Women in Engineering
Incorporating Education and Experience from behind the Iron Curtain in United States

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Abstract-*When I was in school in Bulgaria, education in engineering was very popular among women; in our University women were about 40% of all students. After graduation most women join design companies, however very seldom does a woman join a construction company and work in the field. Statistically the admission and graduation scores for women were higher than men, but when they started working they never achieve as high a position as their male schoolmates did. When I moved to USA I found that my education was very compatible, but that unlike my native home, the opportunities here for women engineers are tremendous. I have had the opportunity to work on a challenging construction, design and consulting projects. Engineering is one of the oldest professions in the world and even with today's advanced technology engineering principles are still very conservative and do not change. But the mind of the engineer is changing. Women are accepted in all engineering fields and they can advance in this profession regardless of where in the world they've been graduated. In this presentation I would like to share and compare my experience working in Bulgaria and United States and to compare women's involvement in civil/structural engineering*

INTRODUCTION

For centuries engineering has been considered a man's field, however, nowadays many women from all over the world have found success within the engineering profession. Twenty years ago I graduated with BS and MS in structural engineering - with major in bridge design - from the University of Architecture, Civil Engineering and Geodesy in Sofia, Bulgaria. At that time Bulgaria was one of the Soviet Union satellite countries. For ten years I worked in one of the largest transportation design companies in Bulgaria as bridge designer. Then, ten years ago, I moved to the United States and began the challenging and often difficult process of following my chosen profession in a very different social and political environment. During this presentation I will give a woman's perspective relative to working as a civil/structural engineer under two different environments by comparing my experience studying and working in Bulgaria and working in the United States.

When I was in school in Bulgaria, engineering was a very popular course of study among women. For example, at the time I was at University in Bulgaria, over 40% of 613 students admitted to study engineering were women (260)[1]. However, during that same period in the United States, engineering was not a popular course of study among women. My first impression of engineering in the United Sates was one of surprise upon seeing the small number of women attending the EIT and PE examinations at the same time that I began my efforts to gain professional accreditation in this country. In the entire auditorium, with more than 200 people in attendance, I saw only a very few women. I would later learn that women comprised only 5% of all registered professional engineers in San Diego, California, according to information from the California State Board for Registered Professional Engineers and Land Surveyors [2]. The question then arises as to why there is such a marked difference in the representation of women in the engineering profession between my native Bulgaria to my new country, the United States.

In 1991, I moved to United States and found that my education was very compatible, but unlike my native home, the opportunities here for women engineers were tremendous. I have had the opportunity to work on challenging projects in construction, design and project consulting. One of the most noticeable differences between practicing as an engineer in Bulgaria and the United States is the involvement of the engineer during the construction of the project. In Bulgaria the design engineer is involved from the beginning until the end of construction. They have to approve every major stage in the construction project. This gives the designer a broad prospective and experience with the construction process.

In most design companies in the United States, once the design is complete and turned over to the construction company, the individual designer is rarely involved in the physical construction of the project. As the Design Build process becomes more popular in the United States, more design engineers are getting involved in the actual construction process. The civil engineering programs in the United States now offer education in planning, scheduling, contract administration, estimating, cost control and many other management issues. Civil engineering students

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considering work in the construction or project management fields should take these courses.

My Bulgarian construction field experience helped me when I joined R.E. Staite Engineering, a marine and bridge construction company in San Diego, as a Project Engineer. When I started working for a construction company in San Diego, I had to work very hard to prove that a woman could manage a major construction project. The strong engineering background, and the knowledge and experience in construction I brought from Bulgaria were all I had to document my ability to lead projects. However, I found that people here were very open to accept not only a woman in construction, but also a foreigner. What was needed was an individual, man or woman, with a strong engineering background and construction experience, a combination that is not as common in the United States as it was in Bulgaria.

WOMEN IN MANAGEMENT

There is a difference in the education system in civil engineering between Bulgaria and USA. The University of Architecture, Civil Engineering and Geodesy in Sofia, Bulgaria offers BS and MS programs in the following areas: Architecture, Structural Engineering, Transportation Engineering, Geodesy (Land Survey), Hydraulic Engineering, Water Supply and Sewer. Unlike in the USA, in order to graduate with BS a student has to take all the courses offered in the program in a particular order. My experience shows that even though the education system in Bulgaria was different than in the United States, the mandatory educational programs in Bulgaria give the student a wide range of knowledge over all aspects of the engineering profession and prepare students to be compatible with their peers all over the world.

After graduating, most women in Bulgaria joined design companies. However, very seldom does a woman join a construction company and work in that field. Statistically, the admission and graduation scores for women were higher than men, but when women started working, they never achieved as high of a position as their male schoolmates did. When I was working in Bulgaria, the government had a policy in place that was attempting to create equality between men and women in the engineering profession, however businesses did not follow this policy. It was very rare to have a woman in a low management position, and women never filled a high management position. In other words, in Bulgaria, while engineering education was open to women, males dominated the engineering management.

Like Bulgaria, in the United States most women engineers work in design companies. And, unfortunately, if you compare the percentages of men and women in top management positions in the United States it is not much better than it was in Bulgaria: it is more difficult for the female in society to reach a high position in engineering. While women make up 50% of the workforce in United States, they are significantly underrepresented in the engineering profession. Women comprise only 9% of practicing engineers and less than 1% of that 9% are in senior management. Of the 500 companies listed in the Fortune magazine, women comprise only 2.4% of the highest corporate rank positions. However, the industries with the highest percentage of companies with no women on their boards (43%) are computer/data services, engineering and construction. The US Department of labor indicates that the average woman loses approximately $420,000 over a lifetime due to unequal pay practices [3].

In a survey about engineering salaries, provided in November 2000 issue of Structural Engineer magazine [4], the statistics on women and minorities are disturbing. In every category, based on years of experience, women make less in salaries and bonuses per year than their male counterparts.

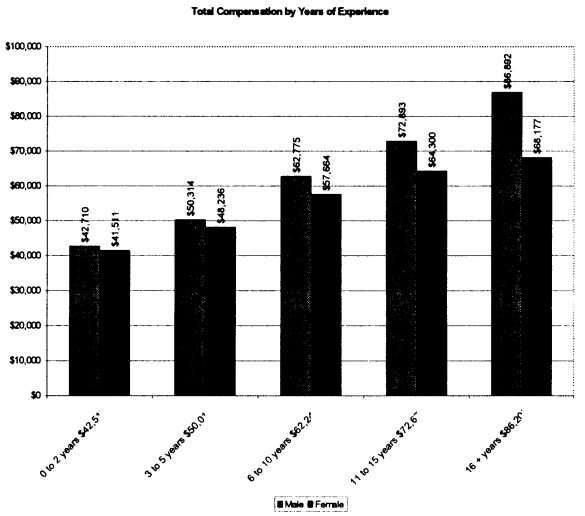

Figure 1. Total Compensation by Years of Experience

As seen from the graph above the gap increases with experience. While females with zero to two years in the profession make an average of $1,200 less than males in that range, females with over 16 years make nearly $19,000 less than males with the same amount of experience.

Construction is the second largest industry in the United States, employing approximately 8 million workers, and in the last fifteen years has been setting new records for work being done. On the other hand the number of college students graduated with bachelor's degree in engineering has been falling gradually. The Engineering Workforce Commission of the American Association of Engineering Societies, Washington, D.C. [5] reported 78,000 students graduated in 1986 and 62,500 in 1999.

There is a stereotype of the construction industry that women are not welcome in construction. But given the shortage of trained, professional engineers, the construction industry must attract more women and minorities in order to grow. Because of this in the last few years some gains have been made. Women have increased from 8.5% of the total work force in 1991 to 9.9% as of 1999 per the Bureau of Labor Statistics [6]. According to the Monthly Labor Review published in the same ENR issue, the growth of women's presence in the work force will be:

- 11% for White non-Hispanic
- 20% for Blacks
- 79%for Hispanic
- 68% for Asians and other non-Hispanic

In October 1998 the U.S. Congress passed the Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology, Development Act [7] (PL 105-255), which indicated:

- Women have historically been underrepresented in scientific and engineering occupations, and although progress has been made over the last several decades, there is still room for improvement.
- Female students earn fewer bachelors, masters and doctoral degrees in science and engineering.
- A substantial salary gap exists between men and women with doctorates in science and engineering.
- Once on the job, many women find paternalism, sexual harassment, allegations of reverse discrimination, different standards for judging the work of men and women, lower salary relative to their male peers, inequitable job assignments, and other aspects of a male-orientated culture that are hostile to women.
- Women to a greater extent than men find limited opportunities for advancement, particularly for moving into management positions, and the number of women who have achieve the top levels in corporations is much lower than would be expected.

The Commission was charged with setting recommendations to help build a domestic work force capable of meeting our nation's strategic Science, Engineering and Technology (SET) needs. The Commission recommended that policies and procedures must be established that will:

- Advance the full and equitable participation of all Americans in Science, Engineering and Technology education.
- Increase the number of qualified American scientists and engineers by expanding the talent pool to include more women, underrepresented minorities and persons with disabilities.
- Increase the number of women, underrepresented minorities and persons with disabilities who are well prepared to enter the Science, Engineering and Technology labor market.
- Increase the retention and reentry of women, underrepresented minorities and persons with disabilities in Science, Engineering and Technology education and SET workforce.

DISSCUSSION

It is very important to have diversity in the engineering profession. Hiring team members with different backgrounds and experience can foster a creative atmosphere that helps everyone to learn and grow professionally.

As I mentioned earlier, in Bulgaria there were similar governmental policies in place to promote the advancement of women in engineering and construction. They did not work. And while it is too early to say what impact the Commission will have on the advancement of women in the industry in the United States, it would be unrealistic to depend upon that one Commission to make the changes necessary.

However, in United States there are some privately owned companies that actively seek out, encourage and promote women in engineering and construction management positions. One of these is The Nielsen-Wurster Group, providing management consulting, construction project risk management and dispute resolution services for the last 25 years on projects all over the world. Patricia Galloway, President and CEO, of The Nielsen-Wurster Group, one of the most recognized trainers and speakers in the world on construction risk management and disputes resolution, is not only an example of a professionally successful woman, she is also highly supportive and energetic in assisting other women to advance in the engineering profession. After 19 years of engineering experience in Bulgaria and United States, I joined the Nielsen-Wurster Group in 1999. After so many years working in design and construction industry, I was heartened to see women in senior management positions. I saw an extraordinary opportunity to advance in my career. The atmosphere of mentoring and motivation of professional growth is remarkable. We need many more companies to follow the example of The Nielsen-Wurster Group.

CONCLUSION

Engineering is one of the oldest professions in the world, and even with today's advanced technology, engineering principles remain the same. However, the world is changing

and the mind of the engineer is changing. Women are increasingly accepted in all engineering fields and they are advancing more than previously in the engineering profession. Nevertheless, more change is needed in the attitudes toward and opportunities for women in engineering

The American Association of Engineering Societies' Engineering Workforce Commission reports that percentages of women and minorities in engineering are rising [8]. While women made up 15% of the total undergraduate enrollment in engineering programs in 1987, 10 years later they comprised 19%. What is needed is to ensure that when those women enter the workplace there are opportunities available that are directly aimed at assisting them to grow and succeed.

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