ANNEX X

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environmental programme

asian regional workshop on environmental training of practising civil engineers

faculty of engineering, university of malaya,
kuala lumpur, 12–23 may 1975.

final report

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final report

UNESCO/RCST/SWA/DRI
Environmental Training
Civil Engineering

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UNESCO/ROST/SEA/DR1.1
Environmental Training
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I. INTRODUCTION

Unesco with the financial co-operation of the United Nations Development Programme (UNDP), has been involved for almost two decades in providing assistance to its Member States for the strengthening of their engineering education systems and particularly for the establishment of new teaching institutions or the upgrading of existing ones.

In recent years, the Organisation has responded to the countries' widespread demands for modernisation of engineering education to bring it in better harmony with the needs of society. Environmental and other social concerns in engineering education are thus becoming an important element in Unesco's programme in the field of education.

The Organisation has joined efforts with the recently created United Nations Environmental Programme (UNEP) in different areas of common competence which include notably the environmental education and training of engineers and other higher technologists as well as architects and town and physical planners.

Unesco/UNEP co-operation made possible the organisation of an International Meeting of Experts on Environmental Aspects of Engineering Education and Training which took place in Paris on 17-21 June 1974. Following the meeting's recommendations a series of experimental activities are being carried out with a view to their expansion into a more comprehensive programme in this field.

The Asian Regional Workshop on Environmental Training of Civil Engineers - the first of its kind organised by Unesco - is part of such experimental programme aimed at the development of the environmental component of the education and training of engineers and members of allied professions. It was convened in pursuance of resolution 2.152 adopted by the General Conference of Unesco at its 18th session.

The Workshop was held at the Faculty of Engineering of the University of Malaya in Kuala Lumpur, Malaysia, from 12 - 23 May 1975. It was held at the invitation of the Government of Malaysia and was organised by the Unesco Regional Offices for Science and Technology for Southeast Asia and for South and Central Asia in co-operation with the Malaysian Unesco National Commissions.

The Workshop's objectives were to give a selected group of experienced Asian civil engineering practitioners and educators the opportunity to:

(a) be informed about new concepts and methodology in their profession in relation with environmental problems;

(b) discuss and advise on ways and means of solving such environmental problems particularly through the development of more adequate education and training of civil engineers.

The Workshop was attended by 21 participants from 18 countries in the region including vice-chancellors of universities, professors and lecturers in civil engineering and practising civil engineers, together with a number of observers including representatives from the United Nations Development Programme (UNDP), the World Health Organisation (WHO) and the International Labour Organisation (ILO) as well as from the World Federation of Engineering Organisations (WFEO).

The Associations for Engineering Educators for Southeast Asia and for South and Central Asia were also represented at the Workshop. The list of participants and observers is given in Annex B.

Appreciation is due to Ir. Chiam Teong Tee, Dean, Faculty of Engineering, University of Malaya, who acted as Chairman of the Local Organising Committee and as Director for the Workshop, and all other persons who assisted with local arrangements.

In particular, special thanks are due to Mr. A.T. Nathan of the Malaysian National Commissions for Unesco and to his staff.

II. ORGANISATION OF THE WORKSHOP

The opening ceremony of the Workshop was held on the morning of Monday, 12 May 1975, in the Jaya Puri Hotel, Petaling Jaya, Malaysia. A welcoming address was given by Ir. Chiam Teong Tee, Dean, Faculty of Engineering, University of Malaya, in his capacity as Chairman of the Local Organising Committee. This was followed by an address by Mr. F.J.C. Pala, Deputy Director, Unesco Regional Office for Science and Technology for Southeast Asia, Jakarta.

The Workshop was then officially inaugurated by The Honourable Dr. Mahathir Mohamad, Minister of Education of the Government of Malaysia.

The text of the addresses delivered at the opening ceremony as well as the first working session is given in Annex C.

The Workshop elected the following officers for the sessions:

Chairman:	Ir. Ainuddin bin Abdul Wahid (Malaysia)
Vice-Chairman:	Mr. H.C.D. de Silva (Sri Lanka) and Mr. Robert George Norman (New Zealand)
Rapporteur-General:	Dr. J.K. Sridhar Rao (India).

The following participants served as rapporteurs for the various sessions:

Dr. M.A. Aziz
Dr. Cheong Hin Fatt
Prof. Marino M. Mena
Mr. G.B. O'Rorke
Dr. M. Islam Sheikh
Mr. A.B. Sinclair
Dr. Surin Setamanit
Dr. Tam Chat Tim

All sessions took place in plenary. The programme and agenda are included in Annex A.

On Monday afternoon, 12 May 1975, the sessions were opened with general remarks by the Workshop Director, Ir. Chiam Teong Tee. Thereafter the programme was adopted and this was followed by a brief introduction on the aims and scope of the meeting by Ir. Carlos Nones Sucre from the Unesco Secretariat (see Annex C). The same afternoon and on Tuesday morning 13 May, country reports were presented by the participants (see Annex D).

The seven topics of the Agenda were introduced by consultants who had prepared background papers for this purpose. These papers are included in this Report as Appendix E.

The introductions of the seven topics by the consultants took place from Tuesday morning 13 May to Wednesday afternoon 21 May. On Thursday 22 May the General Rapporteur presented his draft report and thereafter discussions took place for finalising the Report. On Friday morning 23 May, the Final Report including the conclusions and recommendations of the Workshop was adopted.

III Discussions and Observations

The discussions and observation of the Workshop are given separately in the following pages as per list below:-

1. Country Reports - Salient Environmental Features of Countries in Asian Region
   (Ref.: UNESCO/ROST/DR 2.1(a)

2. Environmental Aspects of Engineering Works - (Role of the Engineers in Society)
   (Ref.: UNESCO/ROST/SEA/DR 2.2(a)

3. Educator for Environmental Training of Future Engineers
   (Ref.; UNESCO/ROST/SEA/DR 2.3(a)

4. Practice of Civil Engineering in its Environmental Aspects
   (Ref.: UNESCO/ROST/SEA/DR 2.4(a)

5. Case Studies
   (Ref.: UNESCO/ROST/SEA/DR 2.5)

6. Methodologies for Environmental Assessment of Major Civil Engineering Works
   (Ref.: UNESCO/ROST/SEA/DR 2.6)

7. Systematic Approaches and Computer Modelling and Simulation in Environmental Problems
   (Ref.: UNESCO/ROST/SEA/DR 2.7)

8. Implication of Engineering Education of Modern Tools
   (Ref.: UNESCO/ROST/SEA/DR 2.8)

9. Curriculum Development
   (Ref.: UNESCO/ROST/SEA/DR 2.9)

IV. CONCLUSIONS AND RECOMMENDATIONS

1. Participants provided many thoughts through oral discussions throughout the seminars, written statements for this session; a number of salient observations were called from the verbal presentation of statements and subsequent discussions.

AT NATIONAL LEVEL

2. Most participants thought that the workshop was held at an opportune time when many countries in the region are introducing environmental protection legislation.

   Exchange of experiences between the countries where legislations were introduced and the countries where legislations were not introduced was considered as a very valuable outcome of this workshop.

3. General agreement was reached on the usefulness of introducing civil engineers to the powerful techniques and methodologies that are available today such as systems analysis, computer usage, environmental impact analysis.

4. Socio-economic, socio-cultural and socio-environmental awareness was considered an essential backdrop for all civil engineers and most of the participants agreed to attempt the introduction of such awareness at all levels of education.

5. Case studies involving environmental impact assessment were considered essential for creating knowledge bank.

6. Participants strongly felt that each would attempt to take back the experiences gained at this workshop to develop environmental awareness for engineering educators and civil engineers practising in the field in the following manner:

   - organizing seminars, workshops, short and long courses as a process for continuing education

   - collecting, collating, and documenting knowledge on environmental implications and results of development

   - exchanging knowledge within countries and between countries at the regional and sub-regional level

   - professional societies taking a lead role in sponsoring training programmes and encouraging rapport between educators, practising engineers, industry and government.

AT REGIONAL LEVEL

7. Need was felt to introduce a network within the Asian region for exchanging knowledge between countries. This could be achieved by:

   a. locating nodal points where enough knowledge is already available and also getting accumulated at a fast rate

   b. exchanging scholars and practitioners between the nodal points and also from locations where these knowledges are needed

   c. providing training facilities for those countries where there is a dearth of such facilities

   d. intra-regional exchange of expertise was thought particularly relevant because of the likely similarity of situations and the faster understanding which would be obtained between the advised-advisor countries of the region

   e. initiation of a series of case studies at various locations in the Asian region was considered significant for developing knowledge and experience

   f. texts and manuals incorporating such knowledge through techniques and methodologies were considered vital in the regional context

   g. introducing a series of roving workshops/seminars rotating between the participating countries of the region

   h. promoting of continuing programs of environmental training of practising civil engineers and educators on a, regional basis

   i. promotion and encouragement of support of engineering institutions together with the appropriate regional engineering educational Association was also considered significant bringing out journals specially incorporating case studies, newsletter etc to assist specialists, generalists, administrators including decision-leaders, and the public

The meeting felt that UNESCO could be approached to give assistance in developing these and other suggestions.

The participants acknowledged the initiative of UNESCO and UNEP in promoting this workshop and considered that UNESCO could continue in furthering the above recommendations.

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Environmental Training
Civil Engineers

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL
TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

RESOLUTION OF THANKS

Whereas, the Regional Workshop on the Environmental Training of Practising Civil Engineers under the auspices of UNESCO was successfully hosted by the University of Malaya;

Whereas, the hospitality and kindness of the host country had definitely contributed to the success of the workshop as well as to the pleasure of the stay of the participants in Kuala Lumpur;

Whereas, the organizing committee headed by Professor T.T.Chiam had succeeded outstandingly in attending to the personal as well as official needs of the participants during the workshop;

Whereas, the generous guesture of the host country will go a long way in stimulating among practising civil engineers awareness of environmental problems in their country in particular and in the Asian region in general;

Whereas, the workshop may serve as a modest beginning for the enhancement of mutual cooperation among countries in the region in providing answers to the complex environmental issues;

The workshop participants unanimously resolve to express their sincere thanks to U.N.E.S.C.O. for organizing this workshop; to the government and people of Malaysia for their warm welcome and sincere hospitality; and to the University of Malaya for the excellent arrangements made for their confort and the success of the workshop.

Attested

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General Rapporteur

UNESCO/ROST/SEA/Mis6
Environmental Training
Civil Engineers

SUMMARY OF DISCUSSIONS AND OBSERVATIONS

1. Country Reports - Salient Environmental Features of Countries in Asian Region
   (Ref: UNESCO/ROST/SEA/DR 2.1(a))

2. Environmental Aspects of Engineering Works - (Role of the Engineers in Society)
   (Ref: UNESCO/ROST/SEA/DR 2.2(a))

3. Educators for Environmental Training of Future Engineers
   (Ref: UNESCO/ROST/SEA/DR 2.3(a))

4. Practice of Civil Engineering in its Environmental Aspects
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   (Ref: UNESCO/ROST/SEA/DR 2.7)

8. Implication of Engineering Education of Modern Tools
   (Ref: UNESCO/ROST/SEA/DR 2.8)

9. Curriculum Development
   (Ref: UNESCO/ROST/SEA/DR 2.9)

UNESCO/ROST/SEA/DR2.1(b)
Environmental Training
Civil Engineers

SALIENT ENVIRONMENTAL FEATURES OF COUNTRIES IN ASIAN REGION
(SUMMARY OF COUNTRY REPORTS)

1. Introduction

The countries in this region from which experts participated in the Unesco Workshop consisted of: Afghanistan, Australia, Bangladesh, Burma, Hong Kong, India, Indonesia, Iran, Japan, Republic of Korea, Malaysia, Nepal, New Zealand, Pakistan, Philippines, Singapore, Thailand and Sri Lanka. The country reports presented by the experts at the meeting formed the basis for formulating a general overview of salient environmental features.*

Among these countries there is a wide variation in climatic, physiographic, demographic, economic, socio-cultural factors as well as in levels of resource endowment and development, methods of coping with environmental problems (arising out of development) and legal instruments, their enforcement mechanisms and the public response. There is a growing feeling that environmental considerations should be incorporated at the project planning stage - whether it is a river basin project, a thermal power plant, a new city, a slum squatter settlement, or industries and industrial estates, etc.

Salient environmental features and problems in most countries of this region include:

(1) Rapid population growth, migration and poverty in many countries;

(2) Water supply, sewerage, drainage and general sanitation;

(3) Industrial wastes (from manufacturing, mineral processing, etc.), solid wastes;

(4) Rural - Urban imbalances in levels of rural, urban and regional development (in the context of resource base, population, spatial distribution of industries, etc.);

(5) Human settlements and built environment (housing, transportation, communication, other manufacture; material resources and energetics consumption/capital);

(6) Environmental pollution and health hazards (land, air, water, noise, intensive agricultural practices and deforestation, mining, urban sprawl, slums and squatters);

(7) Natural disasters and calamities (floods, tidal bores, cyclones, earthquakes, etc.);

(8) Protection, preservation and enhancement of natural environment, scenery, historical monuments, etc.

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* This report is limited to the information that was made available by the participants in the workshop.

In addition to overpopulation, poverty/low G.N.P. and illiteracy and the problems listed above, the countries which are at earlier or intermediate stages of development have special features including the following:

> Social inequity and inadequate infrastructure; inefficient resources management; low stage of aggregate human resources development; interrelated problems of urbanisation, agriculture, industrialisation, transportation, other economic development including employment generating measures, and impact of the environment on the quality of life.

The environments include natural, modified natural (for example: agricultural eco-systems, river valley hydroelectric projects) and built environment. Each of these needs to be looked at from ecological, socio-cultural and socio-economic aspects. It is also important to understand the resource requirements in production, amenities, conservation, health, etc. and the basic orientation of life style of countries in directions such as "consumerism", " recycling/ resource recovery", "resource conserving".

The environmental features also include agricultural ecosystems including forestry in terms of denudation, deforestation, man-made forests, irrigation and drainage, modified surface run-off, effects of fertilizers,pesticides and other toxic chemicals; protection of natural flora and fauna, and endangered species; coastal and marine pollution (fish and other aquatic life) etc. - i.e. environmental aspects of natural resource development and management.

2. General Factors

The countries of Asia have to tackle some of the world's most difficult problems of water supply, waste disposal, pollution, natural resources management, built environment, natural calamities etc., with widely differing levels of resources, population and stages of development. Geography, population and economy further complicate the task of improving the quality of life. The region includes the highest point of earth, Mt. Everest (Nepal), rainiest spot, Cherrapuriji (India), the highest density of population as compared with other countries. The population density varies from less than 1 person per square km. in Mongolia to 500 per square km. in Bangladesh to about 4000 per square km. in Hong Kong and Singapore. The densities in various states, cities, and parts of cities vary widely and Asia has some of the highest densities of built environment in the city states of Hong Kong and Singapore, and in pockets of other metropolitan cities. The total population represents a significant part of the world's population.

Several member states of this region, China, India, Indonesia, Bangladesh, Pakistan, Philippines, Thailand, Japan are among the 17 most highly populated countries in the world as of 1971. Although most of the countries in this region are predominantly rural, there are over 25 cities with more than a million population and the density in urban areas can go as high as 25,000 per sq. km. In many of these cities there are tremendous problems of overcrowding, very high pressures on services and infrastructure, lack of adequate and effective mass transportation, problems of extremely low human environmental conditions especially for the poor, problems of urban renewal, etc. In many of the developing countries of this region, environmental problems arise out of the survival conditions and as the result of unsatisfactory sanitary conditions; they are aggravated by the scarcity of potable water supplies, by water pollution by insufficiently pretreated industrial effluents and by problems of severe budgetary and financial limitations.

3. Demographic and Socio-Economic Features

Table I indicates the countries of the region with five different demographic types indicating several levels/stages of development and population control. (Population increase is not necessarily a true indicator of level of development or of efficiency in resource utilisation). The percentage increase in population varies from less than 1% in the case of Japan, to around 3% for Indonesia, Thailand, Malaysia and Sri Lanka. A number of factors including stage/level of development, health care facilities, and population control affect this value.

Literacy rate levels vary greatly with highs nearing 100% for Japan, Australia, New Zealand, to lows of 21% for Bangladesh and 15% for Afghanistan. This gives rise to widely varying situations relating to the environmental awareness of the public and the differing roles of public opinion and community participation in planning of developmental works.

The economic conditions vary widely within the region. Among the countries with GNP/capita/year less than 100 US$ are Afghanistan, Burma, Bangladesh, Indonesia, India, Pakistan, Nepal.

On the other hand Australia, Japan, Hong Kong, New Zealand are at least in the 1000-2000 range with different sets of environmental problems. The GNP however, is not indicative of the range of disparities and equity which pose problems of human environment especially in the economically weaker sections of society. It is observed that the percentage of urban population in a country generally tends to increase as the GNP increases.

In this region, the approximate percentage of urban population is 5% for Nepal, 7% for Afghanistan, 10% for Bangladesh, 16% for Burma, Pakistan; 18% for Indonesia and about 20% for India. At the other end of the spectrum, the value is 88% for Australia, 90% for Hong Kong and Singapore. In predominantly rural countries, the rural-urban disparities are very high. In many countries, resources are deployed for urban development and industrial agglomeration, causing pressures of urban migration. In this region, there are primal countries (countries with mainly one major metropolitan centre as a growth pole) such as Afghanistan, Philippines, Sri Lanka, Thailand, etc. (there are attempts to have more growth poles) while many countries which are in the intermediate and advanced stages of development there is dispersal of growth poles. In many of the countries there are large backward areas which need development for balanced national and regional growth.

The agricultural land ratio has wide variations in the countries in the region. It is less than 100 persons/sq.km. for Australia and New Zealand as high as 800 persons/sq.km. for Bangladesh, Hong Kong, and Singapore and slightly less than this value for Japan. This factor is indicative of the pressure of population on agricultural land and problems relating to natural ecology and resource conservation. The value is between 200-300 in Indonesia, Republic of Korea, Malaysia, Pakistan, etc. while in Burma, India, Philippines, Thailand, the range in from 301-400 persons/sq.km.

While countries like Australia and New Zealand have a history of modern habitation of about 100-150 years, the rest of the countries have a long history of human settlements and civilization with traditional skills, and lifestyles which are undergoing changes, in space and time frames. The socio-cultural and historical land marks in various areas of the countries are to be protected while contemplating any "built developmental" programmes, for example, Kathmandu in Nepal has many historic and cultural treasures that are being protected while making development programmes.

Table I

Demographic Types with names of the countries of the region

Type	Birth Rate per thousand	Death Rate per thousand	"Indicative" stage of development	Countries
I	13-19	8-14	Advanced stage of technological development	Australia, Japan
II	20-45	5-13 ("low")	intermediate stage of development	Burma, Hong Kong, Republic of Korea, Malaysia, New Zealand, Pakistan, Sri Lanka, Singapore, Thailand
III	20-45	15-19	developing	Iran, India, Philippines
IV	20-45	20-25 ("high")	developing but with inadequate health services	Indonesia, Nepal
V	50-52 ("high")	16-27	developing with high population growth	Afghanistan, Bangladesh

Ref: Data from Country Reports and Asia 1975 Yearbook; Far Eastern Economic Review.

4. Environmental Policy Trends and Implementation

Environmental policy trends in this region vary from country to country depending on the stage of development and the extent of public awareness and literacy. Australia, New Zealand and Japan exhibit environmental policy trends characteristically found in North America and Europe. In these three countries, there exist lobby-groups to exercise great influence in framing policies for improving the environment and also for setting standards for examining the externalities of development. Common environmental protection legislation for natural resource environments such as air, water and land are in existence and are enforced effectively. The two city-states of Hong Kong and Singapore are up-to-date with the current environmental protection legislation and enforcement while both countries are trying hard to keep their automobile movement to a minimum at least in the business districts. Singapore has one industrial waste-water-reuse scheme but otherwise these two cities operate on linear technology rather than on recycling.

Countries which are developing rapidly such as Malaysia and Korea have undertaken environmental protection measures for the conventional environmental components of air and water. Cases of public awareness in the Republic of Korea are exhibited through a number of law-suits on marine pollution.

Countries like India, Pakistan, Bangladesh, Sri Lanka, Thailand, Indonesia and Philippines are on the threshold of formulating legislation for the protection of water and air. Pakistan, through pressures exerted by professional societies, introduced "Protection of Human Environment and Ecology" as one of the concurrent subjects in its constitutional framework. Similarly, a high-powered committee has been set up to advise on major development projects with respect to environmental implications.

Countries like Afghanistan, Iran and Nepal are fully aware of their growing environmental problems but no legislation has yet been formulated.

It appears that the models of legislation such as in USA, and UK, have had a determining influence on the formulation of legal instruments in the Asian Region, with slight modifications in environmental standards. These, however, need to be reviewed with effective case-studies and R & D efforts indigenously so that these legal instruments may be better focussed for the socio-cultural, and economic conditions peculiar to each country.

5. Environmental education

Environmental Engineering, in the traditional form of Sanitary Engineering and Public Health engineering courses are taught in most of the countries in the region as a part of the undergraduate civil engineering curriculum.

Postgraduate programmes in public health or sanitary engineering are also offered in some countries of the region.

Meaningful environmental engineering programmes transcending to other disciplines and interweaving personnel, faculties, and experts from various disciplines are in existence only in some of the countries.

Education for environmental considerations is educating for "ultimate pragmatism" combined with short term and medium range socio-economic goals so that man can live as custodian of nature rather than its master.

UNESCO/RCST/SEA/DR 2.2(a)
Environmental Training
Civil Engineers

ENVIRONMENTAL ASPECTS OF ENGINEERING WORKS
(Role of engineers in society)

I. Overall Considerations

1. While considering the relation of man and his environment, an overall perspective to cover ecological, socio-economic, socio-cultural aspects is necessary for engineers. In addition to consideration of costs and economics of projects, it would be necessary to consider the above mentioned environmental aspects.

2. Engineering works must also be considered in terms of material resources and energy so that a composite view of population, resources, environment and development activity can be taken. This would help to have a balanced outlook in terms of weighing benefits and risks of each different project in terms of its primary functions as well as the surrounding factors that would influence the outcome of engineering works during its design and operative life. In terms of developing countries it might be necessary to have trade offs between (1) reasonable development with environmental consideration, and (2) highest possible development that people can cope with without serious consideration of the impact of these on human environment.

3. Although engineers are concerned with the highest possible technical efficiency taking into consideration the various technical alternatives and economic viability, they should also consciously take into account a broader spectrum of human environment, both in terms of time and space frames. This will ensure the success of development projects without undesirable after effects.

4. It is suggested that it may be necessary to plan for materials, energy, manpower in a medium and long range perspective (30-50 years), so that the planes about twice or thrice the "doubling time" in terms of production to meet the growing needs of increasing numbers of people. It may be necessary to organise society within the means and resources of a country or in terms of the capacity to invent solutions to take care of rising human needs and expectations.

5. It is observed that the life styles in many developed countries are wasteful of materials and energy in terms of resource consumption per capita (out of the total energy consumed in such societies it is estimated that a small fraction of approximately 6% is used for absolute physiological needs and genetic development). In developing countries of this region it would be necessary to think afresh in terms of devising resource conserving solutions for basic problems such as food, water, shelter, recycling of wastes, transportation, communication, employment-generation, industrial location etc; in terms of resources, population and environment.

6. Many of the countries in this region are predominantly rural, poor and are characterised by wide disparities between different classes of people causing social inequity which may raise problems of a socio-political nature (in the sense that these may not be tenable for a long time in terms of present status quo). The need, therefore, is to develop an effective mixture of technologies for providing the basic necessities to the large masses of people, especially the poor, in terms of low cost food, hygienic water, shelter, low cost housing, basic health services and mass transportation in various forms.

II. Framework and considerations in dealing with the built environment in the urban context in developing countries.

1. In view of the tremendous rural-urban imbalances, it is necessary to have a comprehensive framework for integrating rural, urban and regional development in the context of resources, population and societal needs. Unless this is taken care of urban development would create problems of over-crowding, migration and inadequacy of services and infrastructure, especially for the poor and average citizen of the country. There are wide differences in population, demographic, technological, human and natural ecological factors between developing countries and developed countries which would be necessary to keep in mind in order to promote effective development which requires a fresh outlook and possibly unconventional solutions to these problems. A need for an effective human and natural resources management, as well as a change from procedure orientation to performance orientation,would be required in many of the countries of the region.

2. The environment of urban development needs an understanding of goals, objectives, problems and an analysis of needs. While choosing solutions there is a need to clarify concepts and to be innovative in problem solving i.e. to search for the optimum use of resources within the maximum allowable risk from an environmental view-point. In order to choose the best out of a number of alternatives it is necessary to expand broad goals into associated problems with spatial objectives and performance indicators and subjective measures for choice for the many components for urban development, for example utility systems, mass transportation etc.

3. A framework for technology assessment which envisages analysis of benefit-risk-costs in different time frames, both in terms of direct and indirect, was also discussed.

4. A check list for reviewing and evaluating policy measures for the urban environment in terms of (a) natural (b) spatial (c) transportation - utility (d) community neighbourhood/social (e) household (f) population and economy (g) administrative and management environments was also discussed.

III. Environmental aspects of role of construction in development

1. All construction change the environment - the scope and nature of change is variable and may be so designed that it is within acceptable limits. Many of these changes have brought about problems which transcend the boundaries of traditional

disciplines. The adverse effects on the environment can usually be reduced by careful and judicious design before the implementation of development projects by consideration of the significance of environmental aspects. This may often require the services of experts from different disciplines, professions and natural ecology etc; and is very much a scheme preferred, especially for very large scale constructions. The object is to try to optimise the benefits and reduce the detriments.

2. It is generally observed that there is a need for more comprehensive review of the environmental effects on engineering projects than that has been done in the past. In terms of planning and design factors, especially relating to river valley projects as well as agricultural ecosystem development some of the factors that need consideration are: (a) adverse effects of large scale replacement of low-land rainforest by monoculture (b) adequate soil conservation practices (c) proper use of vegetation cover (d) emulsion spraying, terracing etc (e) environmentally sound construction practices etc. (f) building of a series of small dams (g) minimum amount of surfaced roadways to reduce runoffs, consistent with topography and functional needs of transportation.

3. In the area of physical development, a need for preparation od development master plans of urban development with effective methods of land preparation and land use and proper industrial location and siting of industries in accordance with waste production classification in industrial estates are necessary.

4. A need for multi-discipline, inter-agency review of all development projects and preparation of environmental impact analysis reports are necessary. This calls for team work with effective coordination and civil engineers need to be trained not only for the task of coordination but also as specialists in specific areas such as hydrology and water resource, water supply, sanitation and drainage, industrial waste technology etc. Civil engineers involved in planning and design at the feasibility stage of a project must also consider environmental factors in addition to techno-economic considerations. For this he must be assisted by a team of specialists including environmental engineering specialists from physical, chemical and mechanical engineering backgrounds as well as those in the built environment and natural ecology. A practising civil engineer should, therefore, have a broad based background so that he can seek the advice of experts whenever the size and nature of project demand so and be able to function in his primary task to plan and design in a balanced manner to conserve both short-term and long-term objectives. This is becoming increasingly important in view of the adverse environmental consequences of many developmental projects, (for example many large dams planned and built during the 50's and 60's). This has increased the need for innovation in terms of concepts and skills and generation of many alternate solutions, for better acceptance at different levels of decision making, and public response to this action of practising civil engineers. The need is felt for well documented case studies for effective dissemination among practising civil engineers professionals and educators, so as to fulfil the gap within the shortest possible time.

5. Some referred to advanced engineering techniques and machinery used in developed countries, outstripping our ability to plan and define community goals and environmental factors (e.g. massive earthworks), thus leading to a technically or socially wrong end product.

6. Some were concerned that planners are middle-class and decision makers are elitist, leading to all plans and decisions ignoring the urban poor, thus building a "straitjacket" urban framework ignoring the real needs of the mass of the people.

7. Some also referred particularly to the urban planning problem and the interaction of urban structure, transportation, drainage, land use etc. We have inherited city concepts in which Urban structure, transportation, densities etc. are out of date and wasteful of land and other resources. They referred to "the compact City" and asked that these concepts be applied to conserve energy material and other resources. They also referred to "Resource - conserving urbanism - the design of resource-conserving cities". These concepts are equally applicable to other physical developmental projects.

IV. Role of Engineers today and tomorrow and their relevance to environmental problems, their links and responsibility to other professions and to society at large.

1. Many participants from developing countries felt that Engineers are used as tools and agents to create goods and services for the society. Their role as agents of change for benefit of mankind must be identified into a programme of action; by broadening the education base especially at macro - and policy levels (including decision - making and knowledge of political processes).

2. Our early settlements could be abandoned totally when they became environmentally unacceptable; migration was an integrated style of living.
(Example: Irans kanat; habitation in Tigris and Euphrates in Syria; exchange of culture in the whole of Southeast Asia).

3. Present situation suggests that all human settlements may need to stay where they already are. More and more engineering skills and innovations are demanded to keep those establishments viable. (However, the problem of migrations need further considerations in terms of regional decentralisation).
(Example: Hong Kong water resource; Bombay water resource; Madras water resource, Singapore water resource)

4. In addition to 3 above, man's number and his demand for more resources are increasing at an accelerated rate.
(Example: Population change) Increase food production; create surplus rural people; open up roads; make them urban migrants; industrialisation absorbs them; when migrants are in excess, it ends up in substandard living and low quality of life.

Educators for Environmental Training of Future Civil Engineers

1. The educators and practioners interacted with each other in the discussion about the training of educators for various macro and micro level environmental considerations and "externalities" in civil engineering works.

2. Educators, to a greater extent than in the past, should be in touch with the goals and objectives of society - specifically they should be concerned with the demand for their students: forward manpower planning is a difficult exercise but nonetheless of utmost importance.

3. It was recognised that environmental concerns and the increasingly urgent need to address them were a challenge that had only been met but with a partial response, in all fields and in civil engineering in particular.

4. Environmental educators in this field were acknowledged a rare supply item: there are so many fields associated with the environment that practising civil engineers could acquire knowledge in. As educators they would convey to students the limitations of their own training in civil engineering in practical and theoretical aspects intermeshed with environmental considerations at each stage.

5. The participants agreed that in such a wide field, greater importance should be given to the "case-study" and "engineering clinic" (practical training) methods to acquaint students with broader horizons. The educators themselves should have practical experience thus avoiding the inbreeding of educators directly from the graduating class.

6. It was suggested that in tomorrow's scene, educators themselves would have to further expand and continue their own education, in academic and functional areas, at the peril of irrelevance and narrowness.

7. Educators then would not only have to have wider horizons in the environmental aspects of civil engineering but perhaps come from other faculties, through cross-faculty appointments as well as from non-academic sources such as government, industry and the community so as to make students aware about policy, regulations, planning, design, construction, maintenance, legal instruments, decision making and public opinion.

8. Since civil engineers are basically pragmatic people, they may not face undue difficulty in being exposed to the "hard knocks" of politics, business or public opinion. Still they as educators have a long way to go in that direction and special programme in understanding political processes and decision-making at different levels and environmental management.

9. The use of foreign academic staff was thought useful in the natural sciences (for example: ecology) and to some degree in technology, but it was noted that the appropriateness of foreign appointments should be tested at the capacity to understand local conditions of the society, technological practices and local skills, and the degree of development of the country. The necessity of using "appropriate" technologies, suitable to the conditions in the countries of the region, was emphasized.

10. It was felt easier to look at education and educators in sanitary and public health engineering: they are engineers and their field is already well recognised. They could be used as specialists. Much discussion and eventual agreement obtained that nevertheless environmental education for civil engineers should be on a multi-disciplinary basis.

11. Several speakers thought that the problems associated with the environment would probably cause educators to take a harder look at the question of ethics for the profession, to the extent perhaps of internalising this question within the faculty rather than leaving it mainly to professional societies.

12. Some participants feared that educators would find it difficult to acquire their needed environmental experience just during their regular holidays. However, non-academics such as industrial managers and government officials and policymakers maybe ready and willing to discuss their experience. Educators would also have to reach out themselves and become more familiar with environmentally relevant science research applications. Universities should facilitate this process through sabbatical years, allowance for industrial consultancy and a liberal policy regarding leave of absence.

13. In this area it was pointed out that much could be accomplished by having existing environmental research results and case studies made more available and accessible. (In addition, the "success" stories should also be reported). Unesco should play an effective role in this respect, especially in developing countries.

14. The recognisable fact that much of the civil engineer's work has to do with transportation systems. These include liquids and solids waste and their management, and environmentally trained engineer would be identified with non-socially desirable specialties.

15. At any rate, educators would have to acquire a greater sensitivity to environmental problems, perhaps by becoming familiar with overall functional areas such as human settlements, materials and energy, resources management. To achieve this, there would have to be greater exchange of information between university, business, industry and government, and documentation of the same, as teaching resource. UNESCO could play a role in this.

16. It was generally agreed that whatever interest educators would display for environmental questions, their own educational background would have to be rooted in "hard-core" academic disciplines, combined with knowledge in functional areas of wider socio-cultural and socio-economic importance. (Resources, shelter, transportation as examples).

17. Besides the substance or contents of an environmental approach, much must be done to become familiar with the processes of decision making, of policy planning, of alternative project development proposals.

18. In the contemporary university scene, educators would have to meet the students with problems that are ill-structured, open-ended; programmes that are "real-life" oriented, that are responsive to the directions in which students can be motivated to learn.

19. This question led to the lag times involved in adapting educators and curricula to an acceptable response to societal needs. It was recognised that here again the educators would have to become more aware of the frame-work of the society and to its most pressing priorities as well as longer term needs.

20. Because of the greater familiarity of civil engineers with tangible, quantifiable data, and systematic methodology, it was suggested that all environment-oriented sciences and engineering should develop at the earliest the kind of meaningful indicators that engineers would use as signposts for guidance and professional support. (These could come from a multi-disciplinary team-work approach at policy, regulatory, design and operative levels).

21. The methods which educators would use to become more exposed to environmental problems and responses were given considerable attention:

    a) roving seminars;

    b) study tours elsewhere in the country and abroad, university, government industry exchanges;

    c) acquisition of second academic discipline (economics, political science, law, sociology) and orientation of educators to a wider field covering socio-economic-technical aspects of specific functional areas (food, water, for example).

22. The participants recognised the value, at least on a mid-to long-term basis, of instilling environmental concern at the level of secondary education and even at the community level as a basis for easier teaching of engineering candidates.

23. There was an underlying feeling that the civil engineering profession, already an easy target for environmental recriminations, should take this opportunity to rethink its role in society and thereby to become more concerned with the tools and materials which it uses in its endeavour and with the ultimate effects of their intervention on man and his environment. UNESCO could play a useful role in bringing out instruction manuals suitable to the various countries from the region.

24. Such an approach would be central to coping with the rising distaste of informed public opinions for purely technological solutions rooted in a value system which may well be foreign to that espoused in this part of the world.

25. Some comments were made on the location of environmental teaching in graduate rather than undergraduate studies: undergraduate civil engineers already have a heavy course load for which educators and time barely suffice. In this, educators would, for the undergraduate level, confine their teaching to overall environmental awareness and perhaps familiarity with the subject, but reserving proficiency and mastery in this area to post graduate courses.

26. The discussion was capped by a plea that all sectors of society recover a sense of ethics, sometimes lost in the life of today and a capacity for unconventional and fundamental thinking, for understanding the need to accommodate the pleas of those who are deprived. The cultural and religious ethical traditions prevalent in the region would bring a great sense of meaning and of purpose in that direction.

PRACTICE OF CIVIL ENGINEERING IN ITS ENVIRONMENTAL ASPECTS

1. The session discussed in depth how best the Civil Engineers be acquainted with socio-environmental impacts of developments so that they could practise more effectively in the field. A balanced participation of fifty percent educators and fifty percent practising civil engineers made the discussion more direction-oriented.

2. It was recognized that the practising civil engineers were required to be made aware of social, cultural, economic and environmental impacts of developments because the very nature of responsibility and obligation made the civil engineers the forerunners of development and as agents of change for benefit of mankind.

3. It was also recognized that

   - by professional attachment, the civil engineers were most directly involved in manipulating and manoeuvering the natural systems for human benefit.

   - as professionals the civil engineers were the people who knowingly and unknowingly interact with wide varieties of professionals belonging to many disciplines, with decision-leaders and planners, and also with the public.

   - the very nature of participation made the civil engineer a more knowledgeable person and the knowledge gathered from field experiences, if analysed, rationalised, coordinated and documented (as case studies, instruction manuals, etc.) should serve as the best form of feedback knowledge to revise the educational input to succeeding generation of civil engineers as well as continuing education of engineers.

4. In the transfer of technology from developed societies to developing societies, care must be taken to modify the innovations making those compatible to the developing societies. In many cases there is need to think afresh and find unconventional technological solutions appropriate to local conditions.

5. Every developmental programme should be looked into in its totality plugging in the knowledge available in the country in a realistic way. Civil engineers must remain aware of the scope of the problem and should know whom to consult from other professionals and academic disciplines and in what measure to incorporate in their designs/practices.

6. Practising engineers should practise consulting the people involved in a proposed development. A case study was cited where a river basin project in New Zealand was initiated as a hydro-electric project and some ten different alternatives were examined under the guidance of a study team consisting of government engineers. The Government selected one of the alternatives for intensive study. Subsequently a change in policy required the river basin project to be re-examined on a multi-purpose basis, and for local people to have direct involvement in the planning process. They were advised and serviced by the same group of engineers who were able to develop a much more far-reaching project of which power development was only one objective.

7. In-profession short term appreciation course for various levels of practising engineers were considered essential to equip them to the changing situation of environmental sciences, design and management.

8. Practising civil engineers should contribute more by observing, collecting, collating and documenting the unintended and undesirable externalities and social costs of developments in different time-frames of these projects; for which, of course, they in turn required more training. Today's practising engineers would do justice in equipping tomorrow's civil engineers by ploughing back the appropriate knowledge from field as feedback to institutional education framework. Suitable mechanisms need to be initiated by UNESCO and professional societies for meeting the above objectives.

9. In growing recognition of training the practising civil engineers both in the field and in the school, it was considered important to orient the civil engineers undergraduate education system with an overview of environmental implications of developments. It was thought that it could be best organized

   - by not just introducing a few courses on environmental science and engineering in the present curricula for the civil engineering undergraduates. However, a broad based appreciation type course on "Man and Environment" introducing environmental systems in terms of technology, policy, development process and legislative and regulative framework.

- by injecting into the existing courses the desirable degree of attention to the unintended and undesirable, of externalities, of material and energy resources, and social costs of every systems that they would learn to plan and design.

10. The above point 9 should not be considered in conflict with developing educational programme for specialists in the field of environmental engineering (for civil engineers, mechanical, chemical engineering, ecologist, who would be very much required for interdisciplinary studies on environmental impacts of development by team-work. Some of the civil engineers in practice and management need to be trained in policy making and effective coordination.

11. Professional societies should also get involved in organizing, in collaboration with various appropriate agencies, continuing educational programme for practising civil engineers.

12. Practising engineers should be made aware of national goals and aspirations of people with a view to better conceive the objectives of developments in specific functional areas such as water, food, shelter, trans-portation, employment-generation, management.

13. Developed countries had accumulated sizable quantity of knowledge through case study exercises on environment and development and it was seriously considered their documentation, collation and circulation for helping the practising engineers. A number of innovative and un-conventional solutions are tried in many developing and developed countries which should be speedily disseminated for speedier growth with better quality of human environment.

14. Practising civil engineers were demanded to provide due regard to cultural heritage, appropriate technology while conceiving developments.

CASE STUDIES

A number of case studies involving environmental concerns of civil engineering projects were presented by the participants. These are shown in the appendices. These case studies generated discussion on many environmental issues concerning civil engineering. Although a number of case studies on river valley projects as well as water supply projects were discussed, other case studies relating to human settlement, appropriate technology, energetics and waste disposal programmes were also presented. Some of the salient points that arose from the discussion are:

1. Investigations associated with the development in regions must take into account the environmental issues in any major development programme in consultation with related professionals, local interested groups and public opinion. Further reappraisal should be based on the context of socio-cultural, economic, and political issues. Although the solutions may be technological from the civil engineering viewpoint, they should have their broad based framework in terms of their relevance to the development process at large and environmental considerations.

2. It was generally felt that there was large scale development taking place in the region without a proper programme in river valley development projects or large land clearance for urban development without adequate incorporation of natural ecology and soil conservation. These should be integrated with adequate programmes relating to swamps and marshy lands in terms of agricultural ecosystems (especially when it concerns forest denudation and monoculture practices). In this regard the reclamation of tidal marshy regions in Indonesia using a multi-disciplinary approach and systems analysis, is particularly useful for other such projects in the region.

3. Though in some Asian regions, the development of a major water resource programme with an appraisal of its impact on the environment, is highly multi-disciplinary, time-consuming and involves coordination with a large group of professionals, its potential benefits are very much worthwhile. A rational land use policy is necessary to cover the effective implementation of legislation for the protection of the environment. An effective monitoring and enforcement programme is often very difficult to carry out, particularly in the areas remote from the central administrative units.

4. The conclusion from the case study of Sri Lanka regarding the aided self help housing programme is noteworthy. It was found that such programmes are most viable in semi-urban areas and for programmes dealing with environmental improvement of slums. It was also pointed out that housing programmes must be structured within constraints of the limited resources in the region.

5. Developing economies can profitably use labour intensive production methods with the help of adequate tools, without necessarily going for full scale mechanisation, although the latter may be relevant for largescale projects with short gestation periods. The importance of using appropriate technologies in the context of development processes was emphasised in the descriptions. The elements of appropriate technology are:

(a) use of locally available resources including manpower and materials to meet the local needs;

(b) promotion of social progress by enabling mass participation and wide sharing of attendant benefits among the mass of people.

6. The success of a major water resource programme depends to a great extent on the effective water quality management to balance the cost of control measures employed and the benefit accrued through a higher measure of quality.

7. A strategy of development through decentralisation of pollution prone industries with sufficient infrastructure to attract investment was felt. In addition the allocation of green areas in cities and industrial centres to combat pollution was especially found desirable. The means to decentralise industry could be done by cooperation which needs to be vested with funds and responsibility to ensure that development of infrastructure actually takes place. It was mentioned that industry will follow where final authority rests. The decentralisation is required not only in terms of planning but also in decision making.

8. There was an increasing concensus towards increased research and development especially in the field of bio-gas technology and other aspects of bio-technology such as organic manures, soil conditioners and fertilisers. These are found to be especially desirable with the difficulties of getting mechanical fertilisers and the constraints to fuel and energy. The techniques of waste disposal such as oxidation ponds, oxidation ditches, aerated lagoons are relevant in many of the countries where it is necessary to have a lesser capital investment and basence of sophisticated maintaining equipment. These need to be developed in the light of local conditions and constraints, to meet the full potential of bio-technology for industry and community waste disposal.

9. The case of Japan wherein there has been continual upgrading of yearly water pollution standards with effective feedback is emphasised. Also a feature making it compulsory for industries to have at least a 30% green area could be a trendsetter. Further, the establishment of a training institution for environmental protection in civil engineering works with a speedy programme for preparing instruction manuals and case studies in Japan should take care of growing disenchantment with the fast pace of construction in Japan.

10. The concentration level of pollutants prescribed in standards is also to be jacked up by insisting that the cumulative total values which are needed to be controlled.

11. The steps taken in Japan in terms of abatement of noise pollution by provision of buffer zones, barrier walls, trees and indirect measures for restricting traffic density and introduction of special bus lines in Tokyo as well as Singapore are worthy of emphasis.

12. While fixing environmental quality standards for a particular place the after effects of such standards, if they are unduly very high or very low could affect others in the whole region with the concommitant effects on cast and may cause public health hazards. It was felt that some of the standards are not realistic and may be arbitrary without considering benefits, risks and costs in a manner that would be optional for the society.

13. The role of energy conserving transportation mode such as canal transportation, mass transport etc as compared with the energy intensive modes of trucks, and of personal automobile transportation have been pointed out by some of the participants. These considerations need to be incorporated in designing a resource conserving hierarchy of transportation networks in terms of modes and spatial distribution, intensity.

14. The vicious cycle of poverty - low incomes generating low savings which produces low capital which may entail low use of technology which may cause low productivity which again causes low income; needs to be broken by various means. It was suggested that injection of appropriate new/unconventional technologies with high output/capital ratios and high employment generation capacity may be beneficial.

UNESCO/ROST/SEA/DR 2.6
Environmental Training
Civil Engineers

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL
TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

METHODOLOGIES FOR ENVIRONMENTAL ASSESSMENT OF MAJOR CIVIL ENGINEERING WORKS

The following points arose from the discussion of the background paper (See Appendix - CP 1)

1. The methodology of Environmental Impact Studies is an emerging and developing art and is not yet approaching any finality; may be it never will.

2. Present and past construction and analysis tools have assumed infinite availability of energy and resources. We must now adapt to the concept of finite limits to the assimilative and carrying capacity of the universe.

3. By making the environmental impact study part of the planning process rather than a post-event cosmetic, developing countries can avoid the dangers of the "mistake-planning process" of some countries and the guilt feelings associated with cosmetic environmental studies.

4. Government agencies tend to guard jealously their traditional authority and resent loss of this authority to reviewing agencies. They should be prepared to have their proposals subject to public review and scrutiny.

5. There is a pessimism and suspicion of "Environmental Impact Statements" in many quarters, which may be more related to incorrect application rather than methodology.

6. Some environmental legislation are poorly drafted and costly in time and money to test in courts, leaving undue discretionary authority in the executive. Account should be taken of intent of legislation, and machinery incorporated for review and updating.

7. In controversial situations the engineer should understand the motivations and points of view of opposing groups and have the ability to identify and enlarge the common ground.

8. There is a significant absence of basic data in many countries on which EIS can be based, and programmes of establishing base data conditions are recommended.

9. It is essential that an EIS fully state all assumptions, so that lines of reasoning and sensitivity to change assumption can be assessed at any time.

10. Assumptions of the value of rare, endangered or unique factors (whether infinite or zero) are difficult to agree on and should be stated. Reference was made to the value the world put on the uniqueness of the Abu Simbel temples in its wide response and assistance to its relocation.

11. Some impacts have a delayed effect which may only be experienced in the future, at which time society's own values may have changed. Again assumptions and expectations must be stated.

12. The decision making process and the use made of the EIS is affected by the "onus of proof" condition of the country, (e.g. British - innocent unless proved guilty; French - guilty unless proved innocent) India's Office of environmental planning feels that the "burden of proof" should be on the project sponsor on all issues and at all times.

13. There is a wide range of available EIS procedures and check lists published. These are continually updated and there is no excuse for claiming ignorance of major effects. Various countries, agencies and consultants have specific procedures for their particular requirements including in some cases dual matrices, time sensitive matrices and evaluation procedures.

14. There is merit in retrospective studies, which have generally only been done for large projects. There is much to learn from applying this technique to smaller and unusual projects.

15. Assumptions of linear effects simplify analysis but cause a loss of accuracy. Non-linear effects and discontinuities may add accuracy but may make the analysis almost impossible to handle. There is a need for trade-off (use of modern computational tools, if available) between increased accuracy, cost and value of the increased accuracy on the final product's performance.

16. Engineers should be aware of the power of such tools as cross-impact languages.

17. Decisions are made once only, but may have far reaching effects. At the moment of decision the decision-maker is subject to many social economic and political pressures as well as engineering and environmental issues. Engineers need to be familiar with social aspects of political decision-making, and be sensitive to the moods and pressures of the moment to select the right timing for presentation of proposals and analyses.

SYSTEMATIC APPROACHES AND COMPUTER MODELLING AND SIMULATION IN ENVIRONMENTAL PROBLEMS

1. Civil engineers are filling the ranks of engineer-planner-analysts, who must prepare proposals including social, political and economic aspects. All engineers, including those in "hard engineering" must be aware of and sensitive to these aspects. Training is being adapted to emphasise systems planning in undergraduate courses.

2. The engineer is looked upon to apply environmental and systematic considerations because of his ability to use the tools.

3. Systems Planning provides us with a range of tools that let us do tasks to a degree of thoroughness never before possible.

4. Modern computers let us examine the interaction of multiple variables and optimise against a wide range of conflicting objectives, and some hundreds of thousands of end options. Systems analysis can also reduce the risk inherent in traditional intuitive procedures.

5. With these techniques we must use discretion as to what tools we use for what problems and what calculations are worthwhile. In general, we are looking for the appropriate answers to the questions of search and choice.

6. Search involves optimizing and simulation to identify dominant alternatives and preferred regions of design study.

7. Choice involves a hierarchy of methods ranging from cost-benefit through social cost-benefit and decision analysis to negotiation in its most sophisticated sense.

8. The Systems Analysis discipline is still being developed and codified, in the cause of finding application to project analysis and decision making.

9. Some advanced technological procedures may be inapplicable to developing countries because of their inability to absorb results. The concept of "appropriate technology" should be borne in mind.

10. Developing countries may be more receptive and flexible in their thinking than countries with established technologies and career systems. There is no difficulty, for example, in generating very capable systems-oriented engineers for Latin America. The engineering teaching philosophies that have emerged in the 1960's have particular validity in this objective. Engineering thinking and problem solving may be intermeshed with empirical knowledge based on experience and application of modern tools.

11. Concern was expressed that teaching of systems may be inhibited in some countries that concentrate on teaching engineering technique for immediate application rather than engineering discipline for subsequent in-service technique training. A problem in some countries is to get the engineer to identify and think about problems and concepts, to be flexible to learn and apply new problem-solving techniques. A balance between problem definition (including experience) and tools of solving problems is necessary for educating engineers in the developing countries.

12. There was a need to simplify mathematical models without loss of accuracy. The best avenue for this appears to lie in improved simulation, but the technique is still evolving.

13. It was also pointed out that in developing countries; questions relating to appropriate planning and design standards; development of basic construction materials, equipment, and the industry; need attention as they are very much relevant to the context of the problem. The consideration of resources to satisfy the needs would also require analysis of information, skills, value systems and the generation of alternate concepts to satisfy the needs to satisfy pre-fixed optimization criteria. These considerations are necessary to be incorporated in procedures of Systems Analysis.

POINT OF VIEW OF DEVELOPING COUNTRIES ON NEW "TOOLS" FOR ENGINEERING (CP-5)

1. There was discussion initiated on "some of the sophisticated methods and tools of systems analysis that could be used in the context of environmental problems in developing countries" (CP-5) The view proposed was that most of the tools (in terms of models for environmental assessment) in developed countries can generally be used directly with minor modifications in developing countries. Particular mention of the following models was made

   1. Models for Physical Effects of Environment

      a) Water environment
      b) Air environment
      c) Land environment

   2. Models for Assessment of Ecological Effects

   3. Models for Assessment of Development Programmes on Human Uses.

   However, the feeling was expressed that in the area of human uses, the models for developed countries have very little relationship with those of developing countries. The models and methodology in this area have therefore to be tailor-made for the developing countries.

   It was also emphasized that if models are to be used, then it is necessary to have a "bank" of basic reliable data. Though an impact matrix of the environmental components versus the environmental changes can be developed, such an analysis will only give a subjective assessment. A more quantitative approach to environmental effects would require the use of models.

Some modelling works that were done in Malaysia such as in the generation of hydrologic data in areas where only spot data are available was given as an example. Mention above the use of the Sacramento Model in comparing observed and real time forecast values was also made. The observation that the use of these tools could generally save considerable time and cost in the assessment; was made.

General Comments made on the above paper is presented below

2. The availability of vast resources in the region - natural and human resources - had been mentioned. In many countries, these resources remained undeveloped because of limited financial resources and ineffective, inadequate management practices. The utilization of these new "tools" which were developed in advanced countries, whenever applicable (without or with some modifications) could accelerate or enhance the development of such resources in developing countries.

3. There are some systems models which were derived empirically. It was pointed that care be observed in the adaption of such models derived from elsewhere because they may not be applicable to local conditions unless they are understood in terms of basic parameters and suitably modified. One of the participants cited the failure of some of these models when applied in his country to 3 large river basins (which originate in another country) because of the prevailing unique conditions in the area. He suggested that experimental stations be established in such developing countries and develop models which are applicable in the region.

4. Some regions or countries have insufficient data for model development. Singapore, for example, have to use Malaysian data to develop a model in flood forecasting.

5. Some delegates emphasized the need for balancing software and hardware in development planning and design in many countries. Some mentioned the need to isolate various choices in software (design concepts and those of levels of hardware in deciding an appropriate combination, suitable for socio-economic goals of the region. The use of labor-intensive technology program (with use of tools to increase productivity) for a given time frame to help in also generating employment was also suggested for application, whenever the context and problem solution allowed it. On this point, there must be some trade-off between technological advantages and socio-economic goals. For example, mention of pipe manufacturing projects which need high precision in for production and laying. Under such circumstances, machine cannot be replaced by labor in terms of cost-effectiveness.

6. There seems to be a general consenses that the use of the computer as a tool not only saves considerable time but also allows detailed analysis of a problem which may not be possible if we use conventional tools. These advantages of computer use could be well appreciated in such projects as modelling of interactions of multiple variables and optimization techniques (linear programming, queuing theory, simulation models) and choosing optimum solutions among a number of alternate solutions generated using a computer. The delegate from Japan illustrated the application of computer technique in developing a strategy of transportation planning.

7. The University as well as the practising engineers have key roles in the use of the computer as a tool for development. While the University could provide information on the developments of such tools, new trends and demonstrate its general application, the practising engineers could determine the areas where such tools could best be applied wisely to help in engineering practice.

8. The planning, design, and implementation of development projects entail many kinds of decision making. Planning decisions are made by the community, by legislative bodies, and by administrative agencies. It is therefore important that engineers be able to translate their plans in such a manner that it can be understood, accepted and implemented by these levels of decision making.

"Implications for Engineering Education of Modern Tools"

1. The central theme of the talk was the implication of new, computer-based "tools" for engineering education. It was said that engineering education in general is in the midst of a fundamental evolution and therefore anything about environmental training is enhanced by such evolution. In this changing profession, there are new possibilities of analysis (for planning and decision making) and associated pressures for sensitivity to social, economic, and environmental factors.
If the engineer has the traditional type of training without new tools, incorporation of complex environmental concepts would be difficult. On the other hand new tools would enhance the opportunities of dealing with large number of alternatives and possible effects.

2. In the environmental training of engineers, the following choices were emphasized:

    1. less detail, more scope
    2. suitable methods
    3. suitable topics.

    Development of a curriculum in environmental engineering is dependent on these choices - the types of problem, its context and the appropriate tools. To equip the students with the necessary basic tools, the traditional engineering curricula has to be modified to incorporate such topics as matrix algebra, statistics, engineering economics, optimization techniques and system analysis. The case-study approach as part of the student's learning process was emphasized. The student learns from experience and a concept at an integrated framework is required.

    It was emphasized that the development of a curriculum should recognise that the engineering planner would probably find employment in or for the public sector, working for a governmental agency or as a consultant. This fact should guide the selection of subjects and the emphasis to be placed on them.

3. The following points emerged from the discussion by the participants:

    (a) It was suggested that project planning must be comprehensive because each activity profoundly affects the ability of society to accomplish many diverse activities. A comprehensive plan must analyze all possible interactions as they currently exist, while at the same time having sufficient flexibility to adjust for changing conditions in a dynamic interaction process. The engineer has a definite role to play in the planning process.

(b) Reference was made to some of the recommendations adopted during the meeting of experts on environmental aspects of engineering education and training that was held in Paris in June, 1974. Among other things the following recommendations were found relevant:

(1) That members of the engineering profession have a clear responsibility to their countries and to the world at large in the safeguarding and improvement of the quality of the human environment. This responsibility stems from the role of the engineer as the creator of new technology and as one of the decision-makers on the conditions under which this technology is used for the ultimate progress or destruction of human society.

(2) That as a possible means of strengthening social science components of engineering education, experimentation be encouraged in the use of case studies on past and present impact of technology on human beings and their environment.

(c) There seems to be a consensus that engineers may have active participation in decision-making to link policy and operative levels. However, existing political set-up in some regions are not conducive to such participation. In other countries, engineers are involved in the planning as well as decision-making processes (policy making and management).

(d) The area of environmental engineering may be divided into the following:

(1) Sanitary engineering

(2) Industrial hygiene engineering

(3) Air pollution control

(4) Radiation and hazard control

(5) Solid waste management

(6) Environmental Impact assessment

(7) Environmental design and assessment.

Considering the type of training practising civil engineers have had in the past, there is need to pinpoint which of the above-mentioned areas should be given emphasis on the environmental training of civil engineers in different functional areas (hydro-electric projects, water supply projects, housing, transportation, etc.).

(e) UNESCO Secretariat informed the body that it is the consensus of member states of UNESCO that the engineering education must have the environmental component.

CURRICULUM DEVELOPMENT

1. The content of curriculum would need the following interacting aspects

   a) clear understanding of the problem areas of professional work

   b) consciousness of the context and the environment appropriate to the type of problem area

   c) tools for problem solving and incorporating environmental considerations in analysis and synthesis.

   It is important not only to understand the elements of environmental planning but also to know about the tools, such as those of systems analysis, needed to organize and evaluate information about environmental impacts.

2. It was felt that the real role of a curriculum at a university was to educate people for continuous education. The observation implies that the precise content of a course of study is not critical. Rather, educators should be most concerned with developing the students' understanding of basic principals, introducing to important subject areas, and stimulating to life-long education.

3. The process and problems of incorporating environmental concerns, in the civil engineering curriculum could vary from country to country. Different situations in different countries call for different solutions on curriculum development and educational methods.

4. Possible ways of influencing engineer in practice are

   a) In-service short course
   b) Out of service, or pre-service long courses
   c) Seminars, conferences of professional societies.

   These could be designed for particular situation to make the civil engineering profession responsive to the environment.

5. Short courses have several advantages. They can be tailored in content, and may be easy to give. They are mainly meant to stimulate rather than to have in depth content. They may thus be appreciation, or "cosmetic" courses whose net result is to expose the practising engineer to broad aspects of an area as well as to have contacts with knowledgeable persons and information resources. The short courses in universities may be helpful

to practising engineers to make them familiar with new tools, techniques, and insights into environmental problems. For example, they may provide information on how to fill environmental statements on prescribed formats to help engineers in fulfilling the requirements of new environmental legislations. However if it is desired to provide depth of understanding and imparting of skills, "in depth" long term courses are required. These, however, would pose a number of problems both in terms of practising engineers and educators and institutes which give these type of courses. Long courses for practising engineers may be difficult to introduce into the university. However, they are the only way to provide depth. It must be done if the idea is really to influence practice.

6. The effective use of teaching resources may involve the following

a) team teaching using several professionals from academic, government, and practice, wherever possible/or from several specialities in a department or faculty.

b) Multi-disciplinary approach by recommending the civil engineering students to take courses and subjects taught in other departments.

c) Elective courses, which develop competition among faculty and promote better teaching, help to enthuse students in an effective manner.

7. One of the features of training practising engineers is the problem of reeducation to make them aware of present or new problems, contexts, tools. There are a number of ways of incorporating environmental concerns in the training of civil engineers depending upon the functional areas and level of responsibility of engineers in the group to be trained. The areas of knowledge, skills and tools, level of depth and mode of transfer of knowledge would depend on the above and the educational resources available (including instruction manuals, documented case-studies, etc.) Thus there is great diversity and many choices which could be used for particular situation.

8. It was recommended that it would be helpful to bring practising engineers together periodically to familiarize them with the latest developments in related fields.

9. Environmental education in developing countries for civil engineering could have a suitable mix of background in the following areas

Development Policy
Ecology and other Environmental Principles
Systems Analysis
Law and Legal Instruments
Policy (Resources, Population and Environment)

In addition to the usual courses in Engineering Sciences, Humanities and Social Sciences, Economics and Management etc that may be usually taught in Civil Engineering. The level of depth may vary from place to place depending on their resource and the needs of the trainees.

Decision-Making in Education Planning

10. The complex nature of decision-making as well as implementation in education planning was discussed. The process of arriving at decisions about the introduction of environmental concerns in civil engineering curricula requires by Research, Information, Advice and Consultation, Planning, consideration of Alternatives, Selection of Priorities and Decision. While implementing tho decision, the legal framework, legal instruments, execution, administration, control, monitoring, evaluation must be incorporated. As these have to be target specific there must be capacity and willingness to supply missing links.

11. The need to incorporate environmental training in civil engineering curriculum was endorsed by all. But the manner, and type of programmes would have to be made by individual institutions and country in terms of the context of their own situations. There may be difficulties and huddles in incorporating environmental concerns in all activities in civil engineering works through formal education programmes. The rigidity of existing university framework acts as a constraint but can neverthelessly be handled. However there is a need to develop suitable "knowledge bank" to educate the educators in terms of theory and engineering practice.

12. Although there are a number of ways of incorporating environmental concerns in civil engineering one cannot be precise and not be in a position to recommend a particular solution for everyone, as the situations vary from country to country and institution to institution. A number of valuable suggestions were made regarding conflicting requirements of breadth and depth; short term engineering practice requirements and long term educational objectives.

13. At the undergraduate level the students must be made to appreciate the environmental aspects of engineering problems.

UNESCO/ROST/SEA/Mis5
Environmental Training
Civil Engineers

ANNEXES

A - Programme

B - List of Participants

C - Addresses at opening and closing sessions

D - List of Country Reports

E - List of Consultants Papers

F - List of Case Studies

G - List of Workshop Papers

H - List of Information and Miscellaneous Sheets presented at the Workshop.

APPENDIX A

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur.

Workshop Programme

1. Opening of the Workshop
2. Election of the Chairman, Vice-Chairman and General Rapporteur
3. Introductory Remarks
4. Methods and schedule of work
5. The Agenda for the Workshop are as follow;-
   - (i) Country Reports
   - (ii) Environmental Aspects of Engineering Works
   - (iii) Educator of Civil Engineering Training of Future Engineers
   - (iv) Practice of Civil Engineering in its Environmental Aspects
   - (v) Case Studies
   - (vi) Methodologies for Environmental Assessment of Major Civil Engineering Work
   - (vii) Systematic Approaches and Computer Modelling and Simulation in Environmental Problems
   - (viii) Implication of Engineering Education of Modern Tools
   - (ix) Curriculum Development
   - (x) Conclusions and Recommendations
   - (xi) Adoption of the Final Report
6. Closing of the Workshop

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

List of Participants, Consultants and Observers

I. PARTICIPANTS

AFGHANISTAN

1. Prof. Ata Mohammad Nazar,
Faculty of Engineering,
Kabul University.

2. Prof. Abdul Samad Saleem,
Geologist,
Secretary, Association for Engineering Education in South & Central Asia (AEESCA),
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Kabul University.

AUSTRALIA

3. Mr. A.B. Sinclair,
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BANGLADESH

4. Dr. M.A. Aziz,
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Bangladesh University of Engineering & Technology,
Dacca.

BURMA

5. Mr. U Tha Nyunt,
Director of Engineers,
Construction Corporation,
Rangoon.

HONG KONG (Colony of United Kingdom)

6. Mr. G.B. O'Rorke,
New Town Project Manager,
New Territories Development Department,
Public Works Department, Hong Kong.

INDIA

7. Dr. J.K. Sridhar Rao,
Coordinator, Built Environment and Waste Utilization,
National Committee on Science and Technology,
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INDONESIA

8. Dr. Sugandar Sumawiganda,
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Civil Engineering Department,
Institute of Technology, Bandung.

9. Ir. Adil Abas,
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Lecturer on Civil Engineering Subject,
Indonesian Petroleum Institute, Cepu,
Academy of Oil & Natural Gas,
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10. Mr. Bijan-Namvar,
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JAPAN

11. Mr. Hidio Natamura,
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12. Ir. Ainuddin bin Abdul Wahid,
Vice-Chancellor, University of Technology.

13. Ir. Chan Weng Onn,
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14. Ir. Fong Thin Yiew,
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15. Ir. Talha bin Hj. Mohd. Hashim,
Deputy State Director, Public Works Department,
Kedah.

16. Ir. Dr. Tam Chat Tim,
Acting Head, Department of Civil Engineering,
University of Malaya.

NEPAL

17. Mr. Lekh Raj Upadhyaya,
Senior Engineer,
Department of Housing, Building and Physical Planning,
Kathmandu.

NEW ZEALAND

18. Mr. Robert George Norman,
Assistant Commissioner of Works,
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SRI LANKA

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II. CONSULTANTS

1. Ir. Chiam Teong Tee,(Workshop Director),
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4. Ir. A. Sekarajasekaran,
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5. Prof. Richard de Neufville,
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6. Ir. Dr. D.J. Gunaratnam, (Guest Speaker),
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Malaysia.

III. UNESCO SECRETARIAT

1. Dr. James F. McDivitt,
Director, Unesco Regional Office for Science and Technology for South East Asia,
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2. Dr. Frans J.C. Pala,
Deputy Director,
UNESCO Regional Office for Science and Technology for S.E.Asia,
Jakarta, Indonesia.

3. Ing. Carlos Nones-Sucre,
Programme Specialist,
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IV. OBSERVERS

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2. World Health Organization

Mr. Robert E. Stafford,
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3. Government Organizations and Institutions, Malaysia.

Drainage and Irrigation Department

Ir. Fadzil bin Hassan,
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Ir. Abdul Aziz bin Din,
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Ir. K. Pathmanathan,
Lecturer.

Mr. Ahmad Bakri bin Abdul Ghaffar,
Lecturer.

Mr. A.D. Thavarajah,
Lecturer.

4. Institution of Engineers, Malaysia

Tan Sri Hj. Yusoff Ibrahim

Ir. Chan Yew Cheong

Ir. P. Ganendra

Ir. Khoo Choong Keow

Ir. Kumarasivam K.

Ir. Patrick Gan Teik Hock

Ir. Tuan Syed Muhammad Shahabudin

Ir. Wong Kok Heng

Ir. Wong Kong Young

Ir. Yuen Kai Meng

Appendix C.1

UNESCO/ROST/SEA/DR 4.3.1
Environmental Training
Civil Engineers

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL
TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

Speech by Y.B. Dr. Mahathir bin Mohamad,
Minister of Education, at the Opening of the Asian
Regional Workshop on Environmental Training of Practising
Civil Engineers at Dewan Tan Sri Abdul Rahman Hashim,
Hotel Jayapuri on 12.5.75 at 10.30 a.m.

Mr. Chairman, Your Excellencies, Distinguished Delegates,
Ladies and Gentlemen,

It is indeed a pleasure for me to be here today to declare open the Asian Regional Workshop on Environmental Training of Practising Civil Engineers sponsored by Unesco in co-operation with the United Nations Environment Programme.

I would like first to extend my warmest welcome to the distinguished delegates to this regional workshop. To those delegates from overseas, I wish you all a very pleasant stay in Kuala Lumpur.

We are happy to host this workshop as the theme chosen is very appropriate for us at this juncture when we are preparing the 3rd Malaysian Development plan and are giving considerably increased emphasis to the environmental issues. Malaysia is probably the first developing country in the world to invite a World Bank Mission to assess the state of knowledge of the Environment and to guide us in formulating a policy for the 3rd Malaysian Plan to conserve an exploit our natural resources rationally.

The Government of Malaysia has taken this step because we are conscious that the rapid development that is taking place in all sectors of economic development requires a balance that can only come from judicious environmental considerations. The major development programmes that have been implemented or are taking place have incorporated in them inter-disciplinary studies to evaluate the effects of rapid development on the environment.

The Government has also collaborated with the Royal Society of Great Britain and the Japan Society for the Promotion of Science in conducting research in Tropical Forest ecosystems at the Pasoh Forest Reserve and Tasek Bera (Fresh Water Lake) under the International Biosphere Programme. Similar research programmes have been conducted in the medical fields.

In addition to this the government has established in 1973 a Division of Environment Service to co-ordinate all work in relation to activities which would have an impact on the environment. In order to strengthen these activities an enabling piece of legislation "The Environmental Quality Act", was passed by Parliament in 1974, and the provisions of this Act has been brought into effect as from 15th April this year.

This workshop is an encouraging manifestation of the increasing interest and initiative of professional groups who are bringing to light invaluable information on the overall effects of rapid industrialisation and development.

In the development of engineering skills you have been extremely single minded and purposeful in helping to fulfil the physical objectives of national development. I must say, judging from the high quality of work accomplished by our engineers in Malaysia you have done well. But it is only recently that we have become aware of the damage to the environment caused by the very technology that was intended to improve it. In the past when the engineer was requested to provide a facility for eliminating the solid wastes generated by industry in the community he did a marvellous job by inventing the incinerator. When he was faced by dust, and smoke ash problems due to inefficient burning of the solid wastes he devised various means and systems for reducing, if not eliminating these pollutants. But it took a public outcry against pollution before these by-products of engineering inefficiency were attended to. The engineers of today should no longer wait for requests to solve the problems of environment due to development but to anticipate them and where possible incorporate corrective measures in his overall plans. When such direct initiative is not possible he should become involved in the social, economic, and even political process of educating and controlling the environment. The engineering projects undertaken or which are being developed should be planned to serve both social and environmental needs and not merely those of economic considerations. Economic development must be a part of integrated balanced systems with full assessment of their overall impact on the environment. You should try to correct the mistakes that have been made in the past and prevent their repetition in the projects that are being planned for the future. It is only in so doing that they will contribute towards the national development objectives without the mistakes and problems that in the past have been regarded as inevitable.

The achievements of modern technology is undeniable. We will not be where we are today without the systematic and scientific approach to human developmental needs through modern technology. However the rapid advancement of technology and the rapidity of development through technology have brought numerous environmental problems in their wake. These problems can no longer be ignored as they were in the past. But whereas there is general agreement on the need to conserve nature and prevent pollution, there is often conflict between the various interests involved. Engineers will therefore find that on the one hand they are exhorted to do everything possible to prevent pollution, on the other they will meet resistance to their ideas and suggestions. They should not be disheartened by this. Society will always resist change even if the change is to their own good.

The organisation of seminars and workshops on environment which contribute towards the knowledge of professions in this field also serve to highlight this problem. The attention of the public and the decision-makers are thus drawn to the dangers they face and must eventually accept the views of the professionals. Your education is therefore also their education.

Here I reach the two main objects of your workshop: engineering and education.

Firstly we are beginning to realise that the next scientific revolution will aim more at wisdom and ingenuity than at "hardware". Engineers will become more and more concerned, that, in a perspective of resources recycling (almost of zero-net-wastes) they have to bear in mind the social and ecological implications of their activities. Secondly educators will be faced with the necessity of helping to provide the people with knowledge and ability to help them cope with change, and fashion for themselves meaningful lives and opportunities.

To achieve these objectives it will be necessary for the technologist to expand his general background knowledge to allow for full understanding of the implications of his proposals while at the same time becoming more competant in his specialized field - This is the challenge that you face.

If we do not plan and act for a future in both short and long range time frames we cannot expect to achieve desirable conditions. The old saying that "as ye sow, so shall ye reap" is still valid and singularily appropriate to environmental planning.

This is then the task before you. I will not point here dark backdrops of inequity and of disparity and of instability. You who come here in answer to the call of UNESCO know full well the job to be done and I wish you all a profitable discussion.

With these remarks, ladies and gentlemen, I have pleasure in declaring this workshop open.

Annex C.2

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING FOR PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

Address by Dr. FRANS J.C. PALA, Deputy Director, Unesco Regional Office for Science & Technology for Southeast Asia.

Your Honourable Minister Dr. Mahathir bin Mohamed, Your Excellencies, Distinguished Participants, Ladies and Gentlemen

It is an honour and pleasure for me to greet and welcome you all, on behalf of the Director-General of Unesco, at the Opening of the Asian Regional Workshop on Environmental Training of Practising Civil Engineers. This activity has been organized by Unesco in co-operation with the United Nations Environment Programme and the Government of Malaysia.

Honourable Minister Dr. Mahathir, we feel honoured that you have made your precious time available to attend this opening session and to deliver the opening address. We see this as an expression of the importance your Government and you personally attach to the subject of this meeting. I would like to use this opportunity to convey to you the sincere gratitude of Unesco to your Government for the generosity to act as host for this activity. Our particular thanks go to our host, Prof. Ungku Aziz, Vice Chancellor of the University of Malaya, who generously agreed to hold the workshop at the Faculty of Engineering of his University.

Your Excellency, I would also liketo express our gratitude to the staff of your Ministry, especially the members of the Malaysian National Commission for Unesco and the members of the Local Organizing Committee for the excellent arrangements they have made for this workshop. I would like to mention here especially Mr. A.T. Nathan with whom we conducted in such a cordial and efficient way our initial and further arrangements for organization of this activity.

We are very thankful also to Mr. Chiam Teong Tee, Dean of the Faculty of Engineering of the University of Malaya, who agreed to act as technical director for the workshop and I would like to thank here also the specialists who agreed to serve as consultant for this activity.

It is a particular pleasure for me to welcome here all our participants and observers. We are glad that most of our invitees have arrived in time. Distinguished participants, we are very pleased that you have accepted our invitation to attend this workshop and through you I would like to thank your Governments, your Unesco National Commissions and your Institutions and Organizations which have supported your participation.

Honourable Minister, Ladies and Gentlemen, the objective of our workshop is to give a selected group of practising civil engineers and engineering educators from the Asian region the opportunity to be informed about new concepts, methods and teaching in their profession and to discuss and advise and exchange views on ways

and means of solving environmental problems in the region, including issues of environmental education and training of civil engineers.

I would like to take this opportunity to say a few words about Unesco's role in dealing with environmental problems.
Unesco has a long history of concern with the environment, dating back to the early years of its existence. As a result our organization has a special responsibility for general questions relating to the environment while other agencies of the United Nations System are better equiped to deal with some of the specific issues. Unesco has a broad range of specific competence which covers such diverse fields as psychology, sociology, biology, anthropology and education, all of which are of crucial importance in dealing with the environmental problems.

Since many years Unesco has been engaged in numerous activities promoting the rational exploitation and conservation of natural resources. Examples of large scale programmes in this field, developed, implemented or supported by Unesco are: the former Arid Zone Research Programme, the International Biological Programme, the International Hydrological Decade (which is now continued under the name International Hydrological Programme) and the activities of the Intergovernmental Oceanographic Commission. These programmes and other activities in the field of natural resources were developed and implemented in a somewhat [illegible] way until the study of the environment and its mutual interaction with humanity became the great integrator.

In the early sixties the world as a whole was not yet worried so much on environmental problems. Making use of resources was at that time still considered more important than preserving them. But, as we all know, the environment did not wait, the world suddenly found itself trying to cope with a number of problems generated by the increasing pressure on the biosphere caused by man-made environmental hazards such as air and water pollution or harmful substances in food chains. Related to these issues are the questions of population growth and population distribution, since both are major factors that influence man's relationship with his environment. In some countries population growth is perhaps the most pressing environmental problem.

Environmental problems are not confined to the industrially advanced countries alone. Continuing industrialization and urbanization in the developing countries are creating such problems in these countries as well. In some ways, the urban situation in the developing world is, according to some environmentalists, already relatively worse than it is in highly industrialized countries; it is, however, perhaps more amenable to positive change. There is a chance here for developing countries to design environments for their peoples which are significantly more pleasant than those in the industrialized world. To do so will require a more considered knowledge of what men regard as satisfying environments - at the level of the individual room or house, at the level of the small town and city, and also at the level of which new urban centres fit in with the surrounding region.

To tackle the problem of the environment in time requires vigorous action all over the world. The United Nations Conference on the Environment which took place in Stockholm in June 1972 gave a boost to the launching of several programmes. It also led to the establishment of the United Nations Environment Programme (UNEP) which has its headquarters in Nairobi. The aims of UNEP include: supporting and encouraging the training of experts in various environmental fields, including the environmental aspects of development planning.

Already in 1965, Unesco's Advisory Committee on Natural Resources Research suggested that something be done about the rational use and conservation of the biosphere. Outside scientific circles the advise was at that time still hardly noticed. The following year (1966), amids more or less general indifference, Unesco's General Conference approved to hold an intergovernmental conference on the problem. By that time the first rays of the environmental crisis were becoming visible at the horizon. The Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere was held at Unesco headquarters in Paris in September 1968. This Biosphere Conference, as it was called, drew an impressive response. In its recommendations, the conference launched the idea of an international research programme on the problems of man and the biosphere, which would in particular provide a follow-up and an expansion of the International Biological Programme that Unesco had been assisting for several years.

The result was the establishment of the Man and the Biosphere Programme. This, as you know, is an intergovernmental and interdisciplinary programme of research, emphasizing an ecological approach to study of the interrelationships between man and the environment and the problems relating to rational use, conservation and regeneration of the resources of the biosphere. It is an intersectoral programme designed to stress the human aspects of the environmental problem. It, therefore, specifically concerns the relationship of man to his natural, social and cultural environment.

In the activities foreseen at the international level in this programme, close cooperation is being maintained with the United Nations Environment Programme (UNEP), FAO, WHO, WMO and ILO, as well as with competent international non-governmental organizations such as the International Council of Scientific Unions (ICSU) which has a Scientific Committee on Problems of the Environment (SCOPE) and the International Union for the Conservation of Nature and Natural Resources (IUCN). Within Unesco's Programme coordination is also ensured with the sectors of Education, Social Sciences, Humanities and Culture, and of Communication, as well as with other international scientific programmes such as the International Hydrological Programme and that of the Intergovernmental Oceanographic Commission.

As far as the educational sector is concerned, a long-range programme on environmental education has been set into motion by Unesco. Following a preparatory stage, it will try to include environmental education in overall educational planning and design, and to devise new teaching materials for this purpose.

At a higher level, efforts are also being made to promote the introducing of the environmental factor into the education of engineers.

Unesco, with the financial co-operation of the United Nations Development Programme (UNDP), has been involved for almost two decades in providing assistance to its Member States for the strengthening of their engineering education systems and particularly for the establishment of new institutions or the upgrading of existing ones.

As a follow-up of the International Conference on Trends in the Teaching and Training of Engineers, held at Unesco Headquarters in Paris in December 1968, Unesco launched in 1971 a long-term programme to promote greater international and regional cooperation in efforts to improve the education of engineers and technologists on a world-wide scale. The objectives of the long-term programme are the stimulation of reform in this sector of education so that it will contribute more effectively to national economic and social development. This involves consideration of curricula, social science aspects, environmental aspects, structure, staffing, methodology, relations with industry, and provision of suitable facilities.

Preparations are now being made by Unesco for convening in 1976 a second international conference on the education and training of engineering personnel. This conference will be held in Asia. It will review the progress of the just mentioned long-term programme and examine the overall status of international and regional cooperation in this field.

Within the framework of the long-term programme for the promotion of reform and development of engineering education, Unesco convened in June 1974 with financial support from UNEP, a first meeting of experts on environmental aspects of engineering education and training. As a follow-up of this meeting an international inter-disciplinary working group on the environmental aspects of engineering education was established and this group will hold its first meeting at Unesco headquarters in September of this year to examine the recommendations of the 1974 experts meeting on this subject and to prepare the follow-up action required.

Unesco cooperates currently with UNEP in the implementation of several projects on the environmental training of engineers. An experimental project in this field, for instance, is being established at the College of Engineering of the University of the Philippines, Quezon City. Another example is our present workshop here in Kuala Lumpur.

As far as civil engineers are concerned, they have traditionally played a key role in the early stages of development of any country. They have designed and built harbours, roads, railways, water supply and sewerage schemes, irrigation projects, hydro-electric plants, flood control projects, and they have often laid out new

towns and cities. The infrastructure thus created has been the basis for further development, and in some instance history has subsequently shown that the environmental consequences of these works were not fully appreciated at the time of their construction.

Furthermore, because of the initial need for civil engineers, in many countries the universities have initially only trained civil engineers, with other fields such as mechanical and electrical engineering being introduced at a later date. Thus, in many instance, civil engineers have risen high in the national civil service, sometimes moving into non-engineering areas, and they are in positions where they are able to greatly influence national development. It is for this reason that this workshop on environmental training of engineers - which is the first of its kind - has been especially designed for civil engineers and educators of civil engineers.

Establishment and strengthening of mechanisms for international, regional and national cooperation is an important aspect of Unesco's long-term programme for the promotion of education and training of engineers, technologists and higher technicians.

A mechanism for international collaboration has been created at an international and regional level, through the strengthening and creation of associations grouping together those concerned with engineering education and training. Through these Associations work is being done in priority areas such as curricula reform, education-industry co-operation, continuing education, and provision of information for educators in developing countries. Regional journals and newsletters are being published, so through these Associations a mechanism exists for the dissemination of the results of activities and the establishment of links between institutions.

As you will know, in Asia the Association for Engineering Education for Southeast Asia was established in Manila in October 1973 and the Association for Engineering Education for South and Central Asia was established in Kabul in March 1974. It is gratifying for us to see that both these Associations are represented in this workshop and that arrangements have been made that the report and papers of our workshop will be published in their Journals. This will assure that the results of the workshop will be widely disseminated in Asia and other regions.

Honourable Minister, Ladies and Gentlemen, it is hoped that this workshop will help to awaken the conciousness of the need to include environmental issues in engineering education and training and that it will lead to follow-up actions and continuing contributions of all participants who are present here, for preserving and improving the quality of the environment in all sectors and at all levels.

I would like to conclude with wishing the technical director, consultants, participants, observers, and local organizers every success with this workshop. We hope that this activity will respond to your and our expectations.

4.3.3

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

UNESCO/ROST/SEA/DR ~~1.1~~

MAY 12 - 23, 1975, Kuala Lumpur

Introduction of aims and scope of the meeting
by
Ing. Carlos Nones-Sucre

May I, once more, on behalf of Unesco, thank all of you for being at this Workshop as well as your governments and organisations for having made your time available to accept the invitation of the Director-General of Unesco.

To the expression of the Organization's gratitude towards the Government and people of Malaysia formulated by my colleague, Mr. Frans Pala, at the opening ceremony, I wish to add also my personal thanks to Prof. Chiam, Dean of the Faculty of Engineering of this University, and to our team of consultants, for their zeal and enthusiasm in their association with Unesco to organise and carry out this meeting.

As you may know, the overall programme of Unesco covers, in a closely inter-related fashion, the main areas of

- education;
- science and technology and their application to development;
- social sciences, the humanities and culture
- and the field of communication (including, notably, mass media, libraries and documentation).

We shall see that this is useful and important in dealing with the subject of our meeting.

The present Workshop is included in Unesco's Programme and Budget for 1975-1976, approved by the General Conference at its 18th session in late 1974. It is part of the Organization's efforts, initiated more than two decades ago, to contribute to World reform of engineering education in response to the needs of contemporary societies. The workshop is being held under a joint plan of Unesco and the United Nations Environmental Programme (UNEP), aimed at the development of environmental education and training of engineers and other higher technologists, architects and town and physical planners.

In the workshop we shall be concerned primarily with the environmental education and training of civil engineers, both at present and in the decades to come.

We have been able to bring here together a balanced group of distinguished civil engineering "practitioners" as well as educators [redacted] Our objective is to promote an intensive exchange of ideas, experiences and opinions on the ways and means of providing the practising civil engineers of today as well as those of tomorrow, this is to say, civil engineering students, with such environmental education and training that be most appropriate and relevant, not only to their countries' natural geographical configuration, but to its evolving technological, economic, political and social conditions.

The problem, as our still limited experience reveals, is complex, difficult and at the same time challenging, fascinating. Its attack and solution requires contributions and insights as much from the so-called "hard" sciences and technology as from the "soft" components of engineering, this is to say, the applied social sciences and the humanities.

You have before you the programme and schedule that you just approved for the workshop and which provides details on the distribution of time. Schedules may be of course altered if the development of the workshop so requires.

We shall begin by an effort to identify the most salient environmental characteristics and problems of Asia in relation to civil engineering. A comparative review will also be made of significant legislative responses given by countries in the region to needs for environmental quality preservation.

Then we shall attempt to analyze the characteristics of civil engineering practice as well as education in the Asian region and discuss the needs for educating - environmentally speaking - the engineers of tomorrow as well as their teachers.

Following introductory presentations by our consultants, we also hope to stimulate a substantive discussion of two closely related areas of first importance to civil engineering practice:

- evaluation of the environmental impact of major works, and
- the role of overall analysis and computer simulation in the design of environmentally sound civil engineering systems.

Finally, we shall all join our efforts in order to organise our findings and conclusions and present them in the form of a report.

Appendix C.4

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

OPENING ADDRESS OF ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS BY ORGANISING CHAIRMAN

Your Honourable Minister of Education, Dr. Mahathir b. Mohamad,
Your Excellencies,
Distinguished guests and Participants,
Ladies and Gentlemen,

On behalf of the Organising Committee it is my honour and privilege to welcome all of you to the Asian Regional Workshop on Environmental Training of Practising Civil Engineers.

We consider it indeed a great honour to have with us this morning our Honourable Minister of Education who has found time off from his very tight schedule to be present at this opening ceremony.

The Asian Regional Workshop on Environmental Training of Practising Civil Engineers is organised under the auspices of Unesco with the assistance of U.N. Environmental Programme. It is hosted by Malaysia; and the University of Malaya is extremely happy to participate in the organisation of this Workshop. In 1970, a Unesco Seminar on New Approaches to Engineering Education was also held at the Faculty of Engineering, which speared the way for the formation of the Association for Engineering Education for Southeast Asia; and I am indeed happy to represent also the Association at this Workshop.

Speaking as an engineer and also as a representative and member of the Association for Engineering Education I would like to congratulate Unesco, particularly the Unesco Regional Office of Science and Technology for Southeast Asia for bringing to fruition this First Regional Workshop on Environmental Training.

The world is getting smaller and smaller and no longer can it continue to tolerate the damage caused to its environment, one of the objectives of this Workshop is in bringing awareness of the needs of the environment to the civil engineers. This Workshop, I am sure will leave a tremendous impact on engineering education as a whole.

I will be failing in my duties if I do not mention the very strong support given to me by my colleagues in the Organising Committee and I would like to take this opportunity to say how grateful I am for their dedication.

To our distinguished participants from overseas, we bid you a very special welcome. We wish you a very pleasant stay in our country and hope that you will carry back with you happy memories of your visit to Malaysia.

Speech by Mr.N.Jagatheesan, Secretary General,
Ministry of Local Government and Environment
at the Closing Session of Asian Regional Meeting
on Environmental Training of Practising Civil
Engineers on 23rd May,1975 at 1.00 a.m.

I feel greatly honoured to have been invited to the closing session of the Regional Meeting on Environmental Training of Practising Civil Engineers and to be amongst such a distinguished gathering of senior civil engineers from the region. I am not merely a disinterested bystander in the field of environment, as I pay not only great personal importance to the subject but I also have statutory responsibilities in this area.

2. Coming from developing countries as we all do, there was a stage in our development when owing to urgent need to bridge the gap in economic progress between the developing and developed worlds, environmental considerations were often neglected. In fact there was a time when very little was known of the effects of rapid development on the environment. However, looking broadly at the region as a whole, the state of the environment is in fairly good shape and environmental damage, if any, has been minimal. That the environment in this region is still relatively free of the pollution that has bedevilled the more advanced countries is a tribute to practising civil engineers and other professionals engaged in development planning. The one main area of concern however has been and still is the state of the human environment in squatter area and slums caused by the influx of rural inhabitants into the major urban centres.

3. I am glad, that as responsible professionals and citizens, you have taken time off from your onerous duties to attend this workshop in order to equip yourself with knowledge on the effects of development on the environment so that we and future generations can live in complete harmony with Nature and with each other.

4. We, in Malaysia, have been exploiting our natural resources in the past with little regard to the environment but have now realised that we cannot do this any further without imperiling our natural resource base and the stability of our communities. When development was taking place at a pace at which Nature could accommodate and absorb without much detriment to its carrying capacity, as well as its capacity to absorb our wastes and by-products, we did not pay much heed nor attention to the environment. Now with the unprecedented pace of development which we have been experiencing in our country, we have found that the cost of unbridled development might be too high a price to pay unless we heed the warning that Nature cannot be held to a bad bargain indefinitely. We therefore have to encompass in our decision making process the need to balance economic and social progress with our environmental well-being. We are all well aware that environmental problems are not simply a question of conversation or of pollution control; our concerns must be rooted in a fundamental understanding that our resources must be maintained on a sustained yeild basis. If we use our resource base beyond the annual interest it will sustain, we will be dipping into capital and therefore imperilling our capacity to guarantee the generations who follow, their right to our inheritance on this one and only Earth. Many of our communities are still in the early stages of so-called development,

placing heavy reliance on their cultural heritage and on their social cohesion. Development without concomitant education is not really development; development with an overly strong reliance on the highest technology available, on technology beyond our capacity to pay for it and beyond the capacity of our communities to cope with the changes it imposes, is also not development, in the sense that it is imbalanced and not in harmony with the welfare of our people.

5. It is with these urgent considerations in mind, that our Government brought about the Environmental Quality Act of 1974, the implementation of which has become my Ministry's responsibility. I have therefore followed your deliberations very closely as it has a direct bearing on the supply of qualified manpower in sufficient numbers to form our national cadre of trained personnel while placing a heavy reliance on environmentally trained civil engineers who, as their vocations will require them to do, will be at the forefront of the major public works which this country needs to structure its development programme. I am sure that my Ministry's Environmental Division will also rely heavily on the contribution that civil engineers will make to the development of design (industrial) and construction standards so as to constantly upgrade engineering response to environmental problems with an economy of materials which will help release resources for foreign trade. By this I mean, to the extent possible, the use of local building materials and of local skills, with the use of a technology which we can handle well. Design should be related to our needs and should reflect the cultural traditions and diversity of the Malaysian scene. We will no doubt see greater interplay yet of civil engineers with architects, urban planners, behavioural scientists, recreation planners, botanists

and many other professions with whom you are in frequent contact; some of you will join the ranks of government and industry and be called upon to play decisive roles in shaping and developing the countries of our region and its peoples. Your training and experience will be basis upon which, hopefully, sound decisions will be made, and that such decisions will rest on a balanced understanding of natural science, engineering principles, and the requirements of the society they are designed to serve. It is, therefore, with great interest and anticipation that I receive a copy of your final draft report and I can assure you that I shall heed your comments very carefully and, to the extent possible, incorporate them in the future design and planning of my department.

6. With these words I wish to take this opportunity to bid you a safe and pleasant journey back to your homes and families. From the discussions that took place I have been told that they were profound and of a high order and I hope that your exchange of experiences have been rewarding and that all countries participating will benefit by the experiences you have gained at this Workshop. I have now great pleasure in declaring the Workshop closed.

ANNEX D

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur.

List of Country Reports presented at the Workshop

UNESCO/ROST/SEA/CR1		:	A Resume of Environmental Problems in Afghanistan by Prof. Abdul Samad Saleem.
"	CR2	:	Environmental Problems in Bangladesh and Ways and Possibilities of providing Environmental Training for Practising Civil Engineers through Continuing Education by Dr. M.A. Aziz.
"	CR3	:	Country Report on Burma by U Tha Nyunt.
"	CR4	:	Environmental Problems in Hong Kong by Mr. G.B. O'Rorke.
"	CR5.1	:	Some Aspects of Environmental Problems in India - An Overview by Dr. J.K. Sridhar Rao.
"	CR5.2	:	Some Thoughts on Education in "Built-Environment" by Dr. J.K. Sridhar Rao.
"	CR6	:	System Engineering Approach for Planning and Design of Tidal Swamp Region by Dr. Sugandar Sumawiganda Ph.D.
"	CR7	:	Malaysia - Country Report
"	CR8	:	The Environment and Engineering in New Zealand by Mr. Robert G. Norman.
"	CR9	:	Salient Environmental Problems in Pakistan by Prof. Dr. M. Islam Sheikh.
"	CR10	:	Environmental Quality: Implications to Civil Engineering Education in the Philippines by Mr. Marino M. Mena.

UNESCO/ROST/SEA/CR11 : Environmental Qualities of Republic of Korea
by Dr. Eung-Bai Shin

" CR12 : Environmental Problems and on the Possibilities for providing Environmental Training to Practising Civil Engineers through Continuing Education
by Dr. Cheong Hin Fatt.

" CR13 : Salient Environmental Problems in Sri Lanka and Ways of Providing Environmental Training for Practising Civil Engineers through Continuing Education
By Mr. H.C.D. de Silva.

" CR14 : Thailand National Report on Environmental Training of Practising Civil Engineers
by Dr. Surin Setamanit.

" CR15 : Country Report - Afghanistan
by Prof. Ata Mohammad Nazar.

" CR16 : The Environmental Position in Australia.
by Mr. A.B. Sinclair

" CR17 : Brief Report on Environmental Problems concerning Transportation in Japan
by Dr. H. Nakamura.

ANNEX E

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL
TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur.

List of Consultants Papers presented at the Workshop

UNESCO/ROST/SEA/CP1	:	Some Methodologies for the Assessment of Environmental Impacts by Christian De Laet
" CP1 Add 1:		References
" CP1 Add 2:		Reading List
" CP1 Add 3:		Checklist of Characteristics and Conditions of the Environment to be Considered in an Environment Impact Statement (Australia).
" CP1 Add 4:		- do - Roads & Highways
" CP1 Add 5:		Sorenoex - Matrix
" CP1 Add 6:		CNYRPDB - Matrix
" CP2	:	Gradual Indoctrination of Civil Engineers to the Concept of Environment Man and Development.
" CP3	:	The Role of Construction in Development Environmental Aspects by A. Sekarajasekaran
" CP4	:	Synthesis of Systems Analysis with Engineering Planning by Richard de Neufville
" CP5	:	Point of View of Developing Countries on New 'Tools' for Modeling, Simulation and Systems Analysis for Engineering by Dr. D.J. Gunaratnan

ANNEX F

UNESCO/ROST/SEA/DR 4.6
Environmental Training
Civil Engineers

List of Case Studies Reports presented at the Workshop

UNESCO/ROST/SEA/CS1		:	Case Study - Malaysia by A.S. Sekaran.
"	CS2	:	New Territories Stream Pollution Study of Hong Kong presented by G.B. O'Rorke.
"	CS3	:	Development of the Resources of the Clutha Valley, South Island by Robert G. Norman.
"	CS4	:	Sugar Mill Waste and the Mae Klong River Pollution by Dr. Surin Setamanit.
"	CS5	:	Water Resources Plan for Metropolitan Manila Area as a Case Study by Prof. Marino M. Mena.
"	CS6	:	Human Settlements in Sri Lanka by H.C. Daya de Silva.
"	CS7	:	Energy and Appropriate Technology by H.C. Daya de Silva.

ANNEX G

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL
TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

List of Workshop Papers distributed for Discussion

UNESCO/ROST/SEA/WP 1	:	Environmental Engineering Problems and Concerns in the Asian Region
WP 2	:	Asian Workshop Signposts for background discussion
WP 3	:	Asian Regional Workshop on Environmental Training of Practising Engineers
WP 4	:	Role of Engineers Today and Tomorrow and their relevance to Environmental Problems, their links and responsibility to other professions and to society at large by N. Chaudhuri
WP 5	:	A Possible framework for dealing with the Urban Environment in the context of Developing Countries by Dr. J. K. Sridhar Rao and A.K. Gupta
WP 6	:	Curriculum Development for Civil Engineers for Environmental Considerations by Dr. J. K. Sridhar Rao

ANNEX H

ASIAN REGIONAL WORKSHOP ON ENVIRONMENTAL TRAINING OF PRACTISING CIVIL ENGINEERS

MAY 12 - 23, 1975, Kuala Lumpur

List of Information and Miscellaneous Sheets presented at the Workshop

UNESCO/ROST/SEA/INF 1 : Professional Notes on the Consultants

INF 2 : The United Nations Environmental Programme Objectives and Priorities

INF 3 : Discussion Topics Raised at the June 74 UNESCO meeting on Environmental Aspects of Engineering Education

INF 4 : Notes on the Meeting on Environmental Aspects of Education and Training of Engineers by Robert G. Norman

INF 5 : World Health Organisation Statement

INF 6 : Questionnaire on a FORMAT FOR INFORMATION RETRIEVAL FOR THE TOPIC ON "GENERAL OVERVIEW OF THE PRESENT SITUATION OF THE ASIAN REGION FROM AN ENVIRONMENTAL POINT OF VIEW (POPULATION, ECONOMIC AND SOCIAL DEVELOPMENT, ENVIRONMENTAL QUALITY)"

INF 7 : Participants' Statement

UNESCO/ROST/SEA/MIS 1 : Workshop Evaluation Form

MIS 2 : Part Extract from A Ballad of Ecological Awareness by Kenneth E. Boulding

MIS 3 : Departure Form

MIS 4 : Afghanistan's position on environmental education of practising civil engineers