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THE POSITION OF WOMEN ENGINEERS IN THE UNIVERSITY

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ABSTRACT:

At present there is a great increase, both numerically and percentagewise, of women pursuing degrees in engineering. This places a new dimension to the demands upon engineering faculty and one for which they have been ill-prepared. One result is the increased need for female engineering faculty. But engineering in the US has been a typically male dominated field and resistance to change in some quarters has been great. Consequently, life for women engineering faculty has not been serene recently.

This paper reviews the situation for women engineering faculty over the last twenty years, abstracts and outlines the problems faced passing through 1981, and discusses changes important for the future advancement of women engineers in the university. It is concluded that the situation should improve but that there are many problems to be faced.

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I. Introduction

During the last decade women entering university academic positions in engineering have been faced with a number of problems. Here we outline some of these with a view to being able to understand their nature, reason for existing, and, more importantly, for charting a course for the future. From the analysis made we hope that the conclusion we make will be clear:

The future is bright but there are many struggles ahead to achieve equality.

Our paper is structured as follows. Next we present a few comments on the nature of engineering as a professional field. Following this, in Section III we give a bit of an overview through an historical perspective with some data about women within it during recent times. In section IV, the main body of our paper, we discuss, through situations known to us, typical problems met by a woman at different points in her faculty career. Finally, in the last section, we draw some conclusions. Our information is based upon personal knowledge of the situations associated with over a dozen female engineering faculty members with the opinions expressed of course being our own.

II. Background - Engineering as a Profession

Engineering is considered, at least by those who practice it, among others, as a professional field. As such it is subject to registration rules, placed by state governments, has codes of ethics, and is set off in the universities in separate colleges.

In some sub-fields, such as civil engineering, registration is an important factor in the professional life of a practicing engineer primarily because of the public safety factor. In other sub-fields, such as electrical and computer engineering, some of the professional aspects, such as registration, are less important.

Besides these professional aspects there is another and primary aspect which differentiates engineering from other "sciences", such as physics. This is the design factor: engineering is a professional field based upon DESIGN. The design orientation of engineering means that its practitioners place a constructive outlook, rather than an analysis one, on their approach to problems. As such the outlook of practicing engineers verges as much upon the arts as it does upon the sciences.

But because engineering requires a good background in the sciences before constructive designs can be contemplated, it requires years of background study in the sciences. In reality a student wishing to pursue engineering must be so oriented in high school so that the mathematics, physics, chemistry, etc., is well in hand when college studies begin.

We make the above comments such that it can be realized what a woman going into engineering has to overcome. First she needs to start early, in high school probably at the latest, to build up background. Then she must be oriented to engineering design, something frowned upon for girls and young women in previous generations in American society. Finally she needs to enter the engineering profession, a profession which until now has been male-dominated. The extent of this domination we next briefly discuss.

III. Historical Perspective

Engineering is a cyclic field in that generally the demand for BS graduates oscillates as does the number of BS graduates. The oscillation is typically about five years between maxima and minima with the demand being out-of-phase with the number of graduates (that is, when there is the most demand there is the least number of graduates, and vice-versa). However, because there are so few female engineering graduates, the demand for women BS engineers has recently been rather constant due to factors such as equal opportunity goals.

Nevertheless, the field is still strongly male dominated. From our own experiences at the BS level we would imagine the numbers to be roughly as follows:

$\approx$ 2 female/600 BS graduates; 1955-1965

$\approx$ 20 female/600 BS graduates; 1965-1975

$\approx$ 60 female/600 BS graduates; 1975-1980

As can be seen, the number of female students has been increasing but the percentage of female graduates is still very small. Engineering is clearly a male dominated field and is still remaining so. The percentage of women now entering engineering curricula is undoubtedly much greater than the percentage that graduate; we would estimate that probably one-quarter of an engineering freshman class may be female whereas only somewhat near one-tenth of the graduating class may be female.

The difference is much more striking at the Ph.D. level. For example, in round numbers, 40 out of 1800 Ph.D.'s given in engineering in 1976 were female [1] and probably seven out of eight of these females were non-US citizens. In terms of faculty,

this means that there has been, even until now, a very small pool of female engineers from which faculty can be recruited.

But, the case of Professor Flügge - Lotz [2] shows how bad the situation has been for those females wishing to go into the university. As recalled by her husband, concerning an appointment at Göttingen, in the 1930's she was "blocked from any possibility of ever getting into a university career, just because of being a women". When coming to the US in 1947 the situation was only slightly improved as it is noted that her husband became a professor of engineering at Stanford while she only a lecturer in engineering mechanics. As one of us (RWN) can vouch from having worked with her and her students, she was as capable, or moreso, as the other professorial staff at Stanford where she did eventually achieve full professorial status.

In short, the number of women in engineering has been and remains significantly small. The number available for faculty positions has been even smaller and for years those females attempting to enter engineering faculties have not found themselves the most welcome. The problems met by those actually entering such faculties recently constitute our next topic.

IV. Position of Faculty Women

Although at present the greatest number of females in the university are students, the female students stand in relatively good stead, being a relatively small threat, if any at all, to the majority of faculty. Consequently, we concentrate our discussion upon women in faculty positions. There are four major areas of concern which we wish to discuss: recruitment, assignments

development, and promotion.

A. Recruitment

At present there is a considerable push to interview female candidates for engineering faculty positions, probably because of equal employment needs of the universities. This has led in our opinion to some abuses. Thus, it appears that some universities are interviewing females for engineering faculty positions without any real intent of hiring them, the purpose being primarily to show that they have considered female candidates. Of course it is difficult for a female candidate to know beforehand that this might be the case without inside knowledge, and with so few female faculty such knowledge is essentially unavailable to her.

On the other hand there are so few new Ph.D. female engineers, and such a demand for them, especially at times as now when all engineers are in demand, that those universities which are serious find themselves in a hard bargaining position. In order to attract female engineering faculty we find that commitments are being made which can not be held to. As a case in point, we understand one person was offered a light teaching load, one course, and the opportunity to have this in a graduate course of her specialty. But when she showed up to assume her position she found that the pressures of high enrollments had necessitated a much higher teaching load and the dropping of the course in her specialty.

Along similar lines female Ph.D.'s do find it possible to get part-time positions at beginning professorial levels in engineering. This is attractive to married females because society, being what it is, still puts pressure on beginning professionals to maintain the home. Consequently, part-time positions are a great recruitment

tool for attracting young female engineering faculty. Unfortunately part time positions presently hold a trap, of which some of the candidates seem unaware, in that the faculty members holding them are locked-out of promotion opportunities .

Summarizing the situation on recruitment, although there are some pitfalls of which women should be wary, it is generally very favorable to young Ph.D. female engineers wishing to enter university teaching. As they advance, the situation becomes much less favorable to them.

B. Assignments

Once committed to a particular university a woman faces the problem of her teaching assignments. Initially this may be made by a chairman who had recruited her and who can safeguard her needs. But after the first few terms, her assignments undoubtedly revert to a committee, and as the faculty is almost surely male-dominated, the committee will most likely not have her interests as a high priority. Thus we have found it rare that a women engineering faculty member draws choice teaching assignments. More often than not she will be given undergraduate courses rather than graduate ones pertinent to her research interests and vital for promotion. Indeed we are aware of cases where, after being denied the opportunity of teaching graduate courses, female engineers have introduced senior electives in the research specialty area only to find that they were then denied the chance to teach these, outsiders being brought in to handle them.

In many cases the woman engineer's advising assignments turn out to be heavier than mens. This is particularly true recently

because of the influx of female engineering students who flock to the female faculty irrespective of whether they are their assigned advisor. Since there rarely has been more than one female engineering faculty in any given department, the female students really have at most one female role-model to which to turn. Because the female students do generally have more problems than the men, this indirect advising load becomes a significant but little rewarded factor in a female engineering faculty member's daily activities.

Concerning committee assignments, where these are chosen by vote as usually is the case for important committees, our knowledge of several cases across the country indicates that these will not go to the females. On the contrary females are more likely to be placed on committees by administrative assignment and consequently end up on women's studies or minority status committees, rather than budget or course assignment ones. In short the female engineer is rarely given committee assignments that lead to her own administrative development or which have much say in the professional development of her department.

C. Development

Besides the lack of opportunity to develop through committee assignments female engineering faculty have found their development blocked in other traditional areas normally open to males.

For example, beginning male faculty are often placed in charge of teaching laboratories which they are encouraged to develop and from which they proceed to setting up research facilities. We are aware of at least two cases of female engineering assistant professors who attempted to obtain charge of teaching laboratories with disastrous results. For example, in one case she was encouraged

in this development by a progressive department chairman who was so pleased by her initial performance that she was asked to design, take charge of, and direct a unique research oriented laboratory in her specialty. The succeeding department chairman apparently under pressure from what appeared as his jealous faculty, had her locked out of the laboratory and stripped of any contact with it.

Of course research is of fundamental importance to any faculty member in a research oriented university. Consequently, stripping a faculty member of contact with needed and planned for facilities can only have damaging effects upon the faculty member's career. But there are less blatent and more subtle ways of also blocking a female's development. For example, researchers need collaborators, research students, and mentors, especially at the start of their careers. Collaborators for female researchers in a male-dominated field seem to be hard to come by for various perhaps psychological reasons, and similarly for research students and mentors. Thus, a female researcher must be able to "go it alone", a fact which many find extremely hard to stomach, let alone understand.

The situation is somewhat the same in the area of research grants where most females have not had sufficient contact with the field of "grantsmanship" to be able to proceed unassisted. Fortunately, this situation is improving and we understand that a very significant number of last year's NSF initiation grants in electrical engineering went to females.

D. Promotion

If the situation on assignments and development for female engineering faculty is discouraging, the situation concerning

promotion is what one of us (RWN) would term an utter disgrace to the profession of engineering. We are aware of only a handful of women who presently have tenure and even less who have been able to advance to full professor level. In electrical engineering the State of Washington alone stands out in our knowledge for allowing women engineers entry into university administration, there being two striking examples of enlightenment there.

The problems at present can not be because of lack of availability of appropriate positions, since today's journals are full of announcements of openings at all professorial and administrative levels. But a carry-over of previous generations' outlooks still exists. For example, as of this writing female faculty salaries throughout our own university are claimed to be on the average $2,000 less than for males in the same positions [3]!

Promotion to faculty positions most often occur through voting of the next higher level faculty and usually this is through a secret ballot. In most such considerations of a female engineering faculty there are no other females casting ballots. If humans were completely objective this would raise no problems, but humans when voting on other humans do often appear to be not completely objective. As no reasons are necessarily given when casting a negative secret ballot, the system is open to abuses. Of course this procedure applies to male candidates too, but the voters are almost completely male-dominated. Consequently, casting a negative ballot for the reason that "woman's place is in the home" would not be put forth in the case of a male candidate whereas we are aware of this feeling among some male professors, though primarily those who were raised in what might be termed a

macho-culture. Unfortunately, a very large proportion of engineering professors in the US were raised in a culture other than US, in which case the chance is far from zero of a female having votes cast on her promotion by someone who feels, perhaps only subconciously, that the woman's place is in the home. Our quote above concerning Professor Flugge-Lotz shows that in the past this has been an extremely significant problem for the advancement of women on engineering faculties.

However, it is not the only problem in promotion considerations. Standard criteria involve research, teaching and service, generally in order of priority, and no-one wishes that females who are incompetent in these areas should be promoted. But, as we have seen, it has been traditionally harder for a female to set a recognizable record in these areas than it has been for males. Consequently, a female most likely must work much harder to set a comparable record, in which case comparatively fewer would be promoted at the same time point in their careers. Just such seems to be the case and would be, we believe, reflected in promotion statistics of the last decades.

The above comments show why it is important that final promotion decisions should be in the hands of capable and sensitive administrators. Unfortunately university administrators are not generally willing to overrule faculty votes. However, we are aware of one case where an administrator did but this was to halt the promotion of a female engineer that had been voted for promotion by the faculty! In any event the reluctance of university administrators to change "errors" has certainly led to heartbreaks for a number of women. Certainly this has been a factor in at

least one of our female colleagues, who has been a dedicated teacher, decision to switch fields within her university. On the whole it means that females must consider legal means for support at critical stages in their careers, this being another source of discouragement. Fortunately state and national governing bodies have been willing recently to lend legal assistance and in some cases of which we are aware this has made a big difference.

V. Conclusions

We have briefly discussed the situation of women engineers in the university from which we see that there are an increasing number of such engineers. Although this puts pressure for an improved environment for female engineers within the university, their numbers are still orders of magnitude less than the numbers of males. Hence the field will remain male-dominated for the foreseeable future.

At the beginning levels, students or assistant professors, the problems being met appear to be readily solvable from which the future bodes well. However, when a female reaches the tenure position she may inadvertently become a threat to some established male faculty and there is little pressure her senior female colleagues can apply to counter this because such colleagues scarcely exist. Consequently, she becomes at mercy of the system which at present does not appear to be well-structured to handle her case. Thus, secret ballots may well determine her academic future and certainly have been a source of discouragement to some. With time and social changes though the situation appears to be inproving and at present there is momentum gathering to make engineering a field in which eventually women will feel at home at all levels. Consequently we hold considerable hope for the

future while realizing that the road will not always be easy to travel. But to smooth the road by way of recommendations we would make the following at the least:

1. When an administrative decision is made concerning a female, more thorough investigation be made prior to fixing the decision such that costly administrative errors can be caught and corrected before they become fixed and require legal action to change.

2. More administrative effort be made in assisting and guiding beginning female engineering faculty especially in the crucial areas of research establishment and performance and of teaching and committee assignments.

3. Promotion consideration be made solely an administrative responsibility such that voting on females by possibly hostile male-dominated faculty is avoided.

References

[1] "Earned Degrees Conferred in 1976", The Chronicle of Higher Education, October 11, 1977, page 10.

[2] "Irmgard Flugge-Lotz" in "Notable American Women", edited by B. Sicherman and C.H. Green, The Belknap Press of Harvard University, Cambridge, Mass., 1980, pp. 241-242.

[3] "Inequities Revealed in New Salary Report", The Diamondback (an independent student newspaper-University of Maryland, College Park), Vol. 73, No. 104, February 23, 1981, page 1.

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