FEATURES

ENGINEERING EDUCATION IN SRI LANKA STATUS AND SOME ASPECTS FOR DEVELOPMENT

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Pro.K.K.Y.W. Perera, Head of the Faculty of Engineering of Katubedda Campus and Chairman CEB argues that University Engineering Education in Sri Lanka which has grown rapidly over the past 30 years will need improved and expanded facilities of Sri Lanka if to benefit from the growing advances in this field and it is imperative that immediate action towards this end must be recognised and implemented.

RECENT PAST AND THE PRESENT STATUS

Thirty five years ago almost the entire formal engineering education in Sri Lanka centred round a single institute - the Ceylon Technical College, situated in the heart of Colombo. This College provided education leading to the first degree, technician and craft levels.

The degree course was of four years' duration and coached students for the London University External Examinations in the fields of Civil, Mechanical and Electrical Engineering. Entrance was at Matriculation level. The laboratory, surveying, engineering drawing and other course works performed at the Ceylon Technical College were recognised by the University of London for purposes of the B.Sc. Engineering degree students could also obtain the Ceylon Technical College Diploma based on the results of local examinations conducted by the College.

As we should consider the subject of Engineering Education along with Technician Education, some details of Technician Education are also discussed here. Technicians were produced through the "Junior Technical Officers" course, which was of two years' duration. Entrance was at the Senior School Certificate level. There were only two fields of specialization; (a) Civil, (b) Electrical-Mechanical. These J.T.O.'s fitted well into the requirements of the country at that stage.

Crafts such as Motor mechanism, Radio servicing, Building Construction etc., were also taught at the Ceylon Technical College. The courses were of durations from three months to two years and led to certificates of the College.

In 1950, the Faculty of Engineering of the University of Ceylon commenced teaching for the B.Sc. Engineering (Ceylon) degree. Thus the Ceylon Technical College was left with only the Technician (J.T.O.) and craft level courses.

The Hardy Senior Technical Institute at Amparai also commenced Technician level courses in 1953. Teaching at Katubedde, Moratuwa commenced in 1960, and with this the J.T.O. Courses conducted formerly at the Ceylon Technical College were shifted to Katubedde.

Present Status

Presently, Engineering First Degree level Courses are conducted at the Faculties of Engineering at the University of Peradeniya and at the University of Moratuwa. The Courses at both Universities have a duration of four years and lead to the B.Sc. Engineering Degree.

The University of Peradeniya caters to the following fields of specialization:

Civil Engineering,
Electrical and Electronic Engineering,
Mechanical Engineering,
Mechanical Engineering with specialization in Chemical Engineering,
Production Engineering.

The University of Moratuwa allows specialization in the following fields:

Group I -
(Civil Engineering
(Electrical Engineering
(Electronics and Telecommunication Engineering
(Mechanical Engineering

Group II -
(Chemical Engineering
(Materials Engineering
(Mining and Mineral Engineering.

A certain extent of "In Plant" training is arranged by both Universities during normal University vacations.

The Institute of Engineers, Sri Lanka, also conducts classes in Engineering leading to the Examinations of the Institution. The laboratory requirements for Engineering Courses are generally arranged with the Universities and are conducted during weekends and University vacations. The Institution Examinations are normally considered adequate for Engineering appointments in the Public Service, Corporations and Private Sector. The Degrees of Engineering at the Universities of Peradeniya and Moratuwa are considered by the Institution of Engineers, Sri Lanka, as exempting qualifications from Institution's Examinations. Thus, those

who either complete the Institution's own examination requirements or those who graduate from the Universities of Peradeniya or Moratuwa become eligible for admission as Associate Members of the Institution of Engineers, Sri Lanka.

Post-Graduate programmes in restricted fields leading to M.Sc. and M. Phil. degrees are conducted both at the University of Peradeniya and at the University of Moratuwa.

Technician Courses went through several curricula and name changes. Presently recognised technician courses are conducted by the Hardy Senior Technical Institute at Amparai and by the University of Moratuwa. Even those who follow the course at the H.S.T.I. Amparai attend the Courses at the University of Moratuwa during the second year. The duration of the Course is two years internal teachingfollowed by an year of industrial training at suitable work places. On satisfactory completion of the two academic years and the industrial training year the technicians obtain the National Diploma in Technology awarded by the Commissioner of Examinations of the Government Department of Examinations.

CURRICULUM

The curricula of most Engineering Courses in Sri Lanka were based on the pattern of corresponding Courses in the United Kingdom or other advanced countries. Undoubtedly, the ambition of most e gineering teachers has been to produce graduates of high quality, who are internationally recognised. This latter criterion, together with the fact that the basics of Engineering are the same all over the world, has kept the Engineering Degree Course curricula closely following those in advanced countries. Several improvements keep the curricula abrest of those in advanced countries, as well as serve useful local requirements.

It cannot however be said that the curricula have been completely designed to suit local conditions after critical examination of requirements in industry, business, government and school, education system. For instance, the lack of teaching regarding tea factories and processing Machinery although tea is the most stable export product of the country, may be considered as an example of this defect. The introduction of courses at the technician level specilizing in Textile Technology and Rubber Technology occured in the last decade and this certainly is a recognition of local requirements. Recently approval has been obtained to develop post-graduate courses in Textile Technology.

Interest of Industry

In recent times,the major Government and Corporation sectors involved with engineers and industry have shown a healthy interest in the engineering curriculum. The Institution of Engineers, Sri Lanka is also actively interested. Often, the view-point expressed by senior practical engineers in industry is that the University education is too theoretical. It has been pointed out that some civil engineering graduates were "ignorant of practical details such as the size of an ordinary brick". Industrial in-plant training has been introduced partly to reduce the gap in practical knowledge of the above form.

While acknowledging the view point of the practical engineers from Industry, engineering educators have also to consider other relevant aspects. A student who enters the University in 1984 will not graduate till 1988. The knowledge imparted to him should be sufficient to enable him to keep up with the advances in engineering for at least another 10 to 15 years, which will run beyond the year 2000. Thus, educators tend to think that the young under graduate should be supplied with adequate mathematical and other background, even if such knowledge may not often be useful for his immediate employment. He should also be equipped with sufficient general material to enable him to adapt to the actual job that he may secure: e.g. a civil engineer may get a job in Building work, highways, irrigation, public health or other speciality. It would thus appear that the educator has virtually to compress an impossible amount of material into a finite human capacity within a limited time, if the finer practical details pertaining to all the future engineers' possible work is also to be encompassed. Obviously a compromise becomes necessary - this is one instance where a continuous dialogue with engineers in industry is essential.

Such a dialogue is necessary to bring down any dons from possible "ivory towers", as well as to keep industry conscious of the necessity to produce engineers suited for the present as well as for the future.

In a small country like Sri Lanka, it is best to establish this dialogue with industry and the desired feedback through interviews and personal contact. Professional Bodies such as the Institution of Engineers, Sri Lanka, where both practising engineers and engineering teachers participate, are found to be extremely useful for this purpose.

RECENT TRENDS

Due to reasons elaborated in the last section, there has been a tendency to increase the content of theoretical education over the last 15 years. The coverage and depth of Mathematics in the Engineering Courses also increased. There has been a growing awareness of the importance of introducing aspects of Management, Humanities

and Industrial Economics; these are now covered by compulsory subjects in the Engineering Courses.

In addition to increasing theoretical content as well as humanistic studies, one desires to give intimate and detailed practical knowledge in the particular branch that the graduate will ultimately work. This could be achieved during a limited time only through specialization into narrower fields. The tendency is reflected in the large number of specialized fields now available in Sri Lanka both for undergraduate and technician students. It is also evident from the increasing number of "optional" subjects, particularly at Final Year degree level, both at Peradeniya and at Katubedde, Moratuwa.

In the present state of development in Sri Lanka, it has been accepted that too much specialization at the undergraduate level is not desirable. Quite often an Electronics Engineer has to perform Electrical Power Engineering work, and at times even some Mechanical Engineering and Civil Engineering functions. Then, without resorting to specialization, how can all the desired aspects of education described above be imparted within the duration of a normal engineering course? One proposition is to turn out a general grade of graduate engineer for the majority of maintenance and construction jobs. The advocates of this proposition state that an additional year or two of education can be given to a selected few engineers to fit into Research and Development functions. An extract from the Minutes of a meeting of a Special Committee appointed by the Institution of Engineers, Sri Lanka, held on January 29, 1974, is relevant in this context.

"It was noted that while the University had lately included several extra subjects into their curricula there was a need for introducing more community oriented subjects into the undergraduate engineering curriculum to ensure that engineering graduates had training in the social sciences, communications (Public speaking and writing) to better equip them for a community service oriented profession. It was recognised that this could only be done at the expense of some of the higher engineering science content of existing 4 years University curricula. Committee were of view that a new curriculum could be devised to provide for adequate coverage of the basic engineering sciences, directed vacation practical training, practice oriented courses of the students choice in one or two areas together with perhaps a 30% core of community oriented courses aimed at broadening the outlook of the engineering graduate. This course would provide the basic education for all engineering graduates.Those who show an aptitude for Research, Development, Creative design etc., and achieve high grades in the 1st degree would automatically be entitled to go on to higher degrees (Masters) of one and two years duration after a period of say 2 - 3 years, in practice. Such Masters courses would ensure that Engineers had access to the latest applicable knowledge in more relaxed and meaningful climate than in the final year of a 4 year undergraduate curricula. Schemes of recruitment, utilization and merit promotion would also have to be revised to suit such a scheme".

SOME PRESENT NEEDS AND DEVELOPMENT ASPECTS

In planning or designing the future of Engineering Education in Sri Lanka, there are several questions to which answers must be first defined. Some years ago it was generally thought that the engineering education should be planned in such a manner that it will serve the needs of the country. While this is certainly an undoubted need, the exodus of engineers over the last 10 years and the present policy of unrestricted exodus of Engineers leave room to question the above assumption. Perhaps about half the Engineers who graduate from the Universities have sought employment abroad within the first 15 years from production. The exodus of Engineers continues unabated. In this context it is inadequate to plan the number of Engineering graduates just to cater for the internal needs of the country. One has in these circumstances to cater to the internal needs of the country as well as for the very large exodus.

The number of graduate Engineers who would leave the shores of Sri Lanka are quite high now but is an unpredictable quantity for the future. The exodus depends on local salaries, housing availability, educational possibilities for children, other living conditions etc. It also depends on the attractiveness of foreign jobs available. As these factors are influenced by local and foreign situations it is difficult to put a tab on the exodus requirements even for a medium term period of 5 to 10 years. Thus it becomes extremely difficult to plan for numbers required for engineering education. If one is to cater only entirely for the local requirements an appropriate assessment could be made.

One crude method of assessment would be through the growth in members of engineering admissions to the Universities over the past and by extrapolating it in a suitable manner. In the year 1950, the first batch of engineering students admitted to the then University of Ceylon consisted of 25 students. In the year 1975 the numbers of admission to the Universities had risen to 310. The numbers progressively rose to 480 in the year 1981. (See appendix - Undergraduate entry to the Faculties of Engineering 1971 - 1981). These increases indicate a doubling period of 7.3 years, coressponding to an approximation -

$$S = 25. \times 1.1^t$$

where S = admissions per batch
t = times in years after 1950

Although there have been certain small time periods where engineering employment was uncertain, the position is that practically all Engineers have found suitable employment. The importation of Engineers for work required in Sri Lanka has been small and has been where major projects were rushed or accelerated; t this to some extent cancels the exodus numbers. Thus one may indirectly infer that the production of Engineers by the Universities has at least approximately matched the requirements. The inference assumes the dropouts to be a constant factor.

Future requirements of Engineering Admissions

If one were to predict based on the above crude law, the number of engineering undergraduates required to be admitted per year to Universities by the year 1990 should be over a 1000. These numbers are not high when compared with per capita values prevailing in developed countries.

However much would depend on the country's general planning of major projects and whether the present economic growth rates should be sustained or improved. When one thinks of the increasing population as well as the demand for higher and better living conditions, it has to be concluded that the construction and commissioning of major projects will have to go on in an expanded manner. For example in the electrical power and energy sector, demand forecasts indicate doubling of power and energy every 7 years. This means that additional power development schemes as big as Victoria, Kotmale and Randenigala have to be found and constructed continuously in the years to come. If such hydro projects are not available or not economical, other energy sources of large engineering magnitude will have to be constructed. Similar demands would also be necessary in the other major engineering areas such as in highways, buildings and in mechanical engineering industry. The advent of Television, Computers and expansion of Telecommunications all require larger numbers of high calibre engineers and technicians.

If salary and other living conditions of the engineers are not improved substantially and the present policies are continued then it would be necessary to cater for the Engineers required for local purposes as well as for exodus. Unrestricted export of Engineers is of course going to be extremely expensive because in the production process of one good Engineer, primary and secondry education costs of more than 50 persons would have had to be met. Some estimate this figure as high as a 100.

For the education and training of the required number of quality Engineers for the future, several requirements can be easily identified. The requirements would include buildings, laboratories, equipment, etc. in the different dields of Civil, Mechanical, Electrical Electronics and other Engineering discipline. Suitable staffing is another vital component which deserves very careful consideration and attention.

Teaching Staff Shortages

In the Faculties of Engineering of the Universities in Sri Lanka, the most critical and important factor at the present time is remedy the poor staff availability. Among these factors are the necessities for:

(a) Attraction of suitable high calibre staff for University teaching positions.

(b) Necessity for a well planned programme for initial staff training.

(c) Devising of methods for the retention of trained staff.

(d) Programmes and incentives for continuous staff development to a level of high calibre.

In all these fronts urgent attention and systematic follow up is necessary.

In recent times the best qualified students graduating from Engineering Faculties of the Universities, either seek to go to industry or to seek University teaching positions. This by itself is healthy. However it is very seldom that the Engineer with good theoretical ability and considerable practical experience joins a University for academic work. This indicates that the remuneration package of the Universities must be improved if a healthy Engineering Faculty is to be brought up.

In the field of staff training, very often Assistant Lecturers have to either seek foreign University places without support for their subsistance abroad from the University which employes them. This results in their entering Post-Graduate Courses which may or may not be the exact requirements of the University where they are employed. Only a small fraction of foreign post-graduate training caters to the exact fields which are required.

Teaching Staff Retention

Retention of University staff of adequate quality and sufficient numbers is another major problem area. Many University Lecturers have left and are leaving the shores of Sri Lanka seeking foreign employment, which offers salaries of 10 to 20 times that paid within the country. This is natural because certain basic necessities such as housing have become beyond the means of University teachers. Quite a few of those remain-

ing have had to find other sources of income to suplement the University salaries. Such other sources of income vary from lectures at other institutions, private tution to undergraduates, private tution to those seeking admission to the Universities, consultancy to industry, repair jobs in industry, business unrelated to Engineering and so on. While a certain extent of high calibre consultancy may be beneficial to the development of the University teacher; one cannot be satisfied that all the avenues which are now pursued to earn money are conducive to the development of a proper teacher. It is necessary to recognise these and to take corrective action urgently. Otherwise, rather than expanding engineering education in a healthy manner, deterioration is bound to set in.

The most effective way towards retention of University Staff would be through direct higher renumeration as well as through incentive packages for housing, transport, etc. If these were not possible due to some reason or other, a substitute which could help to some extent would be through research contracts given by industry to the University Faculties. This implies certain specific work of a research and development nature or even purely of analytical nature leading to practical requirements of industry to be formed out to the Universities. The results of the research contract will have to be produced to the industry prior to payment and such results would be of a nature that is justifiable by the industry. The University Faculties can perhaps distribute such research contract funds among researchers who participate, thereby enhancing the renumeration. Such a method would be far better than allowing Faculty members to undertake odd jobs of varied nature primarily for the purpose of enhancing financial renumeration.

SUMMARY AND CONCLUSION

Engineering education in Sri Lanka which was restricted to major fields of Electrical, Mechanical and Civil Engineering in 1950 has expanded to cover Production Engineering, Electronic and Telecommunication Engineering, Chemical Engineering, Material Engineering and Mining and Mineral Engineering by the 1980's. Also University Engineering admissions have increased from 25 students per year in 1950 to 480 students in the year 1981. Further expansion of students numbers are considered necessary and Sri Lanka may well require an admission of a 1000 students by the year 1990. The Universities will also have to cater to new advances in all fields of engineering and cater to rapidly developing fields such as in Electronics, Computers and Space Communications.

Improved and expanded engineering education will need such items as buildings, laboratories, equipment, etc. The most vital bottle-neck identified is adequate academic staff which should be attracted, developed and retained by the University. Immediate corrective action towards this end must be recognised and implemented .

ENTRY NUMBERS TO THE FACULTIES OF ENGINEERING 1975 - 1981

INSTITUTION	Number of Undergraduates admitted						
	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
University of Moratuwa	160	171	167	185	201	229	252
University of Peradeniya	150	150	250	250	243	247	228
TOTAL	310	321	417	435	444	476	480