

Employment and Wage Distribution Investigation in the Construction Industry by Gender

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ABSTRACT

The construction industry has insufficient interest and participation from women, as well as an existing gender wage gap. To address these issues, a better understanding of the recent situation regarding gender workforce biases and income differences is required. Therefore, this study analyzes employment levels and wage distributions in 2015 by gender through data collected from reputable sources such as BLS, Data USA, and the U.S. Census Bureau on employment and wage gaps related to gender in the construction industry. This data was normalized, and an analysis was conducted to compare males and females, versus the total population and median wages. The analysis confirms the existence of gaps in both of these areas, reports that this trend has remained steady over the years, and identifies the top ten construction occupations in which discernable gaps from Data USA can be observed. The purpose is to emphasize the latest status of construction industry employment and wage discrepancy related to gender. This study will

contribute to the area of Workplace Diversity and Discrimination by drawing the attention of decision-makers to the problem and encourage them to develop approaches to reduce disparities. Subsequently, with the attainment of the objectives above, the researchers hope this technical note can help increasing the interest and sustain participation of women across the construction industry.

Keywords: Construction Industry, Labor Issues, Workplace Diversity, and Discrimination, Wage Gap

INTRODUCTION

As one of the most significant contributors to economic markets in the United States and Canada (Albattah et al. 2015, Choi et al. 2018), the construction industry plays a vital role in generating good-paying jobs for an average skill-level workforce. The Construction and Extraction sector employment share is expected to increase by 11% from 2016 to 2026 (Bureau of Labor Statistics U.S. Department of Labor [BLS] 2019). As of 2017, the median weekly earnings of female workers was 82% of that of males (BLS 2018). More recently, the construction industry is facing a labor shortage of skilled workforce, which has also impacted project management in construction (Kim et al. 2019). As the demand for construction workers increases over the years, the construction industry needs to hire and retain more women (Morello et al. 2018).

The workforce demographics of the construction industry are afflicted with many problems requiring complex solutions. Some of the more noted problems are that worker safety and how it affects their behavior in construction (Choi et al. 2017). Another such problem is lack of English proficiency affects workers in effectively understanding safety training materials causing accidents (Lin et al. 2017). However, a more pressing and critical issue is that women are not joining or sustaining employment in the field, relative to their overall labor force

participation rate. Therefore, the industry must better understand potential discrimination, measured by wage and employment gaps based on gender. It should identify the status of various occupations and determine significant differences in employment levels and wages by gender within these specific jobs. Identifying jobs with significant gaps can further help the industry to improve in these areas. Therefore, this study aims to investigate employment distribution and wage gaps in the construction industry based on gender. The findings of this study will help practitioners and researchers in the industry to better understand the gap issues for women in terms of employment and wages.

REVIEW OF LITERATURE

The authors have organized the literature into three groups: 1) *Reasons for Employment Disparity*; 2) *Reasons for Wage Gap*; and 3) *Bias Issues in the Construction Industry*. The researchers referred reputed journals and references such as ASCE JME, ASCE JCEM, Bureau of Labor Statistics (BLS), and other ASCE sources. While performing the literature review, keywords such as gender bias, workforce discrimination, construction industry, labor issues, workplace diversity, the wage gap, and other similar terms were used, and more recent articles, i.e., 2010 onwards, were prioritized. Through this literature review, the researchers aim to understand the recent working situation and wage disparity in the construction industry, as well as understand the gaps that persist within different occupation types in the industry. The authors want first to provide an understanding of the reasons for the disparity and the wage gap, followed by a brief review of what biases exist in the industry.

Reasons for Employment Disparity

Several studies have attempted to investigate the reasons for employment disparity in the construction industry. Some primary reasons are issues in engineering-construction education

81 programs and the construction workforce, including attraction, retention, and support of
82 underrepresented groups. The construction industry has consistently failed in attracting many
83 women to the field (Menches and Abraham 2007; Minooei et al. 2017; Sewalk and Nietfeld
84 2013). For instance, in 2016, 56.8% of women were in the labor force, while 69.2% of men were
85 participating, but women represented just 9% of the construction industry workforce (BLS
86 2017a). There has also historically been a lack of interest and participation by women studying in
87 STEM majors (Malcom and Dowd 2012; Monks and James 2000; Perna 2004; Sax 2001; Zhang
88 2008) , which may be one major governing factor for the industry's inability to attract women,
89 leading to a smaller share of women in the industry. Although gender disparity levels have been
90 decreasing in general, due to increasing participation of highly educated women in managerial
91 and professional occupations/positions (Burris and Wharton 1982; Cotter et al. 2004; Jacobs
92 1992; Mandel 2013; Weeden 2004;) the participation of women in the construction industry is
93 still low. Not enough effort is being made in either education or workforce levels to sufficiently
94 improve this employment disparity. One example of this can be seen in the Australian
95 construction industry where a research study cited gender disparity when there were not enough
96 female respondents for a study on gender (Francis et al. 2013, p. 8).

97 Further, the industry has failed to focus on the retention of females or provide appropriate
98 support. According to Sunindijo and Kamardeen (2017), women in the age groups of 18-24 and
99 over 65 are considerably more likely to leave the construction industry than other groups. One of
100 the possible reasons is that female workers are subjected to more discrimination and sexual
101 harassment and exhibit more stress and anxiety than male workers in the construction industry
102 (Sunindijo and Kamardeen 2017). Some of the factors that induce this stress are lower pay rates,
103 fewer opportunities for personal development, requirements for business travel, and keeping up

to date with the trends in the field, as well as the cumulative effects of other minor tasks (Loosemore and Waters 2004). Additionally, workplace bias, segregation, culture, and compensation mechanisms are other possible reasons why women feel discouraged from entering or remaining in the construction industry. A study in 2006 corroborates the reasons mentioned above by concluding that a combination of “complex interplay of structural, cultural, and action-oriented variables” serve as barriers to career opportunities for women (Dainty et al. 2006, p. 9).

Reasons for Wage Gap

Several studies have researched wage gaps on gender and found that they are common to all professions (Bishu and Alkadry 2017). Various rationales have been proposed for the existing wage gaps, such as occupational construct, job preference, and education. According to the American Association of University Women (Miller 2018), the gender pay gap exists because women are categorized into industries, and consequently jobs, that pay differently across the economy. For example, men were more often associated with dangerous and unappealing jobs, like underground mining (Jacobs and Steinberg 1990). According to this notion, it is the social construct that drives different genders towards different types of occupations, rather than discrimination. However, occupational segregation is a significant factor in gender wage disparity. In fact, according to Mandel and Semyonov (2014), occupational segregation is the second most influential factor for the gender wage gap, after working hours. Therefore, if women are provided more opportunities to work in occupations dominated by men, this could result in improvement in the gender wage gap (Cotter et al. 2004; Mandel 2012; Mandel 2013).

Another possible reason for the gender wage gap is explored in a general study done by the Center for American Progress (Glynn 2014). The study reports that overall women invest

fewer hours at work than men, claiming that men working full time invest 35 minutes more per day than women working full time, noting that women gravitate towards spending this extra time with their families and children, which may be a reason for some pay differentials in general industry (Glynn 2014). Discrimination based preference of women for jobs, as cited above, is considered positive discrimination in the construction industry (Barreto et al. 2017).

Finally, some studies have discussed education as one of the possible factors for the existing wage gap. It has been reported that the economic standing of women has improved noticeably over the past few decades (Blau et al. 2006; Blau et al. 2013; Charles and Grusky 2005; DiPrete and Buchmann 2013; Jacobs 1992; Weeden 2004), and the educational attainment levels of women have played a significant role in improving their earnings and reducing income disparity (Bobbitt-Zeher 2007; Frehill 1997; Monks and James 2000; Zhang 2008). However, as discussed in the previous paragraphs, education alone cannot improve the wage gap, as there are other factors as well also need attention, especially in the construction industry.

Bias Issues in the Construction Industry

The literature has shown that bias also plays a role in the limited representation of women in the construction industry. Although the employment situation for women has improved since the 1970s, with women now being nearly half of the labor force in the U.S., holding significant positions, and earning higher wages, they are still the victims of unequal pay (BLS 2015). This is also a concern in the construction industry, as women are compensated less than men for doing the same jobs with the same responsibilities. Johnson and Solon (1986) cited the 1960s Civil Rights Legislation that prohibits men and women from being paid differently for the same work and makes it illegal to differentiate between men and women while hiring, assigning job tasks, or promoting. However, even in the face of existing legislation, men and women are still paid

differently (BLS 2018; Grey-Bowen et al. 2010), and women are subjected to structural discrimination during the hiring process, both in terms of getting jobs and the salaries they receive (Bentley and Adamson 2003; Xu 2008). Women face "invisible barriers" and are privy to fewer work opportunities than men (Barreto et al. 2017).

In addition to compensation differences, promotion inequity has been reported. According to a conference on women in construction, for women to get promoted, three crucial elements are required: performance, image, and exposure. Of these factors, 60% of promotions are attributed to exposure, 30% to an image, and only 10% to performance. (Groundbreaking Women in Construction [GWIC] 2017). The construction industry is facing a labor shortage, and women could be a significant boon to the workforce if the industry can hire and retain them. The literature discusses employment disparity and wage bias for women as compared to men. It also sheds light on some of the reasons for such disparity in the industry. For a more extensive review of the related literature, the researchers recommend referring to Shrestha's (2017) master's thesis.

METHODOLOGY

The study includes the following research steps: 1) identification of the problem and completion of a literature review; 2) identification of data and data sources; 3) collection of data; 4) detailed data analysis; and 5) key findings (Figure 1).

Identification of Problem

To identify a gap in the literature, the researchers performed a literature review, which identified two critical needs: 1) to understand the latest situation of workers and wage disparity in the construction industry; and 2) to understand the gaps that persist within different occupation types in the construction industry.

Identification of Data and Data Sources

The researchers identified the type of data required for this study: 1) the number of workers employed in the construction industry based on gender; 2) the wage distribution in the construction industry for both genders; 3) the wage distribution of different occupation types in the construction industry by gender; and 4) the total population of the U.S. by gender. The sources of data used in this study are 1) the U.S. Bureau of Labor Statistics (BLS); 2) Data USA; and 3) the U.S. Census Bureau.

Characteristics of Sample

The researchers collected employment and wage distribution data for various occupations in the industry. Data USA had information pertaining to 192 different occupations in the construction industry related to gender. The descriptions for these occupations can be found in the Occupational Outlook Handbook (BLS 2019).

Detailed Data Analysis

The data analysis was conducted in two phases: 1) industry-level analysis, and 2) occupational level analysis.

Industry Level Analysis

This analysis shows the employment and wage distributions by gender in the U.S. construction industry. For consistency, the researchers normalized the data for the percentage of male workers in construction (Eq. 1); the percentage of earnings of males in construction (Eq. 2); and the total percentage of the male population in construction (Eq. 3). Similar analyses were carried out for females and males.

$$\left(\frac{\text{Number of Male workers employed in construction}}{\text{Total Number of workers employed in Construction}} \right) \times 100 \quad (1)$$

$$\left(\frac{\text{Median Weekly Earnings of Males in Construction}}{\text{Total Median Weekly Earnings in Construction}} \right) \times 100 \quad (2)$$

$$\left(\frac{\text{Number of Male population in the U.S}}{\text{Total population of the U.S}} \right) \times 100 \quad (3)$$

Occupational Level Analysis

To investigate the employment and wage distributions in construction occupations for gender, the researchers calculated the percentage of difference in the number of men employed versus women (Eq. 4), and the percentage of difference in average wages between men and women (Eq. 5). The researchers conducted analyses for 1) the all 192 occupations in the construction industry identified by BLS [The full results for all 192 occupations can be found in Shrestha's thesis document (Shrestha 2017).; and 2) the 22 traditional construction occupations (see Table 1 for the list). These 22 occupations were chosen with the help of a construction industry expert, with over 30 years of construction industry experience. The authors would like to stress that these 22 occupations do not include all occupations relating to the construction industry (for instance, managerial occupations are missing). The authors focused on the 22 traditional construction occupations since there were too many indirectly relevant occupations in the 192 occupations selected by BLS. However, to remove bias, the authors present the analysis results of both the 192 occupations and the 22 traditional construction occupations in this paper.

<Insert Table 1 here>

After obtaining all percentages for these occupations, the researchers discerned the top 10 occupations, with the highest percentages, and produced Figures 3 and 4. The following formulas were used for the analyses:

$$\left(\frac{\text{Number of employed Male} - \text{Number of employed Female}}{\text{Number of employed Female}} \right) \times 100 \quad (4)$$

$$\left(\frac{\text{Average Wage of employed Male} - \text{Average Wage of employed Female}}{\text{Average Wage of employed Female}} \right) \times 100 \quad (5)$$

RESULTS AND DISCUSSIONS

In the following sections, the findings of both the industry level and occupational level analyses are presented and discussed, including figures. Thus, in the following sections, the authors not only present the results, but also discuss and show a link between the existing relevant literature and the results, and so will refer to the existing relevant literature and compare it with the results obtained in this study.

Industry Level Analysis - Employment

The study showed that, overall, there are fewer women in the workforce compared to men (Catalyst 2004). While women in the general workforce grew from 18.4 million in 1950 to 73.5 million in 2015, making up 46.8% of the labor force (BLS 2017b), the construction industry has not shared the same fate. According to BLS reports (2017a), women constitute only 9% of the total construction workforce. The researchers can conclude from this study that from 2005 to 2014, there was no discernible change in the percentage of women employed in the construction industry (Fig.1).

<Insert Figure 1 here>

In the U.S. construction industry, the percentage of men employed was 90.36% in 2005, which steadily increased to 91.11% in 2014. This confirms previous research showing that the industry has not been able to attract or sustain the participation of women (Menches and Abraham 2007; Minooei et al. 2017). Moreover, there was no discernible change (0.58%) in the gap between the slopes representing the total population of the U.S. and workers employed (by gender) in construction. In fact, there is an increasing trend in the gap.

Industry Level Analysis – Wage Gap

Miller and Deborah (2018) noted a decrease in the gender wage gap since the 1960s, due to the higher educational attainment of women and their increased participation in the workforce.

If the rate of the wage gap decrease from 1960 to 2017 is extrapolated, it shows that women will catch up to men by the year 2059 (Miller and Deborah 2018). The outcome of the study (Fig.2) also shows a decrease in the wage gap; from 2006 to 2014, the gap between the trend line for median weekly earnings between men and women decreased from \$27 to \$19, respectively (a decrease of \$8).

<Insert Figure 2 here>

However, it seems that the slope over the years for the trend line (see Fig. 2) more or less stayed the same (wage gap was \$27 in 2006 and \$19 in 2014, which is not a considerable change). This confirms that the gap has not closed discernably, although there has been an increase in the income of men and women over the years. This is further evidenced by Fontenot et al. (2018), who reported that as of 2017 in the U.S., women are earning 80% of what their male counterparts are being paid.

Occupational Level Analysis – Employment

There has been a continuing decrease in the gender segregation rate of employment in the U.S. (Burris and Wharton 1982; Cotter et al. 2004; Jacobs 1992; Mandel 2012; Mandel 2013; Weeden 2004). However, results from this study (Fig.3 – Top 10 out of 22 traditional occupations by gender for employment difference) show that in 2015, the percentage of employment difference by gender was large within various traditional construction occupations.

<Insert Figure 3 here>

The percentage difference ranges from 9808.54% to 3777.84% in the top 10 jobs for gender differences in employment, confirming that the trend of men having a larger share of employment in the construction industry is of concern.

Not only for the 22 traditional occupations, but the researchers also conducted an analysis of the gender gap for all 192 employment occupations and identified the top 10 with the most substantial gap. The results are as follows: 1) heating, air conditioning, and refrigeration mechanics and installers (16,969.50%); 2) brick masons, block masons, stonemasons, and reinforcing iron and rebar workers (9808.54%); 3) pipe layers, plumbers, pipefitters, and steamfitters (8869.49%); 4) carpenters (8028.82%); 5) roofers (7848.51%); 6) glaziers (6678.46%); 7) electricians (5275.81%); 8) structural iron and steel workers (4479.74%); 9) carpet, floor, and tile installers and finishers (3826.43%); and 10) driver/sales workers and truck drivers (3796.63%). The complete analysis results for all 192 occupations can be found in Shrestha's thesis document (Shrestha 2017).

When compared to the top 10 list of the 22 selected occupations discussed in this paper, it can be seen that the top 10 list from 192 employment occupations includes new occupations which the top 10 list from the 22 selected occupations (see Figure 3) does not include: heating, air conditioning, and refrigeration mechanics and installers; and driver/sales workers and truck drivers. The readers may be cautious in interpreting the results as the authors' selection of the 22 traditional occupations might be biased.

Occupational Level Analysis – Wage Gap

Mandel and Semyonov (2014) reported that after working hours, occupational segregation is the second most influential factor for the gender wage gap. According to the analysis result (see Fig.4 - Top 10 out of 22 traditional occupations by gender for wage difference), the percentage difference in wages in 2015 was large within different construction occupations.

<Insert Figure 4 here>

The differences in percentages ranged from 114.23% to 9.63% in the top 10 jobs with disparities. The median of the average wage for males and females was \$49,837.10 and \$42,810.80, respectively, a difference of \$7,026.30. This confirms that the wage differential, in terms of average, has not improved for women in this industry.

Not only for the 22 traditional occupations, but the researchers also conducted an analysis of the wage gap for all 192 occupations and identified the top 10 with the most substantial gap. The results are as follows: 1) market research analysts and marketing specialists (270.83%); 2) production clerks (178.42%); 3) property, real estate, and community association managers (144.97%); 4) glaziers (114.23%); 5) computer programmers (105.39%); 6) insulation workers (90.54%); 7) other healthcare practitioners and technical occupations (86.71%); 8) chief executives and legislators (86.33%); 9) miscellaneous office and administrative support workers, including desktop publishers (81.86%); and 10) production, planning, and expediting clerks (76.33%). The complete analysis results for all 192 occupations can be found in Shrestha's thesis document (Shrestha 2017).

When compared to the top 10 list of the 22 selected occupations, it can be seen that the top 10 list from 192 occupations has new occupations which the top 10 list from 22 selected occupations does not have (see Figure 4): market research analysts and marketing specialists; production clerks; property, real estate, and community association managers; computer programmers; other healthcare practitioners and technical occupations; chief executives and legislators; miscellaneous office and administrative support workers, including desktop publishers; and production, planning, and expediting clerks. The readers may be cautious in interpreting the results as the authors' selection of the 22 traditional occupations might be biased.

The results demonstrate that the recent status of employment and pay in the construction has substantial gender differences, which may be attributed to various reasons. The paradigm shift in the demographic composition of workers in the United States has not been reflected in construction employment, due to lower participation of women. Additionally, a survey conducted among construction workers and employers by Real Estate Monitor Worldwide (2018) indicated that only one woman in the construction industry is promoted to every three men, due to gender discrimination.

There are many possible reasons that have hindered women in gaining opportunities for equality, both in terms of employment and wages. According to Kmec (2011), there is a culture of penalizing women for being mothers. Xu (2015) also notes that culture and society today are not open and embracing towards women performing the dual responsibilities of family and work. These types of problems continue from the past, as according to Firestone et al. in 1999, the United States' work environment was more favorable for male careers.

The researchers believe that without understanding the recent situation and pinpointing its root problems – lack of education, education inequality, and bias in the industry – the construction industry will not adequately address the situation. These concerns are supported in the literature by Malcom and Dowd (2012), Monks and James (2000), Perna (2004), Sax (2001), and Zhang (2008).

Contributions

The researchers have confirmed a vast employment disparity by gender in the construction industry, demonstrated that a wage-gap exists, and illustrated that the trend has not changed over the years. One of the key findings is the identification of the top 10 construction industry occupations with discernable gender gaps, both in terms of employment and wages.

This will help researchers and practitioners more clearly understand the recent employment situation in the industry. This contributes to the body of knowledge in the area of Workplace Diversity and Discrimination by bringing the issue to the attention of leaders, educators, and decision-makers in the industry, asking them to recognize the situation, and encouraging them to take action to solve the issue.

Limitations

The study did not consider control variables, such as years of experience when selecting data for wage and employment numbers. The focus was on providing a general overview, and therefore, researchers considered all data, regardless of years of experience or other control variables.

Recommendations for Future Research

The analysis conducted deals with temporal variations by gender in the recent past. Therefore, the researchers recommend conducting an analysis of gender for spatial distribution on the metro level to help determine how such differences have varied around the U.S., and how the labor market has responded to the inequities that exist.

Furthermore, the researchers believe it is important to study and understand perceptions/interests/images/understandings of high school students in regards to the construction industry. The authors recommend conducting a survey of high school students, asking questions about their views of the construction industry. This type of study would help offer explanations of why gender employment differences exist, and why women exhibit a lack of interest in the industry.

Moreover, the researchers recommend studying why the trend of wage gap behaves in certain ways. (For instance, in figure 2 of this paper, the wage gap is seen to decrease in 2007

and 2012 whereas it increased in 2008, 2009, and 2013.) The researchers recommend analysis on why this happens whether it is associated with economic reasons or other reasons, and believe that evaluating the wage gap within three periods – before the recession, during the recession, and after the recession periods will bear fruitful results.

Finally, the researchers suggest an analysis considering control variables, such as: educational attainment, years of experience, job requirements related to technical education and apprenticeships, entry-level jobs, commonalities, and differences among the occupations. It is essential to understand what differences may exist within a dataset that includes persons with the same industry experiences or educational levels.

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DATA AVAILABILITY

Some or all data, models, or code generated or used during the study are available from the corresponding author by request (Items: 1. Employment in the construction industry from 2005 to 2014; 2.Total population of the U.S. from 2005 to 2014; 3. Total median weekly earnings in the construction industry from 2006 to 2014; 4. Employment in 2015 by construction occupation; and 5. The annual average wage in 2015 by construction occupation).

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Table 1. 22 Construction Occupations selected out of 192 occupations

No.	Construction Occupations (Trade)	No.	Construction Occupations (Trade)
1	Boilermakers	12	Painters and paperhangers
2	Carpenters	13	Pipelayers, plumbers, pipefitters, and steamfitters
3	Carpet, floor, and tile installers and finishers	14	Plasterers and stucco masons
4	Cement masons, concrete finishers, and terrazzo workers	15	Roofers
5	Construction laborers	16	Sheet metal workers
6	Paving, surfacing, and tamping equipment operators	17	Structural iron and steel workers
7	Construction equipment operators except paving, surfacing, and tamping equipment operators	18	Brickmasons, blockmasons, stonemasons, and reinforcing iron and rebar workers
8	Drywall installers, ceiling tile installers, and tapers	19	Helpers, construction trades
9	Electricians	20	Construction and building inspectors
10	Glaziers	21	Elevator installers and repairers
11	Insulation workers	22	Fence erectors

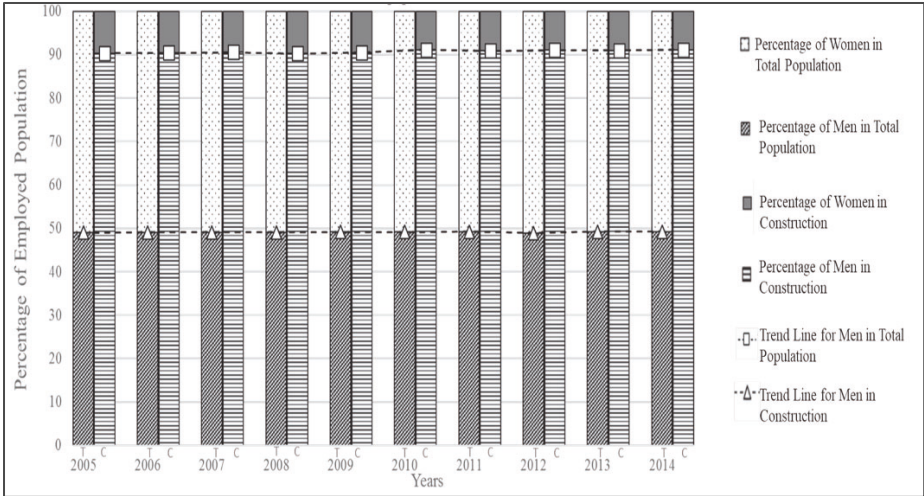


Fig 1. Percentage comparison between total population and employment by gender in the Construction Industry

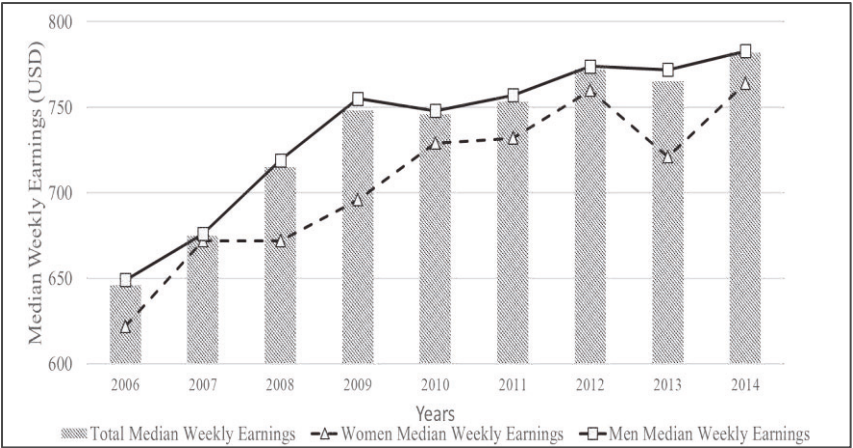


Fig 2. Wage distribution by gender in the Construction Industry

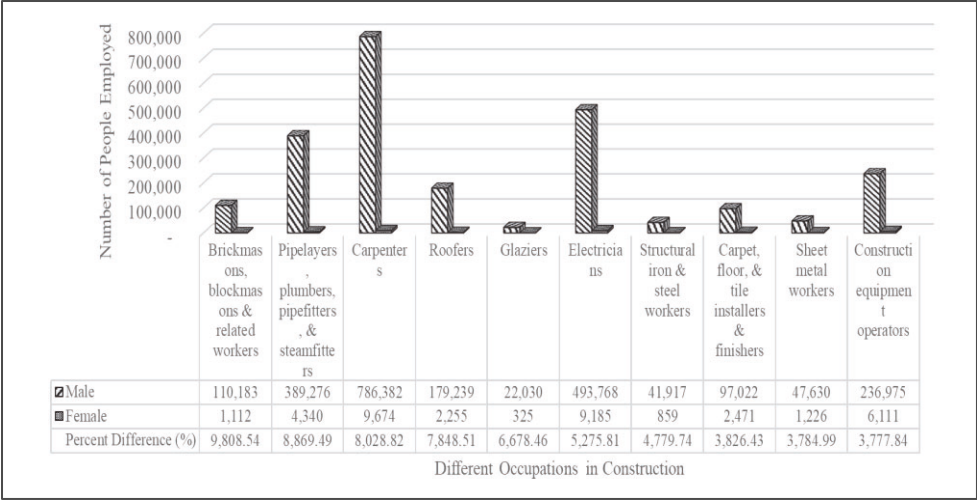


Fig 3. Top-10 occupations by gender for employment difference within different construction occupations

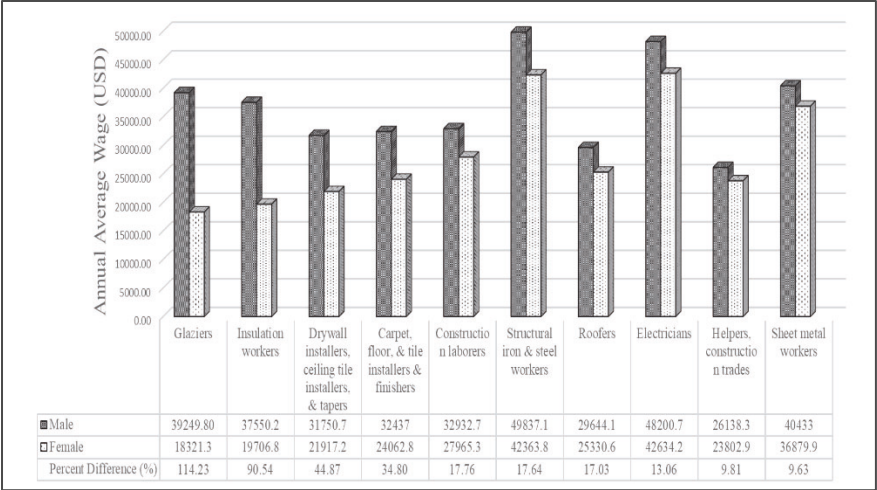


Fig 4. Top-10 occupations by gender for wage difference within different construction occupations

Figure Caption List

Fig 1. Percentage comparison between total population and employment by gender in the Construction Industry

Fig 2. Wage distribution by gender in the Construction Industry

Fig 3. Top-10 occupations by gender for employment difference within different construction occupations

Fig 4. Top-10 occupations by gender for wage difference within different construction occupations