



Diversity in the Structural Engineering Profession

Challenges and Opportunities

By Abbie B. Liel, with the SEI Young Professionals Committee

There are many benefits to a diverse workforce of structural engineers. The representation of multiple perspectives and experiences in the workplace has shown to enhance innovation, creativity, knowledge, and productivity (NAS 2006). Even so, less than 15% of civil engineers are women and less than 20% are nonwhite. In contrast, women now make up over 30% of lawyers and physicians, and over 70% of psychologists (BLS 2012). Since no evidence exists that significant gender or racial differences in math or science ability exist (Valian 1998; NAS 2006), discrepancies in engagement and achievement in engineering have been attributed to a range of factors including a lack of preparation and encouragement, workplace and academic cultures, and the public image of engineering. As the structural engineering profession grows and advances in the 21st century, it is critical that it be able to recruit and retain the most talented individuals, regardless of gender or race. To this end, this article examines the current demographics of the structural engineering profession and investigates how the experiences of structural engineers vary with gender and race/ethnicity. A full report on the Young Professionals Committee's study will be published as an SEI report.

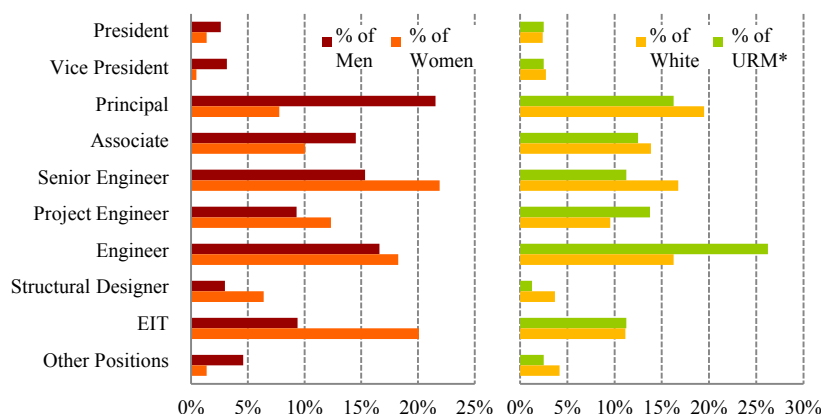


Figure 1. Demographics of structural engineers at U.S. firms, by position. Values shown are percent of each gender or race/ethnic category holding the position titles listed.

* URM = Underrepresented Minorities.

Current Demographic Statistics

Statistics on gender and racial diversity in the structural engineering industry in the U.S. were gathered in 2012 and 2013 from four different sources: (1) firms employing structural engineers; (2) professional organizations; (3) state licensure boards; and (4) universities. Data from firms employing structural engineers were obtained through a short questionnaire distributed to offices across the

U.S. Results were collected from 45 firms (representing approximately 1,350 engineers). The study also collected demographic data from professional organizations: ASCE, SEI, regional chapters of the Structural Engineers Association (SEA), and the Earthquake Engineering Research Institute (EERI). The gender breakdown of registered engineers-in-training (EIT), professional engineers (PE), and structural engineers (SE) was obtained from inquiries directed to state licensing boards. University data describes the demographics of students and faculty in civil or architectural engineering at 50 universities; for a limited subset of institutions, information about structural engineering students and faculty could be identified separately.

Table 1 summarizes the representation of women and underrepresented minorities among the selected groups of structural engineers. The firm data suggest that about 17% of structural engineers are women. Women appear to comprise a smaller fraction, approximately 9%, of membership in the industry's professional organizations. Moreover, ASCE data reveal that, at 6.7%, SEI has the lowest representation of women among all of ASCE's institutes. There is also a decline in the representation of women between EIT, PE and SE licensees, indicating a shift in demographics over various career stages. Indeed, the percentage of women among SE licensees did not exceed 4.5% in any of the nine states providing these data. The participation of underrepresented minority groups

Table 1. Structural engineering demographic data compiled from various sources.

	% Women	% Hispanic	% African American	% Native American
Structural Engineering Firms	16.7	5.0	0.6	0.1
Professional Organizations				
ASCE	11.7	n/a	n/a	n/a
SEI	6.7	n/a	n/a	n/a
SEI Committee Chairs	8.9	n/a	n/a	n/a
Regional SEA	9.1	n/a	n/a	n/a
EERI	7.4	n/a	n/a	n/a
Engineering Licensure				
EIT	15.3	n/a	n/a	n/a
PE	7.4	n/a	n/a	n/a
SE	2.9	n/a	n/a	n/a
Universities – Civil <Structural> Engineering				
Undergraduate Students	24.8 <24.3>	10.3 <14.9>	2.9 <1.8>	0.6 <0.7>
Graduate Students	29.2 <20.5>	4.3 <2.9>	2.0 <1.2>	0.2 <0.2>
Faculty	17.4 <18.7>	6.1 <2.2>	1.1 <1.5>	0.0 <0.0>

of Hispanics, African Americans and Native Americans was harder to obtain, but results suggest that Native Americans make up less than 0.5% of structural engineers, African Americans less than 2%, and Hispanics somewhere between 3 and 5%.

The lower representation of women among the licensure and professional organization data as compared to the firm data implies that women are disproportionately absent from leadership positions. This implication is supported by *Figure 1*, which reports the demographics of firms by job title. As shown, women are more likely to hold the more junior positions, while men are more likely to hold management and executive positions. Similarly, engineers who are non-white are less likely than white engineers to be found in roles of senior engineer or above. Of the 45 firms for which responses were received, six have women or underrepresented minorities in president or vice president positions. These firms appear also to have a greater presence of women and minorities at other levels.

According to the data in *Table 1*, undergraduate students have the highest representation of women and racial/ethnic minorities, but this diversity decreases through the pipeline of structural engineering careers, with the lowest representation among licensed SEs. This trend suggests that white men are more likely to persist through structural engineering career pathways. An alternative hypothesis is that more women and minorities are starting structural engineering careers now than in the past. However, nationwide data show that women and minority representation among students entering science and engineering disciplines have decreased slightly over the past 10 years (NSF, 2012), refuting this hypothesis.

Survey of Structural Engineering Professionals

The Young Professionals Committee also distributed online surveys to structural engineering professionals and students. This article focuses on professionals' responses to questions about current roles and responsibilities, compensation, and career satisfaction, and examines how much these experiences differ according to an engineer's gender or race/ethnic background.

A total of 676 individuals responded to the survey with complete gender and race/ethnicity information. The survey participants are 74% male and 26% female. The respondents identified as 86% White, 9% Asian American or Pacific Islander, 3.7% Hispanic, and 1.2% Black/African American; there were no responses from Native Americans. The average

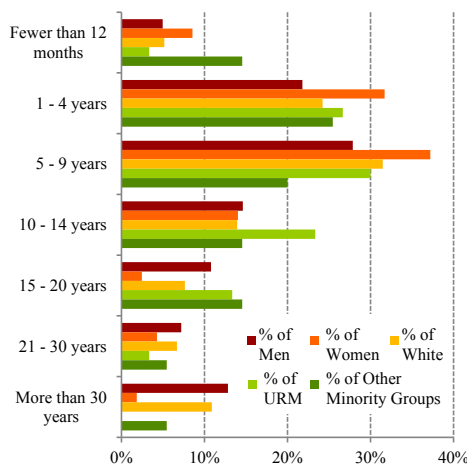


Figure 2. Survey respondents' reported number of years working as a structural engineer.

ages of the male and female respondents are 37 and 32 years, respectively. The relative overrepresentation of women in the survey pool (as compared to the data presented above) is consistent with a number of studies suggesting that women are more likely to respond to surveys than men (Underwood et al. 2000).

Roles and Responsibilities

Survey respondents ranged from those who had just started their careers to those who have been practicing for over 30 years. The average male respondent had worked in the profession longer than the average female respondent (12 vs. 7 years). As shown in *Figure 2*, there is a substantial reduction in the representation of women among engineers with 15 or more years of experience. This trend coincides with a relative decrease in women older than 35. These differences may represent changing demographics over recent years, but this hypothesis is not supported by nationwide demographic data of science, technology and mathematics fields (NSF, 2012). The results instead seem to indicate difficulty retaining women. As with the data from engineering firms, the survey responses indicated lower representation of women holding more senior positions. Race/ethnic minorities are also more likely to hold more junior positions, but these differences are not as stark as those based on gender.

On average, the survey respondents reported working 40-50 hours per week, which did not vary significantly with gender or race/ethnicity. Answers to questions about the type of work and responsibilities yielded many similarities across different groups, although substantially more men (54%) than women (28%) reported that they are responsible for managing at least one person; women reported spending more time on design relative to men. Interestingly, underrepresented minorities were more likely than white engineers to indicate that they are responsible

for managing at least one other person (63% compared to 47%). Anecdotal evidence has suggested that women may be more interested in certain aspects of structural engineering, such as green building and historic preservation. In the survey, however, these choices were no more likely to be selected by women than any other subset of respondents and all groups identified the same most interesting aspects (steel design, concrete design, and seismic design). Nevertheless, women were more likely to report having LEED certification from the U.S. Green Building Council (26% of female compared to 16% of male respondents).

Compensation

Figure 3a shows the annual salaries reported by survey participants (if provided). On average, the survey respondents reported salaries (excluding bonuses) of \$86,100 per year (as of Fall, 2012). Average annual salaries were higher for men (\$91,600) than women (\$71,600). In *Figure 3b*, salary is plotted as function of the respondents' years of experience. The data show that men earn slightly more than women, even when engineers with the same years of experience are compared. Although the data are limited for the underrepresented minorities (only 21 responses included salary information), the responses suggest that their salaries are approximately equal to or higher than white engineers.

Career Satisfaction

The survey asked engineers about their level of satisfaction with their career progress and advancement. Men (43%) and whites (38%) were more likely than other groups to report that they are "very satisfied" than women (22%) and underrepresented minorities (33%). Although relatively few respondents chose "dissatisfied," this selection was more popular among women (9%) and other race/ethnic minorities (9%) than among men, whites, and underrepresented minorities (2-3% of these groups). When asked why they are dissatisfied, respondents most frequently responded that they felt that there are no opportunities for advancement in their company.

As another measure of satisfaction, the survey inquired if respondents had considered leaving or had left a company, or considered leaving the profession entirely. The desire for more opportunities for career advancement was cited often as a reason for switching companies or considering quitting structural engineering. Women more frequently selected reasons of better work-life balance and better work environment, while men more frequently selected reasons related to financial compensation. White engineers were also more likely than underrepresented minorities to cite financial

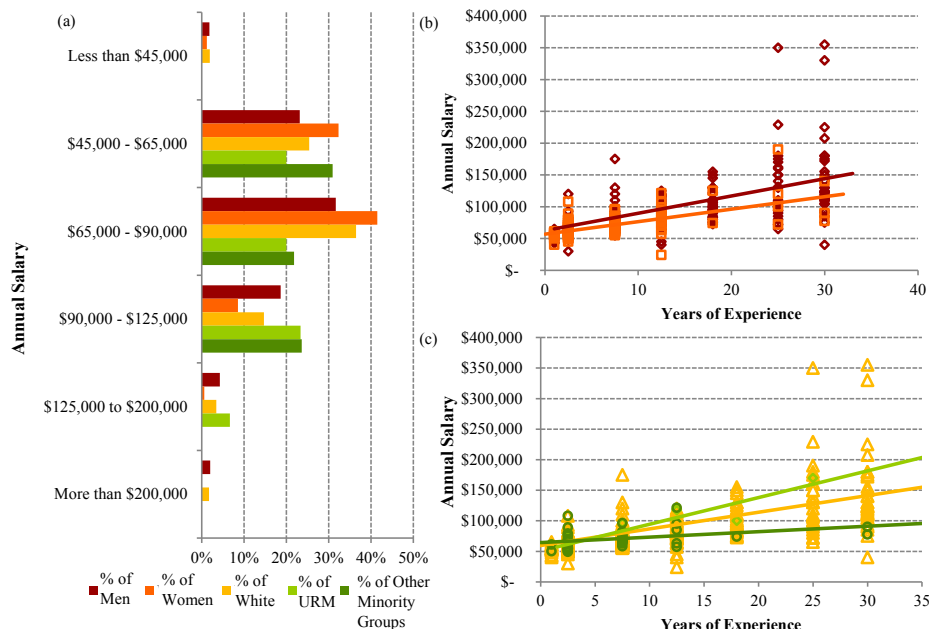


Figure 3. Survey respondents' (a) salary, and salary as a function of years in the workforce by (b) gender and (c) race/ethnic background (salaries reported in 2012).

compensation as a reason to switch companies or consider a different career. Underrepresented minorities and women were more likely to respond that they had thought about leaving the structural engineering field.

Perspectives on Diversity in Structural Engineering

In the final section, the survey asked about respondents' perceptions of equality in the workplace. Although most of those surveyed said they had not experienced discrimination, women and underrepresented minorities were much more likely to have experienced discrimination (Figure 4). Women and underrepresented minorities are also much less likely to believe that equal opportunities exist for all. A follow-up question asked respondents to identify reasons for a lack of equality. Of the reasons listed in the survey, the top reasons respondents identified were: lack of women (14%) or minority role models (9%) in the industry, family commitments (10%), and inequalities that exist in the profession (12%). Comments from the survey (a sample of which are provided in the online version of this article) showed that equality in the workplace was seen as highly coupled to workplace philosophy and attitudes of supervisors and coworkers.

Challenges

This study shows that representation of women and minorities remains low in structural engineering, and is lower than civil engineering as a whole and other science and technology disciplines. The scarcity of women and race/ethnic minority engineers is apparent

particularly among leadership positions both in individual companies and professional organizations. The lack of diversity in leadership positions appears to stem from challenges with retention, indicated in particular by a decrease in women in their mid-thirties, in addition to challenges associated with creating a more diverse student base from which to recruit future structural engineers.

The survey data reported here indicate that there are a lot of similarities in terms of how engineers in different demographic groups experience structural engineering careers. Nevertheless, statistically significant differences exist in terms of pay and career satisfaction based on gender and race/ethnic background, and almost 60% of women see fewer opportunities for women than men. Minority male engineers seem to experience

somewhat less discrepancy in pay (relative to white men) than women, but their concerns about respect and promotion were similar to those expressed by women.

Opportunities

Despite these challenges, the study offers some insights into how we can help talented individuals of all backgrounds achieve success in structural engineering. Some recommendations for structural engineering leaders are as follows:

- 1) Promote mentoring and develop mentorship programs. Responses to both the professional and student survey indicate that engineers are more likely to feel and be successful if they have a mentor. Diverse mentors and diverse leaders seem to promote a more diverse workplace.
- 2) Develop procedures for regularly evaluating potential biases in hiring and promotion decisions. Pay and responsibility inequities persist, even when adjusted for experience. Unintentional biases in these processes can be reduced by a culture of awareness.
- 3) Be aware that workplace culture can have a large influence on whether employees feel valued. Many of the frustrations expressed with the structural engineering workplace had nothing to do engineering, but rather social and cultural attitudes.
- 4) Foster policies to ease pressures of work-life balance. Part time opportunities and more flexibility in work schedules could substantially improve retention.

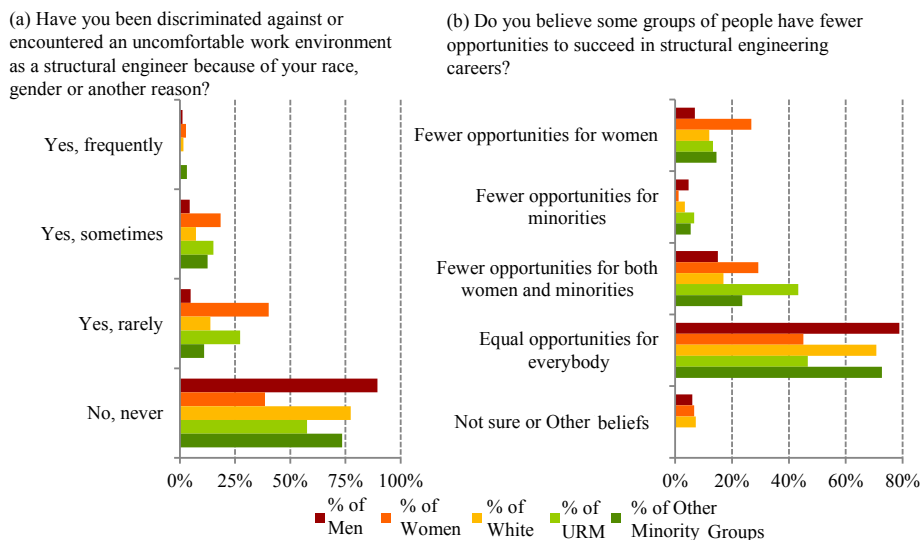


Figure 4. Responses to survey questions about (a) workplace discrimination and (b) opportunities for success.

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Abbie Liel is Assistant Professor in the Department of Civil, Environmental and Architectural Engineering, University of Colorado Boulder. She can be reached at abbie.liel@colorado.edu.

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Workplace Respect and Responsibilities

“Women need to gain the respect that men automatically receive as engineers.” Female, White, Age 30-34

“There have been clients who questioned my technical skills and experience and were more comfortable with junior engineers with less experience.” Male, URM, Age 40-49

“Younger, less educated, male engineers were paid more than me and given technical work ... Also, I was given all the management work because the guys were not as good at writing reports or presenting as I was. So they got to do all the engineering while I got all the paperwork. They never got better at writing because they were not given the opportunity. I saw the same treatment I got given to other females and minorities.” Female, White, Age 40-49

“I have frequently found myself defending my credentials... The additional time, stress, and annoyance can be highly stifling to creativity and being willing to propose and explore truly innovative solutions that must, by nature, be met with a higher degree of scrutiny. I have faced situations where my ability to “sell” a design to a client has been directly undermined by members of the design “team” of which I was supposed to be a part. Yes, I once had a project manager call me a nigger to the client...” Male, URM, Age 35-39

“I am the only woman in the office, and I am often asked to order the lunches, organize the parties, etc.” Female, White, Age 25-29

Promotion and Pay

“I was hired at the same time as another employee where I first worked. He was male. I had more construction background. He made more money from the beginning and from the beginning made more in raises and in salary.” Female, White, Age 50-59

“I was laid off from my first job over a lesser qualified white male structural engineer... because the manager wanted to keep him employed.” Female, Other, Age 30-34

“At my current employer, women are often passed up for advancement but women are often less likely to put in excessive hours (+55).” Female, White, Age 30-34

Family Responsibilities

“I once went to a job interview during which the managing principal asked if I planned to have children soon, clearly as a way to determine, in his mind, how dedicated to my job I would be... I answered simply that no, children were at least a few years off. If the question hadn’t caught me so off guard, I would have told him that he has no right to ask such questions.” Female, White, Age 30-34

“I was discriminated against at my previous job because I had young children who I took time to be with as a caregiver.” Male, White, Age 30-34

Workplace Environment

“It’s not easy to be a woman in this field. I am the only remaining woman in my office and I often feel as if I am invading a meeting of the boys club.” Female, White, Age 25-29

“I had a boss who would frequently take us out to bars and ... promote girls who showed special interest in him.” Female, Other, Age 30-34