

Women in Civil Engineering: A Literature Review of Barriers, Stress, and Alignment with the Sustainable Development Goals

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Article Information	ABSTRACT
Article History Received : August 28, 2025 Revised : October 06, 2025 Published : October 20, 2025 Keywords: <i>Gender Bias;</i> <i>Women in Civil Engineering;</i> <i>Sustainable Development Goals.</i>	Research across various countries has shown that women in civil engineering and construction still face barriers that limit their participation and career advancement. These include gender bias, unsafe or inflexible work environments, limited mentorship access, and difficulties balancing work and personal life. Such conditions harm women’s mental health, job satisfaction, and long-term retention in the industry. This study analyzes these challenges and proposes strategies to address them through a qualitative literature review of previous research conducted in several countries, including Indonesia. The review identifies recurring patterns of inequality and examines how these barriers relate to the Sustainable Development Goals (SDGs), particularly those concerning health and well-being, education, gender equality, and decent work. The findings demonstrate that coordinated, evidence-based efforts involving inclusive workplace policies, equitable leadership, mentorship, and institutional support are crucial for enhancing women’s participation, well-being, and career sustainability. This review highlights that promoting gender equality in civil engineering is not only a matter of social justice but also a key driver of innovation, sustainability, and industry resilience.

INTRODUCTION

Civil engineering remains one of the most male-dominated sectors in the construction industry. Although the number of women entering this profession has grown in recent years, they continue to face barriers that affect both career development and personal well-being (Hickey & Cui, 2020; Naoum et al., 2020; Wang et al., 2025). Persistent challenges, including gender inequality, workplace stress, limited opportunities for advancement, and cultural bias, continue to exist in the industry (Bridges et al., 2020; Salamah & Widaningsih, 2022). These systemic issues not only restrict women’s participation but also undermine broader goals of organizational sustainability and social equality.

Research from China and Chile showed how inequality continues to hinder women’s professional growth and integration into the workplace (Araya et al., 2025; Wang et al., 2025). Evidence from Australia, the United States, and the United Kingdom similarly reveals that women encounter barriers to leadership, face difficulties with retention, and often struggle to receive recognition for their contributions (Ghanbaripour et al., 2023; Naoum et al., 2020; Senaratne et al., 2025). These barriers often translate into stressors such as job insecurity, professional isolation,

and the ongoing challenge of gaining legitimacy in a male-dominated environment (Curtis et al., 2022; Schmitt, 2021).

Another recurring issue is work–life balance. Female engineers frequently manage dual responsibilities at work and at home, creating additional stress and threatening the long-term sustainability of their careers (Ghaleb et al., 2025; Tunji-Olayeni et al., 2021). The absence of supportive workplace policies and flexible arrangements has led many to leave the profession altogether (Smith et al., 2022; Zhang et al., 2021). Stress-related health concerns, including burnout and inadequate safety support, further highlight the risks women face in construction workplaces (Hardtke et al., 2023; Mariam et al., 2021).

The lack of mentorship and role models also limits women’s professional development in civil engineering. Mentorship, social support, and visible female role models are widely recognized as essential for sustaining motivation and professional identity in STEM (Science, Technology, Engineering, and Mathematics) fields (González-Pérez et al., 2020; Ramachandran et al., 2024; Wilson & VanAntwerp, 2021). However, many women report difficulty accessing such networks, leaving them vulnerable to exclusion and slower career progression.

While these challenges have been thoroughly examined in national and organizational studies, few have been explicitly connected to the broader sustainability agenda. Research rarely frames the barriers and stressors faced by women in civil engineering in relation to the Sustainable Development Goals (SDGs). This is an important gap, as gender equality, good health and well-being, quality education, and decent work are directly aligned with SDG 3, SDG 4, SDG 5, and SDG 8. Positioning women’s experiences within this framework emphasizes not only their individual struggles but also the broader societal importance of addressing gender inequality in the construction sector.

Therefore, this paper presents a structured qualitative literature review that synthesizes research on the barriers and stressors experienced by women in civil engineering and construction. It further analyzes how these findings intersect with the SDGs and identifies integrated strategies supported by previous studies to promote inclusion, well-being, and career sustainability. By bridging gender research with the sustainability framework, this review contributes evidence-based insights that can guide policy and institutional reform toward a more equitable and resilient industry.

RESEARCH METHODS

A descriptive, qualitative approach and systematic literature review were used to examine the challenges faced by women in the civil engineering industry. The main purpose was to identify barriers, stressors, and workplace inequalities experienced by women and to analyze how these issues align with the SDGs. Relevant studies were gathered using keywords such as “women in civil engineering,” “gender bias in construction,” and “mental health of female engineers.” The Publish or Perish software was used to ensure a comprehensive and structured collection of both international and national research.

This review focused on studies from reputable academic databases, including Scopus, Google Scholar, and ScienceDirect, ensuring that all sources were credible and peer-reviewed. The selection covered journal articles published between 2020 and 2025, ensuring that the analysis reflected the most recent developments related to gender, sustainability, and professional challenges in the civil engineering and construction fields. The study emphasized gender equality, women's participation, and workplace culture by examining research from multiple countries to understand how cultural, structural, and institutional factors shape women’s experiences in the profession.

After the selection process, a thematic analysis was conducted to identify recurring issues such as gender bias, limited mentorship, work-life imbalance, and mental health stressors. Each identified theme was then compared with the targets and indicators of the SDGs to determine its alignment. For example, well-being-related challenges were mapped to SDG 3 (Good Health and Well-being), education and professional training gaps were linked to SDG 4 (Quality Education), gender-based inequalities were aligned with SDG 5 (Gender Equality), and workplace-related barriers were associated with SDG 8 (Decent Work and Economic Growth). This analytical process established a clear and evidence-based connection between the challenges identified in the reviewed literature and the global SDG framework, ensuring that the findings were contextually grounded and aligned with sustainable development priorities.

RESULTS AND DISCUSSION

Based on a review of 20 peer-reviewed studies published between 2020 and 2025 from various countries, including Indonesia, the literature shows that women in civil engineering continue to face persistent barriers rooted in industry structures, organizational practices, and social expectations. The selection of these studies was guided by clear criteria, focusing on gender-related challenges, workplace inequalities, and professional stressors, and the findings were analyzed thematically to identify recurring patterns and align them with the SDGs.

The reviewed studies highlight that limited access to mentorship, supportive colleagues, and inclusive workplace policies exacerbates these challenges, as environments with low flexibility make career development and confidence-building more difficult for women. Male colleagues rarely encounter these obstacles, contributing to workplace imbalances and increasing mental stress for women in engineering roles.

Several studies also suggest that addressing these challenges requires an integrated approach. For instance, mentorship programs (Araya et al., 2025; Ghanbaripour et al., 2023), flexible work arrangements (Chew et al., 2020; Wilson & VanAntwerp, 2021), and supportive organizational policies (Curtis et al., 2022; Zhang et al., 2021) can jointly promote mental well-being, equal opportunities, and career advancement. Critically, while these interventions show promise, their effectiveness often depends on cultural and organizational contexts, and some studies note that policies alone are insufficient without addressing broader social norms and structural barriers.

These challenges and potential solutions align closely with the SDGs, particularly those emphasizing health, quality education, gender equality, and decent work. However, gaps remain, such as limited research in certain cultural settings, insufficient longitudinal studies, and a lack of evaluation on the long-term impact of integrated interventions, which may affect the generalizability of the findings. Overall, tackling these issues is essential not only for promoting gender equality but also for strengthening the civil engineering industry by fostering innovation, efficiency, and sustainable growth.

Gender Inequality

In civil engineering, gender inequality remains a significant challenge, with women underrepresented in both technical roles and leadership positions. Evidence from multiple studies suggests that women encounter structural, cultural, and institutional barriers that restrict their opportunities for training, professional visibility, and career advancement (Bridges et al., 2020; Hickey & Cui, 2020; Wang et al., 2025). Women are often sidelined from key projects and leadership discussions, restricting access to mentorship and professional networks, which are critical for career growth (Wilson & VanAntwerp, 2021).

Evidence from multiple studies suggests that addressing this gap requires integrated approaches that combine organizational policy reform, mentorship programs, workplace safety

improvements, and cultural interventions to support women's participation and career advancement. Across countries, research indicates that although some interventions improve representation, persistent challenges rooted in local cultural expectations and workplace norms remain, highlighting the need for multi-layered solutions rather than isolated policies. Women in the industry also face elevated health and safety risks compared to men, including exposure to hazardous materials, ill-fitting protective equipment, and unsafe working conditions, which may have long-term consequences (Mariam et al., 2021). These risks are compounded by limited senior female role models, unequal access to strategic opportunities, and workplaces lacking flexible or supportive policies (Naoum et al., 2020).

Analytically, these findings demonstrate that gender inequality in civil engineering is not solely a matter of numerical representation. It is also about the quality of opportunities, inclusion in decision-making, and the intersection of workplace policies, culture, and structural barriers. Integrated, evidence-based interventions targeting these multiple dimensions are essential to achieve meaningful progress. Aligning these strategies with SDG 5 (Gender Equality) and SDG 8 (Decent Work and Economic Growth) supports not only gender equity but also innovation, efficiency, and sustainable growth within the industry.

Educational and Social Factors

Gender inequality in civil engineering often begins long before women enter the workforce, starting in school. Many still perceive civil engineering as a "man's domain" (González-Pérez et al., 2020), which discourages young women from pursuing it. Cultural beliefs that construction requires physical strength, mobility, and a male-dominated culture intensify these barriers. Social expectations from family, school, and society further limit exposure to STEM opportunities.

Once women enter the construction sector, their experiences remain shaped by both educational and workplace factors. Corporate training programs provide mentorship and skills development (Zhang et al., 2021); however, entrenched gender stereotypes continue to hinder career progression. Similarly, studies in Chile report that women face obstacles at every career stage, from cultural expectations and parenthood-related barriers to underrepresentation in leadership roles (Araya et al., 2025). In Yemen, inadequate support during education weakens confidence and fosters feelings of isolation (Ghaleb et al., 2025). Globally, structural barriers persist despite increasing interest in STEM among women (Hardtke et al., 2023; Ramachandran et al., 2024). Women often face a double bind: adopting "masculine" traits to be taken seriously risks criticism if perceived as "too feminine."

These findings suggest that isolated interventions such as mentorship or training alone are insufficient. Evidence indicates that integrated approaches combining gender-responsive curricula, mentorship programs, and supportive workplace policies yield better outcomes for retention, career progression, and well-being of women engineers. This cross-study comparison underscores that addressing both educational and professional structures simultaneously is crucial. Educational interventions can directly support SDG 4: Quality Education by promoting inclusive learning environments, while workplace and policy measures reinforce SDG 5: Gender Equality by ensuring equitable access to career opportunities. These strategies emphasize the importance of a comprehensive approach to reducing gender inequality in civil engineering.

Work-Life Balance and Double Burden

Maintaining a healthy work-life balance remains a major struggle for women in civil engineering, as the profession often demands long working hours, frequent travel, and physically demanding fieldwork, leaving little energy for family or personal responsibilities. Salamah & Widaningsih (2022) described this as a "double burden," where women are expected to manage

both their careers and primary parenting duties. This dual responsibility can limit career advancement, as women may skip promotions or avoid projects requiring extra commitment.

Studies across different countries suggest that the intensity of this challenge varies depending on workplace policies and cultural context. Research by Ghaleb et al. (2025) and Curtis et al. (2022) indicates that many construction companies offer minimal maternity leave, limited childcare support, and few remote work options. (Smith et al. 2022) further highlighted that these gaps often lead women to leave the profession, not due to lack of interest, but because balancing work and personal life in an unsupportive environment becomes overwhelming.

Comparative findings show that integrated strategies can mitigate these challenges. For instance, in Lagos, Nigeria, (Tunji-Olayeni et al., 2021) reported high stress and burnout due to heavy workloads and domestic responsibilities, whereas Schmitt (2021) observed in Germany that peer support, mentoring, and professional networks help women manage workplace stress and maintain overall stability. These results suggest that interventions addressing both organizational structures and social support systems are critical.

Evaluating these findings, it is evident that isolated policies such as maternity leave without mentorship or flexible work are insufficient. Integrated approaches combining flexible work arrangements, fair parental leave, professional development opportunities, and supportive networks provide a more holistic solution, reducing burnout, promoting well-being, and improving retention. Implementing such strategies aligns with SDG 3: Good Health and Well-being, SDG 5: Gender Equality, and SDG 8: Decent Work and Economic Growth, while also strengthening organizational performance and career sustainability for women in civil engineering.

Work Culture, Discrimination, and Psychological Safety

Culture in civil engineering has traditionally been shaped by masculine norms. Long working hours, hierarchical structures, and confrontational communication remain dominant, which can hinder women's success, particularly for those who lead with collaboration or empathy. Naoum et al. (2020) observed that women adopting inclusive leadership styles are sometimes perceived as less capable, even though such approaches enhance team collaboration and project outcomes. This demonstrates that deeply embedded gender norms continue to restrict recognition and slow career progression for women.

Discrimination is often subtle and systemic. Senaratne et al. (2025) noted that ignoring women's ideas, withholding praise, or excluding them from decisions reduces trust and psychological safety, causing women to withhold contributions. Curtis et al. (2022) highlighted that neglecting emotional stress and providing limited mental health support increases burnout and disengagement. These findings reveal that isolated interventions such as standalone leadership programs or anti-discrimination policies may yield limited improvements if underlying cultural and structural barriers remain unaddressed.

Emerging research emphasizes integrated strategies that combine cultural transformation, policy reform, and psychological support. For instance, policies promoting gender equality without addressing hierarchical norms may improve formal equality but fail to enhance everyday psychological safety. Conversely, coordinated interventions that cultivate inclusive leadership, provide mental health resources, and implement clear anti-discrimination measures have greater potential to sustain women's participation, career advancement, and overall well-being.

Although many studies focus on specific organizations or national contexts, collectively they underscore the necessity of coordinated and multifaceted approaches. Implementing combined cultural, structural, and policy-level interventions not only addresses SDG 5 (Gender Equality) and SDG 3 (Good Health and Well-being) but also strengthens team performance and fosters innovation within civil engineering. Critically, the literature suggests that addressing only

one aspect of the problem is not enough; lasting change requires combining efforts across organizational culture, leadership, and support systems.

Mentoring, Networking, and Institutional Support

Professional mentorship and networking play a crucial role in helping women succeed in civil engineering. These mechanisms provide guidance, encouragement, and practical advice, allowing women to navigate workplace challenges, develop leadership skills, and plan their careers with confidence. Senaratne et al. (2025) emphasized that structured mentoring programs, whether formal organizational initiatives or informal professional networks, offer consistent support, emotional encouragement, and direct guidance. Such programs enhance decision-making, goal setting, and career development.

Inclusive professional networks allow women to engage in strategic discussions, participate in important projects, and collaborate without exclusion (Curtis et al., 2022). Similarly, Ramachandran et al. (2024) highlighted that institutional support, including mentorship programs tailored to gender equality, mental health resources, and professional communities that consider employees holistically, strengthens retention and career satisfaction. Chew et al. (2020) further showed that workplaces with equitable leadership and strong HR support experience higher job satisfaction, productivity, and career growth.

Evaluating these findings, it becomes clear that discrete mentoring and networking initiatives alone may not fully address systemic challenges. Ghanbaripour et al. (2023) caution that inconsistent implementation, lack of monitoring, and unclear strategies can limit the effectiveness of such programs. Evidence suggests that integrated approaches combining mentoring, networking, inclusive workplace policies, and institutional support are more effective at sustaining women's participation, career advancement, and well-being. Aligning these strategies with broader organizational reforms and cultural change maximizes impact, promoting SDG 5 (Gender Equality) and SDG 3 (Good Health and Well-being).

Integration with the Sustainable Development Goals

The barriers and challenges that women face in the civil engineering industry, along with solutions to address them, were systematically mapped to the SDGs using a thematic analysis of the 20 reviewed studies. This integration followed a structured process: after identifying recurring themes such as gender bias, limited mentorship, workplace stress, and career progression barriers, each theme was explicitly compared to relevant SDG targets and indicators. This method ensured that the connections between the literature findings and the SDGs were evidence-based and traceable.

1. SDG 3 (Good Health and Well-Being)
Ensuring women's mental and physical health in the workplace requires a safe and supportive environment. Interventions such as access to counseling, structured emotional support, and flexible work schedules directly address stress, fatigue, and burnout reported across multiple studies (Curtis et al., 2022; Schmitt, 2021). By mapping health-related challenges identified in the literature to SDG 3 targets, the integration is grounded in empirical evidence.
2. SDG 4 (Quality Education)
Barriers beginning at the educational stage, such as limited access to STEM programs or lack of female role models, were identified in the reviewed studies (González-Pérez et al., 2020; Hardtke et al., 2023). These findings were systematically aligned with SDG 4 targets to show how inclusive curricula, scholarships, mentorship, and educational reforms can prepare women for careers in civil engineering.
3. SDG 5 (Gender Equality)

Workplace inequalities such as unequal access to promotions, underrepresentation in leadership, and discriminatory practices were consistently reported (Naoum et al., 2020; Senaratne et al., 2025). The integration process explicitly linked these challenges to SDG 5 indicators, showing which organizational policies, such as anti-harassment measures, maternity leave, and fair promotion practices, address each identified barrier.

4. SDG 8 (Decent Work and Economic Growth)

Women's full participation in civil engineering enhances innovation, productivity, and sustainable growth (González-Pérez et al., 2020; Naoum et al., 2020). Flexible work arrangements, anti-discrimination policies, social security, and childcare support help women balance professional and family roles (Ghaleb et al., 2025; Tunji-Olayeni et al., 2021). These integrated measures not only reduce career interruptions and foster long-term advancement but also directly support SDG 8 by promoting decent work, sustainable economic development, and workforce inclusivity.

Policy Recommendations

The following table summarizes evidence-based policy recommendations aimed at enhancing women's participation, retention, and well-being in the civil engineering industry. These recommendations are synthesized from recurring themes and findings across the reviewed studies, ensuring that they are grounded in empirical evidence. Each recommendation aligns with relevant SDGs to ensure that interventions are both practical and globally relevant.

Table 1. Evidence-Based Policy Recommendations and Their Alignment with SDGs

No	Policy	Intention	Implementation	Key Benefits	Related SDGs
1	Flexible Work Policy	To reduce work-life conflict and stress, enabling better participation and retention for women engineers.	Introduce remote work options, flexible hours, and job-sharing with fair performance evaluations.	Enhances work-life balance, reduces stress, and improves productivity and retention.	SDG 5, SDG 8
2	Anti-Bias Training	To foster an inclusive culture by increasing awareness of gender bias and discrimination.	Conduct mandatory gender bias and sensitivity training across all organizational levels.	Promotes equality, reduces discrimination, and strengthens collaboration.	SDG 5
3	Mental Health Services	To improve well-being and reduce burnout associated with workplace stress.	Provide counseling, wellness programs, and stress management workshops.	Enhances mental health, promotes consistent attendance, and supports workforce stability.	SDG 3, SDG 8
4	Networking, Women's Community, Mentoring	To strengthen women's confidence, professional growth, and sense of belonging.	Establish internal women's forums and connect with external professional associations.	Expands career opportunities, builds support networks, and improves engagement.	SDG 3, SDG 5

5	Educational Outreach	To encourage young women's interest and participation in engineering fields.	Offer scholarships, workshops, and industry visits featuring female role models.	Reduces gender gaps in education and increases women's representation in engineering.	SDG 4
6	Family-friendly policy	To support women balancing professional and family responsibilities.	Implement paid maternity leave, childcare facilities, and family-supportive schedules.	Improves job satisfaction, retention, and gender equity in the workplace.	SDG 3, SDG 5, SDG 8

Implementing these strategies in an integrated manner, together with flexible work, anti-bias initiatives, mental health support, mentorship, educational outreach, and family-friendly policies, can reduce gender disparities, strengthen workplace culture, and enhance organizational performance. These measures directly contribute to SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 8 (Decent Work and Economic Growth), offering both ethical and practical benefits for the civil engineering industry

CONCLUSION

The civil engineering industry plays a vital role in shaping communities, enhancing connectivity, and improving the quality of life. However, persistent gender discrimination, structural biases, and unequal access to education, career opportunities, and leadership positions limit the full potential of the workforce. This review demonstrates that women face multifaceted barriers, including inequitable hiring and promotion practices, excessive workloads, inflexible work culture, limited mentorship, and insufficient institutional support.

Addressing these challenges requires integrated, evidence-based strategies rather than separate or one-time efforts. Thoughtful policies, inclusive workplace practices, mentorship programs, and supportive professional networks can collectively reduce barriers, promote well-being, and foster equitable career advancement. Evidence from multiple studies shows that combining policy reform, cultural change, and targeted support is more effective than implementing any single measure.

Linking these strategies to the SDGs underscores their broader societal impact. Gender equality in civil engineering contributes to workforce well-being (SDG 3), inclusive education and training opportunities (SDG 4), equal participation in professional growth (SDG 5), and sustainable economic development (SDG 8). By implementing integrated interventions and fostering inclusive environments, the industry can become a model of gender equality while enhancing innovation, collaboration, and sustainable infrastructure development. Transforming civil engineering into an inclusive field empowers women and strengthens the industry's innovation, resilience, and sustainability.

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