

# State of Illinois Model Programs of Study Guide: Architecture, Construction, and Energy

August 2021



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### **About ICCB**

In 1965, the Illinois General Assembly established the Illinois Community College Board to create a system of public community colleges that would be within easy reach of every resident. Today, the Illinois Community College System covers the entire state with 48 colleges and one multi-community college center in 39 community college districts. Community colleges serve nearly one million Illinois residents each year in credit and noncredit courses and many more through their public service programs.

Illinois' community colleges meet both local and statewide needs for education and workforce development through high-quality, affordable, accessible, and cost-effective programs and services. Learn more at [iccb.org](http://iccb.org).



### **About Education Systems Center**

Education Systems Center (EdSystems) is a mission-driven policy development and program implementation center based within Northern Illinois University's Division of Outreach, Engagement, and Regional Development. EdSystems' mission is to shape and strengthen education and workforce systems that prepare more young people for productive careers and lives in a global economy. EdSystems leads and manages the Illinois P-20 Council's College and Career Readiness Committee, which recently drove the development and adoption of the Postsecondary and Workforce Readiness Act ([pwract.org](http://pwract.org)). Learn more about EdSystems at [edsystemsniu.org](http://edsystemsniu.org).

## About the Model Programs of Study Guide

The Illinois Community College Board (ICCB) sponsored the development of Model Programs of Study Guides in crucial industry areas as part of the Illinois State Plan for Strengthening Career and Technical Education for the 21st Century Act (also known as the Perkins V Plan). This Guide was developed in consultation and collaboration with the Illinois State Board of Education (ISBE) through a process led and facilitated by Education Systems Center at NIU (EdSystems). As further detailed in this Guide, the process involved extensive research into labor market information and credential programs, and dialogue across secondary, postsecondary, and employer stakeholders.

The primary purposes and goals for the Model Programs of Study are to:

1. **Provide guidance and exemplars** for local programs to adopt or customize as they develop programs of study for approval as part of the Perkins V Plan.
2. **Establish a framework** for State agencies to develop and implement program supports.
3. **Identify priority dual credit courses** that are foundational to the industry area and well-situated for statewide scaling and articulation.
4. **Define the competencies** that should be sequenced across a program of study course sequence to prepare students for the future of work in that industry area.
5. **Identify entry points** for employers to support coursework and related experiences.

Model Programs of Study supplement and complement other State of Illinois career and technical education and career pathway resources, including the [ISBE Career Guide](#), [State of Illinois Career Pathways Dictionary](#), [Career Development Experience Toolkit](#), [Postsecondary and Workforce Readiness Act Recommended Technical and Essential Employability Competencies](#), [State of Illinois Workforce Development Strategic Plan](#), [Workforce Education Strategic Plan](#), and related state and regional data resources. School districts, community colleges, and their partners are encouraged to use this Guide, state resources, and local program and course information to develop materials for student and family outreach.

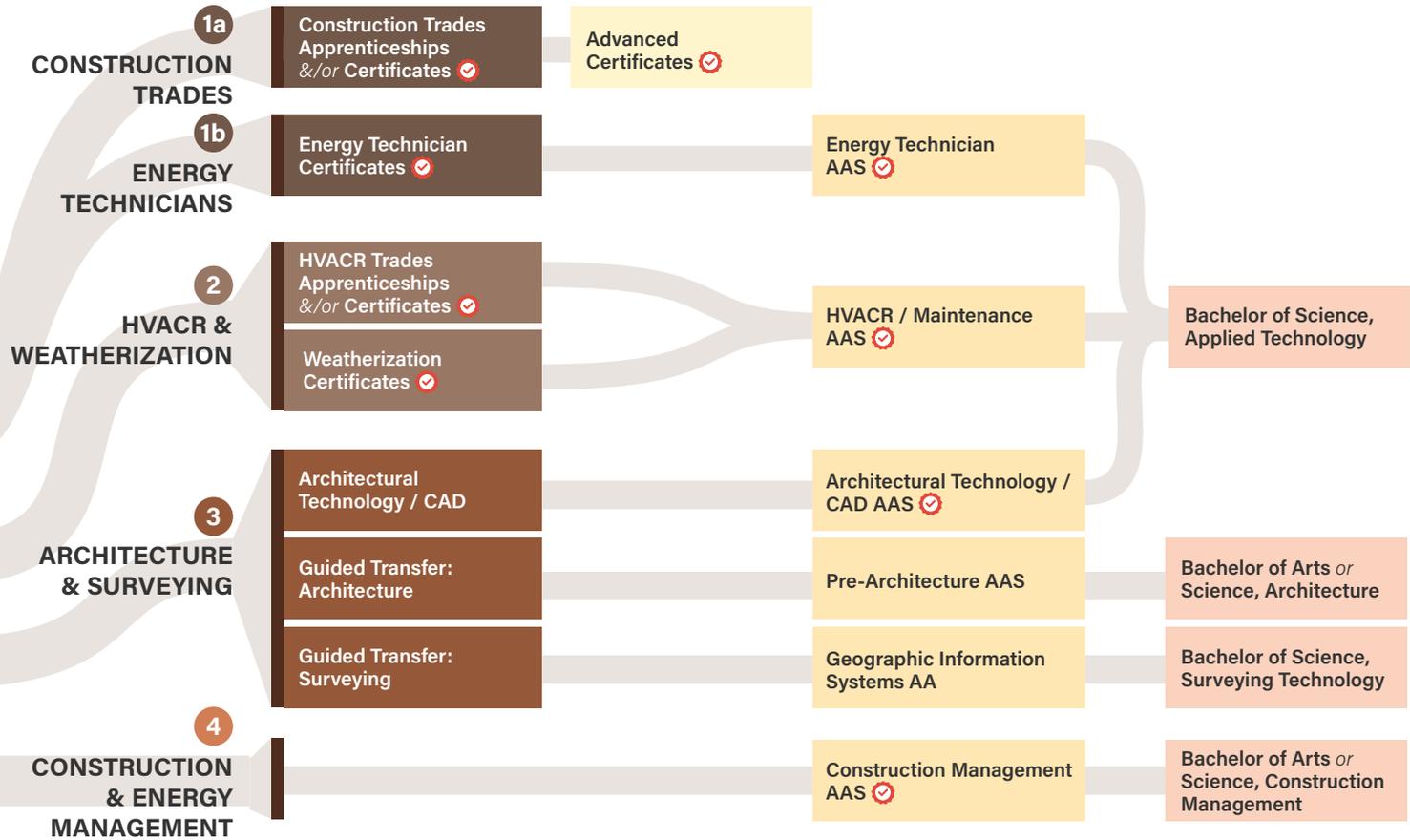
The full Model Programs of Study for Architecture, Construction, and Energy, depicted graphically on pp. 4 – 5, can be used as a reference in local planning processes. The Guide then presents and describes in detail each component of the sequence, including descriptions of the underlying research, analysis, and Advisory Committee input leading to each component:

- I. Background and Process for Developing Model Programs of Study ([pp. 6 – 7](#))
- II. Priority Occupations and Promising Credentials in Architecture, Construction, and Energy ([pp. 8 – 11](#))
  - a. Promising Credential Program Categories ([pp. 8 – 9](#))
  - b. High-Priority Occupations ([pp. 9 – 10](#))
  - c. Levels of Education Needed ([p. 10](#))
  - d. Advisory Committee Considerations ([p. 10](#))
  - e. Union vs. Non-Union Pathway Opportunities ([p. 11](#))
- III. Programs of Study Sequence Description ([pp. 12 – 19](#))
  - a. High School Career-Focused Instructional Sequence and Related Work-Based Learning ([pp. 12 – 15](#))
  - b. Recommended High School General Education Courses ([pp. 15 – 16](#))
  - c. Recommended First Year Postsecondary Courses ([p. 16](#))
- IV. Strategic Dual Credit Courses – Competency Descriptions ([pp. 17 – 19](#))

Appendix A includes the PWR Act Recommended Essential Employability Competencies. Appendix B includes the Advisory Committee membership.



## POSTSECONDARY OPTIONS



## SELECTED OCCUPATIONS, WAGES, & JOB GROWTH

Program	Typical Job	Near or Above Living Wage Threshold for 1 Adult + 1 Child <sup>1</sup>	Median Hourly Wage <sup>2</sup>	Growth in IL: Annual Job Openings <sup>2</sup>	Growth in IL: % Change Over 10 years <sup>2</sup>	Stackable?
1a Construction Trades	Construction Carpenters	Y	\$33.22	3,250	6%	Not Typically Stackable
	Electricians	Y	\$39.17	2,580	7%	
	Pipefitters & Steamfitters	Y	\$43.85	2,160	14%	
1b Energy Technicians	Electrical Power Line Installers & Repairers	Y	\$43.49	310	11%	Typically Stacks to Related Bachelor's Programs at <b>Select</b> IL Universities
	Wind Turbine Service Technicians	Y	\$25.76	170 <sup>3</sup>	57% <sup>3</sup>	
	Solar Photovoltaic Installers	N	\$21.58	720 <sup>4</sup>	20% <sup>4</sup>	
2 HVACR & Weatherization	Heating & Air Conditioning Mechanics & Installers	Y	\$27.52	800	13%	
	First-Line Supervisors of Mechanics, Installers, & Repairers	Y	\$33.55	1,390	7%	
	Weatherization Installers & Technicians	Y	\$26.42	170	9%	
3 Architecture, CAD, and Surveying	Architectural & Civil Drafters	Y	\$30.20	240	5%	Typically Stacks to Related Bachelor's Programs at <b>Most</b> IL Universities
	Architects	Y	\$38.06	390	0%	
	Surveyors	Y	\$33.89	90	6%	
4 Construction & Energy Management	Construction Managers	Y	\$43.59	960	7%	
	Cost Estimators	Y	\$32.04	740	9%	
	Energy Auditors	Y	\$36.81	5,570	7%	

1. Living wage calculations are based on: Glasmeier, Amy K. Living Wage Calculator. 2020. Massachusetts Institute of Technology. [livingwage.mit.edu](https://livingwage.mit.edu). As of January 2021 for the state of Illinois, the "Living Wage" for 1 Adult + 1 Child equaled \$26.27/hour and "near," defined as 85% of that statewide living wage, was \$22.33/hour. In March of 2021, the Living Wage calculator updated its calculations for Illinois, but information presented in this guide reflects the wage levels as of January 2021, when the project team conducted its analysis.

2. U.S. Department of Labor, CareerOnestop ([careeronestop.org/explorecareers](https://careeronestop.org/explorecareers)), Illinois Department of Employment Security Virtual Labor Market Information ([www2.illinois.gov/ides](https://www2.illinois.gov/ides)), except where otherwise noted

3. Estimate derived from available data on CareerOnestop

4. Estimate derived from data published in [National Solar Jobs Census 2019](https://www.bls.gov/news.release/archives/solar20190801.pdf)



## Background and Process for Developing Model Programs of Study

Programs of study are a coordinated, non-duplicative sequence of academic and technical content at the secondary and postsecondary levels that culminate in a recognized postsecondary credential. In Illinois, Perkins V programs of study are aligned with broader State policy goals to promote college and career readiness, including the State of Illinois' ESSA plan (in particular, the College and Career Readiness Indicator), the College and Career Pathway Endorsement framework and other elements of the Postsecondary and Workforce Readiness Act, the Dual Credit Quality Act, the Illinois WIOA Unified State Plan, and the State's Career Pathways Dictionary.

### Process for Development

Each Model Programs of Study was developed using a data-driven, backward-mapping approach that extended from the areas of job growth down through to the high school course sequence. The specific steps in this analysis included:

1. **Identifying high-priority occupations** in the industry sector that are high-skill, high-wage, and in-demand based on federal Department of Labor data for the State of Illinois.
2. **Identifying promising postsecondary credentials** (degrees or certificates) that are broadly accessible through the Illinois community college system and lead to high-priority occupations.
3. **Mapping the stackable degrees and certificates** that progress to promising credentials.
4. **Identifying strategic community college courses** that appear across the maximum number of promising credentials, provide a broad foundation of knowledge essential to that industry sector, and are feasible for dual credit delivery.
5. **Mapping a course sequence from secondary through the first year of postsecondary** that incorporates strategic early college credit (including at least six early college credits in the career-focused course sequence) and considers industry trends and innovations in career and technical education.
6. **Defining related technical competencies** for the foundational program of study courses that can be utilized to guide course development and postsecondary articulation.



Using Department of Labor<sup>1</sup> data and the MIT Living Wage Calculator<sup>2</sup> for the State of Illinois as a reference, the project team identified “high-priority occupations” as jobs with a positive growth outlook and median salaries near or greater than the living wage for one adult and one child.<sup>3</sup> Thus, a “promising credential” is a degree or college certification that immediately prepares an individual for entry into a high-priority occupation or is a stackable credential for a high-priority occupation.

After identifying the promising credentials in each industry area, the project team analyzed community college programs leading to these credentials from a sampling of six to ten colleges from across Illinois, representing a mix of urban, suburban, and rural institutions.<sup>4</sup> EdSystems analyzed and categorized all of the career-focused and general education courses across the full sampling of the promising credential programs to determine which of these courses:

- Are most common across all programs in the sample,
- Are broadly accessible for dual credit opportunities considering prerequisites and teacher credentialing requirements, and
- Are included within the Illinois Articulation Initiative.

This analysis and categorization process led to a recommended set of “strategic” career-focused and general education courses that provide a critical foundation for the program of study sequence.

Following this internal analysis, EdSystems and ICCB convened a stakeholder Advisory Committee of secondary, postsecondary, and private sector representatives to vet the recommendations and provide expertise and guidance on the development of the Model Programs of Study (see Advisory Committee listing in Appendix B). Over multiple webinars and feedback sessions across four months, the Advisory Committee and smaller working groups provided information about industry trends that may not be reflected in the Department of Labor data, credentials and degrees that are emerging as most promising in the field, on-the-ground implementation considerations for secondary and postsecondary programs, and future of work implications for the sector. The Advisory Committee further informed important decision-points in the Model Programs of Study process, including adjusting the Model of Programs of Study course map and promising credential endpoints, selecting strategic early college credit courses, and identifying key competencies for target courses in the Model Programs of Study currently lacking current statewide articulation. The culmination of EdSystems’ analysis and the input of the Advisory Committee is reflected in the draft Model Programs of Study and course competencies included within this Guide.

<sup>1</sup> U.S. Department of Labor, Career Onestop: [careeronestop.org/ExploreCareers/explore-careers.aspx](https://careeronestop.org/ExploreCareers/explore-careers.aspx), Illinois Department of Employment Security Virtual Labor Market Information, [www2.illinois.gov/ides](https://www2.illinois.gov/ides)

<sup>2</sup> Glasmeier, Amy K. Living Wage Calculator. 2020. Massachusetts Institute of Technology. [livingwage.mit.edu](https://livingwage.mit.edu)

<sup>3</sup> The “Living Wage” as of January 2021 for 1 Adult + 1 Child, which equaled \$26.27/hour for the state of Illinois. “Near” is defined as 85% of that statewide living wage, which is \$22.33/hour. In March of 2021, the Living Wage calculator updated its calculations for Illinois, but information presented in this guide reflects the wage levels as of January 2021, when the project team conducted its analysis.

<sup>4</sup> For the analysis of Architecture, Construction, and Energy, the community colleges surveyed were City Colleges of Chicago, College of DuPage, Elgin Community College, Illinois Central College, Illinois Eastern Community Colleges, Kankakee Community College, Lake Land College, and Rock Valley College.

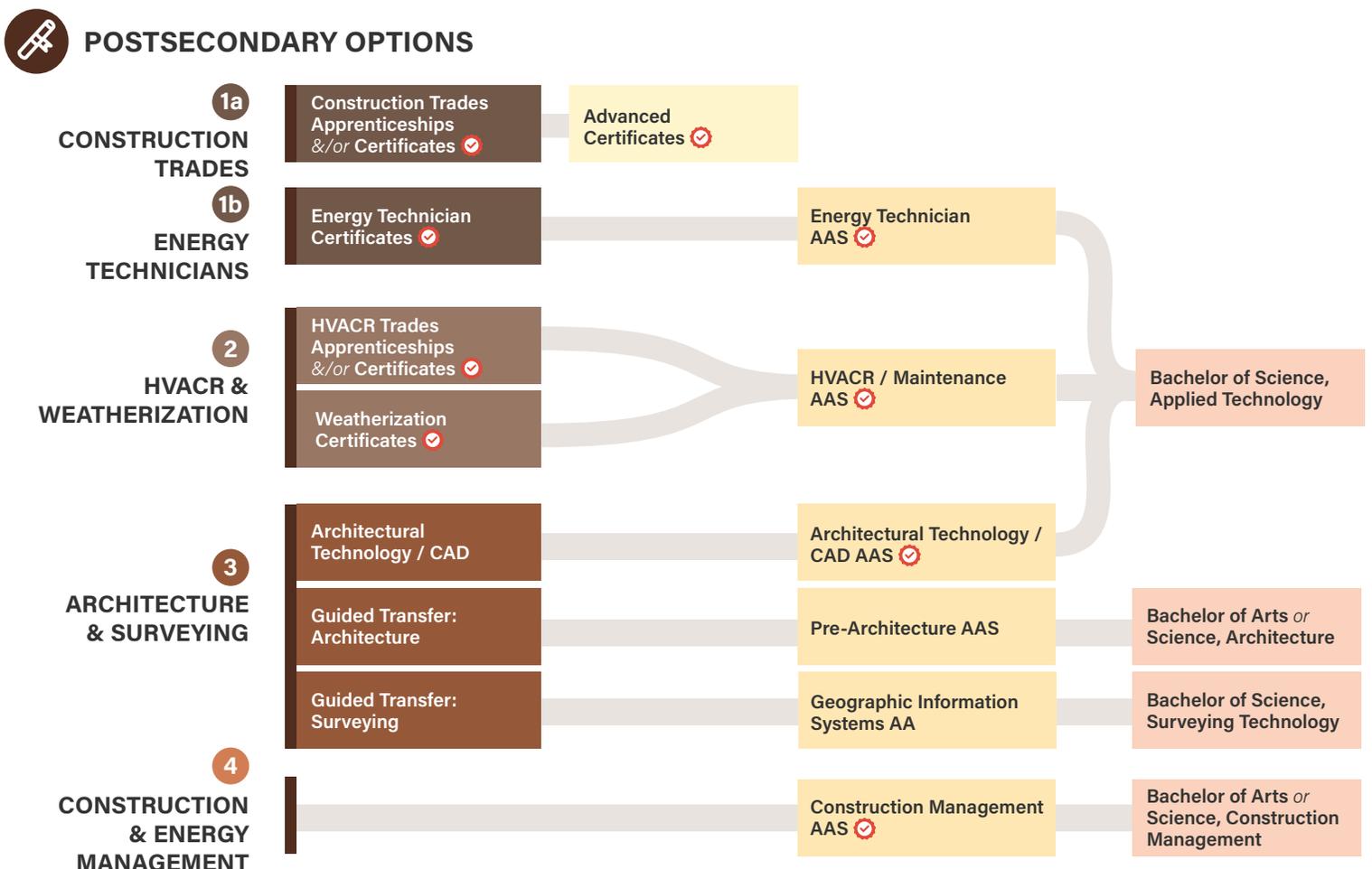
# Priority Occupations and Promising Credentials in Architecture, Construction, and Energy

Occupations in architecture, construction, and energy encompass an ever-growing array of well-paying career opportunities across Illinois. In the Chicago area, the Chicagoland Workforce Funders Alliance estimates there are more than 100,000 construction trades workers in the region, with 11,000 new hires expected annually through 2026.<sup>5</sup> Illinois is a leading state for jobs in the energy industry, with the state ranked 13th in the nation for the total number of solar jobs<sup>6</sup> and positioned as one of the top states in the nation for wind industry employment.<sup>7</sup> As both the State of Illinois and the federal government consider infrastructure and climate change investments to support the economic recovery from COVID-19, the continued availability of a qualified workforce for these occupational areas will continue to serve as an anchor for Illinois' economic growth and recovery.

## Promising Credential Program Categories

The project team's analysis of occupations and related postsecondary credentials in the architecture, construction, and energy sectors led to an identification of four overarching categories and additional subcategories:

1. **Trades and Technicians** pathways and credentials leading to hands-on, skilled positions relating to the installation and repair of various building and energy system projects. Subcategories include:
  - a. **Construction Trades**, involving a variety of occupations in the building trades such as carpenters, electricians, boilermakers, plumbers, and operating engineers.
  - b. **Energy Technicians**, involving the installation and repair of renewable energy systems, such as wind and solar, and electric and gas utility systems.



- HVACR & Weatherization** credentials for skilled labor positions as Heating, Ventilation, Air Condition, and Refrigeration technicians or as installers of weatherization and energy efficiency improvements for residential and commercial buildings.
- Architecture & Surveying** credentials that either prepare individuals for entry-level computer aided drafting and design (CAD), or that prepare students to transfer into bachelor's degree programs in architecture and surveying.
- Construction & Energy Management** credentials preparing students to actively manage complex construction and energy installation projects.

Although not depicted in the diagram, Engineering credentials are also critical for these occupational areas, which prepare students for a range of careers

to analyze, design, evaluate, and continuously improve complex manufacturing and industrial systems. Pathways to Engineering credentials are detailed in the [Illinois Models Programs of Study Guide: Manufacturing and Engineering](#).

### High-Priority Occupations

The high-priority occupations associated with each of these areas are identified in the table entitled Select Occupations, Wages, and Job Growth. As shown in this table, a wide range of occupations in the Construction Trades, Energy Technicians, and HVACR & Weatherization areas both meet the living wage criteria and project substantial growth, both in percentages and total projected openings. While the median hourly wage for Solar Photovoltaic Installers falls just below the "Near Living Wage" threshold, this occupation is projected to see



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4. Estimate derived from data published in [National Solar Jobs Census 2019](http://NationalSolarJobsCensus2019)

substantial growth over the next decade and is therefore included in the analysis. This table also demonstrates the substantial job growth projected for occupations in the Construction and Energy Management area, in contrast to substantially fewer openings in Architecture, CAD, and Surveying occupations.

### Levels of Education Needed

The levels of education needed for the various pathways in the Model Programs of Study vary greatly. More than 60% of carpenters, pipefitters, and installers have no postsecondary education, making this pathway highly accessible for students receiving industry credentials and training in high school. Entry-level positions for energy technicians, HVACR, and weatherization are accessible after high school graduation or upon completion of a short-term postsecondary credential. A key consideration for individuals seeking to enter the construction trades after high school is whether to enter directly into entry-level non-union employment, seek a union apprenticeship, or pursue postsecondary education at a community college. While individuals can enter directly into entry-level, low-wage positions directly after high school, an apprenticeship or further education is generally required for higher-skill and higher-paying occupations. Other considerations for advising students on union vs. non-union pathways are detailed on p. 11. In the construction trades, progression into supervisory and project management roles is typically through on-the-job training and related industry credentials, rather than through attainment of an associate or bachelor's degrees.

Careers in Architectural Technology / CAD typically require at least a long-term certification (e.g., 40 or more credits) or an Associate of Applied Sciences (AAS) degree. As completion of the AAS better positions workers to enroll in a Bachelor of Science (BS) degree program at a later stage in their careers, the Model recommends an AAS in this pathway.

Several Illinois universities offer a BS degree in Applied Technology that articulates to AAS degrees in the Model.<sup>8</sup> Whenever possible, community colleges should ensure that AAS degrees articulate to these BS options, recognizing that students may need targeted instructional supports in mathematics to complete the math sequence requirements typical of BS degrees.

Architects must be licensed by the Illinois Department of Financial and Professional Regulation, which requires completion of a professional architecture degree program approved by the National Architectural Accrediting Board (NAAB). Typically, students must complete a pre-professional bachelor's degree program in architecture, and then a NAAB-accredited Master of Architecture

program requiring an additional 2-3 years of study. The Model incorporates a Pre-architecture AAS program, which several Illinois community colleges offer to articulate into baccalaureate architecture programs within the Illinois university system. Pre-architecture AAS programs ensure students meet the requirements for junior year studio placement; a key milestone necessary for a student to complete the program in two additional years. Surveyor positions typically require a Bachelor of Science degree and is therefore depicted in the Model as a Guided Transfer pathway from an Associates to a BS with a major in Surveying Technology. Surveyors must also attain state licensure as a Professional Land Surveyor, following a Surveyor-in-Training period.

Occupations in Construction and Energy Management typically require a bachelor's degree. The Advisory Committee noted that individuals with an AAS can enter certain roles in construction and energy management, but these individuals would need extensive on-the-job training and, most likely, additional education for continued advancement into higher paying roles.

### Advisory Committee Considerations

The Advisory Committee emphasized the need for students to leave high school with a fundamental set of both business and construction skills foundational to all pathways. The Advisory Committee noted the growing role of technology in all areas of construction and design, and that current technologies must be integrated into all stages of the pathway model. The Advisory Committee also emphasized the need for students to have a strong understanding of reading schematics (including traditional "blueprints" and electronic versions), suggesting that this skillset should be embedded across pathways courses instead of through a single course on blueprint reading. In the construction trades, the Committee recommended informing students of the differences between union and non-union pathways, and the requirements and expectations for union apprenticeships. Finally, the Advisory Committee recommended that pathways expose students to occupations in construction and energy management, as areas that provide significant job opportunities but are not often presented to high school students.

<sup>5</sup> Chicagoland Workforce Funders Alliance. Construction Trades Guidebook. December 2020. Available at [careerpathways.net/wordpress/wp-content/uploads/2021/01/Construction-Trades-Guidebook.pdf](https://careerpathways.net/wordpress/wp-content/uploads/2021/01/Construction-Trades-Guidebook.pdf).

<sup>6</sup> Solar Jobs Census 2019: Illinois – The Solar Foundation. Available at [thesolarfoundation.org/solar-jobs-census/factsheet-2019-il/](https://thesolarfoundation.org/solar-jobs-census/factsheet-2019-il/) (last visited February 23, 2021).

<sup>7</sup> Joel Jaeger. What Are the Top 10 States for Clean Energy Jobs? World Resources Institute. April 6, 2017. [wri.org/blog/2017/04/what-are-top-10-states-clean-energy-jobs](https://wri.org/blog/2017/04/what-are-top-10-states-clean-energy-jobs)

<sup>8</sup> Examples include NIU's BS in Technology, SIU's Industrial Management and Applied Engineering Degree, or GSU's BA in Manufacturing Management.



## Union vs. Non-Union Pathway Opportunities

School districts and colleges preparing students for the construction trades need to ensure that students leave high school with a strong understanding of both union and non-union pathways.

The following information is adapted from a September 2020 report prepared for the Chicagoland Workforce Funders Alliance, *Pathways in the Chicago-Area Building Trades*,<sup>9</sup> along with information provided by the Advisory Committee.

- Estimates of the unionization rate of Illinois construction workers varies significantly by source, ranging from one-third to one-half of construction workers (with the remainder non-union).
- In the construction trades, hourly wages vary significantly for union and non-union positions. Non-union workers typically work for smaller contractors, on smaller projects.
  - The starting hourly wage for non-union positions are typically close to minimum wage, while union trade apprenticeships start at 50% of union journey worker wage (\$17 - \$25/hour in the Chicago area)
- Annual compensation levels will depend on the number of hours worked, and young people must factor in expected hours when determining compensation. Some non-union roles with lower hourly wages may be able to provide consistent work hours if the hiring company has a consistent workflow.
- Union apprenticeships involve from 3 to 5 years of near full-time paid work experience combined with extensive schooling during the first 2 years. While union apprenticeships require years of training, the unions are seeking individuals for their programs that can add value on “day one.”
- The typical apprenticeship program requires apprentices to be 18; have a high school diploma or GED; have a driver’s license and access to a car (for transportation to both training locations and jobsites); pass an aptitude test that typically involves questions on simple algebra, unit conversions, mechanical reasoning, and reading comprehension; pass a drug test; demonstrate physical fitness; and demonstrate motivation and relevant experience through an interview.
- Unions limit the number of applicants and can be highly competitive. Some have as many as 5,000 annual applicants for only a few hundred positions.
- Few trade apprentices begin immediately out of high school, with most beginning after age 21. However, it is unclear whether younger applicants are being filtered out, or whether younger people are not applying. High school pathway program coordinators should seek strong relationships with trade apprenticeship programs to increase opportunities for high school graduates to enter directly into trade apprenticeships after high school graduation. Entry-level positions with a non-union construction company can develop experience for individuals that intend to later apply to an apprenticeship, as can training through community college programs.
- The vast majority of construction trades training outside of union apprenticeships is for electricians, HVACR, and welding. Community college programs in the construction trades and HVACR either provide preparation for an apprenticeship program or non-unionized entry-level employment in the trades or with utilities.

<sup>9</sup> Source: Rob Paral & Associates. Pathways in the Chicago-Area Building Trades. September 2020: [chicagoworkforcefunders.org/wp-content/uploads/2021/01/Construction-Report-Jan-2021.pdf](https://chicagoworkforcefunders.org/wp-content/uploads/2021/01/Construction-Report-Jan-2021.pdf)

# Programs of Study Sequence Description

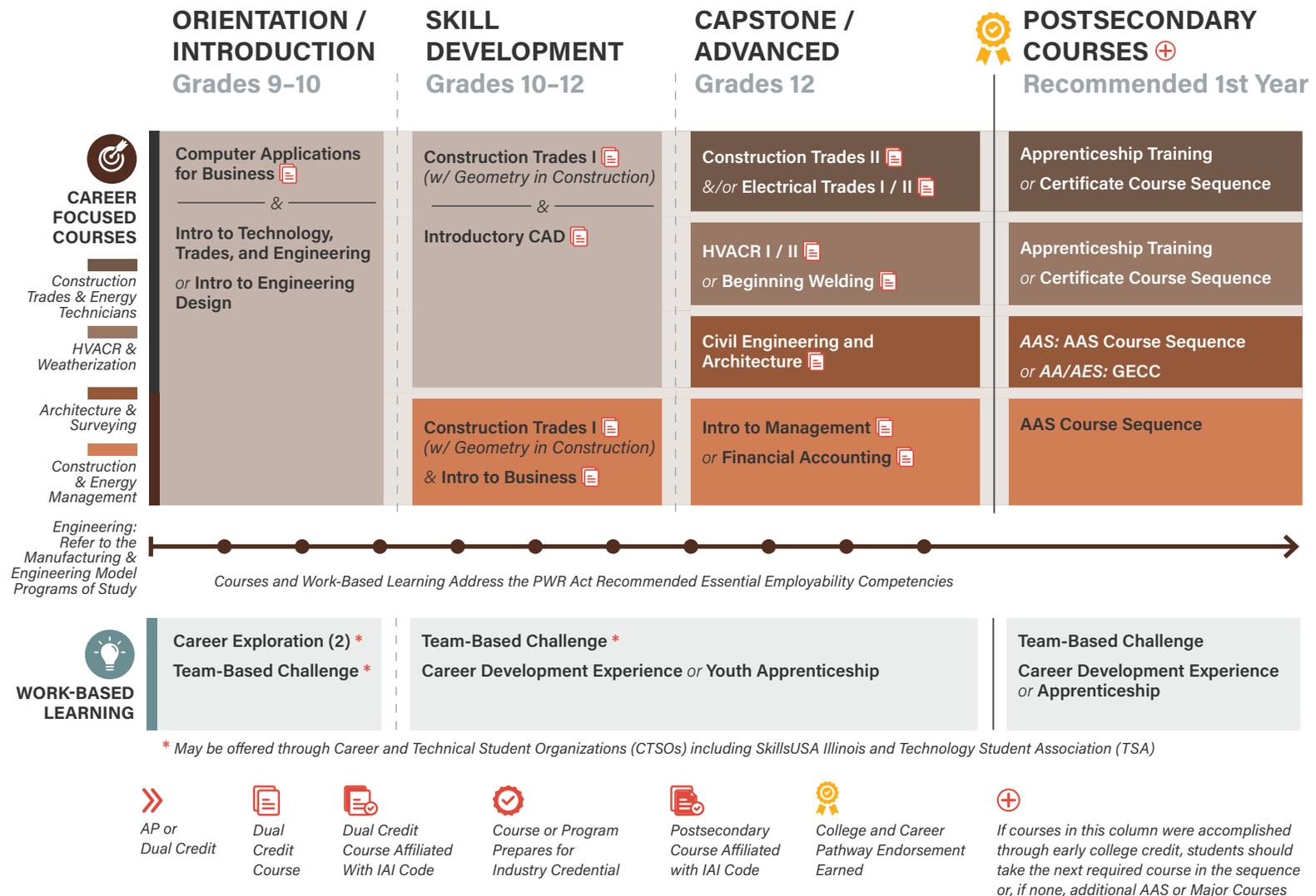
The Model Programs of Study for Architecture, Construction, and Energy begin in high school by addressing foundational skills and knowledge across all pathways, and then, at the Skill Development and Capstone level, branch into separate pathways for: (1) Construction Trades and Energy Technicians; (2) HVACR and Weatherization; (3) Architecture and Surveying; or (4) Construction and Energy Management.

Within postsecondary, students are prepared to pursue promising credentials in all of these areas, with trades apprenticeships serving as an option for the Construction Trades and HVACR pathways. In most areas, students can continue the Model Programs of Study sequence through stackable credentials and degrees to a Bachelor of Science degree program.

While not depicted in this Guide, engineering is another key occupational area for these sectors, and students interested in these fields should also be exposed to engineering pathways detailed in the [State of Illinois Model Programs of Study Guide for Manufacturing and Engineering](#).

## High School Career-Focused Instructional Sequence and Related Work-Based Learning Overview

The career-focused instructional sequence in the Model Programs of Study for Architecture, Construction, and Energy builds from a set of courses providing an orientation to careers across the sectors and emphasizing key foundations skills, towards a set of Capstone/Advanced courses tailored to each of the separate pathways. Ideally, students would begin career awareness and exploration in the middle school grades then start the career-focused



instructional sequence with an orientation course in 9th grade. With an early start, students will have more openings in their schedule to complete Skill Development and Capstone options, to obtain significant early college credits, and to earn valuable industry credentials before high school graduation. As school districts and their community college partners develop the career-focused instructional sequence, they should ensure the high school coursework enables all students to attain the State's Cross-Sector Essential Employability and Entrepreneurial Competencies (see Appendix A). While important for all careers, the Essential Employability competencies are particularly critical for success in the construction trades.

The proposed package of courses at the Orientation and Skill Development levels provides students with information on an array of careers in the Architecture, Construction, and Energy sectors, includes courses that can typically be offered using high school facilities and instructors, and builds a general skillset needed for different careers across these sectors. The more advanced coursework at the Capstone level enables students to deeply explore a pathway of interest and develop skills needed for entry-level employment or further postsecondary education.

### **Orientation (Grades 9–10)**

The Model Programs of Study for Architecture, Construction, and Energy commences at the Orientation level with two suggested courses: a course focused on foundational computer applications and technology, and an introductory course providing a broad orientation to the field.

The first suggested course, focused on computer applications and technology, is the IAI-affiliated Computer Applications for Business. This course is designed for prospective business majors but applicable to all, aiming to train students in general software applications including word processing, spreadsheets, and internet access methods.<sup>10</sup>

The second suggested course provides a broad introduction to all pathways in the Architecture, Construction, and Energy sector grouping. Two course options are provided: Introduction to Technology, Trades, and Engineering (aligned to the ISBE Introduction to Technology and Engineering course title) or Introduction to Engineering Design (combining pathways orientation with an introduction to the design development process). While Introduction to Engineering Design is affiliated with an IAI course, it may be difficult for high schools to offer the IAI course due to the teacher qualification and course content requirements. Through either version of this introductory

course, (1) students should participate in multiple virtual and in-person site visits to employer locations to better understand authentic professional environments and have the opportunity to engage with adults in the field, and (2) students should be prepared to document their own personalized career pathway that leads to a promising credential defined in the Model.

### **Skill Development (Grades 10–12)**

The Skill Development course recommendations in the Model Programs of Study include (i) Construction Trades I for all students, across all pathways; (ii) Introductory CAD, for students in all pathways other than Construction and Energy Management; and (iii) Introduction to Business, for students in the Construction and Energy Management pathway.

The Construction Trades I course (or two-semester course sequence) provides all students in Architecture, Construction, and Energy pathways a strong foundation in safety, the design and construction process, measuring and scaling, and other foundational concepts for promising credentials in the field. A strong foundation in construction practices, processes, and principles is critical for students planning for a career in any of the proposed pathways, even if the student ultimately pursues a role in the business- or design-oriented pathways. The Model Programs of Study recommends integrating this course with Geometry in Construction, a course model where geometry curriculum is taught in the construction context, co-taught by a math and career and technical education teacher. Even if not taught as an integrated Geometry in Construction course, math competencies should be incorporated with reference to the State's Transition to Technical Math Content Competencies.<sup>11</sup>

The recommended Construction Trades I course competencies, detailed on p. 17 of this Guide, scaffold on to the Orientation-level courses to continue to emphasize awareness and understanding of career pathways in the field. It emphasizes application of safety, construction processes, and other basic concepts under close teacher direction, and should utilize authentic projects addressing realistic customer needs. Essential Employability competencies should be reinforced, with a priority emphasis on Communication, Problem-Solving, Initiative & Self-Drive, Reliability & Accountability, and Adaptability & Flexibility.<sup>12</sup>

Classroom instruction should include a team-based challenge that provides hands-on experience with, at minimum, fundamental construction techniques for framing,



drywalling, and finishing. These trade areas are more feasible for incorporation into a high school classroom, as opposed to areas such as masonry or machinery operation. Students may also gain hands-on experience through SkillsUSA Illinois or Technology Student Association of Illinois competitions.

In addition, students should attain the Occupational Safety and Health Administration (OSHA) ten-hour course completion card, which can be earned online through the CareerSafe program.<sup>13</sup> Some Illinois community colleges offer prior learning to students who enroll with this credential.

At the Skill Development level, the Model Programs of Study also recommends that students enroll in either Introductory CAD or, for students in the Construction and Energy Management pathway, Introduction to Business. Introductory CAD provides an introduction to computer aided drafting and design and its role in various technical occupations. The course's recommended competencies, detailed on p. 19, include a progression from fundamental principles of hand drawing to the basics of 2D CAD operations, with a preliminary introduction to 3-D CAD (with students learning more advanced 3D CAD operations in a subsequent course). This course should also provide students with an understanding of how different drawings are used for different trades, with a basic overview of the construction drawing process.

For students in the Construction and Energy Management pathway, Introduction to Business is a recommended Skill Development course that provides students with a foundational understanding of business and management principles applicable across multiple business-related postsecondary programs. While Intro to Business is recommended, students in the Construction and Energy Management pathway with sufficient schedule flexibility should also consider Introductory CAD as an additional elective at the Skill Development level.

### Capstone

At the Capstone level, students engage in advanced topics relating to their individualized postsecondary pathway direction.

The Capstone recommendations for students with a Construction Trades and Energy Technician focus are to either complete Construction Trades II, or, for students interested in pursuing an electrician career, Electrical Trades I/II.

The Construction Trades II course (or two-semester course sequence) develops students' advanced construction skills, either for entry-level employment, to continue into an apprenticeship or postsecondary program, or as a foundation for other related programs such as Energy Technicians or HVACR. As further detailed in the recommended course competencies on p. 18, students in this course should be supported to make an informed decision as to whether to pursue postsecondary training and employment in the trades and be prepared for local apprenticeship application processes and requirements. The course's other competencies scaffold upon those introduced in Construction Trades I to prepare students for either entry-level employment or further postsecondary education and training. The course competencies intentionally emphasize knowledge needed for energy technician roles, including an understanding of work at height expectations typical for solar and wind energy jobs, and introduce students to the relationship between building envelopes and systems to energy utilization and efficiency.<sup>14</sup> At the Capstone level, all students should complete a Career Development Experience (CDE) of at least 60 hours in length. As their schedules permit, students can participate in a for-credit cooperative class to obtain work experience in addition to the career-focused courses shown in the pathway model.

The Capstone recommendations for pathways other than Construction Trades and Energy Technicians enable

students to engage in advanced topics specific to the pathway, with coursework aligned to community college program sequences. In the Construction & Energy Management pathway, students should be offered Intro to Management because that course is broadly applicable to construction management and business sequences.

### Recommended High School General Education Courses

The Model Programs of Study for Architecture, Construction, and Energy identifies several key considerations for general education coursework:

- In **science**, students should complete physics, where possible, as either Advanced Placement or dual credit. At the senior year, Survey of Renewable Energy was identified by the Advisory Committee as an emerging dual credit or dual enrollment course opportunity

and is included in the Model. This course involves the exploration of environmental, social, and basic technological issues relating to renewable energy technologies.

- In **math**, students should complete the highest math course possible in a calculus-based course sequence to be prepared for the full range of career options in Architecture, Construction, and Energy. Districts should consider math courses that contextualize math application in career fields, such as Geometry in Construction for all students in 9th or 10th grade, and Technical Math courses emphasizing application for students planning to pursue a career in the trades or as technicians. Students that do not demonstrate readiness for an early college math course during their senior year of high school should enroll in a Transition to STEM Transitional Math Course that guarantees

#### ORIENTATION / INTRODUCTION Grades 9-10

#### SKILL DEVELOPMENT Grades 10-12

#### CAPSTONE / ADVANCED Grades 12

#### POSTSECONDARY COURSES Recommended 1st Year

	ORIENTATION / INTRODUCTION Grades 9-10	SKILL DEVELOPMENT Grades 10-12	CAPSTONE / ADVANCED Grades 12	POSTSECONDARY COURSES  Recommended 1st Year
 <b>SCIENCE</b>	Science Sequence	Science Sequence AP Physics 	Science Sequence Survey of Renewable Energy 	Science Sequence
 <b>SOCIAL SCIENCE</b>	Social Science Sequence	Social Science Sequence	Social Science	Social Science
 <b>MATH</b>  <i>Trades, Technicians, HVACR Other Pathways</i>	Algebra/Geometry (Geometry in Construction)	Geometry (Geometry in Construction)/Algebra 2	Technical Math  Transitional Math: STEM	Technical Math College Algebra
	Algebra/Geometry (Geometry in Construction)	Algebra 2/Pre-Calculus	College Algebra  AP Calculus  AP Stats 	College Algebra/Trig  Calculus
 <b>ENGLISH</b>	English Sequence	English Sequence	AP Language & Composition  English Composition I & II 	English Composition I & II 

  
AP or  
Dual Credit

  
Dual  
Credit  
Course

  
Dual Credit  
Course Affiliated  
With IAI Code

  
Course or Program  
Prepares for  
Industry Credential

  
Postsecondary  
Course Affiliated  
with IAI Code

  
College and Career  
Pathway Endorsement  
Earned

  
If courses in this column were accomplished through early college credit, students should take the next required course in the sequence or, if none, additional AAS or Major Courses

placement into College Algebra at the postsecondary level. Students pursuing postsecondary credentials relating to the Trades and Technicians pathways may instead consider a Technical Transitional Math Course if it guarantees placement into the required math for that credential at the partner community college.

- In **English**, students prepared for college-level coursework in their senior year should enroll in a dual credit English Composition course (if available) or Advanced Placement English Language and Composition. If students are not prepared for college-level coursework, students should enroll in a Transitional English course that, upon successful completion, guarantees placement into the partner community college's English Composition course.

### Recommended First Year Postsecondary Courses

The recommended first-year postsecondary courses in the Model Programs of Study for Architecture, Construction, and Energy build upon the knowledge and skills recommended at the Capstone level. As described in Union vs. Non-Union Pathway Opportunities (p. 11), students pursuing careers in the construction trades should carefully consider whether to apply to a trades apprenticeship or enroll in a postsecondary certificate program.

As is recommended at the high school level, community colleges should pursue opportunities to integrate and align career-focused coursework and work-based learning opportunities.

In the general education course areas, students will take the required 100-level courses. If the 100-level courses have been accomplished through early college credit, students will take the next required course in the subject or, if none, additional AAS or courses in their major.

<sup>5</sup> Chicagoland Workforce Funders Alliance. Construction Trades Guidebook. December 2020. Available at [careerpathways.net/wordpress/wp-content/uploads/2021/01/Construction-Trades-Guidebook.pdf](https://careerpathways.net/wordpress/wp-content/uploads/2021/01/Construction-Trades-Guidebook.pdf).

<sup>10</sup> Illinois Articulation Initiative. IAI Major Course Description: BUS902. 2017. Retrieved from [transfer.org/OUCampusIAI/courses/listMajorCourses.aspx?desc=BUS902](https://transfer.org/OUCampusIAI/courses/listMajorCourses.aspx?desc=BUS902)

<sup>11</sup> Postsecondary & Workforce Readiness Act Statewide Transitional Math Competencies and Policies. Available at [edsystemsniu.org/wp-content/uploads/2021/02/Transitional-Math-Competencies-and-Policies-20210205.pdf](https://edsystemsniu.org/wp-content/uploads/2021/02/Transitional-Math-Competencies-and-Policies-20210205.pdf).

<sup>12</sup> Recommended Technical and Essential Employability Competencies for College and Career Pathway Endorsements. Available at [edsystemsniu.org/wp-content/uploads/2020/05/PWR-Report-April2020-Final.pdf](https://edsystemsniu.org/wp-content/uploads/2020/05/PWR-Report-April2020-Final.pdf).

<sup>13</sup> [careersafeonline.com](https://careersafeonline.com)

<sup>14</sup> One curricular resource for energy efficiency concepts is the energy code curriculum provided by the Smart Energy Design Assistance Center, available at [smartenergy.illinois.edu/community-college-energy-code/](https://smartenergy.illinois.edu/community-college-energy-code/).



## Strategic Dual Credit Courses: Competency Descriptions

EdSystems and ICCB convened a stakeholder Advisory Committee of secondary, postsecondary, and private sector representatives to vet the Model Program of Study recommendations. A smaller working group further convened to identify key competencies for the targeted early college courses in the Model Program of Study currently lacking current statewide articulation. In Architecture, Construction, and Energy, these courses are Construction Trades I&II, and Introduction to Computer Aided Drafting (CAD).

### CONSTRUCTION TRADES I

*Recommended for all students in ACE pathways*

**Career Awareness:** Students can demonstrate awareness of the career pathways in architecture, construction, and energy in order to plan a personalized pathway leading to a promising credential.

Students have engaged in career exploration activities that include guest speakers and virtual and in-person site visits with architecture and construction firms, renewable energy companies, and utilities.

**Safety Mindset:** Students can use their awareness of safety practices and PPE in order to demonstrate a safety mindset when navigating a construction environment.

Students are prepared to attain an OSHA 10-hour course completion card.

**Introduction to Tools:** Students can use their understanding of simple hand and power tools in order to identify, correctly set-up, and operate them.

**Material Handling:** Students can use their knowledge of material types, standard sizes, and safe handling practices to identify and utilize materials needed for basic project types.

**Measuring and Scaling:** Students can use their understanding of measurement systems and scaling concepts to demonstrate proper use of measuring tools, as well as conversion between decimal and fraction units.

**Design and Construction Process:** Students can use their awareness of basic concepts in design and construction in order to describe the steps in a residential construction project, with an introduction to, at minimum, blueprints, floor plans, foundations, carpentry, plumbing, electrical, HVAC, and masonry systems.

**Layout and Schematic Reading:** Students can use their understanding of basic project layout and schematic concepts to differentiate among schematics needed for different trade areas (e.g., carpentry, electrical, plumbing) and apply their understanding in authentic situations.

**Cost Estimation:** Students can apply of basic cost estimation principles to estimate labor and material costs in an authentic situation.

**Students have completed** at least one team-based challenge involving an authentic construction project that involves hands-on experience with, at minimum, framing, drywalling, and finishing.

### CROSS-CUTTING COMPETENCIES

#### **Employability Competencies:**

- Generally, see the Statewide Recommended Essential Employability Entrepreneurial Competencies (p. 20 of this Guide)
- For ACE pathways, priority emphasis on: Communication; Problem-Solving; Initiative

& Self-Drive; Reliability & Accountability; Adaptability & Flexibility

#### **Technical Math:**

- Generally, see the [Statewide Transitional Math, Competencies, and Policies](#) – Transition to Technical Math Content Competencies (p. 15-18)

## CONSTRUCTION TRADES II

*Scaffolding upon Construction Trades I; tailored to lead into both construction trades and energy technician pathways*

**Career Decision Making:** Students can use their understanding of the physical demands, education requirements, transportation needs, and earning potential of various construction career pathways in order to make an informed decision as to whether to pursue postsecondary training and employment in a particular pathway.

Students are aware of and prepared for local apprenticeship application, interview, testing, and fitness demonstration processes and requirements.

**Safety Compliance:** Students can use their knowledge of safety principles and regulations in order to maintain a secure work environment, safely engage in construction processes, and comply with local, federal, and jobsite health and safety demands.

Students are prepared to attain or renew CPR and First Aid certifications from an accrediting body.

**Work at Height:** Students can use their understanding of ladders, scaffolding, safety harnesses, and rigging to engage in safe work at height construction practices; students understand work at height expectations in various trade areas.

If work at height cannot be safely experienced or a classroom setting or is restricted by insurance

policies, students may be able to utilize virtual reality and augmented reality systems to experience work at height expectations in different trade areas.

**Cost Estimation:** Students can use their knowledge of material and labor costs and technical math principles to accurately estimate both the material and labor costs of an authentic project.

**Energy Utilization and Efficiency:** Students can apply their understanding of building envelopes and mechanical, electrical, and plumbing (MEP) systems in an authentic assessment of impacts on a building's energy utilization and efficiency.

**Construction Application:** Students can use their knowledge of schematic reading and apply fundamental construction skills and techniques to, with minimal supervision, interpret the requirements of schematics and safely construct or install an authentic project.

Ideally, students are allowed to choose an area of specialization such as carpentry, plumbing, electrical, or masonry.

**Students have engaged in** a career development experience of a minimum of 60 hours with a construction employer.

## CROSS-CUTTING COMPETENCIES

*Foundations of Production & Manufacturing Processes (Minimum 3–6 Dual Credit Hours)*

### Employability Competencies:

- General, see the State's Recommended Essential Employability Competencies (p. 6)
- For ACE pathways, priority emphasis on: Communication; Problem-Solving; Initiative & Self-Drive; Reliability & Accountability; Adaptability & Flexibility

### Technical Math:

- Generally, see the Statewide Transitional Math, Competencies, and Policies — Transition to Technical Math Content Competencies (p. 15-18)

## INTRODUCTION TO COMPUTER AIDED DRAFTING (CAD)

### *Key Competencies*

Students can use their understanding of the construction drawing process and various trades to read and interpret authentic architectural and engineering drawings, including drawings from various trades areas.

**CAD Hardware:** Students can use their knowledge of a CAD workstation to identify and use its hardware configurations.

**Basic Drawing Functions:** Students can use their knowledge of CAD software to construct and revise 2-D Drawings, including basic draw, editing, and layering.

**View Selections:** Students can utilize their understanding of appropriate CAD drawing views to choose among orthographic, section, auxiliary, and pictorial where appropriate.

**Notation:** Students can produce appropriate drawing notes, symbols, and schedules.

**Dimensioning and Tolerancing:** Students can apply their understanding of basic dimensioning and tolerancing concepts in authentic scenarios.

**2D and 3D Comparison:** Students can demonstrate an understanding of how 2D and 3D CAD operations and software are each used in authentic scenarios and processes.

**Reading and Interpretation:** Students can use their understanding of the construction drawing process and various trades to read and interpret authentic architectural and engineering drawings, including drawings from various trades areas.

# APPENDIX A: Statewide Essential Employability and Entrepreneurial Competencies

TOP 10 CROSS-SECTOR ESSENTIAL EMPLOYABILITY COMPETENCY STATEMENTS	
<b>Teamwork &amp; Conflict Resolution</b>	Students can use their understanding of working cooperatively with others to complete work assignments and achieve mutual goals.
<b>Communication</b>	<p><b>Verbal:</b> Students can use their understanding of English grammar and public speaking, listening, and responding, convey an idea, express information, and be understood by others.</p> <p><b>Written:</b> Students can use their understanding of standard business English to ensure that written work is clear, direct, courteous, and grammatically correct.</p> <p><b>Digital:</b> Students can use their understanding of email, keyboarding, word processing, and digital media to convey work that is clear, direct, courteous, and grammatically correct.</p>
<b>Problem Solving</b>	Students can use their critical thinking skills to generate and evaluate solutions as they relate to the needs of the team, customer, and company.
<b>Decision Making</b>	Students can use their understanding of problem solving to implement and communicate solutions.
<b>Critical Thinking</b>	Students can use their understanding of logic and reasoning to analyze and address problems.
<b>Adaptability &amp; Flexibility</b>	Students can use their understanding of workplace change and variety to be open to new ideas and handle ambiguity.
<b>Initiative &amp; Self-Drive</b>	Students can use their understanding of goal setting and personal impact to achieve professional goals and understand personal impact.
<b>Reliability &amp; Accountability</b>	Students can use their understanding of commitment, time management, and follow through to ensure that a professional team functions properly and meets collective goals.
<b>Cultural Competence</b>	Students can use their understanding of diversity and inclusion to communicate and work effectively across a multitude of abilities, cultures, and backgrounds.
<b>Planning &amp; Organizing</b>	Students can use their understanding of time management to plan effectively and accomplish assigned tasks.

## ENTREPRENEURIAL COMPETENCIES

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**Principles of Entrepreneurship**

Students can apply their understanding of the process and characteristics of business development and promotion in order to apply strategies of innovation to personal and professional business pursuits.

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**Innovation & Invention**

Students can use their understanding of idea generation, design thinking, product and business development in order to introduce and process new and effective ideas.

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**Growth Mindset**

Students can use their understanding of learning from challenges, set-backs, and failure in order to adapt strategies and continue efforts to achieve personal goals.



## APPENDIX B: Advisory Committee Membership

### **Craig Anz**

Associate Professor  
Southern Illinois University

### **Jeff Bott**

CTE Division Head  
Buffalo Grove High School

### **John Cabage**

Associate Professor & Construction Management Coordinator  
Eastern Illinois University

### **Kristie Conklin**

Workforce Development Contractor  
ComEd

### **Kimberly Erskine**

Workforce Development Manager  
Ameren

### **Bridget French**

Executive Director of College & Career Readiness  
Rockford Public Schools

### **Angela Gerberding**

Associate Director for Integrated Career Programs  
ICCB

### **Chris Gordon, PhD**

Associate Dean, School of Engineering  
Southern Illinois University Edwardsville

### **Michael Hartge**

Senior Manager, Policy  
Hire 360 Chicago

### **Sam Herr**

CEO  
Renewal by Andersen - Central IL

### **Eric Hill**

Executive Director  
SkillsUSA of Illinois

### **Randy Hines**

Assistant Professor Computer Aided Design & Drafting  
Waubonsee Community College

### *Board Member*

Illinois Design Educators Association

### **Sana Jafi**

Executive Director  
Chicago Learning Exchange

### **Nicole Joerger**

Associate Director for CTE  
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### **Luke Karner**

Pathways Program Manger  
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### **Patrick Klette**

Electrical Technology Program Coordinator  
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### **Eric Lasky**

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Ridgewood High School

### **Steven Lenz**

Chair, Heating and Air Conditioning Engineering Technology  
College of Lake County

### **Scott Loberg**

VP Education Safety  
Associated Builders & Contractors, Inc.

### **Dave Loomis**

Director, Center for Renewable Energy  
Illinois State University

### **Lucretzia Jamison**

Dean, Dawson Technical Institute  
City Colleges of Chicago Kennedy-King

### **Alicia Martin**

President & CEO  
Associated Builders & Contractors, Inc.

### **Chris Merrill**

Executive Director  
Illinois TSA

### **Uzma Noormohamed**

Program Director  
Illinois Science and Energy Innovation Foundation

### **David Osborne**

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### **Kevin Rodgers**

Director, Energy Management and Retail  
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### **Margi Schiemann**

Director, Infrastructure Programs and Support  
Nicor

### **Clint Taylor**

District Council Business Manager  
Illinois Laborers' & Contractors Joint Apprenticeship &  
Training Program

### **Whitney Thompson**

Senior Director for CTE  
Illinois Community College Board

## **Lead Education Systems Center Staff**

### **Jon Furr**

Executive Director

### **Juan Jose Gonzalez**

Pathways Director