



## Program of Study Justifications for Architecture & Construction

| <b>Program of Study</b>                  | <b>Page</b> |
|--|-------------|
| Architectural & Engineering Design       | 2           |
| Interior Design                          | 8           |
| Mechanical, Electrical, & Plumbing (MEP) | 13          |
| Residential & Commercial Construction    | 20          |
| Structural Systems                       | 28          |

## Architectural & Engineering Design

| 2016-17<br>Program of Study                   | Level 1  | Level 2   | Level 3  | Level 4  |
|---|--|---|--|--|
| <b>Architectural &amp; Engineering Design</b> | Architectural & Engineering Design I<br>(6037) | Architectural & Engineering Design II<br>(6039) | Architectural & Engineering Design III<br>(5927) | Engineering Practicum<br>(6141)<br>-or-<br>AP Calculus<br>(3127, 3139, or 3128)<br>-or-<br>AP Physics<br>(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.

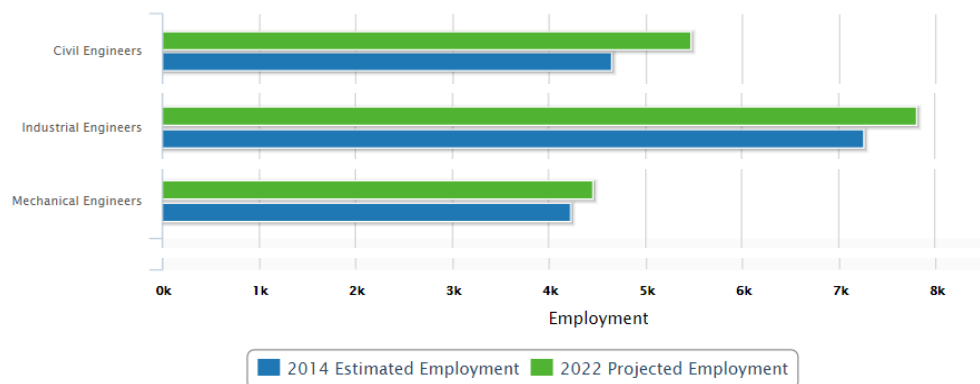
Students will have the opportunity to participate in the *Engineering Practicum* course which places students with industry partners to complete a design project, report the results, and present their project before an audience. Students have the option to complete *AP Physics* or *AP Calculus* as an 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.<sup>1</sup>

**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.<sup>2</sup>

### 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

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

<sup>2</sup> 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](http://www.bls.gov/emp/ep_data_occupational_data.htm).



Tennessee and third nationally. For industrial engineers, Tennessee ranks 5<sup>th</sup> nationally for the highest concentration with a location quotient of 1.61 and 7,770 employed in 2014.<sup>3</sup>

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

| Occupation  | Total Percent Change | Annual Avg. Openings | TN 2016 Median Wage | Education Level |
|---|----------------------|----------------------|---------------------|-----------------|
| Industrial Engineers                              | 7.5%                 | 280                  | \$79,140            | Bachelor's      |
| Civil Engineers                                   | 17.6%                | 215                  | \$95,110            | Bachelor's      |
| Mechanical Engineers                              | 5.3%                 | 170                  | \$85,780            | 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                   | \$55,580            | Associate's     |
| Architects, Except Landscape and Naval            | 12.7%                | 50                   | \$72,860            | Bachelor's      |
| Electronics Engineers, Except Computer            | 17.3%                | 50                   | \$94,650            | Bachelor's      |
| Industrial Engineering Technicians                | 1.1%                 | 45                   | \$46,400            | Associate's     |
| Environmental Engineers                           | 17.1%                | 40                   | \$89,790            | Bachelor's      |
| Surveying and Mapping Technicians                 | 12.4%                | 40                   | \$44,700            | HS Diploma      |
| Nuclear Engineers                                 | 8.8%                 | 40                   | \$125,600           | Bachelor's      |
| Mechanical Engineering Technicians                | 7.5%                 | 35                   | \$52,030            | Associate's     |
|   |                      |                      |                     |                 |

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

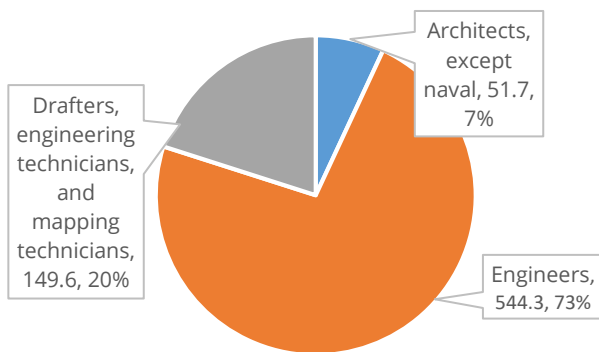
| Occupation  | Total Percent Change | Annual Avg. Openings |
|---|----------------------|----------------------|
| Civil Engineers                                   | 8.4%                 | 106,700              |
| Mechanical Engineers                              | 5.3%                 | 102,500              |
| 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               |

<sup>3</sup> Bureau of Labor Statistics, U.S. Department of Labor, Occupational Employment Statistics. *Occupational Employment and Wages, May 2016. (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

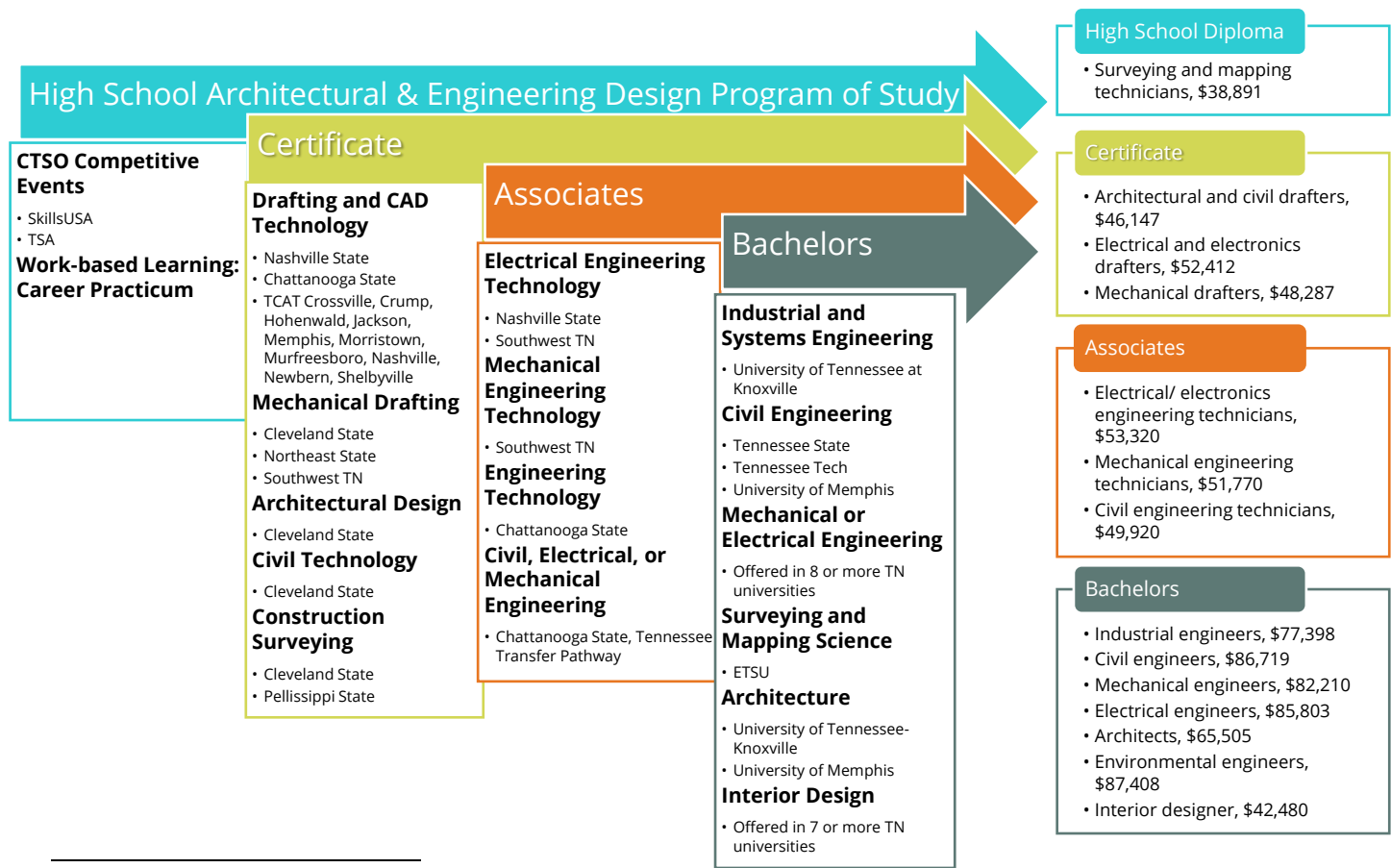


## Current Secondary Landscape

Enrollment in this program of study has grown in recent years. In 2014-15, the program was offered in 60 schools in 34 districts and 6,026 were enrolled in a course in program of study. This number has remained the same at 60 schools choosing this program of study in 2017-18.

## 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.<sup>4</sup> 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.



<sup>4</sup> 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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

## Recommendation

No changes are recommended at this time.

| 2017-18<br>Program of<br>Study                | Level 1                                     | Level 2                                      | Level 3   | Level 4  |
|---|---|--|---|--|
| <b>Architectural &amp; Engineering Design</b> | Architectural & Engineering Design I (6037) | Architectural & Engineering Design II (6039) | Architectural & Engineering Design III <sup>1</sup> (5927)<br>-or-<br><b>Dual Enrollment</b><br>Architectural & Engineering Design (4075) | Engineering Practicum (6141)<br>-and/or-<br>AP Calculus (3127, 3139, or 3128)<br>-and/or-<br>AP Physics (3238, 3239, 3234, or 3240)<br>-or-<br><b>Dual Enrollment</b><br>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](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                         |
|--------------------------|---------------------------------------|------------------------------------|-----------------------------------|---------------------------------|
| <b>Interior Design</b>   | 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.<sup>5</sup> Nationally, the employment of interior designers is projected to grow with 4 percent growth between 2014 and 2024.<sup>6</sup>

**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                   |

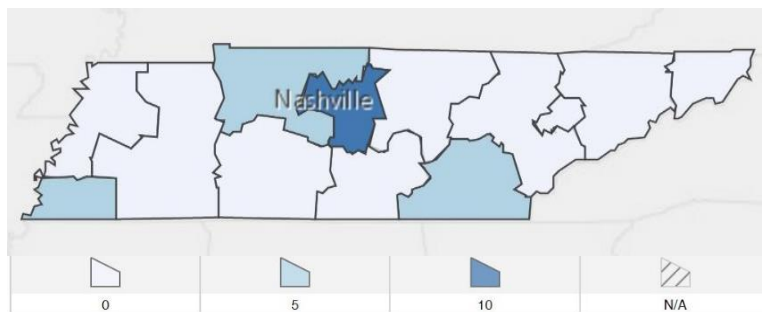
<sup>5</sup> Tennessee Department of Labor and Workforce Development. (2015). Employment Security Division, *Employment Figures*

<sup>6</sup> 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](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)



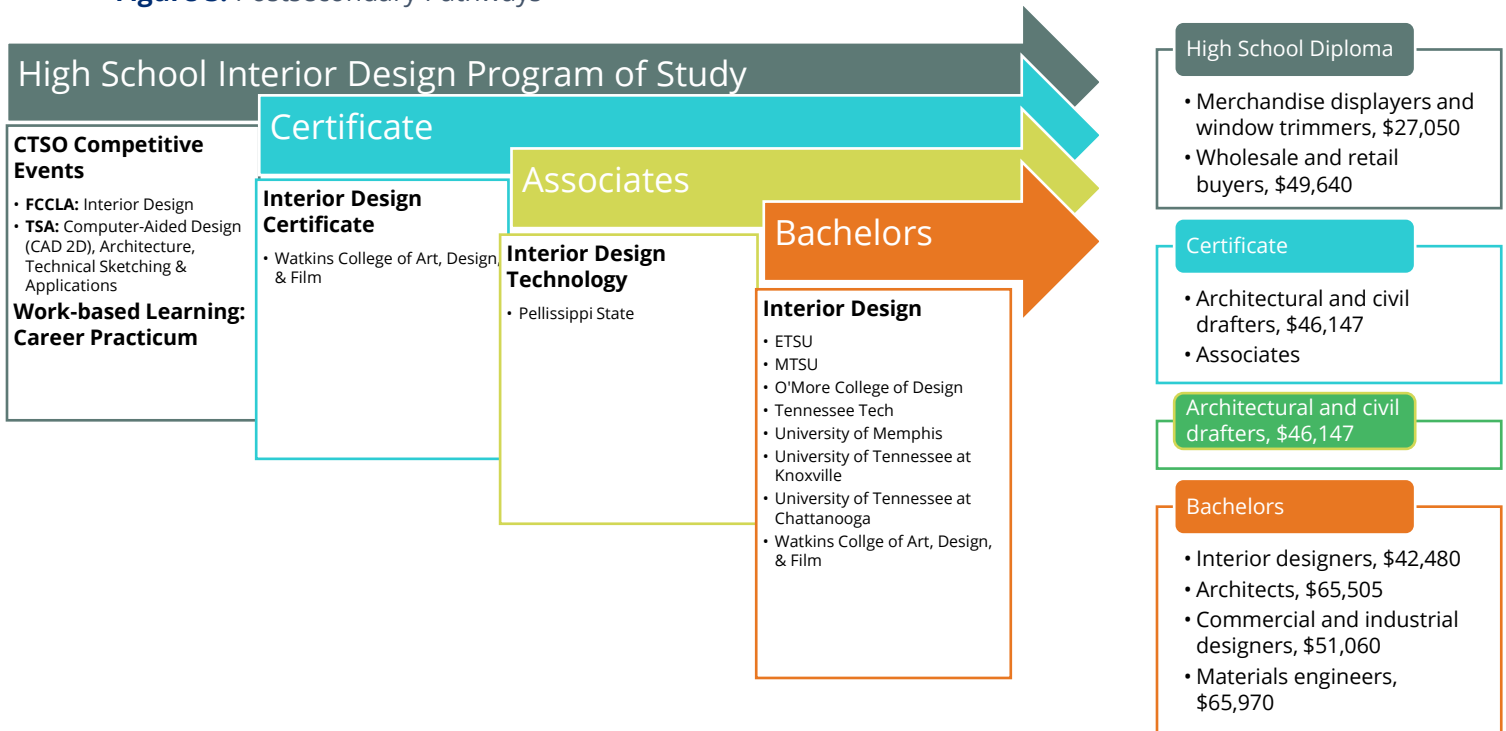
### Current Secondary Landscape

Schools offering this program of study is expected to decrease from 20 in 2016-17 to 17 in 2018-19. The numbers of concentrators are dwindling as well from 51 in 2014-15 to 30 in 2015-16.

### 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.<sup>7</sup>

Figure 3. Postsecondary Pathways



<sup>7</sup> 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>.



**Recommendation**

Over the year, 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<br>Program of Study | Level 1                               | Level 2                            | Level 3  | Level 4  |
|-----------------------------|---------------------------------------|------------------------------------|--|--|
| <b>Interior Design</b>      | Foundations of Interior Design (6014) | Residential Interior Design (6006) | Commercial Interior Design (6122)<br>-or-<br><b>Dual Enrollment</b> Interior Design (4076) | Advanced Interior Design (6121)<br>-or-<br><b>Dual Enrollment</b> 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](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<br>Program of Study   | Level 1                                   | Level 2               | Level 3  | Level 4                             |
|---|---|-----------------------|--|-------------------------------------|
| <b>Mechanical,<br/>Electrical, &amp;<br/>Plumbing (MEP)<br/>Systems</b> | Fundamentals of<br>Construction<br>(6073) | MEP Systems<br>(6161) | HVAC<br>(6077)<br>-and/or-<br>Electrical Systems<br>(6075)<br>-and/or-<br>Plumbing Systems<br>(6082) | Construction<br>Practicum<br>(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.<sup>8</sup> 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).<sup>9</sup> 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           |

<sup>8</sup> 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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

<sup>9</sup> 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.<sup>10</sup> 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 2022<sup>11</sup> (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).

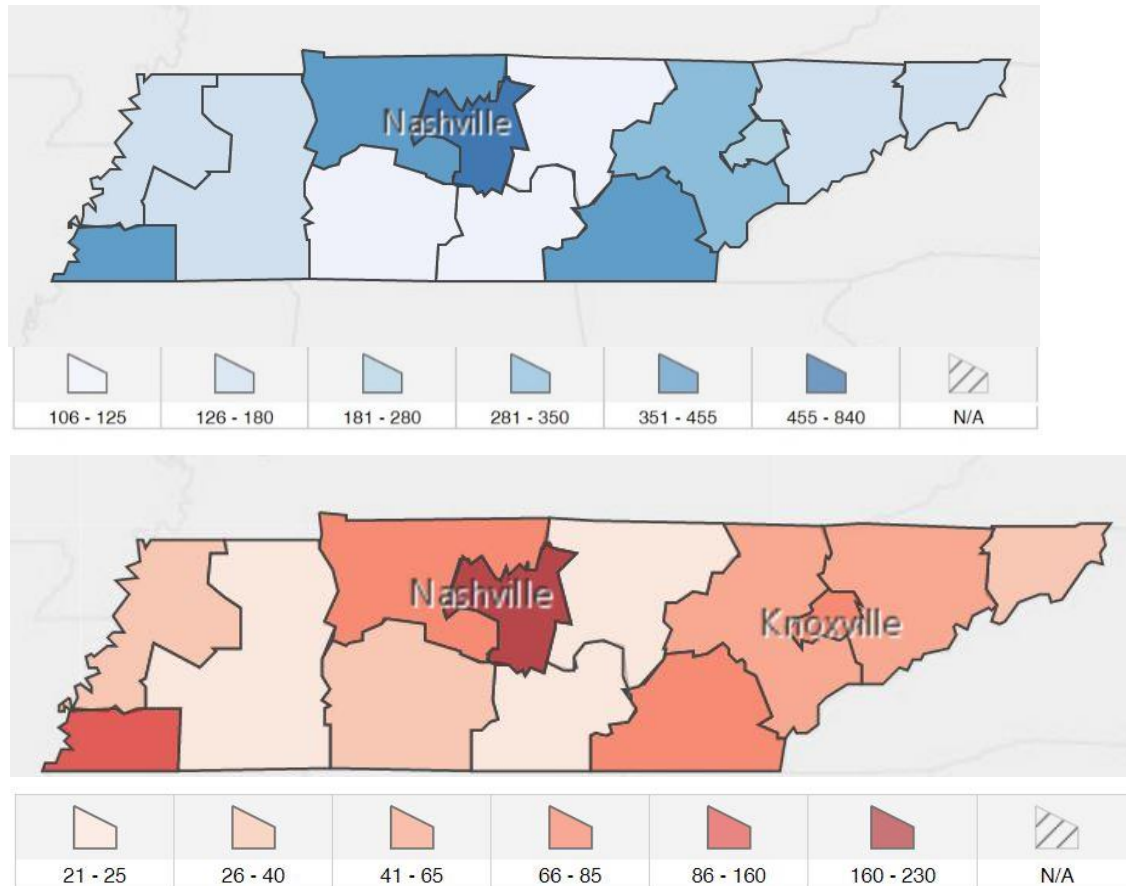
| 2014-2022 Average Annual Openings                                    |     | Training Needed                         | 2013 Median Salary |
|--|-----|---|--------------------|
| Maintenance and Repair Workers, General                              | 850 | Long-term on-the-job training           | \$35,250           |
| 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           |

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

<sup>11</sup> 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

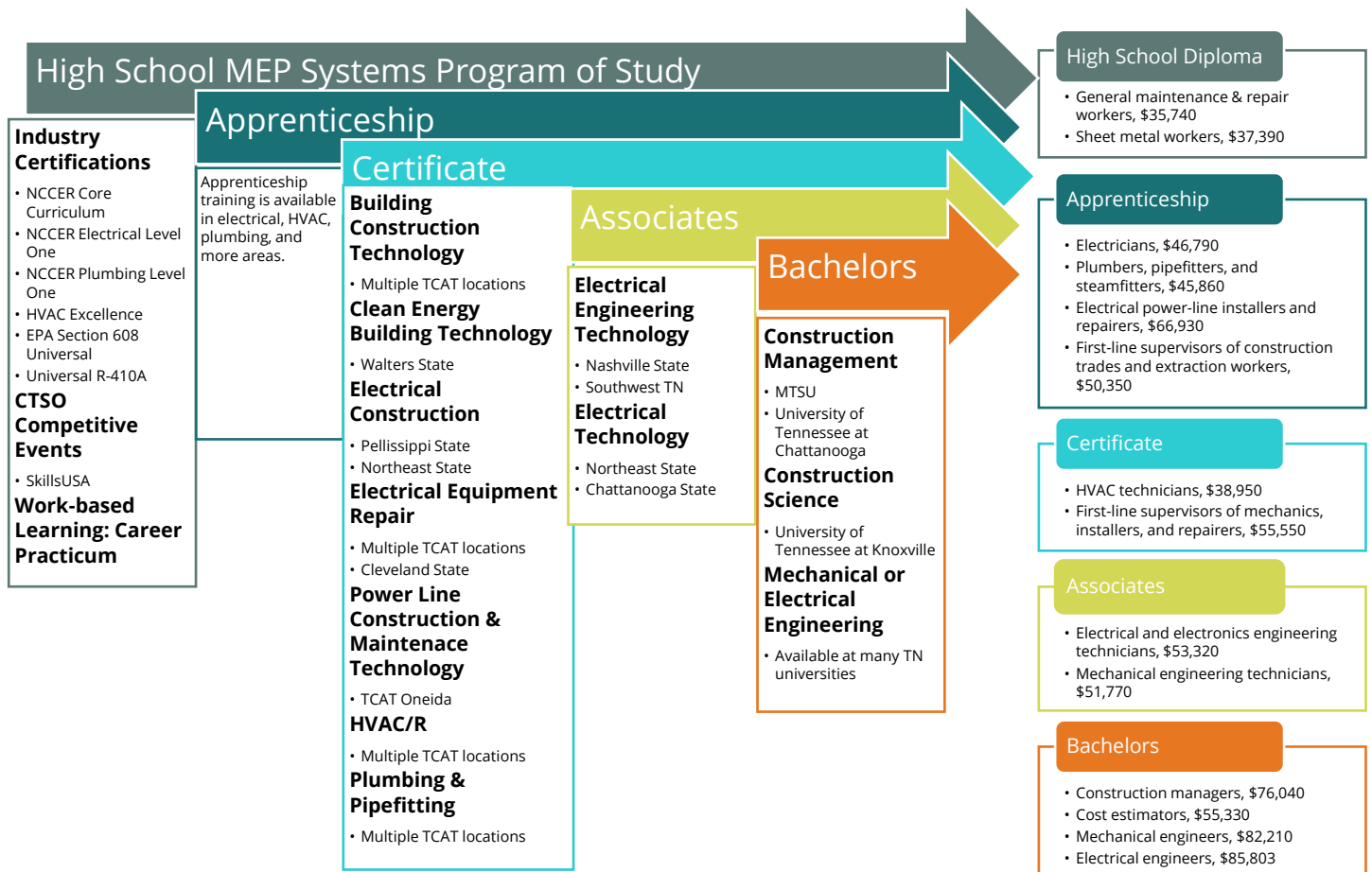


**Current Secondary Landscape**

Enrollment in this program of study has increased from 5,859 students in 2014-15 to 6,376 students in 2015-16. The number of schools offering MEP is growing as well, from 38 schools in 2015-16 to 49 schools in 2017-18.

This program offers several industry certifications, such as the suite of NCCER offerings to HVAC Excellence. This, coupled with rising demand for skilled workers, is likely the reason for the increase in offerings.





### 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

### **Recommendation**

It is recommended that OSHA 10 and OSHA 30 Construction be added to this program of study based on suggestion from industry advisory council and suggestions from local school districts. This certification assesses knowledge of safety specific to the field of construction. Topics include: fire detection and prevention, electrical, flammable liquids, walking and working surfaces, power tool safety, machine guarding, and other pertinent information.

| 2017-18<br>Program of Study                                 | Level 1  | Level 2            | Level 3   | Level 4  |
|---|--|--------------------|---|--|
| <b>Mechanical, Electrical, &amp; Plumbing (MEP) Systems</b> | Fundamentals of Construction (6073)  | MEP Systems (6161) | HVAC (6077)<br>-and/or-<br>Electrical Systems (6075)<br>-and/or-<br>Plumbing Systems (6082)<br>-or-<br><b>Dual Enrollment</b><br>Mechanical, Electrical, & Plumbing Systems (4074)  | Construction Practicum (6160)<br>-or-<br><b>Dual Enrollment</b><br>Mechanical, Electrical, & Plumbing Systems (4074) |
|   | <b>Industry Certification:</b><br>NCCER Core Curriculum<br>-and/or-<br>OSHA 10 |                    | <b>Industry Certifications for 6077:</b><br>HVAC Excellence, Heating, Electrical, Air Conditioning Technology (H.E.A.T.)<br>HVAC Excellence Employment Ready Certifications<br>Universal R-410A EPA Section 608<br>Universal<br><b>Industry Certification for 6075:</b><br>NCCER Electrical Level One |  |



|  |  |  |   |  |
|--|--|--|---|--|
|  |  |  | -and/or-<br>OSHA 30<br>Construction<br><b>Industry<br/>Certification for<br/>6082:</b><br>NCCER Plumbing<br>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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

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

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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<br>Program of Study                      | Level 1                             | Level 2  | Level 3   | Level 4                       |
|--|-------------------------------------|--|---|-------------------------------|
| <b>Residential &amp; Commercial Construction</b> | 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**

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.<sup>12</sup> 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).<sup>13</sup> Opportunities are available in a broad range of occupations.

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<sup>12</sup> 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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

<sup>13</sup> Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

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

| 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           |
| 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           |

### 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.<sup>14</sup> 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**).

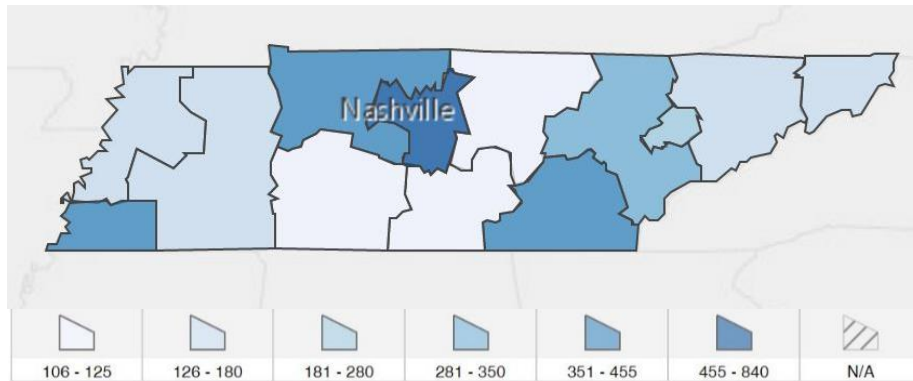
<sup>14</sup> Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

**Figure 2.** Tennessee’s Hot Careers in Construction to 2022<sup>15</sup> (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).

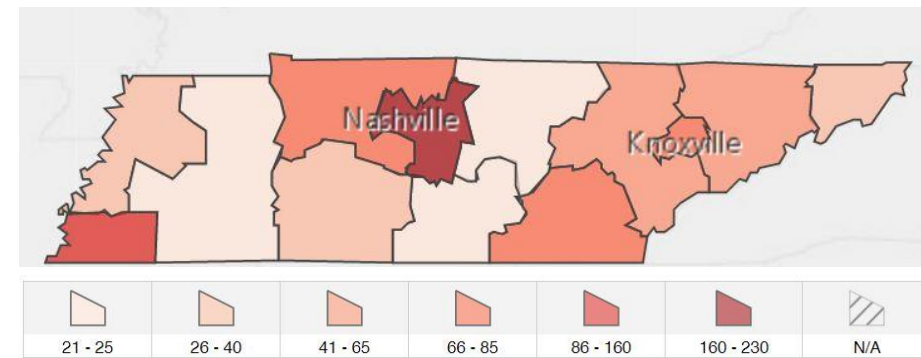
| 2014-2022 Average Annual Openings                                    | Training Needed                         | 2013 Median Salary |
|--|---|--------------------|
| Maintenance and Repair Workers, General                              | Long-term on-the-job training           | \$35,250           |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



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



<sup>15</sup> 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>.

### ***Current Secondary Landscape***

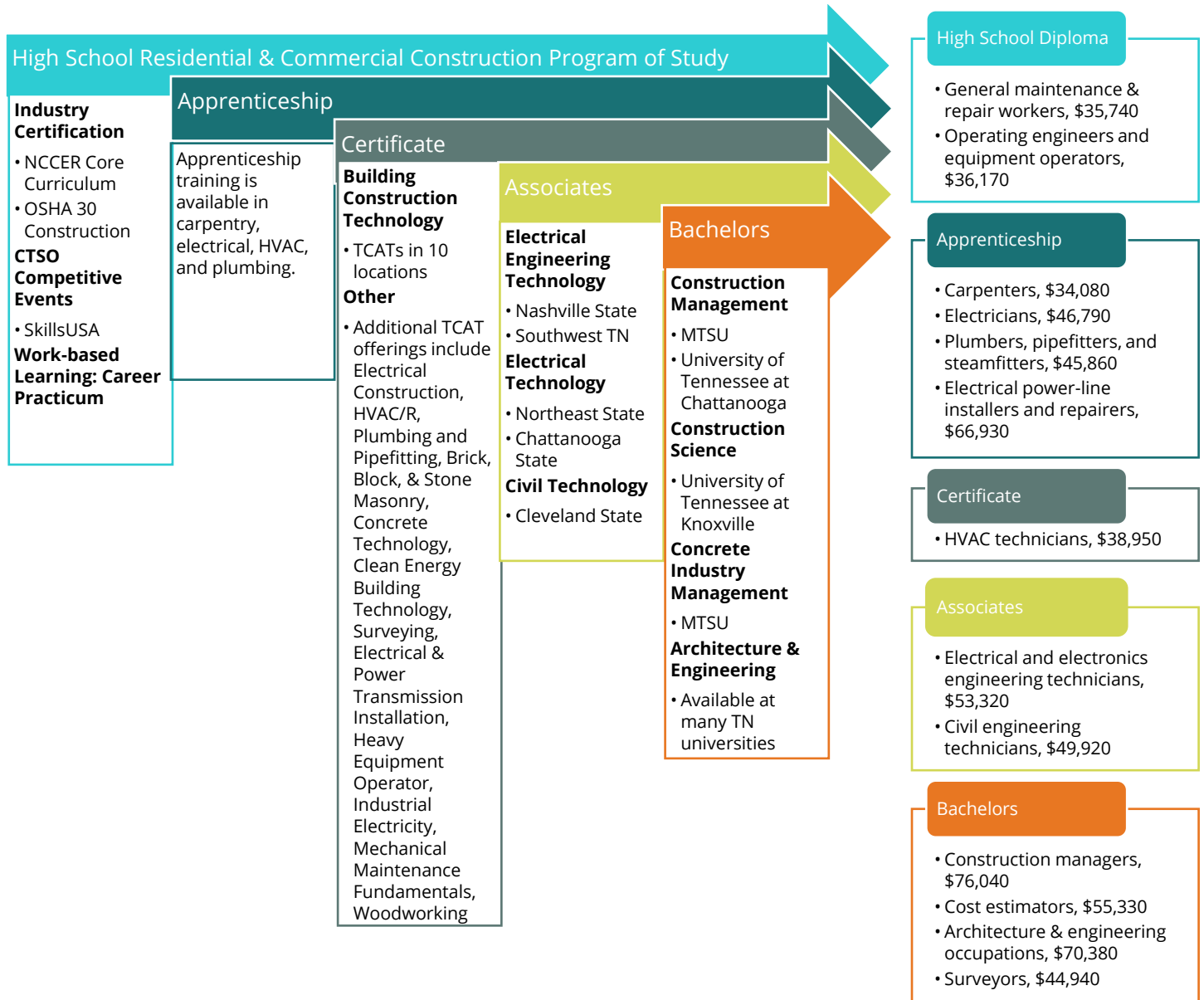
Enrollment in this program of study has seen a dramatic increase in enrollment from 5,483 students in 2014-15 to 7,762 students in 2015-16. In 2015-16, 69 schools offered this program of study. The number grew to 78 in 2016-17 and is expected to be at 78 for the 2017-18 school year. The reason for the increase likely stems from the need for skilled workers in this field and the number of industry certifications offered in this program 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.<sup>16</sup>



<sup>16</sup> Choose Your Career Path! Build Your Future and NCCER. Retrieved from <http://byf.org/path>.



### Recommendation

It is recommended that OSHA 10 and OSHA 30 Construction be added to this program of study based on suggestion from industry advisory council and suggestions from local school districts. This certification assesses knowledge of safety specific to the field of construction. Topics include: fire detection and prevention, electrical, flammable liquids, walking and working surfaces, power tool safety, machine guarding, and other pertinent information.

Based on input from industry, it is recommended that International Code Council's Residential and Commercial Building inspection courses and certifications are researched for possible inclusion in this program of study. We will also research Snap on multimeter certification, mechanical and electronic torque certification and building performance instruments certification to determine if these certifications meet the criteria for promoted industry certifications.

| 2017-18 Program of Study                         | Level 1  | Level 2   | Level 3  | Level 4   |
|--|--|---|--|---|
| <b>Residential &amp; Commercial Construction</b> | Fundamentals of Construction (6073)  | Residential & Commercial Construction I (6162)                  | Residential & Commercial Construction II <sup>1</sup> (6163)<br>-or-<br><b>Dual Enrollment</b><br>Residential & Commercial Construction (4072) | Construction Practicum (6160)<br>-or-<br><b>Dual Enrollment</b><br>Residential & Commercial Construction (4072) |
|  | <b>Industry Certification:</b><br>NCCER Core Curriculum<br>-and/or-<br>OSHA 10 | <b>Industry Certification:</b><br>NCCER Construction Technology | <b>Industry Certification:</b><br>OSHA 30 Construction   |   |

## ***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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

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

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

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

## Structural Systems

| 2016-17<br>Program of Study | Level 1                                | Level 2                        | Level 3                         | Level 4                          |
|-----------------------------|--|--------------------------------|---------------------------------|----------------------------------|
| <b>Structural Systems</b>   | Fundamentals of Construction<br>(6073) | Structural Systems I<br>(6164) | Structural Systems II<br>(6165) | Construction Practicum<br>(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.<sup>17</sup> 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

<sup>17</sup> 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](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.<sup>18</sup> 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           |
| Sheet Metal Workers  | 160                  | 14.4%        | \$37,390           |
| 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**).

**Figure 2.** Occupations related to Structural Systems from Tennessee's Hot Careers to 2022<sup>19</sup>, (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           |

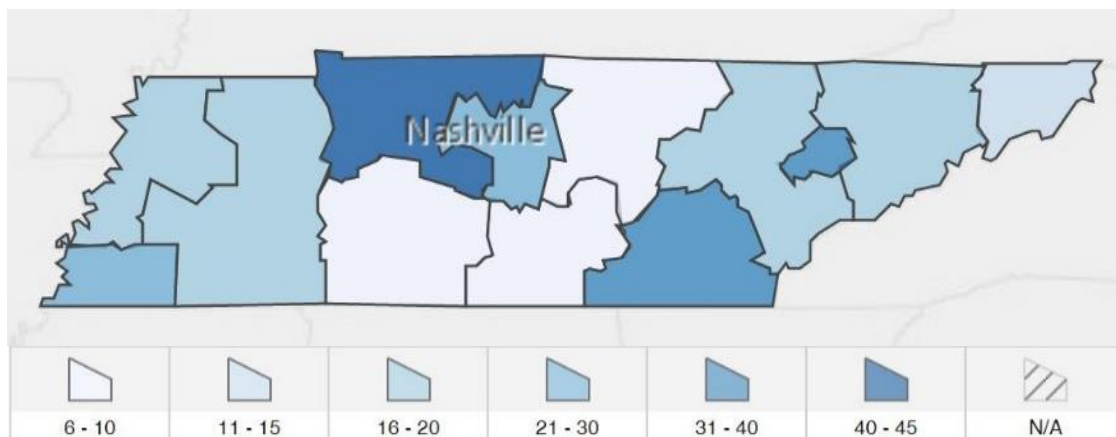
<sup>18</sup> Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

<sup>19</sup> 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>.

|  |     |   |          |
|--|-----|---|----------|
| 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



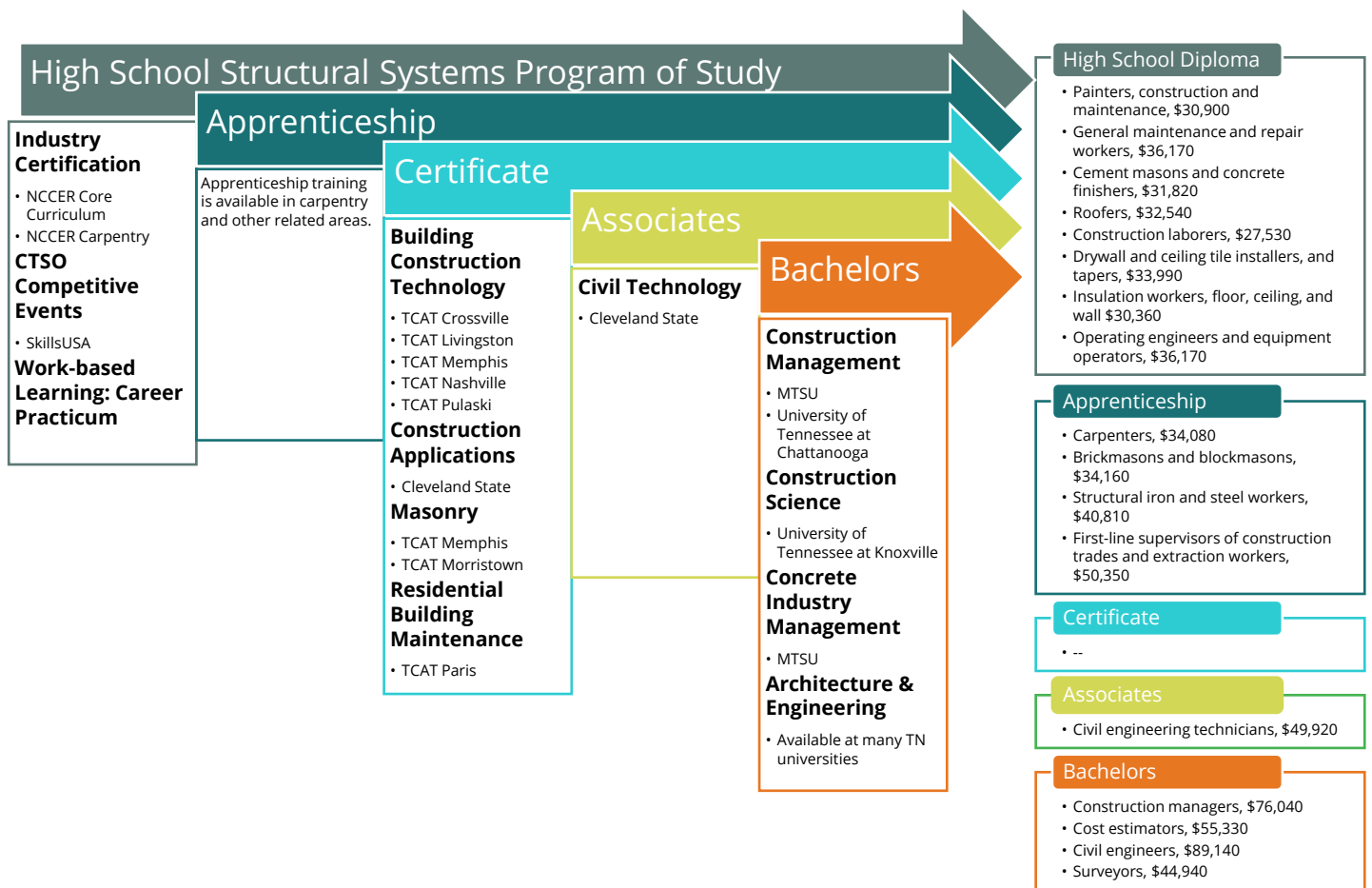
***Current Secondary Landscape***

Enrollment in Structural Systems has increased from 5,483 students in 2014-15 to 7,417 in 2015-16. The number of schools offering this new program of study in 2015-16 was 57. In 2016-17 that number was at 58 and is projected to grow to 65 schools for the 2017-18 school year.

## 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 8.** Postsecondary Pathways





### **Recommendation**

It is recommended that OSHA 10 and OSHA 30 Construction be added to this program of study based on suggestion from industry advisory council and suggestions from local school districts. This certification assesses knowledge of safety specific to the field of construction. Topics include: fire detection and prevention, electrical, flammable liquids, walking and working surfaces, power tool safety, machine guarding, and other pertinent information.

| 2017-18 Program of Study  | Level 1  | Level 2   | Level 3   | Level 4   |
|---------------------------|--|---|---|---|
| <b>Structural Systems</b> | Fundamentals of Construction (6073)  | Structural Systems I (6164)                                 | Structural Systems II <sup>1</sup> (6165)<br>-or-<br><b>Dual Enrollment</b> Structural Systems (4073) | Construction Practicum (6160)<br>-or-<br><b>Dual Enrollment</b> Structural Systems (4073) |
|                           | <b>Industry Certification:</b><br>NCCER Core Curriculum<br>-and/or-<br>OSHA 10 | <b>Industry Certification:</b><br>NCCER Carpentry Level One | <b>Industry Certification:</b><br>NCCER Carpentry Level Two<br>-and/or-<br>OSHA 30 Construction       |   |

### **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](http://www.bls.gov/emp/ep_data_occupational_data.htm).

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

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