

Contribution Of Women In Civil Engineering

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Abstract

Civil engineering has always been a 'man's world' and while women are no longer stranger to it, the numbers remain too few even today, in most part of the world. India with its already low female literacy rates is no exception to such skewed gender distributions. This paper looks into different aspects of contribution of women in civil engineering, which is equally enthralling, encouraging, as well as, demanding for women in the field.

Keywords: *civil; contribution; engineering; women*

INTRODUCTION

Our country has seen extra ordinary growth in the infrastructure and industrial development over the last some decades. The second largest industry in the India is construction. Construction industry can be considered as totally male dominated field in our country. The percentage of unskilled women is high in construction site even though Women contribute for nearly 51.5% of the construction labour force. The male to female ratio in a class of civil engineering is four times is saying that women are only one forth. In the field of civil engineering nearly 20% of women work, while others move on to pursue the other different fields. But now a day's women are also contributing in the field of civil engineering enthusiastically.

HISTORY OF WOMEN IN CIVIL ENGINEERING

Few years ago, women, who were contributing in science and engineering were looked up to as inventors. It is during the World War II, they were formally brought into engineering education. At the beginning of the 20th Century, there were a few women, who took engineering programs. In 1905, Nora Stanton Blatch Barney graduated as the first woman Civil Engineer from the Cornell University.

After few years, in 1920 Olive Dennis became the second one to graduate as a Civil Engineer. Initially, she worked in Baltimore and Ohio railroad as draftsman. After that, she joined as a service engineer. As a service engineer she brought in many changes in the railway system for the public safety and comfort of passengers.

In the completion of Brooklyn Bridge Emily Warren Roebling has given her timeless contribution after her husband's ill-health. She was, one of the first lady field engineers of her times. These women and many more are become role model for the modern-day women civil engineers to make their mark.

LESS PREFERRED PROFESSION

The Forbes magazine concludes that there are only 12% of women, who give preference for engineering job. In spite of Engineering is being one of the highest paid and vast field, the most important thing to notice is that there are only 5% of women's which are at the managerial positions. Civil engineering is the field where women's ratio is less compared to men's. Compare to other jobs which women preferred most, but as a civil engineer they are paid four times than that of other jobs. We can conclude that construction field is a male dominated discipline as the women's ratio is more in design and analysis.

The most perceptive work in civil engineering is site work which is so far away from the truth. As we know the site work job is contributed to trading companies. The most preferred office work jobs are design, surveying, analysis, estimation etc. The era has end up where everything happens manually. Technology is a boon for new era for a unmanageable tasks like design, estimating, drafting, Planning and management. Compare to IT skills although having knowledge of construction fundamentals the interest towards construction industry is very less. The factors where women prevent to work in civil engineering are as follows:

MALE DOMINATION

In every industry male domination is there. Multiple issues related to gender bias are creating in every field. Due to the nature of its work Civil Engineering is male dominated. However, same site work are women laborer also do. In fact, their number is nearly equal to their male counterparts. This is one of the best reasons, why women civil engineers should shed their inhibition about male domination in the field.

LACK OF INSPIRATION

Women contributing in civil engineering are in very less number because of lack of inspiration. Because of very few women taking up civil engineering to continue as their career, there is lack of inspirational stories or personalities to learn. Lack of leadership opportunity for women is also one of the causes of non-contribution of woman in civil engineering industries. But nowadays, there are many organizations are there in the domain of construction which are supporting women working in civil engineering industry. It must say that; the awareness level is far least among professionals. Attending alumni meetings and mentoring must should be a part of the professional training to bring women face-to-face with the industry's Who's Who to aid in networking.

LACK OF SOCIETAL AND INSTITUTIONAL SUPPORT

The ancestors saying that 'Behind every successful woman, there is a man' should be given more importance to attract women in the field of civil engineering. Women have been working since many years doing all household work. Family members and their life partner should encourage them to compete in this Men's world by contributing in civil engineering. Lack of societal and family support decreases the will in women to work long hours, travelling long distance etc. The 21st Century women are far fortunate to receive appropriate societal and institutional support on the work front. However, this can still be improvised to encourage women in this field.

LACK OF APPROPRIATE INFRASTRUCTURE AND FACILITIES

The women laborers working on the sites often face improper facilities regarding sanitary conditions. Instead of thinking it as an extra liability, the sanitary conditions need to be improved on the construction sites for women employees to make use at ease. Even though, there are different regulations and standards, which are applied for construction sites, sanitary regulations need to be considered for women.

LACK OF FLEXIBILITY

Women find easiness to work on different engineering disciplines due to the flexibility the job provides. The construction industry needs to be more organized, in terms of, flexible work timings. Now days, flexibility is a huge issue for women to work in the field of civil engineering.

DREARY IMAGE IN THE SOCIETY

Total number of women working in the field of science, technology, engineering and mathematics are also low. But Women working in the engineering field is the lowest of the all. The uninspiring image of the civil engineering profession prevents them to continue working in the same field. Construction workers come from all classes of society and civil engineers have to deal with all types of people on the field. It is also difficult to ignore the unpleasant comments being passed by fellow men, in spite of women's ability to work as equals or better than their male counterparts. Women feel shy and prefer other profession because of its lusterless image in the society.

WOMEN IMPACT

Civil engineering is a very inclusive discipline. The core of construction engineering can be supported with innumerable disciplines, tools and techniques. The contributory fields, which are congruent to civil engineering, are structural design, architectural design, water resources, space planning, landscape designing, MEP design and many more.

Every phase of construction is carefully planned and executed. It is, at the level of execution when one needs to supervise the site work with great efficiency. History of a few women civil engineers, involved in major projects, without appropriate tools and techniques is not been accepted by the industry. Women in the 21st Century certainly have enough technological projectiles with them to actually prove that they can make a better impact in the construction industry.

In the five phases of construction's life cycle the first phase is Initiation. It involves coordination with different people actively involved in construction of the new structure. The feasibility study needs to be carried out while choosing the project, needs analysis and thorough understanding of numbers. Not only that, it also needs coordination and management. Women are better in multi-tasking because of nature's creation. They tend to be good managers, as they have the innate ability to think about different variables affecting the situation. Women can be considered as good project initiators and managers.

Every project has a design element in it. Designing is one huge opportunity of civil engineering, which can actually become a life changer for women in the field. Design is a discipline, where there can be 80% of the work can be done in office while other 20% are on the site. Analytics and aesthetics are also considered in design. Women are analytical in nature and as well as having a good sense of aesthetics. Designing can also be called as the dependable branch for women in civil engineering. Structural designing is a considerable branch of civil engineering. Among the remarkable and illustrious high-rises, Elma Wilson was the first lady structural engineer to have worked on the historically significant Flatiron Building in Manhattan, New York. It must say, there are quite a few women structural engineers in India, who have been involved in many important projects.

There are also many other challenging and interesting branches of civil engineering for any professional. There are many women architects in the field of architecture while there are very less women civil engineers in India and in other parts of the world too. This definitely shows the conception and design are some aspects, in which women can find their opportunities. However, there is less number of women on the field; they are not less than any of their equivalent. With more than 50% women laborers and workers as construction work-staff, women are able and suitable for the field work as civil engineers. The overall safety of an unskilled woman construction worker is endangering sometimes. These women are harassed and treated badly on site by different category of people, with whom they have no option to work with. Such situations can be minimized, if there are more women civil engineers present on to the field.

Like all the other fields, civil engineering too, has many advantages than disadvantages. It is just a matter of perception, few specific experiences and biases, which build in to make civil engineering as a male stronghold.

CIVIL ENGINEERING A REWARDING CAREER

The best academic performance and better job opportunity draw women towards civil engineering. The percentage of women engineers have steadily increased from 1.8 to 7.9 in the last five to six decades. There is a constant rise in the number of women receiving degrees in engineering. However, there is a steep decline in the number of women engineers getting employment after their graduation. There are plenty of reasons for this. The employers always try to discourage women on the terms of safety and challenges that are a part and parcel of being a civil engineer. Often delicacy, less stamina and long hours of work are given as the main reasons for women not being encouraged to take up this profession. But with CAD and other technological advancements and software, women are now able to pursue their career in the field of civil engineering. This is one of the reasons, why women are moving towards civil engineering in the modern era. Civil engineering is a rewarding profession for women because of its creativity and sheer perseverance with which an idea has to be clear as a building.

FAMOUS FEMALE CIVIL ENGINEERS

I. ROMA AGRAWAL:

In spite of having the physics degree famous structural engineering women worked around 6 years in the Shard which is the tallest building in Western Europe. She designed the Spire and foundations.

Roma also contribute her work for WSP Group's is a UK firm provides property engineering and management services. In every continent the company has 15,000 employees worked in 300 offices and 35 countries.

She won the industry awards and also her career starred in media, includes BBC world news, TEDx, BBC Daily Politics. Cosmopolitans and stylist magazines, Sunday times, and also her documentaries on online blogs. She was the first female who starred in 4's channel documentary on the tallest tower the shard. She also gives her contribution to the M&S's leading ladies campaign in 2014 and there she addressed as the top women by the guardians.

She is advocate now-a-days keen for more women in civil engineering. She also accepts that it is not an easy task to bring women's in this field.

She is now inspiring young talent in scientific and technical careers, especially women's. Roma engaged her topic to institutes and government so that every woman can understand and come forward with new ideas in an effective Ways. for 3 years she contacted and spoke to 3000 people, around 50 schools and universities all over the world.

II. EMILY WARREN ROEBLING

Emily warren Roebling is the world's first female field engineer. she was born in cold Spring, New York on September 23 1843 to Sylvan sand Phebe Warren. She married to the son of John A. Roebling a Brooklyn Bridge Designer named Washington Roebling.

Suddenly Washington and Emily Had a hard phase as Washington's father passed away as he was suffering from tetanus. After's his father death Washington took charge of Brooklyn bridge construction. He was so immersed in this project, he got affected to caisson disease, and the disease affects him in such a way that he was bed –ridden. And this became the turning point of Emily's career and stepped herself as a first female field engineer .and thus she completed his first consignment of Brooklyn Bridge.

III. ELSIE EAVES

She was the first women associated with the membership of American Society of Civil Engineering (ASCE) she was also a founding member of American Association of the cost Engineering.

Elsie Eaves' Achievements

First female elected as associate member, fellow, Life member of the American Society of civil Engineers.

- The first female elected as chapter Honor member, and Chi Epsilon Frternity.
- She was the first women who received the distinguished engineering alumina award from college of engineering and applied science, university of Colorado.
- She got the honorable life membership award from American Association of cost engineers.
- The first female who receives international executive service corps "Service to Country Award".
- She was the first female who received the award of merit from the American Association of Cost engineers.

STATASTIC ON WOMEN IN CIVIL ENGINEERING

(Source: Bureau of Labour Statistics — Current Population Survey)

Table 1: Enrolment of Females and Males in Civil Engineering

Year	Female	Male
2013	17 (13.7%)	107 (86.3%)
2014	32 (17.2%)	154 (82.8%)
2015	26 (12.8%)	177 (87.2%)
2016	18 (12.8%)	123 (87.2%)

Table 2: Numbers Of Women In The Construction Industry Sector

YEAR	NO OF WOMEN
2005	1,079,000
2006	1,131,000
2007	1,119,000
2008	1,069,000
2009	970,200
2010	807,000
2011	828,000
2012	802,000
2013	840,000
2014	872,000
2015	929,000
2016	939,000

Table 3. 2016 General Construction Statistics

Total Workers in Construction	10,328,000
Men in Construction	9,389,000
Women in Construction	9,39,000

Table 4. Occupation Statistic

Occupation Sector	Number of Women	Percentage
Sales & Office	423,000	45%
Professional & Management	293,000	31%
Natural Resources, Construction Maintenance	196,000	21%
Service Occupations	14,000	1.5%
production, Transportation & Material Moving	13,000	1.4%

CONCLUSIONS

The history of woman in civil engineering is honored in nature. By looking towards history, it is quite impressive journey. This paper discusses past data of contribution of woman in civil engineering along with reason behind not choosing civil engineering as a career option. This paper also described the famous female civil engineers who have contributed a lot, towards civil engineering. Today with much technological improvement in place, it is the correct time to move forward and prepare ways for fellow woman civil engineers. With the stand point, in future all these small grains will combine together and every one can proudly say that civil engineering is no more a male dominated, it is in fact an equal opportunity field for both men and women.

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