

## Women in Construction Workshop: Outreach to Female Students from Developing Countries

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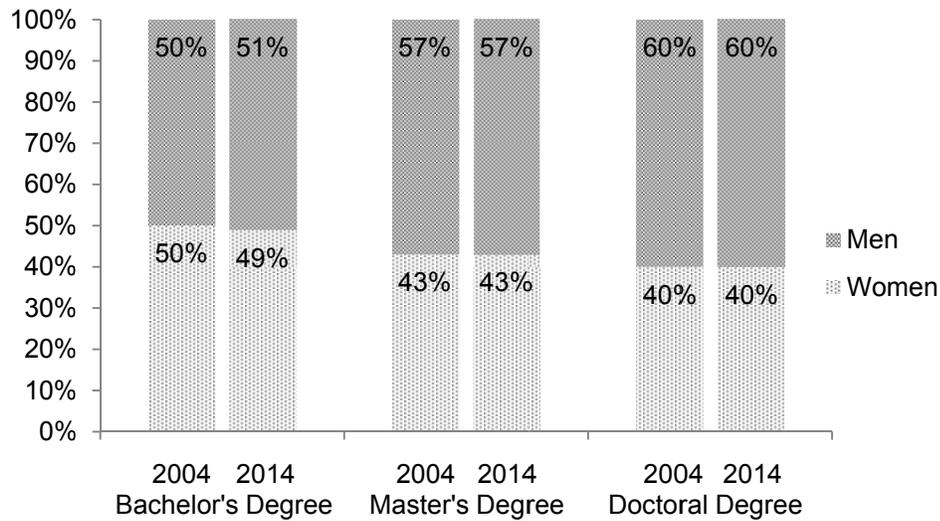
### Abstract

Women comprise only 9% of the entire U.S. construction industry workforce and even a lower percentage in many developing countries in Asia (7.5%) and South America (0.5%). Educational institutions can help resolve this problem by providing proper training to underrepresented minority (URM) students and encourage them to pursue a successful career. Since many students from developing countries who study abroad often choose not to return home upon graduation, those who do not leave their home countries in the first place become the real assets for the growth and development of their homelands. The first women in construction workshop (WCW) was organized and hosted in Orlando, Florida in partnership with two universities from China and Brazil to target this latter population. Through a rigorous application process, a number of female students were selected to attend the event which included discussion sessions and seminars led by several female construction faculty, career development experts, and industry practitioners. This paper presents the program details, outcomes, assessment results, and success stories to demonstrate the impact of training female graduate students as future role models on recruiting and retaining younger generations of women and minorities in developing countries.

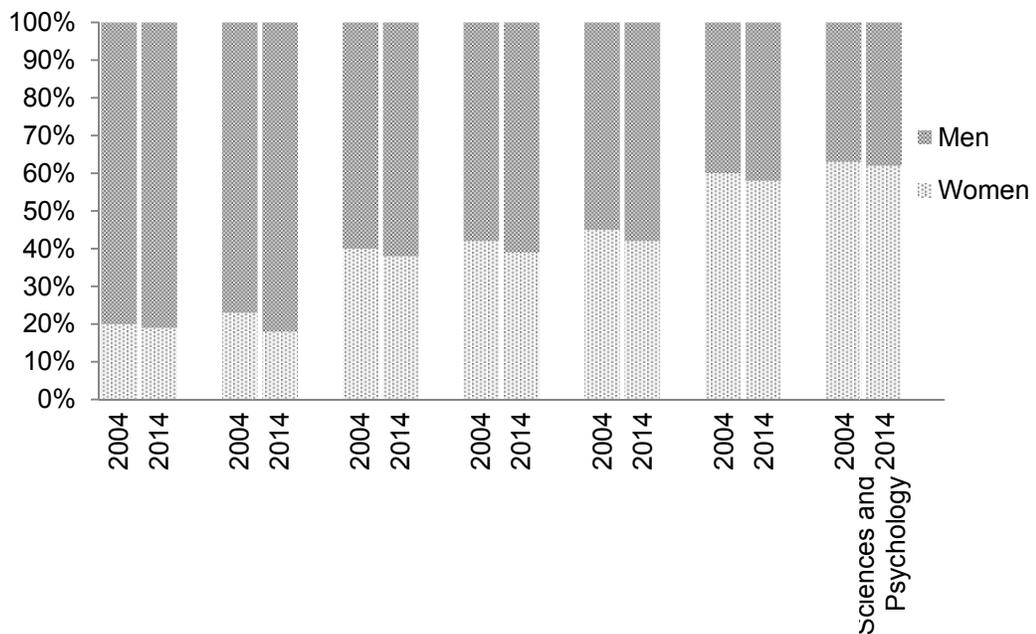
### INTRODUCTION

#### Women in STEM

Historically, science, technology, engineering, and math (STEM) programs at colleges and universities have not been able to attract female students in sufficient numbers. According to the National Student Clearinghouse, degrees earned by women constitute more than half of all the undergraduate degrees awarded in the U.S. from 2004 to 2014 (see Figure 1). This is while there is no consistent distribution of female students across all disciplines. Female students are overrepresented in some fields such as social sciences and psychology, while they are underrepresented in other fields such as engineering (see Figure 2).

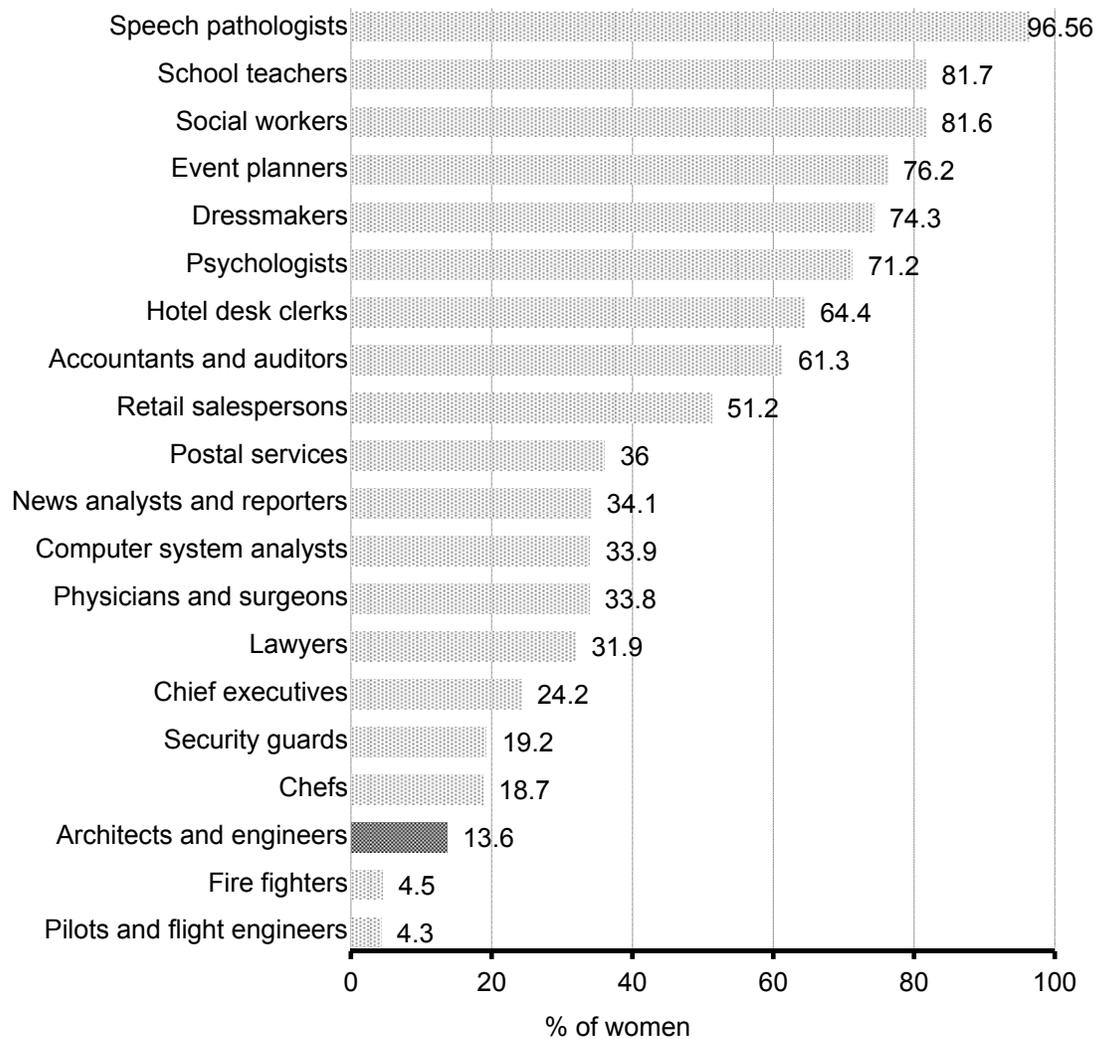


**Figure 1. Gender distribution of science and engineering degrees by level**



**Figure 2. Gender distribution of undergraduate degrees in science and engineering disciplines**

In 2011, the U.S. Bureau of Labor Statistics has released data which uncovered more severe issues related to women’s employment in architecture and engineering occupations (U.S. Bureau of Labor Statistics, 2011). As shown in Figure 3, the data showed that women only comprised 13.6% of the architecture and engineering occupations.



**Figure 3. Women employees as a % of total employed in selected occupations (U.S. Bureau of Labor Statistics, 2011)**

In spite of increasing investments in STEM education and training, the low degree of retention of women in the science, technology, and engineering labor force has become a persistent issue (Hill et al. 2012). Previous research in this area has mostly focused on uneven employment rates and conditions of women compared to men in STEM fields, trying to find the reasons of this inequality (Maharaj and Edigheji 2011). Few researchers have further investigated the problem of women's retention relative to men's in other areas (Glass 2013). Some researchers have explored parameters affecting women's retention (Smith-Doerr 2004, Stephan 2005, and Gray 2007). Others have highlighted the relatively lower number of women employees in STEM compared to men in academia, and proposed improvement strategies to promote the involvement of women in academia (Long 2001, Preston 2004, and Williams 2012).

Although a comprehensive research is needed to explore solutions to address this important issue, training and development programs targeting women's education could be also extremely beneficial to prepare them as successful future role models for the next generation of women in STEM. Moreover, studies in this area can help to explore key parameters affecting the recruitment and retention of women in STEM occupations.

### **Women in developing countries**

In recent decades, international and multinational institutions and organizations have made significant efforts to eliminate gender inequalities (Ganguli 2014). In doing so, the first priority has been mostly given to equality in education (Ganguli 2014) which is a leading factor for global growth and development. Although the lack of a holistic view has created egregious differences in equal education in some fields, such efforts have been generally effective in filling certain aspects of the gender gap in women's education. As expected, these movements have been more cohesive and systematic in developed countries than developing parts of the world. Therefore, a more severe problem still exists in many developing countries such as those in Asia and South America. This has caused a large number of students from these countries (both male and female) to leave their homelands behind in pursuit of higher education in one of many universities and colleges in Europe and North America. For example, a 2012 study shows that the number of Indian students going overseas to study increased 256% (from 53,266 to 189,629) in a span of only nine years (2000 to 2009) (Mukherjee and Chanda 2012). In 2009, the U.S. hosted 20% of the 3.3 million students worldwide who were pursuing higher education outside their home countries. The U.K. had the next largest portion, with 13% of the total, followed by France (8%), and Germany (7%). Australia and Canada were also among top destinations for international students (Institute of International Education 2009). More recently, in 2013, the total number of Chinese students in the U.S. was up by 21% and reached 235,000. There were also a 20% increase in students from Brazil, to a total of 10,900, and a 30% increase in the number of students from Saudi Arabia, with nearly 45,000 students in the U.S. (Institute of International Education 2013). At a first glance, this may not come across as a major issue, especially since international students contribute approximately \$24 billion to the U.S. economy each year. A closer look, however, shows that upon graduation, a solid majority of these students (including many female students) choose to stay in their host countries (i.e. U.S., U.K., Canada) through seeking employment, marriage, or moving to large metropolitan areas. Many of these students are by definition talented and have great potential to transform the status quo of education and training infrastructure, and prepare younger generations in their home countries for a highly connected world. Therefore, the mere fact of them not returning to their homelands to contribute to the success of the next student generations can be detrimental to the economic growth of their countries in the long term. Arguably, a developing country with an ill education system that cannot attract, retain, and nourish young talents will not be prosperous by globally accepted norms. Depending on one's perspective of world affairs, this can be looked upon as a pure educational crisis or even a humanitarian or global security problem in the long run.

### **Women in construction**

In particular, undergraduate programs in construction and civil engineering are heavily dominated by male students, as is the construction industry. Figures show that women engineers account for just 12.7% of the entire U.S. construction workforce and are therefore in the distinct minority (U.S. Bureau of Labor Statistics 2015). Such data indicates that there is a subset of the population that is prime for education but is not seeking, nor being retained in construction education.

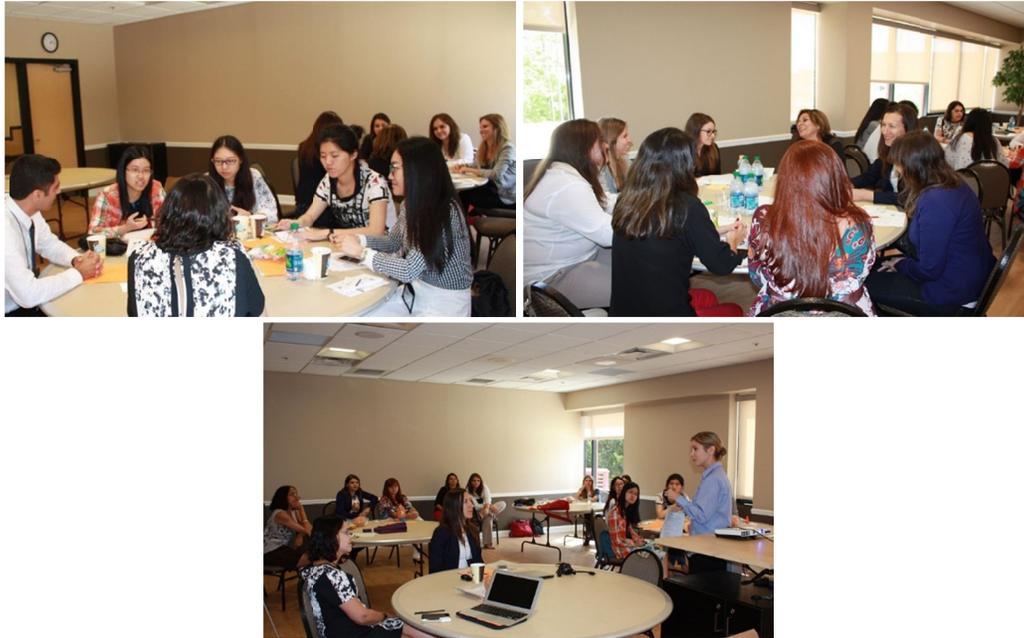
In a 2011 study published by the Association Schools of Construction (ASC), several strategies were suggested to help increase the enrollment and retention of female students in construction and civil engineering programs (Lopez del Puerto Guggemos and Shane 2011). Among the recommended strategies, recruiting more female faculty members was listed as a promising approach as female instructors can serve as role models to female students and influence their perception. It was also stated that female faculty will in turn have more tendency to hire female students, and female graduate school, middle school, and high school students would be more likely to pursue construction degrees if reached out to by a female faculty who shared their experiences with them during a school visit or career fair event. It is thus imperative that educating and training effective female faculty and instructors can play a critical role in attracting more talented female students to construction and civil engineering programs.

### **WOMEN IN CONSTRUCTION WORKSHOP (WCW)**

#### **Workshop Goals**

The overarching goal of the 2015 Women in Construction Workshop (WCW) was to study the impact of family, society, and educational structures on facilitating or preventing retention of women in construction occupations. Given that each of these factors can play an important role in building women's skills and abilities, the work was also extended to investigate further gender stereotypes in two culturally different countries, namely Brazil and China. In order to provide participants with success stories and examples, several female faculty and industry practitioners were also invited to and participated in the event. This event provided an opportunity for the attendees to gain a first-hand experience about the U.S. educational system, interact with their peers in a collaborative and engaging environment, establish long-lasting professional relationships with their U.S. counterparts, and ultimately, take home what they learned so that once they start their independent careers, they can inspire more female students on their path to success.

To achieve the objectives of this workshop, partnerships were established with two universities in Brazil (University of Campinas) and China (Xi'an Jiaotong-Liverpool University). Following a rigorous process, female graduate students from these two universities who were pursuing a degree in an architecture, engineering, or construction (AEC) discipline were selected and received travel grants to participate in the 3-day WCW from June 30 to July 2, 2015. The workshop was successfully organized and held by the authors in Orlando, Florida (see Figure 4).



**Figure 4. Snapshots from the 2015 Women in Construction Workshop (WCW)**

### **Selection criteria and procedure**

A call for participation was sent out to students enrolled in AEC disciplines in two universities: University of Campinas (Brazil), and Xi'an Jiaotong-Liverpool University (China). Students were invited to submit their application materials which included a 2-page essay describing their future ambitions, how they can inspire younger female students to pursue careers in construction and civil engineering in their home countries, challenges they face, and what makes them stand out in a highly competitive academic environment. In addition to assessing a student's ability to write and communicate her ideas, a key factor in evaluating these essays was the display of potential evidence showing how much thought she had put into her future career goals, how serious she was about her aspirations, and whether she held a high promise to pursue a professional career (in academia or industry) in her home country. Each student was also asked to submit a detailed CV as well as two letters of recommendation from faculty in her institution. A total of 20 students participated in the competition. Following a careful examination and ranking of all applications and considering project budgetary limits, 4 students from China and 6 students from Brazil (total of 10 students) were selected.

### **Programs and activities**

During the event, attendees participated in a variety of group activities and seminars that aimed to impart their knowledge about:

- Fundamentals of a successful AEC career in academia or industry,
- Ways to access and properly use the latest technology trends,
- Utilizing a variety of information sources available on public domains, internet, and libraries,
- Creating effective instructional materials,

- Establishing long-lasting work relationships with other peers,
- Developing interpersonal rapport in professional settings, and
- Inspiring younger female students to pursue careers in construction and civil engineering.

To achieve better results, promote diverse opinions, and encourage constructive discussions, the organizing committee also invited successful female faculty from three U.S. institutions to serve as facilitators of workshop sessions and speak to participants about their success stories and challenges, managing their time between school and work, and ways to attract and recruit tomorrow's female students.

Given the small size of the event, students were given ample opportunities to practice what they learned in small-group settings and discuss their opinions in focus groups. This collaborative "learn by doing" format ensured that participants made substantive improvements in their skills by the end of the workshop. The list of main sessions and title of speakers are summarized in Table 1. In addition to main workshop sessions, several social activities including sightseeing and local tours were also arranged for the participants.

**Table 1: 2015 Women in Construction Workshop (WCW) Main Program**

Day	Session Topic	Title of Speaker
1	Opening remarks	WCW Organizing Chair, UCF
	State of STEM education	STEM researcher, UCF
	Industry speaker	Associate Architect, SchenkelShultz Architecture
	Guest faculty Talk	Assistant Professor, California State University East Bay
	State of CECE	Professor and Chair of CECE Department, UCF
2	Mentorship and effective communication	Director of Office of Undergrad Research, UCF
	Pathways to success	Professor and Assistant VP for Research, UCF
	Guest faculty Talk	Assistant Professor, University of Texas Austin
	Diversity and inclusion	Assistant Director of Office of Diversity and inclusion, UCF
	Guest faculty Talk	Professor, Florida International University
	Industry speaker	Senior Engineer, Atkins
3	Guest faculty Talk	Assistant Professor, Iowa state University
	Information retrieval and library research	UCF Libraries
	Closing remarks and assessments	WCW Organizing Chair, UCF

## RESULTS AND ASSESMENT

Based on a comprehensive review of the literature on learning assessment techniques, pre- and post- questionnaire forms were designed and distributed (both before and after the workshop) to assess the participants' knowledge, experience, skill level, and their thoughts and opinions on challenges (e.g. interest, training, employment, retention, culture, society) encountered by women in male-dominated fields such as construction. Students were also asked to fill out a series of feedback

forms after each training session about the quality and content of the session, as well as a general feedback form to reflect on their overall satisfaction and suggest ways to improve the quality of similar events in the future. A thorough analysis was then conducted on the collected data. This section contains a summary of results and related discussions.

Analysis was initiated with reviewing participants' information, and their educational backgrounds. This preliminary phase was then followed by examining participants' current status and future needs. The majority of students (70%) were from urban areas with the remaining (30%) from rural areas. Even though they had an average of 4 years of professional experience in AEC, their experience level was variable from 0 to 10 years. Student participants were enrolled in civil engineering (50%), architecture (30%), or construction (20%) programs.

According to the students' responses collected from the pre-questionnaire forms, 90% of participants believed that women are not presented with equal work opportunities in their countries. Nonetheless, all respondents agreed on the fact that women can work just like men in construction. Students were also asked to rank on a scale of 1 (not at all) to 5 (very important) the importance of different factors (in their opinion) in finding a professional career after graduation in their home countries. According to the results, experience level was ranked at the top of the list (mean = 4.6), followed by personal qualification (mean = 4.5), skills (mean = 4.4), level of education (mean = 3.8), and finally gender as the last factor (mean = 3.3). In addition, in the pre-questionnaire form, participants were asked to rate themselves with respect to personal traits required for a job on a scale of 1 (poor) to 5 (excellent). As seen in Table 2, results indicated that they perceived "productivity" as their best trait (mean = 4.2), followed by "self-efficacy" (mean = 4), while "creativity" and "planning and organizational skills" were ranked at the bottom of the list (mean = 3.7).

**Table 2: Self-perception of personal traits (pre-questionnaire)**

Trait Factor	Pre-Questionnaire	
	Rank (Mean)	Standard Deviation
Productivity	1 (4.20)	0.63
Self-efficacy	2 (4.00)	0.66
Job Knowledge	3 (3.90)	0.87
Experience	3 (3.90)	1.19
Communication	3 (3.90)	0.87
Self-Belief	3 (3.90)	0.56
Creativity	4 (3.70)	0.82
Planning and Organizational Skills	4 (3.70)	0.48

At the end of the 3-day event, each participant also filled out a post-questionnaire form to evaluate the contribution between what she learned and experienced in the workshop to her personal traits. As listed in Table 3, results indicated a slight to moderate improvement in almost all aspects. Moreover, the new rankings of personal traits show a very interesting trend. In fact, comparing Tables 2

and 3, it can be observed that participating in the workshop helped students improve in areas that had been initially ranked at the bottom of the list. For instance, upon completion of the workshop, participants believed that their communication skills, self-belief, and planning and organizational skills were significantly improved.

**Table 3: Self-perception of personal traits (post-questionnaire)**

Trait Factor	Post-Questionnaire	
	Rank (Mean)	Standard Deviation
Communication	1 (4.80)	0.42
Self-Belief	2 (4.70)	0.48
Planning and Organizational Skills	3 (4.60)	0.51
Self-efficacy	3 (4.60)	0.51
Productivity	4 (4.30)	0.67
Creativity	4 (4.30)	0.82
Experience	5 (4.20)	0.63
Job Knowledge	6 (4.10)	0.87

Furthermore, at the conclusion of the workshop, students were asked to provide anonymous feedback about the event and their experience. One participant mentioned that “...the knowledge and information gained from participation at this workshop exceeded my expectations. The informal way of dealing with serious problems facilitated the learning and exchange of experiences”. Another participant stated that “...the workshop changed my mind about the role of women in construction industry. Previously, I just had accepted the situation of women versus men in China. But now I am confident that we are capable of working same as men and can prove it”. Others wrote, “...it is tough to choose the most interesting topic [in the workshop], because all were quite interesting. I really can't imagine more effective [lessons] than what was thought to us”, and “...I enjoyed every single presentation. All topics inspired me in different ways; especially the topic about diversity and communication.”

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