

Program of Study Justifications for Architecture & Construction

Program of Study	Page
Architectural & Engineering Design	2
Interior Design	8
Mechanical, Electrical, & Plumbing (MEP)	12
Residential & Commercial Construction	20
Structural Systems	27

Architectural & Engineering Design

2016-17 Program of Study	Level 1	Level 2	Level 3	Level 4
Architectural & Engineering Design	Architectural & Engineering Design I (6037)	Architectural & Engineering Design II (6039)	Architectural & Engineering Design III (5927)	Engineering Practicum (6141) -or- AP Calculus (3127, 3139, or 3128) -or- AP Physics (3238, 3239, 3234, or 3240)

Description

The *Architectural & Engineering Design* program of study prepares students for a variety of engineering and design professions including architectural, civil, or mechanical design. Students will develop problem-solving and critical-thinking skills by identifying the relationship between available resources and requirements of a project/problem to accomplish realistic planning. Students will employ basic methods of data collection and analysis to provide potential clients with appropriate information for projects. As they progress through the program of study, students create design solutions for increasingly sophisticated problem sets, presenting information through various modes of visual communication such as drawing, rendering, and modeling in combination with verbal and written communication. In the third level course, students may focus in architectural or mechanical design based on students' career interest and/or needs of the local industry.

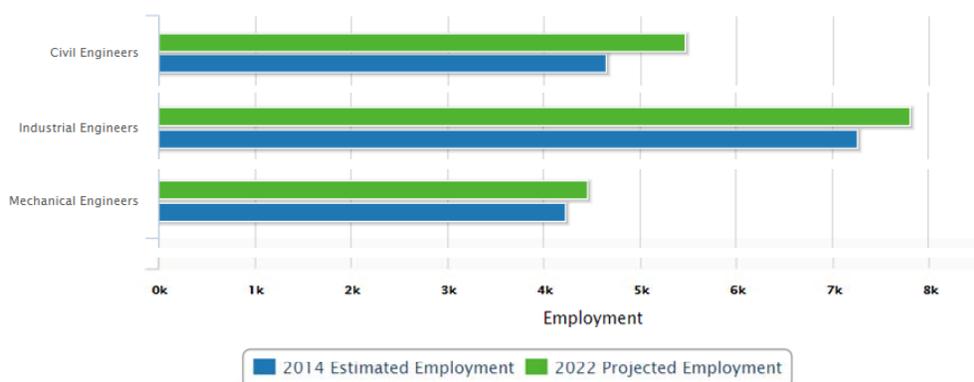
Students will have the opportunity to participate in the *Engineering Practicum* course which places students with industry partners to complete a design project, report the results, and present their project before an audience. Students have the option to complete *AP Physics* or *AP Calculus* as an alternative to the *Engineering Practicum* course. Additionally, students may gain job experience while still in high school through programs such as ACE mentor, local and CTSO competitions, and work-based learning. Some postsecondary institutions will award credit for students who obtain the ADDA certification. Other dual credit/dual enrollments opportunities may be established with local postsecondary institutions.

Job Outlook

Overview

The architecture and engineering occupation group is projected to grow by 8 percent in Tennessee between 2014 and 2022 with a total annual average of 1,475 openings. Industrial engineers, civil engineers, and mechanical engineers are projected to have the most annual average openings in the state. Higher growth and higher pay is projected for occupations which require bachelor’s degrees or higher in this group. Job opportunities are strongest in urban and surrounding areas in Tennessee.¹

Figure 1. Long Term Employment Projections in Tennessee (2014-2022)



Nationally, employment in architecture and engineering occupations is projected to grow at slower rate with 2.3 percent growth between 2014 and 2024. In 2024, approximately 2.6 million are projected to be employed in the occupation group in the U.S. with 67,200 job openings between 2014 and 2024.²

By Occupation

Industrial engineers, civil engineers, and mechanical engineers are projected to see the most openings in Tennessee between 2014 and 2022. **Figure 1** lists occupations with 35 or more openings projected in the group. **Figure 2** lists the architecture & engineering occupations with the most job openings nationally. Industrial engineers, civil engineers, and mechanical engineers are projected to have the most annual average openings nationally as well; however, industrial engineers rank first in

¹ Tennessee Department of Labor and Workforce Development. (2015). Employment Security Division, *Employment Figures*. Retrieved from <https://www.jobs4tn.gov/vosnet/Default.aspx>.

² Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec.

17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

Tennessee and third nationally. For industrial engineers, Tennessee ranks 5th nationally for the highest concentration with a location quotient of 1.61 and 7,770 employed in 2014.³

Figure 1. Architecture & Engineering Occupations with the Most Annual Average Openings in Tennessee (2014-2022)

Occupation	Total Percent Change	Annual Avg. Openings	TN 2014 Median Wage	Education Level
Industrial Engineers	7.5%	280	\$77,398	Bachelor's
Civil Engineers	17.6%	215	\$86,719	Bachelor's
Mechanical Engineers	5.3%	170	\$82,210	Bachelor's
Architectural and Engineering Managers	9.2%	90	\$113,650	Bachelor's
Electrical Engineers	7.5%	80	\$85,803	Bachelor's
Engineers, All Other	10.1%	60		Bachelor's
Electrical and Electronic Engineering Technicians	0.1%	55	\$53,320	Associate's
Architects, Except Landscape and Naval	12.7%	50	\$65,505	Bachelor's
Electronics Engineers, Except Computer	17.3%	50	\$84,330	Bachelor's
Industrial Engineering Technicians	1.1%	45	\$48,180	Associate's
Environmental Engineers	17.1%	40	\$87,408	Bachelor's
Surveying and Mapping Technicians	12.4%	40	\$38,891	HS Diploma
Nuclear Engineers	8.8%	40	\$114,110	Bachelor's
Mechanical Engineering Technicians	7.5%	35	\$51,770	Associate's

Figure 2. Top 8 Architecture & Engineering Occupations with the Most Annual Average Openings Nationally (2014-2024)

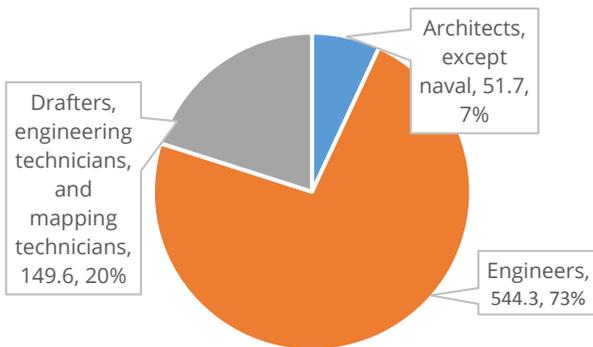
Occupation	Total Percent Change	Annual Avg. Openings
Civil Engineers	8.4%	106,700
Mechanical Engineers	5.3%	102,500
Industrial Engineers	5.3%	72,800
Architectural and Engineering Managers	2.0%	59,500
Electrical Engineers	1.0%	41,100
Electrical and Electronic Engineering Technicians	-2.0%	34,100
Electronics Engineers, Except Computer	-1.4%	30,300
Architects, Except Landscape and Naval	6.9%	26,300

³ Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics. *Occupational Employment and Wages, May 2014. (17-2112 Industrial Engineers)*. Retrieved from <http://www.bls.gov/oes/current/oes172112.htm>.

By Education Level

Higher growth and higher pay is projected for occupations which require bachelor's degrees or higher in this group (engineers, architects, designers), while slight decline overall is projected for occupations which typically require an associate's degree or less, such as drafters. Many drafters will still be needed in the coming years, with 25,800 openings projected in the nation from 2014 to 2024, according to the Bureau of Labor Statistics, but they will only make up 20 percent of all openings and the occupation group is declining by 3 percent overall. The graph below illustrates that the majority of job openings in this occupation group will be in areas that require a bachelor's degree or higher.

Figure 3. Job openings due to growth and replacements in U.S. for architecture and engineering occupations (in thousands), 2012-22



By Region

Job openings are available in all regions of the state; however, more opportunities are available in urban and surrounding areas.

Figure 4. Annual Average Openings for Architecture & Engineering Occupations in Tennessee, 2014-2022

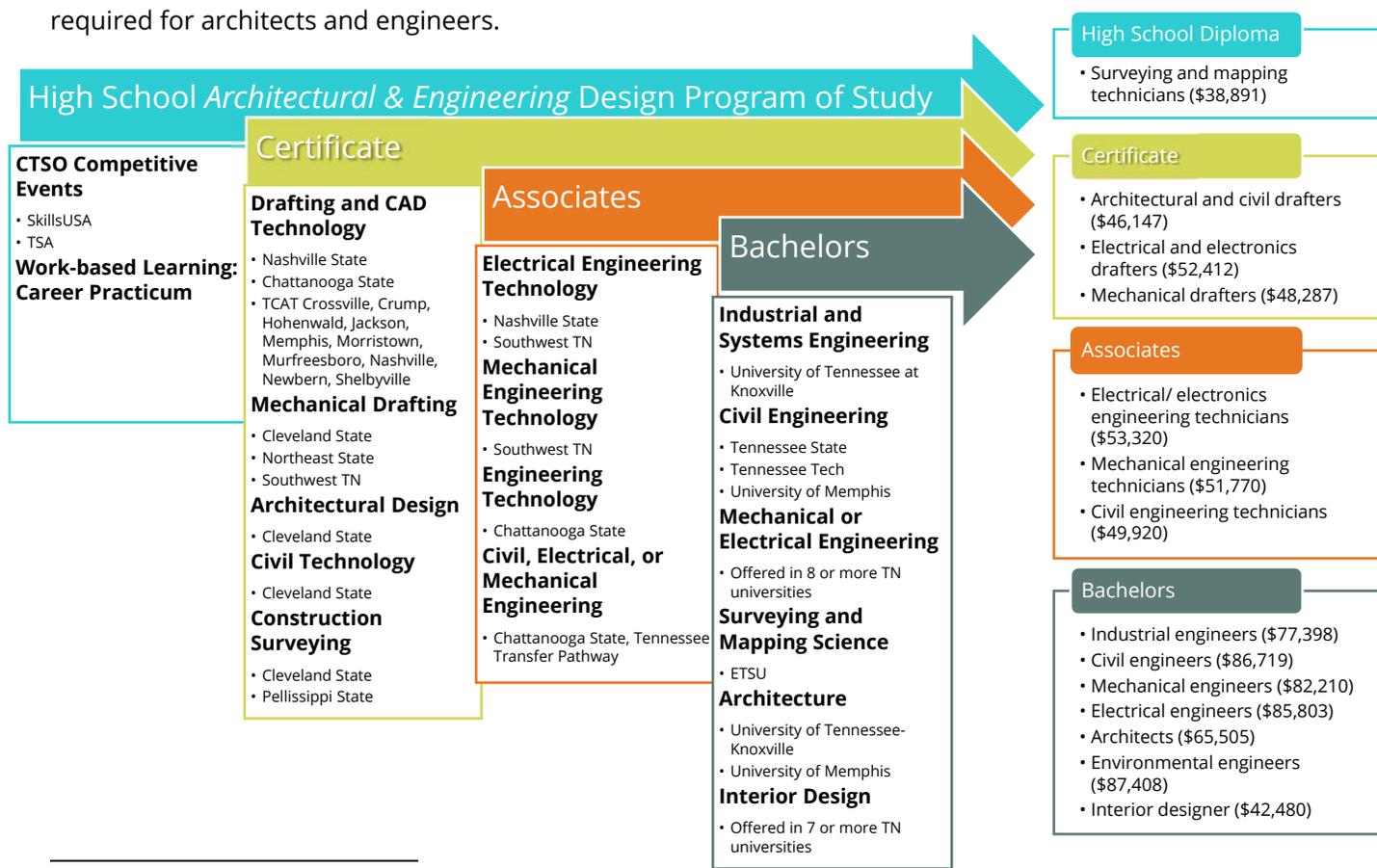


Current Secondary Landscape

Enrollment in this program of study has grown in recent years. In the 2013-14 school year, 5,460 students were enrolled in a computer-aided drafting (CAD) course with 725 students enrolled in the level 3 course. The total number of students enrolled in a CAD course grew from the 2011-12 total of 4,870. In 2014-15, the program was offered in 60 schools in 34 districts and 6,026 were enrolled in a course in program of study. The number of students enrolled in the Level 3 course grew significantly in 2014-15 to 1,174 students.

Postsecondary Pathways

Upon completion of this program of study, students will be prepared to further their study at a postsecondary institution in architecture, engineering, construction, and a number of related fields. Median salaries for architecture and engineering occupations are among the highest for all occupations groups within construction with a median salary of \$75,780 in 2014.⁴ For most occupations in this group, associate's degrees or higher are required. Associate's degrees allow students to enter the field as technicians or drafters while bachelor's degrees or greater are required for architects and engineers.



⁴ Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

Recommendation

No changes are recommended at this time.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Architectural & Engineering Design	Architectural & Engineering Design I (6037)	Architectural & Engineering Design II (6039)	Architectural & Engineering Design III ¹ (5927) -or- Dual Enrollment Architectural & Engineering Design (4075)	Engineering Practicum (6141) -and/or- AP Calculus (3127, 3139, or 3128) -and/or- AP Physics (3238, 3239, 3234, or 3240) -or- Dual Enrollment Architectural & Engineering Design (4075)

References

Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics. *Occupational Employment and Wages, May 2014. (17-2112 Industrial Engineers)*. Retrieved from <http://www.bls.gov/oes/current/oes172112.htm>.

Tennessee Department of Labor and Workforce Development. (2015). Employment Security Division, *Employment Figures*. Retrieved from <https://www.jobs4tn.gov/vosnet/Default.aspx>

Interior Design

2016-17 Program of Study	Level 1	Level 2	Level 3	Level 4
Interior Design	Foundations of Interior Design (6014)	Residential Interior Design (6006)	Commercial Interior Design (6122)	Advanced Interior Design (6121)

Description

The *Interior Design* program of study is designed for students interested in becoming residential or commercial interior designers. Course content covers concepts and skills such as elements and principles of design, sketching techniques for perspective floor plans, computer-aided drafting, board presentation techniques using textiles samples and three-dimensional sketches, building technology, building codes, product applications, product testing research and development, and project management for the interior design industry. Upon completion of the program of study, students will have had the opportunity to participate in a work-based learning internship, and will be equipped for further study of interior design at the postsecondary level.

Job Outlook

In Tennessee, 25 total annual average openings are projected for interior designers between 2014 and 2022. The projected openings are due to replacements. In 2014, 960 interior designers were estimated to be employed in Tennessee. By 2022, that number is projected to decline to 950 representing a 0.4 percent decline for the occupation group. Of the available openings, more are projected in urban and surrounding areas with Nashville leading with 10 annual average openings.⁵ Nationally, the employment of interior designers is projected to grow with 4 percent growth between 2014 and 2024.⁶

Figure 1. Interior design related occupations with most annual average openings in Tennessee in Tennessee (2014-2022)

Occupation	Total Percent Change	Annual Avg. Openings
Architectural and Engineering Managers	9.2%	90
Wholesale and Retail Buyers, Except Farm Products	3.20%	85
Merchandise Displayers and Window Trimmers	9.10%	85
Architects, Except Landscape and Naval	12.7%	50
Interior Designers	-0.4%	25
Commercial and Industrial Designers	2.7%	15
Materials Engineers	7.4%	15

⁵ Tennessee Department of Labor and Workforce Development. (2015). Employment Security Division, *Employment Figures*

⁶ Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

Due to the negative growth rate in Tennessee, the occupation is not expected to be in demand with employers. In a recent year, the TN Department of Labor and Workforce reported that 105 complete training in Interior Design. With only 25 annual average openings estimated, this indicates more than 4 times as many training completers as openings. With the low availability of jobs, students who complete study in interior design may use the knowledge and skills in other occupations such as merchandise displayers and window trimmers or wholesale and retail buyers. Students may seek additional study in a related design area such as commercial and industrial design, materials engineering, or architecture.

Figure 2. Annual Average Openings for Interior Designers in Tennessee (2014-2022)



Current Secondary Landscape

As a brand new program of study in 2014-15, 18 schools in 13 districts offered courses in Interior Design. Programs were scattered across the state with 22% in West Tennessee, 38% in Middle Tennessee, and 38% in East Tennessee. Half of programs were offered in rural locations. In 2013-14, 1,265 students were enrolled in two interior design courses (Foundations of Interior Design and Residential Interior Design). In 2014-15, 1,000 students were enrolled in the same two courses (948 in Foundations of Interior Design and 52 students in Residential Interior Design).

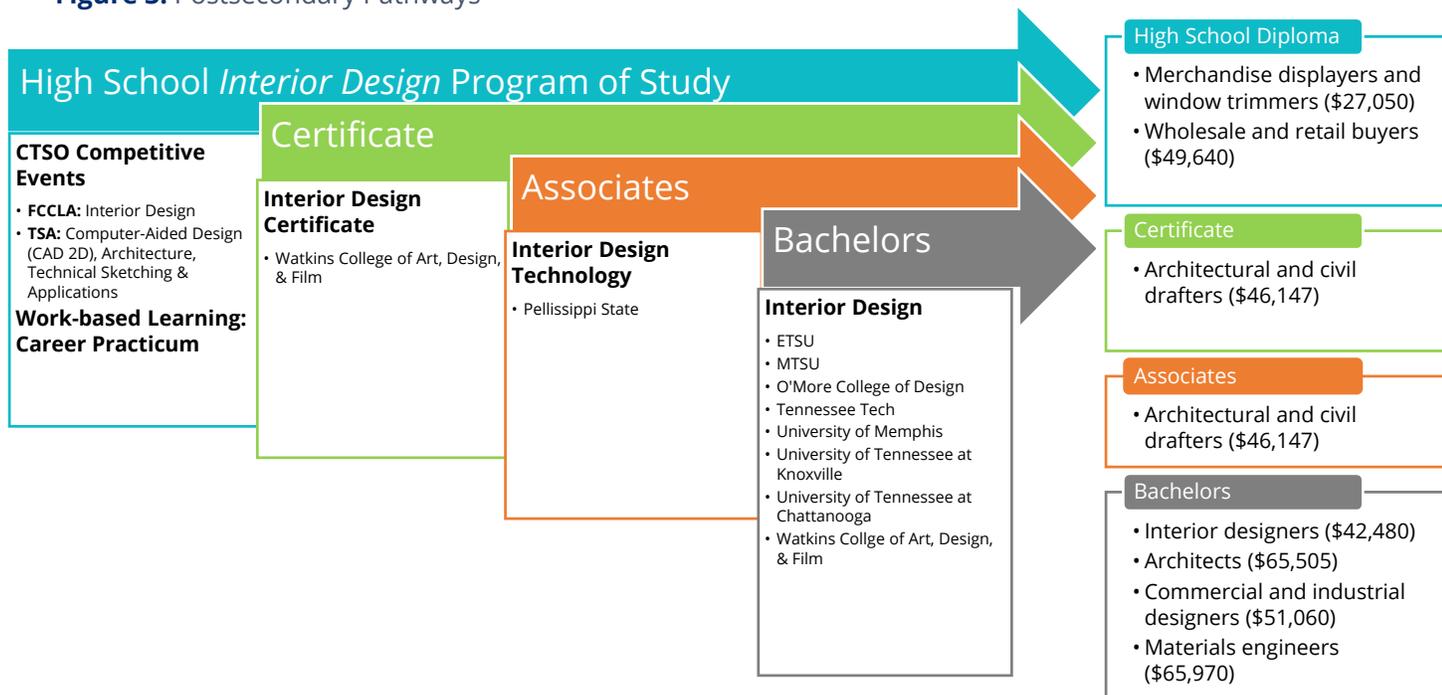
Early reports for 2015-16 indicate 1,059 students were enrolled in Level 1, 91 students were enrolled in Level 2, 19 students were enrolled in Level 3, and 14 students were enrolled in Level 4.

Postsecondary Pathways

Upon completion of this program of study, students will be prepared to pursue advanced study in interior design. The chart below outlines training opportunities in interior design. A bachelor's degree is usually required for interior designers.⁷

⁷ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Interior Designers. Retrieved from <http://www.bls.gov/ooh/arts-and-design/interior-designers.htm>.

Figure 3. Postsecondary Pathways



Recommendation

Over the next couple of years, it will be important to continue monitoring the number of students completing level 3 of this program of study, as the number is currently extremely low.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Interior Design	Foundations of Interior Design (6014)	Residential Interior Design (6006)	Commercial Interior Design (6122) -or- Dual Enrollment Interior Design (4076)	Advanced Interior Design (6121) -or- Dual Enrollment Interior Design (4076)

References

Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Interior Designers. Retrieved from <http://www.bls.gov/ooh/arts-and-design/interior-designers.htm>.

Tennessee Department of Labor and Workforce Development. (2015). Employment Security Division, *Employment Figures*

Mechanical, Electrical, & Plumbing (MEP) Systems

2016-17 Program of Study	Level 1	Level 2	Level 3	Level 4
Mechanical, Electrical, & Plumbing (MEP) Systems	Fundamentals of Construction (6073)	MEP Systems (6161)	HVAC (6077) -and/or- Electrical Systems (6075) -and/or- Plumbing Systems (6082)	Construction Practicum (6160)

Description

The *Mechanical, Electrical, & Plumbing Systems* program of study prepares students to install, service, and maintain building equipment. Course content is arranged around four sequenced, progressive courses that provide students with the opportunity to understand the principles behind mechanical, electrical, & plumbing systems, to apply basic installation skills, and to safely use and maintain appropriate tools, equipment, and resources to accomplish project goals. The *MEP Systems* course introduces students to the physical principals involved with these systems and the fundamental skills needed to work with them. In the third level, students have the option to specialize in a particular craft, electrical, plumbing, or HVAC/R, and earn an industry credential specific to the craft. Students will develop diagnostic and problem solving skills to troubleshoot procedures when solving a maintenance problem in buildings and to plan and practice preventative maintenance activities to service existing buildings. Industry specific business concepts and skills such as cost estimating, scheduling practices, and project management are included throughout the program of study. Students will understand career opportunities in the industry and the steps to achieve those careers (such as how to begin apprenticeships).

In the third or fourth level, students will have the opportunity to participate in the *Work-based Learning: Career Practicum* or a *Construction Practicum* course which places students with industry partners to complete a construction project. Additionally, students may gain job experience while still in high school through local and CTSO competitions. The program of study prepares students to earn industry certifications in NCCER Core Curriculum and NCCER Level One in Electrical, Plumbing, or HVAC. For students who complete the *HVAC* course, the EPA Section 608 Technician Certification and Universal R-410A may also be obtained. Postsecondary and apprenticeship training programs may award credit for coursework completed or NCCER credentials obtained during high school coursework. Dual credit/dual enrollments opportunities may be established with local

postsecondary institutions in the third level and fourth level, as well. Upon completion of the program of study, students will be equipped for entry into the work force or further training at the postsecondary level.

Job Outlook

Overview

Nationally, employment in construction and extraction occupations is projected to grow by 10.1 percent according to the Bureau of Labor Statistics. In 2022, 7.16 million people are projected to be employed in the occupation group in the U.S. with 1.68 million job openings between 2014 and 2022.⁸ The Tennessee Department of Labor and Workforce Development projects a 10.8 percent growth and 3,205 annual average openings in the Construction and Extraction occupation group from 2014 to 2022 with a total of 11,240 added jobs and 115,680 employed in the group in TN by 2022. Additionally, in the Installation, Maintenance, and Repair occupation group, 3,120 average annual openings are projected in Tennessee from 2014 to 2022 (Occupations involving vehicle and mobile equipment not included).⁹ Opportunities are available in a broad range of occupations.

Figure 1 lists the related occupations with the most annual average openings projected.

Figure 1. MEP Systems Related Occupations with More than 50 Annual Average Openings in Tennessee (2014 - 2022)

Occupation	Annual Avg. Openings	Total Change	2014 Median Salary
Maintenance & Repair Workers, General	880	7.7%	\$35,740
Construction Laborers	840	12.9%	\$27,530
Electricians	340	9.0%	\$46,790
First-Line Supervisors of Mechanics, Installers, & Repairers	335	6.3%	\$55,550
HVAC/R Mechanics & Installers	275	10.9%	\$38,950
Construction Managers	235	4.6%	\$76,040
Supervisors of Construction & Extraction Workers	210	9.2%	\$50,530
Mechanical Engineers	170	5.3%	
Cost Estimators	170	11.9%	\$55,330
Sheet Metal Workers	160	14.4%	\$37,390
Electrical Power-Line Installers & Repairers	155	10.0%	\$66,930
Plumbers, Pipefitters, & Steamfitters	140	6.6%	\$45,860
Helpers- Installation, Maintenance, & Repair Workers	100	6.6%	\$23,840
Telecommunications Line Installers and Repairers	80	14.5%	\$36,430
Helpers--Electricians	75	18.9%	\$28,790
Security and Fire Alarm Systems Installers	65	26.3%	\$40,360
Construction and Building Inspectors	55	9.8%	\$45,440

⁸ Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

⁹ Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

Management and Supervisory Occupations

In addition to the construction trade occupations, the program of study prepares students to pursue the number of supervisory and management roles available in the construction industry. These high wage jobs are predicted to have growth and significant numbers of openings in Tennessee.

Construction manager occupations are projected to grow 4.6 percent with 235 average annual openings, supervisors of construction and extraction workers are projected to grow 9.2 percent with 210 average annual openings, and supervisors of mechanics, installers, and repairers are projected to grow 6.3 percent with 335 average annual openings.¹⁰ Due to the demand, positive job growth, and number of expected annual openings, the Tennessee Department of Labor and Workforce Development has identified these occupations and several other construction occupations on Tennessee's Hot Careers to 2022 list (**Figure 2**).

Figure 2. Occupations related to MEP Systems from Tennessee's Hot Careers to 2022¹¹ (Occupations noted as in demand, as requiring more than short-term on-the-job training, with positive job growth, and with at least 160 expected annual job openings).

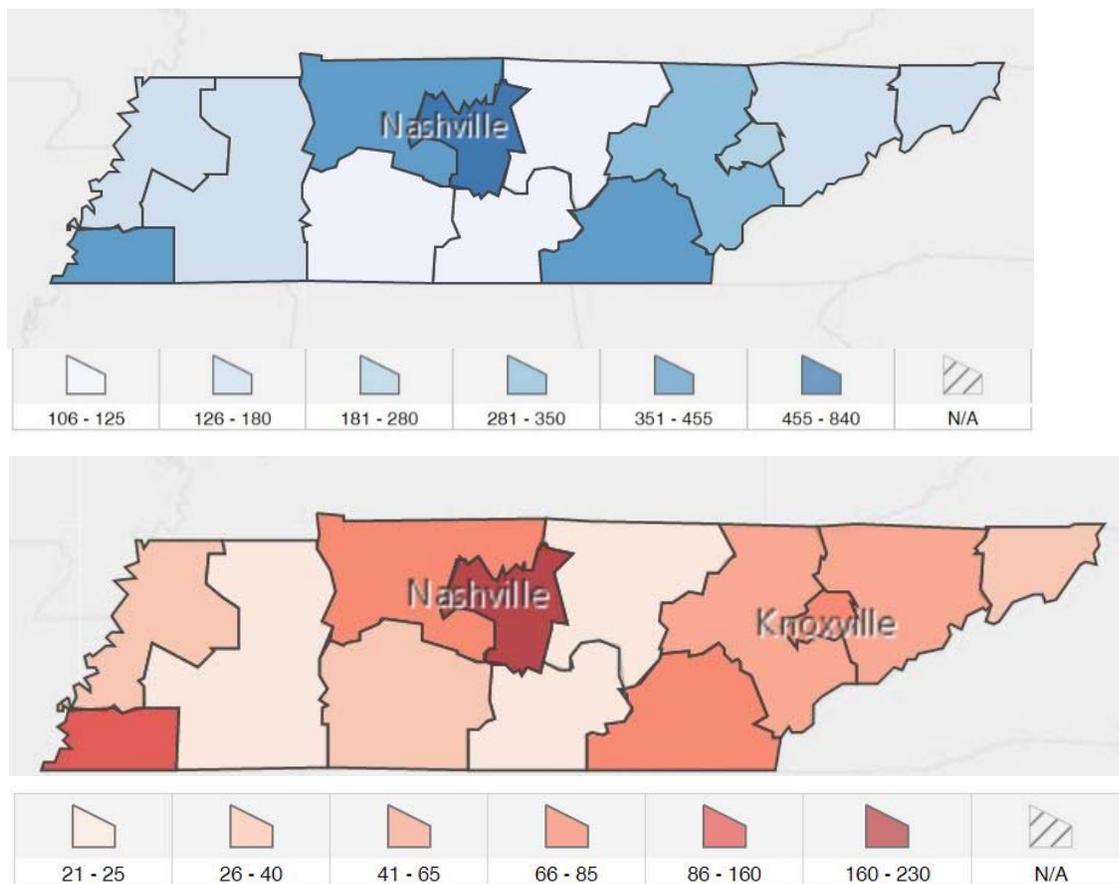
2014-2022 Average Annual Openings		Training Needed		2013 Median Salary
Maintenance and Repair Workers, General	850	Long-term on-the-job training		\$35,250
Electricians	385	Apprenticeship		\$44,529
First-Line Supervisors of Mechanics, Installers, and Repairers	320	Work experience in a related occupation		\$55,246
Construction Managers	265	Bachelor's Degree		\$71,911
First-Line Supervisors of Construction Trades and Extraction Workers	210	Work experience in a related occupation		\$48,552

¹⁰ Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

¹¹ Tennessee Department of Labor & Workforce Development, Occupations in Demand. *Hot Careers to 2022 (Statewide)*. Retrieved from <http://www.tn.gov/workforce/topic/occupations-in-demand>.

Job outlook is positive in all regions of the state; however, more opportunities are available in urban and surrounding areas.

Figure 4. Annual Average Openings for General Maintenance & Repair Workers in Tennessee by Region, 2014-2022



Current Secondary Landscape

As a brand new program of study in 2015-16, the program of study appears to be off to a strong start. 38 schools indicated that they would offer the program of study during the open enrollment period prior to the start of the 2015-16 school year. This number appears to be as expected based on the prior enrollment in electrical, plumbing, and HVAC courses. In the 2013-14 school year, 1,522 students were enrolled in an electrical, plumbing, or HVAC course with the majority in electrical (1,049 students). In 2014-15, 38 schools offered the Electrical Systems program of study, 19 schools offered the HVAC program of study, and 12 offered the Plumbing program of study.

In recent years, overall offerings of programs of study in Architecture & Construction grew every year in Tennessee between 2007 and 2011. According to the TDOE Report Card, 359 programs of study in Architecture and Construction were present in high schools during the 2007-08 school year. In 2011-12 that number had grown to 421 programs of study in Architecture and Construction in Tennessee.

Historically, most Tennessee high school students enrolled in courses in the Architecture and Construction cluster took courses specializing in Carpentry. With the number of schools now offering Residential & Commercial Construction, a large number of students will now be exposed to more aspects of the construction industry outside of carpentry alone (especially in maintenance, mechanical/electrical areas).

Figures 5 – 8 below illustrate how enrollment has shifted with the newly arranged programs of study.

Figure 5. 2015-16 Open Enrollment Program of Study Selections in Architecture & Construction Cluster

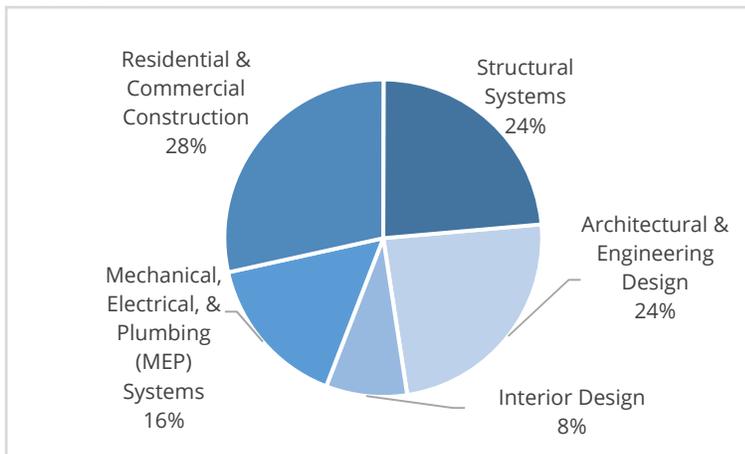


Figure 6. 2015-16 Open Enrollment Program of Study Selections in Architecture & Construction Cluster

Program of Study	Number of Schools
Architectural & Engineering Design	58
Interior Design	20
Mechanical, Electrical, & Plumbing (MEP) Systems	38
Residential & Commercial Construction	69
Structural Systems	57

Figure 7. Students Enrolled in Level 2 & 3 Architecture & Construction Courses in 2012-13 Construction Cluster

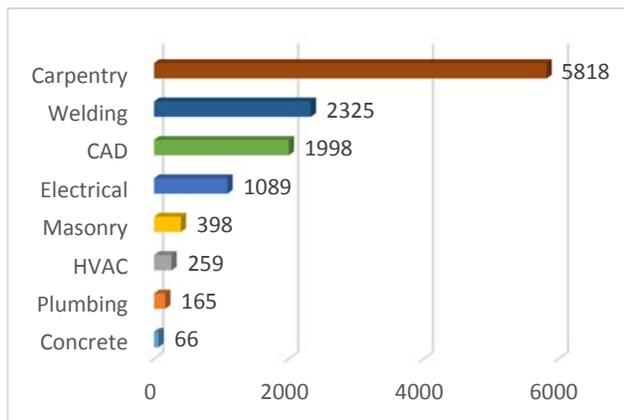
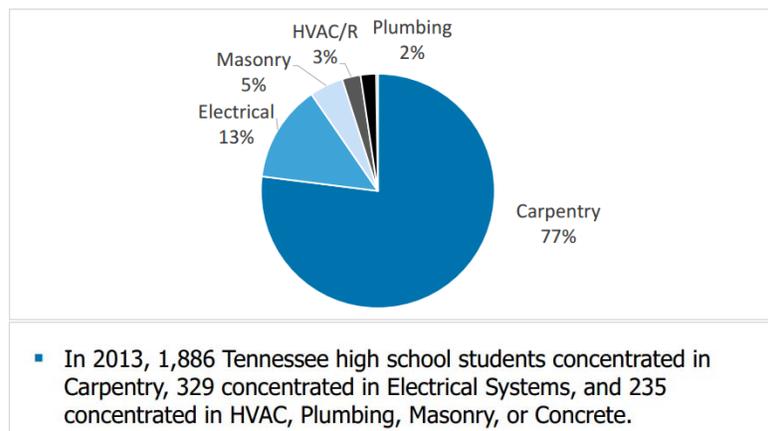


Figure 8. 2012-13 Tennessee Concentrators in Construction Trades Programs of Study



Postsecondary Pathways

Upon completion of this program of study, students will be prepared to enter the workforce, begin apprenticeships, or further their training at skilled trade schools such as TCATs, craft training programs, or other postsecondary institutions. Opportunities for advancement are available as individuals may progress from helper to craftsman to supervisor to construction manager or superintendent. The chart below outlines the related career opportunities and the training necessary for each.

Figure 9. Postsecondary Pathways

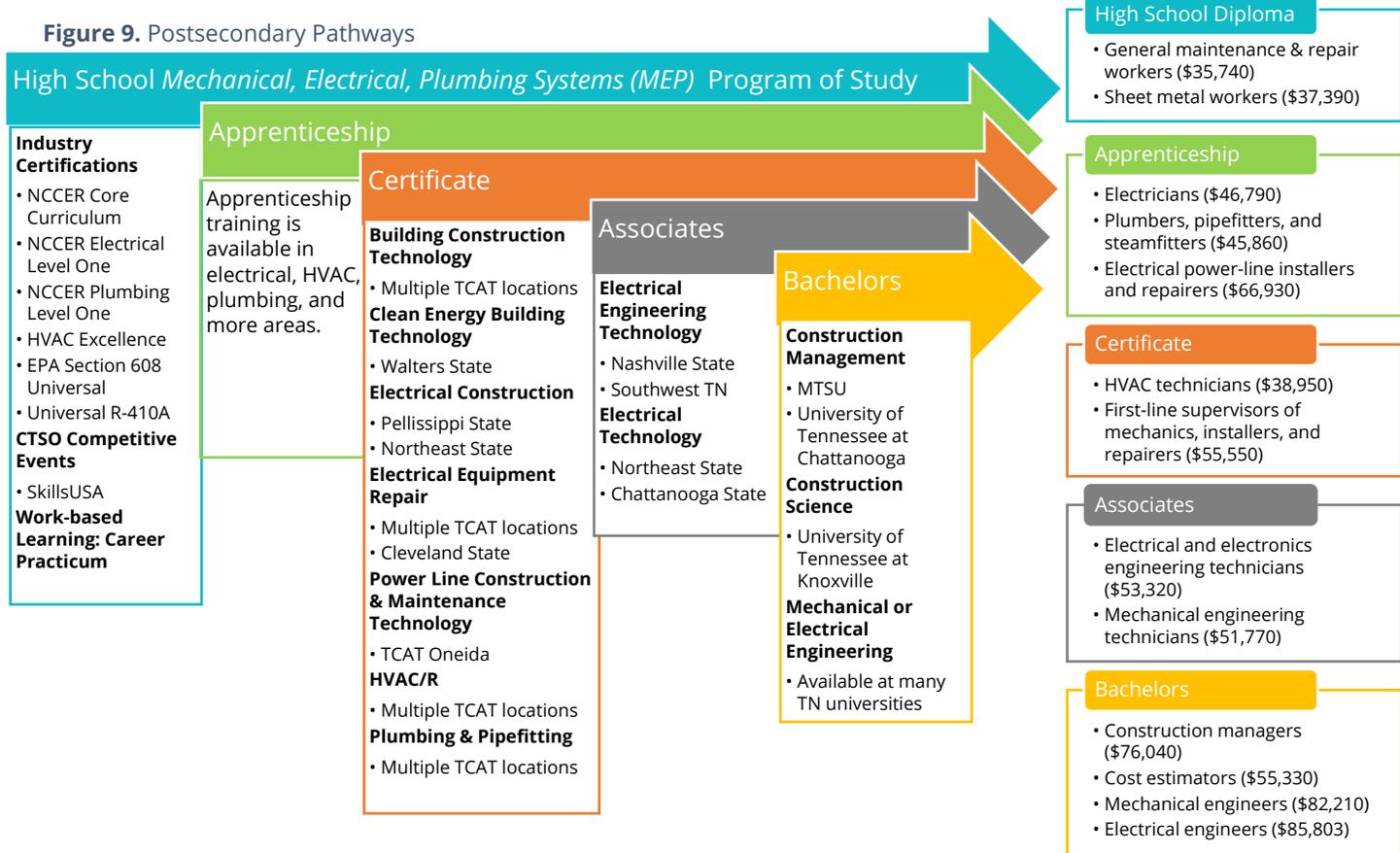


Figure 10. Possible career paths of individuals in the construction industry.¹²



¹² Choose Your Career Path! Build Your Future and NCCER. Retrieved from <http://byf.org/path>.

Recommendation

No changes are recommended at this time.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Mechanical, Electrical, & Plumbing (MEP) Systems	Fundamentals of Construction (6073)	MEP Systems (6161)	HVAC (6077) -and/or- Electrical Systems (6075) -and/or- Plumbing Systems (6082) -or- Dual Enrollment Mechanical, Electrical, & Plumbing Systems (4074)	Construction Practicum (6160) -or- Dual Enrollment Mechanical, Electrical, & Plumbing Systems (4074)
	Industry Certification: NCCER Core Curriculum		Industry Certifications for 6077: HVAC Excellence, Heating, Electrical, Air Conditioning Technology (H.E.A.T.) HVAC Excellence Employment Ready Certifications Universal R-410A EPA Section 608 Universal Industry Certification for 6075: NCCER Electrical Level One Industry Certification for 6082: NCCER Plumbing Level One	

References

Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

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Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

Residential & Commercial Construction

2016-17 Program of Study	Level 1	Level 2	Level 3	Level 4
Residential & Commercial Construction	Fundamentals of Construction (6073)	Residential & Commercial Construction I (6162)	Residential & Commercial Construction II (6163)	Construction Practicum (6160)
Recommended Credits	1 credit	1 credit	1 – 3 credits	1 credit

Description

The *Residential & Commercial Construction* program of study prepares students for the various disciplines of construction. Course content is arranged around three sequenced, progressive courses that provide students with the opportunity to develop a holistic understanding of the building systems and components required for a construction project. Students will be able to interpret construction drawings, perform basic math skills, demonstrate the construction crafts required for each phase of a construction project (including carpentry, masonry, electricity, plumbing and HVAC), and safely use and maintain appropriate tools, equipment, and resources to accomplish construction project goals. Course content covers industry specific business concepts and skills such as cost estimation, relationships among parties involved in the building process, testing and inspection procedures, scheduling practices, and project management. Students will understand career opportunities in the construction industry and the steps to achieve those careers (such as how to enter apprenticeships).

In *Residential & Commercial II*, programs currently have the options to focus in either a) masonry and carpentry, b) electrical, plumbing, and electrical, or c) both a and b. The consultant recommends adding a third focus option in concrete and masonry. *Residential & Commercial II* could then be offered for up to three credits if all standards were covered. Adding the three credit option would allow students to cover additional modules in NCCER Construction Technology on concrete and masonry topics. This would make it possible for students to complete all the modules in NCCER Construction Technology and earn the full certificate. The fourth level course, *Construction Practicum*, places students with industry partners to complete a capstone construction project.

In addition to the *Construction Practicum* course, students may gain job experience while still in high school through local and CTSO competitions and work-based learning. Coursework prepares

students to earn industry certifications in NCCER Core Curriculum and NCCER Construction Technology. Postsecondary and apprenticeship training programs may award credit for coursework completed or NCCER credentials obtained during high school coursework. Dual credit/dual enrollments opportunities may be established with local postsecondary institutions.

Job Outlook

Overview

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Figure 1. Construction Occupations with More than 50 Annual Average Openings in Tennessee (2014 -2022)

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Maintenance & Repair Workers, General	880	7.7%	\$35,740
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HVAC/R Mechanics & Installers	275	10.9%	\$38,950
Construction Managers	235	4.6%	\$76,040
Civil Engineers	215	17.6%	\$86,720
Supervisors of Construction & Extraction Workers	210	9.2%	\$50,530
Carpenters	200	5.0%	\$34,080
Operating Engineers & Other Construction Equipment Operators	185	14.3%	\$36,170
Cost Estimators	170	11.9%	\$55,330
Sheet Metal Workers	160	14.4%	\$37,390
Electrical Power-Line Installers & Repairers	155	10.0%	\$66,930
Plumbers, Pipefitters, & Steamfitters	140	6.6%	\$45,860
Roofers	115	19.0%	\$32,540
Helpers- Installation, Maintenance, & Repair Workers	100	6.6%	\$23,840
Cement Masons and Concrete Finishers	90	23.1%	\$31,820
Painters, Construction and Maintenance	90	4.50%	\$30,900
Telecommunications Line Installers and Repairers	80	14.5%	\$36,430
Helpers--Electricians	75	18.9%	\$28,790
Security and Fire Alarm Systems Installers	65	26.3%	\$40,360
Brickmasons and Blockmasons	60	38.9%	\$40,160
Construction and Building Inspectors	55	9.8%	\$45,440
Highway Maintenance Workers	55	4.3%	\$27,210

¹³ Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

¹⁴ Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

Management and Supervisory Occupations

In addition to the construction trade occupations, the program of study prepares students to pursue the number of supervisory and management roles available in the construction industry. These high wage jobs are predicted to have growth and significant numbers of openings in Tennessee.

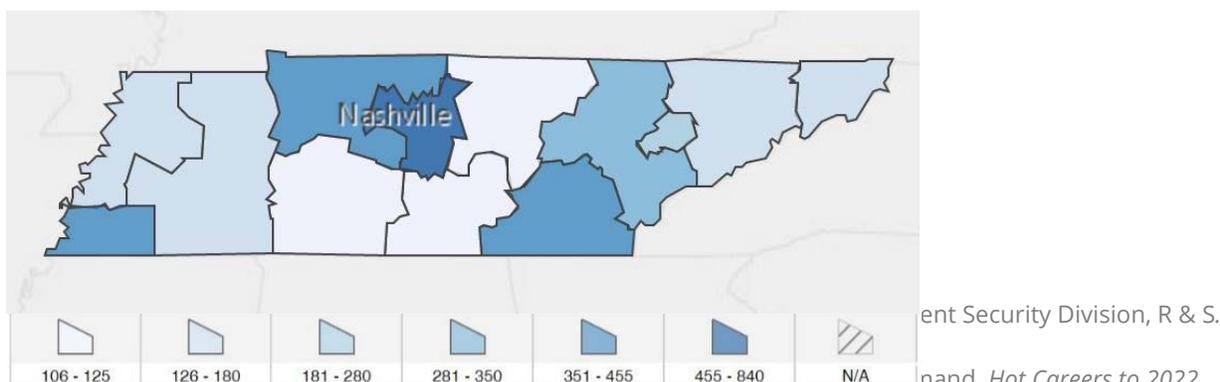
Construction manager occupations are projected to grow 4.6 percent with 235 average annual openings, supervisors of construction and extraction workers are projected to grow 9.2 percent with 210 average annual openings, and supervisors of mechanics, installers, and repairers are projected to grow 6.3 percent with 335 average annual openings.¹⁵ Due to the demand, positive job growth, and number of expected annual openings, the Tennessee Department of Labor and Workforce Development has identified these occupations and several other construction occupations on Tennessee’s Hot Careers to 2022 list (**Figure 2**).

Figure 2. Tennessee’s Hot Careers in Construction to 2022¹⁶ (Occupations noted as in demand, as requiring more than short-term on-the-job training, with positive job growth, and with at least 160 expected annual job openings).

2014-2022 Average Annual Openings	Training Needed	2013 Median Salary	
Maintenance and Repair Workers, General	850	Long-term on-the-job training	\$35,250
Carpenters	525	Apprenticeship	\$34,285
Electricians	385	Apprenticeship	\$44,529
First-Line Supervisors of Mechanics, Installers, and Repairers	320	Work experience in a related occupation	\$55,246
Construction Managers	265	Bachelor’s Degree	\$71,911
First-Line Supervisors of Construction Trades and Extraction Workers	210	Work experience in a related occupation	\$48,552
Operating Engineers and Other Construction Equipment Operators	180	Moderate-term on-the-job training	\$34,866

Job outlook is positive in all regions of the state; however, more opportunities are available in urban and surrounding areas.

Figure 4. Annual Average Openings for Construction & Extraction Occupations in Tennessee by Region, 2014-2022



(Statewide). Retrieved from <http://www.tn.gov/workforce/topic/occupations-in-demand>.

Figure 5. Annual Average Openings for General Maintenance & Repair Workers in Tennessee by Region, 2014-2022



Current Secondary Landscape

As a brand new program of study in 2015-16, the program of study appears to be off to a strong start. 69 schools indicated that they would offer the program of study during the open enrollment period prior to the start of the 2015-16 school year.

In recent years, overall offerings of programs of study in Architecture & Construction grew every year in Tennessee between 2007 and 2011. According to the TDOE Report Card, 359 programs of study in Architecture and Construction were present in high schools during the 2007-08 school year. In 2011-2012 that number had grown to 421 programs of study in Architecture and Construction in Tennessee.

Historically, most Tennessee high school students enrolled in courses in the Architecture and Construction cluster took courses specializing in Carpentry. With the number of schools now offering Residential & Commercial Construction, a large number of students will now be exposed to more aspects of the construction industry outside of carpentry alone (especially in maintenance, mechanical/electrical areas).

Figures 6 – 9 below illustrate how enrollment has shifted with the programs of study.

Figure 6. 2015-16 Open Enrollment Program of Study Selections in Architecture & Construction Cluster

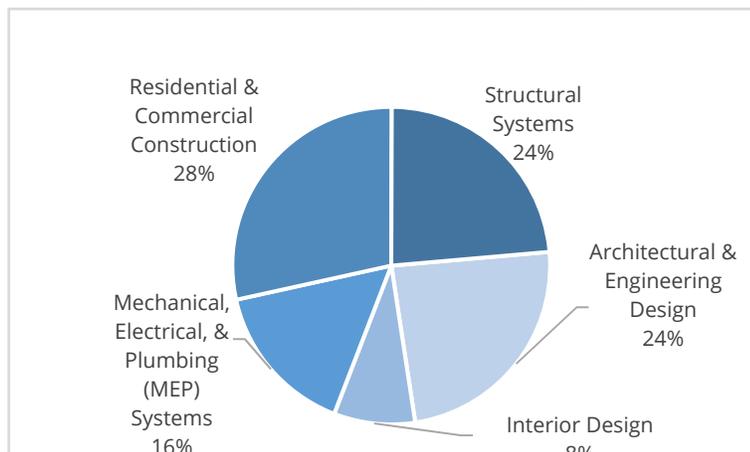


Figure 7. 2015-16 Open Enrollment Program of Study Selections in Architecture & Construction Cluster

Program of Study	Number of Schools
Architectural & Engineering Design	58
Interior Design	20
Mechanical, Electrical, & Plumbing (MEP) Systems	38
Residential & Commercial Construction	69
Structural Systems	57

Figure 8. Students Enrolled in Level 2 & 3 Architecture & Construction Courses in 2012-2013 Construction Cluster

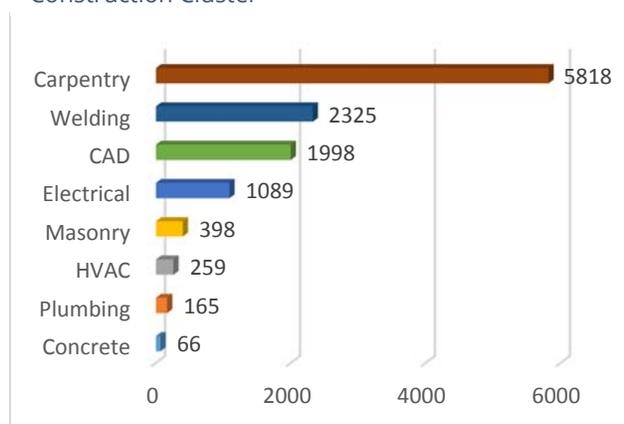
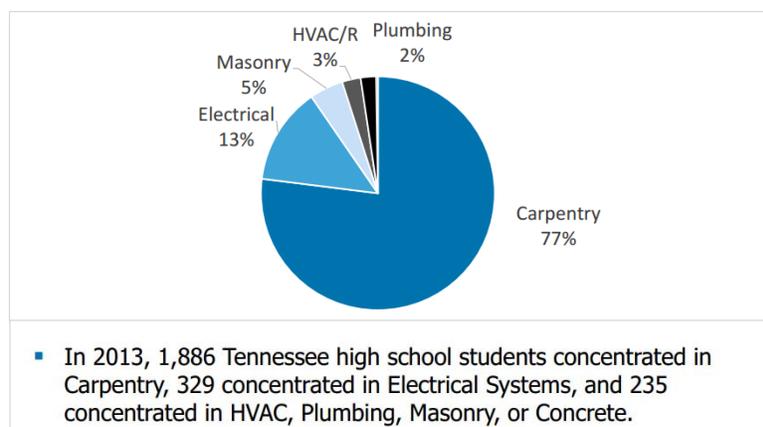


Figure 9. 2012-13 Tennessee Concentrators in Construction Trades Programs of Study



Postsecondary Pathways

Upon completion of this program of study, students will be prepared to enter the workforce, begin apprenticeships, or further their training at skilled trade schools such as TCATs, craft training programs, or other postsecondary institutions. For most of the major occupations related to this program of study, high school diplomas or less are required while on the job training is usually required. Exceptions include construction managers, cost estimators, and architecture and engineering occupations where bachelor's degrees and moderate term on-the-job training are usually needed. Opportunities for advancement are available as individuals may progress from

helper to craftsman to supervisor to construction manager or superintendent. The chart below outlines the related career opportunities and the training necessary for each.

Figure 10. Postsecondary Pathways

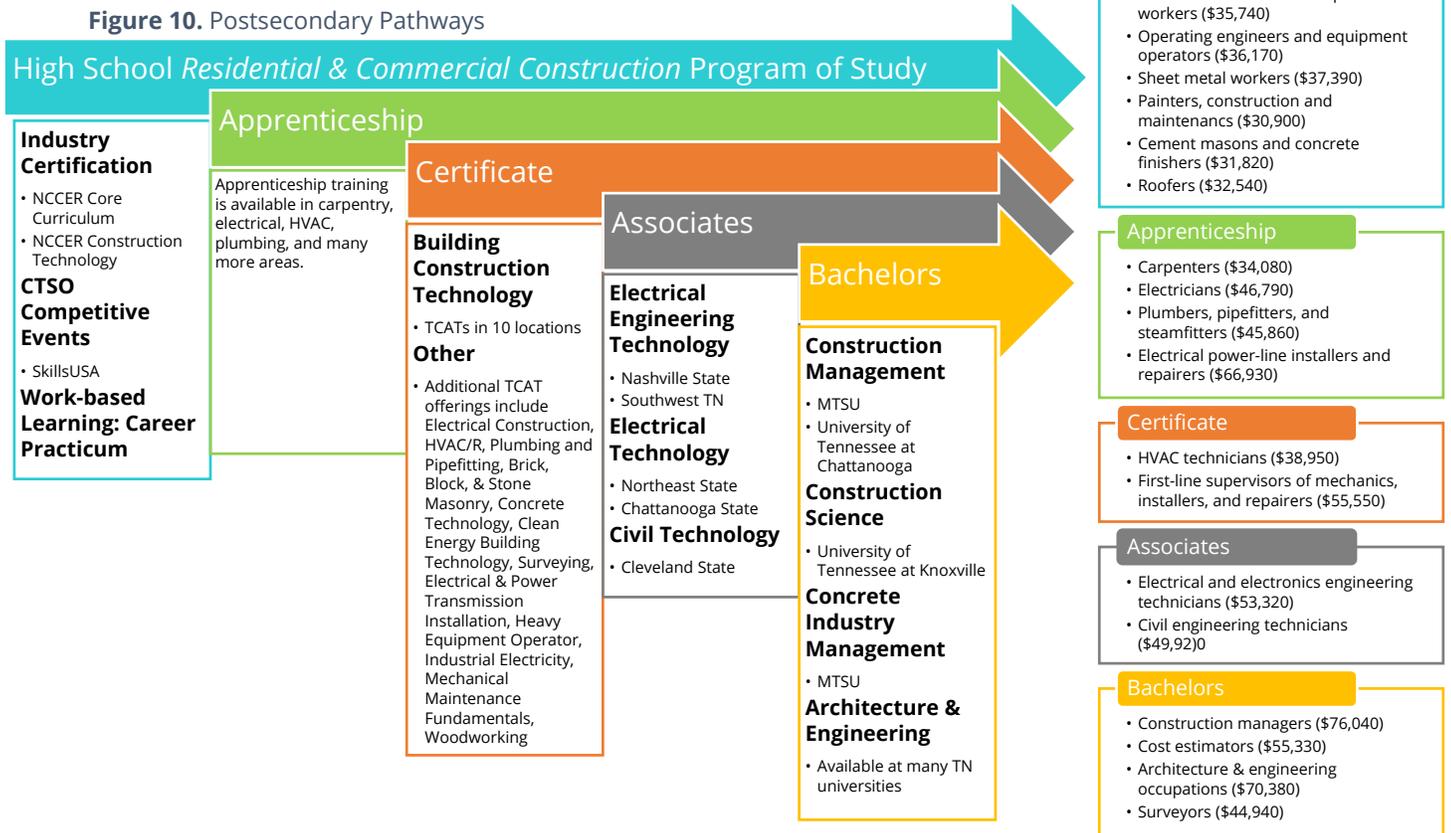


Figure 11. Possible career paths of individuals in the construction industry.¹⁷



¹⁷ Choose Your Career Path! Build Your Future and NCCER. Retrieved from <http://byf.org/path>.

Recommendation

No recommended changes at this time.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Residential & Commercial Construction	Fundamentals of Construction (6073)	Residential & Commercial Construction I (6162)	Residential & Commercial Construction II ¹ (6163) -or- Dual Enrollment Residential & Commercial Construction (4072)	Construction Practicum (6160) -or- Dual Enrollment Residential & Commercial Construction (4072)
	Industry Certification: NCCER Core Curriculum	Industry Certification: NCCER Construction Technology		

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Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

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Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

Structural Systems

2016-17 Program of Study	Level 1	Level 2	Level 3	Level 4
Structural Systems	Fundamentals of Construction (6073)	Structural Systems I (6164)	Structural Systems II (6165)	Construction Practicum (6160)

Description

The *Structural Systems* program of study prepares students with the knowledge and skills related to residential and commercial carpentry. Course content covers wood, metal, and concrete building materials, fasteners, hand and power tools, fabrication based on construction plans, framing of platform and post-and-beam structures, stairs, structural loads, installation and trim of windows and doors, installation and repair of gypsum wallboard, exterior finish work, cabinet installation, and thermal and moisture protection. The fourth level course, *Construction Practicum*, places students with industry partners to complete a capstone construction project. Options in the third and fourth level include 1) dual enrollment with a local postsecondary training center and 2) participation in work-based learning connected with local industry to prepare for immediate entry into the workforce or an apprenticeship.

Students may gain additional experience through local and CTSO competitions. Coursework prepares students to earn industry certifications in NCCER Core Curriculum, NCCER Carpentry Level One and Two, and OSHA- 10 hour. Postsecondary and apprenticeship training programs may award credit for coursework completed or NCCER credentials obtained during high school coursework. Dual credit/dual enrollments opportunities may be established with local postsecondary institutions.

Job Outlook

Employment for carpenters is projected to grow by 5 percent in Tennessee between 2014 and 2022 with a total annual average of 200 openings. Skills students develop in the program of study are transferrable to additional occupations related to structural systems listed in **Figure 1** below. Nationally, employment of carpenters is projected to grow by 6.4 percent according to the Bureau of Labor Statistics.¹⁸ The Tennessee Department of Labor and Workforce Development projects a 10.8 percent growth and 3,205 annual average openings in the Construction and Extraction occupation

¹⁸ Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

group from 2014 to 2022 with a total of 11,240 added jobs and 115,680 employed in the group in TN by 2022.¹⁹ Opportunities are available in a range of occupations.

Figure 1. Structural Systems Related Occupations with More than 50 Annual Average Openings in Tennessee (2014 -2022)

Occupation	Annual Avg. Openings	Total Change	2014 Median Salary
Maintenance & Repair Workers, General	880	7.7%	\$35,740
Construction Laborers	840	12.9%	\$27,530
Construction Managers	235	4.6%	\$76,040
Civil Engineers	215	17.6%	\$86,720
Supervisors of Construction & Extraction Workers	210	9.2%	\$50,530
Carpenters	200	5.0%	\$34,080
Operating Engineers & Other Construction Equipment Operators	185	14.3%	\$36,170
Cost Estimators	170	11.9%	\$55,330
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Roofers	115	19.0%	\$32,540
Helpers- Installation, Maintenance, & Repair Workers	100	6.6%	\$23,840
Cement Masons and Concrete Finishers	90	23.1%	\$31,820
Brickmasons and Blockmasons	60	38.9%	\$40,160
Construction and Building Inspectors	55	9.8%	\$45,440
Highway Maintenance Workers	55	4.3%	\$27,210

Management and Supervisory Occupations

In addition to the carpentry related occupations, the program of study prepares students to pursue the number of supervisory and management roles available in the construction industry. These high wage jobs are predicted to have growth and significant numbers of openings in Tennessee.

Construction manager occupations are projected to grow 4.6 percent with 235 average annual openings and supervisors of construction and extraction workers are projected to grow 9.2 percent with 210 average annual openings, Due to the demand, positive job growth, and number of expected annual openings, the Tennessee Department of Labor and Workforce Development has identified these occupations and several other construction occupations on Tennessee’s Hot Careers to 2022 list (**Figure 2**).

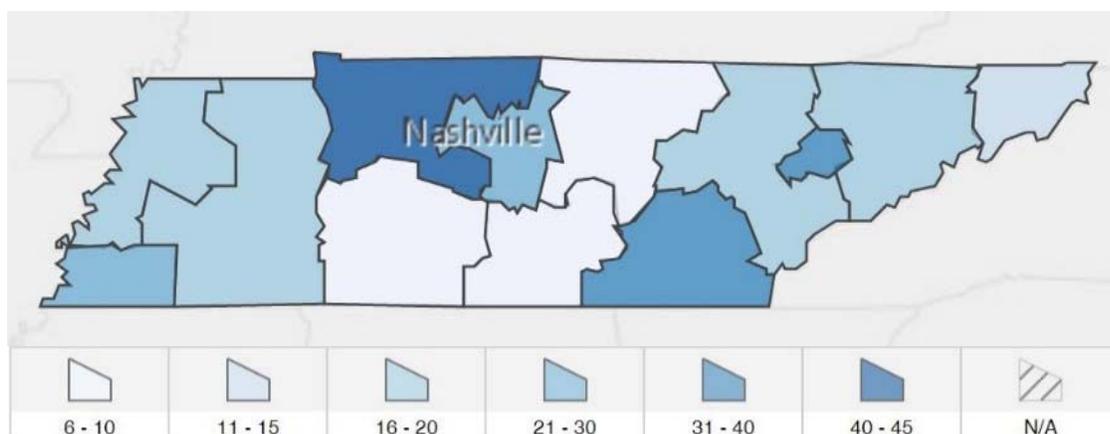
¹⁹ Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

Figure 2. Occupations related to Structural Systems from Tennessee’s Hot Careers to 2022²⁰, (Occupations noted as in demand, as requiring more than short-term on-the-job training, with positive job growth, and with at least 160 expected annual job openings).

2014-2022 Average Annual Openings		Training Needed	2013 Median Salary
Carpenters	525	Apprenticeship	\$34,285
Construction Managers	265	Bachelor’s Degree	\$71,911
First-Line Supervisors of Construction Trades and Extraction Workers	210	Work experience in a related occupation	\$48,552
Operating Engineers and Other Construction Equipment Operators	180	Moderate-term on-the-job training	\$34,866

Job outlook is positive in all regions of the state; however, more opportunities are available in urban and surrounding areas.

Figure 3. Annual Average Openings for Carpenters in Tennessee by Region, 2014-2022



Current Secondary Landscape

Structural Systems was a new program of study in 2015-16 most closely aligned to the former Carpentry program of study. 57 schools indicated that they would offer the program of study during the open enrollment period prior to the start of the 2015-16 school year. This number is down significantly from open enrollment in 2014-15 when 122 schools indicated they would offer the program of study. This change can be explained by the 69 schools that selected the new program of study, Residential & Commercial Construction.

Historically, most Tennessee high school students enrolled in courses in the Architecture and Construction cluster took courses specializing in Carpentry. Prior to 2015-16 school year, the enrollment of students in the Carpentry program of study increased each year between 2011 and 2014 from 5,295 in 2011 to 5,957 students in the 2014-15 school year. Overall offerings of programs

²⁰ Tennessee Department of Labor & Workforce Development, Occupations in Demand. *Hot Careers to 2022* (Statewide). Retrieved from <http://www.tn.gov/workforce/topic/occupations-in-demand>.

of study in Architecture & Construction grew every year in Tennessee between 2007 and 2011. According to the TDOE Report Card, 359 programs of study in Architecture and Construction were present in high schools during the 2007-08 school year. In 2011-12 that number had grown to 421 programs of study in Architecture & Construction in Tennessee.

Figures 4 – 7 below illustrate how enrollment has shifted with the newly arranged programs of study.

Figure 4. 2015-16 Open Enrollment Program of Study Selections in Architecture & Construction Cluster

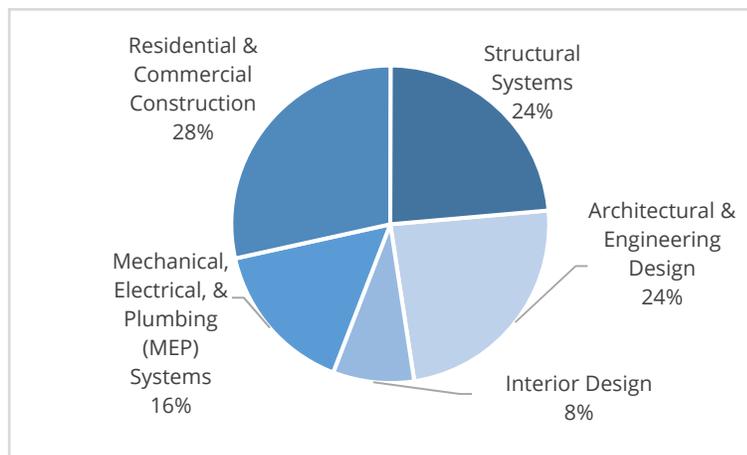


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Figure 6. Students Enrolled in Level 2 & 3 Architecture & Construction Courses in 2012-2013 Construction Cluster

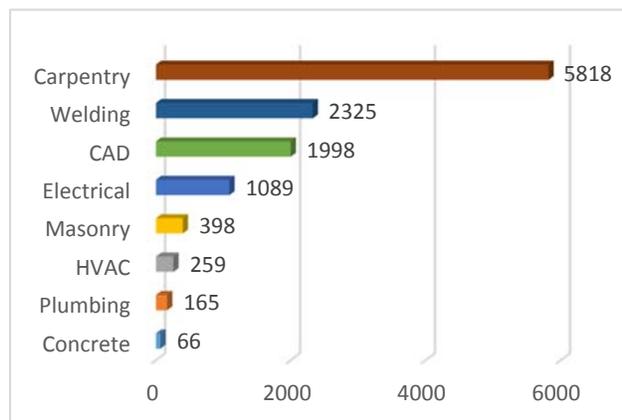
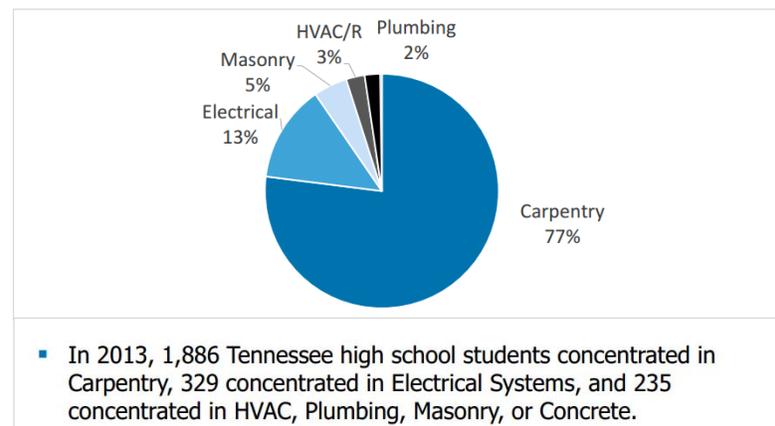


Figure 7. 2012-13 Tennessee Concentrators in Construction Trades Programs of Study



Postsecondary Pathways

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Figure 8. Postsecondary Pathways

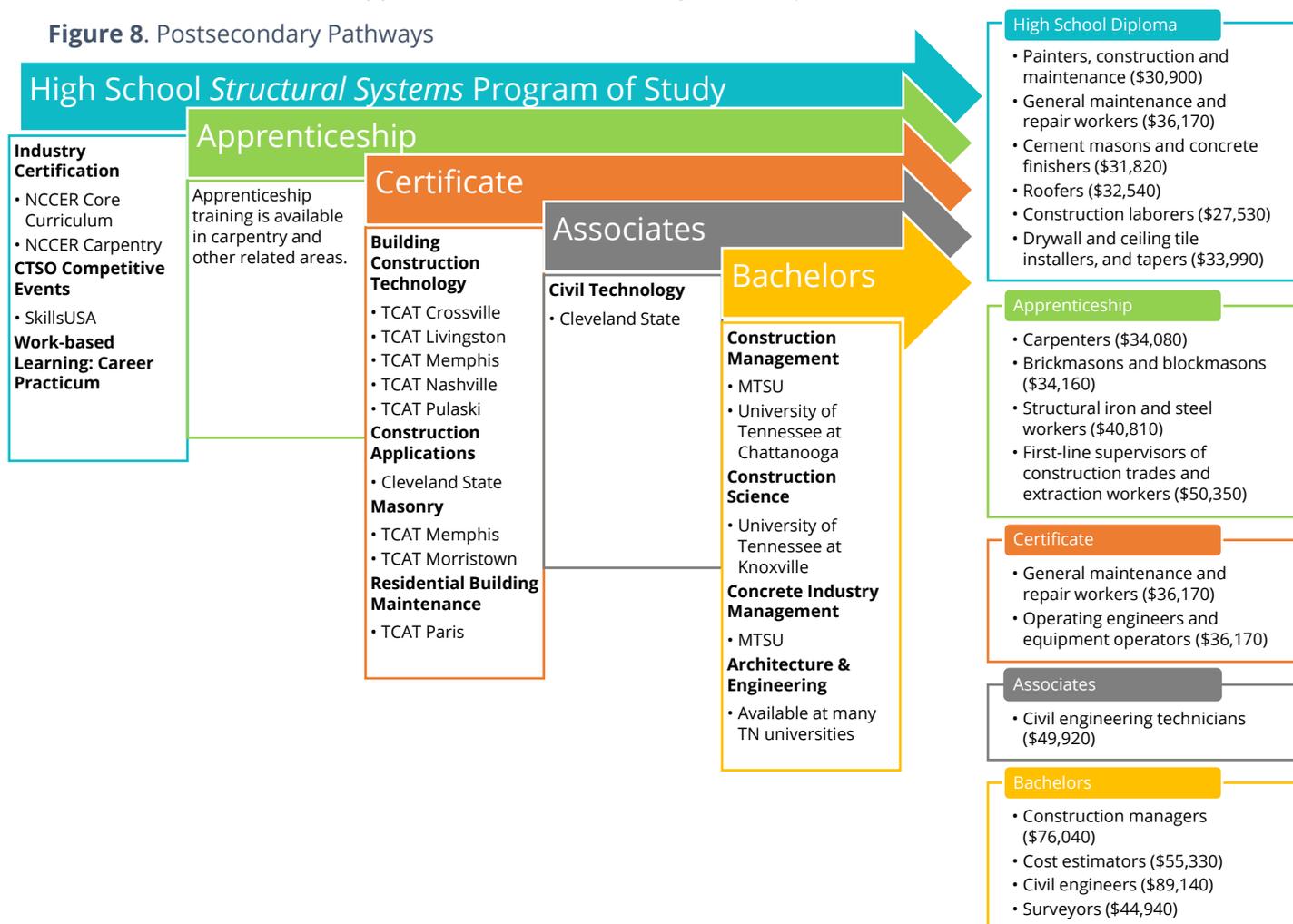


Figure 9. Possible career paths of individuals in the construction industry.²¹



Recommendation

No changes are recommended at this time.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Structural Systems	Fundamentals of Construction (6073)	Structural Systems I (6164)	Structural Systems II ¹ (6165) -or- Dual Enrollment Structural Systems (4073)	Construction Practicum (6160) -or- Dual Enrollment Structural Systems (4073)
	Industry Certification: NCCER Core Curriculum	Industry Certification: NCCER Carpentry Level One	Industry Certification: NCCER Carpentry Level Two	

References

Bureau of Labor Statistics, U.S. Department of Labor, Employment Projections. *Occupational Data*. (2015 Dec. 17) Retrieved from http://www.bls.gov/emp/ep_data_occupational_data.htm.

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²¹ Choose Your Career Path! Build Your Future and NCCER. Retrieved from <http://byf.org/path>.