SURVEY

OF

ENGINEERING EDUCATION

IN VIETNAM

August 26, 1965

Dear Mr. Minister:

We have the honor of transmitting to you, on behalf of the United States Operations Mission to Viet Nam, this report on the "Survey of Engineering Education in Viet Nam."

The survey team members are unanimous in concluding that Viet Nam has a bright economic future and that engineering education must expand if it is to make its necessary contribution to that future.

Your people have been generous and thoughtful in giving guidance, assistance, and hospitality and we wish to express our deep and sincere thanks for making our stay here so very pleasant.

Respectfully submitted:

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Tran Ngoc Ninh
Minister of Culture
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Republic of Viet Nam
Saigon, Viet Nam

SURVEY OF ENGINEERING EDUCATION IN VIET NAM

A Report to
The Minister of Culture and Education
of the Republic of Viet Nam

On behalf of
The United States Operations Mission to Viet Nam

By
Wesley L. Orr, J. Morley English, Thomas E. Hicks, and Ralph J. Smith

Submitted
August 28, 1965

TABLE OF CONTENTS

Introduction	P. 1
Summary	2
Activities of the Survey Team	4
Economic Background	7
The Educational System	13
Engineering Education	15
Analysis and Prediction	20
Observations on Administration	35
Recommendations	40
Appendix	46
A. Analysis of Engineers, Equipment, and Facilities Needed	47
B. Analysis of Engineers Needed in Viet Nam	53
C. Engineering Curricula of National Technical Center	56
D. Charter of National Technical Center	61
E. Placement of Graduates of National Technical Center	66
F. Sample Examinations at National Technical Center	69
G. Short History of School of Civil Engineering	76
H. Bibliography	79
I. Composition of the Survey Team	81

SURVEY OF ENGINEERING EDUCATION IN VIET NAM

At the request of the Minister of Education of the Republic of Viet Nam, a team of university professors representing the major fields of engineering was invited by the United States Operations Mission to Viet Nam to make a survey of engineering education in Viet Nam.

The team conducted its study in Viet Nam during the period from July 26 to August 28, 1965. The members of the team were J. Morley English, Thomas E. Hicks, Ralph J. Smith, and Wesley L. Orr, team leader.

The work of the team was assisted in a very real way by the enthusiastic cooperation of the highly competent faculty of the National Technical Center and of the many officials of government and industry who provided information, counsel, and suggestions. The endeavor was also facilitated by the wholehearted support of the American officials and staff.

The team recognizes, however, that in the limited time available, it could not make an exhaustive analysis of engineering education in Viet Nam. Moreover, the present unsettled condition tends to confuse data and to disturb trends. Travel, at this time, is difficult and limited. Work away from home is always hampered by the inaccessibility of personal libraries and files of information.

Nevertheless, due to the splendid cooperation and capable assistance received, the team was able to reach conclusions that it believes will be constructive.

SUMMARY

On the basis of a brief but intensive study, the survey team is enthusiastic about the future prospects of Viet Nam. In spite of the present struggle, it appears that the economic prospects are bright. The growth rate of 5% per year called for in the Second Five-Year Plan seems attainable if an adequate supply of well-qualified leaders is available.

To supply the necessary technological leadership, in war and in peace, a greatly increased supply of professional engineers will be required. It is clear that there are many young Vietnamese with the intelligence, ability, and desire to complete successfully an engineering curriculum. There already exists in the National Technical Center the nucleus of a greatly expanded institution for the education of professional engineers. The team is convinced that Viet Nam has the resources to establish, perhaps with the help of friendly nations, the first elements of a program for engineering education which is essential in the drive for economic growth.

In working toward that goal, the following major recommendations are submitted:

A master plan for the rapid expansion of engineering education should be developed immediately.

A new educational institution, carefully planned to meet the specific needs of Viet Nam, should be established as soon as possible.

The new institution should build upon the engineering program of the National Technical Center.

A greatly expanded program of advanced study abroad for engineering teachers should be inaugurated immediately.

The present high quality of students admitted to engineering should be maintained.

The number of engineering curricula offered should be expanded, but the character of the education provided should be carefully defined.

Financial aid should be obtained to provide guidance, equipment, and buildings during the period of rapid acceleration of engineering education.

A team of widely experienced engineering professors should be invited to serve as resident consultants during the initial period.

ACTIVITIES OF THE SURVEY TEAM

The team arrived at Saigon on July 26 and was met by Nguyen Chanh, Director General of the National Technical Center, and the team's counterparts, Nguyen Thanh Toan, Dao Kim, Le Ba Tuan, and Truong Cong Hieu, Granville S. Hammond, Chief of the Education Division of USOM, and Robert P. Johnson and Ferdinand V. Liotta of the Education Division of USOM. One week of meetings with Vietnamese Government officials was planned by Mr. Chanh starting with a meeting on the morning of July 27 with the staff at Phu Tho. Present at this meeting were:

Nguyen Chanh, Director General of the Center
Nguyen Tu Duc, Deputy Director of the Center
Vo The Hao, Chief of Services
Cung Tat Cuong, Assistant Director of Electrical Engineering
Nguyen Tranh Diep, Director of Mechanical Engineering
Dinh Van Hoang, Director of Chemical Engineering
Phung Luong Ngoc, Director of the Merchant Marine School
Nguyen Thanh Toan, Counterpart in Civil Engineering
Le Ba Tuan, Counterpart in Electrical Engineering
Dao Kim, Counterpart in Mechanical Engineering
Truong Cong Hieu, Counterpart in Chemical Engineering

That afternoon the team met with Dr. Tran Ngoc Ninh, Minister of Culture and Education at which time the goals of the team were discussed.

On the morning of July 28 the team met with Khuong Huu Dieu, Director of the Industrial Development Center and his staff and later in the morning with Ho Manh Trung, Director General of Mines and Industries, and Tran Van Be, Director of Industries and Handicraft. That afternoon, meetings were held with Bui Quang Minh, Director of the Institute of Statistics, and Luong The Sieu, Assistant Director General of the Industrial Complex at An Hoa Nong-Son.

The meeting of the morning of July 29 was with Lieu Mau Thanh, Director of Research and Planning of the Directorate General of Plan, and the afternoon meeting was with Ngo Trong Anh, Minister of Public Works, Buu Huu Tuan, Deputy Minister of Public Works, and Pham Huu Vinh, Secretary General of Public Works.

The next morning, the team met with Nguyen Huu Minh, Director General of Electricity of Viet Nam and after that meeting visited the thermal power plant and switching station at Thu Duc.

Sources of valuable information, both in the form of printed matter and in the names of persons to contact, were obtained at these meetings. In the weeks following these meetings, the team started to study this information and gather additional information. Many of the above listed people were visited again.

The team also visited with Dr. Tran Quang De, Rector of the University of Saigon and discussed the feasibility of including engineering education in the University of Saigon.

To gain additional information on industry in Viet Nam, the team flew to the Industrial Complex at An Hoa Nong-Son at the invitation of Mr. Sieu. A complete tour of the site was arranged by Le Thuc Can. Director of the Complex, and in discussions with Mr. Can and two of his engineers, Nguyen Huu Tan and Le Kim Dac, many ideas which appear in the report were uncovered. The team also obtained information and ideas in visits with Leroy S. Wehrle, Robert Lafollette, and Charles Saurbier of USOM, and A. Ben Streidt, Project Manager for a U.S. firm making feasibility studies of large scale engineering projects in Viet Nam.

During the entire time of the team's visit, there were frequent consultations with Mr. Chanh and Mr. Hammond and their advice and suggestions were invaluable in guiding the team. It was, however, the almost daily contact between the team and the Vietnamese counterparts Messrs. Toan, Kim, Tuan, and Hieu, and Messrs. Johnson and Liotta of the USOM Education Division that permitted the team to progress as rapidly as it did. The team worked constantly with them on such subjects as admission systems, curriculum, building and laboratory facilities, placement of graduates, estimates of number where no numbers are available, etc.

ECONOMIC BACKGROUND

Level of Economic Activity

Although the economy of the Republic of Viet Nam has virtually ceased to grow at the present time owing to the political unrest, its past growth, from the time it came into existence in 1954, has been significant. Reliable statistical data on economic activity are difficult to obtain however, and estimates of the level of Gross National Product and of its rate of growth are subject to considerable error. The National Bank of Viet Nam estimates that in 1962 the Gross National Product was 89 billion $VN, or 6,300 $VN per capita, and capital investment was 7.2 billion $VN, or 8.1% of Gross National Product.* This is equivalent to a Gross National Product of $2.6 billion U.S. and capital of $210,000 ,000 U.S. at the official exchange rate. The official rate is a reasonable index for establishing equivalence when considering relative purchasing power of the average Vietnamese and U.S. consumer.

The capital investment does not adequately reflect the capital provided under foreign aid and military assistance programs. U.S. Aid amounted to $166 million and military assistance $215 million in 1964 (Reference 1). A large part of these expenditures would have to be considered as capital investment.

The planned economic growth rate of the Directorate of Plan in its 2nd 5-year plan is 5% per year. A country like Viet Nam with a

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* The survey team did not have time to make a sufficiently detailed study to obtain an authoritative estimate, if indeed such an estimate is possible. The estimates are only to be construed as very rough guides.

positive economic growth objective of 5% per year might be assumed to require new capital formation of about 18% of its Gross National Product.

Although past growth cannot be determined directly, a few important items for which data were obtained provide an indication of the growth which has occurred (Reference 2). According to the publication "Industrial Development of Viet Nam" (Reference 3), agriculture accountsfor 84.2% and industry 2% of the labor force of 6.5 million people. Thus, growth in the principal crop, rice, is an important indicator of the economy as a whole. Rice production increased from 2.08 million tons per year in 1954 to 5.21 million tons per year in 1962. This increase would correspond to an equivalent annual growth of 11.5%. At the same time, rubber, a second important crop, increased from 51,085 tons to 68,288 tons, or an equivalent rate of 3.6% per year.

One indicator of economic development and, in particular, the growth of the industrial sector of the economy, is electrical power consumption. Power consumption increased 98% - from 181,000 kilowatt hours in 1954 to 360,000 kilowatt hours in 1962, or an equivalent rate of 8.6% per year. Since the population of Viet Nam is growing at 2.8% per year, it would appear that the 5% growth rate objective of Plan is attainable.

Professional Occupations

Another important indicator of the growth in the material standard of living is the number of people engaged in professional occupations. The ratio of professional groups to population, and

the rate at which this ratio increases, provides a measure of development. For example, medical doctors increased from 398 in 1954 to 748 in 1962. At that time, the ratio of doctors to population was approximately 1 for every 20,000 people. This increase represented an equivalent rate of growth in the number of medical doctors of 7.9% per year. Lawyers increased during the same period, at the rate of 9% per year. Included within these professional groups were a number of foreign practitioners. However, their number remained essentially constant over the 8-year period. Consequently, the growth of these professions must be attributed to the increasing number of Vietnamese nationals.

Growth in the professions was accounted for by even greater rates of increase in the students enrolled in the professional schools. The number of medical students increased from 464 to 1,245 or a rate of 14% per year. Law students increased from 763 to 2,769 or 19% per year. Architectural students increased from 27 to 137 or 23% per year. By contrast essentially no growth has occurred in engineering enrolments.

Unfortunately, no data are available on the total number of professional engineers. Only a portion of the engineers are members of "Association Des Ingineurs et Techniciens," (Reference 4). The 1962 roster of the association listed 262 degree holding members; of these, 158 were engineering graduates from French universities and 16 from foreign universities other than French. Only 90 members are graduates of the National Technical Center at Phu Tho, although it is known that 417 engineers have graduated from the National Technical

Center since 1957.

Personal judgment of a number of people questioned indicated that about one half of the foreign engineers were listed. This would indicate a total number of 800. Conceivably there may be as many as 1,000 engineers in Viet Nam at the present time.

There is no estimate of the number of engineers in military service. It is probably quite a high percentage. A survey made in March 1965 of graduates in Engineering from the National Technical Center at Phu Tho indicated that, of the graduating classes of 1962, 63 and 64, 28% were in the army and 44% in government service (See Appendix E).

If the estimate of 1,000 engineers in Viet Nam can be accepted as reasonable, it means that there is less than 1 engineer per 15,000 of population. It would also indicate that the number of engineers practicing in Viet Nam is approximately equal to the number of medical doctors. The normal ratio is usually about 4 engineers per medical doctor. This would indicate the shortage of engineers is more critical than that of medical doctors.

Policy of Industrial Development

Industrial development in Viet Nam in the 8 years, from 1956 to 1963, has been based on a policy "...primarily designed to support agriculture and the processing of agricultural products." This policy was based on the argument that "...prospects for return from agricultural development are much better than those from industrial development."* As a consequence of this policy, a major portion of

the capital investment of the country has been in new industries for textiles, pharmaceuticals and food processing. Additional capital has been invested in power projects, highways, and water supply systems.

A particularly promising aspect of industrial development in Viet Nam is the approach to concentration of development in a complex of industries. An example of such concentrated development is the government-sponsored project at Nong-Son An Hoa. This project is largely financed by French and German interests. Here, an available coal mine coupled with hydro-electric potential in the area will be utilized for an integrated complex of industries including textiles, fertilizers and cement.

The Nong-Son An Hoa complex furnishes some indication of the extent of foreign engineering which is employed in capital expansion programs within Viet Nam. In a report on the project (References 5 and 6), two capital budgets are shown. One is given in Piastres largely devoted to construction of the site. It shows that 0.67% of the 581,000,000 $VN or 4,000,000 $VN is allocated to Engineering. The other is given in dollars largely for heavy machinery and equipment. It shows that of $29,000,000, 3.9% or $1,060,000 is allocated to engineering. Assuming that the numbers of engineers working on the project in each case is in proportion to the relative expenditures, one Vietnamese engineer to 5.7 foreign engineers is indicated. However, this estimate must still contain a bias which exaggerates the number of Vietnamese engineers. The equipment which is purchased for the project includes the engineering cost hidden in the purchase price of

machinery and equipment. Normally in such industrial projects, as much as 10% of the cost will be engineering.

Such developments as Nong-Son An Hoa are planned for other areas and may be expected to create a strong demand for engineers.

THE EDUCATIONAL SYSTEM

Elementary Education

The elementary school is five years in length and offers general childhood education. A student graduates either on the basis of classroom achievement or by passing an examination. He receives a Certificate of Primary Studies.

Secondary Education

1. The secondary school is divided into two parts or cycles, the first part being four years in length. At this point the student chooses either an academic or a vocational program. After completing his course work and successfully passing a terminating examination he receives a certificate appropriate to the studies he pursued.

Diploma of Upper Elementary Studies

Certificate of Further Elementary Studies

Certificate of Vocational Skill

Certificate of Industrial Study

2. The second part of the secondary school is three years in length. Entrance to a particular program is obtained by presenting an appropriate certificate of first cycle education and successfully passing an entrance examination. Graduation is attained through a nationwide competitive examination if the student attended an academic school (lycee) and he receives a Baccalaureate II. To be eligible for this examination the student must have successfully passed the Baccalaureate I examination the previous year.

The technical schools follow a similar program offering the Baccalaureate Technique II which prepares the student to enter the Engineering School.

Other specialized secondary schools include business, commerce, trade, industrial, crafts, agricultural, home economics, pedagogy, etc.

Higher Education

Universities. Entrance to the Faculties of Letters and Science of the Universities is by presentation of a Baccalaureate II and successfully passing an entrance examination for the selected program of study. At the end of the year each Faculty offers examinations. If the student successfully passes his examination, he receives a Certificate from that Faculty. Upon the completion of four Certificates he receives a License indicating he is a graduate of the University.

In the Faculties of Medicine, Architecture, Dentistry, Pharmacy, Pedagogy, and Law, the student is examined at the end of each year and, if he successfully passes his examination, proceeds to the next higher year. The period of study in these Faculties is: Medicine, 7 years; Architecture, 6 years; Dentistry and Pharmacy, 5 years; Pedagogy, 4 years; and Law, 3 years.

Institutions. Several special schools, following prescribed programs for three or four years and requiring special competitive entrance examinations, are located in Vietnam. These include schools of administration, agronomy, forestry, veterinary medicine, and the National Technical Center at Phu Tho.

ENGINEERING EDUCATION

Origin of the National Technical Center

Engineering education in Viet Nam, centered at the National Technical Center at Phu Tho, was created by Decree No. 213-GD on 29 June 1957 and modified by Decree No. 189-GD/PC/NH on 1 February 1961. The Center is directly under the Minister of Education, who is Chairman of the Board of Trustees, and consists of the following technical and professional departments:

Civil Engineering Department	:	Technician Level Engineering Level
Electrical Engineering Department	:	Technician Level Engineering Level
Mechanical Engineering Department	:	Engineering Level Only
Chemical Engineering Department	:	Technician Level Only
Merchant Marine School	:	Technician Level Only Deck Officers Technical Officers

Expansion of this program is permitted by the decree.

The program of the National Technical Center had its origin in the Civil Engineering School for Technicians at Hanoi, started in 1911 and transferred to Saigon in 1947. That same year, training for radio technicians was started and was the origin of the Electrical Engineering Department. The Mechanical Engineering Department was started in 1959; the Chemical Engineering Department was started in 1963; and the Merchant Marine School was started in 1951.

Organization of the National Technical Center

Administration. The National Technical Center is administered

by a Director General and assisted by a Deputy Director and a Chief of Services. To aid the Director General in the operation of the Center, there is a Board of Experts consisting both of Vietnamese professors and foreign technical experts who report directly to the Director General.

Each department in the Center has its own Director who is aided by a Proctor.

Policy. The Board of Trustees provides policy for the Center and consists of the Minister of Education or his representative as Chairman of the Board, a Representative of the Ministry of Public Works and Communication, a Representative of the Ministry of Economy, the Dean of the Faculty of Science of the University of Saigon, the Director General of the National Technical Center, the Deputy Director of the Center, the Director of each of the Departments, the Chairman of the Board of Experts, and the Chief of Services. This Board meets at least once a year, and upon call by the Chairman of the Board.

Pedagogy. Educational instruction at the National Technical Center is directed by the Technical and Pedagogical Board. The Chairman of this Board is the Director General of the National Technical Center. Its members include the Deputy Director, the Director of each of the Departments of the Center, and the Chairman of the Board of Experts.

Each department has a Committee of Professors of that Department. The Chairman of this Committee is the Director of the Department, and the members include the Proctor of the Department, each of the Professors of the Department, and a Representative of the Director

General from one of the other Departments.

Appointment of the Staff

The instructors of the National Technical Center are employed directly by the Ministry of Education upon the nomination of the National Technical Center. There are presently 21 permanent full-time instructors, 15 foreign instructors and 204 part-time Vietnamese instructors. This includes both the engineering and the technician levels.

Admission Requirements

Engineering. Entrance to the Engineering Section of the National Technical Center is by presentation of a technical baccalaureate II or an academic baccalaureate II plus a certificate in one of the science or mathematics programs at a University, plus satisfactory completion of a competitive examination.

Technician. Entrance to the Technician Program is by presentation of one of the first cycle certificates plus successful completion of a competitive examination. In practice most prospective students have completed at least the Baccalaureate I and many have completed the Baccalaureate II.

Examinations. The competitive examinations include mathematics and physics plus descriptive geometry for Civil Engineering, electrical circuits for Electrical Engineering, industrial drawing for Mechanical Engineering, and chemistry for Chemical Engineering. The language requirement was dropped from the entrance examinations in 1964.

Program of Study

Engineering. The Engineering Program requires four years of study, the first two years being essentially common. In each of the four years, the student spends about 23 hours per week in classroom lecture and in Civil and Electrical Engineering about seven hours per week in laboratory work. In Mechanical Engineering the laboratory work averages, over the four years, about 14 hours per week. This higher average is due to the 1,395 hours of shopwork (735 hours in the fourth year) taken over the four-year period. Thus, the student has at least 30 contact hours per week, and if he spends only one hour of study for each hour of class, he is working 60 hours per week. If he spends the more ideal two hours of study per hour of class, he must work a 90-hour week.

Because of the large number of part-time instructors and their necessarily light interaction with other members of the staff, there appears to be duplication in the lectures directly concerned with engineering (the third and fourth years). This duplication does not appear to be present in the more basic courses of science and mathematics, perhaps due to the more completely detailed syllabuses available for these courses.

Technician. The Technician Program requires three years of study and has no common parts. In the Marine Engineering School, the students study for two years, have five years apprenticeship and receive their degree after an additional three months of study.

Enrolment

In the academic year 1964-65, the enrolment at the National Technical Center was:

Civil Engineering Department:
132 Students (Engineering Section)
147 Students (Technician Section)

Electrical Engineering Department:
92 Students (Engineering Section)
129 Students (Technician Section)

Mechanical Engineering Department:
89 Students (Engineering Section)

Chemical Engineering Department:
94 Students (Technician Section)

Merchant Marine School:
71 Students

Total - 313 Engineering Students
441 Technical Students

Graduates

Since 1947, the National Technical Center has graduated engineers and technicians divided as follows:

Civil Engineering College:
262 Engineers
513 Technicians

Electrical Engineering College:
72 Engineers
61 Technicians
179 Radio Technicians

Mechanical Engineering College:
83 Engineers

Chemical Engineering College:
None

Merchant Marine School:
246 Deck Officers
255 Engineering Officers

ANALYSES AND PREDICTION

The Nature of Engineering

Engineering is the professional art of applying science in the optimum utilization of natural resources for the benefit of man. Just as the medical profession assumes responsibility for individual and public health, and as the legal profession assumes responsibility for law and social justice, the engineering profession takes as its primary responsibility the economic welfare of man.

In planning the engineering education program for an aspiring nation over the next decade, a key word in the definition of engineering is "optimum." Where certain resources are limited, it is essential that those resources be utilized in such a way as to achieve maximum results. A nation with limited technical resources, for example, should borrow funds, capital equipment, and techniques from countries where these resources are readily available. It should concentrate its own efforts on doing first those things which it can do well. The education provided in Viet Nam should prepare her engineers to utilize the nation's resources so as to achieve a maximum rate of growth in the standard of living.

Another key phrase in the definition of engineering is "applying science." A newly developing nation cannot afford to invest much of its resources in original scientific discovery. The great need is for skill in adapting existing science and technology to solve national problems. This is not merely imitation; rather this process calls for discriminating analysis and creative adaptation at a high

professional level. Growth will come more rapidly and less expensively if full advantage is taken of existing technical knowledge. To be effective, engineering in Viet Nam requires a blending of the dedication and local knowledge of the Vietnamese engineer with the best principles and practices of engineers in all parts of the world.

The Engineer's Role in Industrial Development

The goal of the engineering profession in Viet Nam should be the utilization of national resources in an efficient, orderly way so that the material standard of living approaches, as rapidly as possible, that in the most developed nations. In order to achieve this goal, it is essential that the role of the engineer in industrial development be clearly understood by those formulating policy.

The Engineer in Enterprise. National policy in Viet Nam calls for growth in the economy at the rate of 5% per year (See Ref. No. 7). An essential ingredient of balanced economic growth is industrial development. Industrialization requires the investment of capital, but capital cannot be employed effectively without competent engineers. In fact, experience in industrial nations indicates that there is a direct relation between the amount of capital invested in production and the number of engineers employed (See Appendix B).

The engineer is an innovator and in addition to a strong technological training, the successful engineer must have imagination and initiative. By identifying unfulfilled needs and developing

products, tools, and plants to satisfy those needs, the engineer creates demands and jobs. The jobs in turn provide the income for satisfying needs and the basis for new demands. The industrial growth of Germany and Japan illustrate how the introduction of new consumer products can increase the standard of living.

A second activity of the engineer is in increasing the efficiency of existing production facilities. The agricultural engineer is responsible for reducing the manpower required in crop production. The power plant engineer is responsible for reducing the fuel required per unit of electrical energy generated. The production engineer is responsible for reducing the cost in labor and materials of manufactured articles. Viet Nam has a great need for engineers trained in the efficient operation of equipment, systems, and plants.

Improvement in production efficiency increases the supply of goods, reduces the cost of goods, and frees workers for other employment. Development of new products creates demands and jobs. Under ideal conditions these two processes are balanced and a steady growth in the standard of living results. In a newly developing nation, the engineer must participate in the economic decisions which lead to a proper balance.

The Engineer in Government. In every developing society governmental policy plays an important part. On the one hand, it must create an environment in which private enterprise can flourish; on the other hand, it must undertake large scale investment programs

on its own. In both cases the engineer employed by the government has a key role. In the first case, he is instrumental in establishing and administering rules for technical compliance on the part of the private sector of the economy. He may be called upon to prepare the specifications for the development of new enterprises by interested foreign corporations. Therefore, he must understand the long-range effects of his policy on the economic development of the country.

In the second case, his initiative and imagination will determine the economic and social value of the projects which the government undertakes. He will be instrumental not only in getting new programs started but also supervising the construction and installation by foreign contractors. In many situations he will be the negotiator for the government on foreign agreements. For this reason he needs the same broad understanding as his counterpart in private industry.

The Contribution of Foreign Engineers. For a rapid rate of industrial growth, full advantage must be taken of the engineering available from foreign nations. This can be obtained in three forms:

a. Engineering consultation by direct contract with engineers.

b. Engineering services made available by friendly nations.

c. Engineering design included in the price of capital equipment.

Initially, a large part of the engineering effort of a developing nation may be obtained externally. Viet Nam is, quite properly, taking advantage of external engineering resources in all three forms.

Prediction of Needs

One purpose of this report is to predict the enrolment, faculty, equipment, and building space needs for engineering education in Viet Nam.

The function of engineering education is to produce engineers. In order to determine the size of the student body, it is necessary first to estimate the number of engineers that will be needed. To do this, two approaches were taken.

Horizon Goals. The first approach required setting a horizon or long-range goal. The economic goal of most developing countries is to achieve a standard of living equal to the most developed countries, as measured by the ratio of Gross National Product to population. Since there is a remarkable relationship between the amount of engineering in a country and its gross national product, the number of engineers divided by population serves as a measure of the economic well-being of a country. Consequently, a long-term goal for a developing nation will be an equality with the most developed countries in the engineer to population ratio.

For any assumed rate of growth in the ratio of engineers to population, it is possible to calculate the number of years it will take to reach substantial economic equality. If a short span of time to equality is desired, there must be a large and increasing investment in engineering education. If a long span of time can be tolerated, the investment in engineering education can be lower.

At a growth rate of 15% in the engineer to population ratio,

40 years will be required to reach equality. This is shown in Curve 1 of Fig. 2. It indicates that a level of about 2,300 engineers will be attainable by 1975 if the growth can be started by 1970 from an initial number of 1,100 engineers.

This represents a very ambitious rate of growth but not an impossible one. Detailed calculations are shown in Appendix A. Other rates could have been considered. For example, at 10% per year it will take over 60 years to reach equality and at 6% per year, it will take about 150 years.

Projection of Need. The second approach is a direct forecast of need. It is the sum of the number of engineers needed for the operation of industry plus those needed for the capital investment in new industrial development.

On the basis of one engineer required per 200 industrial workers, 650 engineers* are needed for the present industrial labor force of 130,000.

Taking an equivalent dollar Gross National Product of $2,600,000,000, assuming that 18% of this is needed for new capital, and predicating the number of engineers needed for capital development on the basis of 1 engineer per $200,000, results in a need for 2,700 engineers. Most of these engineers are foreign. Their services are hidden in the cost of purchased equipment or obtained by foreign engineering contracts. However, it is felt that at least 20% of the engineering or 470 engineers should be provided by Viet Nam. Combining the two gives a present need of 1,120 engineers.

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*Amplification of these estimates and the bases on which they were made are contained in Appendix B.

Viet Nam should be in a position to develop even with a low ratio of Vietnamese engineers to foreign engineers. This requires a willingness to continue reliance on turn-key-plant contracts and employment of foreign engineering companies. In time it is desirable that the ratio increase. However, the curve for need was drawn on the assumption that the ratio remains constant.

If the objective of a 5% economic growth rate is to be achieved, then industry must grow faster than this. A 12% industrial growth rate will require that at least 18% of Gross National Product be invested in capital, although some of this capital must be furnished from foreign sources. A 12% growth rate of industry will require a corresponding growth in the need for engineers. This is reflected in the curve for the condition that the ratio of Viet Nam engineers to foreign engineers remain constant. This is shown in Curve II of Fig. 2. It indicates a need of 3,600 engineers by 1975. A higher rate of growth of need will be indicated if the ratio of Viet Nam engineers to foreign engineers is to increase.

Once the number of engineers that will be needed is estimated, it is a fairly straight-forward matter to calculate the number of enrolments, the size of the faculty, the amount of equipment, and the amount of space that will be needed.

Projected Enrolments. As projected in the calculations in Appendix A, the number of engineers in Viet Nam will have increased from the present estimated 1,000 to about 4,500 by 1980 and in that year there will be almost 1,600 students graduated. Thus, Viet Nam

will have made the remarkable progress of raising the number of its graduates from roughly $\frac{1}{200,000}$ of the population to about $\frac{1}{10,000}$. Even in the most developed areas the ratio is only about $\frac{1}{4,000}$.

To produce this number of graduates, the number of undergraduate students enrolled in engineering must increase to about 12,000 by 1980. Figure 3 shows the projections of engineers and student enrolments.

Projected Faculty, Space, and Equipment. At a student/faculty ratio of 25, there must be almost 500 full-time faculty members for the 12,000 students projected for 1980. At an allowance of 10 square meters per student and assuming that the buildings of 1980 must be completed one year ahead of the projected 14,350 enrolment for 1981 (to allow for equipment installation), about 143,000 square meters of space will be needed by 1980.

At an estimated equipment investment of $300 per enrolled student and assuming that the equipment must be purchased one year in advance of use, the total equipment investment will be about $4,300,000 by 1980.

These costs are shown graphically in Figure 4. The calculations are included in Appendix A.

Start-Up Costs. When the change in enrolments takes place, from the present number to the larger number that will be required to provide a 15% yearly increase in the engineerpopulation ratio, certain start-up costs will occur which will be over and above those which would have existed had the increases already been in effect. For instance, the faculty, buildings, and equipment for one complete

engineering educational institution will be required to get the new system started, after which the yearly costs will be only those associated with the 15% increase. These extra costs, above those that would have existed if the yearly increase had been in effect, will be:

Equipment - - - - - - - - $350,000

Space - - - - - - - - - - 11,600 square meters

Faculty - - - - - - - - - 35

The calculations for these projections are included in Appendix A.

Activities to be Performed by Vietnamese Engineers

After the total number of engineers required has been determined, the next question is in what branches of engineering should education be provided. At present, curricula in civil, mechanical, and electrical engineering are offered at the National Technical Center. Two additional curricula may be appropriate in terms of the needs of the Vietnamese economy.

Civil Engineering. The practice of civil engineering is well established here and the contributions of civil engineers are clearly visible. This is important because the civil engineer is responsible for transportation, water, and sanitary systems and other structures which are basic to a developing economy. A major part of the capital investment of an aspiring nation must be in factory buildings, power plants, dams, airports, and highways which facilitate economic growth. In each of these, the civil engineer is responsible for economic planning, effective design, and efficient construction.

Mechanical Engineering. The mechanical engineer is concerned with engines which develop power and machines which apply power to useful purposes. In a developing nation, the mechanical engineer is responsible for planning power installations, specifying engines and controls, supervising equipment installation, and operating completed plants. Skill in modification and improvisation is more important than skill in original design of heavy machinery. The design of consumer products such as small airconditioners or agricultural pumps may become important activities in the near future. Certainly the planning and operation of assembly plants and service organizations will require large numbers of mechanical engineers.

Electrical Engineering. The ease and efficiency with which electrical energy can be generated and distributed and the precision with which it can be controlled all contribute to the importance of electrical engineering. A basic responsibility of the electrical engineer is to provide the power and communications systems without which no nation can grow. The electrical engineer is concerned with locating hydroelectric, fossil fuel, and nuclear power plants, specifying the necessary generators and auxiliary equipment, and operating the plants efficiently. He is also concerned with communication between men by telephone and radio, between men and machine by means of control systems, and between machines in computer operated systems. Many of the products which contribute to the standard of living by freeing men from drudgery are electrically powered or controlled.

Industrial Engineering. The branch of mechanical engineering concerned with the problems encountered in mass production is called industrial engineering. The mechanization of manufacturing creates problems in capital investment, employee training and welfare, and production techniques which require special skills in their solution. Financial decisions must be based on accurate prediction of costs, markets, and profits. Efficient use of human beings requires attention to work simplification methods and to the proper design of assembly tools and fixtures. New workers must be trained to perform specialized tasks well and foremen must be trained to provide skilled supervision. The industrial engineer is also responsible for the selection and modification of production processes to be compatible with the power sources, materials, environment and labor supply available.

Chemical Engineering. Chemical processing is an essential component in the transition from a purely agricultural economy to a balanced agricultural-industrial economy. An immediate need is for food processing to provide preservation and easy storage and distribution. Natural resources such as rubber, wood, and leather became more valuable through processing. At the same time, the local processing of imported raw materials can lower the cost of essential commodities such as petroleum products and soap. Any future development of minerals will require engineers skilled in the application and operation of ore processing. In all of these activities, chemical engineers are necessary.

Engineering Functions. The branches of engineering describe what the engineer works with. Sometimes it is more descriptive to think in terms of the functions he performs. The broad spectrum of engineering includes research, development, design, production, operation, construction, sales, and management functions.

A newly developing nation should leave research and development to the more technically advanced nations. The results of their research are readily available to the well-trained Vietnamese engineer at practically no cost. Each year printing presses pour out a flood of scientific discoveries and engineering developments in the form of books and periodicals. This information is easily obtained, whereas the engineering skill which translates basic discoveries and developments into useful articles and services must be provided by Vietnamese engineers.

At the other end of the spectrum of engineering functions are sales and management. These are important in a newly developing nation, but such functions can be performed by broadly trained engineers with special aptitudes and interests. In the early years of a development program, the specialized techniques of management can be provided through advanced training abroad.

At the center of the spectrum lies a group of four functions which are somewhat similar in characteristics and educational requirements:

The design engineer prepares plans and specifications for the efficient production or construction of a desired product or structure. He selects methods, specifies materials, and determines

shapes to satisfy requirements.

The construction engineer prepares the location, determines the procedures to be followed, directs the assembly of materials, and organizes the personnel to carry out these activities.

The production engineer chooses the process of manufacture, selects tools and materials, integrates the flow of materials and components, and provides inspection and testing procedures.

The operations engineer maintains systems and plants, selects and installs new equipment, inspects and maintains existing equipment, determines operating procedures, and supervises operating personnel.

An adequate supply of Vietnamese engineers trained well to perform these functions could, with the aid of foreign engineers in specialized fields, take advantage of the available technology and move the Vietnamese nation toward its goal of rapid economic growth.

Engineering Education in Viet Nam

The functions of design, production, operation, and construction are characterized by a common level of necessary mathematics and science. Also, there is a common requirement for emphasis on materials, structures, processes, systems, and economics. Preparation for the four functions would constitute an effective program of engineering education in Viet Nam for the next decade.

Curricula. Programs leading to four-year degrees in civil, mechanical, electrical, chemical, and industrial engineering would be desirable. Such curricula could provide a supply of broadly

educated engineers with limited specialization in the specific branches.

As an illustration of the need for general education, the civil engineer must be prepared to work with internal combustion engines, electric motors, and instrumentation. The mechanical engineer must understand automatic controls, structures, and electronic equipment. The electrical engineer needs a working knowledge of metallurgy, internal combustion, and structures. The industrial engineer needs to be prepared to work with mechanical power systems, structures, and controls as well as production processes. The chemical engineer must be able to apply a great variety of processes to a wide range of products.

Basic Courses. The courses outlined for the first two years at the National Technical Center are common to all engineering curricula and this is good. Also, the emphasis on mathematics, physics, chemistry, and basic applied science is desirable. In these first two years all engineering students should receive the scientific training which will enable them to benefit from the advanced engineering courses. The basic training should also permit them to continue their education throughout their professional careers; an engineer can never stop learning.

It is clear that one of Viet Nam's needs is more private industrial enterprise. The development of an enterprise requires evaluating local needs and local resources and providing useful products in an optimum fashion. One way to encourage the development of private manufacturing concerns is to include in the engineering curriculum courses in economics and small business management.

Language Training. A reading knowledge of a modern technical language is essential. This could be French, German, Japanese, Russian or English. Since the time available is limited, the emphasis should be on technical reading, not writing or speaking. Use of foreign language references in engineering courses is desirable. Probably English would be most beneficial since there are more technical books and periodicals available. To the young Vietnamese engineer with a reading knowledge of English and the desire and ability to learn, there is available an inexhaustible storehouse of scientific knowledge and engineering techniques.

Advanced Courses. The last two years of the engineering program provide the general knowledge of materials, structures, processes, circuits, and systems needed by all engineers along with the specialized knowledge for a particular branch. In a developing nation the engineer needs a combination of fundamental principles and skill in adaptation to local conditions. A common engineering problem is the modification of available equipment to meet a new requirement. Another problem is in determining whether available materials can be substituted for those specified. Skill in testing and evaluating local materials, processes, and equipment is important.

Graduate Education. For many engineering activities four years are not sufficient. Graduate study may provide greater specialization in a branch of engineering, a higher level of technical achievement, broader training in combination with another engineering discipline, or education in a related area such as business management. Many Vietnamese engineers will need graduate study, but for the present this should be obtained in well-staffed and equipped schools abroad.

OBSERVATIONS ON ADMINISTRATION

Over a span of time it is inevitable that Viet Nam will establish a number of institutions devoted to the education of professional engineers. The number of such institutions may well exceed 20 at the end of the next forty years, assuming Viet Nam achieves equality in engineering education with the most developed countries.

The establishment and operation of an enterprise of such magnitude deserve careful planning. This planning might best be performed by a board consisting of engineers representing the various industries and government but acting independently of undue industry, government, or faculty influence. Long-term appointments would assure this independence and also help provide continuity of policy. Only those who are willing to attend regular board meetings and who will spend the necessary time to perform the extra duties required of active board members should be appointed.

The duties of the board would be to allocate budget among the several institutions, to appoint the chief officers of the institutions, to establish new institutions, to formulate broad educational policy and to set salary scales and titles (such as professor, lecturer, etc.).

It is generally in the best interest of both technical education and engineering education that the two be separated both administratively and geographically. The board, contemplated here, should have jurisdiction only over professional engineering education.

In general, engineering colleges should be distributed geographically over the country. Preferably, they should be placed near planned industrial centers.

When the number of students in a single institution is too small, the number of courses necessary to serve the basic curricula cannot be conducted efficiently. When the number of students is too large, certain administrative problems arise. An undergraduate engineering enrolment of about 2,500 is usually considered to be about the optimum and an enrolment of 3,000 is a desirable upper limit.

Each institution, insofar as is possible, should have control of its own budget, establish policy within the framework of board policy, appoint its faculty, and determine courses and content. While broad policy and control need to be vested in a central board, as much autonomy as possible should be given to the local units.

Each separate institution should offer the basic engineering curricula. However, the more highly specialized curricula should be allocated among the different schools.

In the interest of economy, many of the courses offered by each institution should be common to all the curricula of that institution. Generally, most of the work of the first two years and part of the work of the third year should be common.

Also, in the interest of economy, it is seldom feasible to provide each student taking a laboratory course with his own piece of equipment. A single item of equipment can be shared by dividing the students into several sections, each section taking his laboratory

work at a different time of the day. Another method is to offer the course more often than once a year. A measure of the efficiency of the administration of an institution is the percentage of the total hours of the year that classrooms and laboratories are in use.

Curricula should train for those duties which the engineer must perform during the early part of his professional career. Many of the techniques and much of the knowledge that he will need during his later years will not have been known at the time he is pursuing his college studies. He must, therefore, be taught to study on his own so that he can keep abreast of his profession. In this regard, emphasis should be placed on self study using textbooks and references in addition to learning from lectures.

If the correct balance is maintained between the curricula aiming toward entrepreneurial, design, and operations engineering, engineering will tend to be self-generating, that is, it will create its own demand.

Engineering is a "practical" art in the sense that it solves problems of the real world. But the practical skills of the professional engineer are decision-making in character and they are seldom the manipulative skills of the technician. Care should be taken that the skills taught in the engineering institutions are those that will be useful to the professional engineer. A strong link between theory and practice is the introduction of many problems which simulate the real-life problems of the practicing engineer. Thus, every chapter of every textbook should contain problems which serve to illustrate the theory.

A good portion of the time that the teachers and students are working together should be devoted to the discussion of such problems. Professors should not spend much time on material that is incorporated in textbooks which students study on their own. This implies that faculty members must be acquainted with the real problems of the practicing engineer and that the student should have the necessary time available to study the textbooks and to solve the problems. His understanding of the material should be tested by frequent examination. In this procedure, the student becomes an active doer rather than a passive listener.

Curricula in developing countries should be different from those in the more developed countries. In the developed country the engineer tends to be concerned with the improvement of the design of existing machines. He must minutely analyze each component of the machine. In this activity, he is indirectly contributing to the enhancement of the relative position of an existing firm.

In the developing country, the plants do not yet exist. The engineer is concerned with putting plants into existence - in determining the products to manufacture, in locating the plants, in selecting equipment, in finding contractors, and in keeping plants in operation. The curricula in developing countries should stress the practical analysis and synthesis of systems.

The employment by an institution of its own graduates as faculty members should be avoided. Such "inbreeding" will be inevitable in Viet Nam until several independent institutions for engineering education have been established. In the meantime, the effect of

inbreeding can be moderated by sending prospective teachers to a variety of outside educational institutions for further education. In this regard, those American institutions having curricula accredited by the Engineers' Council for Professional Development should be considered as having approximately equal status. From such institutions careful selection should be made of those schools offering curricula appropriate to the needs of developing nations.

RECOMMENDATIONS

From their brief study, the survey team has gained a fairly clear picture of the economy and the educational system of Viet Nam. On the basis of information gathered here and experienced obtained in other countries, the team has reached some general conclusions about the scope and character of an educational system to meet the needs of Viet Nam. These conclusions are embodied in the following set of recommendations.

National Policy

1. In striving for the high standard of living to which the people of Viet Nam are entitled, the Government should adopt as a goal the attainment of equality with the more developed countries in the ratio of engineers to population.
2. As a first step toward this goal, work should start immediately upon a national master plan for the rapid expansion of engineering education on a high professional level. Preparation of the plan should be the responsibility of a special board appointed by the Minister of Education and consisting of representatives from Industry, Education, and Government.
3. To provide professional engineering education of the necessary high quality for the necessary large number of students, there should be established a new institution which might properly be designated the National Institute for Engineering.
   a. The National Institute for Engineering should be located on a campus site large enough to accommodate an undergraduate

engineering program for 3,000 students and, ultimately, a modest program of graduate study, research, and engineering service to government and industry.

b. If national goals are to be achieved, additional institutions for engineering education will be necessary within the next decade. Consideration should be given to locating campuses near major industrial centers. In any event, engineering institutions should be distributed throughout the country.

4. Because of the quality of its engineering staff and program, the National Technical Center should be used as the nucleus of the new institution.

   a. As soon as possible, however, technician training should be separated from engineering education, administratively and geographically.

   b. The present site and facilities at Phu Tho should be reserved for the training of technicians; much of the present equipment is well suited to that type of training.

5. Engineers are equally valuable in war and peace; there should be no interruption in the program of engineering education and no delay in initiating the necessary expansion.

Operation of the National Institute for Engineering

1. The National Institute for Engineering should have autonomy in the administration of the assigned budget, the appointment of faculty, and the establishment of educational standards.

2. First priority should be given to building an adequate engineering faculty.

a. The number of qualified candidates sent abroad for advanced study should be increased greatly and immediately.

b. Foreign schools selected for advanced study should be leading engineering schools with programs meeting the needs of newly developing nations.

c. For the present, study abroad should be at the masters degree level. At a later time, opportunity for study at the doctors degree level should be made available.

d. The program for study abroad should be planned in terms of the responsibilities to be assumed upon return to Viet Nam.

3. Second priority should be given to maintaining the present high quality of student body as the number admitted is greatly increased.

a. There should be a careful review of admission policy, entrance examination procedures, and student financial support.

4. In order to improve equipment and space utilization, consideration should be given to dividing the school year into two equal parts with two new classes of students admitted each year.

The Engineering Program

1. In addition to providing sound technical training, the educational program of the National Institute for Engineering should emphasize the development of professional responsibility and individual initiative

2. In addition to the present civil, mechanical, and electrical engineering curricula chemical and industrial engineering curricula should be initiated as soon as possible.

a. At first the curricular offerings should emphasize preparation for the engineering functions of design, production, construction, and operation.

b. When the transition to a fully developed economy is well under way, emphasis on original development, scientific research, and graduate study should be added.

3. The concept of a common program for the first two years of all curricula is good; it should be retained and, if possible, extended.

a. The strong preparation in mathematics and the basic sciences should be retained.

b. A course in engineering economics taught by a qualified engineer should be included in all curricula.

c. A good reading knowledge of a modern technical language is essential and this part of the curricula should be strengthened by increasing the formal language training and by increasing the use in engineering courses of foreign textbooks and references.

d. Some experience in design should be provided in each of the four years, and each student should gain experience in improvising and adaptation.

4. Consideration should be given to reducing the number of formal classroom lecture hours per week.

a. Emphasis in lecture should be on basic concepts rather than on descriptive material.

b. The emphasis on solving practical professional problems and undertaking individual projects should be increased.

c. Students should be given time and encouragement to do work on their own.

AID Support

1. Maximum AID support should be available during the critical period associated with the transition from the existing program to a rapidly accelerated program of engineering education.
2. There should be provided a team of carefully selected American engineering professors to serve as resident consultants in engineering education.
   a. The consulting team should assist the responsible agency in conducting a detailed study of the needs of Viet Nam in engineering education.
   b. The team should assist the faculty of the National Institute for Engineering in planning curricula, organizing courses, designing laboratories, and selecting equipment.
3. Support should be provided in the form of study grants to provide qualified teaching candidates with up to two years of education abroad at the masters degree level.
   a. If time permits, there should be provided an opportunity for industrial experience abroad.
   b. There should be available in the USOM Education Office a coordinator familiar with graduate engineering training who could assist in school selection and preliminary program planning. A recently returned participant could also assist in program planning.

4. AID support should be provided for laboratory equipment in the approved curricula.

   a. An operating budget to cover equipment maintenance and instructional supplies should be provided by the Vietnamese Government.

5. AID support should be provided for the initial complement of buildings required by the recommended expansion program.

6. An adequate collection of engineering textbooks and references should be provided whenever there is evidence that students have sufficient reading skill to benefit.

EDUCATION SYSTEM OF VIET-NAM

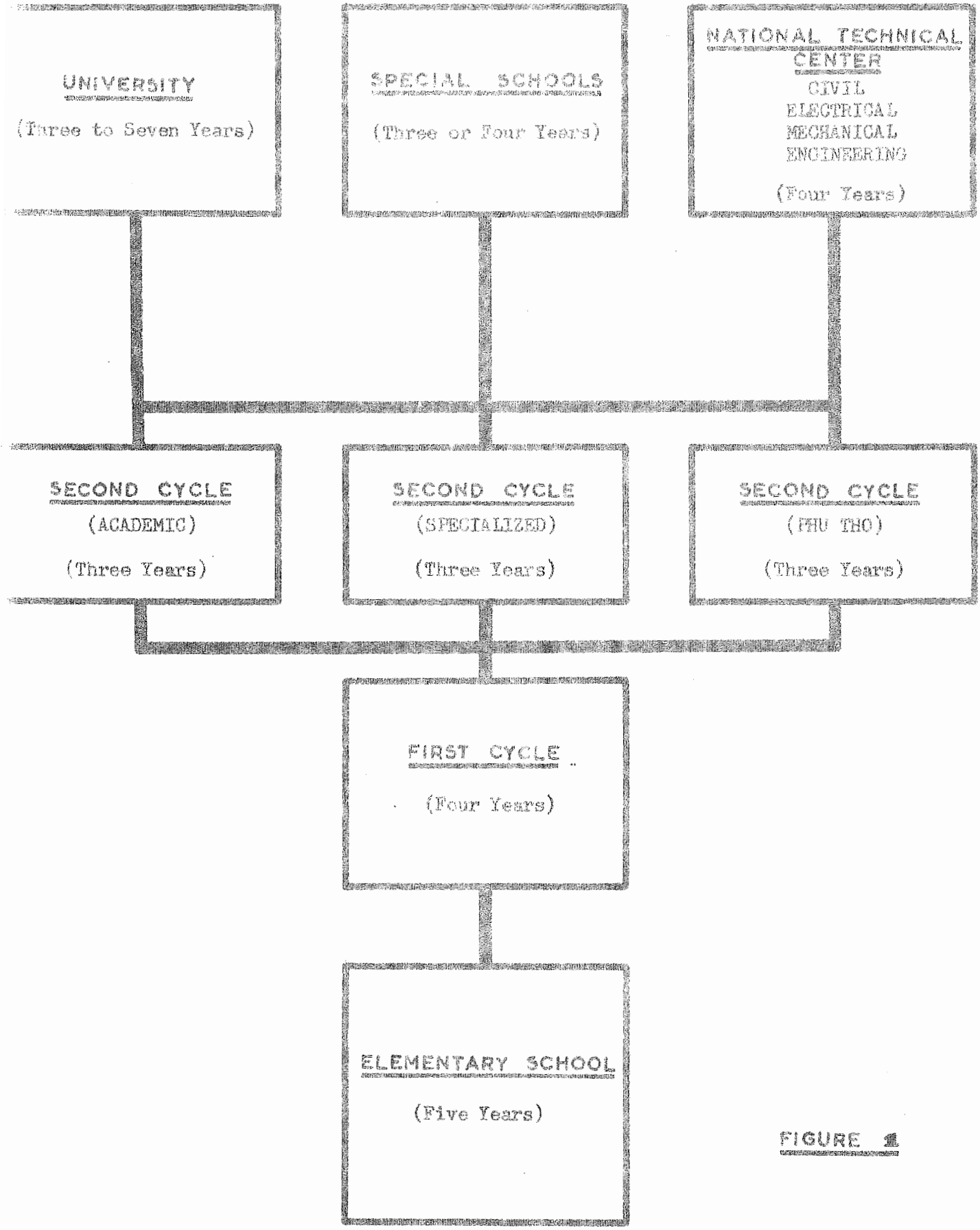

FIGURE 1

THE ENGINEER GAP in VIET-NAM

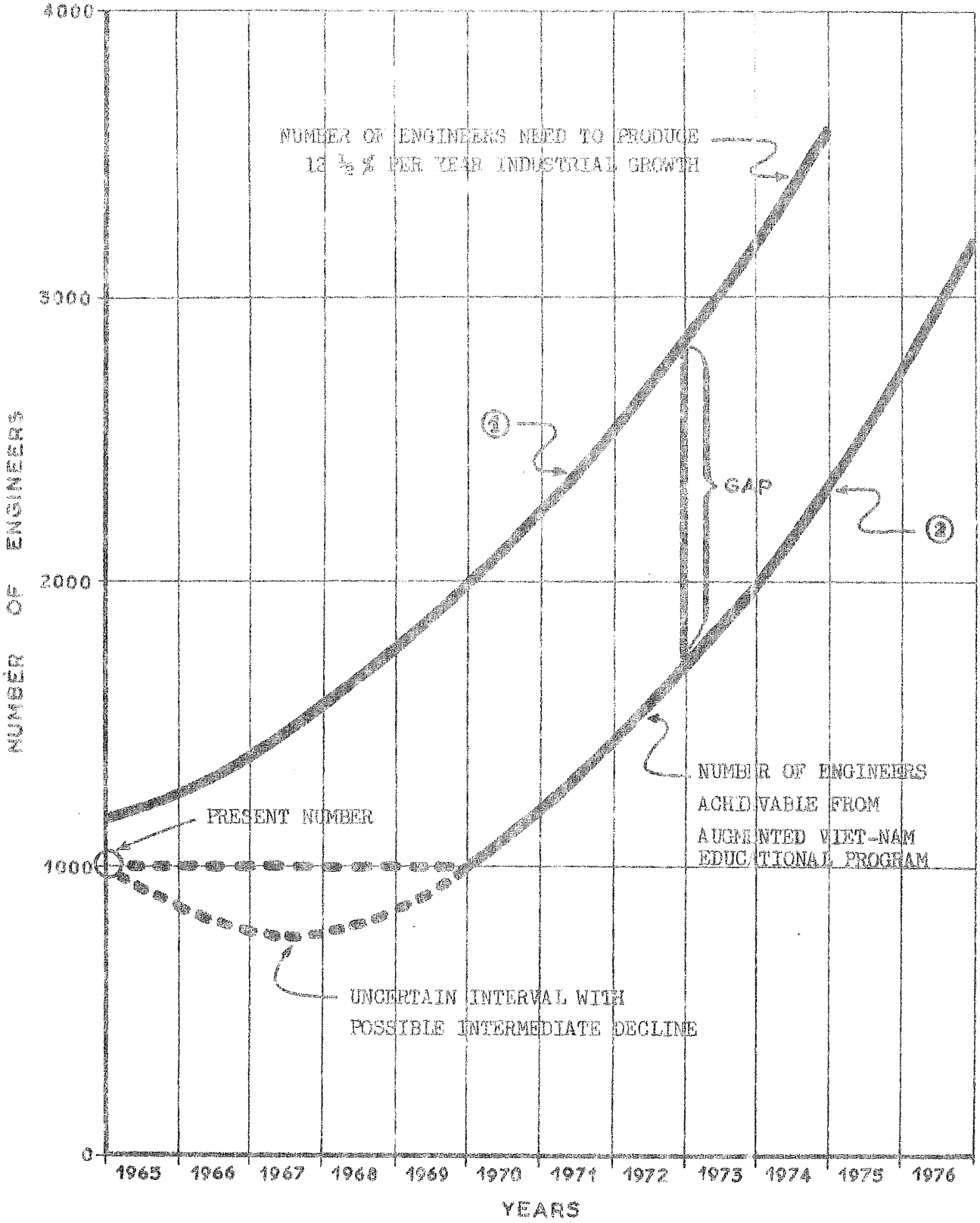

FIGURE 2

YEARLY ENROLLMENTS AND GRADUATES

NECESSARY FOR AN ANNUAL INCREASE OF 15% IN ENGINEERS POPULATION

SEE PAGE - FOR EXPLANATION
SEE APPENDIX - FOR SAMPLE CALCULATIONS

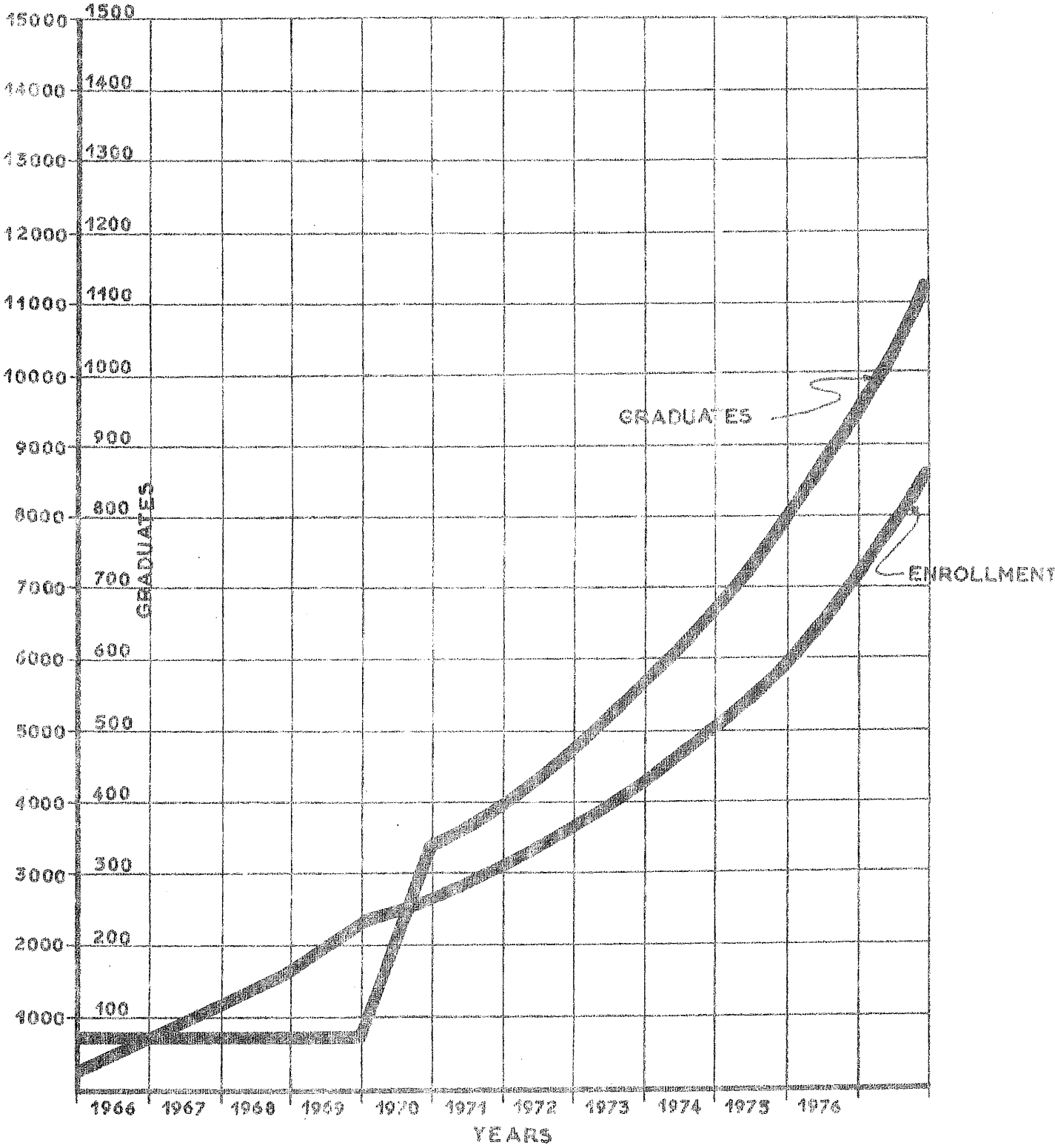

FIGURE 5

FACULTY, EQUIPMENT AND SPACE

CUMULATIVE FACULTY, EQUIPMENT AND BUILDING REQUIREMENTS FOR AN ANNUAL INCREASE OF 15% IN THE ENGINEER - POPULATION RATIO

SEE PAGE - FOR EXPLANATION
SEE APPENDIX - FOR SAMPLE CALCULATIONS

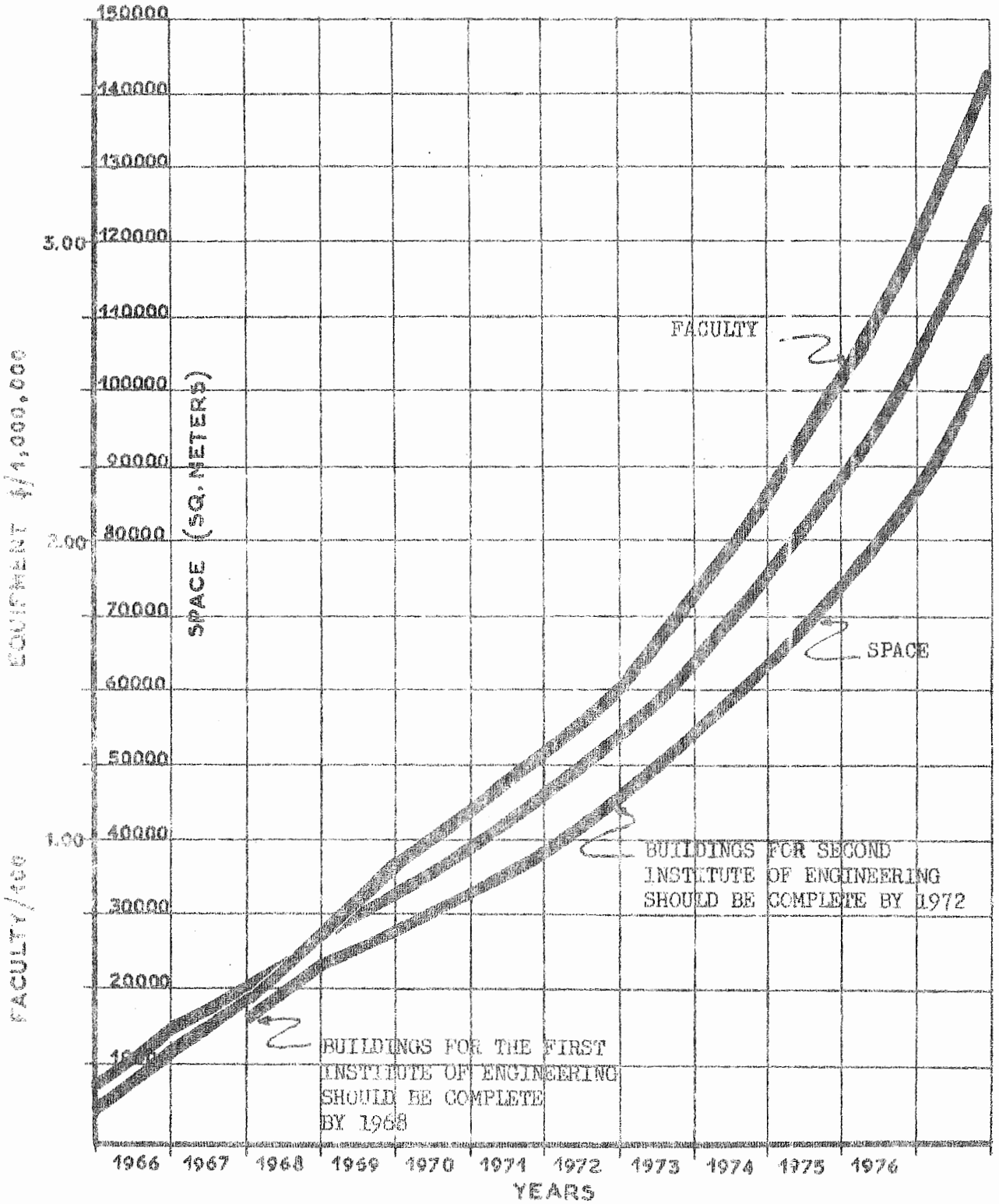

FIGURE 4

APPENDIX A - ANALYSIS OF ENGINEERS, EQUIPMENT AND FACILITIES NEEDED

1. Assuming that there are 1,000 engineers and 15,700,000 people in Viet Nam, the engineer-population ratio (E/P) is $\frac{1}{15,700}$ or 0.0000637.

2. The E/P in the most developed countries is approximately $\frac{1}{250}$ or 0.004. The ratio of the E/P's is

$$\frac{\text{E/P in most developed countries}}{\text{E/P in Viet Nam}} = \frac{15,700}{250} = 62.8$$

3. Estimating a rate of growth of E/P of 3% per year for the most developed countries and assuming a 13% per year rate of growth in E/P for Viet Nam, it will take 37.6 years for Viet Nam to reach parity with the most developed countries.

4. Assuming a population rate of increase of 2.8%/year for Viet Nam and the 15%/year increase in E/P, the number of engineers in Viet Nam each year for ten years will be:

Time	Cumulative Number of Engineers
0	1,000
1	1,182
2	1,398
3	1,654
4	1,956
5	2,321
6	2,735
7	3,230
8	3,820
9	4,520
10	5,340

5. Assuming a loss of 20% of all engineers each year due to transfer to non-engineering positions, to death, and to retirement, the

following number of engineers must be produced each year for ten years to meet the 15% growth assumption.

Year	No. of Engrs. at Beginning of the Year	No. of Engrs. to be Produced during the Year
1	1,000	350
2	1,182	414
3	1,398	490
4	1,654	580
5	1,956	686
6	2,321	813
7	2,735	959
8	3,239	1,132
9	3,820	1,340
10	4,520	1,585

6. If 92% of the students of each year's class continue their studies to the next year, the enrolments necessary to produce these graduates will be:

(Year-4)	(Year-3)	(Year-2)	(Year-1)	Graduates
476	440	408	378	350
563	521	482	447	414
666	617	571	529	490
789	730	676	627	580
933	864	800	742	686
1,106	1,024	948	878	813
1,305	1,207	1,118	1,037	959
1,540	1,425	1,320	1,222	1,132
1,820	1,680	1,560	1,450	1,340
2,160	2,000	1,850	1,710	1,585

7. When the present capacity of the classes in engineering at the National Technical Center are included, the enrolments appear as follows (considering the present first-year admission of 75 students and the present loss of 2.6% of the students each year for the current program).

Year	1st Year Students	2nd Year Students	3rd Year Students	4th Year Students	Total Enrolment	Increase in Enrolment	End of the year Graduates
1966	75	73	71	69	288		68
1967	476	73	71	69	689	401	68
1968	563	440	71	69	1,143	454	68
1969	666	521	408	69	1,664	521	68
1970	789	617	432	378	2,266	602	68
1971	933	730	571	447	2,681	415	350
1972	1,106	864	676	529	3,175	494	414
1973	1,305	1,020	800	627	3,752	577	490
1974	1,540	1,207	948	742	4,437	785	576
1975	1,820	1,425	1,118	878	5,241	804	686
1976	2,160	1,680	1,320	1,037	6,197	956	813
1977	2,580	1,980	1,560	1,222	7,342	1,145	959
1978	3,060	2,340	1,840	1,445	8,685	1,343	1,132
1979	3,620	2,760	2,170	1,710	10,260	1,585	1,340
1980	4,280	3,260	2,560	2,020	12,120	1,860	1,585

8. If an optimum-sized undergraduate enrolment is considered to be around 2,500 students, it can be observed, from the above enrolments, that the first institution for engineering education should be completed by 1968, a second should be completed before 1973, and a third by 1976.

9. Assuming a student/faculty ratio of 25/1 the following number of full-time* (or equivalent) faculty members will be needed.

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* The full-time faculty member, as contemplated here, means a teacher devoting not less than 40 hours a week to teaching, grading problem assignments and tests, coaching individual students, advising students on curricular matters, administration of the college, and a small amount of research and devoting about 8 hours a week to the intimate study of industry.

Year	Total Enrolment	Full-time Faculty Equivalents
1966	288	12
1967	689	28
1968	1,143	46
1969	1,664	67
1970	2,266	91
1971	2,681	107
1972	3,175	127
1973	3,752	150
1974	4,437	178
1975	5,241	210
1976	6,197	248
1977	7,342	294
1978	8,685	348
1979	10,260	410
1980	12,120	485

10. Assuming an admission of 75 students and a loss of 2.6% each year, the present engineering capacity is:

1st Year Students	2nd Year Students	3rd Year Students	4th Year Students	Total Capacity
75	73	71	69	288

Assuming a student/faculty ratio of 25/1, the present engineering-phase full-time equivalent faculty capacity is $\frac{288}{25}$ or about 12.

11. By subtracting 12 full-time faculty-equivalents from the total needed, the number of new faculty members needed will be:

Year	Full-time-equivalent Faculty Needed	Full-time equivalent Needed Above Present Supply	Additions for the year
1967	28	16	16
1968	46	34	18
1969	67	55	21
1970	91	79	24
1971	107	95	16
1972	127	115	20
1973	150	138	23
1974	178	166	28
1975	210	198	32
1976	248	236	38
1977	294	282	46
1978	348	336	54
1979	410	398	62
1980	485	473	75

12. If 10 sq. meters of net building space is allowed for each student, the following net space will be required. Space should be completed one year before student use so that equipment may be installed.

Year	Next Year Enrolment	Cumulative Space Required (net sq. m.)	Increase for the Year
1966	689	6,900	6,900
1967	1,143	11,400	4,500
1968	1,664	16,600	5,200
1969	2,266	22,700	6,100
1970	2,681	26,800	4,100
1971	3,175	31,700	4,900
1972	3,752	37,500	5,800
1973	4,437	44,300	6,800
1974	5,241	52,400	8,100
1975	6,197	61,900	9,500
1976	7,342	73,400	11,500
1977	8,685	86,900	13,500
1978	10,260	102,600	15,700
1979	12,120	121,000	18,400
1980	14,350	143,500	21,500

13. If an equipment cost of $300 per enrolled student is estimated, the equipment costs will be as follows: (The assumption is made that the equipment should be ordered one year ahead of student use to allow for delivery time and installation).

Year	Next Year Enrolment	Total Equipment Investment	Equipment Purchases for the year
1966	689	$ 206,700	$ 206,700
1967	1,143	342,900	136,200
1968	1,664	499,200	156,300
1969	2,266	679,800	180,600
1970	2,681	804,300	124,500
1971	3,175	952,500	148,200
1972	3,752	1,125,600	173,100
1973	4,437	1,331,100	205,500
1974	5,241	1,572,300	241,200
1975	6,197	1,859,100	286,800
1976	7,342	2,202,600	343,500
1977	8,685	2,604,500	401,900
1978	10,260	3,078,000	473,500
1979	12,120	3,636,000	558,000
1980	14,350	4,305,000	669,000

14. Certain start-up costs for the first year are evident from these calculations as shown in the following tables:

Start-up Equipment Costs

Year	Equipment Purchases For the Year	Normally Increasing Costs for the Year	Extra Start-up Costs for the Year
1966	$206,700	$ 64,000	$142,700
1967	136,200	75,500	60,700
1968	156,300	89,200	67,100
1969	180,600	105,400	75,000
1970	124,500	124,500	None

Start-up Building Costs

Year	New Building Space Required for the Year	Normally Increasing Space Required for the Year	Extra Start-up Costs for the Year
1966	6,900 sq. m.	2,100 sq. m.	4,800 sq. m.
1967	4,500 sq. m.	2,500 sq. m.	2,000 sq. m.
1968	5,200 sq. m.	3,000 sq. m.	2,200 sq. m.
1969	6,100 sq. m.	3,500 sq. m.	2,600 sq. m.
1970	4,100 sq. m.	4,100 sq. m.	None

Start-up Faculty Costs

Year	New Faculty Needed for the Year	Normally Increasing Faculty Needed for the Year	Extra Start-up Faculty Needed for the Year
1967	16	8	8
1968	18	10	8
1969	21	12	9
1970	24	14	10
1971	16	16	None

Note: Slide-rule accuracy was considered sufficient in view of the fact that several of the assumptions are necessarily tentative at this time. Also because of the tentative nature of assumptions, new calculations should be made as more accurate data become available.

APPENDIX B - ANALYSIS OF ENGINEERS NEEDED IN VIET NAM

In a developed country, approximately 25% of all engineers are concerned with operations of existing plants (ref. 8). The remainder are needed to perform the engineering work essential for profitable new capital investment. At the present time, one engineer is required for every $200,000 per year of new capital investment.

The same ratio should be approximately valid for Viet Nam if the correct equivalence of piastres with dollars can be established. This ratio has been taken as the official exchange rate. A higher ratio undoubtedly applies when comparing imported luxury goods but a much lower ratio is more representative of values of internally produced services.

A large part of investment in Viet Nam will be in dollars for purchase of foreign capital goods in which the engineering costs are already included. Much of this investment is in the form of aid programs and military assistance and so its identity as capital is lost. Other investments will be reflected directly in dollars for purchase of capital goods. Much of this will be made by foreign investors. If the economy is to grow at the projected rate of 5% per year, a reasonable assumption is that new capital amounting to 18% of the Gross National Product must be invested each year. This means that a Gross National Product equivalent to $2.6 billion requires $470 million in capital or $\frac{470,000,000}{200,000} = 2,350$ engineers.

If 4/5 of this engineering is done by foreign engineers and included in the purchase of equipment or obtained under contract,

then the number of Vietnamese engineers needed to prepare specifications, arrange contracts and supervise construction and installation will be $\frac{2,350}{5} = 470$.

According to "Industrial Development in Viet Nam" (ref. 5), the industrial labor force was 2% of the total labor force of 6.5 million or 130,000 in 1962. Suppose that this is essentially the same at present (this estimate may be low). If the amount of labor per unit of production which is used in Viet Nam's more advanced industries is twice that of comparable industries in the developed countries, then the required number of engineers per 1,000 production workers may be approximately half as many. In the developed countries, roughly 10 engineers are needed per 1,000 production workers. This establishes a present requirement of 650 engineers for continued production operations. Combining this need with the need for engineers in capital development gives a present need of 1,120 engineers.

The growth of the Vietnamese economy at 5% per year will depend on increasing agricultural productivity per farm laborer. However, this can only bring about an overall growth, if industry can absorb the labor which is released from the farms. This requires that industry grow at many times the rate of the economy as a whole. To illustrate, a 3.2% increase in farm production per farm laborer in a society which is 80% agriculture will release 3.2% of the 80% for work in the 20% non-agricultural sector of the economy. This means that the non-agricultural sector should grow by 12.8%.

As an example, in Korea the economic growth of the past 5 years has been 7%. Population growth was 2.8%, the same as Viet Nam. This overall economic growth was induced by an industrial rate of growth of 25% per year. Parenthetically, Korea has about 1 engineer per 3000 of population (ref. 9, 10 and 11).

Suppose that an industrial growth rate equal to 2.5 times the economic growth rate can be sustained in Viet Nam. This would be 12½% per year or based on the estimate of a present need of 1,120 engineers will require the numbers in table below over the next 10 years. This will be without changing the ratios of engineers to industrial workers and to capital investment.

In a rapidly changing environment for engineering activity, a high attrition rate should be expected. In addition to the normal loss from death and retirement, there will be considerable transfer into other occupations. A normal attrition rate of 20% is assumed.

Year	Engineers Needed	Attrition at 20%	Number That Should be Added
1965	1,120		
1966	1,260	224	364
1967	1,418	252	410
1968	1,595	288	465
1969	1,794	319	518
1970	2,018	359	583
1971	2,271	404	657
1972	2,555	454	738
1973	2,874	511	830
1974	3,233	575	934
1975	3,637	647	1,051

APPENDIX C - ENGINEERING CURRICULA

OF NATIONAL TECHNICAL CENTER

CIVIL ENGINEERING

SUBJECTS	Number of Hours per year	
	Classroom	Laboratory
First Year		
Mathematics	180	
Physics	150	90
Chemistry	90	75
Technology	90	
Design	90	
French language	45	
Testing and Recitation	90	
Total Hours	735	165
Second Year		
Mathematics	90	
Mechanics (rational)	90	
Physics (general)	165	90
Strength of Materials	60	
Descriptive Geometry	45	
Graphic Design	30	90
English language	45	
Technology	45	
Shopwork		60
Testing and Recitation	60	
Total Hours	630	240
Third Year		
Related Mathematics	30	
Strength of Materials	45	
Topography	45	60
Geology	30	
Materials and Processes	75	15

SUBJECTS	Number of Hours per year	
	Classroom	Laboratory
Third Year (continued)		
Roads; Soil Mechanics	90	15
Hydraulics	60	
Architecture	60	
Metallurgy	30	
Thermal Motors	30	
Electrical Technology	60	
Hygiene	15	
Political Economy and Administrative Law	60	
Testing and Recitation	30	
Projects: Strength of Materials		
Roads		
Architecture	30	
Visits to construction sites		
Total Hours	690	150
Fourth Year		
Nomography	20	
Reinforced and pre-stressed concrete	45	
Steel frames	30	
Bridges	90	
Maritime Works	30	
Air bases	45	
Agricultural Hydraulics (Fluvial)	45	
Urban Hydraulics	30	
Railroads	90	
Electrical Technology	30	
City Planning	30	
Topography and Photogrammetry	45	150
Testing and Recitation	30	
Visits to construction sites		90
Projects: Electrical Technology		
Reinforced Concrete		
Hydraulics		
Bridges	40	
Total Hours	600	240

ELECTRICAL ENGINEERING

SUBJECTS	Number of Hours per year	
	Classroom	Laboratory
First Year and Second Year		
Same as Civil Engineering		
Third Year		
Political Economy	30	
Administrative Law	30	
Hydraulics (general)	45	
Hydraulics Forces	45	
Thermal Motors	30	
Related Mathematics	30	
Metallurgy	30	
Testing of Electrical Machines	60	90
Construction of Electrical Machines	60	
Electrical Fittings	45	
Electrical Technology (general)	90	
Lighting	30	
Electrical Measurements	45	90
Electrical Machines	30	
Testing and Recitation	45	
Industrial Design and Electrical Diagrams	90	
Visits to Construction Sites and Factories		30
Total Hours	735	210
Fourth Year		
Electro-chemistry and Electro-metallurgy	45	
Radio and Electronics	60	
Mechanical Calculation of Energy-carrying lines	30	
Servo-mechanisms	30	
Electrical Calculation of Energy-carrying lines	30	
Energy Distribution	45	
Electrical Traction	30	
Telecommunications	30	

SUBJECTS	Number of Hours per year	
	Classroom	Laboratory
Fourth Year (continued)		
Applications of Electricity	45	
Thermal Central Stations	60	
Equipment of Electrical Central Stations	30	
Electrical Technology (general)	60	
Testing of Electrical Machines	45	120
Concrete	20	
Testing and Recitation	45	
Conferences and Projects	75	
Electrical Measurements		120
Visits to Construction Sites and Factories		60
Total Hours	680	300

MECHANICAL ENGINEERING

SUBJECTS	Number of Hours per year	
	Classroom	Laboratory
First and Second Year		
Same as Civil Engineering		
Third Year		
Hydraulics	60	
Political Economy and Administrative Law	60	
Hygiene	15	
Mathematics and Descriptive Geometry	45	
Mechanics	116	32
Kinematics	56	
Chemistry - Metallurgy	47	32
Technology of Construction	45	
Industrial Design	240	
Professional Technology	45	
Shopwork		300
Total Hours	729	364
Fourth Year		
Mathematics and Descriptive Geometry	20	
Mechanics	50	20
Electricity	75	32
Technology of construction	45	
Industrial Design	240	
Professional Technology	60	
Shopwork		735
Total Hours	490	787

APPENDIX D - CHARTER OF NATIONAL TECHNICAL CENTER

Republic of Viet Nam

Ministry of Education

Decree No. 189 - GD/PC/NH
the 1st of February 1961
for the organization of the
National Technical Center
at Phu Tho.

The Minister of National Education

Decree:

Item 1: The National Technical Center of Phu Tho founded by the decree No. 213-GD on the 29th of June 1957 is a new organized as follows:

Paragraph I - Organization

Item 2: The National Technical Center includes:

1) The following technical and professional departments:

The Superior Public Works (C.E.) Department with -

The Engineer Section (superior level)
The Technical Section (secondary level)

The Superior Electrical Department with -

The Engineer Section (superior level)
The Technical Section (secondary level)

The National Mechanical Engineering Department with -

The Engineer section only

The Viet Nam Marine School with -

Section of Deck Officers (secondary level)
Section of Mechanical Officers (secondary level)

As our country progresses, the Center may be expanded by adding other technical departments.

2) The following laboratories and workshops:

The physics laboratory
The chemistry laboratory
The soil mechanics and strength of materials laboratory

The electrical laboratory
The electronics laboratory
The mechanical workshop and the electric-mechanical workshop

3) The sections common to the pre-cited organizations:

Administrative office (secretariat)
The board of experts
The library
The boarding house

Paragraph II - Administration and Personnel

Item 3: The National Technical Center is directed by a Director General responsible for administration, pedagogy, and technics and is assisted by a Deputy Director.

The task of the Deputy Director is to help the Director and temporarily replace the Director when he is absent.

Item 4: To help the Director General in administration, there is an administrative office (Secretariat) directed by the Chief of Services.

The administrative office includes the following services:

Administrative paper work: letters, personnel (dossiers), students (dossiers), library
Accounts: salaries, scholarships
Social and Sports: take care of current social questions and organize physical education for the students.

The personnel section of the administrative office includes:

A number of secretaries, accountants, typists
Other employees depending upon the needs

Item 5: To help the Director General of the Center in the planning of technics and specialization, there is a Board of Experts

constituted by a number of Vietnamese professors or technical experts and a number of foreign experts sent by friendly countries through programs of technical aid. The Experts are headed by a Chief of the Board and aid directly in the organization of the Center to:

Determine the programs of the different Departments of the Center
Study educational methods
Collect educational documents
Assist in the project of settling or completing the laboratories and workshops

Item 6: Each Department of the Center is directed by a Director. To help the Director of each Department there is a Proctor and experts and office employees as needed.

The Teaching Staff:

Item 7: While the status of the teacher of the Superior Technical Education is not yet established, the teaching staff of the National Technical Center includes the instructors of different branches of the University, of the secondary school, and of the engineers.

Item 8: The instructors of the National Technical Center are employed by the Ministry of the National Education upon the proposal of the National Technical Center after they have asked for the advise of the Board of Technics and Pedagogy.

Paragraph III - Different Boards

Item 9: The organization that manages the National Technical Center is the administration and completion (trustees) board including:

The Minister of the National Education
or his representative . . . . . President

The Representative of the Ministry
of Public Works and Communication . . Member

The Representative of the Ministry
of Economy . . . . . Member

The Director General of the National
Technical Center . . . . . Member

The Dean of the Faculty of Science
of Saigon . . . . . Member

The Deputy Director of the Center . . . Member

The Directors of the different
Departments of the Center . . . . . Member

The Chief of the Board of Experts
of the Center . . . . . Member

The Chief of the administrative office
of the Center . . . . . Member

The task of the Administration and Completion Board is to study all measures relating to the management and expansion of the Center and to discuss the necessary supplies.

The Administration and Completion Board should have at least one meeting each year and additional meetings when the President of the Board judges that it is necessary to do so.

Item 10: The organization that directs education at the National Technical Center is the Technics and Pedagogy Board including:

The Director of the National Technical
Center . . . . . President

The Deputy Director . . . . . Member

The Directors of different Departments of the Center . . . . . Member

The Chief of the Board of Experts of the National Technical Center . . . . Member

Item 11: The organization that directly directs the education at each Department is the Committee of Professors of the Department that includes:

The Director of the Department . . . . . President

The Representative of the National Technical Center . . . . . Member

All of the Professors of the Department . . . . . Member

The Proctor of the Department . . . . . Member

The task of the Committee of Professors is to examine the problems of education relating to the Department only, and to propose the disciplinary punishment for students (in which case the Committee of Professors will include a Representative of the Students). Proposals of the Committee of Professors shall be approved by the Director of the National Technical Center before they may be executed.

The Committee of Professors shall meet at least once every three months and additionally when the President judges that it is necessary.

Item 12: These Boards and Committees replace the ones previously existing at the National Technical Center.

Item 13: The Chief of Cabinet, the Secretary General of the Ministry of National Education and the Director General of the National Technical Center shall execute this decree in accordance with their functions.

Said on the 1st of February 1961,
The Minister of the National Education

Signature: TRAN HUU THE

APPENDIX E - PLACEMENT OF GRADUATES OF THE CLASSES OF 1962, 1963 and 1964

TOTAL ENGINEERING

PLACEMENT	1962		1963		1964		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Government	21	42.0	16	33.3	27	57.5	64	44.2
Private Enterprise	8	16.1	13	27.1	9	19.1	30	20.6
Army	18	35.9	15	31.4	7	14.9	40	27.6
Foreign Countries	2	4.0	3	6.2	4	8.5	9	6.2
Misc. or Un-accounted for	1	2.0	1	2.0	0	0	2	1.4
TOTAL	50	100.0	48	100.0	47	100.0	145	100.00

CIVIL ENGINEERING

PLACEMENT	1962		1963		1964		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Government	7	33.3	6	35.3	15	79.5	28	49.0
Private Enterprise	2	9.5	1	5.9	2	10.3	5	8.7
Army	10	47.7	7	41.2	1	5.1	18	31.5
Foreign Countries	2	9.5	3	17.6	1	5.1	6	10.8
Mis. or Un-accounted for	0	0	0	0	0	0	0	0
TOTAL	21	100	17	100	19	100	57	100

ELECTRICAL ENGINEERING

PLACEMENT	1962		1963		1964		TOTAL	
	No.	%	No.	%	No.	%	No.	%
Government	7	50.0	8	53.3	11	61.2	26	55.2
Private Enterprise	2	14.2	3	20.0	1	5.6	6	12.8
Army	4	28.6	3	20.0	5	27.6	12	25.6
Foreign Countries	0	0	0	0	1	5.6	1	2.1
Misc. or Un-accounted for	1	7.2	1	6.7	0	0	2	4.3
TOTAL	14	100	15	100	18	100	47	100

MECHANICAL ENGINEERING

PLACEMENT	1962		1963		1964		TOTAL	
	No.	%	No.	%	No.		No.	%
Government	7	46.7	2	12.5	1	10.0	10	24.4
Private Enterprise	4	26.6	9	56.2	6	60.0	19	46.3
Army	4	26.7	5	31.3	1	10.0	10	24.4
Foreign Countries	0	0	0	0	2	20.0	2	4.9
Misc. or Un-counted for	0	0	0	0	0	0	0	0
TOTAL	15	100	16	100	10	100	41	100

APPENDIX F - SAMPLE EXAMINATIONS

BACCALAUREATE EXAMINATION 1964 - SECOND PART

(Corresponds to High School Graduation)

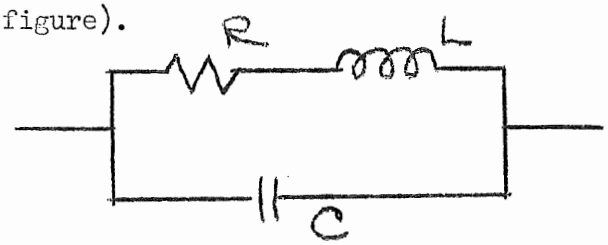
CHEMISTRY AND PHYSICS

Chemistry: The students have to answer the 3 following questions:

1. Methods of analysis of an organic compound.
2. Actions of chloride on Methane (CH_4), Ethylene (C_2H_6) and Acetylene.

Physics:

1. With an alternating current of voltage:
   $v = 110\sqrt{2} \sin 314\ t$, we mount successively:
   A pure resistance R, a self-induction L, a capacity C.
   In all the three cases, the effective current intensity is measured to be 1, 1 amp. Calculate R, L And C.
2. Now, we mount R, L and C in series with a current of the same voltage as the preceding one. Calculate the intensity of the current and the voltage at the ends of each part of the circuit.
3. Under the same voltage v, we mount in paralel the following circuit (see figure).



Write the expression of the main current intensity.

ENTRANCE EXAM - AUGUST 9, 1965

MATHEMATICS - (ENGINEERING)

3 hours

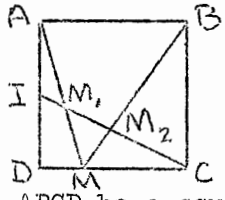
I. Let a plane pass by two perpendicular axes Ox and Oy. Take a point I having coordinates (u, v) and a point M having coordinates (x, y). Homothecy of center I and ratio K transforms M into M_1 (x_1, y_1). Rotation of center O and angle Θ transforms M_1 into $M_2(x_2, y_2)$.

1/ Calculate (x_1, y_1) in terms of (x, y); then calculate (x_2, y_2) in terms of (x_1, y_1); deduce (x_2, y_2) in terms of (x, y). Find the invariant point J of that successive transformation. Besides, give also a geometrical method to find J.

2/ As above, given a point I, we have a corresponding point J, (K and Θ are given numbers). Show that there is a definite operation transforming I into J depending uniquely on K and Θ. Determine this operation when K=2 and $\Theta = \frac{\pi}{3}$

3/ Suppose I describes a straight line; find the locus of J and that of the point symmetrical to O with respect to IJ.

II.



Let ABCD be a square having sides equal to 1. Let I be the center of AD, and M be a point on DC. MA and MB cut IC at M_1 and M_2. Let DM= x, calculate the area of triangle MM_1M_2 in terms of x. Plot this function when x varies from o to 1.

4. Assume the given self-induction L has a length of 54 cm and a number N of loops; the mean section area is 15 cm^2. Calculate No.

5. We want to make the capacity C of the 1st question with mica sheets (thickness 0, 2 mm; area 0, 72 m^2) and aluminum sheets of same area. Calculate the number of mica sheets. The dielectric power of mica is known to be 8.

ENTRANCE EXAM - AUGUST 9, 1965

Time: 2 hrs. 30 min.

PHYSICS - (ENGINEERING)

I. Let it be an electrical circuit composed of a resistor R, a capacitor C and an inductor L in series with a sinusoidal power source having an effective e.m.f. value V fixed and a variable frequency. Calculate in terms of R, L, C the frequencies FR, Fl, Fc, of the source at which:

a. The voltage across R is maximum (Fr).

b. The voltage across L is maximum (Fl).

c. The voltage across C is maximum (Fc).

II. A segment of conductor having length l, mass m, resistance R may glide with no friction while remaining horizontal, on two parallel conducting wires placed tilted at an angle θ with respect to the horizontal plane. The two parallel conducting wires have resistance negligible with respect to R, and are connected electrically at the lower end. The whole system is in a uniform magnetic intensity B pointed vertically. At first one lays the segment of conductor perpendicular to the other two parallel conducting wires then releases it with no initial velocity, a velocity v is rapidly reached for the segment of the conductor.

1/ Calculate the value of the induced e.m.f.

2/ Find the direction, sense, and magnitude of the electromagnetic force acting on on the segment of conductor.

3/ Value of v?

III. At a definite place, one observes a compound pendulum L whose period is $T_o = 2$ seconds if it oscillates in vacuum, and, T if it oscillates in a gas K.

1. Admitting that the difference between the two periods is due to Archimedes' law of push, calculate T in terms of T_o and r; r being the ratio of the specific mass d' of the gas to the specific mass d of the pendulum (r negligible with respect to 1). Calculate T, if density of K with respect to air is 0.518 and density of L with respect to water is 1.675.
2. Pendulum L and a second identical one oscillate in two parallel planes; but L does it in vacuum and the latter in gas K. Show that the time between two coincidences can be seen as inversely proportional to r ($r \ll 1$). Calculate this time with numerical values given above. (Specific mass of air is 1.293 g/l).

ENTRANCE EXAM - AUGUST 10, 1965

Time: 1 hr. 30 min.

ELECTRICITY - PROBLEM (ENGINEERING)

I. Let it be a voltage U=155.5 sin 314t across two points A and B. Between A and B one connects in series a resistor R = 5 and a pure indicator L = 0.016 heavy.

a. Calculate the value of current in R at time t.

b. Calculate the r.m.s. voltage across A and B, and the r.m.s. current I.

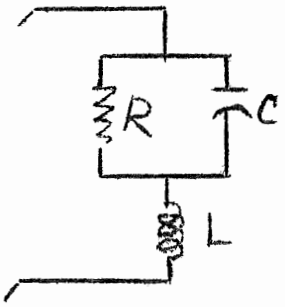
c. Now, between A and B are connected in series the resistor R, the inductor L and a capacitor C (connecting wires have negligible resistance).

Calculate C so that the current in the circuit will be in phase with the voltage across A and B.

d. Knowing U = 110 volts, calculate the effective voltage Ur, Ul, Uc across the resistor, the inductor and the capacitor.

Suppose the sinusoidal source is replaced by a direct current source so that the voltage between A and B will be again 110 volts, what will happen to Ur, Ul, Uc in steady state?

II.



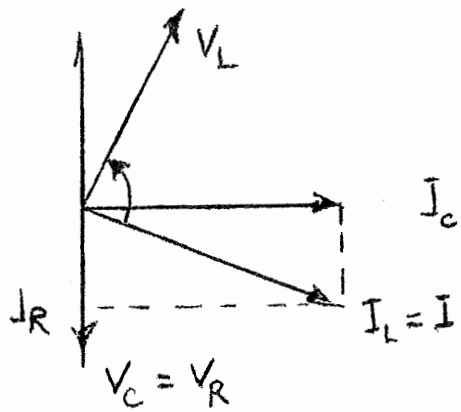
Between A and B a circuit as as follows is set up:

A capacitor C is put in parallel to a resistor R and then the whole thing in series with a pure inductor L. Across A and B is then applied a

sinusoidal voltage of angular frequency W. U is for effective voltage across A and B; and I is for effective current in R.

a. Calculate I in terms of R, L, C, W.

b. Condition for I not depending on R?



APPENDIX G - SHORT HISTORY OF THE SCHOOL OF CIVIL ENGINEERING

Prepared by Nguyen Thanh Toan

The School of Civil Engineering of Viet Nam was founded in 1911 at Hanoi (North Viet Nam) by the French and referred to as the school of Public Works. At the beginning, the aim was to form only a subordinate class of technicians, something like the foremen; the leading class (engineers) was to be fulfilled by the French people. But as time went on, the development of the country needed more and more engineers in Public Works, and the School of Civil Engineering opened a higher section for technicians and engineers.

The development of the School of Civil Engineering can be summarized as follows:

From 1911 - 1937: Period of formation of a subordinate class of technicians (foremen, draftsmen, operators in surveying, etc.).

From 1938 - 1942: Formation of technicians class (secondary level). These technicians, when they had worked for a long time (15 years for example) could become engineers by appointment or by professional examination.

In 1944, the French governor of Viet Nam signed an official act proclaiming that the School of Civil Engineering of Hanoi be organized in order to produce Vietnamese engineers and other Vietnamese classes of technicians.

The conditions to enter the School, the length of study, and the programme were not the same as they are today. Essentially, they permitted a lower level and a lighter programme.

The Act of 1944 was very important because it formed the basis of all the later changes and modifications of the curriculum of the School.

In March 1945, because of the struggle of the Nationalists against the French, the School was closed.

In 1947, the French reopened the School of Civil Engineering, but this time at Saigon.

In 1950, after Viet Nam declared herself independent (1949) the School of Civil Engineering was transferred to the Vietnamese Government by the French Government.

In 1957, the School of Civil Engineering was integrated into the National Technical Center with its present buildings.

In 1958, a new regimen with a completely new curriculum for the engineer studies was instituted. This new curriculum was conceived to produce engineers with approximately the same standard of knowledge as the engineers from foreign countries.

It is to be noted that before 1958, under the old curriculum, the engineer-students and the technician-students had the same three-year program. At the end of the third year, the brilliant students had to study one more year to become engineers, the others were technicians.

Another feature of the School of Civil Engineering is that it has a minor section of surveying-engineers and technicians in addition to the Civil Engineer students.

Data on the number of graduates of the School of Civil Engineering dates back to 1956.

Number of Graduates from the School of Civil Engineering

Year	56-57	57-58	58-59	59-60	60-61	61-62	62-63	63-64	64-65
Civil Engrs	19	23	19	17	21	17	14	17	22
Surveying Engrs	8	5				4	3	5	3
Civil Tech'n	51	69	30	25	23	23	24	23	25
Surveying Tech'n	6	17	12	10	11	8	12	7	9

APPENDIX H - BIBLIOGRAPHY

1. The Foreign Assistance Program, Annual Report to Congress, Fiscal Year 1964, U.S. Govt. Printing Office, Washington, D.C.

2. Statistical Yearbook of Viet Nam, 1962, National Institute of Statistics, Saigon, 1964.

3. Industrial Development in Viet Nam, Ministry of National Economy, Saigon, 1964.

4. Annuaire Association Des Ingenieurs et Techniciens Vietnamiens, Saigon, 1962

5. Industrial Complex at An Hoa Nong-Son, Republic of Viet Nam, October 1963.

6. Rapport De L'Avancement Des Travaux de Construction Du Complexe Industriel De An Hoa Nong-Son, Republique du Viet Nam, Saigon, 1964.

7. Plan Quinquennal, 1962-1966, Direction Generale Du Plan, Saigon.

8. ENGINEERING AS A CAREER, Ralph J. Smith, McGraw-Hill Book Co., New York, 1962.

9. Report on Survey of National Higher Education in the Republic of Korea, Ministry of Education, Republic of Korea and U.S. Operations Mission, 1960.

10. Korean Independence Day, article in the Saigon Post, August 14, 1965.

11. Far East Manpower Assessment and Educational Planning Seminar Report, USAID/Manila, February 1965.

12. Curriculum in Engineering and Technology, National Technical Center, Saigon, September 1962.

13. Ky-Thuat Phu Tho, Thong 1 - 1965.

14. General Industrial Survey for the Republic of Viet Nam, Vol. 1, Day & Zimmerman, Engineers, Philadelphia, 1958.

15. Notes & Etudes, Actualization Agriculture - Elevage - Foret - Peche, Direction Generale Du Plan, Saigon, 1965.

16. Economic Expansion of Viet Nam in 1963, Supplement to the Monthly Bulletin of Statistics, National Institute of Statistics, Saigon, 1964.

17. Studies in Vietnamese Economy, Alek A. Rozental, U.S. Operations Mission to Viet Nam, Economic and Planning Division, Vol. 1, Saigon, 1964.

18. Official Documents on Investments in Viet Nam, Industrial Development Center, Saigon, 1964.

19. Thong-Ke Nguyet-Son (Monthly Bulletin of Statistics, National Institute of Statistics, Saigon, June 1965.

APPENDIX I - COMPOSITION OF SURVEY TEAM

Dr. J. Morley English, Professor of Engineering, UCLA; Consultant to the Engineering Advisory Council of the Regents of the University of California on long-range planning for the needs for Engineering Education in the State of California; Consultant to the U.S. Navy on an economic replacement policy for power generating equipment; related experience included Director of Engineering Research, UCLA; Fullbright Scholar in Turkey.

Dr. Thomas E. Hicks, Professor of Engineering, Dean for Graduate Studies in Engineering, Director of the Nuclear Reactor Laboratory, UCLA; Consultant to the United States Atomic Energy Commission on nuclear engineering education; formerly professor of Engineering, Gadja Mada University, Djogjakarta, Java, Indonesia.

Professor Wesley L. Orr, Team Leader, Professor of Engineering and Head of the Division of Engineering Design, Management and Planning, UCLA; Member of the Board of Advisors, SEATO Graduate School of Engineering, Bangkok; has been a consultant to AID on engineering education in Asia; was Campus Coordinator, AID-UCLA Gadja Mada Indonesia Project; has worked in Pakistan, Indonesia, and Thailand.

Dr. Ralph J. Smith, Professor of Electrical Engineering, Stanford University; First Dean of Engineering, San Jose State College (1945-57), responsible for curriculum planning, building design, faculty recruitment; Advisor on Electronics to Department of Education, Republic of the Philippines (1957-58); now responsible for undergraduate curriculum, laboratories and advising at Stanford University; his book ENGINEERING AS A CAREER used at over 100 schools in United States.