

# Women in Engineering Education in India

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## Abstract

Participation of women in science and technology is not only an important aspect in social and economic development of the nation; it is a critical constituent in the process of improving the quality of life of women themselves. However, engineering education has remained male dominated segment of higher education. In this background, the paper tries to analyze data on women enrolment as well women faculty members through out the country. Though enrolment in term of number as well as percentage, women participation has increased through out the country, the growth is not even through out the country. It varies between states and regions. Though affirmative action as reservation and hostel facility for women students has already been taken, but there is need to expand to enhance scope for affirmative action as fellowship for meritorious students and incentive for women students to join Science, Mathematics and Physics stream at +2 level.

Key Words: Women Enrolment, Faculty, Engineering Education, Engineering Institution

## 1. Introduction

Participation of women in science and technology is not only an important aspect in social and economic development of the nation; it is a critical constituent in the process of improving the quality of life of women themselves. At same times, 81 % women engineers are as good as male counterparts in terms of technical skill, interpersonal skill and confidence as opined by executives of 104 organizations surveyed by IIT Bombay (Parikh & Sukhatme, 2004). In this background, the paper tries to analyze status of women in engineering education. Women's participation in engineering at world level and at all India level has been discussed in the second and third section respectively. Fourth section discusses women in engineering education at state level. The discussion has been made on the basis of intake of female students and female faculty members with different qualifications. Theoretical framework for women in engineering education has been discussed in fifth section. Affirmative actions as special facilities and reservation for

female in engineering institutions have been discussed in sixth section. Last section concludes the discussion followed by recommendations. .

## **2. Women's Participation in Engineering at World Level**

Women constitute almost half of the global population. Still their contribution in many professions is limited. It is evident in the field of engineering, which is the second largest profession in the world (Durchholz, 1997). Historically, women have been in engineering almost as long as men. Although the first women to obtain an engineering degree is reported to be as early as in 1892 (Jagacunski et. al., 1987), the percentage of women in engineering has continued to remain quite low the world over (Nguyen, 2000). Even in Nordic countries, which are widely known for their commitment to gender equity and their policies for women's integration into nearly all spheres of public life have experienced low women participation in engineering occupation. Women in those countries have indeed entered the labour market in strength in recent decades, so that there are now roughly equal numbers of men and women workers in the labour force. The gap between the male and female earnings in the Nordic countries is smaller than in other countries and law have been adopted on equal pay for equal work. But even in these countries, there are more male engineers in the labour market. Roughly, 90 per cent of engineers in Finland and Norway were men in 1990. Interestingly, there is very little difference in feminization between high-and low-status engineering occupation, rather both are similarly masculinized. Furthermore, what little change occurred over the 1970s and 1980s in the feminization of engineering occupation tended to increase the feminization gap between high-and low status engineering occupation. Technical occupation are thus an area of the Nordic labour market where there is a great deal of sex segregation, both horizontal and vertical – not only do men predominates, but men are also more likely to occupy the higher status and better paid occupation as compared to women (Meelkas and Anker, 1997). In the case of the most developed country, United States of America, women constitute 9% of engineers. Within engineering, women are also more highly represented in some fields than in others, For example, women represented 12 per cent of chemical and industrial engineering, but only 6 percent of aerospace, electrical and mechanical engineers (Science & Engineering Indicators, 2000).

### 3. Women's Participation in Engineering at all India level

Though there are policies of Government to encourage women at par with men in the field of higher and technical education, presence of women in engineering is minimal. Due to unique socio-cultural conditions of the country, till two decades back, enrollment of girls in higher education especially in technical education was dismal. It is clear from table 1 that in 1980 women enrolment 3.8 % of total enrolment. It has increased phenomenally in recent years and has experienced three fold increases in next ten year. In 1990, women enrolment was 15840 which grew to 109069 in 2000. It was almost seven

Table 1: Enrolment of Students in Engineering/ Technology in India

Year	Total Enrolment Engineering/ Technology	Total Enrolment of Women in engg/Tech	% of women in engg/ tech
1980	128937	4947	3.84
1990	216837	15840	7.31
2000	529461	109069	20.6

Source: Thankachan, 2003. pp. 35.

times increase in ten years and has become 20.6 % of the total enrolment of engineering/technology (Thankachan, 2003). However, there is variation in women enrolment between different states.

### 4. Women's Participation in Engineering at State level in India

Assessment regarding women's participation in engineering education at state level has been made on the basis of National Technical Manpower Information System (NTMIS) data. NTMIS is Ministry of Human Resource funded project which gathers data on technical education through out the country. Percentage of women enrolment in state varies quite significantly at all levels - post graduate (Table 2), graduate (Table 3) and diploma (Table4). At the level of faculty also, there is variation at degree level (Graph 1) and diploma level (Graph 2) between states. They have been discussed as follow:

#### 4.1 Women's Participation at Post Graduate Level

At post graduate level, women enrolment was low for Maharashtra, Rajasthan and West Bengal (< 10%) in 2000 which marginally increased in terms of percentage during next

six years and became 9.9% and 12% for Rajasthan and West Bengal respectively in 2006. In Tamil Nadu and Karnataka, the percentage of women enrolment was around 15 percent in 2000 which became 22.7 percent in 2007 for Karnataka and 31 per cent for Tamil Nadu. In Gujrat and Kerala, the women enrolment were were 22% and 27.4 % respectively in 2000 which rose to 41.3 percent in 2007 for Kerala and 28 % for Gujrat in 2005 (data for 2006 and 2007 are not available). In case of Assam, percentage enrolment has decreased from 26.5 in 2001 to 11.4 percent in 2005 and 13 per cent in 2006. For Maharashtra, data is available for 2000 and 2001. Both years have recorded 8.07 % and 8.2 % respectively.

**Table 2: Participation of Women at Post Degree in Engineering Level**

Sl. No.	Percentage of Women Enrollment	2000	2005
1.	< 10 %	Maharashtra, Rajasthan, West Bengal	Rajasthan
2.	Between 10% and 15 %	Tamil Nadu,	Assam, West Bengal
3.	Between 15% and 20 %	Karnatka	
4.			
5.	Between 20% and 25 %	Gujrat, Karnatka, Assam	Karnatka,
6.	Between 25% and 30 %	Kerala,	Gujrat
7.	Between 30% and 40 %		Kerala, Tamil Nadu

Notes: 1. Table has been made by the author on the basis of data given for the year 2000, 2005 in the Annual Technical Manpower Review for particular state.

Source: Compiled by author from Annual Technical Manpower Review for different years and states, National Technical Manpower Information System, Ministry of HRD.

Number wise, enrolment was just 12 for Rajasthan in 2000 which rose to 29 in Rajasthan. In Karnataka and Kerala, the number was 156 and 133 respectively in 2000 which rose to 707 and 402 respectively in 2007. For Gujarat and Tamil Nadu, the number was 110 and 230 respectively in 2000 which rose to 255 and 937 respectively for 2005. For Maharashtra, the number was 196 in 2000.

#### 4.2 Women's Participation at Degree Level

Women's enrolment at degree level engineering education was 7.5 % and 6.15 % in Maharashtra and West Bengal respectively in 2000. It was just 10.5 % at Rajasthan. In Punjab, Karnatka, Delhi, Himachal Pradesh, Chandigarh, Gujrat and Tamil Nadu, percentage enrolment of female students at degree level engineering education is 12.4 %, 12.8 %, 14.5%, 19.4 %, 19.8 % and 20.3 % respectively during same year. Kerala has 31.7 % female enrolment at degree level in 2000. In 2005, there were 12.3 % female students in Rajasthan and 12.5 % in West Bengal. However, for Rajasthan, this year may be a special case when the participation was low because, participation was 16.8 % in

**Table 3: Participation of Women at Degree in Engineering Level**

Sl. No.	Percentage of Women Enrollment	2000	2005
1.	< 10 %	Assam, Maharashtra, West Bengal	
2.	Between 10% and 15 %	Delhi, Himachal Pradesh, Karnataka, Rajasthan, Punjab	West Bengal, Rajasthan
3.	Between 15% and 20 %	Chandigarh, Gujarat, Haryana	Madhya Pradesh, Himachal Pradesh, Haryana
4.	Between 20% and 25 %	Tamil Nadu	Punjab, Karnataka, Gujarat, Delhi
5.	Between 25% and 30 %		Chandigarh, Tamil Nadu
6.	Between 30% and 35 %	Kerala,	
7.	Between 35% and 40 %		Kerala, Andhra Pradesh

Note: For Andhra Pradesh, Orissa and Madhya Pradesh, data is not available for 2000.

For Maharashtra, data is of 2004 in place of 2005 and for Andhra Pradesh, Orissa and Assam, data is of 2006 in place of 2005.

Source: Compiled by author from Annual Technical Manpower for Different States for years between 2000 and 2005.

2004 and 21.6 % in 2006. Participation was 15.1 % for Himachal Pradesh, 17.7 % for Haryana and 17.8 % for Madhya Pradesh. Delhi was having 20.8 %, 20.2 % in Gujarat,

24.2 % in Karnataka, 22.7% in Punjab and 26.2 % in Tamil Nadu. Andhra Pradesh and Kerala were having larger representation as 35.1 % and 40 %.

When analyzing on the basis of number, enrolment was 63, 87 and 196 for Chandigarh, Punjab and West Bengal respectively in 2000 which rose to 122, 616 and 1832 respectively in 2007. For Karnataka and Kerala, enrolment was 1562 and 1539 in 2000 which rose to 5087 and 2553 respectively in 2007. For Madhya Pradesh, the enrolment in 2005 was 395 which is 17.8% of the total enrolment. For Assam, women enrolment has remained almost same during 2000 and 2006. In 2000, it was 129 which rose to 132 in 2006. Percentage wise, women enrollment was 15.55 % in 2000 and 14.70 % in 2006. It means overall expansion in the facilities of engineering education has not increased much in comparison of southern states. Number wise, there were only 14 in 2001 and 38 in 2005 in Himachal Pradesh. In Andhra Pradesh, there was 7771 women student in 2006.

### **4.3 Participation of Women at Diploma level**

Participation of Women at Diploma level for Delhi and Tamil Nadu were having 14.4 % and 14.2 % women enrolment in 2000. Assam, Haryana and Karnataka were having 15.6 %, 16.41 % and 16.8 % women enrolment in the same year. Diploma level enrolment in Delhi was 22.75 in 2005 and 16.08 % in 2006. In Punjab and Gujarat, female enrolment was 20.5 % and 20.8 % respectively in 2000. In Kerala, it was 29.8 % and 49.8 % in Chandigarh during the same year (2007). For Andhra Pradesh, data for 2005 is 43.34 %. For Chandigarh, 2007 data was available which was 41.59 %. In Karnataka, Kerala, Rajasthan, Punjab, Orissa and West Bengal, women enrolment during the same year was 22.7 %, 32.64%, 31.26 %, 28.41%, 20.35 % and 18.59 % respectively. For Assam, women enrolment was 43.34 % in 2005. For Haryana, women enrolment in 2006 was 16.08.

If analyzed on the basis of numbers, in Delhi and Himachal Pradesh, women intake was 61 and 60 respectively in 2000. In Chandigarh and Punjab, it was in three digits during the same period which was 101 and 156. Rajasthan also enrolment was in three digit but almost five times of Chandigarh and was 553. In Gujarat, Karnataka, Kerala and Tamil Nadu, the women intake was in four digits. It was 1629, 2506, 2305

and 4532 respectively. In Chandigarh, Karnataka, Kerala, Punjab, Rajasthan, Orissa and West Bengal women intake in 2007 was 141, 26.10, 2014, 736, 529, 699 and 1031 respectively. In Tamil Nadu and Gujrat, the women intake in 2005 was 5471 and 5714 respectively.

**Table 4: Participation of Women at Diploma in Engineering Level**

Sl. No.	Percentage of Women enrollment	2000	2005
1.	< 10 %	West Bengal	
2.	Between 10% and 15 %	Delhi, Tamil Nadu	
3.	Between 15% and 20 %	Assam, Haryana, Karnataka	Assam, Delhi, Haryana, Karnataka, Tamil Nadu, West Bengal
4.	Between 20% and 25 %	Gujrat, Himachal Pradesh, Punjab, Maharashtra, Orissa	Gujrat, Himachal Pradesh, Punjab, Orissa
5.	Between 25 % and 30 %	Kerala, Rajasthan	Maharashtra, Rajasthan
6.	Between 30 % and 35 %	Madhya Pradesh	
	Between 35 % and 40 %		Kerala
7.	Between 40 % and 45 %	Chandigarh	Andhra Pradesh Chandigarh, Madhya Pradesh
8.	Between 45 % and 50 %		

Note: For Andhra Pradesh, Orissa and Madhya Pradesh, data is not available for 2000.

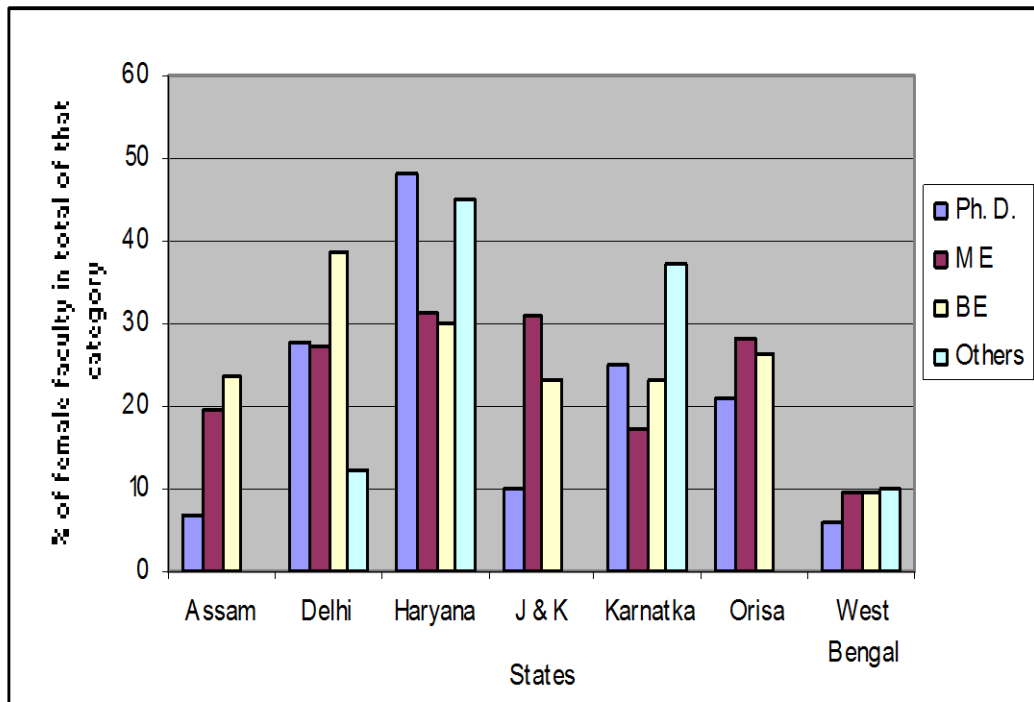
For Maharashtra, data is of 2004 in place of 2005 and for Andhra Pradesh, Orissa and Assam, data is of 2006 in place of 2005

Source: Compiled by author from Annual Technical Manpower for Different States for years between 2000 and 2005.

#### **4.4 Female Faculty at Degree level**

Teaching is generally considered as female forte. However, Graph 1 shows that percentage of female faculty members is not even one third except at Ph. D. and Degree level in Haryana and P.G. Degree level in Delhi in 2006. At Ph. D. level, female faculty

members were 5.7 %, 6.9 % and 9.8 % in West Bengal, Assam and Jammu & Kashmir. It was 20.8 %, 24.8 % and 27.6 % in Orissa, Karnataka and Delhi. At P.G. Degree level, Female faculty members were only 9.67 % in West Bengal during the same period. An Assam and Karnataka, percentage of female faculty members were 17.3 %b and 19.5 %.



Graph: 1: Detail of Female Teacher in Different States at Degree Level in 2006

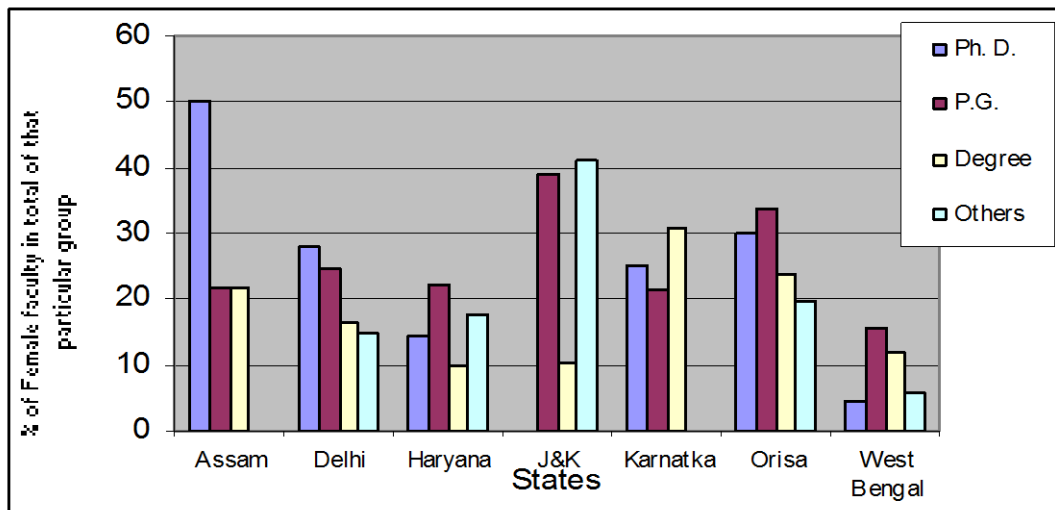
Source: Annual Technical Manpower for Different States for 2006.

In Delhi, Haryana, Jammu & Kashmir, Karnataka and Orissa, the percentage of female faculty members were 27.6%, 31.3 %, 30.7 % and 28.4 %. Among Degree holder, it was 9.8 % in West Bengal and 38.7 % in Delhi. Share of Female faculty members in the group was Between 20 to 30 in Assam, Haryana, Jammu & Kashmir, Karnataka and Orissa. There is another category “Others” which includes M.Phil, MCA etc. which makes insignificant except in Delhi. Haryana, West Bengal and Karnataka,



#### 4.5 Female Faculty at Diploma level

Graph 2 discusses state wise detail of female faculty members in different states at diploma level in 2006. Ph.D. holder female faculties are equal in number of male faculty member in Assam. The group consists of 30% in Orissa, 27.8% in Delhi and 24.9% in Karnataka. In Haryana, it is 14.3% and in West Bengal, it is 4.4%. In J&K, no female faculty member has done Ph. D. Regarding post graduate degree holder, 38.8 % faculty are female in J&K and 33.9% in Orissa. In Assam, Delhi, Haryana and Karnataka, 20% to 25% faculties are female. Regarding degree holder faculty, 9.8% in Haryana, 10 % in Jammu & Kashmir and 23 % in Orissa are female. The share becomes little bigger in case of Assam (21.6 %), Karnataka (30 %) and Orissa (23.6 %). In case of “Others”, in Delhi, Haryana and Orissa, share of female teacher in 15 %, 17.6 % and 19.8 %. In J& K, female faculty constitutes 41.2 %.



Graph 2: Detail of Female Faculty in Different States at Diploma Level in 2006  
Source: Annual Technical Manpower for Different States for 2006.

#### 5. Low women participation in engineering education: A theoretical frame work

Two types of explanations have been given by experts for low female participation in engineering education. First is Feminist or Radical Theory and the other is Low Human

Capital Investment Theory. Feminist or Radical theory is based on social factor and other theory banks on economic factors. They have been discussed as follow:

### **5.1 Feminist or Radical Theory**

The first approach underlines various societal restrictions that are placed on women which restrict women from entering into engineering field. According to the feminist theories, the subordinate position of women in home/ family and low participation in engineering education are inter related and part of an overall social system in which women are subordinate to men. Marxist feminist economist attributes capitalism and patriarchy responsible for lower participation of women in engineering education. Both are enter related and cause and effect for each other. In patriarchy, the woman holds inferior position in family than her male counterpart. Man is considered as main bread winner and women responsible for house keeping (Singh, 2000). The women lots are educated only for being a better wife and mother. At the same time, she can also earn also if required and/ or if she has surplus time than her daily work load. Women are considered as reserve in the family as they only work if the man folk are not able to earn enough. Consequently, much attention on education of male child is given than a female child which ultimately lead to lower participation of women in engineering education.

### **5.2 Low Human Capital Investment Theory**

The second theory, on the other hand stresses the role of unequal investments in human capital with respect to sex which restrict the women from entering in engineering education. It should, however, be noted here that the explanation through unequal investment in human capital has also has a social dimension. According to the Neo-classical approach, the factors like family responsibilities, physical strength, lower investment are responsible for development of human capital which generally are lower for women than their male counterpart (Singh, 2000) which ultimately restricts women from entering in engineering education.

## **6. Affirmative Action**

Throughout the world initiatives are being taken to encourage participation of women in engineering education like other areas of education and work. Indian Government has

few novel schemes to encourage girls into technical education. Table 5 discusses about engineering institutions which provides seats for women. These all are diploma level institutions except Mahila Institute of Technology which is degree level engineering college for women. Many institutions have hostel facilities for girls which enhances participation of women because difficulties in staying alone discourage women from joining engineering education. These days, alternative arrangement as paying guest, private hostel, working women’s hostel etc. have also come up in metros and other big cities. However, in small cities, female students really face problems.

**Table 5: Reservation of Seats for Women in Engineering Institutes of Delhi**

<b>Sl. No.</b>	<b>Name of the Institution</b>	<b>Level of Education</b>	<b>Reservation of Seats for Women</b>
1	Aditya Institute of Technology	Diploma	7.5 %
2.	Father Angel Polytechnic	Diploma	7.5 %
3.	Guru Teg bahadur Polytechnic	Diploma	7.5 %
4.	Maharaja Suraj Mal Polytechnic	Diploma	5 %
5.	Ambedkar Polytechnic	Diploma	7.5 %
6.	Mahila Institute of Technology	Degree	100 %

Source: Singh, “Facilities for Engineering Education in Delhi”

## **7. Conclusion and Suggestion for Improvement**

Traditionally, engineering education has remained a male dominated segment of higher education. Women entrance in this field was very limited and of recent origin. However, in recent times, female enrollment in engineering education has experienced an increase. Now days, it is very common to meet a woman engineering student. But percentage wise analysis does not substantiate the proportion of enhancement. Large women enrolment is ultimately result of exponential growth in over all facilities of engineering education. But share of women student has not increased in that proportion. At the same times, the state level data reveals that expansion both in terms of number as well as percentage is not even. There is need to enhance balanced growth in enrolment of women engineering students. Apart from reservation as well as hostel facilities following initiative in this direction may be helpful:

- i. Fellowship for meritorious female students needs to be introduced.
- ii. Women students need to be encouraged to opt for Mathematics, Physics and Chemistry stream at + 2 level.

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