DEPARTMENT OF LABOR AND INDUSTRY

Ensuring the safety of youth in skilled trades training programs

Report to the Minnesota Legislature

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Contents

Executive summary

The Legislature directed the Minnesota Department of Labor and Industry (DLI) to study ways to allow for the safety of middle school and high school students who receive hands-on training in skilled trades, including on location at construction sites, and identify safety precautions that should be undertaken.

In studying ways to provide hands-on training in the skilled trades and necessary safety precautions that should be undertaken, DLI reviewed the research on occupational injuries and illnesses, which shows youth have an increased risk of work-related injuries, and the research on factors that contribute to that increased risk.

Risks factors identified in the research include:

1. The hazardousness of the work youth are assigned to perform and the work environment in which they perform the work.
2. Lack of education, training and experience needed to perform assigned activities and tasks properly and safely.
3. Lack of necessary supervision.
4. The level of physical, mental and emotional development of adolescents. Key developmental attributes are concerning for youth working in construction: immature musculoskeletal physique; hormonal changes that influence behaviors; and a brain that is still in training to perfect balance, coordination and executive functioning.

DLI, after engaging representatives from youth skilled-trade training programs, construction sector representatives, educators and the occupational safety and health experts in DLI's OSHA Division, identified the following safety precautions that are responsive to these risk factors:

1. Require training be provided in a controlled environment, using simulator equipment and virtual training when possible.
2. Require OSHA 10-hour safety training, first aid training, and safety and health training that is integrated into the training for specific skills.
3. Require the provision of necessary personal protective equipment (PPE) and ensure it fits properly and is worn.
4. Establish and require compliance with safety and health rules, including rules that training must be free from distractions, such as cellphones.
5. Ensure individualized attention and supervision by conducting training in small groups and requiring a low ratio of youth to instructors.
6. Require instructors to be qualified to provide training in the skills to be learned, including how to properly use tools, equipment, machinery, chemicals and materials used in the program, to be trained in occupational safety and health and instructing youth.

Current Minnesota skilled-trades training programs expose youth to careers in the skilled trades and many provide hands-on training in skills youth would use in those careers while protecting their health, safety and wellbeing.

Existing Minnesota youth skilled-trades training programs require many of the recommended safety precautions identified by DLI in this report, exposing youth to the skilled trades through safe hands-on training in controlled environments. Training programs offer a spectrum of activities, including career fairs, construction curricula in the classroom and apprenticeship readiness courses. They address safety through various methods, including low instructor to student ratios, direct supervision of hands-on learning, instructor and student safety training, use of personal protective equipment and implementation of safety and health rules. Minnesota training programs aim to provide meaningful exposure and training experiences so youth can make informed decisions about embarking on a career path in the skilled trades upon graduation from high school.

The factors that place youth at an increased risk of work-related injuries make active construction sites inconducive to the safe provision of hands-on training to middle school and high school aged students.

Active construction sites are dangerous work environments, as exemplified by the thousand workers who died on construction sites in 2018. Training middle school and high school students on an active construction site would mean placing them in a hazardous environment while training them on highly technical skills using dangerous tools, equipment and machinery. In addition, their physical development, hormonal changes and lack of mature judgment make youth particularly vulnerable to injuries while performing strenuous activities and tasks using tools and equipment designed for adults and in circumstances requiring mature judgment about hazards and risks. Efforts to protect youth from injuries by limiting the tasks they may perform on construction sites have proved unsuccessful. While federal child labor laws and laws in other states include such limitations, data about injuries and fatalities indicate that despite those limits, youth are regularly injured while performing construction work. Even in Minnesota, where children under the age of 18 are prohibited from working on or about active construction sites, youth suffer construction-related injuries despite those prohibitions.

Legislative recommendations

Demand for existing Minnesota youth skilled-trades training programs frequently exceeds program capacity and resources. Legislators could consider expanding support, including increased funding, for this type of programming, including construction career training programs and technical education in Minnesota schools, to introduce more middle school and high school students to the skilled trades.

The Department of Labor and Industry also recommends to the Legislature the safety precautions identified in the report for youth skilled-trades training programs, which many of Minnesota's programs already follow.

Introduction and background

Through its 2019 Special Session Education Finance Bill, the Minnesota Legislature gave the Department of Labor and Industry (DLI) the following mandate:

> *The commissioner of labor and industry must study ways to allow for the safety of middle and high school aged students who receive hands-on training in skilled trades, including on location at construction sites. The report must identify safety precautions that should be undertaken, including proposed legislation, if any.*[1]

DLI contracted with The Improve Group, DeYoung Consulting Services and the Midwest Center for Occupational Health and Safety at the University of Minnesota to support its work in preparing this report.

Because the legislation requires the commissioner to consider ways to safely train youth as well as recommend safety precautions, the department believed it was important to engage stakeholders who are currently training youth in Minnesota and/or working in the skilled trades to hear their thoughts about youth training and this legislative mandate.

In conducting this study, multiple stakeholders were engaged, including representatives of educational institutions, representatives of the construction trades, representatives of the construction industry and individuals involved in programs that provide training in the skilled trades to youth. Stakeholders were engaged to obtain their views about ways for middle and high school students to receive hands-on training in the skilled trades, including on active construction sites, and recommended safety precautions to protect their health and safety.

Overall, stakeholders communicated their support for youth being exposed to and receiving training in the skilled trades for a variety of reasons. Some stakeholders expressed the belief that there is a workforce shortage in the skilled trades and to respond to that workforce shortage there is a need to attract youth to skilled trades careers. Youth training programs were thought by stakeholders to be a way to expose and introduce youth to the skilled trades. Some stakeholders maintained there is a negative perception of the skilled trades and providing youth with training opportunities helped overcome those negative perceptions. Further, some stakeholders expressed that youth training programs introduce youth to career pathways besides a four-year degree. Finally, stakeholders thought youth training programs could prepare students for the changing economy and the changing world of work.

Stakeholders held differing views about how to safely provide training to youth in the skilled trades and had conflicting positions about whether youth could be safely trained on an active construction site. Some felt

[1]Minnesota Session Laws 2019 1st Special Session Ch 11, Art. 2, Sec. 32.

training youth on construction sites would help them better understand the industry and culture of construction worksites and that risks to their safety could be mitigated. Others strongly believed there was not a way to safely train youth on an active construction site and that attempting to do so would put not only the youth but other workers on the construction site at risk.

The skilled trades workforce

Stakeholders who perceive a workforce shortage believe exposing youth to and providing them training in a skilled trade is a way to attract them to careers in the skilled trades.

Some industry and education representatives believe there is a skilled trades workforce shortage in Minnesota.

"It exists," said one industry representative of the workforce shortage. "I know this because I've been doing work in [the] workforce arena for a number of years now. ... It's a very real phenomena and the trades and the construction industry have ... a real challenge ahead of them."

Certain stakeholders expressed the belief that the workforce shortage is limited to specific trades and cannot be generalized to all skilled trades. One education representative estimated 80% of the contractors in an association s/he represented are struggling to find electricians.

Other stakeholders did not agree there is a workforce shortage in the skilled trades. Some expressed the opinion that a workforce shortage may be exaggerated.

In response to these comments, DLI believed it important to review construction labor supply and demand in Minnesota to obtain insights into the perceptions of some stakeholders that there is a skilled trades workforce shortage in the state.

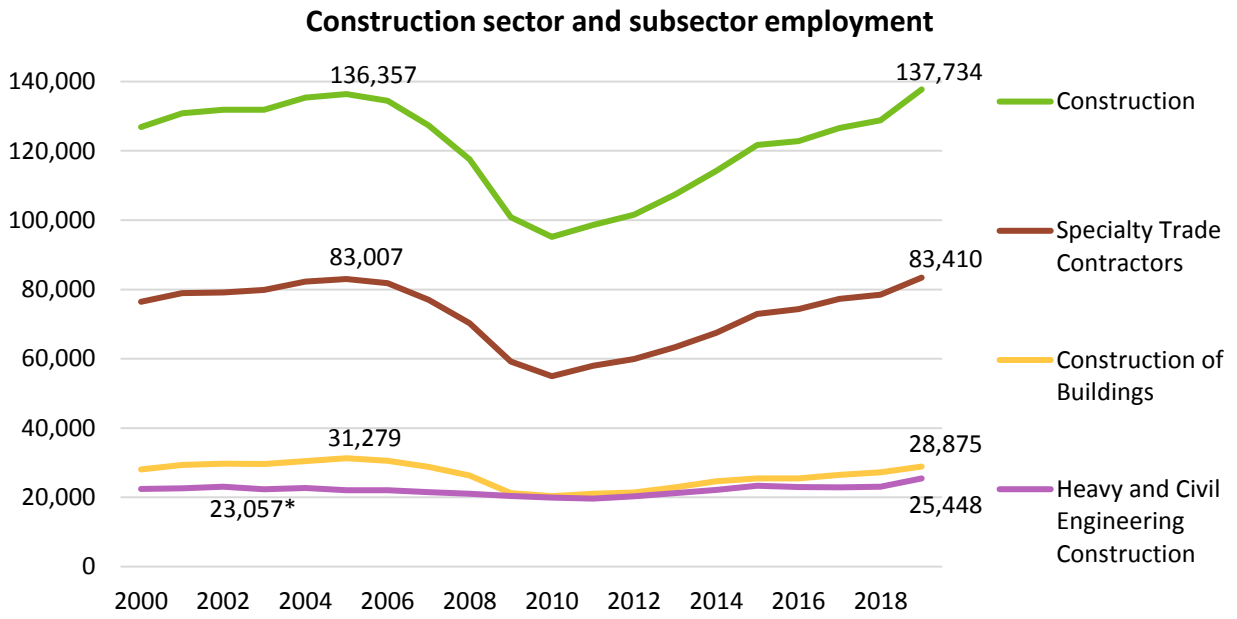
> "So many of my contractors want to hire journey workers right now, but there's no journey workers to hire so they need to grow their own. So, the number of journey workers at this point in time is limiting the number of individuals that can enter the industry and there is a need. There is a workforce shortage."
>
> — Education representative

The department looked at employment trends, job vacancy data and permit data to better understand the construction workforce in Minnesota.

EMPLOYMENT TRENDS IN THE CONSTRUCTION SECTOR

DLI reviewed employment trends in construction from 2000 through 2018[2], finding that construction employment decreased by more than 40,000 workers between 2005 and 2010 and has rebounded by a similar number during the past eight years, indicating the industry as a whole has mostly returned to pre-recession employment levels. Employment numbers do not include workers classified as independent contractors.

Figure 1



[2]Employment trend figures show construction wage and salary employment trends from 2000 until the second quarter of 2019. Construction employment in both the private and public sectors are included. Employment data was produced using the Quarterly Census of Employment and Wages (QCEW) data tool from the Minnesota Department of Employment and Economic Development (https://mn.gov/deed/data/data-tools/qcew). The QCEW does not include workers properly or improperly classified as independent contractors, a trend for securing labor that continues to grow in the construction sector. Consequently, there are likely more workers currently working in the construction sector who are not captured by the quarterly census because they are not classified, legally or illegally, as employees.

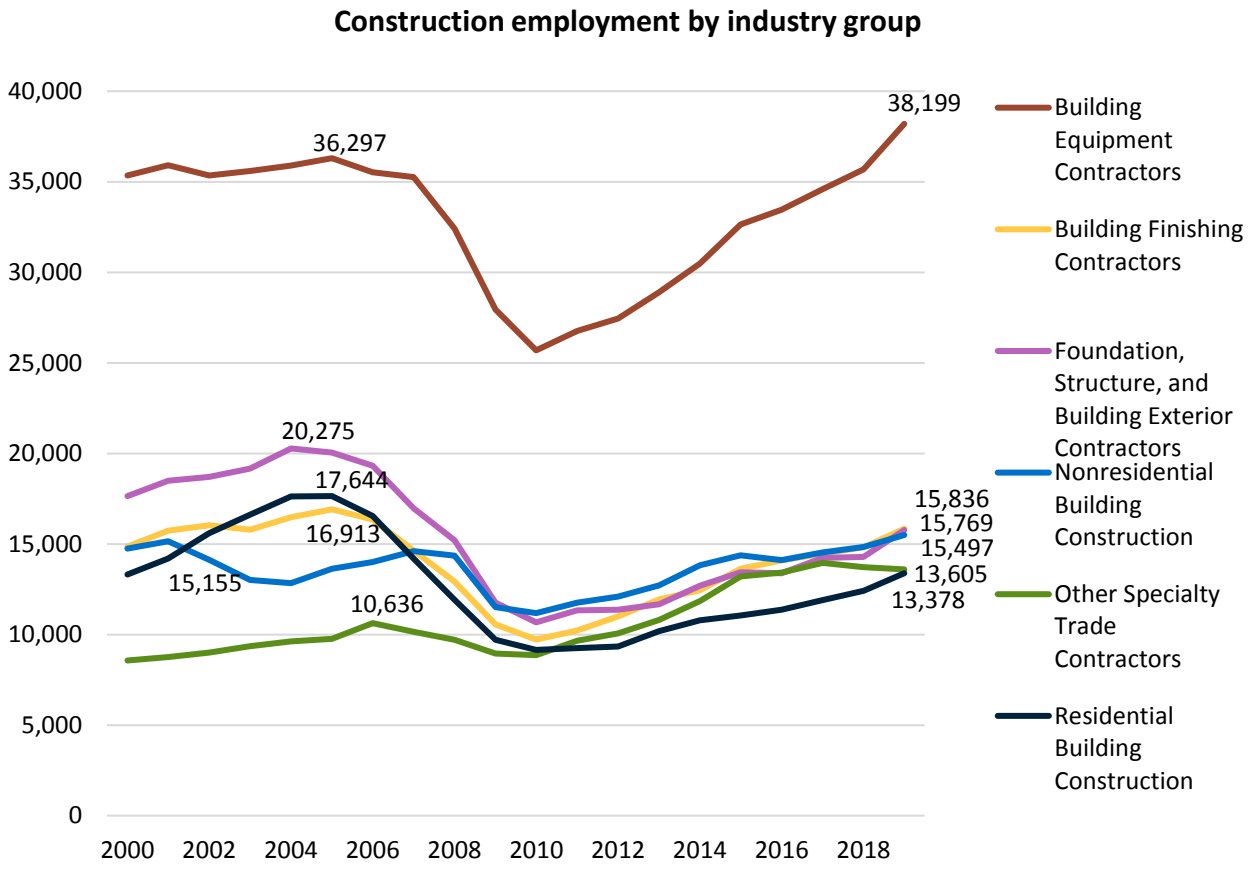
For all years except 2019, the employment number is the annual average employment. For 2019, the second quarter (April, May, June) employment is the most recently available data. Examination of the relation of construction quarterly employment counts to the annual average shows that the second quarter's figures averaged only 1.7% different from the annual average for 2000 through 2018; closer to the annual average than any other quarter. Therefore, the second quarter is a suitable estimate of the annual total for 2019.

Another factor to consider is that construction employment peaks in the third quarter of the year (July, August, September), 11.3% above the annual average (measured from 2000 through 2018). This value ranged between 8% and 13% over the annual average employment during this time span.

*Employment numbers are presented for the highest pre-recession employment level for each industry trend and for 2019 Q2.

Figure 1 shows the highest levels of organization of the construction sector within the North American Industry Classification System (NAICS), which is the construction sector and its three subsectors.[3] Specialty trades contractors account for the largest subsector of the construction sector and its employment pattern heavily influences the construction sector total employment. Employment in heavy and civil engineering was the least affected by the recession but also employs the fewest number of workers.

Figure 2

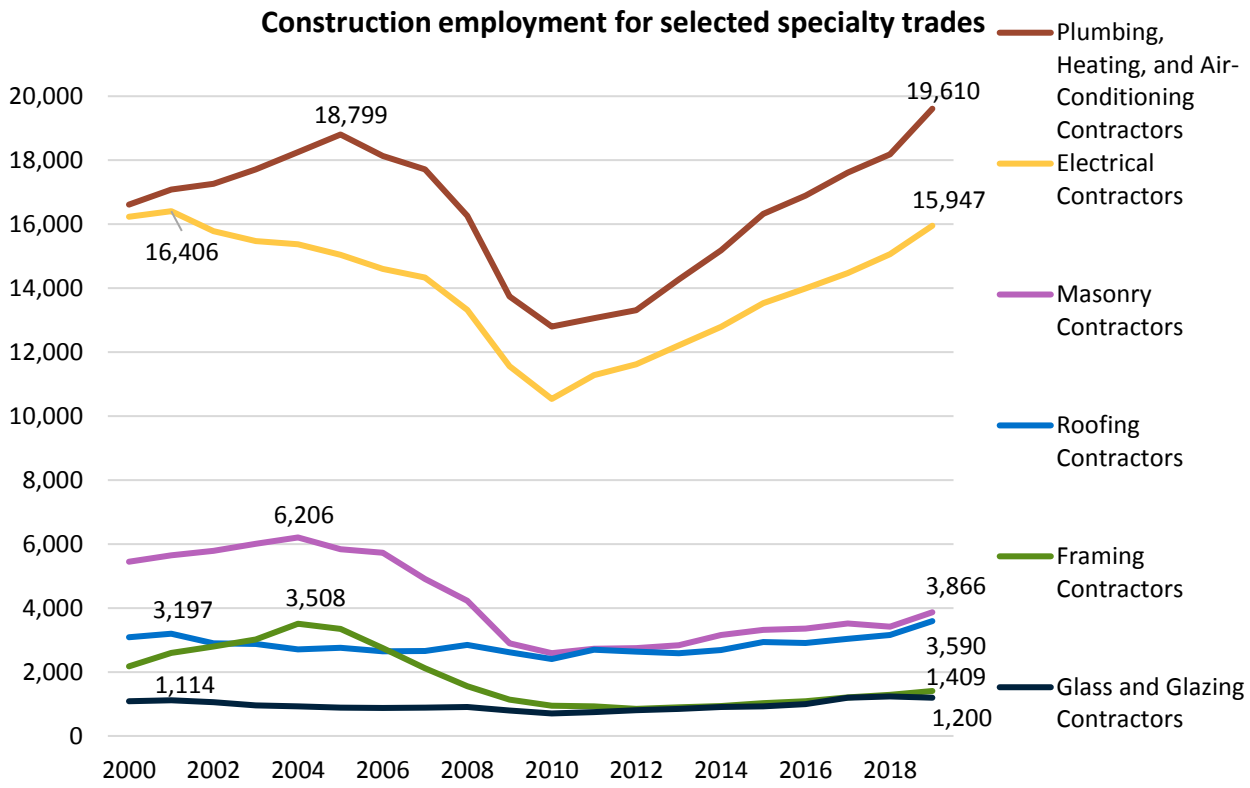


As Figure 2 illustrates, building equipment contractors, which includes electrical, plumbing and heating and air conditioning contractors, experienced the most dramatic changes in employment among construction subsectors during the past two decades, but has fully recovered from its lowest employment point in 2010. The foundation, structure and building exterior contractor group, which includes framing, masonry, glass, roofing and siding contractors, is at only 78% of its pre-recession high mark. Residential building construction remains approximately 4,000 employees below its pre-recession high mark. While the building finishing contractor

[3]Employment in the heavy and civil engineering construction subsector is limited to this figure.

group, which includes drywall, painting, flooring, tile and finish carpentry contractors, has almost reached its pre-recession level of 16,913 employees and the non-residential building construction and other specialty trade contractors have slightly overtaken their pre-recession levels. These employment numbers may be affected by a trend in the construction sector, that continues to grow, of engaging workers, in many instances illegally, under the classification of independent contractor. Independent contractors are not captured in the Quarterly Census of Employment and Wages (QCEW).

Figure 3



The specialty trades have a variety of employment trends since 2000. The most consistent and common trend is that post-recession employment was at its highest level in 2019 Q2 except for glass and glazing contractors, which was slightly higher in 2018. Employment has passed pre-recession levels for plumbing, heating and air-conditioning, roofing, and glass and glazing contractors, but not significantly. Employment continues to lag below pre-recession levels for masonry and framing contractors. Employment by roofing contractors and glass and glazing contractors did not lose much ground during the recession.

Examination of the trends among the building and specialty trades industry groups shows employment has passed the pre-recession high points for nonresidential building construction, building equipment contractors and other specialty trades contractors (Fig. 2).

The trends among six prominent specialty trades shows employment has passed pre-recession levels for plumbing, heating and air-conditioning contractors, roofing contractors, and glass and glazing contractors. Employment during 2019 Q2 for masonry contractors was 62% of its pre-recession high mark; for framing contractors, employment was only 40% of its highest level.

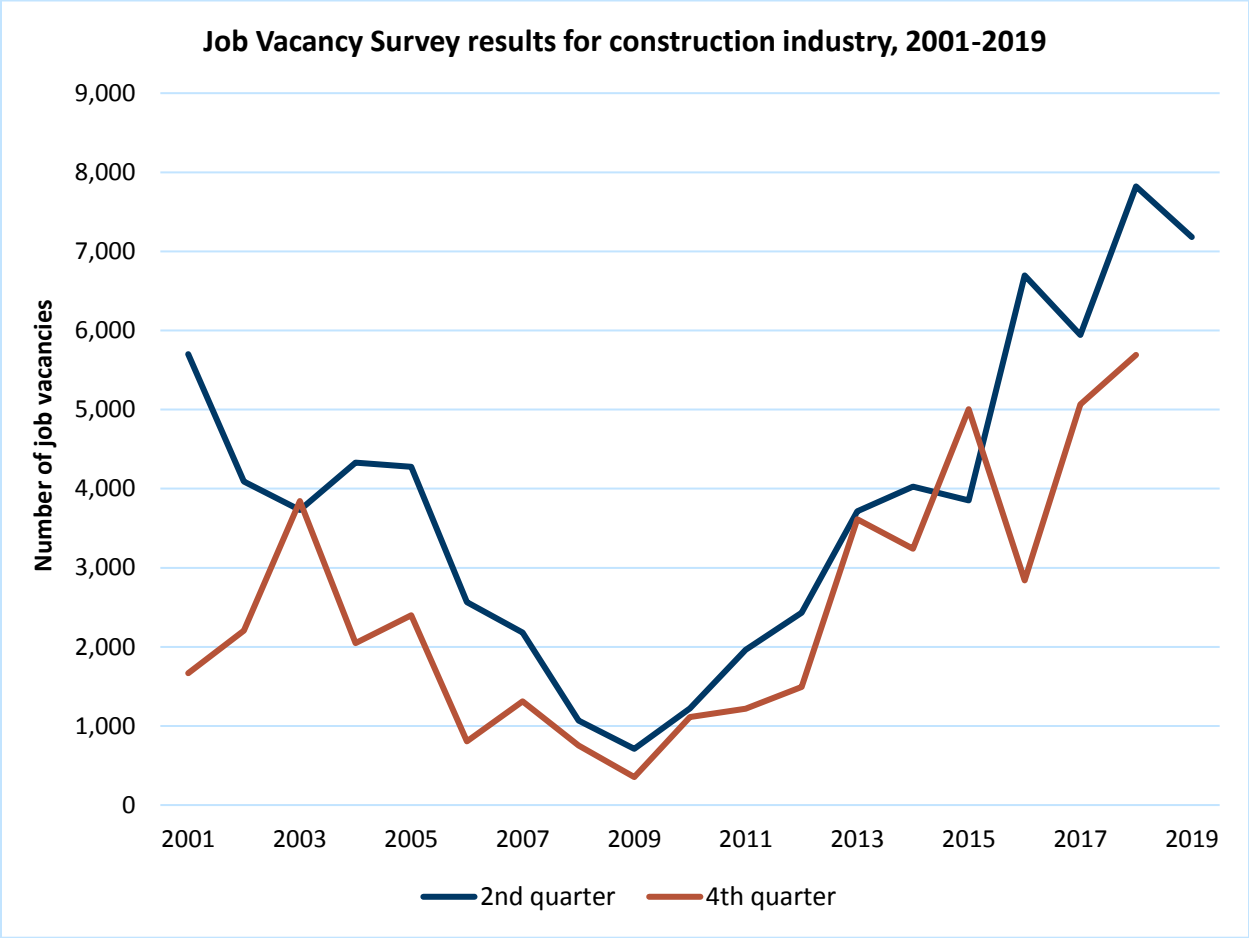
Employment in the building construction subsector has not yet matched its pre-recession level, although employment has increased by 42% above the recession low mark. In contrast, employment in the heavy and civil engineering subsector reached its pre-recession high point in 2018, although employment is only 28% above the recession low point. Employment in this subsector increased by 10% from 2018 to 2019 Q2 (Fig. 1).

JOB VACANCY SURVEY

DLI also reviewed the Job Vacancy Survey, another tool from the Minnesota Department of Employment and Economic Development (DEED) that shows the number of job openings, typical wage offers and typical education requirements by occupation and industry, by region and statewide.[4] It is a biannual survey of employers to estimate hiring demand and job vacancy characteristics. It can be used as a measure of hiring demand for workers.

[4] https://mn.gov/deed/data/data-tools/job-vacancy.

Figure 4



Because work in the construction industry is seasonal, job vacancy rates are examined for the second quarter (April, May, June) and fourth quarter (October, November, December) of each year. Overall, there is an upward trend of job vacancies in the construction industry.

DEED's Employment Outlook data, which examines job openings by occupation, shows 10,000 additional construction and extraction jobs are expected to be created between 2016 and 2026. Since the number of additional jobs includes both construction and extraction jobs, it is not possible to determine how many of the estimated additional jobs would be in construction. Further, construction jobs are often filled by apprentices enrolled in apprenticeship programs, who earn as they learn. In 2019, 1,454 apprentices completed their apprenticeships and entered the workforce as a journey person in their skilled trade.[5]

[5]See discussion below about Minnesota Registered Apprenticeship programs.

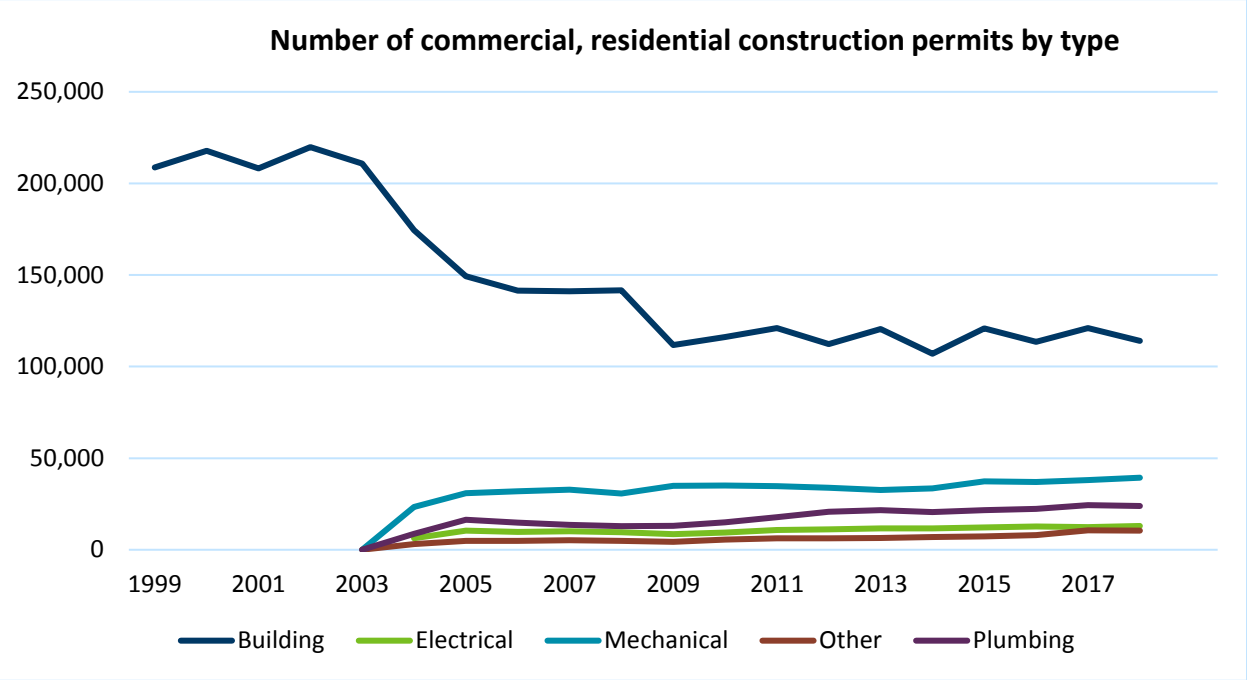
Table 1. Job Vacancy Survey results for construction industry

	Second quarter	Fourth quarter		Second quarter	Fourth quarter
2001	5,699	1,668	**2011**	1,962	1,216
2002	4,092	2,205	**2012**	2,431	1,493
2003	3,730	3,844	**2013**	3,716	3,614
2004	4,330	2,048	**2014**	4,027	3,242
2005	4,277	2,399	**2015**	3,852	5,006
2006	2,564	804	**2016**	6,696	2,840
2007	2,182	1,310	**2017**	5,944	5,067
2008	1,070	753	**2018**	7,821	5,691
2009	711	354	**2019**	7,180	
2010	1,221	1,111			

SURCHARGE DATA

Finally, the department reviewed surcharge data to better understand the status of construction activity in the state. The Quarterly Building Permit Surcharge Report is submitted to DLI by municipalities in code-enforced areas of Minnesota. All residential and commercial construction activities in Minnesota require a permit from the local municipality where the project site is located. This data set covers only areas in Minnesota where the state building code is applicable, which covers almost all the areas where most construction activities take place. The surcharge data includes the number of permits and valuation of construction projects, which is a proxy measure of construction activity and, therefore, demand for workers. Highway and heavy construction projects are not included.

Figure 5



Unlike valuation, the number of permits is not influenced by inflation or real estate market fluctuations and, therefore, is a more reliable measure of residential and commercial construction activity. Electrical, mechanical, plumbing and other types of permits are typically issued in support the construction of buildings. These permit types follow the trend of building permits. The numbers of permits for all permit types are generally stable since the 2008 through 2010 recession.

What the data shows

The above data sources provide a high-level picture of construction activity and employment in Minnesota. Although an incomplete picture, it gives enough information to show the construction industry, as a whole, has almost fully recovered since the Great Recession. Construction employment numbers have steadily increased while construction activity has stabilized. However, figures 2 and 3 indicate employment growth in some specialty trades is lagging behind others. Specialty trades, such as masonry contractors and framing contractors, have not recovered to their pre-recession employment level.

While it is clear employment in the construction sector has almost fully recovered from the Great Recession, this high-level picture does not tend to indicate, as of the second quarter of 2019, there is a labor shortage in the construction sector in Minnesota. It is possible the perception that there is a shortage of workers is influenced by a decrease in the number of readily available workers, which was the case as the economy was recovering from the Great Recession. Further, due to its seasonal nature, it is possible employers feel a sense of urgency in the peak construction months when they most need workers, and a slower-than-desired pace for filling vacant positions may give them a sense of a heightened labor shortage.

However, to the degree the demand for skilled trades workers is outpacing supply, there is the need to support and invest in programs that expose youth to the skilled trades and provide them training experiences. Offering and promoting those opportunities will be important to meeting future workforce demands as the state's economy continues to drive growth in the construction sector.

Registered apprenticeship

Registered apprenticeship is a primary pipeline for the skilled construction trades workforce and is a time-tested workforce development and training model that assists employers with recruiting, training and retaining a highly skilled and diverse workforce. Registered apprenticeship is an "earn as you learn" model where workers are employed while receiving structured on-the-job training that is complemented by related technical instruction. When completing their journey of mastering the skills of their occupation, they earn a nationally recognized credential issued by the State Apprenticeship Authority in Minnesota – the Department of Labor and Industry. Since its inception in 1939, with passage of the Minnesota Apprenticeship Act, this "earn as you learn" model has grown to be a successful workforce development strategy for the construction industry while providing an attractive career pathway and economic ladder for Minnesotans seeking in-demand, highly skilled careers with family-sustaining wages and benefits.

Today, registered apprentices in construction represent 90% of the 12,413 apprentices actively training in Minnesota. The number of apprentices in the construction industry in Minnesota has dramatically expanded from even a decade ago. In 2010, there were 6,902 apprentices in the construction trades. Today, there are 11,237 apprentices actively training in construction apprenticeship programs, including 700 women (6.2%), 2,276 people of color (20.3%), 802 veterans (7.1%) and 50 persons reporting a disability (0.4%). A total of 3,181 construction apprentices ages 18 to 24 make up 28% of those actively training in the construction industry. In 2019, apprenticeship programs attracted and registered nearly 500 Minnesotans who were 18 and 19 years old, almost five times the number attracted in 2010. In 2019, 1,454 apprentices completed their apprenticeship programs. Programs that expose youth to career opportunities in the construction trades and offer them training opportunities, many of which are supported by registered apprenticeship programs, are in turn a pipeline for registered apprenticeship programs. Individuals may enroll in registered apprenticeship programs upon graduating from high school if they are 17 years of age or older.

Exposing youth to skilled trades careers and offering them training in the skilled trades as a workforce development strategy

Stakeholders expressed the belief that one strategy to meet perceived workforce gaps is to expose more youth to careers in the skilled trades and offer them hands-on training experiences.

There is increased youth interest and enrollment in training programs for the skilled trades, according to education representatives.

Generally, education representatives interviewed reported increased enrollment in skilled trades training programs in recent years. For some programs, enrollment is limited by available funding. For example, one

education representative shared that for a recent program, more than 300 youth indicated interest, 200 applied and 72 were enrolled — the maximum that funding allowed.

When participants in a youth focus group were asked how interested they are in the skilled trades on a scale of 1 to 10 (1 = not interested at all; 10 = very interested), the average score was 7, indicating strong youth interest in the skilled trades.

Overall, stakeholders believe youth need greater exposure to the skilled trades.

Stakeholders' responses indicated an important distinction between exposure and hands-on training. Examples of "exposure" included youth being made aware of future career options in the skilled trades by tradespeople visiting middle school classrooms to speak about skilled trades careers and providing hands-on construction experiences in a tradeshow-like setting where students are paired with industry and union leaders, apprenticeship training coordinators and educators. Examples of "training" include youth participation in hands-on education and training programs, in or outside of school, where they learn age-appropriate skills involved in a skilled trade.

Exposure: Efforts such as career days or tours of training centers that raise awareness of types of skilled trade careers with students.

Hands-on training: Involves actually training youth in the skills and knowledge needed for a career in the skilled trades.

For middle schoolers specifically, most stakeholders supported increased opportunities for exposure to the skilled trades, while none supported hands-on education and training for middle school children on active construction sites.

Stakeholders raised the need for exposure, through a campaign or rebranding of the industry, to lessen the stigma around working in construction. As one education representative stated, what is needed "is truly a mind shift" through a "statewide campaign on what career technical education is, and what it isn't. And we have many people who will think about some of these really very viable career pathways as being dirty jobs, and it's how do we really change that mindset?"

Referencing this stigma, an industry representative lamented the elimination of career technical education courses (CTE) from high school curricula, leaving few hands-on education and training opportunities that would expose youth to the skilled trades, and said the challenge is "feeding that pipeline. And that's part of why that whole concept of 16- and 17-year-olds being on the job site is so vital ... it's an exposure problem ... with CTE being eliminated in high schools, you don't have exposure anymore."

Knowledge, skills and competencies employers want youth to have when entering the workforce

Stakeholders expressed that both technical skills and general professional competencies are keys to success in the skilled trades.

Stakeholders note that basic skills in areas such as math and safety are beneficial and that training programs do a good job of onboarding and training participants with these skills.

For example, one education representative said an individual applying to be an entry-level electrician needs to be capable of using trigonometry, geometry and algebra, as well as having good reading comprehension. "If they don't have it coming into the job, they need to quickly get there because they use all of those in the scope of work," the stakeholder said.

In terms of safety skills, stakeholders pointed out current Minnesota training programs do a good job providing OSHA 10-hour training and building knowledge of personal protective equipment. Many industry representatives are pleased with how prepared training program graduates are with their technical job skills. As one industry leader said, "[Training programs] do a marvelous job training the individual on the skill sets they need to advance their career in the industry."

Stakeholders agree professional competencies, in addition to technical skills, are critical for job success.

Professional competencies mentioned by stakeholders include: showing up consistently and on time; passing a drug test; a willingness to learn; the ability to focus; good communication skills; and the ability to work in a team. Stakeholders said many new hires lack these competencies. Some participants reported it is challenging to even find job applicants who can pass basic requirements, such as passing a drug test.

> "When I speak with adults in the trades area, again, the biggest thing I have been told is, can they [youth] show up? I think the biggest thing is being on time, being diligent, teaching these teenagers, unfortunately, if you have a bad day, nobody cares — you got to get to work, right?"
>
> — Education representative

Employers are willing to train young workers about the particulars of a job, but want them to have "employability skills." An education representative expressed that employers want "people with basic skills, basic intelligence, who are willing to work — who are dependable, drug free and willing to work."

Stakeholder opinions regarding youth receiving hands-on training on an active construction

Generally, stakeholders said they believe middle schoolers are too young to receive training on active construction sites. Opinions were divided about whether older youth, 16- and 17-year-olds, should be trained on active sites.

Stakeholders generally agree middle school is too young for youth to begin hands-on training on an active construction site.

Stakeholders agreed middle schoolers do not have the skills, mental development and maturity to safely be on an active construction site. Rather, stakeholders suggested middle schoolers receive more exposure to careers in the skilled trades.

Stakeholders have divergent perspectives about whether high schoolers should be allowed to receive training on an active construction site.

Certain stakeholders expressed the belief that the maturity and mental development of 17-year-olds, and possibly some 16-year-olds, as compared to younger youth, better equips them for training on an active construction site. Stakeholders who believe it could be appropriate for 17-year-olds to be trained on-site stated these youth still need significant skills and safety training in a controlled environment before receiving training on an active construction site. They also suggested means for continued on-site support, including mentoring programs and individualized training plans, to increase the safety of youth receiving on-site training.

> "I just know the mindset of a 17-year-old student is quite a bit different than even a 16- or a 15-year-old. ... At 17 you're talking about generally a senior in high school, who's going to be turning 18 at some point within that school year in general. Those students are at a maturity level that is a little bit higher. ... With mentoring and training, they can do really quite well. ... I think a 17-year-old can do it."
>
> — Education representative

Meanwhile, other stakeholders expressed strong opinions that no one under the age of 18 should be allowed on an active construction site. They cited multiple reasons, including compliance with child labor laws, that work on active construction sites is profit-driven and not child-centric, and the development level of youth under the age of 18 made on-site training inappropriate. They cited safety concerns for both the youth and other professionals on the site.

> "Child labor is illegal for a reason and we don't think it should be made legal."
>
> —Industry representative

As expressed by an industry representative, “When you start working on a construction site, it is no longer about the kid, it is now about the project. ... [Training programs] should be focused on the kid and making sure that the child is given the opportunity to explore, in their own space, in their own way, in a safe environment.”

Stakeholders have divergent views about whether there are benefits of receiving hands-on training on an active construction site and whether safety risks outweigh those benefits.

Benefits expressed by stakeholders focused on the opportunity to learn skills in a real-world setting. Those who believed youth 17 years of age would benefit from receiving hands-on training on active construction sites said that in addition to learning the skills of the job, the youth also learn day-to-day skills, such as how to work within the fast pace of the job site.

Certain stakeholders expressed the opinion that training programs include a combination of classroom instruction and on-site hands-on training: “I like to take an 80/20 approach to it,” an education representative said, “where 80 percent [of skilled trades training] would be at an active job site, but you still need some of that classroom type instruction because everybody needs a little basis to go off of before they go off on the job site.”

Conversely, other stakeholders expressed the opinion there were no benefits to be gained from youth being trained on an active construction site. This belief was expressed by an industry representative: “There are none [benefits to youth being on an active construction site]. There’s a lot of safety risks, there’s a lot of liability risks, and I actually think it’s a very bad idea.” Some stakeholders said active construction sites are simply too dangerous for youth to receive hands-on training.

“If you have a child working on your site, it puts everybody at risk.”

— Industry representative

“I don’t think that there’s many advantages of putting a high school[er], [a] young kid like that in an active construction site,” an education representative said. “In a ... controlled environment, I think that you could get them exposure and get them interested in it and like I say, you can control what’s going on. On an active construction site there’s too much production-oriented time. I mean, it’s about making dollars and cents, not training people. That’s going to put young kids in a dangerous situation.”

Stakeholders who expressed concerns about youth safety also raised the risks posed to other workers by having youth receiving hands-on training on-site. As one industry representative said, “We cannot in good conscience ever put children at risk in that way [working on an active construction site]. And then, also, the safety of every other professional working on that job site. So much of it is teamwork; so much of it is based on what the other trades are doing at the same time as other people. You’ve got somebody flying over a beam; you’ve got somebody moving a wheelbarrow. All of it requires a level of training and professionalism that if you have a child working on your site, it puts everybody at risk.”

Summary

Stakeholders readily shared their perceptions, beliefs and opinions about exposing youth to the skilled trades and providing them with opportunities to participate in education and training programs. In general, stakeholders supported increasing youth exposure to the skilled trades and opportunities for youth to participate in education and training programs. That support was driven by concerns about a workforce shortage, the desire to overcome a negative stigma about the skilled trades, and the need for youth to have basic knowledge, skills and competencies when they join the workforce. Stakeholders also expressed a need for increased support for these opportunities due to youth interest that current programs cannot meet.

However, there was significant disagreement among stakeholders about whether opportunities for training should include training on active construction sites. For those who believed there would be benefits of on-site training, they expressed that on-site training should be limited to youth 17 years of age and only under certain conditions. Other stakeholders were strongly opposed to on-site training for youth of any age.

These stakeholder perceptions, beliefs and opinions provide a snapshot of the discussions that presumably precipitated the Legislature's decision to require the department to prepare this report and, importantly, provide context for the subsequent sections of the study that address:

- Work-related injury and illness data;
- Safety and health risk factors for young workers that inform ways to provide for youth safety in training programs;
- State and federal child labor laws that restrict employment of children in hazardous occupations and the training program exemptions to those laws;
- Descriptions of youth skilled-trade training programs in Minnesota, the ways they provide youth training and the safety precautions included in those programs; and
- Recommendations for safely providing training opportunities for youth in the skilled trades.

Work-related injury and illness data

In 2018, 5,250 workers in the United States died of work-related injuries and illnesses.[6] Of the 5,250 worker fatalities, 1,008 were in the construction sector, with a fatality rate of 9.5 per 100,000 full-time-equivalent (FTE)

[6]The Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI) produces comprehensive, accurate and timely counts of fatal work-injuries. CFOI is a federal/state cooperative program that has been implemented in all 50 states and the District of Columbia since 1992. To compile counts that are as complete as possible, the census uses multiple sources to identify, verify and profile fatal work-injuries. Information about each workplace fatal-injury — occupation and other worker characteristics, equipment involved and circumstances of the event — is obtained by cross-referencing the source records, such as death certificates, workers' compensation reports, and federal and state agency administrative reports. To ensure fatal injuries are work-related, cases are substantiated with two or more independent source documents or a source document and a follow-up questionnaire. Census of Fatal Occupational Injuries, 2018.

workers. More than half of the fatalities in the construction sector were due to falls (333), struck by object (112), electrocutions (86) and caught in/between (55).[7] In addition to fatal injuries, it is estimated that the private construction sector had 199,100 nonfatal injuries in 2018. The majority of hazards that kill and injure workers on construction sites are not occupation specific, they are hazards that are pervasive in the work environment and to which almost every worker, no matter their occupation, is exposed.

> Between 1994 and 2013, 143 children ages 15 to 17 died while working in construction.
>
> — Census of Fatal Occupational Injuries of Young Workers

In Minnesota in 2018, there were 75 worker fatalities. The construction sector had the second-highest number of worker fatalities, following the agriculture sector, with 14 deaths, resulting in a fatality injury rate of 7.4 per 100,000 FTE workers. Minnesota's construction industry had the highest total injury and illness rate, at an estimated five cases per every 100 FTE workers.[8]

Based on summary data from the Census of Fatal Occupation Injuries of Young Workers compiled by researchers with the National Institute for Occupational Safety and Health (NIOSH), during the 20-year period of 1994 through 2013, 942 children under the age of 18 died from work-related injuries. Transportation incidents, falls from heights, and contact with objects and equipment were the leading causes of these young worker deaths.[9] One hundred and forty-three children, ages 15 to 17, died while working in construction. Based on the above data, approximately one in six young worker fatalities occurred in construction during the period of 1994 through 2013.

Small employers with one to 10 workers accounted for the majority of the youth fatalities.[10]

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[7]Caught in/between includes when a worker is caught in or compressed by equipment or an object and struck, caught or crushed in a collapsing structure, equipment or material.

[8]The Survey of Occupational Injuries and Illnesses (SOII) is a federal/state program in which employer's reports are collected annually from approximately 200,000 private-industry and public-sector (state and local government) establishments and processed by state agencies in cooperation with BLS. Summary information about the number of injuries and illnesses is transcribed by these employers directly from their recordkeeping logs to the survey questionnaire. The questionnaire also asks for the number of employee hours worked (needed in the calculation of incidence rates) as well as its annual average employment (needed to verify the unit's employment-size class). Survey of Occupational Injury and Illnesses, 2018.

[9]Perritt KR, Hendricks KJ, Goldcamp EM. Young Worker Injury Deaths: A Historical Summary of Surveillance and Investigative Findings, p. 33.

[10]Perritt KR, Hendricks KJ, Goldcamp EM. Young Worker Injury Deaths: A Historical Summary of Surveillance and Investigative Findings, p. 35.

Researchers have found there is an inverse relationship between age and non-fatal work-injuries. As age decreases, injuries increase.[11] While data sources vary, both teenagers and young adults in developed countries have rates of work-related injuries up to two times greater than workers older than 25 years of age.[12] Using data from the Survey of Occupational Injuries and Illnesses (SOII) the fatality rate in construction for workers 15 to 17 years of age, from 1994 through 2013, was 16.5 per 100,000 FTE workers, almost double the fatality rate of 9.5 per 100,000 FTE workers for construction workers 18 years of age and older in 2018.[13]

A closer investigation of 99 of the 143 youth fatality cases that occurred between 1994 and 2013, revealed the majority of youth were working during times and for the number of hours that were permissible under child labor laws, but many were performing tasks that were not permissible under federal and state child labor laws.[14] The most common impermissible tasks for youth 16 and 17 years of age who died of work-related injuries, outside of agricultural production, were: operating power-driven hoisting equipment, including forklifts; excavation operations; roofing operations; driving a motor vehicle or being an outside helper; and wrecking, demolition and shipbreaking operations. For youth 14 and 15 years of age who died of work related-injuries, the most common impermissible tasks were operation of power-driven machinery, working in roofing operations, working in construction, and driving a motor vehicle or being an outside helper.

Eighteen of the cases investigated were construction fatalities and involved youth who were male and 16 to 17 years of age. Formal training was documented in only four of the fatalities and in only seven investigations were youth working in sight of a supervisor. In 14 investigations the youth was performing an activity or task that was impermissible under state and federal child labor laws – youth working on or about a roof and in excavation operations.

Head injuries were the most common form of injury and falls were the most common injury event, with structures and surfaces, including the floor and the ground, being the most common injury source.

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[11]Health and Safety at Work – Protecting Youth at Work. www.ncbi.nim.nih.gov/books/NBK230171/ p. 4.

[12]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. p. 80.

[13]Perritt KR, Hendricks KJ, Goldcamp EM. Young Worker Injury Deaths: A Historical Summary of Surveillance and Investigative Findings, p. 33.

[14]Perritt KR, Hendricks KJ, Goldcamp EM. Young Worker Injury Deaths: A Historical Summary of Surveillance and Investigative Findings, p. 50.

Even though Minnesota prohibits youth in this age group from working on construction sites, there are youth 16 and 17 years of age working in construction in the state based on injury claim data from 1999 to 2018. During that period there were 186 workers' compensation claims filed by workers who were 16 and 17 years of age for injuries incurred while working in the construction sector. While Minnesota workers' compensation records indicate a significant proportion – 18% of those young workers – were classified as office or clerical staff within construction establishments and, therefore, should not be working on construction sites, examination of the 186 individual workers' compensation claims records revealed instances where the claimant was classified as an office worker but the injury was clearly associated with construction site work. For example, "fell off ladder." Construction-related workers' compensation claims reported by youth 16 to 17 years of age frequently involved the following descriptors: injured fingers, feet and toes; crushing, burns and contusion injury types; sharp objects and glass, vehicles, struck by falling or flying objects; machinery; and exposures to hot, cold or chemical sources of injury.

> While Minnesota prohibits youth ages 16 and 17 from working in construction, injury claim data indicates youth are working on construction sites, and they are getting hurt.
>
> — Minnesota workers' compensation data

One hundred eighty-six injuries are far too many, particularly when it is the intent of Minnesota child labor laws to prevent those injuries by prohibiting youth from working on construction sites. But for the purpose of comparison, Washington State, which allows youth 16 to 17 years of age to work on construction work with certain restrictions on their work activities, 714 youth 16 to 17 years of age reported work-related injuries between 1999 and 2018. That is almost four times the number reported in Minnesota during the same time period.

Work injuries sustained by youth have real heath and economic consequence for the youths and their families. Fifteen- to 26% of injured workers under the age of 18 have reported permanent impairments, including chronic pain, scarring, sensory loss and loss of range of motion.[15] More serious injuries, such as fractures, amputations and head injuries, can have even more devastating long-term consequences for youths and their families.

[15]Breslin, CF, & Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. p. 80.

Factors that contribute to young workers' increased risk of work-related injuries and illnesses

The above injury and illness data makes clear young workers are at higher risk of suffering work-related injuries and illnesses than their adult counterparts and that while construction work is hazardous for all workers, it is particularly hazardous for young workers despite the limitations placed on the work they may perform under federal and state child labor laws. Identifying the factors that place young workers at greater risk of work-related injuries and illnesses is essential for the identification of safety precautions necessary to effectively eliminate and control those risks. For purposes of this discussion "risk factors" refers to individual or situational characteristics that are associated with an increased likelihood of injury.

> "Through work experiences, youth learn responsibility, develop social skills and gain independence; however, youth are at high risk for work-related injuries due to a variety of risk factors."
>
> – Breslin & Smith

Young worker occupational safety and health risks have been explored in many countries across the world. For example, the Nordic countries – Denmark, Finland, Iceland, Norway and Sweden, in the report "Young Workers' Occupational Safety and Health Risks in Nordic Countries: A Systematic Literature Review," identified four main categories of risk factors.

Characteristics of young workers: including physical, cognitive and emotional maturity levels; relative inexperience; risk-seeking behaviors; lack of skills training and occupational safety and health risk awareness; social and interpersonal characteristics; and being in transition between school and work – youth and adulthood.

Nature of work: including shift work; part-time work; and short term, seasonal and on-call work.

Workplace characteristics: including hazard and risk assessment and awareness; occupational safety and health training; supervision; and the safety and health culture and management.

Work characteristics: including work involving physical, chemical, biological, mechanical and psychosocial hazards and risks.[16, 17]

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[16]Therese N. Hanvold, TN, Kines, P, Veiersted, KB Occupational Safety and Health Among Young Workers in the Nordic Countries: A Systematic Literature Review, Safe Health Work 2019 Mar: 10(1): 3-20.

[17]Improving the Safety and Health of Young Workers, International Labor Organization 2018 ISBN:978-92-2-131651-0 (web pdf), p. 13.

Youth risk factors have been similarly discussed in many reports and studies in the United States, including the following discussion in the report authored by researchers with NIOSH and the American Society of Safety Engineers (ASSE):

> Although the literature on work-related injuries among adolescents is limited in comparison with that on injuries among adult workers, a substantial base of evidence has been built over the past two decades that identifies both individual factors and work-related factors that increase the risk of job-related injuries among youth. Individual factors including minority status [CDC 2020; Mardis and Pratt 2003], low socioeconomic status [Rauscher and Meyers 2008], and adolescent risk taking and sensation seeking – the desire to pursue novel and intense experiences [Spear 2000; Steinberg 2005; Steinberg et al. 2011] – may increase young people's likelihood of experiencing a job-related injury [Sudhinaraset and Blum 2010].
>
> Work-related risk factors include fast pace of work [Breslin et al. 2007], inadequate supervision [Runyan et al. 2006; Runyan and Zakocs 2000; Zakocs et al. 1998], equipment use [Knight et al. 1995; Mardis and Pratt 2003], working late, and working with cash and customers [NIOSH 2003; Richardson and Windau 2003; Zierold and Anderson 2006]. Lack of job knowledge and skills, lack of job training, and lack of job control also contribute to heightened risk among younger workers, who might be less likely to recognize hazards, less likely to speak up regarding safety issues [Tucker and Turner 2013], and less aware of their legal rights as workers [NIOSH 2003].[18]

Risk factors are consistently identified across research studies. The consistency of these findings provides strong support for prioritizing safety precautions that are responsive to these risk factors and to ensure those safety precautions are required for all youth training programs.

Among the risk factors identified, those particularly relevant to youth training programs[19] include: the hazardousness of the activities and tasks youth are being trained to perform and the environment in which those activities and tasks are performed; the level of education, training (including safety training) and experience youth have in performing the activities and tasks they are assigned; and the level of supervision provided and whether the supervision is provided by qualified individuals trained in working with youth. In addition, of importance to youth training programs, are the risk factors associated with the various stages of youth physiological, psychosocial and emotional development and the impact those various stages of development have on the ability of young workers to perform safely activities and task they are assigned. The following sections discuss each risk factor and provide a sampling of the research related to each risk factor, the findings of which are relevant to many of the opinions held by stakeholders.

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[18]Flynn MA, Cunningham, TR, Guerin, RJ, Keller B, Chapman, LJ, Hudson, D, Salgado, C. Overlapping vulnerabilities: the occupational safety and health of young workers in small construction firms. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2015-178.

[19]Risk factors such as shift work, part-time work, and short-term, seasonal and on-call work would be applicable to the work context.

Risk factor 1: Hazardousness of the work and the work environment

It matters what types of jobs youth perform and the environment they perform them in. Prohibiting or limiting youth from performing hazardous activities and tasks or from performing activities and tasks in hazardous environments is an effective means to eliminate or reduce young workers' risk for work-related injuries caused by those hazards. As stated in the above discussion of work-related injury and illness data, a significant percentage of youth are injured while performing activities or tasks that are prohibited by child labor laws. Because young workers often have limited job skills, work experience and bargaining power, their employment opportunities are often limited and characterized by hazardous work.[20] Interviews with young workers in North Carolina demonstrate the prevalence of young workers engagement in particularly hazardous activities and tasks. Of 562 youth interviewed, "36% reported using ladders or scaffolds at work, 31% reported using forklifts, tractors or riding mowers on the job; and 27% reported working around very loud noises."[21]

Further, the more hazards in a work environment, the more injuries. Researchers have examined the relationship between the number of hazards workers are exposed to in a workplace and the likelihood of injury, and found the number of hazards in the workplace, as compared to demographic, individual and other workplace factors, was the strongest predictor of work-related injury.[22]

Risk factor 2: Education, training and experience necessary to safely perform assigned work activities and tasks

Young workers lack of education and training necessary for them to safely perform the work they are assigned, in particular an understanding of safety and health hazards and risks associated with the work, is a significant risk factor. A survey of 146 children age 14 to 16 who were treated in hospital emergency rooms for occupational injuries found 54% reported no safety training and the children who didn't receive safety training suffered more significant injuries than the children who did.[23] The lack of knowledge about workplace hazards makes it unlikely that youth will recognize hazards or speak up about them.[24] The long-term benefit of safety training during youth education and training programs was demonstrated by a recent study of French apprentices and students at the end of their schooling and during the first two years of their work careers, which

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[20] Improving the Safety and Health of Young Workers, International Labor Organization 2018 ISBN:978-92-2-131651-0 (web PDF), pg. 18

[21]Runyan CW, Dal Santo J, Schulman M, Lipscomb HJ, Harris TA. Work hazards and workplace safety violations experienced by adolescent construction workers. Arch Pediatr Adolesc Med. 2006 Jul;160(7):721-7. http://doi.org/10.1001/archpedi.160.7.721.

[22]Breslin, CF, Smith, PM, Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures, Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia*, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health – 2013, p. 91. www.cdc.gov/niosh.

[23]Health and Safety at Work – Protecting Youth at Work. www.ncbi.nim.nih.gov/books/NBK230171/ p. 13.

[24]Okun A, Guerin RJ, Schulte PA. Foundational workplace safety and health competencies for the emerging workforce. J. Safety Res. 2016 December: 59: 43-51, http://doi.org/10.1016/j.jsr.2016.09.004.

found those who had received occupational safety and health training while in school had two times fewer work-related injuries that those who reported receiving no training.[25, 26]

There is also strong support for incremental assignment of activities and tasks at a pace that allows youth to acquire the skills and knowledge necessary to perform assigned tasks properly and safely. A worker's risk of injury is four times greater during the first month on a new job than it is after 12 months on the job, and a young worker's risk of harm in their first months on a job is higher that that of older workers (Smith & Breslin).[27]

Work pace pressure has also been positively associated with youth injury risk.[28, 29] In interviews of young workers with work-related injuries who received treatment in emergency rooms, 32% reported they were working quickly at the time they were injured.[30]

Risk Factor 3: Level of supervision by individuals trained in working with young workers

A recent national study reported 67% of workers younger the 18 years of age worked at least part of the day without an adult supervisor and as many as one-third reported receiving no health and safety training.[31] Another

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[25]Boini S, Regis C, Grzebyk M, Effect of occupational safety and health education received during schooling on the incidence of workplace injuries in the first 2 years of occupational life: a prospective study. http://dx.doi.org/10.1136/bmjopen-2016-015100.

[26]In the United States, there are currently several states, including California, Florida, New York, Oklahoma and Oregon that are working to integrate occupational safety and health training for youth into school curriculum and youth training programs. These states are using the NIOSH Talking Safety program and tools. The Talking Safety program teaches foundational workplace safety and health skills and knowledge, known as the NIOSH 8 Core Competencies. The 8 Core Competencies include: recognize that work has both benefits and risks, and that all workers can be injured, become sick, or even be killed on the job; recognize that work-related injuries and illnesses are predictable and can be prevented; identify hazards at work and predict how workers can be injured or made sick; recognize how to prevent injury and illness; identify emergencies at work and decide on the best ways to address them; recognize employer and worker rights and responsibilities; find resources that help keep workers safe and healthy on the job; and demonstrate how to communicate effectively with others on the job when feeling unsafe. www.cdc.gov/niosh.

[27]Improving the Safety and Health of Young Workers, International Labor Organization 2018 ISBN:978-92-2-131651-0 (web PDF), p. 13.

[28]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia*, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 92. www.cdc.gov/niosh.

[29]Okun A, Guerin RJ, Schulte PA, Foundational workplace safety and health competencies for the emerging workforce. J. Safety Res. 2016 December: 59: 43-51, http://doi.org/10.1016/j.jsr.2016.09.004.

[30]Rauscher KJ, Runyan CW, Prevalence of Working Conditions Associated with Adolescent Occupational Injury in the U.S. A Review of the Literature, Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia*, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 127. www.cdc.gov/niosh.

[31]Runyan CW, Schulman M, Dal Santo J, Bowling JM, Agans R, Ta M. Work-related hazards and workplace safety of U.S. adolescents working in the retail and services sectors. Pediatrics. 2007;119:526-34.

study reported, "the average young worker spent only 12% of his or her time in the presence of a supervisor."[32] In a survey of adolescents injured at work, 80% of the adolescents reported no supervisor was present at the time of their injury.[33] While limited in number, studies have shown that supervision of young workers has a positive impact on reducing youth work-related injuries.[34]

Studies have also shown supervisor attitudes toward young workers and their attitudes about safety have an impact on the young workers' risk of injury. Youth perceptions that supervisors cared about young workers and that supervisors viewed risk-taking negatively reduced the risk of injury.[35]

Risk factor 4: Physical, cognitive, psychosocial and emotional development level of young workers

Adolescence, a rapid period of physiological, psychological and emotional development, presents significant injury risks to young workers.[36] A review of the published literature was conducted to identify developmental vulnerabilities relevant to adolescents who work on construction sites and several key development issues emerged as concerning for youth working in construction: immature musculoskeletal physique; hormonal changes that influence behaviors; and a brain that is still in training to perfect balance, coordination and

Managing hazards in construction is a daunting task for the developing child experiencing rapid changes in physiology, musculature and cognition.

[32]Health and Safety at Work – Protecting Youth at Work. www.ncbi.nim.nih.gov/books/NBK230171/ p. 13.

[33]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia*, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, 2013, p. 88. www.cdc.gov/niosh.

[34]Rauscher KJ, Runyan CW, Prevalence of Working Conditions Associated with Adolescent Occupational Injury in the U.S. A Review of the Literature, Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia*, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 128. www.cdc.gov/niosh.

[35]Okun A, Guerin RJ, Schulte PA, Foundational workplace safety and health competencies for the emerging workforce. J. Safety Res. 2016 December: 59: 43-51, doi:10.1016/j.jsr2016.09.04.

[36]Glendon I. Brain development during adolescence: Some implications for risk taking and injury liability. 2006. Journal of Occupational Health and Safety;16:1-15.

Sudhinaraset M, Blum RW. The Unique Developmental Considerations of Youth-Related Work Injuries. Int J Occup Environ Health. 2010;16(2):195-201. doi:10.1179/oeh.2010.16.2.195.

executive functioning. Review of the literature identified changes in brain functioning related to reward sensitivity and self-regulatory processes along with context could have an impact on youth work-related injuries.

Musculoskeletal development occurs across a wide age-range among children, from 10 to 20 years old. During this dynamic phase, growth plates begin to fuse and rapid changes in height and musculature occur, and these factors increase risk of injury to ligaments and fractures. Injury risk is further exacerbated in occupations where work youth are subjected to involves "awkward positions, high force, and repetitive motions."[37] These types of physical exposures are pervasive in construction. It is not surprising then that compared with other occupations, musculoskeletal injuries are 50% higher among construction workers compared with other occupations.[38] A study of U.S. Department of Labor and Training Administrative data reported "construction jobs require significantly more balancing, climbing, crouching, stooping, kneeling, and crawling than non-construction jobs."[39]

Another risk faced by youth in construction is the "mismatch between youth's size and the dimension of equipment or machinery designed for adults." This mismatch may be one reason machinery and equipment are a significant source of injury for young workers, as has been demonstrated previously by the Consumer Product Safety Commission in a study of ride-on mowers and youth injuries. In addition to age, reduced height and weight were associated with increased injury on mowers.[40] Smaller body size is a concern that translates to other types of machinery used in construction. In an analysis of workers' compensation claims in Minnesota, 18% of injuries involved machinery and hand tools. Examples of activities that led to injury involving machinery included moving heavy equipment and materials, such as cement mixers and drywall, and using powered machinery, such as drills, press machines and saws. In another study of OSHA reports, teens were more likely than adults to be injured from electrical apparatus/wiring, materials handling equipment and industrial motor vehicles." [41]

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[37]Glendon I. Brain development during adolescence: Some implications for risk taking and injury liability. 2006. Journal of Occupational Health and Safety;16:1-15.

[38]Schneider S, Griffin M, Chowdhury R. Ergonomic exposures of construction workers: an analysis of the U.S. Department of Labor Employment and Training Administration database on job demands. *Applied Occupational and Environmental Hygiene*. 2011;13(4):238-241. http://doi.org/10.1080/1047322X.1998.10390074.

[39]National Research Council and Institute of Medicine Committee on Health and Safety Implications of Child Labor. Health and Safety at Work. In: Protecting Youth at Work: Health, Safety and Development of Working Children and Adolescents in the United States. Washington, DC: National Academies Press (US); 1998.

[40]Suruda A, Philips P, Lillguist D, Sesek R. Fatal injuries to teenage construction workers in the US. Am J Ind Med. 2003 Nov;44(5):510-4. http://doi.org/10.1002/ajim.10304.

[41]Oswald D, Sherratt F, Smith S. Exploring factors affecting unsafe behaviours in construction. In: Smith, S.D and ARCOM Conference, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management; 2013; 335-344.

Hormonal changes can lead to risk-taking behaviors in young workers. Increased arousal, heightened emotions and social processing result in novelty-seeking, sensation-seeking and risk-taking behaviors that can compromise the safety of youth working in risky industries like construction.

> "Young workers 'see' the same things as adult workers but cannot always perceive the risks."
>
> – Gordan, 2006

Puberty represents a period of accelerated reproductive growth, with peaks at 12 years of age for girls and 14 years of age for boys. Generally, puberty does not end until around 17 years of age. During puberty, the "brain is driven by hormonal changes." Increased arousal, heightened emotions and social processing result in novelty-seeking, sensation-seeking and risk-taking behaviors that can compromise the safety of youth working in risky industries like construction. Though not focused on youth, a prior study of construction workers' perceptions about factors that affect on-site injuries reported that risk-taking is among the top two contributing factors, second only to safety culture.[42] Furthermore, as previously discussed, teen construction workers themselves reported performing illegal, hazardous work activities, such as roofing, excavation and trenching, wrecking and demolition, and operation of powered machinery, in North Carolina.[43] In Minnesota, many youth were injured while engaged in prohibited activities, including falling from ladders and using powered saws.

The adolescent brain is also still in training to maintain balance, coordination and executive functioning. The cerebellum, which maintains balance, coordination and motor skills, continues to develop through late adolescence until age 25. The ability to maintain balance and coordination is particularly important in the construction industry with tasks at elevated heights.[44]

In just the past two decades, researchers have also begun to recognize that the pre-frontal cortex, the portion of the brain that processes information needed for decision-making and emotional regulation, does not fully mature until the mid-20's. Interestingly, adolescents' visual-spatial skills outpace their ability to interpret visual cues. Thus, "young workers 'see' the same things as adult workers but cannot always perceive the risks."[45]

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[42]Oswald D, Sherratt F, Smith S. Exploring factors affecting unsafe behaviours in construction. In: Smith, S.D and ARCOM Conference, 2-4 September 2013, Reading, UK, Association of Researchers in Construction Management; 2013; 335-344.

[43]Runyan CW, Dal Santo J, Schulman M, Lipscomb HJ, Harris TA. Work hazards and workplace safety violations experienced by adolescent construction workers. Arch Pediatr Adolesc Med. 2006 Jul;160(7):721-7. http://doi.org/10.1001/archpedi.160.7.721.

[44]Schneider S, Griffin M, Chowdhury R. Ergonomic exposures of construction workers: an analysis of the U.S. Department of Labor Employment and Training Administration database on job demands. *Applied Occupational and Environmental Hygiene*. 2011;13(4):238-241. http://doi.org/10.1080/1047322X.1998.10390074.

[45]Glendon I. Brain development during adolescence: Some implications for risk taking and injury liability. 2006. Journal of Occupational Health and Safety;16:1-15.

Lastly, changes in the brain and the context in which work is performed may affect adolescents' ability to engage in safe practices. There are two key changes in the adolescent brain that may be relevant to increased risk of work-related injury. First, changes in reward sensitivity related to developments of the limbic system may be the cause of increased novelty-seeking and higher levels of stimulation that is observed among adolescents. Second, relatively slow development of self-regulatory processes, including impulse control, foresight and planning, may be linked to the slow maturation of the pre-frontal cortical systems.[46] Researchers posit that "these processes could provide a propensity for different behaviors when engaging in similar job tasks as adult workers (e.g. adherence to safety practices) but possibly through mechanism other than risk appraisal such as social and motivational issues. Social-motivational issues that are more salient during this life stage include particular needs for affiliation, being attractive to others, achievement and independence."[47]

"More controlled contexts inhibit teen risk-taking."

– Breslin 2013

Consequently, while youth may be able to accurately appraise risk, they may not be able to engage in safe practices due to social and emotional development factors. For example, males experience pressure to take physical risks at an early age and may react differently to near misses, minor injuries or a willingness to engage in safety practices.[48] These pressures may also make youth more reluctant to speak up about hazardous conditions or difficulties they are experiencing with work activities or tasks they are performing.[49] Pressures like these may be more present in certain work contexts such as construction, which is male dominated, physically demanding and requires significant skill.

[46]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia,* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 86. www.cdc.gov/niosh.

[47]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia,* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 86. www.cdc.gov/niosh.

[48]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia,* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 86. www.cdc.gov/niosh.

[49]Improving the Safety and Health of Young Workers, International Labor Organization 2018 ISBN:978-92-2-131651-0 (web pdf), p. 12.

Also, of interest is the evidence that youth risk-taking may be influenced by controlled contexts. The research on this relationship "appears to indicate that more controlled contexts inhibit teen risk-taking."[50] A study of fast-food chains where work processes are heavily engineered and controlled, showed lower than average injury rates among youth.[51] For purpose of identifying needed safety precautions, these risk factors related to youth development need to be taken into account so training can be provided in manner that effectively responds to these challenges.

State and federal law – child labor laws

State and federal child labor laws address two of the risk factors discussed above – the hazardousness of work performed and the environment in which work is performed – by prohibiting children from performing work activities and tasks or performing work in environments that are particularly hazardous. Work activities and tasks and work environments are particularly hazardous when the hazards to which workers are exposed are difficult to eliminate or control and exposure to those hazards creates a significant risk to children of serious injury, illness or death.

At a minimum, safety precautions required for hands-on training in the skilled construction trades must meet the requirements of Minnesota and federal child labor laws. Minnesota child labor laws prohibit children from being employed in or about construction or building projects because the DLI commissioner has determined, based on authority delegated to the commissioner by law, that construction work and the environment in or about construction and building projects are particularly hazardous for children. As a result, a necessary safety precaution for youth training programs is for those programs to be conducted in controlled environments where hazards have either been eliminated or are being effectively controlled.

Minnesota child labor laws

In 1974, the Legislature rearticulated the legislative purpose of Minnesota's child labor laws as follows:

> "The purpose of sections 181A.01 to 181A.12 is to aid in the economic, social and educational development of young people through employment. Work is an integral factor in providing a sense of purpose, direction, and self-esteem necessary to the overall physical and mental health of an individual. Young people, especially those who have completed high school or occupational training, should not be

[50]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia,* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 86. www.cdc.gov/niosh.

[51]Breslin, CF, Smith, PM Risk Factors for Nonfatal Work Injuries for Young Workers: A Review of Two Relevant Literatures. Health and Safety of Young Workers – *Proceedings of a U.S. and Canadian Series of Symposia,* U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health 2013, p. 86. www.cdc.gov/niosh.

denied employment opportunities. Work, however, must be coordinated with schooling and safety considerations in order to serve the best interest of the young."[52]

This statement of purpose makes clear that youth employment must be coordinated with youth schooling and youth safety to ensure the best interests of Minnesota's youth are served. To achieve that coordination, the Legislature itself set standards for the minimum age, maximum hours and times of day that children may work, and how work would be coordinated with schooling. Minnesota Statutes 181A.04 provides the following.

Subdivision 1. Minimum age

No minors under the age of 14 shall be permitted employment in this state except as authorized by section 181A.07.

Subd. 2. During school

On school days, during school hours, no minor under the age of 16 years shall be permitted employment except as provided in section 181A.05.

Subd. 3. Time of day, under 16

No minor under the age of 16 shall be permitted to work any day before 7:00 a.m. or after 9:00 p.m.

Subd. 4. Maximum hours

No employer shall be permitted to work a minor under the age of 16 more than 40 hours a week or more than eight hours in any 24-hour period.

. . . .

Subd. 6. Time of day, high school students

A high school student must not be permitted to work after 11:00 p.m. on an evening before a school day or before 5:00 a.m. on a school day, except:

(1) as permitted by section 181A.07, subdivisions 1, 2, 3, and 4;

(2) *this subdivision does not apply to a high school student age 18 or older, unless the student provides a written request for the hours restrictions to the employer at least two weeks before any restricted hours begin;* or

[52]Minn. Stat. Sec 181A.02.

(3) *if a high school student under the age of 18 has supplied the employer with a note signed by the parent or guardian of the student, the student may be permitted to work until 11:30 p.m. on the evening before a school day and beginning at 4:30 a.m. on a school day.*

For the purpose of this subdivision, a high school student does not include a student enrolled in an alternative education program approved by the commissioner of education or an area learning center, including area learning centers under sections 123A.05 *to* 123A.08.[53]

Minnesota's Child Labor Law prohibits children under the age of 18 from working in any occupation the commissioner "shall find to be particularly hazardous for the employment of children under 18 years of age or detrimental to their well-being"[54] and directs the commissioner to develop, through rulemaking, a list of such occupations.[55]

The list of occupations and occupational activities and tasks the commissioner has found to be particularly hazardous for the employment of children or that would be detrimental to their health and well-being are organized into two groups. One group includes occupations and occupational activities and tasks that children under the *age of 18* may not be employed to perform[56] and the second group includes additional occupations and occupational activities and tasks that children under the *age of 16* may not be employed to perform. Below are the occupations and occupational activities and tasks included in those groups that are relevant to the construction occupations and work that may be performed on construction and building project sites.[57]

No minor under the age of 18 shall be employed:

A. In or about a place of employment where chemicals, compounds, dusts, fumes, vapors, gases, or radioactive materials, or other substances are present at excessive temperatures or in injurious, explosive, toxic, or flammable quantities. *Minors employed in retail stores, service stations, and automobile service garages are not covered by this prohibition.*

. . . .

F. In or about construction or building projects.

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[53]Minn. Stat. 181A.04, subd. 6.

[54]Minn. Stat. 181A.04, subd. 5, Hazardous occupations: No minor under the age of 18 shall be permitted to work in any occupation which the commissioner shall find to be particularly hazardous for the employment of children under 18 years of age or detrimental to their well-being. A list of such occupations shall be established and promulgated by rule pursuant to section 181A.09.

[55]Minn. Stat. Sec. 181A.09, subd. 2.

[56]Minnesota Rules 5200.0910, Prohibited employments of minors under 18 years old.

[57]Minnesota State Regulations, The Child Labor Standards Act, and Related Rules and Regulations, Department of Labor and Industry, p.5 1974 (Minnesota Historical Society, Main KFM 5735.5.A3 1974).

. . . .

I. To operate or to assist in the operation of power-driven machinery, including but not limited to: industrial trucks (forklifts); meat saws and meat grinders; milling machines; punch presses, press brakes, and shears; and woodworking machinery such as circular saws, radial saws, jointers, and shaping machines.

J. To operate any nonautomatic elevator, lift, or hoisting machine.

K. To drive motor vehicles, except as follows:

(1) Sixteen- and 17-year-old minors may drive up to 24,000 pound, single-unit vehicles (excluding buses) and may carry passengers at any time with a class D license.

(2) Sixteen- and 17-year-old minors may drive over 24,000 pound, single-unit vehicles (excluding buses) with a class B license but may not carry passengers.

(3) Fifteen-year-old minors who have completed an approved driver education course may, with a restricted farm work license, drive a motor vehicle in accordance with Minnesota Statutes, section 171.041.

However, as provided in Minnesota Statutes, section 171.322, no one under 18 years of age shall operate a motor vehicle while in use as a carrier of persons for hire, nor shall any person under 18 years of age drive a passenger-carrying vehicle as a hired driver.

. . . .

Q. In window-washing, wall-cleaning, painting, or other building maintenance or repair higher than 12 feet above the ground or floor level, using ladders, scaffolding, safety belts, outside vertical conveyors, or like equipment.

R. In oxyacetylene or oxyhydrogen welding.

S. In any occupation or activity, or on any site, which is hazardous or dangerous to life, limb, or health.

In addition to the restrictions for minors under the age of 18, no minor under the age of 16 may be employed in the following occupations or to perform the following occupational activities or tasks that are relevant to the construction occupations and work that may be performed on construction and building project sites:[58]

B. except as stated in part 5200.0910, item K, subitem (3), as a driver of a motor vehicle or an outside helper thereon;

[58]Minn. Rules 5200.0920, Prohibited employments of minors under 16 years old.

. . . .

E. to do welding of any kind;

F. to operate or assist in the operation of machinery, including but not limited to:

. . . .

(4) drill presses, milling machines, grinders, lathes, and such portable power-driven machinery as drills, sanders, and polishing and scrubbing equipment for floor maintenance;

. . . .

G. in oiling, cleaning, or maintaining any power-driven machinery, either portable or stationary, while in motion or at rest;

. . . .

When establishing these child labor standards, both the Legislature and the commissioner, through rulemaking authority, have provided for certain exemptions to these standards. Exemptions include both those imbedded in subdivisions (see, for example, the italicized text above) and those referenced but set out in separate subdivisions or subparts.

Of importance to this study, the Legislature authorized the commissioner to grant exemptions to child labor standards for youth participating in training programs approved by the commissioner and for students in a valid apprenticeship program taught by or required by a trade union, the commissioner of education, the commissioner of employment and economic development, the Board of Trustees of the Minnesota State Colleges and Universities or the Board of Regents of the University of Minnesota.[59] This authority to grant

[59]Minn. Stat. 181A.07, subd. 7, Approved training programs: The commissioner may grant exemptions from any provisions of sections 181A.01 to 181A.12 for minors participating in training programs approved by the commissioner; or students in a valid apprenticeship program taught by or required by a trade union, the commissioner of education, the commissioner of employment and economic development, the Board of Trustees of the Minnesota State Colleges and Universities or the Board of Regents of the University of Minnesota.

exemptions to child labor standards applies to specific work-based learning initiatives intended to prepare students for future employment and to expose them to possible careers and the pathways to those careers.[60]

Federal child labor laws

Federal child labor laws establish minimum nation-wide standards with which employers covered by federal law must comply. Federal law allows states to enact child labor laws that establish minimum standards for employers covered by state law.[61] Employers covered by both federal and state child labor laws must comply with the law that provides the greatest protections for children. If federal child labor laws are more protective than a state's child labor statute and regulations, the more protective provisions of federal law must be complied with. As such, the Legislature may not enact laws that do not meet the minimum protections of federal child labor laws. Similarly, the Commissioner does not have the authority to issue exemptions from more protective federal child labor provisions.

Under federal child labor laws,[62] children under 16 years of age are prohibited from working in construction occupations except for office work or sales work performed away from the construction site.[63] Children age 16

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[60]Under rulemaking authority, the commissioner has similarly adopted exemptions to the statute and rules, some mirroring provisions in the statute related to training and apprenticeship programs. Minn. Rules 5200.

> **Subpart 1. Approved training programs**
> Prohibitions related to employment do not apply to a minor being trained in a state-approved apprenticeship training program or to a minor enrolled in a training program approved by the Division of Vocational-Technical Education, Minnesota Department of Education.
>
> **Subp. 2. Tasks outside of area of hazard**
> A minor who performs employment tasks which do not require being in or entering the immediate area of the hazardous operation, equipment, or materials is excluded from the prohibitions of parts 5200.0910 and 5200.0920.
>
> **Subp. 3. High school graduates**
> A minor who has reached the age of 17 and has graduated from high school shall be excluded from the prohibitions of part 5200.0910.
>
> **Subp. 4. Parental corporations.**
> The prohibitions under parts 5200.0910 and 5200.0920 do not apply to a minor working for a corporation totally owned by one or both parents in which the daily corporate business is supervised by the parent or parents. In addition, with respect to agricultural employment, parts 5200.0910 and 5200.0920 do not apply to a minor employed by a family farm corporation as defined under Minnesota Statutes 1973, section 500.24, where the minor's parent is a member of the said family farm corporation.

[61]29 U.S.C. 218(a).

[62]Minors less than 16 years of age may not work during school hours except in student related work experience and career exploration programs and work-study programs and are limited in the hours they can work when school is not in session. 29 C.F.R. § 570.35; 29 C.F.R. § 570.36(d); 29 C.F.R. § 570.37(c).

[63]29 C.F.R. § 570.33(n)(4).

and 17[64] may be employed in construction except for the following hazardous construction occupations or occupation related activities and tasks the U.S. Secretary of Labor has found to be particularly hazardous for the employment of children 16 and 17 years of age or detrimental to their health or well-being:[65]

1. *Demolition:* Occupations involved in wrecking and demolition operations.[66]
2. *Driving motor vehicles:* Occupations of motor-vehicle driver and outside helper.[67]
3. *Power driven woodworking machines:* Occupations involved in the operation of power-driven woodworking machines.
4. *Excavation:* Occupations in excavation operations.[68]
5. *Elevators and hoists:* Occupations involved in the operation of power-driven hoisting apparatus.[69]
6. *Power driven saws:* Occupations involving the operation of circular saws, band saws, guillotine shears, chain saws, reciprocating saws, woodchippers, and abrasive cutting discs.[70]
7. *Roofing:* Operations in roofing operations and on or about a roof.[71]
8. *Power-driven metal forming:* Occupations involved in the operation of power-driven metal forming, punching, and shearing machines.

Similar to Minnesota's child labor law, federal child labor laws allow children to participate in various work-based learning programs. However, federal child labor laws place express limitations on children's participation in those programs and the work they may perform. Under federal law[72] students age 14 and 15 may only participate in work-study programs that are in "permissible occupations."[73] Under federal law, construction is not a permissible occupation for that age group.[74] Therefore, students age 14 and 15 may not participate in construction work-study programs. There are no exemptions from this limitation. In addition, students age 14

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[64]The federal child labor provisions do not limit the numbers of hours or times of day that workers 16 years of age and older may legally work, though many states do, including Minnesota. Child Labor Provisions for Nonagricultural Occupations under the Fair Labor Standards Act, U.S. Department of Labor, Wage and Hour Division, Child Labor Bulletin 101 WH1330 REV 11/16, p. 2.

[65]29 U.S.C. 203(l)(2).

[66]29 C.F.R. § 570.66.

[67]29 C.F.R. § 570.52.

[68]29 C.F.R. § 570.68.

[69]29 C.F.R. § 570.58.

[70]29 C.F.R. § 570.65.

[71]29 C.F.R. § 570.67.

[72]29 C.F.R. § 570.37. Work-study programs are for the number of hours of class-room instruction required by the State Educational Agency for the completion of a fully-accredited college preparatory curriculum.

[73]29 C.F.R. § 570.37(b)(4)(i).

[74]29 C.F.R. § 570.37(b)(4)(i); 29 C.F.R. § 570.34; 29 C.F.R. § 570.33(n)(4).

and 15[75] may participate in work experience and career exploration programs that are in "permissible non-hazardous occupations."[76] Construction is not a permissible non-hazardous occupation.[77] Therefore, under federal law, students age 14 and 15 may not participate in construction work experience or career exploration programs.[78] However, there is a limited exception for work experience and career exploration programs that may be granted by the administrator of the Wage and Hour Division of the U.S. Department of Labor.[79]

Federal law prohibits Minnesota from providing hands-on training to middle school students and high school students under the age of 16 on location at construction sites and does not allow students 16 and 17 years old in training programs to work on construction sites that contain certain hazardous construction operations, which would be the majority of construction sites.

Children age 16 and 17, under federal law, may be enrolled in federal or state registered apprenticeship programs[80] and be student-learners enrolled in recognized educational vocational training programs. But they may not be employed through those apprenticeship and educational vocational programs in the following hazardous construction related occupations:[81]

[75]29 C.F.R. § 570.36. Work experience and career exploration programs program are for high school credits for both in-school related instruction and on-the-job experience. 29 C.F.R. § 570.36(b)(3)(ii).

[76]29 C.F.R. § 570.36(c)((3).

[77]29 C.F.R. § 570.36(c)((3); 29 C.F.R. § 570.34; 29 C.F.R. § 570.33(n)(4).

[78]29 C.F.R. § 570.37(b)(4)(i); 29 C.F.R. § 570.34; 29 C.F.R. § 570.33(n)(4).

[79]The Administrator may grant a request for a special variation if the applicant school demonstrates that the activity will be performed under adequate supervision and training, including safety precautions, and that the terms and conditions of the proposed employment will not interfere with the health or well-being or schooling of the minor enrolled in an approved program. 29 C.F.R. § 570.36(c)((3).

[80]The apprentice must be registered by the Bureau of Apprenticeship and Training of the United States Department of Labor as employed in accordance with the standards established by that Bureau, or is registered by a State agency as employed in accordance with the standards of the State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, or is employed under a written apprenticeship agreement and conditions which are found by the Secretary of Labor to conform substantially with such Federal or State standards. 29 C.F.R. § 570.50 (b).

[81]29 C.F.R. § 570.50(b)&(c). There are no exemptions for apprentice or student training programs for these hazardous construction occupations.

1. *Demolition:* Occupations involved in wrecking and demolition operations.[82]
2. *Elevators and hoists:* Occupations involved in the operation of power-driven hoisting apparatus.[83]
3. *Driving motor vehicles:* Occupations of motor-vehicle driver and outside helper.[84]

Youth age 16 and 17 enrolled in a registered apprenticeship program and student-learners enrolled in a recognized educational vocational training program, may be employed through those apprenticeship and educational vocational programs in the following hazardous construction occupations if the work performed is "non-hazardous." Work performed is "non-hazardous" if it is incidental to the apprentice or student's training, intermittent and for short periods of time, and under the direct and close supervision of a qualified and experienced person:[85]

1. *Power driven woodworking machines:* Occupations involved in the operation of power-driven woodworking machines.
2. *Excavation:* Occupations in excavation operations.[86]
3. *Power driven saws:* Occupations involving the operation of circular saws, band saws, guillotine shears, chain saws, reciprocating saws, woodchippers, and abrasive cutting discs.[87]
4. *Roofing:* Operations in roofing operations and on or about a roof.[88]
5. *Power-driven metal forming:* Occupations involved in the operation of power-driven metal forming, punching, and shearing machines.

While federal child labor laws do not have a blanket prohibition against youth 16 and 17 years of age working on and about construction and building projects, the prohibitions set out in the applicable federal "Hazardous Occupation Orders" leave few activities and tasks youth are permitted to perform on a construction and building project. However, as the injury and illness data demonstrates, despite these limitations, once allowed on construction sites, youth are exposed to a highly hazardous work environment and are often assigned work the limitations prohibit, putting their health and safety at risk.

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[82] 29 C.F.R. § 570.66.

[83] 29 C.F.R. § 570.58.

[84] 29 C.F.R. § 570.52.

[85] 29 C.F.R. § 570.50(b)&(c). The following hazardous construction occupations exempts apprentices and student-learners, and permits them to do non-hazardous work that is incidental to the apprentice or student's training, intermittent, and for short periods of time, and under the direct and close supervision of a qualified and experienced person in relationship to the following hazardous occupations: Occupations in excavation operations 29 C.F.R. § 570.68(b); Power driven saws 29 C.F.R. § 570.65(c); Operations in roofing operations and on or about a roof 29 C.F.R. § 570.67(c).

[86] 29 C.F.R. § 570.68.

[87] 29 C.F.R. § 570.65.

[88] 29 C.F.R. § 570.67.

Minnesota youth skilled-trades training programs

Several skilled trades training programs are available to middle school and high school students in Minnesota that provide safe hands-on opportunities for learning in controlled environments. These programs range from tradeshow-like gatherings to in-depth opportunities to build complete homes. Multiple stakeholders noted that enrollment in programs is limited by funding availability and that there is high interest from youth.

Current Minnesota hands-on training programs in controlled environments are viewed as safe.

Stakeholders believed current hands-on training programs conducted in controlled environments are safe. One of the educators interviewed reported only a couple minor injuries during the 10 years they had worked in the field. No one in youth focus groups had heard of any youth having an accident in a controlled environment.

Youth in focus groups said they felt very safe in their controlled environment programs, citing precautions including the personal protective equipment (PPE) provided by the school and training about how to use tools before actually using them.

Personal protective equipment: According to the Occupational Safety and Health Administration, equipment meant to minimize exposure to hazards that cause serious workplace injuries and illnesses can include gloves, safety glasses and shoes, and earplugs or muffs.

Minnesota training programs with example safety precautions

The table below includes descriptions and goals for a sample of skilled trades training providers in Minnesota and the precautions they take to control risk factors and ensure the safety of youth while they learn construction skills.

Each of the construction training programs in the table have established safety precaution protocols and guidelines. For example, some programs set ratios of students to instructors; others train youth about material safety data sheets (MSDS) and product or tool safety manufacturers' documentation; other programs train staff members and youth using standardized safety coursework provided by OSHA or others provided by union groups.

Unions were engaged by several programs, including training conducted at union sites, unions provided instructors and use of union-developed curriculum distributed to schools and districts across the country. Several programs rely on instructors who are experienced tradespeople with real-world experience, many of whom have union affiliations.

These programs have effectively addressed, through their safety precautions, many if not all of the risk factors discussed in this study that are relevant to youth training programs, including conducting their programs in

controlled settings that either eliminate or effectively control the hazards and risks found on active constructions sites, consistent with requirements of Minnesota and federal child labor laws.

Program	Description	Safety precautions summary	Eligible ages
Construct Tomorrow	Construct Tomorrow provides high school students with multiple hands-on construction experiences in a tradeshow-like setting, usually in convention centers. Students are paired with industry and union leaders, apprenticeship training coordinators and educators. The program's objective is to expose high school students to the type of work performed by various skilled trades and the pathways to careers in those skilled trades, including registered apprenticeship. Construct Tomorrow brings representatives from multiple trades to introduce students to construction careers. Hands-on experiences include nail hammering contests, stacking bricks, wiring circuits, troweling cement, setting tiles and many others. Events are held statewide.	• Students wear safety glasses during hands-on activities. • Simulator equipment used for training in welding, painting, heavy equipment operation and lift operation. • The event organizer walks through the pathways in the event center to ensure they are kept clear. Event management "common sense" and space safety experience are used to ensure general safety during the event, for example ensuring electrical cords from an outlet to a demonstration table are not a trip hazard. • Relies on the presenters to provide and use safety precautions related to their industry during an event.	14 to 18+

Learn2Build	Learn2Build provides hands-on, STEM-focused experiences for youth in grades four through nine related to careers in the construction industry. Experiences include team competitions and projects that focus on construction concepts and designs. Hands-on activities include projects that teach students how to measure and cut, and how to read blueprints. Learn2Build exposes middle school students to construction through guest speakers, field trips and building projects. The program's aim is for students to consider taking career and technical education construction courses in high school and, ultimately, consider a career in the skilled trades.	• Program rules require experiences must *not* include the following:
		  ○ power tools (hand tools only);
		  ○ ladders; or
		  ○ chemicals.
		• Teachers must provide instruction about the proper use of hand tools before projects begin and at any time needed thereafter.
		• Students must appropriately wear personal safety equipment for each project.
		• There must be a five-to-one ratio of students to instructors.
		• The program has an accident and injury protocol and safety evaluation process in place for accidents, but no accidents have
			10 to 14

		occurred since the program's inception. • Students must wear closed-toe shoes, hard hats, safety vests and long pants to attend active construction or industry site tours.	
Minnesota Trades Academy Internships	Paid summer internships offered in partnerships with the Apprenticeship Coordinators Association of Minnesota, Minnesota Building Trades Councils and various city youth internship programs. The Minnesota Trades Academy offers two programs, Track I and Track II. Track I, participants, called "interns," receive an eight-week introduction to career opportunities in the construction and building trades (such as carpentry and electrical) and are exposed to related careers, including architecture, project management and design build. Track II prepares interns to select a career path in construction (be that additional training, such as an apprenticeship, or moving directly into the construction workplace). Over nine weeks, the interns visit up to 16 apprenticeship training centers, where industry experts provide training and supervision as interns complete projects using hand and power tools.	• All interns receive training in a controlled environment. Track I interns receive training at one of the Construction Apprenticeship Preparation (CAP) schools. Track II participants are provided training at union training centers. • There is a six-to-one ratio of students to instructors. • Instructors and interns receive mandatory OSHA 10-hour training. • Interns must always wear personal protective equipment while working. • Instructors must have worked with youth to be contracted. • Prior to beginning a project, instructors must provide a demonstration and discuss safety precautions before youth start working. • Youth are given a "three-strikes disciplinary protocol" related to safety requirements, behavior and attendance.	Track I: 16 to 18; Track II: 16 to 21
Construction Apprenticeship Preparation Schools (CAP)	This is high school based construction hands-on learning, paired with the Multi-Craft Core Curriculum (MC3), an apprenticeship-readiness training curriculum (created by Building Trades National Apprenticeship and Training Committee of the Building Trades Council in 2008). One chapter in MC3 is called Construction Health and Safety. Hands-on activities include welding, plumbing and carpentry. Exposure includes guest speakers and field trips. The goal of CAP schools is to increase industry awareness and prepare students for apprenticeship.	• All CAP schools: Each school district follows its own set of rules for safety, including professional development about safety (including OSHA 10-hour training), but all must follow industry and manufacturers' guidelines for use of tools. • Minneapolis Public Schools (MPS) example: Each MPS technical education course has a unique set of safety lessons aligned to the equipment, supplies and hazards associated with the trade, which aligns with policy and protocols set forth by MPS and child labor laws.	14 to 18+

	Eight metro-area high schools are currently participating.	• MPS uses online tutorial and assessment site S/P2 for industry-specific safety lessons. Training helps students recognize hazards and includes modules about: personal protective equipment; power tool safety; fire safety; and fall protection (S/P2, 2019). • MPS students must pass the online tutorials at a proficient level before being allowed to progress to hands-on training at the school. • MPS teachers must take a course about safety called “Safe Schools.”	
Youthbuild	The Youthbuild program provides specialized training for youth and young adults between the ages of 16 and 24 who are at risk of not completing or have not completed their high school education. Participants are trained in construction, job-readiness skills and leadership skills. Programs include a work experience component to rehabilitate or construct residential units for the homeless, improve the energy efficiency or environmental health of residential units, facilities to support community garden projects, or public or private nonprofit facilities that provide services to very low-income individuals. The work experience component provides youth with an opportunity to develop skills working with tools and performing job functions related to the renovation of residential units. Youthbuild partners with members of the Apprenticeship Coordinators Association of Minnesota to offer youth tours of their apprenticeship training facilities. Registered apprenticeship instructors lead youth in hands-on activities at their facilities, such as grouting and laying tile, mixing cement, constructing metal tool boxes and using a simulated paint gun machine.	• The program starts with the trainers teaching National Center for Construction Education and Research (NCCER), the Carpenter's International Training Fund curriculum, "One Trade, Many Careers," North Central States Regional Council of Carpenter's curriculum, "Career Connections," and Home Builder's Institute Pre-Apprenticeship Training curriculum (HBI PACT). • Participants receive OSHA 10-hour certification. • Students and trainers are first-aid and CPR certified. • Work projects must include direct supervision by individuals skilled in each specific vocation (Minn. Stat. 116L.364).	16 to 24
High School Career and	Minnesota high schools statewide offer 888 career and technical education programs in construction, serving 24,518 students grades 9 through 12 in 2018 and	• Specific safety training curriculum is not mandated at the state level. Each district is responsible for identifying and documenting the	14 to 18

Technical Education	2019. The top courses are wood, construction and finishing, and general construction. Many of the schools have been offering construction-based programs for at least 20 years. During the 2017/2018 school year, students assisted in building more than a dozen residential homes, as well as several tiny or fish houses. They also participated in a number of Habitat for Humanity projects.	appropriate level of safety training needed for each course. • Schools require students to use personal protective equipment. • A specific career and technical education license is required of each instructor in an approved CTE program. • The Minnesota Department of Education is developing a safety resource for schools to use as a guidebook as they are designing and implementing their construction programs.

Highlight: South St. Paul High School program

The South St. Paul High School career exploration class is an eight-week course for 30 sophomores and juniors that meets one to two days a week. Staff members from the Carpenters Training Institute co-teach the course alongside a certified teacher. The class focuses on safety, tool orientation and meeting current registered apprentices. The program has an in-depth focus on mathematics, measuring, cutting and building projects that is dedicated to hands-on training in a safe environment. Students build wood partitions and frame-out window and door openings, among other projects.

During a site visit to the school, the department and consultants observed a number of safety precautions. Upon entering the shop some students carried 4' x 4' posts safely in pairs, those with long hair pulled their hair back and everyone wore eye protection. After a demonstration about how to use a saw to cut lumber, students consulted with their trainer before using the equipment.

Highlight: Roosevelt High School program

At Roosevelt High School, in Minneapolis, students can enroll in construction careers courses that introduce students to carpentry, cement masonry, electrical work, welding and plumbing. The program provides basic entry-level skills and introduces students to pathways to a construction career through hands-on activities and tours of skilled trades training facilities.

The program requires students to pass safety exams through S/P2's Construction Safety and Pollution Prevention Modules that cover hazard communication, power tool safety, electrical safety and fall protection, among other safety topics. In the class, students receive training about specific equipment prior to use, including watching safety videos and instructor demonstrations. The program also addresses safety by taking away students' cell phones to keep youth from being distracted while learning.

Highlight: Big Ideas, Inc.

Big Ideas, Inc., in New Ulm, Minnesota, is a skilled trades training program where students as young as 13 (target ages are 13 to 21; adults can also receive training) are trained in carpentry, welding and plumbing, among other topics. Classes are in numerous locations throughout the state and are taught by experienced tradespeople. Big

Ideas partners with high schools and industry to provide hands-on training aimed at helping students discover, explore and learn the skilled trades.

All courses start with a full safety brief that includes personal protective equipment, an introduction to equipment and their safety mechanisms, and safety protocols. Big Ideas ensures safety by creating a safe environment, prohibiting cell phones and teaching through virtual simulators.

Recommended safety precautions

The recommended safety precautions identified below have been developed based on the following:

- they are responsive to the factors that contribute to young workers' increased risk of work-related injuries:
    i. Risk factor 1: Hazardousness of the work and work environment,
    ii. Risk factor 2: Lack of education and safety training,
    iii. Risk factor 3: Inadequate supervision, and
    iv. Risk factor 4: Youths' physical, cognitive and emotional development level;
- they are safety precautions successfully used by Minnesota youth training programs highlighted in this report;
- they are safety precautions suggested by stakeholders interviewed for this report; and
- they are safety precautions recommended by the occupational safety and health experts in DLI's OSHA Division.

1. **Require training be provided in a controlled environment, using simulator equipment and virtual training when possible, to eliminate and control hazards associated with training activities and task and the training environment.**

    Providing training in a controlled environment and using simulators and other virtual training is responsive to Risk Factors 1, 2 and 4.

    Paramount to youth safety and health and addressing identified risk factors is for youth training programs to be conducted in controlled environments where hazards have either been eliminated or are being effectively controlled.

    Based on input provided by DLI occupational safety and health experts, a controlled environment is one in which:

    - training activities are well organized and managed, with training processes clearly defined;
    - only training activities are performed in the environment and the environment is appropriate for the training provided and the age of youth participating in the program;
    - safety and health hazards have been either eliminated or effectively controlled, including through the use of simulators, virtual training and other training methods;

- the entity providing training has an established safety and health program that includes regular hazard assessments of the program's training activities including tools, equipment, machinery, materials and chemicals and the environment in which the training is being provided, and if hazards are identified they are corrected;
- if chemicals and other hazardous materials are being used, MSDS information is readily available;
- safety and health duties of everyone in the training program, including administrators, instructors and youth learners, are defined and understood; and
- necessary training, resources and assistance are available for individuals to carry out their safety and health duties.

The highlighted Minnesota youth training programs described their programs as being provided in a controlled environment and Construct Tomorrow uses simulator and other virtual training as part of its exposure and training programs.

Stakeholders expressed the opinion that youth training in the skilled trades should be provided in a controlled environment for training and safety reasons. This sentiment was articulated by an industry representative as, "When you start working on a construction site, it is no longer about the kid, it is now about the project. ... [Training programs] should be focused on the kid and making sure that the child is given the opportunity to explore, in their own space, in their own way, in a safe environment."

Stakeholders suggested simulators as a safer way to teach real-world construction skills without the dangers of being on an active construction site. Simulator equipment is offered by multiple unions and others, and includes training on aerial lift, scissor lift, etc. in a controlled environment like a warehouse. For example, with simulated high-wire work, "they're a foot off the ground, not 30 feet off the ground," an education representative said.

In the words of one industry representative, "learning in a controlled environment is going to be the safest place for children to learn" about the skilled trades.

2. Require OSHA 10-hour safety and health training, first aid training and CPR training, and integrate safety and health training into training about specific skills.

Requiring the provision of occupational safety and health training is responsive to Risk Factor 2.

Input provided by DLI occupational safety and health experts emphasized the importance of providing youth the OSHA 10-hour training at the beginning of training programs. The OSHA 10-hour training is a cornerstone upon which subsequent safety and health training necessary to safely perform specific skills should build. Training about specific skills should include both

OSHA 10-hour training: 10-hour training about the recognition, avoidance, abatement and prevention of workplace safety and health hazards.

safety training and health training related to environmental hazards, including noise, dust, chemicals, heat and cold.

All of the highlighted Minnesota youth training programs provide occupational safety and health training. Many require OSHA 10-hour training, including Minnesota Trades Academy internships and the Construction Occupations Program, along with safety and health training for specific skills.

Stakeholders expressed the strong opinion that OSHA 10-hour safety training – an introductory safety course – is critical for students to complete. "I think it's really important that minors have [OSHA 10-hour training] ... I think that does a really good job [of teaching safety]," one education representative said.

Input provided by DLI occupational safety and health experts emphasized the need to provide youth training in basic first aid. Training about how to properly respond to accidents if they happen, such as a laceration, a splash of chemicals on skin or a sprain, is necessary to ensure the safety and health of youth. The focus of occupational safety and health training is the prevention of injuries and illnesses and the focus of first aid training is knowing how to respond to injuries if they happen. Several of the Youthbuild programs require students and trainers to be first aid and CPR certified.

3. Require the provision of necessary PPE and ensure it fits properly and is worn.

Requiring the provision of necessary PPE is responsive to a Risk Factor 1. Ensuring PPE fits properly and is worn by youth is also responsive to Risk Factors 2, 3 and 4.

Input provided by DLI occupational safety and health experts emphasized the importance of youth understanding why PPE is necessary when performing specific skills. That knowledge will assist them in recognizing the need for PPE in future situations. Youth should also understand PPE is used only when elimination of the hazard through other control measures, including engineering controls and administrative controls, have not been successful.

PPE is required by all surveyed Minnesota youth training programs.

PPE, such as safety glasses, hard hats, gloves, appropriate footwear, hearing protection and other safety equipment, is a method for protecting youth from hazards when other controls are not effective in eliminating or sufficiently minimizing the hazards. The type of PPE needed depends on the hazards to which the trainee is exposed. Youth must not only have appropriate equipment that properly fits them, they must know how and when to use it, one education representative advised. "[Youth] need to know that you have to have the proper attire," an industry representative said. "You have to have clothing that protects you. You have to have shoes that protect you. You have to know you need hard hats and safety vests and glasses. ... You have to understand that that is a critical component of their uniform."

4. **Establish and require compliance with safety and health rules, including rules that training must be free from distractions, such as cellphones.**

   Requiring that youth training programs establish and require compliance with safety and health rules is responsive to Risk Factors 2, 3 and 4. Rules that training must be free from distractions, such as cellphones is responsive to Risk Factors 1 and 4.

   Input provided by DLI occupational safety and health experts emphasized the importance of youth understanding that work-related injuries and illnesses can be prevented, and their prevention is dependent on everyone adhering to a common set of safety and health rules.

   Several Minnesota training programs use the Minnesota Technology and Engineering Educators Association website[89] as a resource for safety rules. The website provides a Shared Safety Folder of different guides and resources for ensuring safety. Several of the programs also prohibit youth from using their cellphones.

   Stakeholders recognized the amount of time youth use their cellphones and the distractions and risks this can pose, both to trade skills training and safety demonstrations. “Kids cannot have their phones on them,” an educator said. “... It’s so normal for them just to [say], ‘Oh, my phone buzzed. I should check it.’”

5. **Ensure individualized attention and supervision by conducting programs in small groups and requiring a low ratio of youth to instructors.**

   Requiring individualized attention and supervision by conducting programs in small groups and requiring a low ratio of youth to instructors is responsive to Risk Factor 2, 3 and 4.

   Effective instruction and supervision are critical to ensuring the safety and health of youth participating in hands-on training. Instructors must be able to engage with youth, often one-on-one, to ensure they understand how various skills are to be performed, to regularly check on whether they are executing those skills properly and safely, and to provide additional instruction and assistance when needed.

   Stakeholders suggested implementing an instructor-to-youth ratio to ensure instructors are able to effectively teach and supervise.

   Examples of ratios established by Minnesota youth training programs highlighted in this report that provide training in a controlled environment include:

   - three students to one instructor (some Youthbuild programs);
   - five students to one instructor (Learn2Build); and
   - six students to one instructor (Minnesota Trades Academy internships).

[89] www.mteea.net.

6. **Require instructors to be qualified (through education, training or experience) to provide training in the skills to be learned and how to properly use tools, equipment, machines, chemicals and materials included the program, to be trained in occupational safety and health and working with youth.**

   Requiring instructors to be qualified to provide training in the skills to be learned and how to properly use tools, equipment, machines, chemicals and materials included the program, to be trained in occupational safety and health and working with youth is responsive to Risk Factors 2, 3 and 4.

   Input provided by DLI occupational safety and health experts emphasized the need for instructors to be qualified through education, training or experience and be trained in occupational safety and health.

   The Minnesota Trade Academy, Preparation School (CAP), Youthbuild, and High School Career and Technical Education Programs require instructors to have specified qualifications, have training in occupational safety and health, and either have experience working with youth or are coupled with instructors who have that experience.

On-site training

The stakeholders who were interviewed had divergent perspectives about whether high school aged youth should be allowed to be trained on an active construction site. While the department disagrees with those stakeholders who believe high school aged youth should be allowed to be trained on active construction sites, based on the injury and illness data, the research on youth risk factors and longstanding state child labor laws, the department believes it important to include the perspectives of stakeholders who believe training youth on active construction sites could be beneficial and the safety precautions they suggested if on-site training were allowed.

> Things can go wrong in a hurry, and it's not a matter of it's just a mistake. It can kill them.
>
> – Education representative, regarding the importance of youth receiving safety training before going on-site

The stakeholders who believe it could be beneficial for youth to receive training on active construction sites, would only allow on-site training for older high school students, those who are 17 years of age, and only when certain safety precautions were implemented.

Stakeholders who believed on-site training could be beneficial, advised that common knowledge of safety protocols is a must when working with minors on active construction sites. Core competencies around safety must be taught to youth learners before and throughout on-site, hands-on training, including through mentorship and continued classroom learning. Stakeholders suggested providing mentors to youth, such as skilled journey workers, to help ensure the students' safety and experience are at the forefront. An education

representative said a mentor can work “side by side with them, making sure that they understand what they’re doing and what the task is and how we do it safely. [They can] keep an eye on them.”

Additionally, these stakeholders asserted it is not enough to know what safety procedures and equipment to use; youth learners must also understand why they are used and the potential risks for injury. A training plan that clearly communicates the training, supervision, requirements and tasks of the youth is important for maintaining good communication and safety.

Not ensuring youth understand safety before going on-site can have grave consequences, said one education representative: “They need to have a general overview of what the equipment or process that they’re doing is, how it’s going to happen and what is capable of happening when the equipment’s running or they’re trying to do a task. Like I say, things can go wrong in a hurry, and it’s not a matter of it’s just a mistake. It can kill them.”

In addition to the requirement for safety training, stakeholders suggested youth receive significant skills training before going on a job site. An industry representative expressed the concern that while the on-site experience can provide real-world scenarios, some learning needs to happen beforehand. Stakeholders also suggested one of the first steps when a youth is on-site should be a thorough orientation of the tools and equipment they will be using at that specific construction site, because the tools and equipment may be slightly different than those in their hands-on training in a controlled environment.

Stakeholders said ratios of youth to mentors or supervisors could help ensure necessary close supervision. “If students are going to be on a job site, there should be a low staff-to-student ratio,” an education representative advised. It is also important that supervisors are skilled in working with youth specifically, so they are effective supervisors and teachers. An education representative explained, “working with youth is much different than working with a grown person. And [so is] teaching them, and then [knowing] how you work with your own team to make sure that they’re ready to accept and support the youth coming in.”

It was also suggested that the state law could allow for youth to train on active construction sites, but with clear prohibitions against youth carrying out the most dangerous tasks. However, as experiences in other states have demonstrated and this report has discussed, prohibiting youth from performing certain activities is not an adequate safety precaution. Youth are regularly injured and killed while performing prohibited tasks.

Conclusion and legislative recommendations

Based on its review of work-related injury and illness data that shows youth have an increased risk of injury and the research on the factors that contribute to that increased risk, it is the department’s recommendation that the way to allow for middle school and high school aged students to safely receive hands-on training in the skilled trades is through programs such as the Minnesota skilled-trades training programs highlighted in this report, which follow the report’s recommended safety precautions. These highlighted programs achieve the objectives of exposing youth to the skilled trades and providing them with meaningful training opportunities. They provide youth with the necessary knowledge and hands-on experiences to decide whether to follow a skilled trades career path upon graduation from high school. Further, it is the strong recommendation of the department that hands-on training for youth under the age of 18 not be provided on active construction sites.

Any possible benefit gained by providing youth under the age of 18 training on an active construction site is overwhelmed by the unacceptable risk to youths' health, safety and wellbeing as demonstrated by the injury data discussed in this report. Youth wanting to pursue careers in the skilled trades have the option of entering registered apprenticeship programs or two- to four-year degree programs after graduating from high school. It is those programs that will provide the on-the-job experience necessary to become a master in the youth's chosen trade.

Currently, youth interest in the programs highlighted in this report exceeds their current capacities and resources. The department recommends the Legislature make a greater investment in these existing programs so they can be expanded to provide opportunities to a greater number of Minnesota's youth. It is also the department's recommendation that when establishing or supporting youth training programs, the Legislature require the recommended safety precautions listed in this report be met by those programs.