RESEARCH REPORT

Apprenticeship as a Tool to Improve Diversity in Construction

What Do the Literature, Current Strategies, and Recent Data Tell Us?

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Glossary

AAI: American Apprenticeship Initiative

ABA: Apprenticeship Building America

Active apprentice: In this report, an "active apprentice" refers to an apprentice who was registered in their apprenticeship program during a calendar year, including apprentices who started or exited their program during that year.

Apprentice: An apprentice is a paid, productive employee who receives a combination of on-the-job learning and related classroom instruction to master occupational skills.

CEO: Chief Evaluation Office, US Department of Labor

CTE: Career and technical education

DEI: Diversity, equity, and inclusion

DOL: U.S. Department of Labor

IT: Information technology

New apprentice: In this report, a "new apprentice" refers to an apprentice who started in their apprenticeship program during the current calendar year.

Nontraditional occupations: In this report, a "nontraditional occupation" is defined as a job in which women make up 25 percent or less of the total number of workers in that occupation.

OA: Office of Apprenticeship, US Department of Labor

OJL: On-the-job learning is training provided on the job by a mentor or supervisor.

RAPIDS: Registered Apprenticeship Partners Information Database System

RTI: Related technical instruction is training in material related to an occupation in a classroom or other instructional environment off the jobs.

SAA: State Apprenticeship Agency

SAE: State Apprenticeship Expansion

Utilization: Utilization is the percentage of total workers in an occupation from an identified demographic group.

Utilization gap: The utilization gap is the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar in terms of required skills.

WANTO: Women in Apprenticeship and Nontraditional Occupations

WIOA: Workforce Innovation and Opportunity Act

YARG: Youth Apprenticeship Readiness Grant

Executive Summary

In onsite construction occupations, women comprise only 3.3 percent and Black people comprise only 6.0 percent of workers, according to Munkacsy and colleagues' (2023) analysis of the utilization of underrepresented groups in the construction industry. This is despite women accounting for 46.8 percent and Black people accounting for 12.6 percent of workers across all industries (US Bureau of Labor Statistics 2023a). A traditional access point into the construction industry has been apprenticeship, which is a paid work-based learning strategy that combines structured on-the-job training with classroom-based instruction in related technical concepts.[1]

This report examines the participation of women and people of color (i.e., people who are not white) in construction apprenticeships to understand whether the underrepresentation[2] of these groups in construction is reproduced in the apprenticeship system. If underrepresentation is not reproduced in the apprenticeship system, or even if underrepresentation is less severe in apprenticeship programs than it is in construction nationally, apprenticeship training may be a viable strategy for improving diversity and equity in construction.

The report begins by providing background on apprenticeship. It then compares the utilization of underrepresented groups in construction apprenticeships with their utilization in the construction industry. Next it describes strategies for improving their representation through recruitment and retention and emerging opportunities for doing this through federal, state, local, and private sector partners. Finally, the report discusses the gaps in data on construction apprenticeship.

Background on Apprenticeship

Apprenticeship is a work-based training model that combines classroom learning with paid on-the-job training from experienced mentors and provides an industry-recognized credential upon completion.[3] It has long been part of the workforce systems in Canada, Europe, and Australia (Lerman 2014)[4] but has

[1] "What is Apprenticeship?" US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/help/what-apprenticeship.

[2] We say a subgroup is "underrepresented" when their share in an occupational group, apprenticeship, or job is lower than their share of the general population.

[3] "What is Apprenticeship?" US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/help/what-apprenticeship.

[4] Chris Taylor, "The Rise of the Apprentice: A European Tradition Comes to the US," *Reuters*, May 31, 2018, https://www.reuters.com/article/idUSKCN1IW174/.

only recently gained traction in the US (Gardiner et al. 2021). Research studies find that apprenticeship is associated with increased earnings (Hollenbeck and Huang 2016; Jacoby and Haskins 2020; Katz et al. 2022; Reed et al. 2012; Walton, Gardiner, and Barnow 2022). Despite the documented benefits, women participate in apprenticeship less than men (Berik, Bilginsoy, and Williams 2011; Bilginsoy et al. 2022; Butrica, Kuehn, and Sirois 2023; Gardiner et al. 2021; Reed et al. 2012) and people of color participate in apprenticeship less than white people (Bilginsoy et al. 2022; Carmardelle 2023; Gardiner et al. 2021; Seleznow and McGhee 2021; Zimmerman 2020).

Once participating in apprenticeships, women and people of color face obstacles to achieving positive employment outcomes in terms of wages and earnings (Katz et al. 2022; Reed et al. 2012), at least in part because they train for lower-paying occupations (Butrica, Kuehn, and Sirois 2023; Walton, Gardiner, and Barnow 2022). The federal government and states are making investments to expand apprenticeship to include people traditionally underrepresented in apprenticeship, including women, people of color, and people with disabilities (Butrica et al. 2023; Harrington et al. 2022; Hauge and Parton 2016; Rosenberg and Dunn 2020; Sattar et al. 2020).

Enrollment and Completion of Underrepresented Groups in Construction Apprenticeship

We use data on registered apprentices from the Registered Apprenticeship Partners Information Database System (RAPIDS) to compare the utilization of women and underrepresented racial and ethnic groups by construction apprenticeship programs to their utilization by the construction industry as estimated by Munkacsy and colleagues (2023).[5] For 2022, our results show that the share of women apprentices was higher than the share of women workers in 18 out of 23 apprenticeable construction occupations. In addition, 18 out of 23 occupations had a higher share of Black apprentices than the share of Black workers and 21 out of 23 occupations had a higher share of Asian apprentices than the share of Asian workers.

Hispanic apprentices provide an intermediate case in the sense that the differences between apprentice utilization and utilization for all workers in the occupation are not as frequently positive as the differences previously discussed for Black and Asian apprentices, and not as negative as those for

[5] Munkacsy and colleagues (2023) define utilization as the percentage of total workers in an occupation from an identified demographic group. This brief uses that definition to compare utilization in construction apprenticeship programs to utilization in national construction occupations. Munkacsy and colleagues (2023) also assess the utilization gap for construction occupations, which is defined as the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills.

Indigenous, multiracial, and white apprentices. Utilization of Hispanic apprentices was higher than utilization of Hispanic workers in 11 occupations and lower in 11 occupations. Higher utilization rates in apprenticeship programs than in the same construction occupations, although small, suggest that apprenticeship programs are doing a better job of recruiting women and people of color into the construction trades.

Strategies for Improving Apprenticeship Recruitment, Retention, and Completion

We review strategies that are currently being used to improve apprenticeship recruitment, retention, and completion. Pre-apprenticeship programs are a strategy aimed at improving access to apprenticeship among women and people and color. Although pre-apprenticeship programs vary in their designs and approaches, at their core they aim to help people learn about an industry and related occupations, build occupational and workplace skills, and provide access to employment pathways that include apprenticeship programs.[6]

Other strategies for improving apprenticeship recruitment, retention, and completion include adopting program designs that are associated with higher utilization of underrepresented groups such as: union-based construction apprenticeship programs (Bilginsoy et al. 2022; Petrucci 2021), women-only training programs (Chuang 2019; Hegewisch and Mefferd 2021), the provision of supportive services (Kelly, Wilkinson, and Nuñez 2019; Walton and Gardiner 2022; Worthen and Haynes 2009), the provision of child care assistance (Butrica and Sirois forthcoming; Kelly 2022; Reed et al. 2012), and the adoption and enforcement of workplace practices to stop harassment and discrimination (Hegewisch and Mefferd 2021).

Emerging Opportunities for Utilization of Underrepresented Groups in Construction through Apprenticeship

Opportunities exist in both the public and private sectors to increase participation in construction apprenticeship that leads to sustaining careers in the construction industry for women and people of color. These include: federal infrastructure investments in apprenticeship; state legislation to support apprenticeship (Council of State Governments 2021); state efforts to increase awareness about

[6] Apprenticeship USA, "Explore Pre-apprenticeship," US Department of Labor, accessed May 13, 2023, https://www.apprenticeship.gov/employers/explore-pre-apprenticeship.

apprenticeship through p*rofessional branding, marketing, and outreach strategies; school-based career pathways that increase awareness about construction apprenticeship among young people and appeal to their interest in wanting to learn more about* apprenticeship (Parton 2017); s*ector, industry, and workplace interventions to* mitigate harassment and discrimination in the construction sector and on construction sites (Hegewisch and Mefferd 2021); and p*ublic–private agreements with apprenticeship targets.* Although research has yet to be conducted regarding the impact of most of these efforts, these factors are important to consider for further study. And while not all these opportunities are focused on underrepresented groups, their commitment to registered apprenticeship and equity may be able to improve representation and equity in construction.

Construction Apprenticeship Data Gaps

Some information that would be valuable for research, evaluation, and policy planning is not currently tracked or measured in a standardized way. Future research and investments in federal and state data infrastructure will focus on filling these gaps can support decision making to advance equity in apprenticeship and in the construction industry. Major data gaps include the lack of pre-apprenticeship data, unregistered apprenticeship, and personal identifiable information that can be used to match apprentice data with employment and earnings data from state workforce agencies. In addition, administrative data on apprentices do not include information on where apprentices were recruited from, which preprogram activities they engaged in, or their postprogram outcomes.

Conclusion

The data reviewed in this report show that women, Black workers, Indigenous workers, and workers with disabilities are underrepresented in the construction industry. Because apprenticeship is a traditional pathway into these jobs and careers, examining its potential for increasing diversity—through more inclusive program designs, support services, and workplace interventions that have shown promise, as described in this report—may point to effective strategies for increasing diversity and representation in the construction trades.

Apprenticeship programs take years to complete, which requires thoughtful aligning and sequencing of research and evaluation efforts surrounding current programs, so they capture the full range of employment outcomes. Existing research finds evidence of the positive effects of apprenticeship on apprentices' earnings and employment (Reed et al. 2012; Hollenbeck and Huang 2016), but currently this research is only suggestive of effective strategies for increasing the diversity

of apprentices. Nonetheless, the dynamic apprenticeship environment federal investments have catalyzed—coupled with large-scale public investments in infrastructure—make possible meaningful improvements in access to construction careers for women and people of color in the near term, and promise broader impact over time.

Apprenticeship as a Tool to Improve Diversity in Construction

In onsite construction occupations, women comprise only 3.3 percent and Black people comprise only 6.0 percent of workers, according to Munkacsy and colleagues' (2023) analyses of the utilization of underrepresented groups in the construction industry, where utilization is defined as the percentage of total workers in an occupation from an identified demographic group. This is despite women accounting for 46.8 percent and Black people accounting for 12.6 percent of workers over all industries (U.S. Bureau of Labor Statistics 2023a). Marginalization of women and people of color in the construction trades[1] has long been recognized as a problem closely related to how Americans access jobs in the industry (Marshall and Briggs 1967). A traditional access point into the construction industry is apprenticeship (Glover and Bilginsoy 2005). Apprenticeship is a paid work-based learning strategy that combines structured on-the-job training with classroom-based instruction in related technical concepts.[2]

This report examines the participation of women and people of color (i.e., people who are not white) in construction apprenticeships to understand whether the underrepresentation[3] of these groups in construction is reproduced in the apprenticeship system. If underrepresentation is not reproduced in the apprenticeship system, or even if underrepresentation is less severe in apprenticeship programs than it is in construction nationally, apprenticeship training may be a viable strategy for improving diversity and equity in construction.

Data on registered apprenticeship programs suggest that while women and Black workers have higher utilization rates in construction apprenticeship programs than in the national construction industry, their utilization rates are still lower than their share of the total workforce (tables 1 and 2). Butrica, Kuehn, and Sirois (2023) find that 38 percent of women apprentices work in occupations where

[1] We sometimes use the term "skilled trades" or "building trades" in this report because the terms are used by apprenticeship programs. A "trade" is similar to an occupation, but denotes a particular craft or technique, such as bricklaying or welding, which may or may not also be a job category. Occupations may combine many tasks or techniques into a job (Autor 2013), but these occupations are defined by how work is organized in labor markets. Trades, in contrast, are defined by the craft or technique mastered by the tradesperson.

[2] "What is Apprenticeship?" US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/help/what-apprenticeship.

[3] We say a subgroup is "underrepresented" when their share in an occupational group, apprenticeship, or job is lower than their share of the general population.

most apprentices active in 2021 were women, such as the health care, education, and personal care sectors. Fifty-nine percent of women apprentices were in occupations where most apprentices were men, and the small remainder of women apprentices did not have their occupations identified in the data. These majority-female occupations typically have lower hourly wages than male-dominated apprenticeship occupations such as construction or maintenance and repair, where only about 5 percent of apprentices are women (Butrica, Kuehn, and Sirois 2023). This report builds on these findings by calculating utilization rates for women and underrepresented racial and ethnic groups in apprenticeship programs in detailed construction occupations.

Some detailed occupations and some apprenticeship programs in construction have been more successful than others at providing equitable employment and training opportunities to women, Black workers, and other underrepresented workers. To learn from successes in the apprenticeship system, this report also discusses current strategies for increasing diversity in construction apprenticeships. Apprenticeship expansion alone will not ensure gender and racial equity in the construction industry, but the progress apprenticeship programs have made in working toward equity can provide lessons for the industry.

This report sought to answer the following research questions through a review of the relevant literature and data:

1. What does current research find on the impact of pre-apprenticeships and registered apprenticeships on short- or long-term employment outcomes in general, for workers in traditionally underrepresented groups, and for the construction industry?
2. What are the strategies used for recruiting populations for inclusion in apprenticeships in construction or related industries traditionally less accessible to women and marginalized racial and ethnic groups? In which cases have these strategies been most successful?
3. How do characteristics of apprentices correlate with various program outcomes including wages and completion?
4. What are some program characteristics that have led to greater retention and successful completion of apprenticeships for women and people of color in construction?
5. What available data may be useful in assessing the impact of apprenticeships for bolstering employment outcomes among underrepresented groups in construction and related industries?

Sources for this report include a review of published literature and current apprenticeship models and strategies, drawing on both our ongoing research and knowledge of the field, as well as data

analyses. In addition to the literature review, the report includes analysis of administrative data on registered apprentices from the Registered Apprenticeship Partners Information Database System (RAPIDS). Unless specified as pertaining to construction apprenticeship, the discussion that follows addresses apprenticeship generally. Most prior research is about apprenticeship broadly or expansion of apprenticeship into new occupations and industries. However, the construction industry accounts for almost half of all apprentices—more apprentices than any other major occupation group. Also, there are lessons to be learned from apprenticeship programs in other occupations outside of construction. Unless distinguished as pertaining to unregistered apprenticeship, the discussion refers to registered apprenticeship (defined below).

Background on Apprenticeship

Apprenticeship is a work-based training model that combines classroom learning with paid on-the-job training from experienced mentors and provides an industry-recognized credential upon completion.[4] Apprenticeship programs provide people with a debt-free way to "earn and learn."[5] Not simply an alternative to traditional educational pathways, apprenticeship is sometimes referred to as an "options multiplier" (Fuller et al. 2022) because it provides direct entry into a career pathway but also opens the door to further postsecondary study. Not all US apprenticeships are registered with DOL, but those that are registered are referred to as the gold standard[6] in workforce training because of their program standards, rigor, wages that increase throughout the apprenticeship, and industry-recognized credentials.

Registered apprenticeship programs are recommended to include at least 144 hours of related technical instruction (RTI) per year of on-the-job learning (OJL), and at least 2,000 hours of OJL, although most construction apprenticeship programs are much longer. The standards required of all registered apprenticeship programs are outlined in 29 CFR § 29.5.[7]

Apprenticeship is associated with increased earnings. Evaluation research has documented the employment and earnings benefits of apprenticeship to workers:

- A study of 70,262 registered apprentices beginning their apprenticeship in 2000 or 2001 in 10 states found an average gain of $6,595 ($8,406 in 2022 dollars[8]8) in annual earnings (relative to nonparticipants) for apprentices six years after completing a registered apprenticeship program; this represents a lifetime average gain of $98,718 ($125,832) in earnings and $25,187 ($32,105) in benefits. The average annual earnings gain after six years was $6,737

[4] "What is Apprenticeship?" US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/help/what-apprenticeship.

[5] "Fact Sheet: Biden–Harris Administration Launches the Apprenticeship Ambassador Initiative to Create Equitable, Debt-Free Pathways to High-Paying Jobs," The White House, September 1, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/01/fact-sheet-biden-harris-administration-launches-the-apprenticeship-ambassador-initiative-to-create-equitable-debt-free-pathways-to-high-paying-jobs/.

[6] "#ApprenticeshipWorks for High School," US Department of Education, accessed May 26, 2023, https://sites.ed.gov/octae/tag/apprenticeship/.

[7] "29 § CFR 29.5 – Standards of Apprenticeship," Cornell Law School Legal Information Institute, October 29, 2008, https://www.law.cornell.edu/cfr/text/29/29.5.

[8] We converted amounts to 2022 dollars using the annual average Consumer Price Index for All Urban Consumers (CPI-U). See US Bureau of Labor Statistics, accessed May 26, 2023, https://data.bls.gov/timeseries/CUUR0000SA0?years_option=all_years.

($8,587) for men and $2,615 ($3,333) for women. These earnings differentials were statistically significant (Reed et al. 2012).

- One study using a statistical matching design found a lifetime net benefit of participation in a registered apprenticeship program in Washington State to be $338,560 ($412,827 in 2022 dollars) per apprentice, $87,198 ($106,326) of that benefit accumulating within two and a half years of program completion (Hollenbeck and Huang 2016). This study relied on an analysis sample of 6,398 apprentices and a comparison group of 485,995 Wagner–Peyser participants from Washington State enrolled between 2010 and 2013.
- A study of the unregistered Kentucky Federation for Advanced Manufacturing Education (KY FAME) apprenticeship program found that apprentices who completed the program had median earnings after five years that were roughly $45,000 ($50,885 in 2022 dollars) more than similar Kentucky community and technical college graduates who did not enroll in KY FAME (Jacoby and Haskins 2020).[9, 10]
- An evaluation of American Apprenticeship Initiative (AAI) registered apprenticeship grants found that the earnings of apprentices increased an average of 49 percent between the year before starting the apprenticeship and the year following its conclusion (Walton, Gardiner, and Barnow 2022).
- Four quarters before their AAI apprenticeship program, apprentices had lower earnings than similar workers not in apprenticeship programs. Ten quarters after starting their apprenticeship, apprentices had higher earnings than their counterparts not in apprenticeship. Over this period, earnings increased 43 percent for apprentices but only 16 percent for comparison workers (Katz et al. 2022).

Apprenticeship is increasing in the US. Apprenticeship has long been part of the workforce systems in Canada, Europe, and Australia (Lerman 2014).[11] Although the National Apprentice Act established the American federal registered apprenticeship system in 1937,[12] apprenticeship evolved as a primary strategy for training in only a narrow set of construction trades such as electricians, plumbers, and carpenters (Jacoby 2014). Unlike peer and competitor countries, apprenticeship in manufacturing, health care, business, and other non-construction trades only started gaining traction in the U.S. during recent decades (Gardiner et al. 2021) as policymakers sought to increase training and employment options for young people who do not enroll in traditional four-year college or post-secondary education

[9] The report described statistically significant differences in mean earnings of $33,802 ($ in 2022 dollars).

[10] The comparison group of non–KY FAME students was constructed by pair-matching with KY FAME students based on being a full-time student in the Kentucky Community and Technical College System associate degree program, identically enrolled or not enrolled during their first year in a program or developmental course designed to compensate for an academic shortcoming, and in the same local workforce area. In addition, matching pairs were approximately the same age, awarded approximately the same Pell Grant amount in the first year of enrollment, and in the same academic class of freshman or sophomore.

[11] Chris Taylor, "The Rise of the Apprentice: A European Tradition Comes to the U.S." *Reuters*, May 31, 2018.

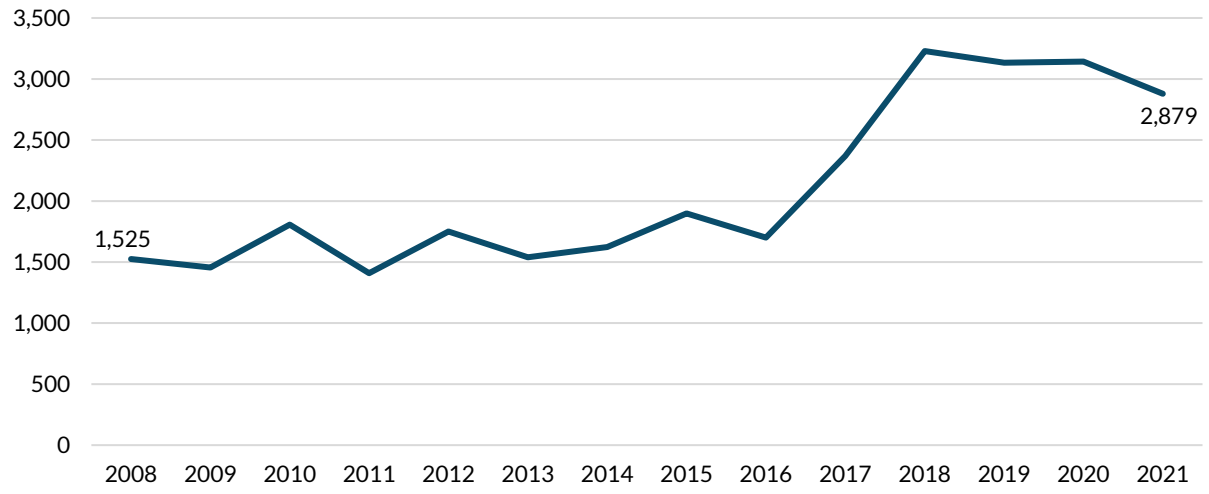
[12] Apprenticeship USA, "Our History," US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/about-us/our-history.

programs and for tens of millions of low-wage workers who lack pathways to advancement (Goger and Sinclair 2021).

Almost 600,000 registered apprentices are actively training in the US in FY 2021 across all occupations.[13] To be a sufficient source of workers for the 11.8 million construction workforce (U.S. Bureau of Labor Statistics 2023a), the registered apprenticeship system will need to grow through both the registration of new programs and new apprentices. Between 2008 and 2016, the number of new U.S. apprenticeship programs registering each year remained relatively constant at around 1,600 (figure 1). There was a large increase in new programs between 2016 and 2018 that has somewhat tapered off but remains elevated over prior new program registration rates. The number of new apprenticeship programs increased 89 percent between 2008 and 2021.

FIGURE 1

Number of New Registered Apprenticeship Programs, 2008–2021



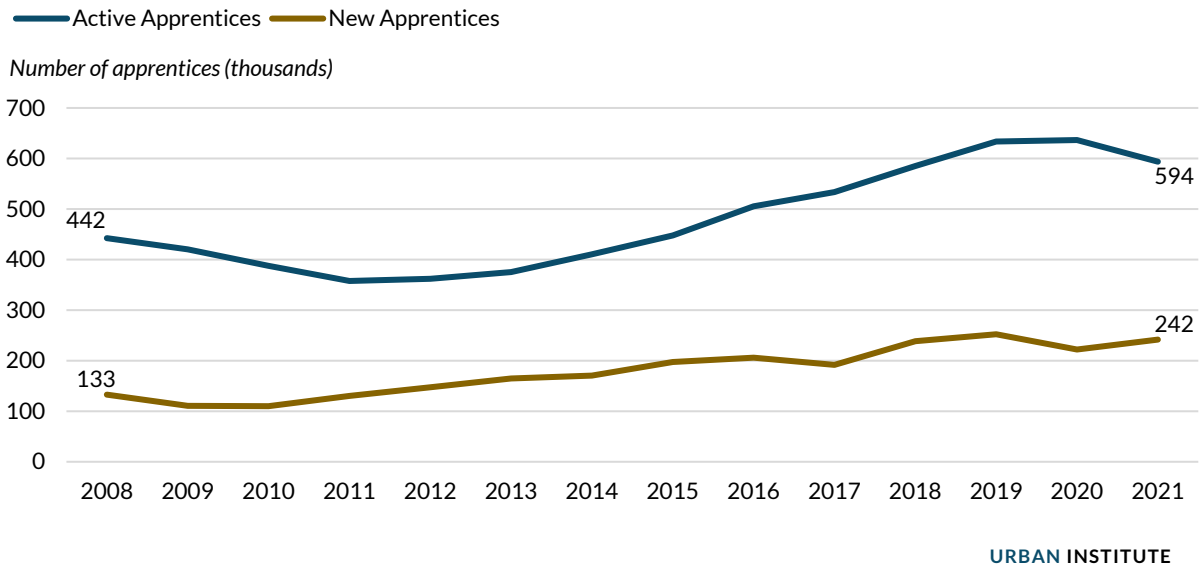
Source: "FY 2021 Data and Statistics," US Department of Labor, accessed May 14, 2023, https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2021.

[13] "FY 2021 Data and Statistics," US Department of Labor, accessed May 14, 2023, https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2021.

Given the increase in new programs, it is not surprising that the number of new apprentices increased 82 percent over the same period (figure 2). As of fiscal year (FY) 2021, there were 27,385 registered apprenticeship programs and 593,690 registered apprentices in the US.[14]

FIGURE 2

Number of Active and New Registered Apprentices, 2008–2021



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Source: "FY 2021 Data and Statistics," US Department of Labor, accessed May 14, 2023, https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2021.
Notes: Apprentices are restricted to individuals in programs in states that report to the Registered Apprenticeship Partners Information Database System (RAPIDS) or nationally registered programs. Active apprentices are defined as apprentices who were registered at some point during the year, including apprentices who started or ended their apprenticeship during the year. New apprentices are apprentices who registered during the year. Completers are apprentices who completed their apprenticeships during the year.

Women and people of color participate in apprenticeship less than men and white people. Despite the documented benefits of apprenticeship, women participate in apprenticeship less than men (Berik, Bilginsoy, and Williams 2011; Bilginsoy et al. 2022; Butrica, Kuehn, and Sirois 2023; Gardiner et al. 2021; Reed et al. 2012) and people of color, especially Black people, participate in apprenticeship less than white people (Bilginsoy et al. 2022; Carmardelle 2023; Gardiner et al. 2021; Seleznow and McGhee 2021; Zimmerman 2020).

Women and people of color earn less than men and white people during and after apprenticeship. Once participating in apprenticeships, women and people of color face obstacles to achieving positive

[14] "FY 2021 Data and Statistics," US Department of Labor, accessed May 14, 2023, https://www.dol.gov/agencies/eta/apprenticeship/about/statistics/2021.

employment outcomes in terms of wages and earnings (Katz et al. 2022; Reed et al. 2012). An analysis of data from the Registered Apprenticeship Partners Information Database System (RAPIDS) found that just over a third of women apprentices were in predominately women-dominated occupations in the health care, education, and personal care sectors (Butrica, Kuehn, and Sirois 2023). These occupations typically have lower hourly wages than traditional apprenticeship occupations such as construction and extraction and installation, maintenance, and repair, where only about 5 percent of apprentices are women (Butrica, Kuehn, and Sirois 2023).

The evaluation of AAI grants documented several findings for women and people of color regarding earnings gains between the year before starting the apprenticeship and the year following its conclusion (Walton, Gardiner, and Barnow 2022):

- Earnings increased more for women (65 percent) than for men (43 percent). Women still earned less than men before and after apprenticeship, but this earnings gap declined from 23 to 11 percent.
- Earnings increased the most for other races[15] (86 percent) followed by Hispanic apprentices (50 percent), white apprentices (45 percent), and Black apprentices (37 percent). This is despite relatively small differences in starting wages by race and ethnicity. White apprentices still earned more than Black and Hispanic apprentices (the earnings gap) before and after apprenticeship. Although the earnings gap between white and Hispanic apprentices declined from 7 percent before the apprenticeship to 4 percent after the apprenticeship. The gap increased from 9 to 14 percent between white and Black apprentices. In contrast, white apprentices earned 14 percent more than other races before apprenticeship but 10 percent less than other races after apprenticeship.
- Earnings increased 106 percent for men of other races but only 33 percent for Black men, and 74 percent for white women but only 48 percent for Black women. After apprenticeship, average earnings were $40,022 for Black women, $44,738 for Hispanic women, $50,138 for Black men, and $51,441 for white women. All other men and women of different racial and ethnic groups earned more than the overall average of $52,876.

The AAI evaluation noted that the differences in earnings growth appeared to be related to differences in occupations. For example, among apprentices in health care occupations a higher share of Black women apprentices than white women apprentices trained for lower-paying occupations such as pharmacy technicians (43 percent compared with 7 percent) and nursing assistants (22 percent compared with 8 percent). In contrast, a higher share of white women apprentices than Black women apprentices trained for higher-paying occupations such as registered nurses (37 percent compared with 10 percent) (Walton, Gardiner, and Barnow 2022).

[15] "Other race" describes non-Hispanic apprentices who reported themselves as Asian, Native Hawaiian or Pacific Islander, Native American, or multiple races.

DOL is making large-scale and ongoing federal investments to expand apprenticeship. Between 2015 and 2023, DOL distributed over $1 billion in apprenticeship grants (Butrica et al. 2023). Many of these investments have an emphasis on the inclusion of people traditionally underrepresented in apprenticeship, including women, people of color, and people with disabilities (Butrica et al. 2023). Although they encourage inclusion, they do not generally require that targeted numbers of underrepresented groups be served. A few grant programs are worth noting here because they do target women or people of color. DOL has awarded Women in Apprenticeship and Nontraditional Occupations (WANTO) grants since 1994, including $3.4 million in 2022, to expand access and support for women in apprenticeships and nontraditional occupations, which are defined as jobs in which women make up 25 percent or less of the total number of workers in that occupation (Pub. L. 102–530, 29 USC § 2501).[16, 17] In 2021, DOL awarded $31 million to establish four Registered Apprenticeship Technical Assistance Centers of Excellence to support the expansion and modernization of apprenticeship and to increase opportunities for women, youth, people of color, rural communities, justice-involved individuals, and people with disabilities.[18]

States are working to expand apprenticeship. In addition to federal investments in apprenticeship, some states are endeavoring to expand and diversify their apprenticeship systems using incentives to engage employers and educational institutions (Harrington et al. 2022; Hauge and Parton 2016; Rosenberg and Dunn 2020; Sattar et al. 2020) and legislation (Hentze, Cesario, and Canada 2019; Hentze and Herman 2021). For example, New Jersey passed a suite of bills in 2020 creating task forces and providing supportive services to diversify apprenticeships so that they are more inclusive of underrepresented populations and people with disabilities (Draeger 2021). The Foundation for California Community Colleges and Community Colleges Chancellor's Office launched the California Apprenticeship Initiative in 2016 to invest in new apprenticeship programs with an explicit focus on equity and advancement for people from underrepresented groups (Parton and Prebil 2020).

[16] Women's Bureau, "WANTO Grant Program," US Department of Labor, accessed December 13, 2022, https://www.dol.gov/agencies/wb/grants/wanto.

[17] Legal Information Institute, "29 U.S. Code § 2501 - Findings; Statement of Purpose," October 27, 1992, https://www.law.cornell.edu/uscode/text/29/2501.

[18] Employment and Training Administration, "US Department of Labor Awards More Than $130M in Grants to Support Registered Apprenticeship Programs; Increase Employment Opportunities," US Department of Labor, June 22, 2021, https://www.dol.gov/newsroom/releases/eta/eta20210622.

Enrollment and Completion of Underrepresented Groups in Construction Apprenticeship

Between 1999 and 2019, the number of new apprentices who were women and people of color increased in construction programs, especially union programs (Bilginsoy et al. 2022). The share of new construction apprentices who were Hispanic workers increased dramatically in both union and nonunion programs, and the share who were women or Black workers increased only slightly in only union programs (Bilginsoy et al. 2022). Still, women and people of color are underrepresented in construction apprenticeship programs, just as they are underrepresented in the construction industry nationally (Bilginsoy et al. 2022; Butrica et al. 2023; Casey 2013; Childers, Hegewisch, and Jackson 2020; Kelly et al. 2022; Petrucci 2021). However, if the utilization of women and people of color in apprenticeship programs is meaningfully or substantively higher than it is in the national workforce of the corresponding occupation, it suggests that scaling or expanding apprenticeship may be a strategy for improving their overall utilization in construction.

Almost half (48 percent) of the active apprentices in 2022 (participating in an apprenticeship at some point during 2022) were registered in construction occupations. **Apprenticeships in construction are themselves concentrated in a few trades, with almost a third of all construction apprentices training to be electricians (31.4 percent). Electricians, together with plumbers (17.4 percent) and carpenters (14.1 percent), made up almost two-thirds (62.9 percent) of all construction apprentices active in 2022.**[19] Almost three quarters (73.7 percent) of construction apprentices active in 2022 were registered in programs lasting three or more years.[20]

This section analyzes data on registered apprentices from the RAPIDS data system to assess the utilization of women and underrepresented racial and ethnic groups in construction apprenticeship programs. It also compares utilization of these workers by apprenticeship programs to utilization for the same groups and occupations in the national workforce, as estimated by Munkacsy and colleagues (2023), who define utilization as the percentage of total workers in an occupation from an identified demographic group. This brief uses that definition to compare utilization in construction apprenticeship

[19] Authors' calculations from RAPIDS.

[20] Authors' calculations from active apprentices in 2022 in RAPIDS.

programs to utilization in national construction occupations. As an example, if 1,000 apprentices were employed in a construction occupation nationally and 40 of those apprentices were women, the utilization rate for women would be 4 percent. Utilization rates for **new apprentices** are for individuals who first registered with programs in 2022. Utilization rates for **active apprentices** in 2022 includes new apprentices as well as those who began in a prior year. New apprentice utilization rates describe the flow into the apprenticeship system, while active apprentice utilization rates describe the stock of apprentices in the system. The distinction is important because new apprentices provide information on recruitment and hiring practices, including potentially discriminatory practices.

Munkacsy and colleagues (2023) also assess the utilization gap for construction occupations, which is defined as the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most like a similar construction occupation in terms of required skills. For example, if the utilization rate for women in a construction occupation is 4 percent, but the utilization rate for a similar set of nonconstruction occupations (identified in 2023 by Munkacsy and colleagues using occupational task data) is 9 percent, the utilization gap would be 5 percent. A larger utilization gap means that, by this measure, there is underutilization of women in that construction occupation.

Data on active apprentices provides information on individuals who are retained in apprenticeship. Appendix tables 1 through 13 show both new and active utilization rates. For reference, these appendix tables also include the total number of apprentices active in each detailed occupation[21] in 2022 and from Munkacsy and colleagues (2023),[22] the corresponding utilization rates for the occupation as a whole and the utilization gap for the occupation.

In many cases in the text we abbreviate detailed occupational codes. For example, we abbreviate "pipelayers, plumbers, pipefitters, and steamfitters" as "plumbers" and "drywall installers, ceiling tile installers, and tapers" to "drywall installers."

[21] Detailed occupations are identified by their four-digit American Community Survey (ACS) occupation code, as in Munkacsy and colleagues (2023), which is comparable with six-digit Standard Occupational Classification Codes.

[22] Utilization rates and utilization gaps from Munkacsy and colleagues (2023) are not provided for appendix tables 8 through 13 because they do not report these data for the intersection of gender and race and ethnic group.

Women in Construction Apprenticeship Programs

In most of the construction occupations (18 out of 23), the share of women apprentices in 2022 was higher than women's share of that occupation nationally in that year (table 1).[23] For example, among electricians, the largest apprenticeable construction occupation, 4.55 percent of active apprentices in 2022 were women compared with only 2.28 percent of the occupation nationally. For plumbers, the next largest apprenticeable occupation, 3.07 percent of active apprentices in 2022 were women compared with 2.19 percent of workers in the occupation nationally. The largest difference in apprenticeship utilization (share of active apprentices) and utilization in the national construction workforce (share of workers in occupation) was for construction and building inspectors, where 18.43 percent of active apprentices were women compared with only 11.34 percent of construction and building inspectors nationally, a 7.09 percentage point difference. Every difference identified in this paragraph is statistically significant, and statistical significance levels for other occupational differences are reported in table 1. Although small, utilization rates for women in apprenticeship programs that are higher than in those of their respective construction occupations nationally suggest that apprenticeship programs are doing a better job of recruiting women into the construction trades than construction companies are in general.

[23] Apprenticeship utilization of women who are new apprentices in construction by occupation are provided in appendix table 1.

TABLE 1

Women's Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices, 2022	Women's Share of Active Apprentices, 2022	Women's Share of All Workers in Occupation
6660-Construction and building inspectors	548	18.43***	11.34 (1.38)
6410-Painters and paperhangers	8,468	9.90***	7.05 (0.38)
6400-Insulation workers	4,088	8.90***	4.67 (1.31)
6305-Construction equipment operators	10,485	8.58***	2.32 (0.30)
6260-Construction laborers	31,746	7.41***	3.32 (0.16)
6210-Boilermakers	3,986	7.10***	2.70 (1.52)
6230-Carpenters	51,658	5.71***	2.13 (0.17)
6530-Structural iron and steel workers	13,016	5.71***	2.71 (0.79)
6600-Helpers, construction trades	1,074	5.21	5.91 (0.97)
6520-Sheet metal workers	16,883	4.61*	4.93 (0.72)
6355-Electricians	115,471	4.55***	2.28 (0.21)
6540-Solar photovoltaic installers	22	4.55	3.25 (1.69)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	3.28***	0.91 (0.39)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	3.07***	2.19 (0.79)
6442-Solar thermal installers and technicians	822	3.04**	1.54 (0.18)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	2.91***	0.87 (0.31)
6240-Carpet, floor, and tile installers and finishers	4,476	2.86	2.90 (0.56)
6710-Fence erectors	39	2.56	2.82 (1.04)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	2.53	2.58 (0.55)
6360-Glaziers	2,822	2.52	2.06 (0.81)
6515-Roofers	8,829	2.38***	1.78 (0.40)
6460-Plasterers and stucco masons	2,855	1.89***	0.73 (0.57)
6700-Elevator and escalator installers and repairers	7,888	1.70	1.65 (1.04)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System RAPIDS. Women's share of all workers in the occupation is from appendix B in Munkacsy and colleagues (2023). The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Notes: Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between women's share of active apprentices and women's share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

The five construction occupations where women have a lower representation in the apprenticeship system than in the national workforce are helpers; sheet metal workers; carpet, floor, and tile installers and finishers; drywall installers, ceiling tile installers, and tapers; and fence erectors (table 1). In all five of these occupations the gap between the apprenticeship utilization rate and the utilization rate for the construction workforce was less than one percentage point and not statistically significant, except for sheet metal workers, where the difference was statistically significant at the 10 percent significance level.s

Comparisons of utilization rates across detailed occupations of widely varying sizes can make it difficult to understand the utilization gap across all construction occupations. The magnitude of the differences in utilization rates across all construction occupations can be illustrated by the difference between the number of women in construction apprenticeship programs[24] and the number of women that would be in those programs if women were represented at the same rate as the women's share of all workers in the occupation.[25] Using this measure, apprenticeship programs employed 87 percent more women than would have been employed if women were represented at rates comparable to their representation in the occupation nationally.

Race and Ethnicity in Construction Apprenticeship Programs

Utilization rates for different race and ethnic groups in 2022 are provided in tables 2 and 3 and in appendix tables 2 through 7. Data on active Black and Hispanic apprentices from appendix tables 3 and 7 are reproduced here in tables 2 and 3 for comparison. Similar to women, 18 of the 23 apprenticeable occupations had a higher share of active apprentices who are Black than Black workers' share of the national workforce in that occupation (table 2). Black apprentices accounted for only 8.05 percent of active electrician apprentices, compared with the 7.03 percent of all electricians reported in Munkacsy and colleagues (2023). This difference in utilization rates was even larger for apprentice carpenters, 11.95 percent of whom were Black, compared with 4.54 percent of carpenters nationally. All these differences are statistically significant. Black apprentices have the highest utilization rates in boilermaker programs, where 14.68 percent of active apprentices are Black, and in brickmason programs, where 14.65 percent are Black. They have the lowest utilization rates in drywall installer apprenticeship programs (4.31 percent) and fence erector apprenticeship programs (2.56 percent).

[24] This is the total number of active apprentices multiplied by the share of active apprentices who are women.

[25] This is the total number of active apprentices multiplied by the share of women in the occupation nationally.

Asian apprentices also had relatively high utilization rates (appendix table 2). Twenty-one of the 23 apprenticeable occupations had a higher share of active apprentices who are Asian than Asian workers' share of the national workforce in that occupation. Asian apprentices had the highest utilization rate in solar thermal installer and technician (7.59 percent) and construction and building inspector (6.71 percent) programs.

Munkacsy and colleagues (2023) found that, on average, the utilization gap in the construction industry is largest for Asian workers, Black or African American workers, workers who identify as multiracial or another race, and white workers. Yet, the higher utilization of Black and Asian workers in apprenticeship programs compared with the national occupational workforces suggests that apprenticeship may be a viable strategy for increasing representation of these workers in the construction industry. Although Black and Asian workers typically have higher utilization in construction apprenticeship programs than they do in the same occupations nationally (appendix tables 2 and 3), Indigenous, multiracial, and white apprentices have lower utilization rates than those identified in Munkacsy and colleagues (2023) for the same occupations (appendix tables 4, 5, and 6). The difference between apprenticeship utilization rates and utilization rates for the construction industry are largest for fence erectors in the case of Indigenous workers, helpers in the case of multiracial workers, and solar thermal installers and technicians in the case of white workers.

TABLE 2

Black Share of Active Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices, 2022	Black Share of Active Apprentices, 2022	Black Share of All Workers in Occupation
6210-Boilermakers	3,986	14.68***	8.50 (2.87)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	14.65***	7.14 (0.91)
6260-Construction laborers	31,746	12.64***	6.63 (0.25)
6230-Carpenters	51,658	11.95***	4.54 (0.25)
6515-Roofers	8,829	11.31***	4.69 (0.67)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	10.42	9.93 (1.72)
6400-Insulation workers	4,088	10.27***	6.49 (1.62)
6530-Structural iron and steel workers	13,016	10.05***	6.15 (1.38)
6442-Solar thermal installers and technicians	822	9.67***	6.77 (0.41)
6410-Painters and paperhangers	8,468	9.17***	4.90 (0.36)
6520-Sheet metal workers	16,883	8.51***	6.93 (1.09)
6355-Electricians	115,471	8.05***	7.03 (0.32)
6360-Glaziers	2,822	7.86***	3.74 (0.97)
6660-Construction and building inspectors	548	7.72	7.72 (1.10)
6600-Helpers, construction trades	1,074	7.26*	8.80 (1.89)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	6.87**	6.63 (1.52)
6460-Plasterers and stucco masons	2,855	6.80***	4.01 (1.47)
6305-Construction equipment operators	10,485	6.68**	6.16 (0.47)
6240-Carpet, floor, and tile installers and finishers	4,476	6.64***	3.51 (0.61)
6700-Elevator and escalator installers and repairers	7,888	5.53	5.89 (1.87)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	4.31***	3.10 (0.60)
6710-Fence erectors	39	2.56	5.22 (1.73)
6540-Solar photovoltaic installers	22	0.00***	8.98 (3.37)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). Share of all workers in the occupation is from appendix B in Munkacsy and colleagues (2023). The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Note: Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Black share of active apprentices and Black share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

The magnitude of the differences in utilization rates for Black workers across all construction occupations can be illustrated by the difference between Black workers in construction apprenticeship programs[26] with the number of Black workers that would be in those programs if they were represented at the same rate as the Black worker share of all workers in the occupation. Using this measure, apprenticeship programs employed 43 percent more Black workers than would have been

[26] This is the total number of active apprentices multiplied by the share of active apprentices who are Black.

employed if Black workers were represented at rates comparable to their representation in the occupation nationally.

Utilization rates for Hispanic apprentices are an intermediate case in the sense that the differences between apprentice utilization and utilization for all workers in the occupation are not as frequently positive as the differences previously discussed for Black and Asian apprentices, and not as negative as those for Indigenous, multiracial, and white apprentices. In 11 of the 23 apprenticeable occupations, utilization of Hispanic apprentices is higher than the utilization of Hispanic workers nationally in those occupations, while in 11 apprenticeable occupations it is lower (Table 3). In the largest apprenticeable occupation in construction, electricians, Hispanic apprentices account for 19.75 percent of all apprentices, which is similar to their share of the electrician workforce nationally (19.60 percent), and not statistically different.

TABLE 3

Hispanic Share of Active Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices, 2022	Hispanic Share of Active Apprentices, 2022	Hispanic Share of all Workers in Occupation
6330-Drywall installers, ceiling tile installers, and tapers	9,980	72.22***	62.64 (2.36)
6460-Plasterers and stucco masons	2,855	65.85	65.05 (4.42)
6710-Fence erectors	39	61.54***	36.97 (4.27)
6600-Helpers, construction trades	1,074	58.81***	38.67 (3.12)
6442-Solar thermal installers and technicians	822	57.16***	23.88 (0.71)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	57.06***	45.90 (2.78)
6540-Solar photovoltaic installers	22	50.00*	29.43 (4.18)
6515-Roofers	8,829	49.65***	53.95 (1.78)
6410-Painters and paperhangers	8,468	44.96***	49.26 (1.18)
6240-Carpet, floor, and tile installers and finishers	4,476	43.45***	47.28 (2.19)
6260-Construction laborers	31,746	36.61***	44.00 (0.56)
6400-Insulation workers	4,088	33.45***	42.42 (3.44)
6360-Glaziers	2,822	32.56***	26.29 (2.77)
6230-Carpenters	51,658	30.6***	34.20 (0.74)
6530-Structural iron and steel workers	13,016	28.09***	22.95 (2.42)
6660-Construction and building inspectors	548	25.81***	12.18 (1.03)
6520-Sheet metal workers	16,883	22.39***	17.24 (1.37)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	21.94***	39.08 (1.69)
6210-Boilermakers	3,986	20.13	20.87 (4.07)
6355-Electricians	115,471	19.75	19.60 (0.46)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	17.00***	29.94 (2.59)
6700-Elevator and escalator installers and repairers	7,888	15.12	14.90 (2.79)
6305-Construction equipment operators	10,485	14.31***	17.80 (0.84)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). Share of all workers in the occupation is from appendix B in Munkacsy and colleagues (2023). The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Note: Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Hispanic share of active apprentices and Hispanic share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

Race, Ethnicity, and Wages in Construction Apprenticeship Programs

Table 4 provides the median starting wages for apprentices in each construction occupation, as well as the share of apprentices active in those occupations who are women, Black, and Hispanic (reproduced from tables 1, 2 and 3). Starting wages are less than or equal to completion wages for apprenticeship programs, with apprentices earning progressively higher wages as they advance through their program. For all construction apprentices who completed their program in 2022, the median starting wage, $17.42, was less than half of the median completion wage, $35.00.[27] Starting wages for construction apprentices who completed their program may not reflect starting wages for all apprentices, so starting wages for all apprentices are provided in table 4. Starting wages are presented but not completion wages because all apprentices have a starting wage, whereas only a nonrandom subset of apprentices who complete their programs have a completion wage.

The data show that there is no consistent relationship between starting wage rates and the share of apprentices who are women, Black, or Hispanic. The apprenticeable occupation with the highest median starting wage, fence erectors, has one of the lowest occupational utilization rates for women and Black workers (2.56 percent for both) and one of the highest utilization rates for Hispanic workers (61.54 percent). Meanwhile, the next highest paying occupation, boilermakers, has the highest Black worker share of all occupations reported (14.68 percent) compared with other occupations for Black workers, a relatively low share of Hispanic workers (20.13) compared with other Hispanic workers, and a low but typical utilization rate for women workers (7.10 percent) compared with other women workers. Analyzed together, the correlation between an occupation's median starting wage and share of women workers is 0.08. The correlation between median starting wage and share of Black workers is –0.12, and the correlation between an occupation's median starting wage and share of Hispanic workers is 0.05. All these correlations are considered low, and none are of statistical significance.

Despite a lack of correlation between median starting wages and representation of women, Black, and Hispanic workers at the occupational level, Camardelle (2023) shows that individual Black apprentices have lower average starting wages ($16) than white apprentices ($18) or Hispanic and Asian apprentices (both $20). Because we establish here that this difference is not mediated by sorting into lower wage occupations, it suggests that the relationship between race, ethnicity, and apprentice

[27] Authors' calculations from RAPIDS. This hourly wage growth is much larger than for occupations outside of construction, where the median starting wage was $17.02 and the median completion wage was $26.44.

wages found by Camardelle (2023) must be driven by the experiences of individual apprentices of color who are either sorted into lower wage programs or assigned lower wages within a program.

TABLE 4

Median Apprenticeship Starting Wages and Utilization of Women Apprentices and Black and Hispanic Apprentices, 2022

Detailed Occupation	Total Active Apprentices, 2022	Median Starting Hourly Wage, 2022	Women's Share of Active Apprentices, 2022	Black Share of Active Apprentices, 2022	Hispanic Share of Active Apprentices, 2022
6710-Fence erectors	39	$28.87	2.56	2.56	61.54
6210-Boilermakers	3,986	$25.69	7.10	14.68	20.13
6700-Elevator and escalator installers and repairers	7,888	$23.51	1.70	5.53	15.12
6305-Construction equipment operators	10,485	$23.31	8.58	6.68	14.31
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	$22.22	3.28	10.42	57.06
6660-Construction and building inspectors	548	$21.98	18.43	7.72	25.81
6260-Construction laborers	31,746	$19.70	7.41	12.64	36.61
6460-Plasterers and stucco masons	2,855	$19.50	1.89	6.80	65.85
6530-Structural iron and steel workers	13,016	$19.19	5.71	10.05	28.09
6330-Drywall installers, ceiling tile installers, and tapers	9,980	$18.98	2.53	4.31	72.22
6240-Carpet, floor, and tile installers and finishers	4,476	$18.94	2.86	6.64	43.45
6230-Carpenters	51,658	$18.91	5.71	11.95	30.60
6515-Roofers	8,829	$18.81	2.38	11.31	49.65
6442-Solar thermal installers and technicians	822	$18.75	3.04	9.67	57.16
6540-Solar photovoltaic installers	22	$18.75	4.55	0.00	50.00
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	$18.70	2.91	14.65	21.94
6600-Helpers, construction trades	1,074	$18.53	5.21	7.26	58.81
6360-Glaziers	2,822	$18.05	2.52	7.86	32.56
6400-Insulation workers	4,088	$18.00	8.90	10.27	33.45
6520-Sheet metal workers	16,883	$17.55	4.61	8.51	22.39
6410-Painters and paperhangers	8,468	$17.53	9.90	9.17	44.96
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	$17.16	3.07	6.87	17.00
6355-Electricians	115,471	$15.00	4.55	8.05	19.75

Source: Apprentice shares and wages are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Apprenticeship Program Completion by Gender and Race and Ethnicity

Apprenticeship is a pathway to mastery of a set of occupational skills, but apprentices must complete their apprenticeship program to be retained in the industry as a journeyperson. Relatively high utilization of women and underrepresented race and ethnic groups in an expanded apprenticeship system will have a reduced effect on the construction industry if those apprentices complete their programs at lower rates than their male and white counterparts.

Analysis of RAPIDS data for apprentices with expected completion rates in 2021 suggests that completion rates for women (35.3 percent) and all people of color in construction programs were lower than for men (43.5 percent) and white apprentices (46.4 percent), respectively. Table 5 provides completion rates through 2022 for a cohort of construction apprentices who were expected to complete their programs in 2021.

TABLE 5

Completion Rates through 2022 for Apprentices Expected to Complete Their Programs in 2021

Category of Apprentice	Completion Rate (%)
All apprentices	43.0
Gender	
Women	35.3
Men	43.5
Race and Ethnic Group	
Asian	44.7
Black or African American	29.4
Hispanic	41.9
Indigenous	33.8
Multiple Race	28.8
Native Hawaiian or Pacific Islander	26.4
White	46.4

Source: Authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS).
Notes: Completion rates are calculated following guidance from US Department of Labor Employment and Training Administration Bulletin 2015-10 and represent the share of apprentices who complete their program within a year of their expected completion date. Data are based on a cohort of 71,973 apprentices with an expected completion date in 2021 who did not cancel their program during a probationary period equal to the lesser of one year or one quarter of the expected length of their apprenticeship.

Women in this cohort had a completion rate of 35.3 percent, compared with 43.5 percent for men. Black apprentices had an even lower completion rate than women (29.4 percent), as did Indigenous

apprentices, apprentices who identified as multiracial, and Native Hawaiian or Pacific Islander apprentices. Although Hispanic and Asian apprentices had higher completion rates than women (41.9 and 44.7 percent, respectively), their completion rates were still lower than white apprentices. All the differences described above are statistically significant at the ten percent level or higher. The completion rate for all construction apprentices, 43 percent, is somewhat lower than the completion rate for all apprentices in RAPIDS for 2014, 46 percent, as reported by the US Department of Labor in Employment and Training Administration Bulletin 2015-10.[34]

Bilginsoy and colleagues' (2022) analysis of construction apprenticeship using RAPIDS data from 1999 to 2019 similarly finds that women had lower completion rates and higher cancellation (i.e., quit or layoff) rates than men, and people of color had lower completion rates and higher cancellation rates than white apprentices.

From interviews with women apprentices, WANTO grantees, and state registered apprenticeship directors, Reed and colleagues (2012) heard that women faced three primary barriers to participating and completing construction apprenticeship programs: incomplete knowledge about skilled trades including the necessary skills and the wage and benefits gains, unrealistic expectations about working in the trades, and harassment and exclusion at male-dominated worksites. In addition, the authors heard from interviewed women that the lack of child care and cost of child care were major challenges for participating in and completing apprenticeships. In their interviews with DOL State Apprenticeship Expansion grantees, Sattar and colleagues (2020) heard reports that the lack of support systems can hurt retention and completion rates for underrepresented groups in apprenticeship programs. Supportive services, including child care, transportation, and work-related tools, and mentoring were suggested strategies for improving program retention and completion.

Apprenticeship Program Completers and Equity in the Onsite Construction Industry

Registered apprenticeship programs utilize women and Black workers at higher rates than the construction industry nationally (tables 1 and 2), and have higher utilization rates of Hispanic workers in certain occupations (table 3). This suggests that an expansion of apprenticeship training may be a strategy for improving the diversity of onsite construction occupations, but it does not provide any

[34] Although the US Department of Labor reports the number apprentices who complete each year, it does not regularly report the completion rate. This completion rate was reported as a part of a data bulletin on calculation of completion rates.

indication of the scale of change that is feasible. Estimating how much the utilization of underrepresented workers in the construction industry would change as a result of an expanded apprenticeship system is not straightforward. Workers of different genders, races, and ethnicities may have different turnover rates, and these turnover rates may vary across occupations. Without data on these labor market dynamics, it is impossible to estimate how increasing the number of new workers accessing jobs through apprenticeship will change the composition of the industry over time.

It is somewhat easier to estimate how utilization rates in new construction hires (as opposed to the stock of all construction workers) would change as a result of an expansion of registered apprenticeship. Projected annual job openings from 2022 to 2032 are provided by the US Bureau of Labor Statistics Occupational Outlook Handbook (table 6). These job openings include both net new jobs and replacements for workers who transfer to different occupations or exit the labor force. Some of these job openings will be filled by apprentices who complete their training. Apprentice completions by occupation in 2022 are presented in table 6. The size of the flow of apprentice completers compared to annual job openings varies by occupation. For example, the 299 apprentices who completed their construction and building inspector apprenticeship represent less than 2 percent of the projected 15,700 annual job openings in that occupation. Apprenticeship is a more common source of new hires for electricians; apprentices who complete an electrician apprenticeship represent 37 percent of projected annual job openings. The impact that registered apprenticeship expansion will have on the construction industry therefore depends on both occupational utilization rates and the importance of apprenticeship in an occupation. Apprenticeship expansion will have a smaller effect on an occupation where apprenticeship is less common.

TABLE 6

Projected Annual Construction Job Openings and Apprenticeship Completions, 2022-2032

Detailed Occupation	Projected Annual Job Openings, 2022–2032	Apprentice Completions, 2022	Apprentice Completions Share of Projected Annual Job Openings (%)
6260, 6600-Construction laborers and helpers	151,400	10,045	6.63
6230-Carpenters	79,500	13,889	17.47
6355-Electricians	73,500	27,221	37.04
6441-Pipelayers, plumbers, pipefitters, and steamfitters	42,600	14,732	34.58
6305-Construction equipment operators	42,300	2,693	6.37
6220, 6250, 6460-All masons and reinforcing iron and rebar workers	21,200	3,936	18.57
6660-Construction and building inspectors	15,700	299	1.90
6515-Roofers	12,200	2,692	22.07
6520-Sheet metal workers	11,400	3,894	34.16
6240-Carpet, floor, and tile installers and finishers	9,800	1,197	12.21
6410-Painters and paperhangers	9,300	2,715	29.19
6330-Drywall installers, ceiling tile installers, and tapers	9,000	3,001	33.34
6530-Structural iron and steel workers	8,100	3,843	47.44
6360-Glaziers	5,500	799	14.53
6400-Insulation workers	4,800	1,026	21.38
6442-Solar thermal installers and technicians	3,500	0	0.00
6540-Solar photovoltaic installers	3,500	2	0.06
6700-Elevator and escalator installers and repairers	2,100	1,599	76.14
6210-Boilermakers	1,100	1,197	108.82

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). Projected annual job openings are from the Bureau of Labor Statistics' Occupational Outlook Handbook, https://www.bls.gov/ooh/construction-and-extraction/home.htm. The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Note: Occupational projections for masons and reinforcing iron and rebar workers are reported collectively for all types of masons, so 6220, 6250, and 6460 are combined for this table. Similarly, occupational projections are reported collectively for construction laborers and helpers, so 6260 and 6660 are combined for this table.

TABLE 7

Utilization of Women Apprentices and Black and Hispanic Apprentices among Apprenticeship Completers, 2022

Detailed Occupation	Apprentice Completions, 2022	Women Share of Apprentice Completions, 2022	Women Share of All Workers in Occupation	Black Share of Apprentice Completions, 2022	Black Share of All Workers in Occupation	Hispanic Share of Apprentice Completions, 2022	Hispanic Share of all Workers in Occupation
6355-Electricians	27,221	4.47	2.28	8.50	7.03	19.55	19.60
6441-Pipelayers, plumbers, pipefitters, and steamfitters	14,732	2.83	2.19	7.58	6.63	16.87	29.94
6230-Carpenters	13,889	5.27	2.13	10.71	4.54	30.53	34.20
6260, 6600-Construction laborers and helpers	10,045	7.15	3.40	11.68	6.70	37.95	43.82
6220, 6250, 6460-All masons and reinforcing iron and rebar workers	3,936	2.65	2.51	11.33	21.08	46.52	
6520-Sheet metal workers	3,894	4.49	4.93	7.47	6.93	21.03	17.24
6530-Structural iron and steel workers	3,843	6.13	2.71	11.22	6.15	23.50	22.95
6330-Drywall installers, ceiling tile installers, and tapers	3,001	2.21	2.58	4.33	3.10	70.31	62.64
6410-Painters and paperhangers	2,715	8.24	7.05	7.68	4.90	50.76	49.26
6305-Construction equipment operators	2,693	7.21	2.32	7.46	6.16	13.18	17.80
6515-Roofers	2,692	2.28	1.78	10.55	4.69	53.60	53.95
6700-Elevator and escalator installers and repairers	1,599	1.06	1.65	5.25	5.89	11.44	14.90
6210-Boilermakers	1,197	7.05	2.70	15.62	8.50	16.21	20.87
6240-Carpet, floor, and tile installers and finishers	1,197	2.10	2.90	7.44	3.51	39.26	47.28
6400-Insulation workers	1,026	7.58	4.67	8.67	6.49	37.82	42.42
6360-Glaziers	799	1.50	2.06	7.38	3.74	28.79	26.29
6660-Construction and building inspectors	299	20.74	11.30	2.68	7.72	96.99	12.18
6540-Solar photovoltaic installers	2	50.00	3.25	0.00	8.98	100.00	29.43
6442-Solar thermal installers and technicians	0	0.00	1.54	0.00	6.77	0.00	23.88

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Notes: Occupational projections for masons and reinforcing iron and rebar workers are reported collectively for all types of masons, so 6220, 6250, and 6460 are combined for this table. Similarly, occupational projections are reported collectively for construction laborers and helpers, so 6260 and 6660 are combined for this table.

The share of apprenticeship completers in 2022 who are women, Black, or Hispanic are provided in table 7. In most occupations, these groups' share of all completers is lower than their share of active apprentices (table 4). Women's share of apprenticeship completers was lower than their share of active apprentices in 16 of 23 detailed occupations. Black workers' share of completers was lower than their share of active apprentices in 14 out of 23 occupations, and Hispanic workers' share was lower in 15 out of 23 occupations. These differences are consistent with the fact that the average completion rates for women are lower than those of men, and that Black and Hispanic workers have lower completion rates than white workers (table 5). Despite these lower completion rates, the representation of female and black completers is still higher than that of the current workforce as shown in most of the trades in Table 7.

No comparable data exist on utilization rates for projected occupational hires or the post-completion experiences of registered apprentices but, by making some assumptions about these data gaps, we can estimate the effect of apprenticeship expansion on utilization rates for new onsite construction jobs. It would be reasonable to assume that before any expansion of the apprenticeship system, the utilization rates for new hires are equal to utilization rates for the total workforce in each detailed onsite construction occupation from Munkacsy and colleagues (2023). Another reasonable assumption is that all apprenticeship completers are employed in their occupation at the time of completion (although they may experience subsequent turnover). Because the utilization rates for new hires who are apprentice completers (table 7) and new hires who are not apprentices differ, we can calculate how the total utilization rates for new hires in the construction industry would change if apprentices made up a larger share of new hires.

Using these assumptions to estimate the effect of apprenticeship expansion, doubling the number of apprentice completers will increase the number of women hired into onsite construction occupations by 12 percent, the number of Black hires by 8.1 percent, and the number of Asian hires by 17.9 percent (table 8). Since we assume that the total number of job openings in construction will remain unchanged, the number of Hispanic, Indigenous, multiple race, and white new hires are estimated to fall.

TABLE 8

Estimated Change in Construction Job Openings Filled as a Result of a Doubling of Annual Apprenticeship Program Completers

Category of Worker	Estimated Change in Annual Job Openings Filled (%)
Gender	
Women	12.0
Race and Ethnic Group	
Asian	17.9
Black or African American	8.1
Hispanic	-1.9
Indigenous	-1.2
Multiple Race	-13.3
White	-2.0

Source: Authors' calculations. Calculations are based on apprenticeship completer data from the Registered Apprenticeship Partners Information Database System (RAPIDS) and projected annual job openings are from the Bureau of Labor Statistics' Occupational Outlook Handbook, https://www.bls.gov/ooh/construction-and-extraction/home.htm. The RAPIDS dataset includes 367,168 apprentices in construction occupations.

Notes: Estimated change in job openings filled are calculated by assuming that utilization rates for projected occupational job openings are the same as utilization rates for occupations nationally, that all apprenticeship occupations double their number of completers at the same occupational utilization rates, and that all apprenticeship program completers obtain a job in their occupation.

These estimates give a sense of the potential for apprenticeship expansion to improve gender and racial equity in construction. The actual change in utilization as a result of an expansion of apprenticeship could be different from table 8 if apprenticeship training grows at different rates in different occupations or if utilization rates in apprenticeship change as apprenticeship training expands. Moreover, utilization rates for the total construction workforce will depend not only on the composition of the flow of new hires, but also on retention and turnover rates for different occupations and workers. For these reasons, occupational projections are always uncertain. However, these estimates suggest that apprenticeship expansion could be a tool for improving gender and racial equity in construction.

Strategies for Improving Apprenticeship Recruitment, Retention, and Completion

This section describes strategies identified in the literature and current initiatives for improving recruitment and retention into apprenticeship—and supporting apprentices to successfully complete programs and become journeypersons.

Pre-apprenticeship Programs as Pathways to Registered Apprenticeship

A pre-apprenticeship program is designed to prepare individuals for entry into apprenticeship. Pre-apprenticeship programs may last from a few weeks to a few months and may or may not include a paid work experience.[35] Although pre-apprenticeship programs vary in their designs and approaches, at their core they aim to help people learn about an industry and related occupations, build occupational and workplace skills, and provide access to employment pathways that include apprenticeship programs.[36] DOL has guidance on the elements of a quality pre-apprenticeship program.[37]

Pre-apprenticeship has roots in diversity. Pre-apprenticeship in construction dates back the 1970s

Box 1. Building Pathways Inc. Pre-apprenticeship Program

In 2011 the Boston Building Trades Union launched Building Pathways Inc. (BPI), a six-week pre-apprenticeship program to increase access to and inclusion in the construction industry for women and people of color.

- BPI delivers rigorous training in skills valued across the construction industry, including construction math, tool recognition and use, measuring, and blueprint reading.
- Training includes hands-on experience on-site.
- BPI actively recruits women who can succeed in construction but who may not have considered a construction job.
- 40 percent of BPI participants are women, 90 percent of participants are people of color.
- Almost 80 percent of BPI graduates have registered as an apprentice or entered industry-related employment.

Source: National Center for Women's Equity in Apprenticeship and Employment (2017).

[35] Apprenticeship USA, "What is Pre-apprenticeship?" US Department of Labor, accessed May 13, 2023, https://www.apprenticeship.gov/help/what-pre-apprenticeship.

[36] Apprenticeship USA, "Explore Pre-apprenticeship," US Department of Labor, accessed May 13, 2023, https://www.apprenticeship.gov/employers/explore-pre-apprenticeship.

[37] Apprenticeship USA, "Explore Pre-apprenticeship," US Department of Labor, accessed May 13, 2023, https://www.apprenticeship.gov/employers/explore-pre-apprenticeship.

when it was used as a strategy to help increase employment opportunities for Black people in the construction trades (Roberts 1970). (See box 1 for an example of a pre-apprenticeship program.) Because pre-apprenticeship exists outside the registered apprenticeship system and is frequently informal, there is little historical documentation of the details of these programs. Today, pre-apprenticeship programs are more frequently the subject of research and evaluation (Butrica et al. 2023). These programs continue to increase knowledge of the trades and other sectors, boost technical skills, and raise awareness about apprenticeship opportunities, especially for young apprentices and people belonging to groups that are underrepresented in apprenticeship and the industries it serves (Gaal 2018; Kelly, Wilkinson, and Nuñez 2019; Lerman and Kuehn 2020; Steva 2017; Wallace 2018; Walton, Gardiner, and Barnow 2022; Worthen et al. 2009).

Pre-apprenticeship programs are more diverse than apprenticeship. In their evaluation of the AAI grant program, Gardiner and colleagues (2021) found that a larger proportion of pre-apprentices than apprentices were from underrepresented populations and that pre-apprentices represented greater diversity in gender, race, and ethnicity than apprentices.[38] In particular, the authors reported that 36 percent of AAI pre-apprentices were women, compared with only 26 percent of AAI apprentices. Recognizing the role that pre-apprenticeship can play in improving diversity in the trades, Illinois started an initiative, the Illinois Works Pre-Apprenticeship Program, designed to create a pipeline for diverse candidates in construction and the building trades.[39]

Mixed evidence on effectiveness of pre-apprenticeship as construction pathway. Although pre-apprenticeship appears to be a promising strategy for increasing diversity in apprenticeship, research on whether pre-apprenticeship leads to starting a registered apprenticeship is mixed.

- A 2009 survey of 236 pre-apprenticeship programs in construction found high completion rates (over half of programs had completion rates higher than 70 percent), but **most construction pre-apprenticeship programs enrolled fewer than 50 percent of graduates in an apprenticeship and more than a third of programs placed less than 25 percent of graduates in registered apprenticeships** (Conway, Gerber, and Helmer 2009).
- One study tracked pre-apprenticeship placement in the construction trades and found that **only 20 to 30 percent of the 77 pre-apprenticeship completers entered registered apprenticeship programs** (Wilkinson and Kelly 2017).
- A longitudinal study of two pre-apprenticeship construction programs with a total of 94 pre-apprentices found that though program completion rates were high (76 and 87 percent), **only a**

[38] Based on a survey of 2,601 AAI apprentices.

[39] "Illinois Works Pre-apprenticeship Program," Illinois Department of Commerce & Economic Opportunity, accessed May 14, 2023, https://dceo.illinois.gov/illinoisworks/preapprenticeship.html.

quarter of participants entered a registered apprenticeship within a year and a half of program completion (Kelly, Wilkinson, and Nuñez 2019).

- An evaluation of the 45 AAI grantees' pre-apprenticeship programs revealed higher rates of entry into registered apprenticeship programs. Among all pre-apprentices who completed their program, 63 percent entered a registered apprenticeship, and another 23 percent took a job in a related field. **Among pre-apprenticeship completers in construction, 84 percent entered a registered apprenticeship and 11 percent took a job in a related field** (Walton, Gardiner, and Barnow 2022). Pre-apprenticeship programs supported by AAI grantees may have seen higher rates of enrollment in apprenticeship among completers because the AAI grantees had targets for apprentice registration, and were therefore incentivized by the grant program to have their pre-apprentices enter an apprenticeship.

Pre-apprenticeship is a pathway into apprenticeship, particularly for women. Although pre-apprenticeship does not lead to apprenticeship for everyone, recent research suggests that it could be a pathway for women more often than for men. Kelly, Wilkinson, and Nuñez (2019) analyzed the Oregon registered apprenticeship data on 94 pre-apprentices and found that **22 percent of white women and 32 percent of women of color apprentices entered construction through a pre-apprenticeship, compared with only 2 percent of men of color and less than 1 percent of white men.** Other analysis found a statistically significant correlation between pre-apprenticeship and completing an apprenticeship for women, but not for men (Kelly et al. 2022). Additionally, interviews conducted with women working in construction found that pre-apprenticeship programs were key to their entry into trades occupations (Wagner and Kulwiec 2020). And a recent survey cited by Hegewisch and Mefferd (2021) reported that **nearly a third of women apprentices had completed a (woman-only) pre-apprenticeship program**.

Lack of standards for pre-apprenticeship may inhibit efforts to increase diversity in apprenticeship. A central problem with pre-apprenticeship is the absence of shared definitions and quality standards (Tieszen et al. 2020). Researchers, advocates, and policymakers are advancing quality frameworks and principles to encourage consistency within and across pre-apprenticeship programs. These quality frameworks are also aimed at increasing the potential of pre-apprenticeship to be a direct pathway into apprenticeship, especially for underrepresented populations.

- Jobs for the Future's (JFF) six-point quality framework calls for clarity around program requirements and the provision of industry-recognized credentials (Jobs for the Future 2019). These elements are consistent with modular program designs organized around competencies that can be learned in flexible ways and continually assessed. The flexibility such programs provide supports caregivers (who are mostly women), people with disabilities, and others with complex needs, schedules, and responsibilities.
- Select WANTO grantees employed modules that can be combined in different ways to customize programs for individuals so that pre-apprenticeship did not function as a barrier to registered apprenticeship but as a strategy for inclusion (Kuehn and Sirois forthcoming). These modules include training in areas such as math skills, occupational skills, and soft skills.

- The Center for Law and Social Policy (CLASP) presents pre-apprenticeship as part of a larger apprenticeship and high-quality pre-apprenticeship model for advancing equity (Tieszen et al. 2020). CLASP's framework (six principles) calls for paid pre-apprenticeships to help women and people from other underrepresented groups persist in these programs, because many are unable to stop paid work while in training.

Program Design of Pre-apprenticeship and Apprenticeship Programs

Another strategy for improving apprenticeship recruitment, retention, and completion is to adopt design program design principles that are associated with higher utilization of underrepresented groups.

Unions play an important role in the diversity of the construction trades. Bilginsoy and colleagues (2022) found that union-based construction apprenticeship programs registered more women and people of color than nonunion programs. **New apprentices in union-based construction programs between 1999 and 2019 comprised: 3.7 percent women, 9.3 percent Black apprentices, 24.1 percent Hispanic apprentices, and 3.1 percent apprentices of other races. In contrast, new apprentices in non-union construction programs comprised: 2.0 percent women, 7.5 percent Black apprentices, 19.6 percent Hispanic apprentices, and 2.9 percent apprentices of other races.** Petrucci (2021) looked at the diversity of construction apprenticeships in the greater Portland area and reported similar findings to Bilginsoy and colleagues (2022). A larger share of women and people of color complete union apprenticeship programs (50 percent of women and 45 percent of people of color) than complete nonunion apprenticeship programs (29 percent of women and 40 percent of people of color). Bilginsoy and colleagues (2022) found that many diversity, equity, and inclusion (DEI) initiatives in union-based construction apprenticeship programs involved partnerships with industry leaders, government agencies, and community-based organizations, the latter being important for identifying, recruiting, and supporting workers from underrepresented groups. In contrast, DEI initiatives in nonunion construction apprenticeship programs were generally less developed.

Women-only training programs may provide a strategy to increase recruitment, retention, and completion in apprenticeship. Training cohorts composed exclusively of women can offer a supportive and comfortable learning environment for obtaining occupational skills and professional development (Chuang 2019)—an important consideration for the construction trades where women consistently report not having been exposed to construction trades until they joined an apprenticeship program. **In a survey of 2,635 apprentice tradeswomen (women working in the construction trades), 18 percent said they learned about the trades through a women's or tradeswomen's organization, and 32**

percent entered an apprenticeship program after completing a women-only pre-apprenticeship program (Hegewisch and Mefferd 2021). A study of the WANTO grants, which support both co-ed and women-only programs, found that the grants increased the probability of women being employed in nontraditional occupations by 5 to 15 percent, or 0.002 to 0.018 percentage points, depending on the regression model (Mastracci 2005). An employment impact of 5 to 15 percent is not trivial, and the effect was statistically significant due to large sample sizes (555,189 and 1,132,173, depending on the model specification), but because few women work in these jobs the percentage point change in employment in nontraditional occupations is small.

Apart from specific skill-building and preparation for entry into registered apprenticeship programs, recent studies point to additional functions that women-only programs could play: providing information, advice, and guidance and peer support and professional networking throughout their apprenticeships and into their careers.

- Kelly and colleagues (2022) found that women who had become apprentices after completing a highway construction pre-apprenticeship program continued to rely on pre-apprenticeship program staff and peer-centered events to navigate difficulties during their apprenticeships and to support them in new professional environments.
- Hegewisch and Mefferd (2021) linked participation in pre-apprenticeship with support, mentorship, and community—and found that 75 percent of the 1,543 surveyed women who reported completing a women-focused pre-apprenticeship indicated it was an important factor in their success in the construction trades.

In addition to helping women navigate the work environment and develop professional relationships, women-only programs were reported to also provide role-models for women early in their careers and prepare them to be leaders in the workplace, in their unions, or within the industry more broadly. Hegewisch and Mefferd (2021) cite the importance of representation reported by women surveyed about their experiences in the trades. During a *Women in Construction Webinar* hosted by the DOL Women's Bureau and the US Department of Transportation Federal Highway Commission, the same point was made by both speakers and attendees who repeatedly asserted "You need to see it to be it."[40]

[40] "Women in Construction Webinar," hosted by the US Department of Labor Women's Bureau and the US Department of Transportation Federal Highway Commission, March 21, 2023, https://www.dol.gov/agencies/wb/events/03212023/women-construction-webinar.

Supportive Services

Providing supportive services is another strategy for increasing apprenticeship recruitment, retention, and completion. These services may include referrals to community services, transportation assistance, child care and dependent care assistance, housing assistance, need-related payments, educational testing assistance, reasonable accommodations for individuals with disabilities, legal aid services, health care referrals, assistance with work-related expenses (e.g., uniforms, tools, protective gear) and education-related expenses (e.g., books, fees, school supplies), and payments and fees for employment and training-related applications, tests, and certifications.[41]

Supportive services may increase recruitment and retention in apprenticeship through program completion as shown in these examples.

- The weekly stipend offered to participants in a construction pre-apprenticeship program was considered by staff and participants to be the most important of several support services, and may have improved registered apprenticeship placement for that program compared to a similar program without the stipend (Worthen and Haynes 2009).
- One study using Oregon Apprenticeship System data found that receiving social supportive services (e.g., mentorship, support hours, and social hours) had a positive effect, even larger than the effect of financial supportive services, on the odds of apprentices completing their program (Kelly, Wilkinson, and Nuñez 2019).[42]
- One study of 5,457 apprentices in construction found that supportive services[43] had a positive association with apprenticeship completion (Kelly et al. 2022). Nonfinancial services were associated with a 20 percent increase in the likelihood of completion, child care was associated with a 15 percent increase in likelihood of completion, ready items were associated with a 13 percent increase in likelihood of completion, and gas or travel support was associated with a 5 percent increase in likelihood of completion.

Supportive services can be particularly important for addressing the needs of traditionally underserved populations programs (Walton and Gardiner 2022). Among apprentices in the AAI program, women and people of color reported personal or family problems as reasons for not completing their apprenticeship programs more often than men and white apprentices—54 percent of women compared with 33 percent of men, and 46 percent of Black and 54 percent of Hispanic

[41] This list of supportive services is provided in 20 CFR § 680.900 and describes the range of supportive services provided under the Workforce Innovation and Opportunity Act (WIOA) for participants in training and other workforce development programs.

[42] Survey respondents were asked "What kinds of ongoing support have you received from your pre-apprenticeship program?" The authors grouped responses into social supportive services and financial supportive services.

[43] Supportive services included nonfinancial services (such as a budget class, mentoring, and referrals to other services), job readiness supplies (such as work tools, work clothing, and personal protective equipment for first-year apprentices), travel assistance (gas, hotel, and food), and child care subsidies.

apprentices compared with 35 percent of white apprentices (Walton, Gardiner, and Barnow 2022).[44] An evaluation of 231 Oregon apprentices found that nonfinancial services and hardship funds had a larger association with completion for women and people of color than for white men (Kelly 2022).

Recognizing the importance of supportive services for underrepresented populations, the city of Buffalo, New York provided employer shuttle buses, bus passes, and app-based driver platforms to address limited public transit access to jobs and training opportunities for many Buffalonians as of 2018 (Johansson 2019). In 2021, New Jersey passed a suite of bills creating task forces and providing supportive services to diversify apprenticeships so that they are more inclusive of underrepresented populations and people with disabilities (Draeger 2021).

Child Care Assistance

Child care assistance (e.g., subsidies, onsite child care, or referrals to program partners providing affordable child care or child care during nonstandard hours) is another supportive service that pre-apprenticeship and apprenticeship programs can provide to improve recruitment, retention, and completion of parents—especially women, who often undertake primary child care responsibilities in their families (Drago 2009; Yavorsky, Qian, and Sargent 2021). It is not known what share of pre-apprentices or apprentices nationally are parents, but in their survey of 1,543 tradeswomen, Hegewisch and Mefferd (2021) found that parenting was common. Fifty percent of tradeswomen surveyed had children younger than age 18, 22 percent had children younger than age 6, and 25 percent were single mothers raising kids under age 18. These women likely face many of the same child care challenges as other working parents (Drago 2009; Yavorsky, Qian, and Sargent 2021).

Reed and colleagues (2012) found that women participating in registered apprenticeship programs reported that the cost of child care made participating in the program a challenge. In a descriptive study of WANTO grants, one grantee staff member expressed their belief that child care assistance is one of the most effective supportive services in helping participants (Butrica and Sirois forthcoming). **One example supporting this is the Moore Community House Women in Construction pre-apprenticeship program, which saw its enrollment nearly triple (from around 60 to 180 women per year) after adding child care services** (Johnson and Spiker 2018). **Additionally, a recent evaluation of Oregon's highway construction workforce development program found that child care subsidies were associated with a**

[44] Based on a survey of 2,601 AAI apprentices.

higher likelihood of completing apprenticeships—37 percent for white men and 21 percent for women and people of color (Kelly 2022).

Beyond its cost, the difficulty of coordinating child care with job schedules can make apprenticeship retention and completion a challenge. Reed and colleagues (2012) also found that women participating in registered apprenticeship programs reported that lack of child care and disproportionate child care responsibilities, especially when resulting in tardiness or absenteeism, made participating in the program a challenge. More than a decade after the Reed et al. (2012) study, managing both child care responsibilities and work was still reported to be a challenge for women in apprenticeship and employment (Butrica and Sirois forthcoming). Parents who work in construction—especially single parents and women who maintain greater responsibility for family care—can face additional challenges accessing care during nontraditional or irregular hours commensurate with construction schedules or in different locations as job sites change. In the same descriptive study of WANTO grants, Butrica and Sirois (forthcoming) heard from one grantee staff member that "most people who are successful [in the program] have someone doing at least part of the child work [e.g. child care]."

Recognizing this, the state of Oregon has two initiatives to help workers in the construction trades with child care costs. The Pre-Apprenticeship Child Care Initiative subsidizes child care costs for individuals enrolled in pre-apprenticeship programs in the construction trades (Hegewisch 2020) and the Apprentice-Related Child Care provides up to $2,500 per child per month to support workers in apprenticeship programs (Hegewisch 2020).[45, 46] Additionally, one initiative in Massachusetts is trying to help with child care for parents who work nonstandard hours. Care that Works is a coalition of community groups and labor unions that offers a nonstandard-hour child care pilot program. The program matches parents in the trades with licensed child care providers in Boston who open as early as 5 a.m. to accommodate workers in industries with nonstandard schedules, such as construction.[47]

[45] Susan Goldenson, Vanessa S. Flynn, Judith Goodstein, and David Brenner, "Recruiting and Retaining Women in the Building Trades," *The Segal Group*, September 7, 2022, https://www.segalco.com/consulting-insights/recruiting-and-retaining-women-in-the-building-trades.

[46] Rebecca Gale, "How Child Care in Oregon is Saving the Construction Trade: Statewide Apprenticeship Program with Generous Child Care Subsidies Also Trains and Recruits Workers," *Early Learning Nation*, January 30, 2023, https://earlylearningnation.com/2023/01/how-child-care-in-oregon-is-saving-the-construction-trade/.

[47] Susan Goldenson, Vanessa S. Flynn, Judith Goodstein, and David Brenner, "Recruiting and Retaining Women in the Building Trades."

Workplace Practices

Workplace cultures that do not eliminate unfair workplace practices, discrimination, and harassment may make apprenticeship retention and completion a challenge. In a recent survey, tradeswomen reported never or rarely ever being treated equal to men in various aspects of their apprenticeship, including unequal treatment with respect to safety (13 percent), hours of work (13 percent), access to overtime (16 percent), use of tools (16 percent), hiring (18 percent), respect (19 percent), on-the-job training (19 percent), work assignments (22 percent), layoffs (26 percent), leadership development (30 percent), and promotions (31 percent). Women in union apprenticeship programs studied by Childers, Hegewisch, and Jackson (2020) report unequal distribution of overtime assignments. **Additionally, the survey revealed that 44 percent of apprentices left or considered leaving the trades and that more than half of these women cited harassment and lack of respect** (Hegewisch and Mefferd 2021).

Vicki O'Leary, an ironworker and member of the Ironworkers International union, led successful campaigns to provide paid leave benefits for pregnant women and new mothers and to encourage coworkers to not be bystanders to workplace harassment.[48] Women in the labor movement have also led efforts to influence the behavior of their male colleagues to combat harassment on the job. For example, O'Leary spearheaded the "Be That One Guy" initiative, which teaches and encourages men in the trades to speak up when they see other men harassing women on the job. The premise of "Be That One Guy" is that women in the trades face professional and personal risks when they confront harassment and can benefit from being backed up by their male colleagues.[49]

Construction Apprenticeship Programs with High Utilization of Women

Another way to identify promising strategies and models for improving utilization of underrepresented groups in construction is to look at the characteristics of apprenticeship programs in construction with high utilization rates. For the analyses in this section, we examine programs with high utilization rates of

[48] Ironworkers International, "ENR Honors Woman for Work in Preventing Workplace Harassment," *PR Newswire*, January 15, 2019, https://www.prnewswire.com/news-releases/enr-honors-ironworker-woman-for-work-in-preventing-workplace-harassment-300778701.html.

[49] "Be That One Guy: Ironworkers Leading the Industry in Diversity and Inclusion," *The Ironworker*, September 2018: 4–6, https://lsc-pagepro.mydigitalpublication.com/publication/?i=526730&article_id=3189415&view=articleBrowser.

women.[50] To identify program features associated with a high utilization of women, table 9 divides the 2,822 construction apprenticeship programs in RAPIDS with 10 or more active apprentices in 2022 into two groups:

- **High utilization programs**, in which 10 percent or more of their active apprentices in 2022 were women, and
- **Low utilization programs**, in which less than 10 percent of their active apprentices in 2022 were women.

Construction apprenticeship programs with the highest share of women apprentices were programs operating in women-only correctional facilities, including the West Tennessee State Penitentiary's carpentry program and the Kentucky Correctional Institution for Women's electrician program. Apprenticeship programs for people involved in the justice system are an understudied part of the registered apprenticeship system, but they train thousands of apprentices each year (Hecker and Kuehn 2019). Private companies registering the highest share of women include the Empire State Highway Contractor Association's construction laborer program (75 percent women) and the Ingalls Pipe Insulator Joint Apprenticeship and Training Committee insulation workers program (73 percent)—a nonunion and union program, respectively.

Most construction apprenticeship programs with 10 or more apprentices (2,450 programs or 87 percent) were low utilization programs. The average utilization rate of women for these low utilization programs was 3 percent, compared with an average of 19 percent for the 372 high utilization programs. Average program size did not differ substantially between high utilization programs, which had an average of 124 apprentices active in 2022, and low utilization programs, which had an average of 126 active apprentices.

[50] We do not show the same US analysis for Black, Hispanic, and Asian apprentices because variation across the country in the utilization of people of color in apprenticeship is likely to be influenced by geographic differences in the populations of white, Black, Hispanic, and Asian workers. This is unlikely to be the case for women.

TABLE 9

Characteristics of Construction Apprenticeship Programs by Utilization of Women in 2022

	High Utilization of Women (10 Percent or More of Apprentices)	Low Utilization of Women (Less than 10 Percent of Apprentices)	All Programs
Average number of active apprentices	124	126	126
Women's share of active apprentices	19%***	3%	5%
Union program (percent)	65.9%***	54.3%	55.8%
Multiemployer program (percent)	64.1%	67.9%	67.5%
Average length (hours)	6,512***	7,444	7,326
Median starting wage (dollars)	$17.00**	$16.18	$16.27
Total number of programs	372	2,450	2,822

Source: Authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS).
Notes: Apprenticeship programs are defined as unique combinations of a sponsor and an apprenticeable occupation. Some sponsors operate multiple occupational programs and these are counted as different apprenticeship programs. Characteristics are only reported for programs with 10 or more apprentices. Asterisks indicate whether differences between programs with high and low utilization of women are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

A larger share of high utilization programs than low utilization programs are sponsored by unions (65.9 percent compared with 54.3 percent). This is consistent with Bilginsoy and colleagues' (2022) finding that union sponsored construction apprenticeship programs recruit and retain more women than nonunion programs. Using a standard 2,000-hour-work year, high utilization programs were approximately six months shorter in length than low utilization programs (6,512 hours compared with 7,444 hours) and had median starting wages that were $0.82 higher than low-utilization programs ($17.00 compared with $16.18).

Emerging Opportunities for Utilization of Underrepresented Groups in Construction through Apprenticeship

Opportunities exist in both the public and private sectors to increase participation in construction apprenticeship leading to sustaining careers in the construction for women and people of color. Most of these initiatives lack impact studies; the effects of these efforts warrant further research. Although not all the opportunities discussed below focus on underrepresented groups, their dedication to equity and registered apprenticeship could improve representation and equity in construction.

Emerging Federal Opportunities

At the federal level, investments in infrastructure that will create new construction jobs and that promote equity have the potential to improve the utilization of underrepresented groups in construction through apprenticeship.

New federal infrastructure investments create opportunities for increasing diversity in construction through apprenticeship. Over the next decade, there may be a significant boost in construction jobs resulting from infrastructure spending across the federal government. The Infrastructure Investment and Jobs Act (IIJA) includes $550 billion in new federal support for infrastructure—roads, highways, ports, bridges, and broadband—and includes prevailing wage provisions[51] to ensure the 800,000 planned construction and construction-adjacent jobs (i.e., similar occupations) supported by the bill are good-paying jobs. Federal investment in recovery, renewable energy, and climate technologies through the $700 billion Inflation Reduction Act (IRA) promise to support job growth in sectors where apprenticeship is a traditional training strategy or an emerging one. The **Creating Helpful Incentives to Produce Semiconductors and Science (**CHIPS) **act** invests $280 billion in the US semiconductor industry. New facilities envisioned under the act will support the creation of another 120,000 construction jobs. Each of these federal initiatives and the programs they support offer opportunities to

[51] "Protections for Workers in Construction under the Bipartisan Infrastructure Law," US Department of Labor Wage and Hour Division, accessed May 24, 2023, https://www.dol.gov/agencies/whd/government-contracts/protections-for-workers-in-construction.

increase the number of women and people of color entering the construction sector through apprenticeship.

Policy support for equity in federal programs is another way to increase diversity in construction. Equity has been elevated as a government-wide priority through the President's executive orders on advancing diversity and equity,[52] which mandate agency equity assessments and contracting provisions, and establish expectation for cross-agency data equity. The Executive Order on Tackling the Climate Crisis[53] directs the federal government to ensure that 40 percent of the overall benefits of relevant federal investments accrue to disadvantaged communities—an initiative known as the Justice 40 Initiative.[54] All these executive orders create incentives for federally funded programs—including apprenticeship—to design and prioritize equity in their implementation. In turn, federal agencies are launching their own initiatives—such as the Department of Commerce Million Women in Construction Initiative[55] and Department of Labor's Apprenticeship Ambassador Initiative[56]—that encourage states, industry associations, labor unions, and communities to support advancing equity in their own activities.

[52] President Biden signed the "Executive Order on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government" on January 20, 2021, the "Executive Order on Diversity, Equity, and Inclusion in the Federal Workforce" on June 25, 2021, and the "Executive Order on Further Advancing Racial Equity and Support for Underserved Communities through the Federal Government" on February 16, 2023, The White House, accessed May 25, 2023. Each of these reaffirmed and further specified the administration's commitment to equity and the expectation for government actions to advance it.

[53] President Biden signed the "Executive Order on Tackling the Climate Crisis at Home and Abroad" on January 27, 2021, The White House, accessed on May 25, 2023, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

[54] "Justice40: A Whole-of-Government Initiative," The White House, accessed May 25, 2023, https://www.whitehouse.gov/environmentaljustice/justice40/.

[55] The initiative aims to double the number of women in the construction trades—from one million to two million over the next decade. See "Secretary Raimondo Calls for More Women in the Construction Industry at NABTU Tradeswomen Build Nations 2022 Conference," US Department of Commerce, accessed May 23, 2023, https://www.commerce.gov/news/blog/2022/10/secretary-raimondo-calls-more-women-construction-industry-nabtu-tradeswomen-build.

[56] See "Apprenticeship Ambassador Initiative," US Department of Labor, accessed May 14, 2023, https://www.apprenticeship.gov/apprenticeship-ambassador-initiative. Also see "Fact Sheet: Biden–Harris Administration Launches the Apprenticeship Ambassador Initiative to Create Equitable, Debt-Free Pathways to High-Paying Jobs," The White House, accessed May 14, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/01/fact-sheet-biden-harris-administration-launches-the-apprenticeship-ambassador-initiative-to-create-equitable-debt-free-pathways-to-high-paying-jobs/.

Emerging State and Local Opportunities

States and localities are expanding apprenticeship opportunities through legislation, marketing and outreach, integrated academic and work-based programs, and school-based pathways.

States are passing legislation to support apprenticeship. To complement federal efforts, many states have passed legislation with the goal of increasing participation in apprenticeship. California, Maine, Oklahoma, and Washington have all used legislation to encourage expansion, amend funding allocations or formulas, formally assign (or reassign) administrative responsibility for apprenticeship, or some combination (Council of State Governments 2021). Many of these laws were not implemented immediately (or lacked tracking mechanisms in the short term). For example, Indiana mandated a work-based learning requirement for high school students in 2017 that took effect in 2022–23.[57]

Some states invested in professional branding, marketing, and outreach strategies to increase awareness about apprenticeship. States have invested in professional branding in different ways—through research (e.g., into public perception), developing logos, and designing specific stakeholder engagement strategies. South Carolina has developed comprehensive, widely recognized brands for apprenticeship called Apprenticeship Carolina.[58] These brands, tools, and outreach strategies also mean that apprenticeship can be found more easily and trusted more readily—by young people and by women who otherwise tend to learn about the trades "accidentally" (Hegewisch and Mefferd 2021).

School-based career pathways could increase low awareness about construction apprenticeship among young people and improve diversity in the construction industry. *Interview and focus group research with apprentices, parents, and apprenticeship practitioners* suggests that overall awareness of apprenticeship among students and parents is low, and that youth do not link apprenticeship to the trades as closely as their parents do. On the contrary, young people were open to the idea of apprenticeship and wanted to learn more (Parton 2017). As states have expanded apprenticeship programs focused on youth, researchers have pointed to the need to engage students in career exploration and work-based learning earlier in their academic careers (Loprest, Spaulding, and Nightingale 2019). This means that career and college counseling and support typically available in high schools and community colleges may need to

[57] A list of frequently asked questions about implementation is available on the state website. See "Graduation Pathways Frequently Asked Questions," Indiana State Board of Education, accessed May 22, 2023, https://www.in.gov/sboe/files/Graduation-Pathways-Frequently-Asked-Questions.final.pdf.

[58] Apprenticeship Carolina, "Apprenticeship Carolina," SC Technical College System, accessed May 22, 2023, https://www.apprenticeshipcarolina.com/.

begin much earlier[59] so that students have time to explore different career pathways. Efforts that engage students and parents well before college and career choices are made can be challenging to identify and evaluate because they are typically small scale, school- or camp-based, and outside the view of apprenticeship program staff. Nonetheless, federal support for pre-apprenticeship, apprenticeship, and work-based learning has prompted states to revisit the provision of career education (Sattar et al. 2020).

The US Department of Education as well as state and local education agencies have recently renewed interest in career and technical education (CTE)[60] and youth apprenticeship as a supplement to CTE (Katz and Elliott 2020; Kreamer et al. 2017; Lerman, Kuehn, and Shakesprere 2019; US Department of Education 2021). States like Colorado, Georgia, Kentucky, Maryland, and North Carolina and private foundations such as the Richard M. Fairbanks Foundation have also invested in youth apprenticeship (Baddour and Hauge 2020; Fiddian-Green 2020; Lerman, Kuehn, and Shakesprere 2019). In addition, Iowa updated its Work-Based Learning Guide in 2022, offering educators a continuum approach to career education and toolkits for activities in student awareness, information, preparation, and training (Iowa Department of Education 2022). Early programming may generate awareness of and interest in the construction trades at young ages, prompting greater interest in pre-apprenticeship and apprenticeship.

Emerging Private Sector Opportunities

The private sector also has opportunities to improve diversity in construction apprenticeship and in the construction industry through sector, industry, and workplace interventions, public–private agreements that include target numbers or percentages for apprentices, and apprenticeship programs for jobs in emerging sectors.

Sector, industry, and workplace interventions to improve workplace inclusion and equity are being developed and adopted. Along with social and political movements around equity (#MeToo,[61]

[59] The Vermont Agency of Transportation and Rhoni Basden (Works4Women) spoke to this issue in a "Women in Construction Webinar," hosted by the DOL Women's Bureau and the US Department of Transportation Federal Highway Commission, March 21, 2023, https://www.dol.gov/agencies/wb/events/03212023/women-construction-webinar.

[60] The Department of Education defines CTE as high school courses and postsecondary programs that focus on the skills and knowledge required for specific jobs or fields of work. See "About CTE Statistics," National Center for Education Statistics, accessed February 26, 2023, https://nces.ed.gov/surveys/ctes/about.asp.

[61] "Me Too," accessed November 18, 2023, https://metoomvmt.org/.

#BlackLivesMatter,[62] etc.), new approaches to workplace inclusion and equity have been developed and adopted by firms and industries. Tools like the National Taskforce on Tradeswomen's Issues framework for promoting equity and inclusion in the trades,[63] job quality standards, strategies that support diversity, equity, inclusion, accessibility, belonging, and anti-bias and implicit bias training are all examples of interventions with the potential to mitigate harassment and discrimination in the construction sector and on construction sites (Hegewisch and Mefferd 2021). Understanding how and whether these tools make a difference in attracting and retaining women and people of color in construction is another area of potential future study.

Public–private agreements with apprenticeship targets are tools for increasing diversity in construction. Public–private partnerships that include community benefit agreements, local hiring agreements, or project labor agreements are supported by IIJA, IRA, and CHIPS, and are a requirement of some grants. Although such agreements are not without precedent, the frequency and emphasis in such large-scale contracting is relatively new.[64] These incentives and requirements are manifesting in new and creative agreements and targets for apprenticeship utilization and workforce diversity (Hegewisch and Mefferd 2021; Walter 2022). The National Taskforce on Tradeswomen's Issues framework, for example, calls for 20 percent utilization of women and people of color on publicly funded infrastructure projects.[65] And Salt Lake City set a minimum target of 10 percent for the share of workers on publicly funded projects who must be apprentices (Walter 2022). Assessing the contexts and elements of agreements that result in more women and people of color in construction apprenticeship and a greater share of underrepresented groups working in the sector is not only a potential topic of study, but also a policy opportunity to require that women and people of color be equitably represented in the construction industry.

Apprenticeship programs can be used to structure training for redesigned or new jobs in emerging sectors, such as renewable energy. Many of the jobs required to transition to a renewal energy economy and adapt infrastructure for more extreme climates are in construction or construction-adjacent

[62] "Black Lives Matter," accessed November 18, 2023, https://blacklivesmatter.com/.

[63] "The National Taskforce on Tradeswomen's Issues' Framework for Promoting Equity and Inclusion for Women and People of Color Working in the Trades on Publicly Funded Infrastructure Projects," Women's Equity Center, accessed April 25, 2023, https://womensequitycenter.org/wp-content/uploads/2021/03/TWTF-Infrastructure-Equity-Framework-FINAL.pdf.

[64] Zhavoronkova and Walter (2023) conducted an analysis of Notice of Funding Opportunity (NOFO) releases from IIJA-funded agencies and found that 54 of 78 documents—69 percent—contained language incentivizing proposals that address job quality, equity, and/or workforce training goals.

[65] "The National Taskforce on Tradeswomen's Issues' Framework for Promoting Equity and Inclusion for Women and People of Color Working in the Trades on Publicly Funded Infrastructure Projects."

occupations (McGinn and Schneer 2019). Some are new, while others are substantially altered because of new materials, technologies, or regulations (e.g., combustion engine automotive technician versus electric vehicle technician). Apprenticeship provides the opportunity to create new jobs and the training they require in tandem. For startups or emerging sectors, apprenticeship can help embed knowledge within the company through mentoring that the apprenticeship model requires.[66]

One example is a renewable energy company in Maine that has embraced apprenticeship as the primary training model for five occupations. The company has found that women appreciate the apprenticeship model and apprenticeship generally. It has leaned into its mission—to solve environmental problems and alleviate social and economic injustice—launching successful, mission-centered marketing campaigns to recruit hard-to-fill positions including those in the construction trades. The company also cited the benefits of apprenticeship on company culture. Senior management, the marketing department, solar installers, and EV technicians are some of the employees involved in apprenticeship—across five registered occupations. Staff report a positive effect on morale and company-wide appreciation for learning, with women citing the potential for increasing diversity (Wolff et al. 2023).

[66] "What is a Registered Apprenticeship Program?" US Department of Labor, accessed November 18, 2023, https://www.apprenticeship.gov/employers/registered-apprenticeship-program.

Construction Apprenticeship Data Gaps

Data collection on apprentices in the US is tied closely to the needs of federal and state agencies in operating the registered apprenticeship system and balancing those needs against the data collection burden placed on apprenticeship sponsors.[67] As a result, some information that would be valuable for research, evaluation, and policy planning is not currently tracked or measured in a standardized way. Future research and investments in federal and state data infrastructure focused on filling these gaps can support decisionmaking to advance equity in apprenticeship and in the construction industry. Major data gaps include:

- **Pre-apprenticeship data:** In the US, pre-apprenticeship programs that provide individuals with basic occupational skills to prepare for success in apprenticeship programs are not registered or regulated. As a result, there is no comprehensive or standardized data collection on these programs. Pre-apprenticeship programs are a recruitment source for some apprenticeship programs, but additional data are required to assess how common it is to enter an apprenticeship from a pre-apprenticeship program and outcomes for apprentices who started in a pre-apprenticeship program.
- **Unregistered apprenticeship data:** It is estimated that almost half of apprentices take part in unregistered apprenticeships (Collins 2019). These programs use a similar earn-and-learn model as registered apprenticeship programs but do not go through the same registration process or DOL review process for apprenticeship standards. For this reason, unregistered apprenticeship programs have similar data gaps as pre-apprenticeship programs. Unlike registered apprenticeships, for example, unregistered apprenticeships are not tracked in RAPIDS.
- **Apprentice recruitment source**: Administrative data on apprentices do not include where the apprentice was recruited or referred from, or any pre-program activities of the apprentice. Information on how an apprentice was recruited can help to identify barriers to equitable and inclusive employment practices and new possibilities for utilization of underrepresented groups.
- **Postprogram outcomes**: Administrative data on apprentices do not include any postprogram outcomes, such as retention with an employer after the apprenticeship or long-term earnings. Postprogram outcomes are essential for tracking whether underrepresented groups who participate in apprenticeship programs connect to good jobs.
- **Inaccessible personal identifiable information (PII)**: Tracking apprenticeship postprogram outcomes could be possible using PII to match apprentice data with employment and earnings data from state workforce agencies. However, inaccessible PII and the difficulty in obtaining data sharing agreements with state agencies limits the ability to connect apprentice data with outcomes.

[67] The federal government tracks data on registered apprentices using the Registered Apprenticeship Partners Information Database System (RAPIDS). For more information about RAPIDS, see Apprenticeship USA, "What is RAPIDS?" US Department of Labor, accessed November 18, 2023, https://www.apprenticeship.gov/help/what-rapids. See Butrica and colleagues (2023) for more discussion of issues related to data and performance management systems for apprenticeship.

Conclusion

In April 2023, the construction industry recorded 4.1 percent unemployment (table A-14, US Bureau of Labor Statistics 2024)—the lowest rate among job seekers with construction experience in the 23 years on record.[68] Fifteen thousand construction jobs were added that month, totaling 7.9 million at an average wage of nearly $34 per hour.[69] The construction industry offers well-paying jobs and careers. However, women, who comprise 46.8 percent of the total workforce (US Bureau of Labor Statistics 2023a) but only 3.3 percent workers in construction (Munkacsy et al. 2023), are vastly underrepresented in these jobs. Black workers, Indigenous workers, and workers with disabilities are also underrepresented in the sector. Because apprenticeship is a traditional pathway into these jobs and careers, examining its potential for increasing diversity—through more inclusive program designs, support services, and workplace interventions that have shown promise, as described in this report—may point to effective strategies for increasing diversity and representation in the construction trades.

Apprenticeship programs in the construction sector generally employ more women (table 1) and Black workers (table 2) than is the case for the construction sector nationally, although the comparative racial and gender equity of apprenticeship varies by detailed occupation. Across all detailed construction occupations, apprenticeship programs employed 87 percent more women than would have been employed if women were represented at rates comparable to their representation in the total workforce. Similarly, across all detailed construction occupations, apprenticeship programs employed 43 percent more Black workers than would have been employed if Black workers were represented at rates comparable to their representation in the total workforce.

Three factors suggest that further research is an urgent priority:

- The federal government has been investing in efforts to increase apprenticeship among traditionally underrepresented individuals for many years. In 2015, the American Apprenticeship Initiative grant program and subsequent federal apprenticeship expansion grants have explicitly prioritized diversity, equity, inclusion, and accessibility. This emphasis on equity has been strengthened since 2021 with the President's executive order on advancing diversity and equity.[70] Studying funded programs may generate new evidence about what

[68] "Construction Firms Add 15,000 Jobs in April as Sector's Unemployment Rate Hits Record Low for the Month," Associated General Contractors of America, May 5, 2023, https://www.agc.org/news/2023/05/05/construction-firms-add-15000-jobs-april-sectors-unemployment-rate-hits-record-low-month-firms.

[69] "Construction Firms Add 15,000 Jobs in April as Sector's Unemployment Rate Hits Record Low for the Month."

[70] President Biden signed the "Executive Order on Diversity, Equity, and Inclusion in the Federal Workforce" on June 25, 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/06/25/executive-order-on-diversity-equity-inclusion-and-accessibility-in-the-federal-workforce/.

works to boost inclusive apprenticeship drawn from a robust sample of programs across the country and spanning different construction and construction-adjacent sectors.

- Large-scale federal investments in infrastructure, energy, and the semiconductor industry will increase the demand for construction workers. Much of this funding encourages diversity and inclusion, the use of apprenticeship, or both. This should create incentives for construction employers to boost efforts to recruit, retain, and advance women, people of color, and other underrepresented groups. Again, because the scale of these investments is so large and the geographic range so great, examining the programs and outcomes in this context could reveal promising innovations or suggest generalizable findings not evident in single-program reviews or evaluations.
- Although we lack sustainable, universally accessible models for delivering high-quality pre-apprenticeship programs and child care, current federal policy has created incentives for both through past grant and contract programs, and especially the new Apprenticeship Building America grant program, which targets funding for pre-apprenticeship programs that lead to registered apprenticeship. Federal policy provides opportunities to document and examine new business models and scaling strategies so we can do more of what works.

In the near term, we can expect continued experimentation rather than the implementation of any single approach or model for increasing diversity in construction apprenticeship. The following are important questions and considerations:

- **A new baseline for participation in apprenticeship.** Will the growth in apprenticeship in nonconstruction occupations result in more equitable participation in apprenticeship for underrepresented groups? Will growth in nonconstruction occupations reduce the stereotype that apprenticeship is better suited to white men than to women and people of color, prompting them to consider apprenticeship training in construction and other fields?
- **New pathways into apprenticeship**. Will expanded career and technical education, pre-apprenticeship, and youth apprenticeship programs help normalize apprenticeship, making it a desirable alternative to post-secondary education for students of all backgrounds? Will such a shift expose more women and people of color to construction apprenticeship? Will women and people of color see construction as a viable career option?
- **A preferred training model for emerging occupations**. Will companies in technology, renewable energy, and construction (and construction-adjacent) industries use apprenticeship training for new and emerging occupations that might be more attractive to women and people from underrepresented groups and communities?

Because apprenticeship programs take years to complete, efforts to evaluate current programs and their full range of employment outcomes warrant thoughtful aligning and sequencing. Research to-date finds evidence of the positive effects of apprenticeship on apprentices' earnings and employment (Reed et al. 2012; Hollenbeck and Huang 2016), but currently this research literature is only suggestive of effective strategies for increasing the diversity of apprentices. Federal investments have catalyzed a dynamic apprenticeship environment which, coupled with large-scale public investments in infrastructure, are enabling meaningful improvements in access to construction careers for women and people of color in the near term, as well as promising broader impact over time. DOL has funded

research studies to build evidence on the success of some of these investments, including the Scaling Apprenticeship grants, the Closing the Skills Gap grants, and the Apprenticeship Building America grants.

Appendix Tables

This appendix provides utilization rates in the apprenticeship system for new and active apprentices in 2022. We use the definition of utilization rates from Munkacsy and colleagues (2023), who define utilization as the percentage of total workers in an occupation from an identified demographic group. Munkacsy and colleagues (2023) also assess the utilization gap for construction occupations—defined as the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most like a construction occupation in terms of required skills. The estimates are derived from the Registered Apprenticeship Partners Information Database System (RAPIDS), which provides administrative data on registered apprentices in 46 states (Minnesota, Oregon, Vermont, Washington, and the District of Columbia currently do not provide data to RAPIDS).

Utilization rates and utilization gaps from Munkacsy and colleagues (2023) for the same detailed occupations nationally are also provided for reference. Active apprentices are defined as apprentices who are active at any time during the 2022 calendar year. Utilization rates for gender and for race and ethnicity are reported for apprentices who report that information. In 2022, a small share of apprentices in RAPIDS (1.2 percent) do not report gender and 10.1 percent of apprentices do not report either race or ethnicity. Statistical significance of differences between utilization shares in apprenticeship and utilization shares for the national industry are indicated in the apprenticeship utilization share columns. Statistical significance testing is not used for tables 8 through 13 because there is no national utilization share in Munkacsy and colleagues (2023) for comparison.

As an administrative data system, RAPIDS data are not static. Registered apprenticeship program sponsors constantly update data on their apprentices to the system. The analyses presented here are based on an extract of data provided to the authors from the first quarter of 2023.

TABLE A.1

Women's Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Women's Share of New Apprentices	Women's Share of Active Apprentices	Women's Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	7.88***	7.10***	2.70 (1.52)	7.99 (1.52)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	3.88***	2.91***	0.87 (0.31)	9.59 (0.32)
6230-Carpenters	51,658	5.81***	5.71***	2.13 (0.17)	8.47 (0.21)
6240-Carpet, floor, and tile installers and finishers	4,476	3.43*	2.86	2.90 (0.56)	10.34 (0.56)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	2.74***	3.28***	0.91 (0.39)	10.00 (0.41)
6260-Construction laborers	31,746	8.00***	7.41***	3.32 (0.16)	10.77 (0.20)
6305-Construction equipment operators	10,485	8.53***	8.58***	2.32 (0.30)	7.71 (0.32)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	4.65***	2.53	2.58 (0.55)	8.69 (0.56)
6355-Electricians	115,471	4.96***	4.55***	2.28 (0.21)	9.83 (0.26)
6360-Glaziers	2,822	4.82***	2.52	2.06 (0.81)	8.87 (0.82)
6400-Insulation workers	4,088	11.52***	8.90***	4.67 (1.31)	6.97 (1.31)
6410-Painters and paperhangers	8,468	12.58***	9.90***	7.05 (0.38)	4.37 (0.39)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	3.53***	3.07***	2.19 (0.79)	7.60 (0.80)
6442-Solar thermal installers and technicians	822	4.52***	3.04**	1.54 (0.18)	8.42 (0.24)
6460-Plasterers and stucco masons	2,855	2.02***	1.89***	0.73 (0.57)	12.8 (0.58)
6515-Roofers	8,829	3.05***	2.38***	1.78 (0.40)	13.44 (0.43)
6520-Sheet metal workers	16,883	5.50***	4.61**	4.93 (0.72)	7.64 (0.73)
6530-Structural iron and steel workers	13,016	6.88***	5.71***	2.71 (0.79)	8.59 (0.80)
6540-Solar photovoltaic installers	22	4.55	4.55	3.25 (1.69)	8.58 (1.70)
6600-Helpers, construction trades	1,074	3.81***	5.21	5.91 (0.97)	7.81 (0.98)
6660-Construction and building inspectors	548	20.87***	18.43***	11.34 (1.38)	10.01 (1.42)
6700-Elevator and escalator installers and repairers	7,888	1.39**	1.70	1.65 (1.04)	7.84 (1.05)
6710-Fence erectors	39	0.00***	2.56	2.82 (1.04)	10.02 (1.04)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined as the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between women's share of new and active apprentices and women's share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.2

Asian Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Asian Share of New Apprentices	Asian Share of Active Apprentices	Asian Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	2.63***	2.63***	1.66 (1.22)	1.00 (1.22)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	1.98***	1.98***	0.67 (0.25)	2.29 (0.26)
6230-Carpenters	51,658	2.28***	3.31***	1.36 (0.12)	1.73 (0.13)
6240-Carpet, floor, and tile installers and finishers	4,476	3.95***	5.16***	1.26 (0.30)	1.54 (0.30)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	4.42***	3.88***	0.08 (0.11)	2.26 (0.13)
6260-Construction laborers	31,746	2.24***	1.93**	1.75 (0.11)	0.84 (0.12)
6305-Construction equipment operators	10,485	1.53***	1.63***	0.63 (0.16)	1.90 (0.17)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	2.89***	5.41***	0.39 (0.18)	2.10 (0.19)
6355-Electricians	115,471	2.37***	2.67***	1.80 (0.17)	0.96 (0.18)
6360-Glaziers	2,822	3.02***	6.15***	1.26 (0.61)	1.09 (0.62)
6400-Insulation workers	4,088	1.49***	3.01***	0.99 (0.54)	1.90 (0.54)
6410-Painters and paperhangers	8,468	3.00***	5.55***	1.21 (0.17)	1.85 (0.18)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	1.34***	1.79***	1.08 (0.46)	1.85 (0.46)
6442-Solar thermal installers and technicians	822	1.32	7.59**	1.14 (0.17)	1.61 (0.18)
6460-Plasterers and stucco masons	2,855	2.14***	6.62***	0.14 (0.23)	2.52 (0.24)
6515-Roofers	8,829	1.59***	4.54***	0.67 (0.19)	2.89 (0.20)
6520-Sheet metal workers	16,883	2.18	3.03***	2.21 (0.45)	0.81 (0.46)
6530-Structural iron and steel workers	13,016	1.40***	2.07***	1.04 (0.39)	1.86 (0.39)
6540-Solar photovoltaic installers	22	0.00***	0.00***	1.35 (1.04)	1.70 (1.04)
6600-Helpers, construction trades	1,074	1.64	2.73***	1.24 (0.66)	1.68 (0.66)
6660-Construction and building inspectors	548	5.33**	6.71***	2.93 (0.45)	0.02 (0.46)
6700-Elevator and escalator installers and repairers	7,888	3.00***	2.51***	1.77 (0.78)	0.99 (0.78)
6710-Fence erectors	39	0.00***	0.00***	0.63 (0.44)	2.55 (0.44)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The Asian share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Asian share of new and active apprentices and Asian share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.3

Black Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Black Share of New Apprentices	Black Share of Active Apprentices	Black Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	16.93***	14.68***	8.50 (2.87)	4.74 (2.87)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	14.55***	14.65***	7.14 (0.91)	2.89 (0.92)
6230-Carpenters	51,658	12.78***	11.95***	4.54 (0.25)	5.07 (0.28)
6240-Carpet, floor, and tile installers and finishers	4,476	6.55***	6.64***	3.51 (0.61)	8.28 (0.62)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	9.21*	10.42	9.93 (1.72)	1.43 (1.73)
6260-Construction laborers	31,746	12.47***	12.64**	6.63 (0.25)	5.45 (0.28)
6305-Construction equipment operators	10,485	6.27	6.68**	6.16 (0.47)	4.77 (0.48)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	4.29***	4.31***	3.10 (0.60)	8.80 (0.61)
6355-Electricians	115,471	8.05***	8.05***	7.03 (0.32)	1.60 (0.35)
6360-Glaziers	2,822	10.44***	7.86***	3.74 (0.97)	7.71 (0.99)
6400-Insulation workers	4,088	11.48***	10.27***	6.49 (1.62)	4.73 (1.62)
6410-Painters and paperhangers	8,468	9.44***	9.17***	4.90 (0.36)	7.66 (0.39)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	7.05***	6.87**	6.63 (1.52)	3.23 (1.52)
6442-Solar thermal installers and technicians	822	11.89***	9.67***	6.77 (0.41)	1.95 (0.44)
6460-Plasterers and stucco masons	2,855	9.71***	6.80***	4.01 (1.47)	8.67 (1.48)
6515-Roofers	8,829	12.50***	11.31***	4.69 (0.67)	7.51 (0.69)
6520-Sheet metal workers	16,883	8.08***	8.51***	6.93 (1.09)	6.61 (1.10)
6530-Structural iron and steel workers	13,016	10.21***	10.05***	6.15 (1.38)	4.25 (1.39)
6540-Solar photovoltaic installers	22	0.00***	0.00***	8.98 (3.37)	3.65 (3.38)
6600-Helpers, construction trades	1,074	6.56***	7.26*	8.80 (1.89)	3.18 (1.89)
6660-Construction and building inspectors	548	6.00*	7.72	7.72 (1.10)	-0.09 (1.12)
6700-Elevator and escalator installers and repairers	7,888	4.68***	5.53	5.89 (1.87)	2.88 (1.88)
6710-Fence erectors	39	0.00***	2.56	5.22 (1.73)	8.24 (1.73)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The Black share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Black share of new and active apprentices and Black share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.4

Indigenous Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Indigenous Share of New Apprentices	Indigenous Share of Active Apprentices	Indigenous Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	1.97***	3.27***	1.34 (1.04)	-0.53 (1.04)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.44***	0.88	0.91 (0.29)	-0.10 (0.29)
6230-Carpenters	51,658	1.34***	0.98**	0.88 (0.09)	-0.04 (0.09)
6240-Carpet, floor, and tile installers and finishers	4,476	0.45	0.27***	0.57 (0.22)	0.27 (0.22)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.43***	0.65	0.77 (0.44)	0.12 (0.44)
6260-Construction laborers	31,746	1.11***	1.05***	0.89 (0.07)	-0.01 (0.08)
6305-Construction equipment operators	10,485	1.56	1.56	1.62 (0.25)	-0.79 (0.26)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	1.44	0.93***	1.47 (0.36)	-0.66 (0.36)
6355-Electricians	115,471	1.19***	0.98***	0.80 (0.11)	-0.02 (0.11)
6360-Glaziers	2,822	0.00***	0.73**	0.41 (0.33)	0.48 (0.33)
6400-Insulation workers	4,088	0.43***	0.60***	0.96 (0.55)	-0.10 (0.55)
6410-Painters and paperhangers	8,468	0.47	0.58	0.53 (0.11)	0.26 (0.11)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	1.15***	1.07**	0.88 (0.40)	-0.10 (0.40)
6442-Solar thermal installers and technicians	822	0.44	0.49	0.78 (0.13)	0.03 (0.14)
6460-Plasterers and stucco masons	2,855	1.89***	1.80***	0.26 (0.21)	0.63 (0.21)
6515-Roofers	8,829	0.59**	0.56***	0.79 (0.22)	-0.05 (0.22)
6520-Sheet metal workers	16,883	1.20***	1.04***	0.56 (0.18)	0.24 (0.18)
6530-Structural iron and steel workers	13,016	2.99***	2.16***	1.28 (0.48)	-0.48 (0.48)
6540-Solar photovoltaic installers	22	0.00***	0.00***	1.05 (0.95)	-0.26 (0.95)
6600-Helpers, construction trades	1,074	0.55**	0.28***	1.01 (0.57)	-0.18 (0.57)
6660-Construction and building inspectors	548	0.00***	0.41	0.65 (0.27)	0.12 (0.28)
6700-Elevator and escalator installers and repairers	7,888	0.47*	0.58	0.61 (0.46)	0.22 (0.46)
6710-Fence erectors	39	0.00***	0.00***	1.37 (0.72)	-0.58 (0.72)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The Indigenous share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).
Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Indigenous share of new and active apprentices and share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.5

White Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	White Share of New Apprentices	White Share of Active Apprentices	White Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	55.79***	54.23***	66.54 (2.22)	-10.66 (2.22)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	56.23***	58.04***	50.79 (1.81)	7.69 (1.81)
6230-Carpenters	51,658	49.32***	51.33***	57.43 (0.42)	3.83 (0.44)
6240-Carpet, floor, and tile installers and finishers	4,476	41.02***	41.86***	46.35 (1.40)	7.44 (1.41)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	26.15***	26.81***	41.63 (1.98)	12.99 (1.98)
6260-Construction laborers	31,746	40.12***	44.20***	45.19 (0.36)	7.22 (0.37)
6305-Construction equipment operators	10,485	73.89***	74.92***	72.52 (0.87)	-14.88 (0.87)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	13.69***	16.09***	31.4 (1.16)	21.39 (1.16)
6355-Electricians	115,471	65.07***	66.77***	68.98 (0.68)	-3.96 (0.69)
6360-Glaziers	2,822	46.40***	50.02**	66.77 (2.30)	-12.46 (2.30)
6400-Insulation workers	4,088	47.08	49.75***	47.50 (2.00)	12.02 (2.00)
6410-Painters and paperhangers	8,468	33.61***	36.93***	42.56 (0.50)	14.38 (0.51)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	70.16***	70.88***	59.94 (2.46)	-0.61 (2.46)
6442-Solar thermal installers and technicians	822	19.38***	22.52***	65.75 (0.68)	-1.68 (0.68)
6460-Plasterers and stucco masons	2,855	11.98***	16.87***	29.60 (3.34)	23.92 (3.35)
6515-Roofers	8,829	27.86***	31.55***	38.55 (1.15)	17.06 (1.15)
6520-Sheet metal workers	16,883	62.48***	63.55***	71.27 (1.06)	-14.95 (1.06)
6530-Structural iron and steel workers	13,016	55.23***	56.26***	66.55 (0.72)	-8.13 (0.73)
6540-Solar photovoltaic installers	22	45.45***	45.45	56.95 (4.63)	-1.99 (4.63)
6600-Helpers, construction trades	1,074	25.68***	28.75***	46.71 (2.48)	7.55 (2.48)
6660-Construction and building inspectors	548	54.00***	57.52***	74.41 (1.24)	-4.87 (1.26)
6700-Elevator and escalator installers and repairers	7,888	74.91	74.64	74.81 (2.29)	-10.36 (2.29)
6710-Fence erectors	39	20.00***	35.90**	54.14 (3.11)	1.81 (3.11)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The white share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between white share of new and active apprentices and white share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.6

Multiracial Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Multiracial Share of New Apprentices	Multiracial Share of Active Apprentices	Multiracial Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	1.31	1.06	1.09 (0.73)	0.53 (0.73)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	1.65	1.05**	1.40 (0.38)	0.21 (0.38)
6230-Carpenters	51,658	1.23***	1.14***	1.60 (0.13)	0.07 (0.13)
6240-Carpet, floor, and tile installers and finishers	4,476	1.08	0.87	1.04 (0.30)	0.60 (0.30)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	1.04***	0.89***	1.68 (0.58)	-0.11 (0.58)
6260-Construction laborers	31,746	1.18***	0.92***	1.54 (0.12)	0.09 (0.13)
6305-Construction equipment operators	10,485	0.64***	0.71***	1.26 (0.22)	0.36 (0.22)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.95	0.62***	1.00 (0.28)	0.68 (0.28)
6355-Electricians	115,471	1.28***	1.06***	1.79 (0.20)	-0.04 (0.21)
6360-Glaziers	2,822	1.86	1.60	1.53 (0.73)	0.05 (0.73)
6400-Insulation workers	4,088	0.74***	1.10***	1.64 (0.69)	0.01 (0.69)
6410-Painters and paperhangers	8,468	1.15***	1.36	1.54 (0.16)	0.10 (0.16)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.93***	0.87***	1.53 (0.60)	0.10 (0.60)
6442-Solar thermal installers and technicians	822	1.32	0.73***	1.68 (0.20)	0.03 (0.21)
6460-Plasterers and stucco masons	2,855	0.38***	1.62***	0.94 (0.60)	0.75 (0.60)
6515-Roofers	8,829	1.04***	1.34	1.35 (0.34)	0.27 (0.34)
6520-Sheet metal workers	16,883	0.99***	0.90***	1.80 (0.42)	-0.17 (0.42)
6530-Structural iron and steel workers	13,016	0.77***	0.96***	2.04 (0.62)	-0.45 (0.63)
6540-Solar photovoltaic installers	22	4.55	4.55	2.25 (1.29)	-0.62 (1.29)
6600-Helpers, construction trades	1,074	0.00***	0.38***	3.57 (1.55)	-1.92 (1.55)
6660-Construction and building inspectors	548	2.00	1.63	2.09 (0.46)	-0.02 (0.47)
6700-Elevator and escalator installers and repairers	7,888	0.37***	0.49***	2.02 (0.99)	-0.33 (0.99)
6710-Fence erectors	39	0.00***	0.00***	1.68 (0.98)	-0.06 (0.99)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The multiracial share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between multiracial/other share of new and active apprentices and multiracial/other share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.7

Hispanic Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Hispanic Share of New Apprentices	Hispanic Share of Active Apprentices	Hispanic Share of all Workers in Occupation	Utilization Gap
6210-Boilermakers	3,986	18.08***	20.13	20.87 (4.07)	4.91 (4.08)
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	23.15***	21.94***	39.08 (1.69)	-12.97 (1.70)
6230-Carpenters	51,658	32.80***	30.60***	34.2 (0.74)	-10.67 (0.77)
6240-Carpet, floor, and tile installers and finishers	4,476	45.78**	43.45***	47.28 (2.19)	-18.14 (2.19)
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	58.69***	57.06***	45.9 (2.78)	-16.69 (2.79)
6260-Construction laborers	31,746	39.56***	36.61***	44.00 (0.56)	-13.59 (0.60)
6305-Construction equipment operators	10,485	15.99***	14.31***	17.8 (0.84)	8.64 (0.86)
6330-Drywall installers, ceiling tile installers, and tapers	9,980	76.58***	72.22***	62.64 (2.36)	-32.3 (2.37)
6355-Electricians	115,471	21.78***	19.75	19.60 (0.46)	1.46 (0.50)
6360-Glaziers	2,822	38.05***	32.56***	26.29 (2.77)	3.13 (2.79)
6400-Insulation workers	4,088	38.79***	33.45***	42.42 (3.44)	-18.56 (3.44)
6410-Painters and paperhangers	8,468	50.71***	44.96***	49.26 (1.18)	-24.25 (1.20)
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	18.69***	17.00***	29.94 (2.59)	-4.47 (2.60)
6442-Solar thermal installers and technicians	822	65.64***	57.16***	23.88 (0.71)	-1.93 (0.75)
6460-Plasterers and stucco masons	2,855	73.90***	65.85	65.05 (4.42)	-36.51 (4.42)
6515-Roofers	8,829	56.18***	49.65***	53.95 (1.78)	-27.68 (1.79)
6520-Sheet metal workers	16,883	24.82***	22.39***	17.24 (1.37)	7.46 (1.38)
6530-Structural iron and steel workers	13,016	29.33***	28.09***	22.95 (2.42)	2.94 (2.43)
6540-Solar photovoltaic installers	22	50.00*	50.00*	29.43 (4.18)	-2.48 (4.18)
6600-Helpers, construction trades	1,074	64.21***	58.81***	38.67 (3.12)	-10.32 (3.12)
6660-Construction and building inspectors	548	32.67***	25.81***	12.18 (1.03)	4.84 (1.07)
6700-Elevator and escalator installers and repairers	7,888	16.39***	15.12	14.90 (2.79)	6.60 (2.80)
6710-Fence erectors	39	80.00***	61.54***	36.97 (4.27)	-11.95 (4.28)

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. The Hispanic share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

Notes: The utilization gap is defined the difference between occupational utilization rates and the utilization rates of "similar occupations" that are most similar to a construction occupation in terms of required skills. Margins of error for national estimates are provided in parentheses. Asterisks indicate whether differences between Hispanic share of new and active apprentices and Hispanic share of all workers in an occupation are statistically significant, with *** indicating $p < 0.01$, ** indicating $p < 0.05$, and * indicating $p < 0.10$.

TABLE A.8

Asian Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Asian Women Share of New Apprentices	Asian Women Share of Active Apprentices
6210-Boilermakers	3,986	0.17	0.33
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.00	0.00
6230-Carpenters	51,658	0.15	0.18
6240-Carpet, floor, and tile installers and finishers	4,476	0.00	0.02
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.25	0.24
6260-Construction laborers	31,746	0.12	0.11
6305-Construction equipment operators	10,485	0.13	0.18
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.13	0.19
6355-Electricians	115,471	0.23	0.22
6360-Glaziers	2,822	0.00	0.04
6400-Insulation workers	4,088	0.33	0.28
6410-Painters and paperhangers	8,468	0.32	0.31
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.09	0.08
6442-Solar thermal installers and technicians	822	0.00	0.00
6460-Plasterers and stucco masons	2,855	0.13	0.11
6515-Roofers	8,829	0.00	0.10
6520-Sheet metal workers	16,883	0.26	0.20
6530-Structural iron and steel workers	13,016	0.00	0.10
6540-Solar photovoltaic installers	22	0.00	0.00
6600-Helpers, construction trades	1,074	0.00	0.19
6660-Construction and building inspectors	548	0.68	1.03
6700-Elevator and escalator installers and repairers	7,888	0.00	0.10
6710-Fence erectors	39	0.00	0.00

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Asian women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

TABLE A.9

Black Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Black Women Share of New Apprentices	Black Women Share of Active Apprentices
6210-Boilermakers	3,986	1.41	1.27
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.90	0.82
6230-Carpenters	51,658	1.30	1.42
6240-Carpet, floor, and tile installers and finishers	4,476	0.64	0.62
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.56	0.90
6260-Construction laborers	31,746	1.11	1.25
6305-Construction equipment operators	10,485	0.67	0.69
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.67	0.34
6355-Electricians	115,471	0.61	0.70
6360-Glaziers	2,822	0.94	0.55
6400-Insulation workers	4,088	3.37	1.67
6410-Painters and paperhangers	8,468	2.04	1.64
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.48	0.42
6442-Solar thermal installers and technicians	822	0.92	0.62
6460-Plasterers and stucco masons	2,855	0.51	0.28
6515-Roofers	8,829	0.39	0.43
6520-Sheet metal workers	16,883	0.98	0.87
6530-Structural iron and steel workers	13,016	1.11	0.90
6540-Solar photovoltaic installers	22	0.00	0.00
6600-Helpers, construction trades	1,074	0.00	0.28
6660-Construction and building inspectors	548	1.36	2.26
6700-Elevator and escalator installers and repairers	7,888	0.19	0.26
6710-Fence erectors	39	0.00	0.00

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Black women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

TABLE A.10

Indigenous Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Indigenous Women Share of New Apprentices	Indigenous Women Share of Active Apprentices
6210-Boilermakers	3,986	0.58	0.97
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.00	0.03
6230-Carpenters	51,658	0.10	0.08
6240-Carpet, floor, and tile installers and finishers	4,476	0.00	0.00
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.06	0.04
6260-Construction laborers	31,746	0.14	0.14
6305-Construction equipment operators	10,485	0.22	0.23
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.04	0.04
6355-Electricians	115,471	0.15	0.09
6360-Glaziers	2,822	0.00	0.00
6400-Insulation workers	4,088	0.22	0.08
6410-Painters and paperhangers	8,468	0.16	0.12
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.12	0.10
6442-Solar thermal installers and technicians	822	0.00	0.12
6460-Plasterers and stucco masons	2,855	0.38	0.21
6515-Roofers	8,829	0.04	0.01
6520-Sheet metal workers	16,883	0.24	0.14
6530-Structural iron and steel workers	13,016	0.39	0.28
6540-Solar photovoltaic installers	22	0.00	0.00
6600-Helpers, construction trades	1,074	0.00	0.00
6660-Construction and building inspectors	548	0.00	0.21
6700-Elevator and escalator installers and repairers	7,888	0.10	0.01
6710-Fence erectors	39	0.00	0.00

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Indigenous women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

TABLE A.11

White Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	White Women Share of New Apprentices	White Women Share of Active Apprentices
6210-Boilermakers	3,986	3.49	2.65
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	2.59	1.53
6230-Carpenters	51,658	2.61	2.52
6240-Carpet, floor, and tile installers and finishers	4,476	1.54	1.45
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.81	0.92
6260-Construction laborers	31,746	4.02	3.70
6305-Construction equipment operators	10,485	6.12	6.38
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.83	0.51
6355-Electricians	115,471	2.86	2.61
6360-Glaziers	2,822	2.34	1.28
6400-Insulation workers	4,088	4.02	3.99
6410-Painters and paperhangers	8,468	5.23	4.37
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	2.19	1.93
6442-Solar thermal installers and technicians	822	2.29	1.12
6460-Plasterers and stucco masons	2,855	0.13	0.39
6515-Roofers	8,829	0.88	0.69
6520-Sheet metal workers	16,883	3.05	2.56
6530-Structural iron and steel workers	13,016	3.66	3.02
6540-Solar photovoltaic installers	22	0.00	0.00
6600-Helpers, construction trades	1,074	1.37	1.51
6660-Construction and building inspectors	548	10.20	9.05
6700-Elevator and escalator installers and repairers	7,888	0.96	1.04
6710-Fence erectors	39	0.00	2.56

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. White women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

TABLE A.12

Multiracial Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Multiracial Women Share of New Apprentices	Multiracial Women Share of Active Apprentices
6210-Boilermakers	3,986	0.00	0.15
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.00	0.03
6230-Carpenters	51,658	0.05	0.10
6240-Carpet, floor, and tile installers and finishers	4,476	0.00	0.07
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	0.06	0.04
6260-Construction laborers	31,746	0.17	0.12
6305-Construction equipment operators	10,485	0.10	0.17
6330-Drywall installers, ceiling tile installers, and tapers	9,980	0.08	0.06
6355-Electricians	115,471	0.11	0.10
6360-Glaziers	2,822	0.00	0.00
6400-Insulation workers	4,088	0.33	0.25
6410-Painters and paperhangers	8,468	0.12	0.18
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.08	0.06
6442-Solar thermal installers and technicians	822	0.00	0.00
6460-Plasterers and stucco masons	2,855	0.00	0.00
6515-Roofers	8,829	0.04	0.02
6520-Sheet metal workers	16,883	0.10	0.08
6530-Structural iron and steel workers	13,016	0.06	0.06
6540-Solar photovoltaic installers	22	0.00	0.00
6600-Helpers, construction trades	1,074	0.00	0.00
6660-Construction and building inspectors	548	0.68	0.21
6700-Elevator and escalator installers and repairers	7,888	0.00	0.00
6710-Fence erectors	39	0.00	0.00

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Multiracial women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

TABLE A.13

Hispanic Women Share of Construction Apprenticeships and Occupations, 2022

Detailed Occupation	Total Active Apprentices	Hispanic Women Share of New Apprentices	Hispanic Women Share of Active Apprentices
6210-Boilermakers	3,986	1.66	1.45
6220-Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers	3,474	0.45	0.53
6230-Carpenters	51,658	1.62	1.41
6240-Carpet, floor, and tile installers and finishers	4,476	1.27	0.64
6250-Cement masons, concrete finishers, and terrazzo workers	4,724	1.00	1.05
6260-Construction laborers	31,746	1.91	1.63
6305-Construction equipment operators	10,485	1.15	0.92
6330-Drywall installers, ceiling tile installers, and tapers	9,980	2.96	1.40
6355-Electricians	115,471	1.06	0.85
6360-Glaziers	2,822	1.64	0.66
6400-Insulation workers	4,088	3.70	2.35
6410-Painters and paperhangers	8,468	4.71	3.23
6441-Pipelayers, plumbers, pipefitters, and steamfitters	63,814	0.52	0.43
6442-Solar thermal installers and technicians	822	1.38	1.24
6460-Plasterers and stucco masons	2,855	0.89	0.92
6515-Roofers	8,829	1.70	1.10
6520-Sheet metal workers	16,883	0.93	0.77
6530-Structural iron and steel workers	13,016	1.63	1.36
6540-Solar photovoltaic installers	22	4.55	4.55
6600-Helpers, construction trades	1,074	2.47	3.21
6660-Construction and building inspectors	548	4.76	4.32
6700-Elevator and escalator installers and repairers	7,888	0.19	0.25
6710-Fence erectors	39	0.00	0.00

Source: Apprentice shares are authors' calculations from the Registered Apprenticeship Partners Information Database System (RAPIDS). The RAPIDS dataset includes 367,168 apprentices in construction occupations. Hispanic women's share of all workers in the occupation and utilization gap is from appendix B in Munkacsy and colleagues (2023).

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