course Credit	1.0
Grade Levels	10-12
Prerequisites	Wood Technology: Two-Dimensional Design

Wood Technology: Three-Dimensional Design is designed to develop skills and knowledge of three-dimensional wood technology manufacturing processes and Computerized Numerical Control (CNC) equipment. Topics include CNC mathematics and programming language, utilizing CAD-CAM software, advanced technology, and designing and manufacturing a three-dimensional product.

Career and Technical Student Organizations are integral, co-curricular components of each career and technical education course. These organizations enhance classroom instruction while helping students develop leadership abilities, expand workplace-readiness skills, and access opportunities for personal and professional growth. Students in the Architecture and Construction career cluster affiliate with SkillsUSA.

Foundational standards, shown in the table below, are an important part of every course. Through these standards, students learn and apply safety concepts, explore career opportunities and requirements, practice the skills needed to succeed in the workplace, develop leadership qualities and take advantage of the opportunities afforded by Career and Technical Student Organizations (CTSOs), and learn and practice essential digital literacy skills. The foundational standards are to be incorporated throughout the course.

Each foundational standard completes the stem *"**Students will**..."*

Foundational Standards	
	1. Incorporate safety procedures in handling, operating, and maintaining tools and machinery; handling materials; utilizing personal protective equipment; maintaining a safe work area; and handling hazardous materials and forces. 2. Demonstrate effective workplace and employability skills, including communication, awareness of diversity, positive work ethic, problem-solving, time management, and teamwork. 3. Explore the range of careers available in the field and investigate their educational requirements, and demonstrate job-seeking skills including resume-writing and interviewing. 4. Advocate and practice safe, legal, responsible, and ethical use of information and technology tools specific to the industry pathway.

	5. Participate in a Career and Technical Student Organization (CTSO) to increase knowledge and skills and to enhance leadership and teamwork.

WOOD TECHNOLOGY: THREE-DIMENSIONAL DESIGN CONTENT STANDARDS

Each content standard completes the stem *"**Students will**..."*

CNC Math	1. Utilize trigonometry and geometry to solve design and product issues and enter information in computer-aided design (CAD) in both two- and three-dimensional spaces. a. Describe how the three-dimensional Cartesian coordinate system is used to produce graphs, using technical vocabulary. b. Use the three-dimensional Cartesian coordinate system to calculate and draw vectors.
CNC Programming Language	2. Describe a CNC program and explain the sequence of operations in a typical CNC program. a. List the most commonly used G codes and M codes, and describe what they do. b. Write code for computer numerical control (CNC) programs to make simple cuts, using proper syntax.
Advanced Technology	3. Compare and contrast Subtractive Rapid Prototyping (SRP) and Rapid Prototyping (RP). a. Compare and contrast prototyping and production machining. 4. Design and manufacture two-dimensional and three-dimensional milling and rotary prototypes and finished products, utilizing CNC procedures and CAD-CAM software. a. Calculate speed and feed rates for specified milling and rotary operations. b. Set machine, fixture, and tool length offsets for a given scenario. 5. Create, maintain, and save files within a CAD-CAM program.

	6. Select tooling, set up a CNC router, lathe, or turner, load and verify a program, and run a part. 7. Create and manage a three-dimensional numeric control operation tool path for a router, lathe, or turner to create a part that meets customer specifications.
Design and Production (Capstone Project)	8. Create an original three-dimensional or rotary design for prototyping or production. *Examples: sculpture, three-dimensional sign, bowl, furniture part* 9. Select materials, work-holding devices, and tooling needed for production of an original three-dimensional design. 10. Create toolpaths, run a simulation for an original three-dimensional design, and troubleshoot as needed. 11. Document CNC routing operation, including part zero, offsets, feeds and speeds, and tooling, for an original three-dimensional design. 12. Produce an original three-dimensional product and prepare a written evaluation of the project. 13. Describe any challenges encountered in designing or producing a finished three-dimensional product and the steps taken to reach decisions or resolve issues.

BIBLIOGRAPHY

Alabama Course of Study: Career and Technical Education. Alabama State Department of Education, 2008.

"Architecture and Construction." Florida Department of Education, www.fldoe.org/academics/career-adult-edu/career-tech-edu/curriculum-frameworks/2020-21-frameworks/ architecture-construction.stml.

"Architecture and Construction Course Standards." South Carolina Department of Education, www.ed.sc.gov/instruction/career-and-technical-education/programs-and-courses/career-clusters/architecture-and-construction. Accessed 30 Jan. 2021.

Cabinetmaking Trainee Guide. National Center for Construction Education and Research (NCCER), 2016, www.nccer.org/docs/default-source/Course-Planning-Tools/cabinetmaking_3e_courseplanningtools.pdf?sfvrsn=799d0d4f_0.

Carpentry: Level 1 Trainee Guide. National Center for Construction Education and Research (NCCER), 2013, www.nccer.org/docs/default-source/Course-Planning-Tools/carpentry_l1_2013_cep.pdf?sfvrsn=f438324f_2.

Carpentry: Level 2 Trainee Guide. National Center for Construction Education and Research (NCCER), 2013, www.nccer.org/docs/default-source/Course-Planning-Tools/carpentry_l2_ceps.pdf?sfvrsn=f938324f_2.

Carpentry: Level 3 Trainee Guide. National Center for Construction Education and Research (NCCER), 2013, www.nccer.org/docs/default-source/Course-Planning,-Tools/carpentry_l3_ceps.pdf?sfvrsn=9239324f_2.

Carpentry: Level 4 Trainee Guide. National Center for Construction Education and Research (NCCER), 2013,

"Competencies/Objectives List, HVAC Level 1." National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/course-planning-tools/hvac_ceps_4th-ed.pdf?sfvrsn=ecea1f4f_4.

Core Curriculum: Introductory Craft Skills: Trainee Guide. National Center for Construction Education and Research (NCCER), 2015, www.nccer.org/docs/default-source/course-planning-tools/core_5e_courseplanning.pdf?sfvrsn=403e0d4f_6.

"Craft Details." National Center for Construction Education and Research (NCCER), 2013, www.nccer.org/workforce-development-programs/disciplines/craft-details/masonry.

"CTE Program Resources." Florida Department of Education, 2021, www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml.

Electrical Level 1. National Center for Construction Education and Research (NCCER), 2020, www.nccer.org/docs/default-source/course-planning-tools/cel_electrical_l1.pdf?sfvrsn=da5d174f_4.

Electrical Level 2. National Center for Construction Education and Research (NCCER), 2020, www.nccer.org/docs/default-source/course-planning-tools/electrical10e_l2_cel.pdf?sfvrsn=875c174f_4.

Electrical Level 3. National Center for Construction Education and Research (NCCER), 2020, www.nccer.org/docs/default-source/course-planning-tools/electrical10e_l3_cel.pdf?sfvrsn=855c174f_4.

Electrical Level 4. National Center for Construction Education and Research (NCCER), 2020, www.nccer.org/docs/default-source/course-planning-tools/electrical10e_lv4_cel.pdf?sfvrsn=845c174f_4.

"Everything You Need to Know About Plumbing Traps." The Plumbing Info Team, 2021. theplumbinginfo.com/plumbing-traps/ Accessed 4 Aug. 2021.

"The Four Most Common Types of Faucets." Lange Plumbing and Fire Protection, 2020, www.langeplumbing.com/ask-bernie/2020/november/the-four-common-types-of-faucets/ Accessed 4 Aug. 2021.

Power Line Worker: Level 1 Trainee Guide. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/Course-Planning-Tools/powerline-worker-ceps.pdf?sfvrsn=1150e4f_0.

Plumbing: Level 1. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/course-planning-tools/plumbing_cel.pdf?sfvrsn=d595164f_6.

Site Layout: Level 1 Trainee Guide. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/Course-Planning-Tools/c-site-layout.pdf?sfvrsn=810c0e4f_0.

HVAC: Level 1-Level 4 Trainee Guide. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/course-planning-tools/hvac_ceps_4th-ed.pdf?sfvrsn=ecea1f4f_4.

Masonry: Level 1 Trainee Guide. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/Course-Planning-Tools/masonry_4e_l1_ceps.pdf?sfvrsn=86700e4f_0.

Masonry: Level 2 Trainee Guide. National Center for Construction Education and Research (NCCER), www.nccer.org/docs/default-source/Course-Planning-Tools/masonry_4e_l2_ceps.pdf?sfvrsn=95700e4f_0.