



INDUSTRIAL AND ENGINEERING SYSTEMS

Statewide Program of Study Framework: Architecture and Construction Career Cluster

Knowledge and Skill Statements/Suggested Performance Indicators

Employability

Career Cluster

Focus Areas

Architectural Design

Carpentry

Electrical

Heating, Ventilation, and
Air Conditioning

Masonry

Plumbing

Overview

The Industrial and Engineering Systems career learning area is comprised of five Career Clusters, which include: (1) Architecture and Construction, (2) Automotive and Heavy Equipment, (3) Engineering Technology, (4) Manufacturing, and (5) Transportation, Distribution and Logistics. This document details the Knowledge and Skill Statements comprising the Program of Study for the Architecture and Construction Career Cluster.

The Statewide Program of Study Framework addresses six Focus Areas: (1) Architectural Design, (2) Carpentry, (3) Electrical, (4) Heating, Ventilation, and Air Conditioning, (5) Masonry, and (6) Plumbing.

When reading the document, note that:

- **A Program of Study spans secondary and postsecondary education**, meaning that students are expected to master the identified skills upon completion of their programming. It is not expected that all Knowledge and Skill Statements will be taught at the high school level.
- **Knowledge and skill statements** (indicated in bold) identify the career readiness expectations that employers seek in entry-level workers.
- **Suggested performance indicators** illustrate how students might demonstrate their understanding of each knowledge and skill statement. They are offered as examples and are not required to be taught.

Secondary and postsecondary educators will collaborate to select the number, type, specificity, and educational level at which performance indicators will be taught.

For more detailed information, see the Architecture and Construction Resource Guide contained in this Google Drive.

Architecture and Construction Knowledge and Skill Statements

Employability Knowledge and Skill Statements

Applicable to all Career Clusters in the Statewide Program of Study Framework.

E-01	Adhere to workplace practices
E-02	Exhibit personal responsibility and accountability
E-03	Practice cultural competence
E-04	Demonstrate teamwork and conflict resolution
E-05	Communicate clearly and effectively
E-06	Employ critical thinking to solve problems
E-07	Demonstrate creativity and innovative thinking
E-08	Demonstrate fluency in workplace technologies
E-09	Plan, organize, and manage work
E-10	Make informed career decisions

Cluster Level Knowledge and Skill Statements

Applicable to all Programs of Study in the Architecture and Construction Statewide Program of Study Framework.

CC-AC01	Describe the roles and responsibilities of the different disciplines that collaborate to design and build residential and commercial properties
CC-AC02	Demonstrate an understanding of and adherence to safe working practices
CC-AC03	Demonstrate the safe use of tools
CC-AC04	Demonstrate knowledge about building materials used in the construction industry
CC-AC05	Describe the existence and purpose of governmental regulations and applicable building codes, laws, and rules
CC-AC06	Demonstrate pre-task planning to ensure a safe and efficient jobsite
CC-AC07	Demonstrate basic measuring practice
CC-AC08	Demonstrate an understanding of basic mathematics as used in the industry

Focus Area Level Knowledge and Skills

Knowledge and Skill Statements for the updated Statewide Program of Study Framework in (1) *Architectural Design*, (2) *Carpentry*, (3) *Electrical*, (4) *Heating, Ventilation, and Air Conditioning*, (5) *Masonry*, and (6) *Plumbing*.

Architectural Design

FA-ACAD01	Demonstrate an understanding of architectural history and culture
FA-ACAD02	Explain the role of the architect during the construction phase
FA-ACAD03	Explain the concepts that form the technical knowledge of architectural design
FA-ACAD04	Develops design solutions applying recognized industry principles
FA-ACAD05	Use computer-aided design (CAD) software to produce architectural drawings
FA-ACAD06	Use hand tools to produce architectural drawing
FA-ACAD07	Use a variety of architectural design media
FA-ACAD08	Know the concept of sustainability and its application in architectural design

Carpentry

FA-ACCR01	Understand the various types of concrete and their uses
FA-ACCR02	Demonstrate knowledge of floor systems using common and engineered lumber
FA-ACCR03	Demonstrate knowledge of wall and ceiling framing
FA-ACCR04	Demonstrate knowledge of various types of windows, skylights, and doors
FA-ACCR05	Demonstrate knowledge of stair layout and construction
FA-ACCR06	Demonstrate knowledge of various types of framed roofs
FA-ACCR07	Demonstrate knowledge of roofing materials
FA-ACCR08	Demonstrate knowledge of the processes used to install exterior finishes
FA-ACCR09	Select and install insulation in walls, floors, and attics
FA-ACCR10	Install and finish drywall
FA-ACCR11	Install trim used in finish work
FA-ACCR12	Install base and wall cabinets and countertops

Electrical

FA-ACEL01	Identify the components of an electrical distribution system
FA-ACEL02	Understand electrical concepts
FA-ACEL03	Demonstrate wiring techniques used in residential construction

FA-ACEL04	Discuss the types and applications of conductors and wiring techniques
FA-ACEL05	Demonstrate the methods for connecting conductors
FA-ACEL06	Describe (and demonstrate) the practical application of fuses and circuit breakers
FA-ACEL07	Select and sizes outlet boxes, pull boxes, and junction boxes
FA-ACEL08	Describe (discusses) the hardware and systems used to mount and support boxes, receptacles, and other electrical components
FA-ACEL09	Demonstrate the installation of switches and outlet receptacles
FA-ACEL10	Discusses the basic principles of lighting and its installation
FA-ACEL11	Understand and demonstrate ways of establishing wiring services
FA-ACEL12	Explain the purpose for grounding and bonding electrical systems

Heating, Ventilation, and Air Conditioning

FA-ACHVAC01	Discuss the principles of HVAC systems
FA-ACHVAC02	Demonstrate an understanding of the fundamental concepts related to air distribution system
FA-ACHVAC03	Demonstrate an understanding of the fundamental concepts related to cooling systems
FA-ACHVAC04	Demonstrate an understanding of the fundamental concepts related to heating systems
FA-ACHVAC05	Select, prepare, connect, and install piping and fittings
FA-ACHVAC06	Demonstrate an understanding of the type and use of different fasteners, hangers, and supports
FA-ACHVAC07	Demonstrate an understanding of the fundamentals of sheet metal planning, layout, and fabrication
FA-ACHVAC08	Maintain heating and cooling systems
FA-ACHVAC09	Discuss (or describe) the relationship between indoor air quality and HVAC
FA-ACHVAC10	Design heating and cooling systems
FA-ACHVAC11	Demonstrate an understanding of the use of conventional and electronic thermostats

Masonry

FA-ACMS01	Demonstrate an understanding of the masonry industry
FA-ACMS02	Demonstrate an understanding of the components of mortar, concrete, and grout
FA-ACMS03	Demonstrate an understanding of masonry units and installation techniques
FA-ACMS04	Demonstrate an understanding of how to apply masonry techniques in residential construction

FA-ACMS05	Understand and apply techniques for reinforcing masonry
FA-ACMS06	Understand and apply advanced masonry laying techniques
FA-ACMS07	Demonstrate an understanding of how to repair and restore masonry structures
FA-ACMS08	Demonstrate an understanding of relationships between construction techniques and moisture control
FA-ACMS09	Demonstrate an understanding of sustainability issues related to the masonry profession

Plumbing

FA-ACPL01	Demonstrate an understanding of water distribution and recovery systems
FA-ACPL02	Demonstrate an understanding of the applications and use of pipes and fittings
FA-ACPL03	Demonstrate an understanding of how to size, install, and test a drain waste and vent (DWV) system
FA-ACPL04	Prepare and install traps
FA-ACPL05	Demonstrate an understanding of how to size, install, and test a residential water piping system
FA-ACPL06	Demonstrate an understanding of how to install plumbing fixtures according to plumbing code
FA-ACPL07	Demonstrate an understanding of the installation of hot water systems
FA-ACPL08	Describe and demonstrate the different types of valves and their uses
FA-ACPL09	Conduct plumbing service and repair
FA-ACPL10	Understand plumbing hazards and how to protect against them
FA-ACPL11	Understand green technology and how it relates to the plumbing profession and environment

Employability Knowledge and Skill Statements with Suggested Performance Indicators

E-01	Adhere to workplace practices
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain and follow workplace standards, rules, and regulations B. Show up on time and prepared to work C. Demonstrate the ability to take direction, be proactive, and work independently
E-02	Exhibit personal responsibility and accountability
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Apply professional and ethical standards of the industry to personal conduct B. Maintain integrity and promote personal and professional integrity in co-workers C. Take responsibility and carry out work assignments
E-03	Practice cultural competence
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Demonstrate awareness of issues related to diversity, equity, and inclusion B. Work effectively with colleagues of differing abilities, cultures, and backgrounds C. Describe issues relating to workplace harassment D. Model behaviors that are respectful and sensitive of others
E-04	Demonstrate teamwork and conflict resolution
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Demonstrate the ability to collaborate and contribute to the work of a diverse team B. Explain when it is appropriate to lead and when to follow another's lead C. Demonstrate strategies for resolving issues with coworkers
E-05	Communicate clearly and effectively
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Listen attentively, and speak and write clearly to convey information correctly B. Interpret information and instructions presented in verbal and written form C. Demonstrate effective communication with colleagues, supervisors, customers, and suppliers D. Demonstrate the ability to communicate verbally, in writing, and using electronic communication tools
E-06	Employ critical thinking to solve problems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Recognize problems in the workplace and diagnose their root causes B. Develop well-reasoned plans to solve identified challenges C. Apply and follow through on plans to ensure that problems are resolved

E-07	Demonstrate creativity and innovative thinking
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Develop ideas to solve problems in new and different ways B. Investigate one’s own and others’ ideas to find those with greatest applicability C. Develop and deploy plans to implement new ideas in the workplace
E-08	Demonstrate fluency in workplace technologies
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Demonstrate knowledge and application of general technology skills, including hardware and software commonly used in the industry B. Use online communication, networking tools and social networks to access, manage, evaluate, and create information to successfully function in a knowledge economy C. Describe and demonstrate a fundamental understanding of the ethical, legal, and security issues surrounding access to and use of information technologies
E-09	Plan, organize, and manage work
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify an intended project outcome including available inputs, materials, labor, timeline for producing work, and job-site obligations B. Effectively plan, monitor, and complete projects on time and within budget using available resources and materials C. Demonstrate ability to write coherent reports and project summaries to communicate the progress of project work and its adherence to schedule
E-10	Make informed career decisions
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify job and entrepreneurial opportunities in the industry and the required education and credentials to obtain employment B. Set short- and long-term career goals based on personal interests and aptitudes C. Maintain a project portfolio D. Develop a professional resume E. Explain and demonstrate how to cultivate and maintain a professional presence in an online environment, including the appropriate use of social media and networking platforms

Architecture and Construction Career Cluster Knowledge and Skill Statements with Suggested Performance Indicators

CC-AC01	Describe the roles and responsibilities of the different disciplines that collaborate to design and build residential and commercial properties
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify how buildings are designed and the various fields involved (e.g., urban planners, architects, engineers, landscape architects) B. Identify the skilled trades and how they contribute to constructing a building (e.g., carpenters, electricians, plumbers, HVAC installers, masons) C. Describe how employers from different disciplines collaborate to design and stage their work to build or renovate properties
CC-AC02	Demonstrate an understanding of and adherence to safe working practices
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the importance of a safety culture in the construction trades B. Demonstrate awareness of and take steps to redress common construction hazards C. Demonstrate the use and care of personal protective equipment D. Explain the purpose and use of Safety Data Sheets
CC-AC03	Demonstrate the safe use of tools
Suggested Performance Indicators	<ul style="list-style-type: none"> E. Demonstrate the ability to use measuring, marking, and layout tools F. Identify the hand and power tools commonly used in the field and describe their uses G. Use hand and power tools in a safe manner H. Demonstrate how to maintain, clean, and store hand and power tools commonly used in the field
CC-AC04	Demonstrate knowledge about building materials used in the construction industry
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify various types of building materials and their uses B. Identify the different types and grades of building materials used in the construction industry C. Describe the fasteners, anchors, and adhesives used in construction work and explain their uses D. Identify the uses of and safety precautions associated with different building materials (e.g., pressure-treated, and fire-retardant lumber).

CC-AC05	Describe the existence and purpose of governmental regulations and applicable building codes, laws, and rules
Suggested Performance Indicators	<ul style="list-style-type: none"> A. State the purpose of regulations and certification requirements B. Explain the types of occupation-specific governmental regulations and federal, state, and local building codes and regulations that apply in the industry and how the professions engage with them C. Describe the process necessary to research and apply applicable building code, zoning requirements, and sustainability initiatives in a selected area D. Describe how the Americans with Disabilities Act influences the compliance requirements for project designs E. Describe requirements related to handling and disposal of environmentally hazardous materials in accordance with the material safety data sheet (MSDS), the Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (EPA) regulations F. Describe the existence and application of quality control and assurance procedures within the industry
CC-AC06	Demonstrate pre-task planning to ensure a safe and efficient jobsite
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the daily scope of work and sequence of activities to perform it B. Identify and safely assemble the equipment required to conduct the daily scope of work C. Estimate the time and materials needed to perform the daily scope of work D. Identify jobsite hazards related to the daily scope of work and take steps to mitigate them E. Describe materials handling and hoisting equipment F. Describe how to set up and maintain scaffolding and elevated workstations
CC-AC07	Demonstrate basic measuring practice
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Use a standard ruler, a metric ruler, a measuring tape, and an architectural/engineering scale to perform measurements B. Describe the imperial and metric systems and how they are used in the construction trades C. Recognize and use imperial and metric units of length, weight, volume, and temperature D. Recognize and use some of the basic shapes used in the construction industry and apply geometric principles to measure them
CC-AC08	Demonstrate an understanding of basic mathematics as used in the industry
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Add, subtract, multiply, and divide whole numbers, fractions, and decimals with and without a calculator B. Demonstrate how to determine area, volume, and length measurements using square feet, cubic feet, and yards C. Demonstrate an understanding of basic principles of density, pressure, and temperature D. Demonstrate an understanding of basic concepts of geometry (e.g., angles, diameters)

Architectural Design Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACAD01	Demonstrate an understanding of architectural history and culture
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Research, compare, and contrast a range of historical and contemporary styles, identifying their site context, general themes, and trends B. Describe how the field has been influenced by the contributions of different cultures C. Describe the social, economic, and environmental impact of decisions made by architects at the local, national, and global levels D. Explain the different design phases throughout a project to identify when critical milestones for design decisions are to be completed
FA-ACAD02	Explain the role of the architect during the construction phase
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the existence and purpose of construction contracts, why they are needed, and their typical components (e.g., scope of work, roles, budget, insurance) B. Describe the process that architects follow when transferring plans to builders C. Explain plans and drawings to builders and relevant stakeholders D. Modify plans to address unanticipated material or site constraints
FA-ACAD03	Explain the concepts that form the technical knowledge of architectural design
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Demonstrate knowledge of architectural terminology, scale, and design principles B. Read and interpret conventional architectural documents, including understanding architectural symbols, schematics, blueprints, work drawings, manuals, and bulletins C. Use the tools, materials, and equipment commonly used by architects to perform their jobs D. Demonstrate knowledge of the various types of construction materials.
FA-ACAD04	Develops design solutions applying recognized industry principles
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Discuss the primary building systems including structure, structural engineering concepts, and environmental systems that are integrated within the building project B. Develop preliminary sketches of a nonresidential or residential architectural design C. Develop a site plan that optimizes building orientation and location relative to views, sun angles, wind direction, and other site factors D. Develop building designs to respond to client requirements E. Develop building designs to promote sustainability and compatibility between building and site design F. Demonstrate the ability to research and select materials

FA-ACAD05	Use computer-aided design (CAD) software to produce architectural drawings
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Customize screen menus to fit specific problems or needs B. Create two- and/or three-dimensional drawings of advancing complexity, accurately incorporating symbols, notes, dimensioning, and line types C. Use CAD software to create pictorial drawings of advancing complexity, such as isometric, oblique, and perspective renderings D. Create accurate auxiliary view drawings of advancing complexity including depth, height, or width auxiliary views; partial auxiliary views; and auxiliary section views
FA-ACAD06	Use hand tools to produce architectural drawing
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Draw schematic site plans, floor plans, building elevations, sections, perspectives, and character sketches B. Draw scaled wall thickness plans, elevations, and sections and/or demonstrate an understanding of the purpose for the scale of drawing/documentation C. Develop details of floor and wall sections as required by client D. Assemble an architectural design in three dimensions
FA-ACAD07	Use a variety of architectural design media
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the different types of media that exist and their uses B. Create visual solutions by elaborating on direct observation, experiences, and imagination C. Create designs for practical applications D. Demonstrate use of architectural media and tools in design, hand drawing, painting, printmaking, and sculpture such as model building.
FA-ACAD08	Know the concept of sustainability and its application in architectural design
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Recognize sustainable design as it relates to architectural design B. Explain the goals of various green building standards, codes, and certification systems C. Integrate sustainable design principles across planning, design, and construction D. Describe the different types of grants, incentives, and business cases that can be applied to support sustainability projects

Carpentry Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACCR01	Understand the various types of concrete and their uses
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the composition and properties of concrete B. Identify types of concrete reinforcement materials and describe their uses C. Identify various types of foundations (e.g., T-shaped footings, slab-on-grade) and explain their uses D. Explain the procedures associated with the construction and use of concrete forms
FA-ACCR02	Demonstrate knowledge of floor systems using common and engineered lumber
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the different types of framing systems B. Identify floor and sill framing and support members C. Select the girder or beam size to conform with industry standards for floor load and span data D. List and recognize different types of flooring, subflooring, and underlayment materials E. Select fasteners that align to industry standards for in various floor framing systems
FA-ACCR03	Demonstrate knowledge of wall and ceiling framing
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the components of a wall and ceiling layout B. Describe the procedure for laying out a wood frame wall, including the installation of plates, corner posts, door and window openings, partition Ts, bracings, and firestops C. Describe the correct procedure for assembling and erecting an exterior wall D. Explain the components of metal studs in wall framing
FA-ACCR04	Demonstrate knowledge of various types of windows, skylights, and doors
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the various types of fixed, sliding, and swinging windows and state the requirements for window installation to industry standards B. Identify the common types of interior and exterior doors and state the requirements for door installation to industry standards C. Identify the various types of locksets used on interior and exterior doors and explain how the locksets are installed D. Identify and explain the use and installation of various door and window hardware, including security hinges, keepers, deadbolts, and peep holes.

FA-ACCR05	Demonstrate knowledge of stair layout and construction
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the various types of stairs and their component parts B. Interpret construction drawings of stairs C. Calculate the total rise, number and size of risers, and the number and size of treads required for a given stairway D. Lay out and cut stringers, risers, and treads
FA-ACCR06	Demonstrate knowledge of various types of framed roofs
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the terms associated with roof framing B. Describe the roof framing members used in gable and hip roofs C. Identify various types of sheathing used in roof construction D. Frame a roof using trusses and with vent openings E. Estimate the quantity of materials necessary for framing and sheathing a roof
FA-ACCR07	Demonstrate knowledge of roofing materials
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the terms associated with roofing systems B. Demonstrate an understanding of the materials and methods used in roofing C. (Explain the safety requirements for roof jobs D. Explain how to install shingles to make various roofs and roof projections watertight E. Demonstrate the techniques for installing other selected types of roofing materials (e.g., wood shakes/metal)
FA-ACCR08	Demonstrate knowledge of the processes used to install exterior finishes
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the purpose of wall insulation and flashing B. Describe the types and applications of common siding products and their uses (e.g., wood panel, fiber-cement, stucco) C. Describe the types and styles of gutters and downspouts and their accessories
FA-ACCR09	Select and install insulation in walls, floors, and attics
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the requirements and characteristics of various types of insulation materials B. Calculate the required amounts of insulation for a structure C. Describe the requirements and methods used for vapor barriers, moisture control, and ventilation D. Demonstrate an understanding of how to install insulation and vapor control materials

FA-ACCR10	Install and finish drywall
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the different types and thickness of drywall and their uses for specific installations B. Identify and demonstrate the use of various fasteners used in differing drywall installations C. Identify the tools used in drywall finishing and demonstrate the ability to use these tools D. Identify the materials used in drywall finishing and state the purpose and use of each type of material, including compounds, joint reinforcing tapes, trim materials, textures, and coatings
FA-ACCR11	Install trim used in finish work
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the different types of standard moldings and describe their uses B. Make square and miter cuts using a miter box or power miter saw C. Select and use fasteners to install trim, including door trim, window trim, base trim, and ceiling trim D. Estimate the quantities of different trim materials required for selected rooms
FA-ACCR12	Install base and wall cabinets and countertops
Suggested Performance Indicators	<ul style="list-style-type: none"> A. State the classes and sizes of typical base and wall kitchen cabinets B. Lay out factory-made cabinets, countertops, backsplashes, and island bases C. Identify and cut the various types of joints used in cabinetmaking D. Demonstrate the ability to build a cabinet from a set of drawings E. Describe how to measure, build, and attach different types of countertops

Electrical Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACEL01	Identify the components of an electrical distribution system
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the basics of how electricity is generated through different sources B. Describe the distribution of electricity into residential and commercial buildings C. Define high voltage, standard voltage, and low-voltage, and compare how they are used differently
FA-ACEL02	Understand electrical concepts
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe basic terms of electricity and formulas used to represent it (e.g., Ohm's law, Kirchhoff's law) B. Explain the difference between conductors and insulators C. Explain the different types of meters used to measure voltage, current, and resistance D. Explain the basic characteristics of a series, parallel, and combined series-parallel circuit E. Explain how to operate test equipment such as ammeter, ohmmeter, volt-ohm-multimeter, continuity tester, and voltage tester F. Explain how to read specific test equipment, including digital and analog meters, and convert from one scale to another when using specified test equipment
FA-ACEL03	Demonstrate wiring techniques used in residential construction
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe how to determine electric service requirements for dwellings B. Explain the grounding requirements of a residential electric service C. Describe service entrance equipment and wiring methods for various types of residences D. Compute branch circuit loads and explain their installation requirements
FA-ACEL04	Discuss the types and applications of conductors and wiring techniques
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Discuss the various wire sizes in accordance with American Wire Gauge standards B. Read and identify markings on conductors and cables and describe the voltage ratings of each C. Describe the different types and coding of conductor insulation D. Describe the equipment and demonstrate the procedures for pulling wire through conduit
FA-ACEL05	Demonstrate the methods for connecting conductors
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe how to prepare cable ends for termination and splices B. Demonstrate how to select and install lugs and connectors onto conductors C. Describe crimping and splicing techniques D. Explain how to use hand and power crimping tools

FA-ACEL06	Describe (and demonstrate) the practical application of fuses and circuit breakers
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the necessity of overcurrent protection devices in electrical circuits B. Define the basic terms associated with and operation of fuses and circuit breakers C. Explain how ground fault circuit interrupters operate and can save lives D. Calculate short circuit currents E. Describe troubleshooting and maintenance techniques for overcurrent devices
FA-ACEL07	Select and sizes outlet boxes, pull boxes, and junction boxes
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the different types of nonmetallic and metallic boxes and how to calculate the required box size for any number and size of conductors B. Describe the different types of supports and fittings used in conjunction with boxes C. Locate, install, and support boxes of all types D. Describe the National Electrical Code regulations governing outlet, pull, junction, and fixture boxes
FA-ACEL08	Describe (discusses) the hardware and systems used to mount and support boxes, receptacles, and other electrical components
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify and explain the use of threaded and non-threaded fasteners B. Identify and explain the use of anchors C. Demonstrate the correct applications and install fasteners and anchors
FA-ACEL09	Demonstrate the installation of switches and outlet receptacles
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Use a wire stripper to strip insulation from a wire B. Explain the components of a light switch and outlet C. Demonstrate the correct installation of various switches and outlets D. Explain the purpose and operation of a ground-fault circuit interrupter
FA-ACEL10	Discusses the basic principles of lighting and its installation
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the characteristics of light B. Recognize the different kinds of lamps and explain the advantages and disadvantages of each type, including incandescent, halogen, fluorescent, and high-intensity discharge C. Select and install lamps into lighting fixtures D. Recognize and install various types of lighting fixtures, including surface mounted, recessed, suspended, and track-mounted units

FA-ACEL11	Understand and demonstrate ways of establishing wiring services
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the purpose of conduit and demonstrate methods of cutting, bending, threading, and installing conduit using hand and using power tools B. Describe the purpose of raceways and the various types and sizes of cable trays and raceways C. Describe procedures for installing raceways and boxes on masonry surfaces, metal stud systems, wood-framed systems, and drywall surfaces D. Demonstrate knowledge of National Electrical Code conduit and raceway requirements
FA-ACEL12	Explain the purpose for grounding and bonding electrical systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Distinguish between a short circuit and a ground fault B. Distinguish between system grounding and equipment grounding C. Explain the National Electrical Code requirements for bonding of enclosures and equipment

Heating, Ventilation, and Air Conditioning Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACHVAC01	Discuss the principles of HVAC systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the history and concepts of heating, air-conditioning, and refrigeration B. Describe and explain the purpose of cooling and heating systems in residential and commercial buildings and their major components C. Define basic terminology used in HVAC D. Demonstrate ability to use of cloud/IT technologies (e.g., smart building technologies, demand-load response) to monitor HVAC systems
FA-ACHVAC02	Demonstrate an understanding of the fundamental concepts related to air distribution system
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the instruments used to make measurements in air systems and make accurate temperature, air pressure, and velocity measurements in an air distribution system B. Describe the airflow and pressures in a basic forced-air distribution system C. Recognize different types of fans and blowers and their function D. Identify the various types of duct systems and explain why and where each type is used E. Demonstrate or explain the installation of ducting, fittings, transitions, diffusers, and registers
FA-ACHVAC03	Demonstrate wiring techniques used in residential construction
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe how to determine electric service requirements for dwellings B. Explain the grounding requirements of a residential electric service C. Describe service entrance equipment and wiring methods for various types of residences D. Compute branch circuit loads and explain their installation requirements
FA-ACHVAC04	Demonstrate an understanding of the fundamental concepts related to heating systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the three methods by which heat is transferred and give an example of each B. Describe the fuels used in heating, how combustion occurs and its by-products C. Identify the major components and accessories of a gas and oil furnace and explain the function of each component D. Demonstrate or describe the factors that must be considered when installing a furnace and the types of preventative maintenance procedures required

FA-ACHVAC05	Select, prepare, connect, and install piping and fittings
Suggested Performance Indicators	<ul style="list-style-type: none"> A. State the precautions that must be taken when installing different types of piping B. Select, cut, and bend tubing C. Safely connect tubing, using flare and compression fittings D. Cut and join lengths of copper, plastic, and/or ferrous pipe, using solder, brazing, and/or reaming and threading techniques as called for by industry standards E. Demonstrate methods to pressure test piping systems
FA-ACHVAC06	Demonstrate an understanding of the type and use of different fasteners, hangers, and supports
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify and describe the various kinds of fasteners used in the sheet metal and HVAC trades B. Describe common methods of supporting air system components C. Install duct fasteners, hangers, and supports D. Describe thermal and acoustic insulation principles
FA-ACHVAC07	Demonstrate an understanding of the fundamentals of sheet metal planning, layout, and fabrication
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify and describe the types of sheet metal and properties of steel and aluminum alloys B. Describe commonly used planning and layout methods C. Demonstrate how to perform cutting and forming using hand tools D. Join sheet metal duct sections using seams and connectors
FA-ACHVAC08	Maintain heating and cooling systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify and install threaded and non-threaded fasteners B. Identify lubricant types, explain their uses, and demonstrate how to apply them C. Identify belt drives, couplings, gaskets/seals and bearings; explain their uses; and demonstrate how to install or adjust them
FA-ACHVAC09	Discuss (or describe) the relationship between indoor air quality and HVAC
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the need for good indoor air quality and recognize the symptoms of poor quality B. Perform an inspection/evaluation of a building's structure and equipment for potential causes of poor indoor air quality and identify corrective actions to remedy common problems C. Use selected test instruments to measure or monitor the quality of indoor air D. (Demonstrate and/or describe the procedures used to clean HVAC air system ductwork and components

FA-ACHVAC10	Design heating and cooling systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the factors that affect heat gains and losses to a building and describe how these factors influence the design process B. From blueprints or an actual job site, calculate system needs and develop material and cut lists C. Describe strategies for estimating the costs of installing various types of heating and cooling systems D. State the principles that affect the selection of equipment and ducting to satisfy the calculated heating and/or cooling load
FA-ACHVAC11	Demonstrate an understanding of the use of conventional and electronic thermostats
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the function of a thermostat in an HVAC system B. Describe different types of thermostats, explain how they are used, and demonstrate the correct installation and adjustment of a thermostat C. Identify the various types of electromechanical, electronic, and pneumatic HVAC controls and explain their function and operation D. Describe a systematic approach for electrical troubleshooting of HVAC equipment and components

Masonry Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACMS01	Demonstrate an understanding of the masonry industry
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Summarize the history of the masonry industry and its importance to the local, state, and national economy B. Describe the properties, characteristics, and uses of different brick and block building materials C. Describe modern masonry
FA-ACMS02	Demonstrate an understanding of the components of mortar, concrete, and grout
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Name and describe the ingredients in mortar, concrete, and grout and their properties B. Identify the types of admixtures and their use in masonry work C. Set and mix mortars using manual tools and by machine D. Identify common problems found in mortar application and how to address them
FA-ACMS03	Demonstrate an understanding of masonry units and installation techniques
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the most common types of masonry units and their applications B. Demonstrate how to cut bricks and blocks accurately C. Demonstrate how to set up a wall and lay units in a true course D. Describe and demonstrate the ability to perform different types of masonry bonds
FA-ACMS04	Demonstrate an understanding of how to apply masonry techniques in residential construction
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain and appropriately select among the methods of basic building layouts and methods of digging, reinforcing, and pouring foundations and footings B. Explain and appropriately select among the methods of forming, grading, reinforcing, and pouring concrete slabs C. Lay out and construct steps, patios, decks, and walls made from various masonry units D. Lay out and construct chimneys and fireplaces
FA-ACMS05	Understand and apply techniques for reinforcing masonry
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the uses and installation of vertical and horizontal joint reinforcement and ties B. Describe the uses and installation of different anchors, fasteners, and embedded items C. Install hollow metal frames, sills and lintels, and metal hardware

FA-ACMS06	Understand and apply advanced masonry laying techniques
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Recognize the requirement for and function of control joints and expansion joints B. Build various types of walls to meet industry standards for reinforcement, jointing, and bonding techniques C. Lay out specialty structures such as maintenance holes, segmented block walls and screens D. Identify the different types of masonry arches and lay out a semicircular and jack arch
FA-ACMS07	Demonstrate an understanding of how to repair and restore masonry structures
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Recognize signs of deterioration and paint failures B. Describe procedures for preventing efflorescence, cracking, and faulty mortar joints C. Demonstrate how to select, prepare, and use repair materials and cleaning solutions
FA-ACMS08	Demonstrate an understanding of relationships between construction techniques and moisture control
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain and demonstrate how to construct masonry around windows, doors, and other openings B. Identify the need for moisture control in various types of masonry construction, and demonstrate the techniques used to eliminate moisture problems C. Identify the various types of insulation used and demonstrate installation techniques
FA-ACMS09	Demonstrate an understanding of sustainability issues related to the masonry profession
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe the impact of the construction industry on the natural environment B. Describe the life cycle phases of a building and its impacts on the environment throughout the life of the building C. Identify specific practices that can lessen adverse impacts on the environment D. Describe tools for assessing building sustainability, such as Leadership in Energy and Environmental Design (LEED) and Green Globes that can lessen adverse impacts on the environment

Plumbing Focus Area Knowledge and Skill Statements with Suggested Performance Indicators

FA-ACPL01	Demonstrate an understanding of water distribution and recovery systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe and explain the earth's water cycle and different water sources B. Describe how water is distributed to residential or commercial houses or buildings C. Describe the process by which wastewater is collected and treated
FA-ACPL02	Demonstrate an understanding of the applications and use of pipes and fittings
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify types of materials, schedules, code requirements, and applications of different types of piping (e.g., PEX, PVC, ABS, copper, steel, cast iron) B. Identify types of fittings and valves used with different pipes C. Demonstrate how to measure, cut, and join pipes of the same and dissimilar materials D. Explain industry standard procedures for the handling, storage, and protection of pipes E. Identify and demonstrate the use of pipe hangers and supports
FA-ACPL03	Demonstrate an understanding of how to size, install, and test a drain waste and vent (DWV) system
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the major components of a DWV system and explain how waste moves from a fixture through the DWV system to the public or private sewer system B. Read and interpret isometric drawings to identify DWV symbols and lines and make a materials list C. Demonstrate how to size and install a DWV system for soil or waste drainage
FA-ACPL04	Prepare and install traps
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Explain the importance of traps and correct trap placement B. Identify the different types of traps and their components C. Demonstrate how to size and install traps D. Describe the ways that traps can lose their seals
FA-ACPL05	Demonstrate an understanding of how to size, install, and test a residential water piping system
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Read isometric drawings to identify hot and cold-water service lines and make a materials list B. Identify factors critical for sizing a water system such as water pressure, velocity, and flow C. Demonstrate how install and pressure test water service lines D. Describe how to employ hammer arrestors and/or air chambers

FA-ACPL06	Demonstrate an understanding of how to install plumbing fixtures according to plumbing code
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Demonstrate how to install a toilet and urinal B. Demonstrate how to install kitchen and lavatory sinks and faucets C. Demonstrate how to install bathtub and shower enclosures and faucets
FA-ACPL07	Demonstrate an understanding of the installation of hot water systems
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Describe types of storage tanks (electric and gas), point of use, on demand (electric and gas), and solar water heaters B. Describe the parts and functions of different heaters C. Demonstrate an understanding of the installation of a gas and electric water heater D. Describe the operation of a hot water recirculating system
FA-ACPL08	Describe and demonstrate the different types of valves and their uses
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify the types of valves used to start and stop flow B. Explain why and where flow regulation, pressure reducing, and directional valves are used C. Explain how to store and handle valves
FA-ACPL09	Conduct plumbing service and repair
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Repair washer and washer less type faucets B. Repair ball cocks and flush valves C. Unclog drains and traps D. Replace kitchen and bathroom plumbing appliances
FA-ACPL10	Understand plumbing hazards and how to protect against them
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify different types of backflows such as gravity, back-pressure, and back siphonage B. Demonstrate ability to identify and mitigate hazards, such as toxic, polluted, and contaminated lines C. Demonstrate an understanding of cross-connection protection (e.g., air gap, reduced pressure zone backflow preventer, vacuum breakers)
FA-ACPL11	Understand green technology and how it relates to the plumbing profession and environment
Suggested Performance Indicators	<ul style="list-style-type: none"> A. Identify different green plumbing fixtures B. Identify different types of reusable plumbing systems C. Design and demonstrate a particular reuse water plumbing system