

# WOMEN'S PARTICIPATION IN CIVIL ENGINEERING: CHALLENGES AND OPPORTUNITIES IN THE CONSTRUCTION INDUSTRY

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## Abstract

The participation of women in civil engineering, particularly in the construction industry, remains lower than that of their male counterparts, especially in leadership and decision-making roles. Despite regulatory advances and gender equity initiatives, structural barriers persist, limiting their professional development and retention in the sector. The literature suggests that these challenges cannot be attributed solely to individual factors but rather stem from a complex interaction of institutional, organizational, and sociocultural conditions that restrict access to growth opportunities. This study conducts a systematic literature review to identify the factors affecting the retention and professional development of women in construction. Rather than merely listing these barriers, the research adopts a holistic approach to uncover the underlying causes of these limitations and their implications for equity in the sector.

The findings indicate that low female representation results from structural and contextual factors. Among the most significant are organizational culture with gender biases, the limited presence of female role models, occupational segregation, the lack of mentoring programs and support networks, and the incompatibility between work demands and caregiving responsibilities. Additionally, adverse effects on women's mental health and well-being are evident due to hostile work environments and excessive demands. Based on these findings, general solutions are proposed to mitigate these barriers and promote a more equitable environment. Furthermore, research gaps are identified, emphasizing the need for studies that delve deeper into organizational dynamics, the impact of inclusion policies, and the effectiveness of retention and female leadership strategies in the construction industry.

**Keywords:** equity, gender bias, inclusion, retention, women in construction.

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## 1. Introduction

The growing inclusion of women in traditionally male-dominated fields, such as science, engineering, and construction, highlights progress and persistent gender equity challenges [1]. While women have increased their participation in managerial roles, their advancement to executive levels remains limited, reflecting structural resistance in specific industries. This is particularly evident in construction, where, despite a smaller gender pay gap compared to other fields [2], female representation in technical and leadership roles remains low, even though female project managers demonstrate competencies equivalent to their male counterparts [3].

The concept of a "career path," traditionally linked to hierarchical progression, has evolved but remains constrained through a gender lens [4]. Promotions often involve moving from technical to people management roles, which may discourage women if contributions at both levels are not equally valued [5]. Advancement criteria are frequently shaped by norms favoring men, especially in competitive sectors like construction. Inclusion goals cannot be achieved without addressing the structural barriers that limit women's participation and advancement [6].

*Cultural and social barriers also restrict women's professional development in male-dominated industries. The construction sector is marked by masculine workplace culture, rigid schedules, and*

*expectations of extended availability, which hinder work-family reconciliation and disproportionately affect women [7]. Many field positions demand excessive hours, including unpaid overtime, contributing to work-life conflict [8]. This is mirrored in the underrepresentation of women in senior leadership across industries, limiting diversity in decision-making [9].*

Despite ongoing efforts, the literature reveals that current strategies may not fully address the real challenges women face [10], and that academic research often lags anecdotal evidence on issues such as work-family conflict, hostile work environments, and lack of confidence [11]. These gaps reinforce the need for updated region-specific studies and interventions that respond more effectively to the realities experienced by women in construction.

*This article analyses intrinsic and extrinsic factors hindering women's retention and professional development in construction, focusing on civil engineering. It explores why many women leave the sector, avoid higher-ranking roles, or face structural barriers despite seeking leadership positions. Based on this analysis, the article identifies the leading causes that limit female participation at senior levels of the industry and contributes to the design of strategies that promote a more inclusive and equitable environment within the sector.*

## **2. Methodology**

This study is based on a systematic literature review, using an adapted PRISMA model [12] to ensure traceability and methodological rigor. The review focused on the 2014–2024 period, considering the creation of Chile's Ministry of Women as a milestone in the development of gender-focused public policies. Searches were conducted across five academic databases (Web of Science, ScienceDirect, Scielo, Rennes, and Rabbit), complemented by a snowball sampling strategy through the references of relevant studies. Keywords were grouped into three categories: (1) Gender: women, woman, female, females; (2) Professional: career development, professional growth, retention; (3) Industry: engineering, construction, mining, Science, Technology, Engineering, and Mathematics (STEM). Studies focused on students, unrelated disciplines (e.g., chemistry, biology), or without gender-based segmentation were excluded. The search process, summarized in Figure 1, initially identified 178 documents. After removing duplicates and irrelevant records, 172 studies were screened by title and abstract. Study selection followed the PICOS model (Population, Intervention, Comparison, Outcomes, Study Design), which structures inclusion and exclusion criteria to ensure relevance [13]. The components of the PICOS method for this study are as follows:

- Population: Professional women in engineering, construction, or mining.
- Intervention: Work experiences, barriers, promotion, and career development strategies.
- Comparison: When relevant to understanding professional development, men or women from other fields.
- Expected Outcomes: Factors influencing career development, retention, gaps, and leadership.
- Study Design: Empirical studies (quantitative/qualitative) and systematic reviews.

Applying the PICOS criteria, 42 studies were selected for full-text review, and 33 articles were included in the qualitative analysis. Following a qualitative content analysis approach, thematic coding was used to analyze the studies. Initial coding was inductive, and findings were organized into three analytical categories: (1) Personal or intrinsic factors (motivations, self-confidence, work-life balance, career aspirations); (2) Extrinsic or structural challenges (discrimination, gender bias, institutional barriers, lack of mentorship and networks); and (3) Quantitative empirical evidence (participation, promotion, retention, wage gaps). An analysis matrix helped systematically record key information, identifying patterns, contradictions, and gaps. This methodology enabled a critical interpretation of the factors influencing women's career development in engineering within the construction industry.

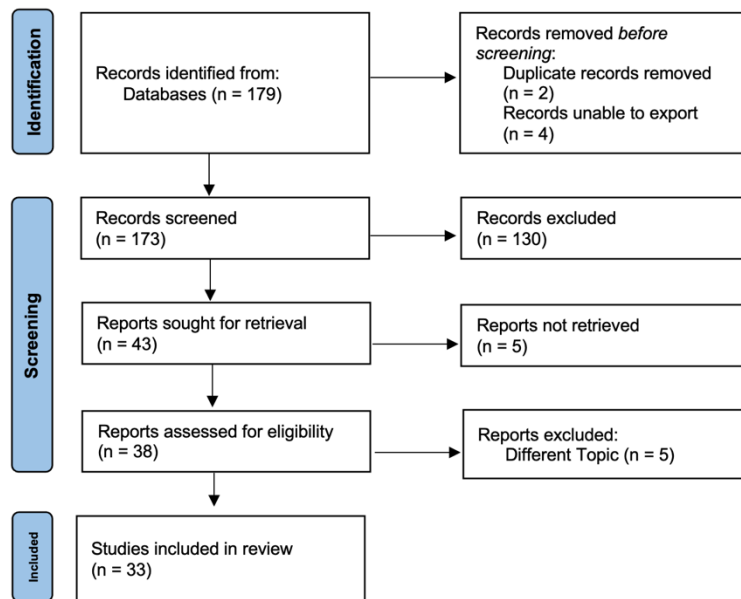


Fig 1. PRISMA 2020 flow diagram for systematic reviews.

### 3. Results

#### 3.1. Personal or Intrinsic Factors Affecting the Professional Development of Women in Engineering within the Construction Industry

The professional development of women in male-dominated sectors such as engineering and construction is deeply influenced by personal or intrinsic factors, including individual, family, cultural, and motivational dimensions. Although not always visible, these factors operate from early socialization and have a sustained impact over time.

##### 3.1.1. Gender Stereotypes and Self-Perception

From an early age, many women internalize stereotypes that distance them from technical or scientific fields. According to Bannikova et al. [14], girls face a combination of low confidence in their technical and scientific abilities, social pressures that assign them secondary roles, and parental expectations that reinforce the selection of more traditionally feminine careers. This dynamic limit early recognition of personal talents in STEM disciplines, creating a mismatch between actual abilities and professional interests. Moreover, vocational decision-making often focuses more on institutional prestige (e.g., university rankings) than on self-awareness regarding personal strengths and interests, leading to uninformed career choices [14].

##### 3.1.2. Family Influence and Generational Traditions

The family plays a key role as a reference model. Parents' professions, and particularly their perceptions of certain careers, influence the vocational choices of their daughters. This effect is especially strong in contexts where family traditions are valued or where intergenerational continuity in professional paths is emphasized [14]. This suggests a cultural component that also varies by generation, with younger cohorts being more influenced by family history than previous generations.

##### 3.1.3. Social Motivations and Perceived Impact

From a motivational psychology perspective, studies show that women tend to value relational goals and social impact more strongly. According to Diekman et al. [15], this "communal goal orientation" leads women to avoid careers perceived as cold, individualistic, or isolated (such as engineering or technology), in favor of those associated with caregiving, education, or direct human interaction. This does not reflect a lack of interest in technical work, but rather a desire for meaningful contribution. In fact, recent studies show that when STEM careers are framed as solutions to social issues (e.g., sustainability, health, justice), female interest increases significantly [15,16].

#### *3.1.4. Work-Life Balance and Professional Development*

One of the most decisive internal factors is the desire to maintain a balance between personal life and professional growth. Motherhood, relationships, and the pursuit of personal fulfilment often shape women's career trajectories [2]. This becomes especially relevant in industries such as construction, where long hours and high demands hinder such balance. Ehrlich et al. [17] emphasize how the social structure of caregiving, where women are primarily responsible for family duties, pushes them to pursue more flexible occupations, which affects their continuity and advancement in rigid fields such as engineering or construction.

#### *3.1.5. Cultural Alignment and Adaptation to Masculine Environments*

A frequently underestimated internal barrier is the need for "cultural fit." Ottemo et al. [2021] point out that the dominant culture in STEM fields, including construction, is still closely associated with "masculine" behaviours such as aggressive competitiveness, a pure technical focus, and constant self-assertion. Many women, to fit in, feel compelled to alter their communication styles or work habits, which implies an additional psychological burden. This need for adaptation creates identity tensions and can reduce a sense of belonging or satisfaction, ultimately influencing the decision to remain in the field [18].

### *3.2. Extrinsic Challenges Affecting the Career Development of Women in Construction*

Unlike intrinsic factors, extrinsic challenges stem from the work, organizational, and sociocultural environment. These factors are not directly dependent on individual will, yet they significantly influence women's participation, retention, and professional advancement within the sector.

#### *3.2.1. Incompatibility Between Job Demands and Family Life*

One of the main barriers reported by women in the construction industry is the difficulty of balancing personal life with the demands of work. Kahn & Ginther [19] and Goldin [20] note that even when women remain in full-time employment, they tend to leave fields such as engineering when these involve inflexible schedules, extended hours, and high pressure, especially after becoming mothers. Francis [21] adds that this incompatibility is normalized within the organizational culture of the industry, perpetuating the exclusion of women or relegating them to secondary roles [22].

#### *3.2.2. Emotional Burnout and Deterioration of Well-Being*

Liu et al. [23] identify occupational burnout as a highly prevalent and contagious phenomenon, with negative physical and psychological effects. This burnout results from the ongoing depletion of personal resources (such as time, energy, and emotional support) and becomes more severe in hostile or exclusionary environments. Additionally, many women report feelings of isolation, chronic stress, and low recognition, which undermine job satisfaction and career aspirations.

#### *3.2.3. Structural and Symbolic Discrimination*

Studies such as that of Rosa et al. [10] show that women face multiple forms of discrimination, including sexualization and harassment in the workplace; exclusion from informal power and decision-making networks, often tied to male-dominated social spaces such as sports or after-work events; and assignment to repetitive or low-impact tasks that hinder professional visibility. The result is a persistent inequality in access to strategic projects, promotions, and institutional visibility [2].

#### *3.2.4. Male-dominated Organizational Culture*

Aboagye-Nimo et al. [9] highlight the disconnect between public equality discourses and actual organizational practices. While many companies outwardly promote equity, they maintain hierarchical structures, leadership dynamics, and evaluation systems based on masculine norms. The phenomenon of "checkerboarding" illustrates how some companies place women in visible roles without real decision-making authority, simulating inclusion without genuine empowerment [24].

#### *3.2.5. Gaps in Participation, Pay, and Leadership*

Montenegro & Schulmeyer [25] and Berdahl et al. [26] highlight significant gender inequalities in salary, project participation, and access to leadership positions. Women receive fewer promotion opportunities and face higher demands to be considered for leadership roles. On average, women place greater value

on positive workplace relationships and recognition, while men tend to prioritize salary and advancement opportunities. However, many women report that the training and development programs offered by companies are not truly aligned with their professional trajectories [2].

### *3.2.6. Stereotypes About Physical Abilities and Leadership*

Zhang et al. [1] reveal the persistence of the perception that construction work requires physical strength, even though many tasks demand specific technical skills rather than brute force. This misconception continues to function as a symbolic barrier. In leadership, Morello et al. [24] observe that women in senior roles often adopt dominant communication styles, though many would prefer more cooperative or communal forms of leadership. This pressure to conform to traditional leadership models creates identity tensions.

## *3.3. Empirical Evidence and Quantitative Findings on the Professional Development of Women in Engineering and Construction*

Empirical evidence supports the notion that the underrepresentation of women in the construction industry is not an isolated or temporary issue, but a structural one. Despite legislative and rhetorical advancements toward gender equality, data reveal a persistent gender gap at multiple levels within the sector.

### *3.3.1. Female Participation in the Construction Industry*

According to data from the U.S. Bureau of Labor Statistics (USBLS, 2017), compiled by Perrenoud et al. [2], women make up only 9.1% of the total workforce in construction. This figure contrasts with their participation in the general labor market, where women account for approximately 47%. Within the sector, only 7.4% of management positions are held by women, and representation in trades is even lower: 6.2% in painting, 3% in electrical work, 2.1% in carpentry, and 1.7% in roofing.

### *3.3.2. Retention and Motivations in the Industry*

In a study cited by Perrenoud et al. [2], 85% of women expressed a desire to remain with their companies long-term, compared to 89% of men. However, among the women who did not plan to stay, the most frequently cited reasons were sexism in the workplace (38%) and lack of female role models (15%). These findings reinforce the view that women's decisions to leave the industry are not due to lack of interest or capability, but rather to unfavorable structural conditions.

### *3.3.3. Perceptions of Gender Diversity*

Perceptions of gender diversity vary significantly by gender. Naoum et al. [7], as cited in Perrenoud et al. [2], report that 70.9% of women consider the lack of diversity a serious issue, and only 39.7% of men share this perception. This disparity in perception points to a gap in organizational awareness, which undermines the effective implementation of inclusive policies [22,27].

### *3.3.4. Educational Attainment vs. Access to Leadership*

Although women show higher levels of education than their male counterparts (with a greater percentage holding university and postgraduate degrees), this does not translate into equitable access to leadership positions [2].

### *3.3.5. Gender Differences in Motivation and Workplace Perception*

While men tend to prioritize salary and career advancement when choosing to enter the industry, women place greater value on positive relationships with colleagues, non-monetary recognition, collaborative and respectful work environments [2]. In addition, many women reported that existing training programs had little influence on their decision to join the sector, suggesting these programs are not effectively designed to attract female talent, particularly in early career stages. This trend may vary across regions and countries [28].

### *3.3.6. Stereotypes About Physical Strength*

Zhang et al. [1] show that the belief that construction work requires excessive physical strength continues to serve as a symbolic barrier. However, many women point out that numerous tasks in the

sector, such as painting, designing, or installing lightweight panels, require technical skills rather than physical force.

### 3.3.7. *Inclusion and Leadership*

Morello et al. [24] highlight that women in senior positions tend to adopt dominant communication styles, although many would prefer more communal leadership approaches. In contrast, companies with a higher percentage of women are more likely to have recruitment or inclusion programs for women, and vice versa. There is a significant ordinal association between the percentage of women in a company and the presence of recruitment and retention programs [29].

## 4. Discussion

The findings of this research show that personal factors play a critical role in the career development of women in engineering and construction. Early socialization, family structure, and personal life goals influence career choices more than organizational dynamics. Traditional gender roles and the lack of female role models create conflicts that often limit aspirations or lead women to opt for less demanding roles. The pressure to balance work and family life partly explains their underrepresentation in leadership positions. It is not a lack of interest or ability that distances women from STEM careers but rather the perception that these fields conflict with their life goals. Therefore, promoting a more inclusive vision of professional success is crucial. Inclusion strategies should address women's identities and life projects, implement work-family balance programs, and provide diverse mentors and role models. Organizations must foster a flexible culture that values different career paths and recognizes women's potential in technical and leadership roles [30,31].

Externally, structural and cultural barriers continue to hinder women's retention. The absence of flexible labor policies, competitive environments, and long working hours, especially during motherhood, limit development opportunities. Low representation in key roles, lack of support networks, and subtle sexism in task assignments further reinforce exclusion. The need to be overqualified to gain recognition increases stress and attrition, while male-dominated informal networks perpetuate inequality. Companies should adopt inclusive policies like adaptable schedules and remote work options, especially for women with family responsibilities [32]. Leadership structures should be reviewed to integrate more women into strategic roles and strengthen formal and informal support networks [33].

Culturally, the industry's prevailing masculinity shapes perceptions and opportunities for women. Leadership models based on traditionally masculine traits pressure women to conform to styles that may not align with their strengths. This restricts access to leadership and professional networks despite women's qualifications. Transforming organizational culture toward inclusive leadership that values diverse management styles is essential [34]. Companies should embed diversity practices in strategic decision-making, expand mentorship opportunities, and actively challenge gender stereotypes in hiring and promotions. These actions will promote equity and enhance innovation and competitiveness within the sector [35].

## 5. Conclusions

The findings reveal that women's professional development in the construction industry, particularly in civil engineering, is hindered by a complex mix of personal, cultural, organizational, and structural barriers. Internalized gender stereotypes, a lack of role models, and tensions between family and career expectations affect their retention and advancement. Unequal caregiving responsibilities intensify these challenges. Organizationally, masculinized cultures, inflexible schedules, and weak promotion mechanisms limit women's leadership opportunities despite their academic qualifications. Persistent biases and differing perceptions of gender issues further obstruct inclusion efforts, emphasizing the need for profound cultural and organizational change. Comprehensive interventions are essential, including work-life balance policies, promotion of diverse leadership styles, revision of promotion criteria, and fostering environments that value diverse professional trajectories. A critical review of current structures is necessary to achieve a truly equitable and inclusive construction industry.

The literature on women's participation in civil engineering reveals significant gaps, especially regarding the construction sector's specific challenges and opportunities. Academic research often lags behind

anecdotal evidence about issues like lack of confidence, chilly work climates, and difficulties balancing work and family roles. Although stress, work-family conflict, and negative perceptions are acknowledged challenges, updated, region-specific research remains necessary. Existing strategies may not fully align with the real challenges women face. While frequently promoted, mentoring programs require further study to assess their actual effectiveness, as some evidence suggests they help retention more than advancement. New strategies must address the root causes of gender imbalance and foster more inclusive environments. Future research should evaluate current strategies' effectiveness and develop new interventions, expanding studies to other regions to capture a broader industry perspective.

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