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The Pre-Career Exodus: Why Female AEC Students Consider Leaving Before Entering the Workforce

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Women remain underrepresented in Architecture, Engineering, and Construction (AEC) education and careers globally, particularly in technical and leadership roles. This comparative study examines the experiences of female students in AEC programs across China, the United States (U.S), and Ibero-America. Survey results reveal that female representation in academic programs varies widely, with mentorship and support systems less accessible in China and Ibero-America than in the U.S. Anticipated career barriers include poor work-life balance, limited promotion opportunities, low salaries, and discrimination, with 72% of Chinese respondents considering leaving the industry before entering the workforce, compared to 41% in the U.S. and 30% in Ibero-America. Students identified effective strategies for retention, such as mentorship programs, leadership pathways, caregiving flexibility, and mental health resources. Although there are variations between regions, cultural norms and recruitment practices continue to be the most significant factors influencing outcomes. Current studies lack cross-regional analyses of pre-career experiences and motivations among women in AEC, highlighting the need for targeted interventions. This study addresses this gap by providing evidence-based recommendations to improve preparation and long-term retention of women in AEC fields.
Keywords: Women in AEC; Career barriers; Cross-regional comparisons; Mentorship.

Introduction

The Architecture, Engineering, and Construction (AEC) industry is a critical global economic contributor, essential for infrastructure development and delivery (Benchmark International, 2024). The underrepresentation of women in AEC reflects a broader global pattern, where the female workforce participation rate is under 47% (ILO, 2022). Within the construction sector, however, this disparity is significantly more pronounced. In the U.S., female labor force participation in construction constituted only 10.9% of the construction sector workforce in 2020 (USBLS, 2022), a figure that decreased to 9.8% by 2023 (NCCER, 2024). For instance, in developing nations, the representation can be even lower, such as 4.1% in the Peruvian total workforce (2016 data) (Barreto et al, 2017) and 7.7% in the Chilean construction workforce (Araya et al., 2025). This gender disparity is often conceptualized using metaphors such as the “glass ceiling,” a concept first introduced in early work on women's advancement into leadership roles in the early 1970s and early 1980s (Dozier, 1988). Similarly, the term “leaky pipeline,” which illustrates the loss of women throughout their career lifecycle, starting from education through the workplace (Grangeiro et al., 2021; Stefani, 2024). To effectively address workforce deficits and achieve Sustainable Development Goal 5 concerning gender equality, deliberate and targeted strategies are necessary to improve the retention of women in

the AEC industry (Adu Gyamfi et al. 2024). Current strategies largely focus on the workplace, including career development, supportive supervision, and flexible practices. However, increasing women's participation requires a focus not just on retention of post-entry, but also on the preparatory stages (Makhathini & Aigbavboa, 2025).

This study reports on a global perspective by comparing the experiences of women studying in AEC programs in the U.S., China, and Ibero-America (Spanish and Portugues Speaking countries). The analysis will identify differences and similarities in educational support systems across these three geographical locations. The purpose of this research is to identify barriers to entry and retention and the factors that support persistence and success across these distinct groups. The goal is to identify specific challenges and similarities among students in these three regions to formulate practical recommendations aimed at improving the preparation and long-term retention of women in AEC fields. To achieve this goal, the study addresses three research questions: **RQ1:** How do female AEC students across the U.S., Ibero-America, and China perceive their academic environments, including female representation and mentorship access? **RQ2:** What career barriers do female AEC students anticipate, and how do these anticipated barriers influence their intentions to remain in or leave the industry before workforce entry? **RQ3:** What institutional and organizational strategies do female AEC students identify as most effective for improving gender equity and retention in AEC? The following literature review examines existing research on these three areas to establish the theoretical foundation for this study.

Literature Review

This study conceptualizes women's persistence in AEC as shaped by an interconnected pathway: (1) pre-career socialization and academic preparation, (2) exposure to gendered norms and institutional climates, and (3) the development of "anticipatory attrition" intentions prior to workforce entry. This framework links what students experience (and observe) in university environments to what they expect from industry and whether they plan to remain in the field. Academic preparation and early career formation. Career intentions are formed well before workforce entry, influenced by prior socialization and early educational experiences (Germeijs & Verschueren, 2007; Soresi et al., 2014; Yan et al., 2024). Women may be drawn to AEC-related study through interest in collaborative, problem-solving work, and broader social impact goals (Dos Santos, 2022; Rokooei et al., 2023). However, AEC education can also transmit field norms and expectations (reinforcing a masculine paradigm) shaping how students interpret belonging, legitimacy, and future fit (Carrasco & Perez Lopez, 2025; Francis & Michielsens, 2021).

Gendered barriers as multi-level and institutionalized. Across the AEC literature, barriers to women's participation are consistently documented at individual, interpersonal, and organizational levels, including gender bias and stereotyping, exclusionary cultures, constrained advancement, and limited access to networks and role models (Phelps, 2024; Shape Talent, 2020; Luppi, 2024). These factors are not merely workplace problems; they can be anticipated and internalized during education through limited mentorship access, inequitable climates, and constrained visibility of women in authority. From barriers to "anticipatory attrition." STEM persistence research shows that students may change or abandon career plans during college in response to perceived incompatibility between identity, opportunity, and expected treatment in the field (Glass et al., 2013; Rosenzweig et al., 2024; Chen, 2013). In AEC, this implies that even prior to graduation, women can form expectations about discrimination, work-life conflict, and stalled advancement that translate into intentions to leave, an early "leak" in the pipeline. Retention and inclusion are context dependent, yet much of the AEC gender-equity literature is concentrated in Western settings (Francis & Michielsens, 2021; Makhathini & Aigbavboa, 2025). In the U.S., research frequently emphasizes recruitment, retention, and leadership trajectories amid persistent underrepresentation (NCCER, 2024; Hickey & Cui, 2024;

Luppi, 2024). In China, evidence points to continuing gender inequality in construction employment and organizational hierarchies, but fewer studies examine how women in AEC programs interpret support systems and future opportunity structures while still in school (Wang et al., 2025; Gao & Wang, 2025). *The Ibero-America Countries* present a critical area for study due to the scarcity of in-depth analysis on this topic. This definition encompasses Spanish and Portuguese speaking countries from Ibero and Latin America regions (Poikolainen, 2023). In Ibero-America contexts, scholarship highlights machismo norms, limited promotion access, and motherhood-related penalties, yet student-focused evidence remains comparatively sparse (Araya et al., 2025; WBG, 2025; Bouhmoud & Loudyi, 2023).

Although research has documented women's barriers in AEC, syntheses note that studies often emphasize professionals already employed and frequently conflate recruitment with retention (Makhathini & Aigbavboa, 2025). There is a noted lack of systematic analysis focusing on the range of strategies that promote retention in the AEC workforce, often conflating retention with recruitment initiatives. The existing studies tend to treat women as a homogenous group (Society of Women Engineers, 2025), and most of the research focus on AEC contexts in Australia, U.S., and U.K. (Francis & Michielsens, 2021). While scholars have studied the underrepresentation of female students, both at the high school and college levels, there remains significant room for improvement. Previous studies often investigate broad factors influencing careers in construction across different career stages, neglecting the fact that women's priorities change as they progress (Leonardis, 2025). The current literature lacks studies that capture students' comprehensive perspectives on gender-related challenges and support needs in AEC careers across diverse global contexts (Carrasco & Perez Lopez, 2025), particularly linking the student experience in developed countries (e.g., U.S.) versus other countries (China and Ibero-America countries). This limits the ability to provide effective, context-specific recommendations for early career intervention and long-term success. The following section will review the current state of knowledge pertaining to the academic environment, anticipated career challenges, career commitment, and support systems for women in AEC, highlighting the research gaps this study aims to address. Specifically, while prior research documents barriers to women's participation and retention, most evidence is drawn from single-country or predominantly Western contexts, leaving limited understanding of how academic support conditions (e.g., mentorship access and perceived representation) shape pre-career expectations across diverse cultural and institutional settings. This study fills that gap by using a common survey instrument to compare female AEC students' academic environments, anticipated barriers, and pre-career attrition intentions across the U.S., China, and Ibero-America. By comparing regions, this study tests whether perceived representation, mentorship access, and intentions to remain in AEC align across contexts.

Methodology

This study employed a cross-sectional survey design to examine female students' perceptions of career barriers, support systems, and retention factors in the AEC industry across three distinct geographic and cultural contexts. The research aimed to understand pre-career attitudes and expectations that may influence female students' commitment to AEC careers before entering the workforce. The objective was to capture how students across diverse cultural contexts specifically the U.S., Ibero-America countries, and China perceive gender equity within academia and anticipate potential barriers in their future professional careers. The survey instrument was developed through an extensive review of existing literature on gender diversity, mentorship, and workforce participation in the AEC industry, alongside expert consultation with faculty members in construction management and civil engineering education. To establish content validity, the instrument was reviewed by a panel of five faculty experts across the three regions, who assessed item relevance, clarity, and cultural appropriateness.

The survey was designed to explore not only students' academic experiences but also their perceptions of the industry they are preparing to enter, thereby bridging the gap between academic preparation and professional expectations. Quantitative items utilized a 5-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree) to measure attitudes toward career recommendations, perceived importance of female faculty, and workplace support assessments. Multiple-choice questions were designed to allow participants to select all applicable options, enabling identification of the full spectrum of anticipated barriers and desired support mechanisms. This approach recognizes that students may perceive multiple, intersecting challenges rather than singular obstacles to their career progression. As a result, percentages reported in the results tables reflect the proportion of respondents selecting each option and do not sum to 100%. The survey was structured around four thematic sections designed to align with the objectives of the study:

1. *Student Demographics and Academic Environment:* capturing the proportion of female students and faculty, mentorship access, and perceptions of the importance of female representation.
2. *Anticipated Career Barriers:* exploring students' willingness to recommend AEC careers, their intentions to remain in or leave the field, and the reasons behind potential attrition.
3. *Student-Identified Solutions*: gathering perspectives on institutional and organizational policies to promote gender equality, prevent harassment, and retain women in AEC.
4. *Cross-Cultural Perceptions:* comparing regional similarities and differences in perceived challenges and priorities across the U.S., Ibero-America countries, and China.

Following institutional review board (IRB) approval from participating universities, female students enrolled in AEC-related programs were recruited across three regions: the U.S., Ibero-America countries (Spain; Brazil; Colombia; Chile; Ecuador; and Peru), and China Participants were enrolled in undergraduate and graduate programs across related AEC disciplines at both public and private institutions. Recruitment targeted a mix of research-intensive universities and teaching-focused institutions to capture diverse academic environments. Recruitment employed a multi-channel approach through academic departments, student organizations, and professional society for student chapters. Department chairs and faculty coordinators were contacted to obtain permission for survey distribution within their programs. Once institutional approvals were secured, participants received recruitment materials including digital flyers, QR codes linking to the online survey platform, and direct email invitations through university listservs. The survey was administered electronically through Qualtrics, ensuring accessibility across different time zones and academic schedules. Survey materials were provided in English for U.S. participants, Spanish and English for Ibero-America participants, and Mandarin for participants in China. Translation followed a back-translation protocol: native speakers translated the instrument from English to Spanish and Mandarin, and independent translators back-translated to English to verify equivalence. Discrepancies were resolved through consultation with bilingual faculty members to ensure linguistic equivalence, cultural appropriateness, and response validity across all three languages. A total of 137 valid responses were obtained: 17 from the U.S., 81 from Ibero-America countries, and 39 from China. Only female-identifying students currently enrolled in undergraduate or graduate AEC programs were included in the analysis. All responses were screened for completeness and consistency before analysis. Participant anonymity and response confidentiality were maintained throughout the study in accordance with ethical research standards and research protocols.

The sample distribution across regions reflects differences in recruitment access and response rates rather than intentional sampling design. As noted by Body (2016) even small samples can reveal meaningful patterns in exploratory cross-cultural research, the small sample size for U.S. (n=17) should be interpreted with caution. The larger Ibero-America sample (n=81) benefited from established faculty networks across multiple countries, while the China sample (n=39) reflects

responses from two participating institutions. These limitations are acknowledged, and findings are presented as exploratory insights rather than definitive conclusions. Data was analyzed using descriptive statistical techniques to identify regional trends and differences. Frequencies and percentages were computed for multiple-choice and categorical items to determine the prevalence of specific barriers, strategies, and perceived support mechanisms. For Likert-scale items, mean values were calculated to compare average perceptions across regions. Given the uneven sample sizes and exploratory nature of this study, inferential statistical tests were not conducted; instead, the analysis focused on identifying patterns and trends that warrant further investigation. The analytic strategy emphasized cross-regional comparison to highlight cultural, institutional, and structural variations influencing how students experience and anticipate gender-related challenges within the AEC field. Comparative tables were developed to present the results systematically, maintaining alignment with the study's three primary focus areas. The following results are organized according to the research questions: academic environment, anticipated career barriers, and student-identified solutions.

Results

Female faculty representation in AEC-related programs remains limited across all regions, with most students reporting that women make up less than half of their cohorts. U.S. respondents showed a somewhat more balanced distribution, with 41% estimating female representation at 11–25% and 35% at 26–50%, while Ibero-America students were more clustered at the lower end, with 25% reporting 0–10% and 22% at 11–25%. Chinese students perceived the highest representation, with 67% estimating 26–50% women and 8% indicating female-majority programs, suggesting relatively greater female faculty visibility in China despite persistent gender gaps overall. Students across all regions rated female faculty presence as important for women's participation in AEC, with higher mean importance scores in China (4.33) and Ibero-America (4.39) than in the U.S. (3.65), underscoring the perceived value of visible female role models for recruitment and retention.

Access to mentoring faculty supervisors showed pronounced regional disparities. U.S. students reported the highest access to mentorship (88%), compared with 40% in Ibero-America and only 31% in China, a concerning gap given Chinese students' strong recognition of the importance of female faculty. This mismatch between perceived need and actual access may negatively affect career persistence. Among those with mentors, Chinese students were most likely to have female mentors (58%), whereas U.S. and Ibero-America students primarily worked with male mentors (60% and 72%), indicating that Chinese students are comparatively more likely to have female role models. Students across regions identified multiple strategies to increase female faculty representation in AEC, with Chinese respondents showing the strongest support for systemic reforms (87% favoring improved hiring practices), U.S. students prioritizing mentorship pipelines (71%), and Ibero-America students offering moderate support across strategies but relatively higher endorsement of enhanced hiring practices (44%).

Table 1. Effective Strategies for Increasing Female Faculty Representation

Strategies	U.S. (n=17)	Ibero-America (n=81)	China (n=39)
Improved hiring practices	47%	44%	87%
Mentorship pipelines	71%	40%	79%
Institutional policies	59%	42%	72%
None of the above	24%	5%	5%

Despite valuing female faculty representation, students showed stark regional differences in their willingness to recommend AEC careers to other women. U.S. and Ibero-America students reported relatively positive scores (4/5 and 4.028/5), suggesting general satisfaction with their chosen field. In

contrast, Chinese students' low score (2.205/5) indicates they would often discourage other women from entering AEC, implying that they foresee greater challenges or fewer opportunities, likely linked to unfavorable labor market conditions for women.

The study also identified substantial pre-career attrition risk, with many students considering leaving AEC before entering the workforce. Chinese students showed the highest risk (72%), compared with 41% in the U.S. and 30% in Ibero-America, signaling a significant loss of talent during academic preparation. As summarized in Table 2, U.S. students who considered leaving most often cited poor work-life balance, limited promotion opportunities, and low salary (57% each). Ibero-America students primarily reported poor work-life balance (83%), followed by lack of mentorship or guidance and low salary (50% each). Chinese students reported a more complex profile, with discrimination and harassment (61%) emerging as a key concern unique to this region, alongside limited promotion opportunities (64%) and low salary (64%).

Table 2. Reasons for Considering Leaving the AEC Industry (Those Considering Leaving)

Reasons for Considering Leaving	U.S. (n=7)	Ibero-America (n=24)	China (n=28)
Poor work-life balance	57%	83%	21%
Lack of promotion opportunities	57%	33%	64%
Low salary	57%	50%	64%
Caregiving responsibilities	0%	33%	4%
Lack of mentorship/guidance	0%	50%	29%
Lack of support programs	0%	17%	46%
Discrimination/harassment	0%	17%	61%

These findings indicate that students' anticipated barriers reflect challenges already documented among AEC professionals, showing that gendered obstacles are institutionalized and recognized early in academic pathways. Regional patterns highlight distinct cultural pressure points, work-life balance in Ibero-America and discrimination and harassment in China, underscore the need for context-specific interventions.

Across all regions, students proposed policy and organizational measures to address gender inequities. There was strong consensus on mentorship, leadership accountability, and mental health support as priorities, though emphasis varied. As shown in Table 3, Chinese students strongly supported comprehensive anti-harassment strategies, with 90% endorsing leadership accountability that holds organizational leaders responsible for enforcing policies and modeling inclusive behavior. They rated all four measures highly, viewing harassment as a multifaceted issue. U.S. students prioritized cultural change (71%), focusing on shifts in workplace norms and attitudes, while Ibero-America students similarly valued culture change (62%) but expressed weaker support for additional interventions.

Table 3. Policies and Practices to Reduce Workplace Harassment

Policies and Practices	U.S. (n=17)	Ibero-America (n=81)	China (n=39)
Training programs	59%	37%	72%
Effective reporting systems	47%	32%	79%
Cultural shifts	71%	62%	79%
Leadership accountability	59%	40%	90%

Table 4 presents the result of the perceived barriers preventing gender-equal representation in design and innovation teams across regions. Chinese students perceived cultural norms and recruitment biases to be the most comprehensive set of barriers (82%). U.S. students primarily focused on team dynamics (71%) and cultural norms (59%), showing less concern about recruitment biases (24%).

Ibero-America students showed moderate concern across all barriers, with cultural norms (49%) as their top priority. This pattern suggests that Chinese students anticipate facing systemic barriers at multiple levels of organizational structure.

Table 4. Perceived Barriers to Gender-Equal Representation

Barriers	U.S. (n=17)	Ibero-America (n=81)	China (n=39)
Cultural norms	59%	49%	82%
Recruitment biases	24%	25%	82%
Team dynamics	71%	37%	72%

Table 5 presents the complete distribution of initiative preferences to be effective by participants. Chinese students showed overwhelming support for recruitment initiatives (97%), while U.S. students prioritized leadership pathways (82%). Ibero-America students showed more moderate support, with leadership pathways (47%) and recruitment initiatives (44%) as their top priorities. This difference suggests Chinese students see the primary challenge as attracting women to the field, while U.S. students focus on advancement opportunities for women in the industry.

Table 5. Initiatives to Increase Women in AEC

Initiatives	U.S. (n=17)	Ibero-America (n=81)	China (n=39)
Mentorship programs	47%	30%	79%
Recruitment initiatives	35%	44%	97%
Leadership pathways	82%	47%	77%

Table 6 summarizes retention programs to help with women attrition in the AEC industry. Chinese students showed unanimous support (100%) for both caregiving flexibility and mental health resources, with 97% also supporting leadership pathways. This suggests Chinese students anticipate needing comprehensive support systems to sustain careers in AEC. Ibero-America students considered caregiving flexibility (57%) as their top priority while U.S. students consider health resources (82%) as their top priority.

Table 6. Programs and Policies for Retention

Programs and Policies	U.S. (n=17)	Ibero-America (n=81)	China (n=39)
Leadership pathways	59%	49%	97%
Caregiving flexibility	71%	57%	100%
Mental health resources	82%	27%	100%

Discussion

The findings reveal persistent gender disparities in AEC education and women's anticipated professional experiences across the U.S., China, and Ibero-America. Although female participation remains low, differences in representation, mentorship, and career expectations illustrate how structural and cultural conditions shape women's persistence in AEC fields. The continued underrepresentation of women aligns with earlier research describing the masculine paradigm of construction education (Carrasco & Perez Lopez, 2025). In China, students reported the highest female representation (82%) but the lowest mentorship access (31%) and highest attrition intentions (72%), reflecting a mismatch between enrollment and support systems (Li et al., 2025; Francis & Michielsens, 2021).

Chinese students also showed the lowest willingness (2.205/5) to recommend AEC careers to women, contrasting with more positive ratings in the U.S. (4.0) and Ibero-America (4.028). This aligns with

evidence of systemic gender discrimination in China's labor market, where women receive fewer interview callbacks and face bias rooted in gender stereotypes (Zhang et al., 2021). Such expectations contribute to high pre-career attrition intentions (72%), echoing STEM research showing that women often exit technical fields due to perceived incompatibility between professional identity and gender norms (Glass et al., 2013; Rosenzweig et al., 2024; Chen, 2013).

Regional variations—72% in China, 41% in the U.S., and 30% in Ibero-America—reflect differences in labor markets, cultural expectations, and institutional support. Discrimination and limited career prospects in China (Zhang et al., 2021), family-centered norms in Ibero-America (Araya et al., 2025), and stronger anti-discrimination structures in the U.S. explain these differences. The lower attrition rate in Ibero-America suggests that social support networks and professional identity formation may reinforce persistence despite gender challenges.

Students cited work-life balance, limited promotion, and low salary as main reasons for considering departure, consistent with prior findings across AEC and STEM professions (Al Salaheen et al., 2024; Jiang, 2021). Regional patterns reveal distinct emphases: Ibero-America students prioritized work-life conflict (83%) linked to family expectations (Araya et al., 2025; Barreto et al., 2017); Chinese students stressed discrimination and harassment (61%) shaped by hierarchical workplace structures (Gao & Wang, 2025); U.S. students reported balanced concerns reflecting ongoing "hidden inequalities" in advanced economies.

Despite contextual differences, students across all regions demonstrated a clear understanding of gender inequality and emphasized mentorship, leadership accountability, and mental-health support as critical reforms. Chinese respondents prioritized anti-harassment policies and leadership accountability (90%; 79%), while U.S. students focused on advancement and leadership pathways. Ibero-America students emphasized mentorship and cultural transformation, though fewer recognized mental health programs (27%), likely due to limited resources or stigma. These perspectives reinforce global evidence calling for multi-level interventions integrating policy reform, inclusive leadership, and well-being support to close gender gaps in AEC (Makhathini & Aigbavboa, 2025; Francis & Michielsens, 2021).

Conclusion

This study advances understanding of women's participation in AEC fields by introducing anticipatory attrition, a process where negative career expectations formed during education lead to planned withdrawal before entering the workforce. It shifts attention from retaining professionals to preventing early disengagement in academic settings. Findings from China show that higher female enrollment does not guarantee career persistence, emphasizing the importance of mentorship, institutional support, and equitable academic climates. The study calls for stronger mentorship systems and inclusive cultures in universities, particularly in China and Ibero-America, and for closer academia–industry collaboration through realistic career exposure, anti-discrimination efforts, and clear leadership pathways. Together, these measures form a framework for gender-sustaining ecosystems linking education and equitable careers. The study's cross-sectional design captures intentions rather than outcomes; future longitudinal and mixed-method research should test whether attrition intentions predict actual exits and how mentorship and institutional factors influence persistence.

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