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DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

School of Public Health
University of North Carolina
Chapel Hill, North Carolina

REPORT ON THE TWELFTH SESSION

OF THE

INTERNATIONAL PROGRAM IN SANITARY ENGINEERING DESIGN

Prepared for

Agency for International Development
Department of State
Washington, D.C.
1971

Headquarters for the International Program
in Sanitary Engineering Design

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THE UNIVERSITY OF NORTH CAROLINA
AT
CHAPEL HILL

THE SCHOOL OF PUBLIC HEALTH
DEPARTMENT OF
ENVIRONMENTAL SCIENCES AND ENGINEERING
ZIP CODE 27514

INTERNATIONAL PROGRAM IN
SANITARY ENGINEERING DESIGN

PHONE: AREA CODE 919
966-1171, 966-1252, 966-2129

January 28, 1972

Mr. A. Dale Swisher, P.E.
Environmental Health
Office of Health
Technical Assistance Bureau
Department of State
Agency for International Development
Washington, D.C. 20523

Dear Mr. Swisher:

In accordance with our Contract AID/csd-1888, we are pleased to submit our report on Task Order 7 covering the Twelfth Session of the International Program in Sanitary Engineering Design. We wish to thank you and your predecessors for your cooperation and support in all aspects of this important work.

Yours very truly,

Richard F. Cole

Richard F. Cole
Director
International Program in
Sanitary Engineering Design

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PREAMBLE

The International Program in Sanitary Engineering Design (IPSED) is conducted by the University of North Carolina at Chapel Hill under contract with the Agency for International Development of the United States Department of State. It has been in operation since 1962, and up until 1967, one or two sessions were held each year, depending upon demand. Since 1967, only one session of the Program has been conducted yearly. Earlier reports on the previous eleven sessions of IPSED are on file. It is intended to make each report complete in itself at the risk of some repetition to those who would read them all.

The need for more water for more people in developing countries is recognized as basic. In fact, meeting this need is prerequisite to all other forms of betterment, whether directed to health, social, or economic improvement. The urgency for providing suitable water supply and sanitation facilities is perhaps too obvious to call for prolonged discussion here, and it is more to the point in this preamble to indicate how a specific program has been established and operated to help in the planning and execution of water supply and related projects in developing countries by training engineers for the work in a way not hitherto attempted.

The technical problems associated with the conception, design, execution, and operation of water supply and sanitation projects are inevitably delegated to the engineer for proper solution. Within engineering are many specializations; however, historically and practically, the overall technical responsibility in this type of work has been that of the civil engineer and more recently, that of the sanitary engineer.

Many of the developing countries have not yet provided educational programs for the preparation of this small but important group of sanitary engineering leaders. Traditionally, the relatively few persons in each country who are selected for these leadership roles have been sent abroad for the necessary study, many of them attending schools in the United States or in Europe.

The most troublesome factors encountered with prevailing programs for study in industrialized countries stem from the radical differences which may exist between climatic, socio-economic, and technological conditions in the student's home country and those in the country where his education is secured. There may be great disparity in monetary resources, in the nature of the labor to be used in the work, in the availability of manufactured products and the necessity of importing material, and in habits, attitudes, and traditions generally. All of these factors are intimately related to design. In the United States, for example, most academic programs leading to the M.S. or Ph.D. sanitary engineering degree are necessarily oriented to conditions prevailing in this country because most of our students originate here and will practice here throughout their careers. Accordingly, much of the technology which is taught, especially in the realm of design, is appropriate primarily for application in this country. A foreign student completing such a program and returning to his homeland is usually confronted with the fact that much of this hard earned knowledge would be impractical for direct application under his own local circumstances. In some

instances, the individual views this as a challenge and uses his formal education as a foundation on which to build new technological concepts for developing solutions more appropriate for local conditions. Obviously, however, much of the effort and expense of obtaining his education is less effective than it might have been had the program been tailored more closely to his own specific needs. In other instances, the reaction is much less favorable and leads to increased frustration because of the incompatibility between his educational background and needs of his country. Sometimes the end result may be an attempt to transfer experience or knowledge not at all appropriate, leading to most undesirable consequences.

The newly graduated sanitary engineer entering practice within the United States generally must serve an internship of several years before he is considered qualified to do independent design work. Because of the many excellent design offices in this country, opportunities for professional growth under the guidance of competent professionals are abundant. Unfortunately, however, such opportunities are sometimes limited or absent in developing countries. To compensate in part for this lack of opportunity for the engineer's normal professional development, the International Program in Sanitary Engineering Design, in addition to its intensive academic phase, arranges for each participant to receive on-the-job practical experience in first rate municipal and consulting engineering organizations, under continued University supervision, during his stay in the United States. Perhaps as important to each participant as his engineering training is this direct exposure to American engineering organization and procedure.

In the United States, the tendency in water and wastes treatment plant design has been, over the years, to supplant rather simple processes and treatment devices, generally characterized by relatively high investment but low operating charges, by more compact and highly mechanized and instrumented processes and structures, sometimes lower in first cost but higher in operating charges. Overall economy is possible because of the labor saving devices which are incorporated. On the other hand, in developing countries, common labor is cheap and plentiful. More appropriate under such consitions are the simpler concepts of plants more readily constructed and operated with unskilled labor, and not highly mechanized. While generalizations are difficult to make categorically, it is nevertheless obvious that engineering design, construction, and operations in developing countries are not likely to be of the same character as one finds in the more technologically developed countries of the United States and Europe.

With all of the preceding considerations in mind, the International Program in Sanitary Engineering Design was established as a unique educational venture, staffed, equipped and planned for specific ends, quite distinct from the ordinary program of study in a university, and in conformity with objectives indicated in the preceding brief discussion. The report which follows describes in some detail the participants from developing countries and what work they do. The reader will note the unique combination of educational discipline and professional internship which has been working so successfully in this program.

A problem associated with study abroad is that sometimes the engineer is tempted to stay abroad, and so the investment in his education is lost to his home country. In the International Program in Sanitary Engineering Design

commitment and orientation are such that all but one of the participants, 102 of the 103 thus far, have returned after completing the program, as intended, to do the work needed at home.

Participants in the Program are brought to the United States for work that takes about a calendar year; shorter programs are arranged in cases where time and funds are limited. This work is carried out in three successive and coordinated phases, which are: 1) a semester of special courses at the University of North Carolina; 2) one month at a municipal waterworks, for operating experience; and 3) an internship of about six months with an engineering organization engaged in the design and supervision of construction of water and sewerage works. The first phase is carried out in classes which all participants attend as a group. The second and third phases are worked out individually for each participant, in such fashion as to insure maximum benefit to him in view of his probable responsibilities after his return to his country of origin. The second and third phases are supervised by the University so that all three phases are properly correlated.

The present report describes the Program in its twelfth session, held during 1970-1971. Counting this session, one hundred and three engineers representing thirty-six different countries in Africa, Asia, the Americas, and the Middle East have enrolled for the Program since its inception. Sixteen engineers representing nine different countries registered for the Twelfth Session of the International Program, and fifteen completed the academic phase. One engineer, Mr. Samuel Kasadha of Uganda, left the Program in December, 1970, and returned to his country to run for Parliament.

_R_E_P_O_R_T_

REPORT ON THE TWELFTH SESSION OF THE INTERNATIONAL PROGRAM IN SANITARY ENGINEERING DESIGN

Section I - General

1. Authority: The work herein reported was carried out under the provisions of Task Order No. 7 of the Contract AID/csd-1888 between the U.S. Department of State and the University of North Carolina at Chapel Hill. The contract is an extension of and supersedes earlier Contracts AID/csd-718 and AID/csd-362.

2. The International Program in Sanitary Engineering Design: The International Program in Sanitary Engineering Design (IPSED) came into existence in 1962. The Program was a joint conception of: 1) the Department of Environmental Sciences and Engineering of the School of Public Health, University of North Carolina at Chapel Hill, and 2) the Agency for International Development of the U.S. Department of State, as part of the latter's global water supply program. During 1971 an evaluation of the IPSED program was conducted by four consultants for AID. Under the direction of Mr. A. Dale Swisher, P.E. the evaluation team consisted of: Mr. Charles S. Pineo, consultant; Dr. John Logan, President, Rose-Hulman Polytechnic Institute; Dr. Edward Cleary, Professor, Environmental Health, University of Cincinnati; and Dr. George Hanna, Jr., Dean of Engineering, University of Nebraska. Fifth former participants were interviewed by members of the team. Only a preliminary report is complete at this time; more comment will be given about this in next year's report after a final evaluation has been submitted.

   The engineering training program encompasses the following:

   a) Academic Phase: A curriculum is set up for a one-semester course of both refresher and new material in such categories as hydraulics, chemistry, pumps and treatment plant equipment, hydrology, treatment processes for water and sewage, etc. Much of the material is written for the course and is issued to participants for reference. In general, mornings are devoted to classes and lectures and afternoons to problem work and design. One day or one afternoon per week a field trip is made to a waterworks or sewage treatment plant, usually within North Carolina, a state which is well supplied with excellent municipal utilities of this character. At the end of the course the participants will have worked out and submitted a project design. Since the groups are limited in size (twenty participants or less), individual attention is given in the work.

      Participants in IPSED can receive, at their option, up to eleven semester hours of postgraduate credit for successful

completion of the courses. Application for enrollment for credit may be made after arrival at the University. Those students not enrolling for credit attend all lectures but may have a lighter work load, at the option of the teacher.

The IPSED courses include:

ENVR 173 - DESIGN OF HYDRAULIC STRUCTURES (three credit hours). Hydraulic design for waterworks and sewerage projects: open channels; backwater curves; siphons; transition sections; dams and outlet works; stilling basins; networks; centrifugal pumps; transients in unsteady flow. (See Appendix A for Lecture Schedule).

ENVR 175 - SANITARY ENGINEERING DESIGN IN DEVELOPING COUNTRIES (three credit hours). Design of public water and sewage facilities including intakes, pumping stations, treatment plants, distribution systems, and waste-water collection works. Design criteria, equipment, and systems for use in developing countries are stressed. Process, mechanical, electrical, and control aspects of design are included. (See Appendix B for Lecture Schedule).

ENVR 181 - GROUNDWATER HYDROLOGY (two credit hours). Ground-water occurrence and exploration; design, hydraulics, drilling, construction, and testing of water wells; operation and maintenance of groundwater supply systems. (See Appendix C for Lecture Schedule).

ENVR 182 - WATER RESOURCES PLANNING IN DEVELOPING COUNTRIES (three credit hours). Preliminary planning of public water supply and sewerage facilities. Planning objectives and design criteria for developing countries are considered. Course topics include collection and analyses of data, rate studies, capital budgeting, decisions on water quality, quality, needs for sewage treatment location, systems analysis and optimization procedures, sizing of facilities, scheduling (CPM), and financing. Preliminary plans, cost estimates, and planning reports are prepared by students. (see Appendix D for Lecture Schedule).

b) Field Trips: As mentioned above, field trips have been made at various times to plants at Chapel Hill, Raleigh, Durham, Greensboro, Fayetteville, Siler City, Lumberton, Charlotte, Winston-Salem, High Point, and, out of the State, to Miami and Gainesville in Florida and to Atlanta, Athens, and Savannah in Georgia. Most trips do not exceed one day's duration, although longer trips have been made, such as the trip to the southeastern part of the United States, made by the participants in the Twelfth Session of the Program.

c) Municipal Phase: In the municipal phase, following the academic phase, the participants are assigned individually to various waterworks for operating experience to learn the intricacies of operating and sometimes of management problems. Most of the municipalities selected are within the State; at times, for special reasons, participants have been sent as far afield as Los Angeles, California, and St. Louis, Missouri. A list of collaborating municipalities is given under Paragraph 5-g.

d) Consulting Office (Internship) Phase: In the consulting office phase, which follows the municipal phase, participants are assigned individually to engineering offices for an internship period varying in length but ordinarily about six months. These are selected with the participant's needs in mind and in relation to the work done in the particular office. In many instances, he will work on projects which the firm is handling for the participant's home country. A list of collaborating engineering firms is given in Paragraph 5-h.

e) Corollary Activities (Professional and Social): As part of their program, the participants are escorted by a member of the UNC staff to one national meeting of the major technical societies, both to listen to important papers and to enlarge their professional acquaintance. In the past, national meetings of the American Water Works Association, The Water Pollution Control Federation, and the American Society of Civil Engineers have been attended by participant groups. They have also attended some state and regional meetings of these societies closer to Chapel Hill and near their consulting assignments. On the social side, the UNC staff has been host to the various groups, all of which have been in the faculty homes on occasion for informal get-togethers. Special attention is given to married couples where participants are accompanied by their spouses. Shopping trips have been arranged, and arrangements are made for participants to take part in University student activities.

3. Qualifications and Support of Participants: Prospective participants must be graduate engineers with some practical experience and be competent in English. They must have the recommendation of their sponsoring agencies and firms. Following acceptance by the parties to this Contract, they come to this country for the period of their fellowship, usually twelve months, during which time they are paid living and travel expense or stipend. These stipends are financed by the supporting agencies, WHO, AID, or by others who may offer scholarships and fellowships for the purpose (see Paragraph 4).

4. Supporting Agencies: The agencies which have given scholarship and financial aid to participants include the Agency for International Development to the U.S. State Department, the Pan American Health Organization, The World Health Organization itself, the Organization

of American States, the Ford Foundation, and the United Nations. In addition, participants are sometimes supported by the government of their home country, through the World Bank or some other organization.

5. Facilities for Conduct of the Program: Facilities for the conduct of the Program include:

   a) Campus Classroom: There is set aside for the exclusive use of the participant groups a classroom especially equipped for their convenience, with individual desks for each man. The room has visual aid equipment, including projectors for motion pictures and slides and screen.

   b) Extra Classrooms: On occasion, especially with guest lecturers, who come to the Program for selected topics on which they are particularly well known experts, a larger classroom is used and the regular graduate students (degree candidates) are invited to attend along with the participants.

   c) Office Facilities and Clerical Staff: In the main building of the School of Public Health, there is a reference room in which plans, specifications, reports, catalogues, reprints, etc., are kept and made available for classroom use.

      Headquarters for the Program is a two-story dwelling (308 Pittsboro Street) near the School of Public Health. This has been equipped for Program purposes. The rooms downstairs house the project coordinator, an IPSED secretary, and, in addition, files, records, reports, etc., relating to the Program and to the Department. On the second floor, there are four separate rooms. Three are used by faculty members whose time is principally devoted to the Program, and the fourth houses a draftsman and is used for drafting and map files.

   d) Shop and Laboratory Facilities: These are available and have been used for building special equipment for the Program.

   e) Car Pool: Frequent field trips for inspection of municipal treatment plants demand the use of cars from the University car pool, or from other sources such as chartered buses, on occasion.

   f) Lodging and Transportation: Participants are housed in one of the newer dormitories on campus. Married couples are assisted in locating appropriate housing - apartments or houses. Participants are issued bicycles, if they wish one, for use around campus and in town.

   g) Collaborating Municipalities: A number of municipalities, principally in North Carolina, have been most cooperative in

receiving participants for experience at the local treatment plant, during their "municipal phase." Among these have been cities listed below:

North Carolina: Chapel Hill, Charlotte, Durham, Fayetteville, Greensboro, Raleigh, Wilmington, and Winston-Salem.

Out-of-State: Dayton, Ohio; Weehawken, New Jersey; Hartford, Connecticut; Los Angeles, California; Philadelphia, Pennsylvania; St. Louis, Missouri; Tennessee, TVA; Wyoming, Michigan; Hackensack, New Jersey; Syracuse, New York.

h) Collaborating Engineering Offices for Design Phase: For taking participants during the design or engineering internship phase of the Program, we are indebted to the following organizations, many of which have collaborated in this phase of the Program on more than one occasion:

Consulting Firms

Albright and Friel
Philadelphia, Pennsylvania
Alexander Potter Associates
New York, New York
Alvord, Burdick & Howson
Chicago, Illinois
Alley, Williams, Carmen & King, Inc.
Burlington, North Carolina
Bechtel Corporation
San Francisco, California
Black & Veatch
Kansas City, Missouri
Brown & Caldwell
San Francisco, California
Buck, Seifert & Jost
Englewood Cliffs, New Jersey
Burgess & Niple
Columbus, Ohio
Camp, Dresser & McKee
Boston, Massachusetts
Carl F. Buettner & Associates
St. Louis, Missouri
The Chester Engineers
Pittsburgh, Pennsylvania
Cornell, Howland, Hayes & Merryfield
Corvallis, Oregon
Dorr-Oliver, Inc.
Stanford, Connecticut
Engineering-Science, Inc.
Arcadia, California
Ford, Bacon & Davis
New York, New York
Gannett, Fleming, Corddry & Carpenter
Harrisburg, Pennsylvania
Gilbert Associates
Reading, Pennsylvania
Greeley & Hansen
Chicago, Illinois
The Harwood Beebe Co.
Spartanburg, South Carolina
Havens & Emerson
New York, New York
Hazen & Sawyer
New York, New York
Henry B. Steig & Associates
Indianapolis, Indiana
Horner & Shifrin
St. Louis, Missouri
Howard K. Bell
Lexington, Kentucky
Hubbell, Roth, & Clark
Birmingham, Michigan
James M. Montgomery
Pasadena, California
John J. Baffa Associates
New York, New York
Jones, Henry & Williams
Toledo, Ohio
Kennedy Engineers
San Francisco, California
Lalonde, Girourard & Lentendre
Montreal, Canada
Charles T. Main, Inc.
Charlotte, North Carolina

Malcolm Pirnie
New York, N.Y.
Metcalf & Eddy
Boston, Massachusetts
National Sanitation Foundation
Ann Arbor, Michigan
Nelson, Haley, Patterson & Quirk, Inc.
Greeley, Colorado
Nusshaumer, Clarke & Velzy, Inc.
New York, N. Y.
Office of City Engineers
Wyoming, Michigan
O'Brien & Gere
Syracuse, New York
Ohio State Department of Health
Columbus, Ohio
J. N. Pease & Co.
Charlotte, North Carolina
Piatt & Associates
Durham, North Carolina
The Pitometer Association
Pittsburgh, Pennsylvania
Smith & Gillespie
Jacksonville, Florida
Stanley Engineering Co.
Muscatine, Iowa
Stanley, Grimble, Robin, Ltd.
Edmonton, Alberta
Stearns & Wheler
Cazenovia, New York
Roy F. Weston, Inc.
Newton Square, Pennsylvania
Whitman & Howard
Boston, Massachusetts
Whitman, Requardt & Assoc.
Baltimore, Maryland
Wiedeman & Singleton
Atlanta, Georgia
Wilson & Co.
Salina, Kansas

6. Faculty: The following list includes University and Visiting Faculty who have taken part in the instructional or academic phase of the Program. Some of those listed are predominantly occupied with IPSED activities, both during the sessions and between sessions, to take care of all the minutiae of work associated with both planning and execution of the work.

George Eric Barnes, Professor of Sanitary Engineering, B.S.C.E., 1923 (Massachusetts Institute of Technology); C.E. (Hon.), 1935 (Case Institute of Technology); M.A., 1953 (Western Reserve University); P.E.; Emeritus.

James Clement Brown, Associate Professor of Sanitary Engineering, B.S., 1949 (Illinois Institute of Technology); M.S., 1961 (Case Institute of Technology); P.E.

Emil Theodore Chanlett, Professor of Sanitary Engineering, B.S., 1937 (College of the City of New York); M.S.P.H., 1939 (Columbia); M.S.S.E., 1941 (University of North Carolina); P.E.

Richard F. Cole, Director of the International Program in Sanitary Engineering Design, Assistant Professor of Sanitary Engineering, B.S., 1959 (Drexel Institute of Technology); M.S., 1961 (Massachusetts Institute of Technology); Ph.D., 1968 (University of North Carolina); P.E.

Donald Thomas Lauria, Assistant Professor in Environmental Engineering and Engineering Associate, B.C.E., 1956 (Manhattan College); M.S.S.E., 1965 (Syracuse University); Ph.D., 1970 (University of North Carolina); P.E.

6. Frederick Eugene McJunkin, Associate Professor of Environmental Engineering, B.C.E., 1955 (North Carolina State University); M.S.S.E., 1961 (University of North Carolina); P.E.

Daniel Alexander Okun, Head of the Department of Environmental Sciences and Engineering and Professor of Environmental Engineering, B.S.C.E., 1937 (Cooper Union); M.S., 1938 (California Institute of Technology); Sc.D., 1948 (Harvard University); P.E.

Jabbar K. Sherwani, Associate Professor of Systems Analysis and Hydrology, B.S. (C.E.), 1945 (Punjab University); M.C.E., 1947 (Polytechnic Institute of Brooklyn); Ph.D., 1951 (Utah); M.P.A., 1958 (Harvard).

Charles Manuel Weiss, Deputy Head of the Department of Environmental Sciences and Engineering and Professor of Environmental Biology, B.S. 1939 (Rutgers University); Ph.D., 1950 (Johns Hopkins University).

Staff: The following list is of the full-time IPSED staff.

Betty Louise Marks, Project Coordinator, A.B. (Sociology) 1946, University of North Carolina.

Elayne Solice McCaskill, Secretary, attended North Carolina Central University.

DIRECTOR, I.P.S.E.D.

Dr. Richard F. Cole

HEAD, DEPARTMENT OF ENVIRONMENTAL SCIENCES AND ENGINEERING

Dr. Daniel A. Okun

FACULTY

Professor G. E. Barnes

Professor J. C. Brown

Dr. D. T. Lauria

Professor F. E. McJunkin

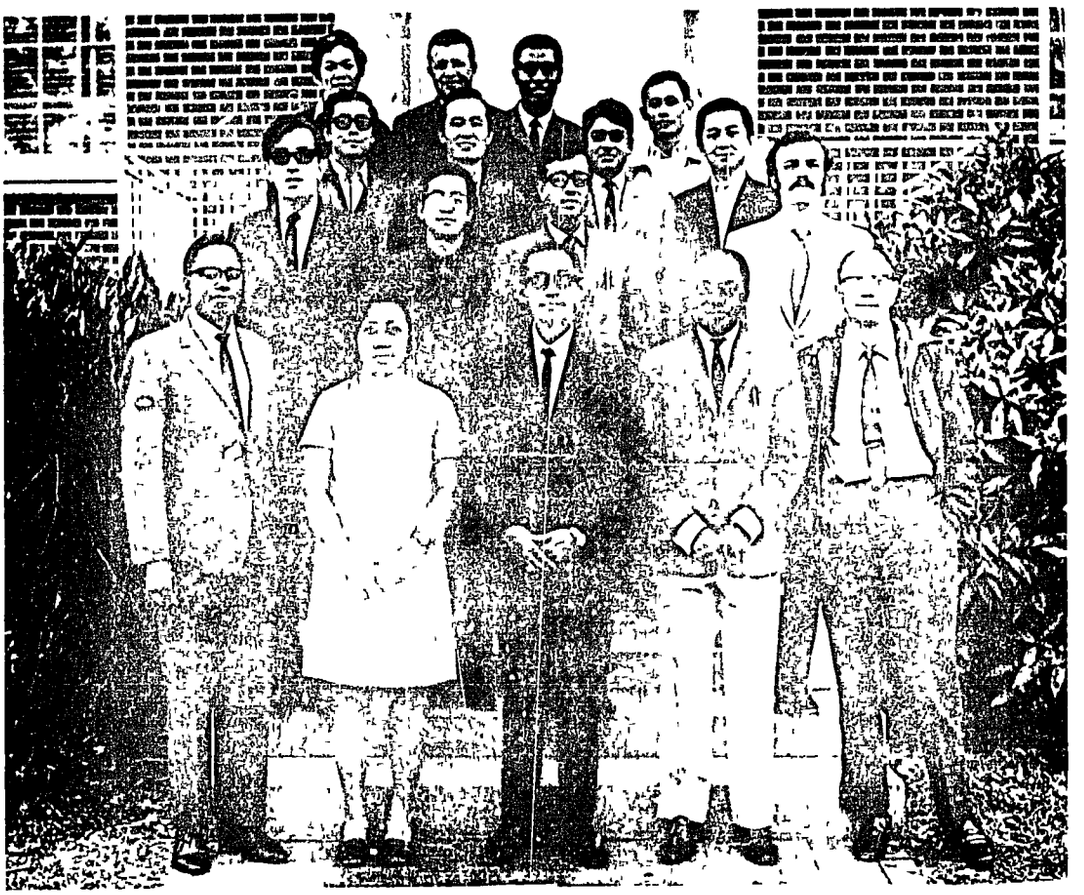
Dr. J. K. Sherwani

STAFF

Miss Betty Marks, Project Coordinator

Mrs. Elayne S. McCaskill, Secretary

CHRISTMAS PARTY



INTERNATIONAL PROGRAM IN SANITARY ENGINEERING DESIGN (Twelfth Session, Fall of 1970)

Left to Right: FRONT ROW—Dick William Nsubuga (Uganda), Mrs. Sri Soewasti Soesanto (Indonesia), Susanto Mertodiningrat (Indonesia), Samuel Benon Kasadha (Uganda), Y.M. Liu (Taiwan); SECOND ROW—Luis E. Medina (Colombia), Chi-Tze Chen (Taiwan), Shamsuz Zoha (E. Pakistan), German R. Ramirez (Colombia); THIRD ROW—Boonyong Lohwongwatana (Thailand), Ching-Hsiung Lu (Taiwan), Muhammad Shafiq (W. Pakistan), Suwanrat Limrat (Thailand), BACK ROW—Quek Cheng Kwee (Singapore), Rigoberto Cerna (Honduras), Samuel Turner Boham (Ghana), Jirasak Jindarojana (Thailand).

SECTION II - REPORT ON TWELFTH SESSION

7. Participants: The Twelfth Session of the International Program in Sanitary Engineering Design was held during the period September, 1970 through August, 1971. There were sixteen participants from ten different countries, as follows:

Sponsored by AID

Name: Samuel Turner Boham
Age: 35
Family: Married
Home: Accra, Ghana
Education: Diploma in Civil Engineering, 1964, Plymouth College of Technology.
Employer: Ghana Water and Sewerage Corporation Accra, Ghana
Title: Co-Manager, WHO/UNDP water and sewerage project for the Accra-Tema district.
Brief Job Description: Responsibility for assignment of engineering and management consultants to the project work according to the agreement under a plan of operation. Assist the consultants in their search for data from government agencies.

Duration of Program: 1 year
Training Officer: Mr. Richard W. Swain

Sponsored by AID

Name: Boonyong Lohwongwatana
Age: 26
Family: Single
Home: Bangkok, Thailand
Education: Bachelor of Engineering in Civil Engineering, 1967, Chulalongkorn University
Employer: Sanitary Engineering Division Department of Health (Potable Water Project) Bangkok
Title: Chief Changwat Engineer
Brief Job Description: Responsibility for field surveying and designing for the National Community Water Supply Project in the west-central part of Thailand.
Duration of Program: 78 weeks; IPSED for academic phase, then graduate school at the University of Illinois
Training Officer: Mr. J. James Bozek

Name: Rigoberto Cerna

Sponsored by PAHO

Age: 42
Family: Married
Home: Tegucigalpa, Honduras
Education: Civil Engineering, 1953, Universidad Autonoma de Honduras; Post-graduate study in Sanitary Engineering, 1956-58, University of Puerto Rico and University of Massachusetts.
Employer: Autonomous National Water & Sewer Service
Title: Chief of StudyThe Design Department
Brief Job Description: Supervisor of preliminary engineering, field surveys, technical design, plan and specifications preparation, quantity and cost estimates, bid and contract details, plan files and records.
Duration of Program: 48 weeks
Training Officer: Miss Jeanne LaMotte

Name: Chi-Tze Chen

Sponsored by WHO

Age: 29
Family: Married
Home: Taipei, Taiwan, Republic of China
Education: Degree in Civil Engineering, 1961 Provincial Taipei Institute of Technology.
Employer: Taiwan Public Works Bureau
Title: Assistant Engineer
Brief Job Description: Planning and design of sanitary and drainage sewerage systems.
Duration of Program: 6 months
Training Officer: Miss Susan Shanley

Sponsored by AID

Name: Jirasak Jindarojana
Age: 25
Family: Married
Home: Bangkok, Thailand
Bachelor of Science in Engineering, 1967, Chulalongkorn University, Bangkok, Thailand
Employer: Sanitary Engineering Division Department of Health (Potable Water Project) Bangkok
Title: Chief of Design Section
Brief Job Description: Planning and design of rural potable water systems.
Duration of Fellowship: 78 weeks; IPSED for academic phase, then graduate school at the University of Arkansas
Training Officer: Mr. J. James Bozek

Sponsored by WHO

Name: Samuel Benon Kasadha
Age: 34
Family: Married
Home: Jinja, Uganda
Education: Diploma in Civil Engineering, 1966 Prague Technical University.
Employer: Town Engineer's Department Jinja Municipal Council.
Title: Assistant Engineer
Brief Job Description: Supervision of the installation of new construction, including setting out and levels as required; roads and storm water sewer design; occasional assistance with water supply and water works.
Duration of Fellowship: 9 months (Mr. Kasadha left in December, 1970 to return home and run for a Parliament seat).
Training Officer: Miss Jeanne LaMotte

Sponsored by WHO

Name: Ching-Hsiung Lu
Age: 29
Family: Married
Home: Taipei, Taiwan, Republic of China
Education: Bachelor of Science in Civil Engineering, 1964, National Taiwan University.
Employer: Taiwan Public Works Bureau
Title: Junior Engineer
Brief Job Description: Planning and design of the community water supply systems in Taiwan.
Duration of Fellowship: 6 months
Training Officer: Miss Susan Shanley

Sponsored by AID

Name: Luis E. Medina
Age: 26
Family: Single
Home: Cali, Colombia
Education: Bachelor of Science in Sanitary Engineering, 1967, University del Valle, Colombia.
Employer: Empresas Municipales de Cali
Title: Sanitary Engineer, Supervisor of Production.
Brief Job Description: Administrative control of personnel in charge of the entity, coordination of production, pumping systems, and reservoir, control of production costs, supervision of bacteriological and chemical control of water.
Duration of Fellowship: 1 year
Training Officer: Mr. J. James Bozek

Sponsored by WHO

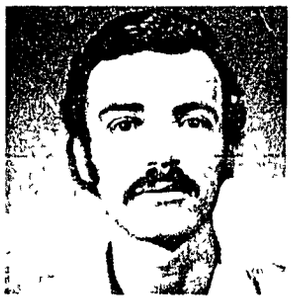
Name: Dick William Nsubuga
Age: 33
Family: Married
Home: Kampala, Uganda
Education: Bachelor of Science in Mechanical Engineering, 1965, Haile Selassiei University
Employer: Kampala and District Water Board
Title: Senior Assistant Engineer
Brief Job Description: Supervision and administration of technical sections of Board, including water production and treatment section and works section; preparation of engineering designs and supervision of contracts.
Duration of Program: 9 months
Training Officer: Miss Jeanne LaMotte

Sponsored by LOKE Scholarship Foundation

Name: Quek Cheng Kwee
Age: 28
Family: Single
Home: Singapore, Singapore
Education: Professional Diploma in Civil Engineering, 1964, Singapore Polytechnic
Employer: Water Department
Public Utilities Board
Singapore
Title: Assistant Engineer
Brief Job Description: Preparation, planning, and execution of water supply schemes (mainlaying) to new estates. Maintenance of existing distribution network.
Duration of Fellowship: 1 year
Contact: Mr. K.S. Khong
Public Utilities Board
Singapore

Name: German Rafael Ramirez Velez
Age: 28
Family: Married
Home: Bogota, Colombia
Education: Bachelor of Science in Civil Engineering, 1965, Universidad Nacional; Master of Science in Civil Engineering, 1967, Universidad Nacional.
Employer: National Planning Department
Title: Sanitary Engineer
Brief Job Description: Elaboration, review, process and publication of the Survey on Water Supply and Sewerage Systems in Colombia; government policies related to water supply systems; evaluation of projects.
Duration of Fellowship: 60 weeks
Training Officer: Mr. J. James Bozek
IIE Contact: Miss Ellen Faucett

Sponsored by AID; IIE/Ford Foundation



Name: Muhammad Shafiq
Age: 30
Family: Married
Home: Lyall Pur, West Pakistan
Education: Bachelor of Civil Engineering, 1963, N.E.D. Government Engineering College, Karachi
Employer: West Pakistan Public Health Engineering Department, Lahore
Title: Assistant Engineer
Brief Job Description: General advisory services for the Planning and Designing Shickhupura Sewerage and Drainage Project.
Duration of Fellowship: 1 year
Training Officer: Miss Susan Shanley

Sponsored by WHO

Sponsored by WHO

Name: (Mrs.) Sri Soewasti Soesanto
Age: 33
Family: Married (Husband: IPSED Participant, Mr. Susanto)
Home: Djakarta, Indonesia
Education: Diploma in Civil Engineering, 1959, University of Gadjah Mada (Djakarta); Post-graduate study, 1963-64, University of Minnesota, Public Health Engineering.
Employer: Division of General Engineering and Sanitary Engineering, The Ministry of Health, Djakarta
Title: Head, sub-division of Waste Disposal & Drainage
Brief Job Description: Helping to plan, design, and supervise the Sanitary Engineering activities in Indonesia, especially in the field of Waste Disposal and Drainage (flood control). The sub-division also deals with air pollution control, housing, stream pollution control, etc.
Duration of Fellowship: 1 year
Training Officer: Miss Nancy Berinstein

Sponsored by WHO

Name: Susanto Mertodiningrat
Age: 36
Family: Married (Wife: IPSED participant)
Home: Djakarta, Indonesia
Education: Diploma in Civil Engineering, 1960, Gadjah Mada University (Djakarta); Post-graduate study in France in Sanitary Engineering, certificate.
Employer: Ministry of Public Works Djakarta
Title: Head, Division of Survey, Investigation and Design
Brief Job Description: Carrying out the surveys, investigations, and designs of sanitary engineering works in Indonesia, mainly for water supply and waste disposal works for urban areas.
Duration of Fellowship: 1 year
Training Officer: Miss Nancy Berinstein

Name: Suwanrat Limrat

Sponsored by WHO

Age: 27

Family: Single

Home: Bangkok, Thailand

Education: Bachelor of Science in Civil Engineering, 1966, Chulalongkorn University; Master of Engineering in Public Health Engineering, 1968, Asian Institute of Technology.

Employer: Division of Sanitary Engineering
Department of Health
Bangkok

Title: Chief of Central Region Community Potable Water Project.

Brief Job Description: Responsibility for both engineering and administrative duties of the Central Region and of the Water Supply and Pollution Control Section; planning and designing water supply systems for rural communities; advise and design waste treatment systems for industries.

Duration of Fellowship: 1 year

Training Officer: Miss Nancy Berinstein

Name: Shamsuz Zoha

Sponsored by IDA

Age: 35

Family: Married

Home: Dacca, East Pakistan

Education: Bachelor of Science in Mechanical Engineering, 1959, Ahsanullah Engineering College, University of Dacca.

Employer: Dacca Water Supply and Sewerage Authority

Title: Executive Engineer, Water (Operation and Installation) Division.

Brief Job Description: Engineer-in-charge of water operation, mechanical and electrical installations.

Duration of Fellowship: 6 months, IPSED for academic phase, then graduate school at the University of Arizona.

Training Officer: R.W. Vanwagenen

8. Academic Program: After an orientation period of approximately one week in which the participants were made familiar with the University and its activities, and after they had been housed and become fairly well settled, the academic program of the session began on September 17, 1970, and extended through January 27, 1971.

9. Field Trips and Meetings Attended: During the academic session (1970), field trips were made by the group to various waterworks and wastewater treatment plants in North Carolina. In addition to field trips in North Carolina, this group visited facilities in the southeastern part of the United States. Also, as is indicated below, they were in attendance at one professional meeting.

   a) Field trips:

   September 23 - Chapel Hill, N.C.: University Lake Pumping Station and the Chapel Hill Water Treatment Plant.

   September 30 - Chapel Hill, N.C.: Water Treatment Plant.

   October 7 - Durham, N.C.: Water Treatment Plant.

   October 28 - Pittsboro, N.C.: Water Treatment Plant.

   November 4 - Chapel Hill, N.C.: Wastewater Treatment Plant.

   December 1-8 - Raleigh, N.C.: Raleigh Water Treatment Plant.
   Fayetteville, N.C.: Fayetteville Water Treatment Plant.
   Wrightsville Beach, N.C.: Saline Research Laboratory.
   Athens, Georgia: Federal Water Pollution Control Administration's Southeast Water Laboratory.
   Atlanta, Georgia: Chattahoochee River Intake Facility.
   Gainesville, Florida: University of Florida, Environmental Engineering Laboratory Facilities, and Waste Treatment Research Facilities.
   Miami, Florida: Miami Waterworks and the Miami Sewage Treatment Plant.

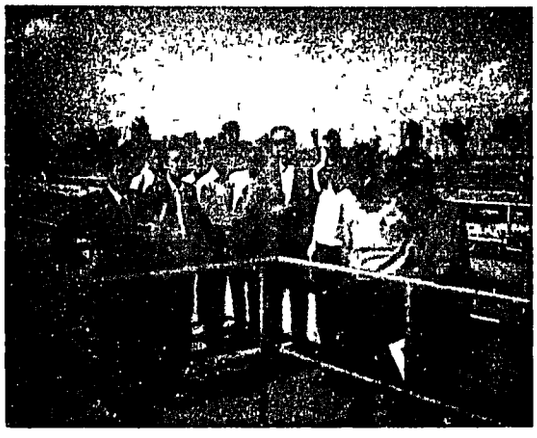
   b) Meetings of professional societies:
   The participants attended the joint meeting of the North Carolina Sections of the American Water Works Association and the Water Pollution Control Federation held in Winston-Salem, N.C., November 10-11, 1970.

10. Municipal Assignments: As stated in Paragraph 2-c, after completion of the academic phase of the International Program, the participants are ordinarily assigned individually to some municipality, usually in North Carolina, for a period of one month, during which time they acquire operating experience in a waterworks plant, or sewage treatment plant; or both. The assignments of the Twelfth Session participants follow:

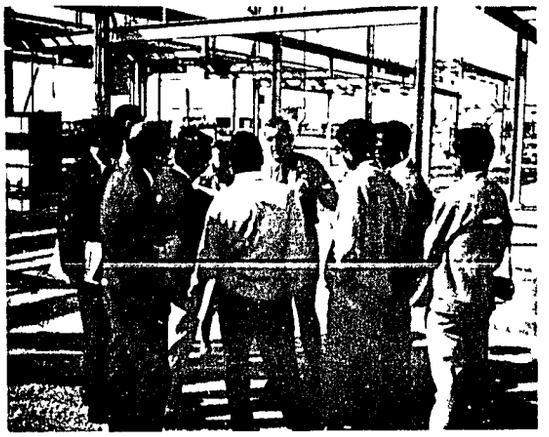
FIELD TRIP

Sledgebeds, Miami, Florida

Latin American
IPSED Participants

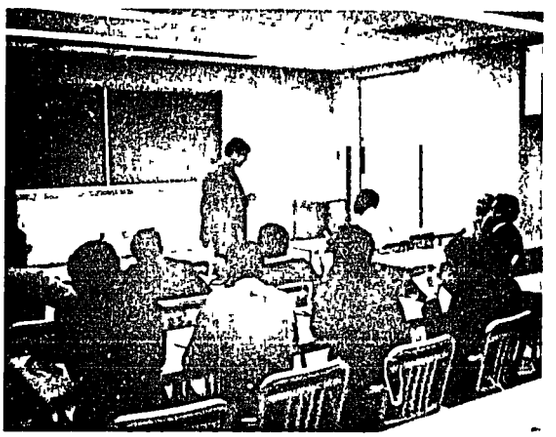


Miami, Florida



Wilmington, North Carolina

Atlanta, Georgia



Southwest Water Lab, Atlanta, Georgia

Gainesville, Florida

Participant	Municipal Assignment
Samuel Turner Boham	Water Department City of Charlotte Charlotte, North Carolina
Boonyong Lohwongwatana	Did not participate in this phase of the program, attended graduate school at the University of Illinois.
Rigoberto Cerna	Water Department City of Fayetteville Fayetteville, North Carolina
Chi-Tze Chen	Water Department City of Winston-Salem Winston-Salem, North Carolina
Jirasak Jindarojana	Did not participate in this phase of the program, attended graduate school at the University of Arkansas
Samuel Benon Kasadha	Returned to Aganda in December, 1970 to run for Parliament.
Ching-Hsiung Lu	Hackensack Water Company Weehawken, New Jersey
Luis E. Medina	St. Louis County Water Company St. Louis, Missouri
Quek Cheng Kwee	Department of Water Resources City Hall Durham, North Carolina
Mrs. Sri Soewasti Soesanto	Department of Public Utilities Raleigh, North Carolina
Susanto Mertodingrat	Department of Public Utilities Raleigh, North Carolina
Suwanrat Limrat	St. Louis Water Department St. Louis, Missouri
Dick William Nsubuga	Water Department City of Charlotte Charlotte, North Carolina
German R. Ramirez	Water Department City of Philadelphia 1160 Municipal Services Building Philadelphia, Pennsylvania 19107

Muhammad Shafiq	Water and Sewer Department City of Greensboro City Hall Greensboro, North Carolina 27402
Shamsuz Zoha	Did not participate in this phase of the program, attended graduate School at the University of Arizona.

11. Collaborating Engineering Office (Internship) Assignments: As has been indicated, the value of IPSED to the participant is as much derived from his assignment to an engineering office, for design and general experience, as from any single phase of the Program. We have listed in Paragraph 5-h fifty engineering firms of first rank in the profession that have been collaborating in this aspect of the work. In making assignment, we can choose the firm with which he will work with some discretion, taking into account the work at hand in each office and how it may benefit the participant in view of his probable future. Often we are able to put him with a firm that is doing work for his own country, which may, in particular instance, have special advantages. Assignments of the sixteen participants in the Twelfth Session were as follows:

Participant	Internship Station
Samuel Turner Boham	Gilbert Associates Reading, Pennsylvania
Boonyong Lohwongwatana	Did not participate in this phase of the program attended graduate school at the University of Illinois.
Rigoberto Cerna	March 1 - June 2, 1971 Black and Veatch International Consulting Engineers Kansas City, Missouri June 3 - June 30, 1971 Black and Veatch International Denver, Colorado
Chi-Tze Chen	March 1 - May 8, 1971 Camp, Dresser, and McKee Boston, Massachusetts May 15 - August, 1971 Camp, Dresser & McKee Pasadena, California
Jirasak Jindarojana	Did not attend this phase of the program, attended graduate school at the University of Arkansas.

Samuel Benon Kasadha	Did not attend this phase of the program, left in December, 1970 to run for Parliament.
Ching-Hsiung Lu	March 1 - May, 1971 Buck, Seifert and Jost Englewood Cliffs, New Jersey
Luis E. Medina	January 28 - June 18, 1971 Hazen and Sawyer New York, New York
Dick William Nsubuga	March 1 - August, 1971 Gilbert Associates, Inc. Reading, Pennsylvania
Cheng Kwee Quek	March 1 - August, 1971 Camp, Dresser, & McKee Boston, Massachusetts
German R. Ramirez	March 1 - August, 1971 James M. Montgomery Pasadena, California
Muhammad Shafiq	March 1 - August, 1971 Brown and Caldwell Consulting Engineers San Francisco, California
Mrs. Sri Soewasti Soesanto	March 1 - August, 1971 Engineering-Science, Inc. Washington, D.C.
Susanto Mertodingrat	March 1 - August, 1971 Engineering-Science, Inc. Washington, D.C.
Suwanrat Limrat	March 1 - August, 1971 Metcalf & Eddy Engineers Boston, Massachusetts
Shamsuz Zoha	Did not attend this phase of the program, attended graduate school at the University of Arizona

12. Final Reports and Recommendations: A final report is required of all participants in IPSED relative to their total experience in the Program. Instructions are issued to participants immediately preceding their municipal and consulting office assignments which outline topics to be covered (see Appendix G). A request is made for recommendations which might be considered for use in improving the Program as time goes on.

The following are excerpts from recommendations made by the participants in their final reports. Their response to the philsoophy and basic structure of the program was favorable. Their recommendations were of the nature of (1) additional course work in certain areas or of (2) administrative smoothness. A frequent request was for more work in the area of sewage treatment, other requests for chemistry and computer courses have already been implemented. The participants felt it would be a valuable experience to visit construction sites and plants where sanitary equipment is manufactured.

There were a number of suggestions made concerning the design phase of the program. Many of the suggestions revolve around closer contact and coordination between the engineering office and the IPSED staff. The participants found in some cases that the consulting firm did not have a sufficient understanding of the nature of the IPSED program and what the participant was to gain from the design phase. Thus the suggestion that a meeting be held with consulting firms to discuss the IPSED program and this phase, as well as visits by the IPSED staff to the consulting firm while the student is assigned there. One suggestion was to pay the consulting firms a stipend to cover basic expenses incurred by them while the participant is assigned to their office.

A final suggestion made by several participants is quite interesting a worthy of serious consideration. Before the participants return to their home countries, they return to Chapel Hill for an evaluation seminar to discuss as a group with the IPSED staff their experiences of the past year.

"I would also suggest that when field trips are arranged, they should include visits to construction sites where Sanitary Engineering facilities are being constructed."

"I suggest that right from the beginning of the IPSED program (Say in September) arrangements for placing participants with Municipal Authorities should be made and possibly be confirmed also."

"The program is a real success and it serves its purpose, the enhancement of the job effectiveness of practicing engineers from developing countries is in a very effective manner for that I must congratulate the staff members of the IPSED program. The academic phase is a very well conceived refresher course and provide an opportunity to review the theoratical knowledge already learnt in undergraduate course, especially in the related subjects of Sanitary Engineering and also acquaint with current design practices. The municipal phase provides a closer look of the problems encountered in operation and maintenance and also enables to differentiate between well designed trouble free plant and poorly designed plant. It gives a clear picture of the points of consideration which the designer should have taken into account while designing the plant to make the plant easily operatable and economical. Actually by discussing the problems encountered, with the operating personnel one learns a lot and can make use of that in future design work. By working with Brown Caldwell, I have been really benefitted due to the fact that I was involved in real

design work and this has created confidence in me to solve some real problems in sewerage treatment plant design especially the selection of some basic mechanical equipment and hydraulic design. My engineering outlook has been now broadened vastly and I feel myself more competent and well equipped technically to solve the problems which I will confront with in my future practical life.

As in most of the developing countries for whom this program has been designed cannot afford separate structural engineers for structural design involved in water supply and wastewater treatment engineering so it will be more beneficial if some course on structural design is also introduced. That will improve the utility of this program.

In the design phase, the participant should be told well in advance about the places and firms where one can go and be told the work which the firm is doing at that time so that he can choose firm of his interest, and prepare himself for that. For example I was interested to have some experience in water supply design especially design of distribution network and design of tubewells and installation but the firm with which I was working did not have any project like that, so something is left which I desired to achieve."

"A general comment to be implemented... would be... for the student to solve some of the problems by computer. It could also be possible in a regular course to introduce the basis of programming by computers.

Since it worked out perfectly for me, I received the best impression of this phase (Municipal) of the Program at the Philadelphia Water Department and the recommendation is directed to find out those aspects involved in a municipal phase that would be similar to the ones the participant will be involved with later in his own country. This should be determined in advance and previous to the visit to the municipality, so that the program assistant can make the necessary arrangement for a better training program.

In order to insure a better performance in the relationship student-consulting firm, it may be pointed out to study the possibility of paying to the company by the participant's sponsorship. The payment will be based on basis expenses that would be incurred by the firm."

"...DESIGN OFFICE PHASE COULD have been better utilized if:
1) The Firm (Company) where we are being placed had known in detail about the duties which should be given to the participants and also about the main goal of IPSED. So that there will be no hesitation in giving the assignments.

2) The participants had known better about what kind of works they may ask to the company, without passing the barrier of those which should be kept confidentially by the company.

Based on the above mentioned reasons, we suggest for another meeting between IPSED staff and the Consulting Engineering firms to discuss and determine the job relations between the participants and the firms and also what kind of assignments they should give to the participants. Final decisions on these should be given to the participants as a guidance during their design office phase.

I would suggest a slight change in the length of each of the three periods (Phases):

I. Academic phase of program: 6 months
II. Municipal phase of program: 1 month
III. Design office phase of program: 5 months

The one month longer Academic Phase would be divided into 2 parts:

a) One semester (5 months) for lectures, field-trips and examinations.
b) One month (the last month) to get more assignments and design practices for complete projects which will ease the participants in going through the Design Office Phase.

I would also suggest that during the IPSED program, the participants are given the opportunity to see the manufacturing of various equipments, pipes and other plant units used in Water and Sewage Treatment Plants, which enable them to evaluate those products manufactured in the U.S.A."

"...but it should be better and worthwhile if the company has a clear understanding about the IPSED program.

Meeting with Engineering Consultants that have cooperated in the IPSED Program should be arranged as soon as possible to explain and discuss about the Program and request for their cooperation.

Seminar on the evaluation of the training result should be arranged at the end of the program at either Chapel Hill or at any other suitable location, so that the result obtained from the seminar may help to shape and strengthen the IPSED Program."

"I have found the IPSED program to be highly organized and I am very much impressed with the balance of work between academic topics and the on-the-job training.

It is evident that the course is geared to the needs of the practicing Engineer, especially from developing countries. However, in view of the limited time available, the program is heavily weighted in favor of Water Engineers who are in the majority compared with Sewerage Engineers.

I am fully satisfied that I have had a worthwhile experience and hope to return to my country better equipped to solve the problems of water supplies and sewerage."

"...I had gained a lot of experience and knowledge in the sanitary engineering, both theorthically and practically."

"...if possible, the courses in academic phase participants attended should include more detail in sewage treatment. And the IPSED should invite some consulting engineers to discuss or exchange the design experience with

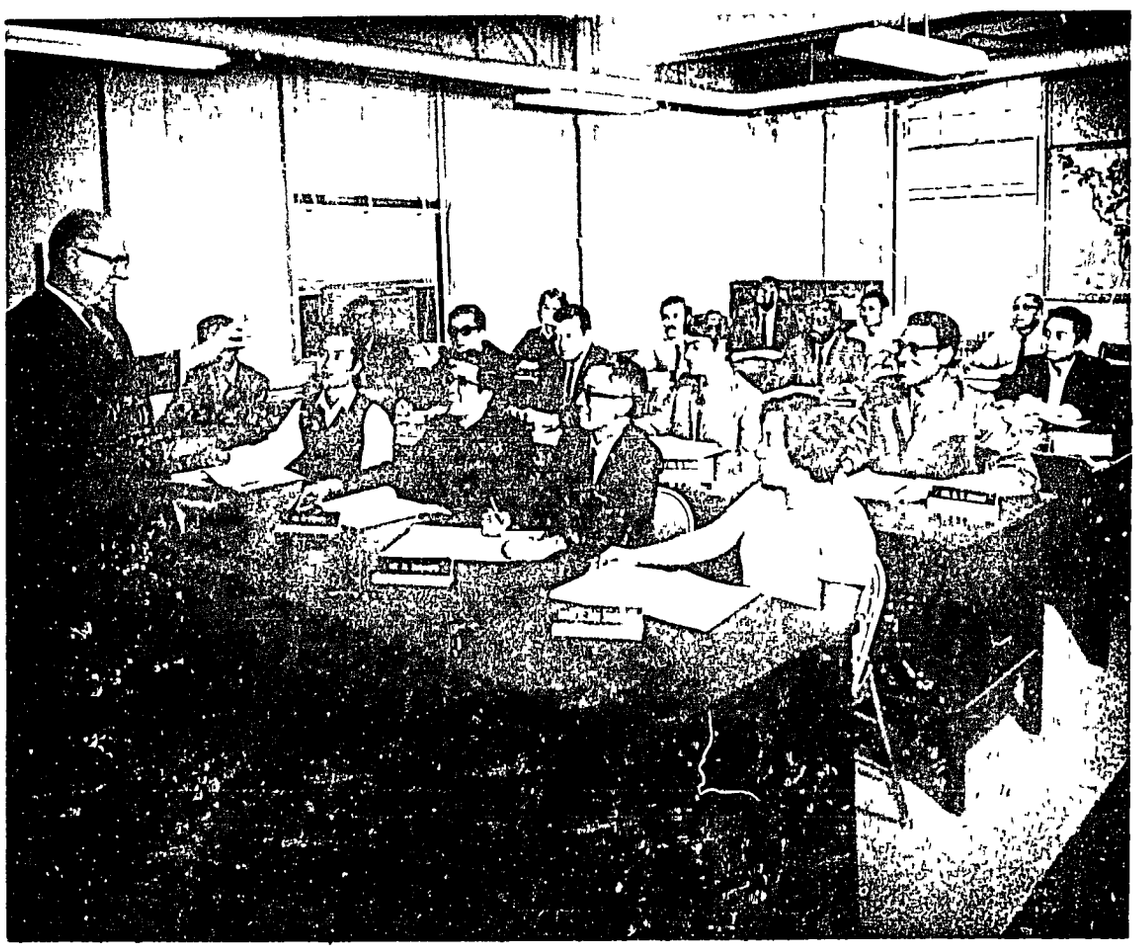
participants."

"The academic phase seems to be too short for the participants to cover both the water supply and waste water disposal system. If it is possible, the subject on Sanitary Engineering Design may be separated into two courses in which one subject deals with water supply system whilst the other deals with the waste water disposal. This could enable the participant select one or both the subjects according to their field of interest at home.

Municipal Phase of one month may be too short depending on the installation or organization the student is attached to, as the student may have to find out about the general organization during the early stage of attachment before going into other aspects of the operation in which the student is interested. In order to save time, it may perhaps be possible to obtain organization charts and other relevant information to be passed on to the participants before he is actually attached. This will enable the students to work out before hand, to get maximum benefit of this phase.

In my opinion, it may be a good idea to have all the participants returned to Chapel Hill during the last two weeks of the course to prepare the final report and discuss the overall training with the other students and present their views to the faculty."

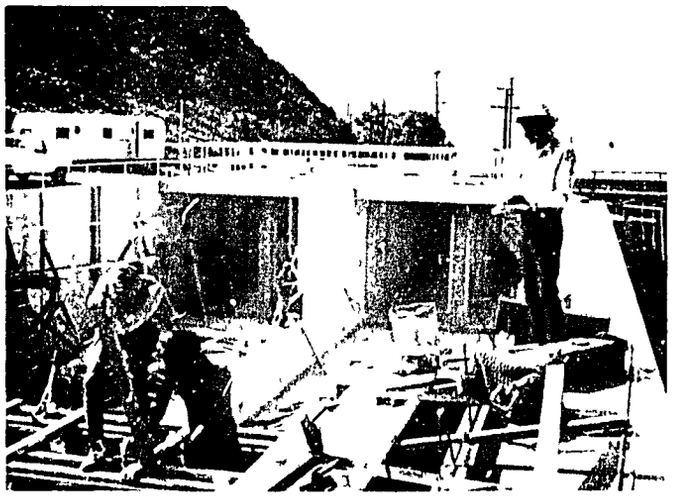
I.P.S.E.D. CLASSROOM



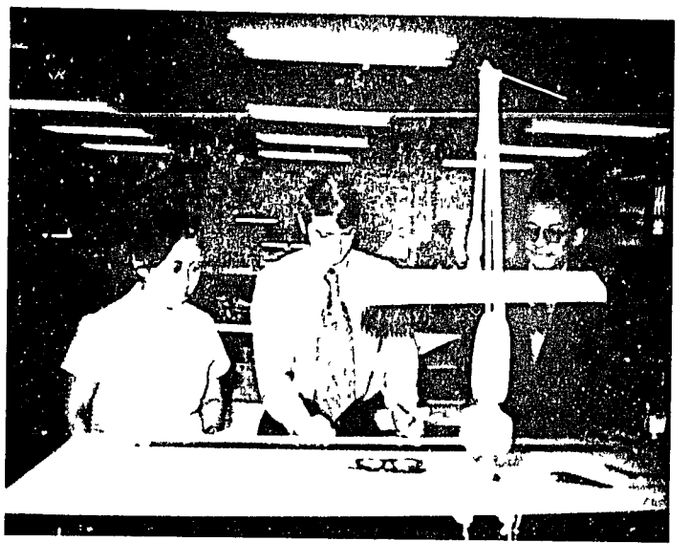
Class conducted by Professor Barnes

Ching-Hsiung Lu, The Republic of China, at Buck, Seifert and Jost, Englewood, Cliffs, New Jersey.

Rigoberto Cerna, Honduras, inspecting improvements being made on the Blue River Sewage Treatment Plant in Kansas City, Missouri by Black and Veatch of Denver, Colorado.



German Ramirez of Colombia interned with James M. Montgomery Consulting Engineers, Inc. of Pasadena, California; inspecting construction of the settling troughs at the Pasadena Water Treatment Plant.



Mrs. Sri Soewasti and Mr. Suranto, husband and wife participant team from Indonesia, in the drafting room of Engineering Sciences, Washington, D.C.

Dick William Nsubuga and Samuel Turner Boham at the Water Department, City of Charlotte, Charlotte, North Carolina.

A P P E N D I C E S

APPENDIX A

Lecture Schedule - ENVR 173: Design of Hydraulic Structures - George E. Barnes

Fall 1970 / 10A.M., MWF / Room 153

Date	Day	Subject
Sept. 18	F	Hydraulics review - general principles
21	M	Hydraulics review - general principles
23	W	Hydraulics and energy gradients
25	F	Dimensional analysis and dynamic similarity
28	M	Origin and basis of formulas for friction losses
30	W	Minor losses - "K" factors and equivalent pipe
Oct. 2	F	Application of loss factors in piping systems (with gravity and pumping heads)
5	M	Distribution systems analysis - Hardy Cross Method
7	W	Distribution systems analysis - method of sections
9	F	Principles of open channel flow (friction and other losses)
12	M	Backwater curves
14	W	Hydraulic jump and applications
16	F	Test
19	M	Design of transition sections
21	W	Design of grit chamber velocity control sections
23	F	Reservoir capacity vs demand
26	M	Design of stilling basin
28	W	Design of overflow spillway and apron
30	F	Flood routing
Nov. 2	M	Centrifugal pump - theory of operation
4	W	Centrifugal pump - losses and actual operation
6	F	Centrifugal pump - types suited to various applications
9	M	Centrifugal pump - specific speed, specifications, and installation requirements
11	W	Winston-Salem, N.C. (AWWA-WPCF)
13	F	Centrifugal pump - pump characteristic curves
16	M	Centrifugal pump - drawing curves from test data
18	W	Centrifugal pump - systems head curves and applications
20	F	Test
23	M	Pump starting and stopping - wet well design for unsteady flow conditions
25	W	Water hammer
30	M	Measuring devices - applications and limitations, weirs, proportional weirs, orifices, venturis, Parshall Flume, others
Dec. 2	W	FIELD TRIP, southeastern part of U.S.
4	F	" " " " " "
7	M	" " " " " "
9	W	Hydraulic instruments

APPENDIX A (continued)

Date		Day	Subject
Dec.	11	F	Hydraulic gradient through sewage treatment plant
	14	M	Hydraulic gradient through water treatment plant
	16	W	Design of dams - masonry
	18	F	Design of dams - earth
Jan.	4	M	Alternate types of outlet works - flood routing
	6	W	"n" for large conduits
	8	F	Wet well design for booster station
	11	M	Siphon design and sanitary sewer design
	13	W	Storm water sewer design
	16	F	Storm Water Sewer Design

APPENDIX B

Lecture Schedule - ENVR 175: Sanitary Engineering Design - Richard F. Cole
in Developing Countries

Fall 1970 / 10 A.M. and 2-4 P.M. (Lab.), Tu; 10 A.M., Th / Room 153

Date	Day	Subject
Sept. 17	Th	Introduction to course
22	Tu (A.M.)	Basis of design
22	Tu (P.M.)	Review of plans and basis of design
24	Th	Outline of treatment methods
29	Tu (A.M.)	Rationale for treatment
29	Tu (P.M.)	Water treatment plant design
Oct. 1	Th	Plant layout
6	Tu (A.M.)	Treatment plant hydraulics
6	Tu (P.M.)	Plant design
8	Th	Screening and aeration
13	Tu (A.M.)	Mixing
13	Tu (P.M.)	Plant design
15	Th	Flocculation basin design
20	Tu (A.M.)	Flocculation basin design
20	Tu (P.M.)	Exam
22	Th	Types of Chemical feeders
27	Tu (A.M.)	Design and selection of chemical feeders
27	Tu (P.M.)	Plant design
29	Th	Sedimentation theory
Nov. 3	Tu (A.M.)	Settling basin design
3	Tu (P.M.)	Plant design
5	Th	Flow distribution
10	Tu (A.M.)	Winston-Salem, N.C. (AWWA-WPCF)
10	Tu (P.M.)	" " " " "
12	Th	Slow and rapid sand filtration
17	Tu (A.M.)	Rapid sand filters
17	Tu (P.M.)	Plant design
19	Th	Filter media
24	Tu (A.M.)	Pressure and diatomaceous earth filters
24	Tu (P.M.)	Chlorination facilities
Dec. 1	Tu	FIELD TRIP, southeastern part of U.S.
3	Th	" " " " " "
8	Tu	" " " " " "
10	Th	Introduction to waste treatment
15	Tu (A.M.)	Screening and grit collection
15	Tu (P.M.)	Primary treatment
17	Th	Trickling filter design
Jan. 5	Tu (A.M.)	Solids handling and disposal
5	Tu (P.M.)	Plant design
7	Th	Biological treatment - fundamentals
12	Tu (A.M.)	Activated sludge
12	Tu (P.M.)	Exam
14	Th	Stabilization ponds

APPENDIX C

Lecture Schedule - ENVR 181: Groundwater Hydrology - J. C. Brown

Fall 1970 / 9 A.M., Tu and Th / Room 153

Date	Day	Subject
Sept. 17	Th	General hydrology
22	Tu	General hydrology
24	Th	Groundwater definitions
29	Tu	Groundwater definitions
Oct. 1	Th	Geology and groundwater occurrence
6	Tu	Geology and groundwater occurrence
8	Th	Groundwater quality
13	Tu	Groundwater quality
15	Th	Groundwater movement
20	Tu	Groundwater movement
22	Th	Groundwater and well hydraulics
27	Tu	Groundwater and well hydraulics
29	Th	Groundwater and well hydraulics
Nov. 3	Tu	Groundwater and well hydraulics
5	Th	Mid-term Exam
10	Tu	Winston-Salem, N.C. (AWWA-WPCF)
12	Th	Groundwater and well hydraulics
17	Tu	Types of wells
19	Th	Well construction
24	Tu	Well design
Dec. 1	Tu	FIELD TRIP, southeastern part of U.S.
3	Th	" " " " " "
8	Tu	" " " " " "
10	Th	Well design
15	Tu	Well design
17	Th	Basin-wide groundwater development
Jan. 5	Tu	Groundwater investigations
7	Th	Groundwater investigations
12	Tu	Artificial recharge of groundwater
14	Th	Seawater intrusion

APPENDIX D

Lecture Schedule - ENVR 182: Water Resources Planning in Developing Countries - F.E. McJunkin - R.O. Cordon

Fall 1970 / 9 A.M., MWF / Room 153

Date	Day	Subject
Sept. 18	F	Introduction to the planning problem
21	M	Time value of money
23	W	Time value of money
25	F	Time value of money
28	M	Comparison of alternatives
30	W	Comparison of alternatives
Oct. 2	F	Comparison of alternatives
5	M	Benefit/cost analysis
7	W	Benefit/cost analysis
9	F	Benefit/cost analysis
12	M	Capital budgeting
14	W	Preliminary engineering studies
16	F	Population forecasting
19	M	Water use
21	W	Period of design
23	F	Period of design
26	M	Economic project staging
28	W	Economic project staging
30	F	Basis of design
Nov. 2	M	Preliminary estimates and financial planning
4	W	Quiz
6	F	Critical path method
9	M	Critical path method
11	W	Winston-Salem, N.C. (AWWA-WPCF)
13	F	Critical path method
16	M	Introduction to systems analysis
18	W	Classical optimization methods
20	F	Linear programming
23	M	Linear programming
25	W	Estimation of flood flows
30	M	Determination of reservoir capacity
Dec. 2	W	FIELD TRIP, southeastern part of U.S.
4	F	" " " " " "
7	M	" " " " " "
9	W	Extrapolation of hydrological data
11	F	Storm drainage
14	M	Quiz
16	W	Microeconomic theory in public policy
18	F	Microeconomic theory in public policy
Jan. 4	M	Microeconomic theory in public policy
6	W	Water rate structures
8	F	Water rate structures
11	M	Water rate structures
13	W	A philosophy of planning and design

APPENDIX E

REFERENCE TO EARLIER REPORTS

Earlier reports pertaining to preceding sessions of the International Program in Sanitary Engineering Design include the following:

Session	Date of Session	Date of Report
1	January, 1963 - November, 1963	March 31, 1964
2	September, 1963 - July, 1964	February 22, 1965
3	February, 1964 - December, 1964	Sessions 3 & 4 jointly reported
4	September, 1964 - July, 1965	January 15, 1966
5	February, 1965 - October, 1965	Sessions 5 & 6 jointly reported
6	September, 1965 - August, 1966	March 15, 1967
7	September, 1966 - August, 1967	September, 1967
8	February, 1967 - January, 1968	September, 1968
9	September, 1967 - August, 1968	Sessions 8 & 9 jointly reported
10	September, 1968 - August, 1969	No printed report
11	September, 1969 - August, 1970	September, 1970

APPENDIX F

SUMMARY LIST OF PARTICIPANTS AND COUNTRIES OF ORIGIN

In the eleven sessions of the International Program in Sanitary Engineering Design, there have been eighty-seven participants from thirty-four different countries, as follows:

Group No.	Name of Participant	Country
1	Eduardo Garcia	Colombia
	Zekal Gurgul	Turkey
	Francisco de Mendonca	Brazil
	Semih Turker	Turkey
	Sacit Unal	Turkey
2	Horace L. Beckford	Jamaica
	Salman M. El-Rawi	Iraq
	Walter B. Fabian	Costa Rica
	Jeff E. Flanagan	USAID Burma
	Vincent E. Hemming	Jamaica
	Emmanuel A. Ojo	Nigeria
	Pedro A. Parada	Bolivia
	Ali H. Shubber	Iraq
3	Andres Bacigalupi	Argentina
	Kofi Mensah Addison	Ghana
	Felipe Ruiz	Chile
	Luckaman Al-Abaddy	Iraq
4	Kofi Mensah Addison (started with 3, ended with 4)	Ghana
	Emilio de la Fuente	Peru
	Philip Peng-fei Kuo	Taiwan
	Nilo Leite Nassar	Brazil
	Augusto A. Navarro	Peru
	Muwaffaq B. A. Sulaiman	Iraq
	German Sanchez	Venezuela
	Najeeb Fotch Tleel	Jordan
5	Benjamin O. Adeyemi	Nigeria
	Carlos Guerrero	Bolivia
	Nguyen Danh Vang	Vietnam
	Tran Phuoc Tho	Vietnam
	Nguyen Dinh Vien	Vietnam
	M. Zeki Aygen	Turkey
	Yuksel Isleyen	Turkey
	O Perakyla	Finland

APPENDIX F (continued)

Group No.	Name of Participant	Country
6	Zafar Ahmad	Pakistan
	Salman Al Mahmoud	Iraq
	Alir Doria	Brazil
	Syed Husain	Pakistan
	Muhammad Khokhar	Pakistan
	Francis Obodoechina	Nigeria
	Claudius Razafy	Madagascar
	Ismail Razee	Pakistan
	Ahmet Takaoglu	Turkey
	Marina Rosa e Silva	Brazil
	Hugo Tejerina	Bolivia
7	Ajit Kumar Bhunia	India
	Boonsong Seuyouyong	Thailand
	Usu-nan Chen	Taiwan
	Frank G. Chu Cheong	Trinidad
	Mohammad Nijat Khan	Pakistan
	Henrique de Mello	Brazil
	Mirajuddin Nagi	Pakistan
	Samuel Adewole Osobamiro	Nigeria
	Benedito E. B. Pereira	Brazil
	Thira Kunavipakorn	Thailand
8	Messale Aberra	Ethiopia
	Sang Yong Chang	Korea
	Velupillai Mahathevan	Ceylon
	Truong Nhu Tu	Vietnam
9	Raul Ernesto Atala	Peru
	Benigno C. Ayson, Jr.	Philippines
	Leopoldo Delgado Bracale	Peru
	Oscar V. Campos	Peru
	Ta-Ko Chen	Taiwan
	Eliseo P. Corpus	Philippines
	Antoliano Diaz	Philippines
	Reynaldo A. Florendo	Philippines
	Enrique La Motta	Ecuador
	Yen-min Liu	Taiwan
	Siddig Mustafa	Sudan
	Mario Peña	Bolivia
	Jen-chei Tseng	Taiwan
10	Tomas V. Argente	Philippines
	Andrew Moche	Kenya
	Luciano Peña D.	Colombia
	Benjamin A. Quaye	Ghana

APPENDIX F (continued)

Group No.	Name of Participant	Country
11	Sylvester D. Agboola	Nigeria
	H. Uslu Arapoglu	Turkey
	Richardus Harjoko	Indonesia
	Ali Rida Mohemed El-Hingari	Libya
	Leckrazsingh Hurpaul	Mauritius
	Penrose K. Johnson	Nigeria
	Sharifullah Khan	Pakistan
	Luis A. Moncada	Honduras
	Pedi Natasuwarna	Indonesia
	Gabriel Babs Omolegbe	Nigeria
	Mauricio A. Rivera	Colombia
	Abdul Wahab Soomro	Pakistan
	Khurshiduz Zaman	Pakistan
12	Samuel Turner Boham	Ghana
	Boonyong Lohwongwatana	Thailand
	Rigoberto Cerna	Honduras
	Chi-Tze Chen	Taiwan
	Jirasak Jindarojana	Thailand
	Samuel Benon Kasadha	Uganda
	Ching-Hsiung Lu	Taiwan
	Luis E. Medina	Colombia
	Dick William Nsubuga	Uganda
	Quek Cheng Kwee	Singapore
	German Rafael Ramirez	Colombia
	Muhammad Shafiq	West Pakistan
	Sri Soewasti Soesanto	Indonesia
	Susanto Mertodiningrat	Indonesia
	Suwanrat Limrat	Thailand
	Shamsuz Zoha	East Pakistan

APPENDIX G

INSTRUCTIONS TO PARTICIPANTS ON PREPARATION OF FINAL REPORT

Each participant in the International Program in Sanitary Engineering Design is required to submit a written final report on his total experience during the assignment. This is to be submitted in Chapel Hill following his assisnment. This is to be submitted in Chapel Hill following his assignment to the terminal phase of the Program (usually with a consulting firm) and immediately before his return to his own country.

The following outline will assist in the preparation of this report. It will indicate the scope of reporting ordinarily to be expected, but need not be followed exactly, in every instance. It should serve rather as a general guide.

Keep a daily log or abbreviated diary of your activities on the Program. This will be of help in writing the final report. The diary will constitute a refresher (particularly with respect to full names of persons, places, dates, etc., and will save time in this sense). It will also be a fine memo book for the future.

The purpose of the report is to help us in evaluating your experience and to plan more effectively for future programs. The report itself will also serve the participant as excellent reference material for the future.

On the next page is a suggested form for the report which you may find useful in its preparation. Content is outlined below.

Report

Identify the writer by full name, permanent address, and office held in your own country. Also give the name of the organization which supplied you with the funds for participation and your adviser.

Substance of the Report:

1. Academic Phase of the Program (dates of attendance):

   a. Discuss topics in which academic work was conducted, such as the world program in water supply, hydraulics, hydrology, development of ground water supply, development of surface supply, conduct of and reporting on preliminary studies, sanitary chemistry, sanitary biology, materials of construction, waterworks equipment, waterworks control equipment, design problems, organization, management, and financing. In this, consider adequacy of coverage, suggestions for improvement in any aspect of the work, value of homework or problem sessions, importance of notes and reference material furnished you. Include work on sewage, if any.

   b. Field trips: number and character, what is gained from them; what information of value obtained.

c. Attendance at national and local waterworks' meetings: papers of major importance to you; value of exhibits; enlarged acquaintance of the profession.

d. General commentaries on this phase of the Program and suggestions for improvement.

2. Municipal Phase of the Program: Municipality to which you were assigned, and with whom associated on the job; dates of attendance; type and capacity of waterworks (and of sewage treatment plants if included); by whom designed, method of treatment, operating features of collection system, treatment plant, and distribution system; organization of personnel and delegation of responsibilities; financing and rate structure, metering and collection of bills for service; provision for planning and future design. Submit copies of municipal reports or other material that might give some of this information, to supplement your own, or offered in substitution of too much descriptive writing on your part, but not to eliminate basic reporting.

3. Design Office Phase of the Program: dates of attendance; name of firm and location.

a. Organization chart, showing chain of responsibilities and their nature for partners or principals, and employees.

b. Projects handled by the organization illustrative of its scope of operations in preliminary project studies, special investigations, design (structural, architectural, mechanical, electrical, hydraulic, and process), and supervision of construction.

c. Library and reference material, how organized and effectiveness.

d. Laboratory facilities, for what purposes used and how effective.

e. Your own specific duties and assignments, name of your immediate superior. Opportunity for varied or narrow experience, whether or not experience applicable to work in view, in your own country.

f. Submit sample reports, plans and specifications related to your own assignment, and make suitable reference to them in your report.

g. General commentaries on this phase of the Program and suggestions for improvement.

Form of Report

Put report in binder, with abbreviated title, date, and name of author on the outside of the binder. Make an inside cover sheet, with full title, date, name of author, and his permanent address in the form of a title sheet.

SUMMARY: After writing the report, make a brief summary of its contents for the quick review of the reader. Bind this summary immediately behind the title sheet.

Report

Purpose	
Scope	
Academic Phase of Program)	
Municipal Phase of Program)	see preceding paragraphs
Design Office Phase of Program)	
Conclusions and Recommendations	

Sign the report on the lower part of the title sheet. It is further suggested that paragraphs be given numbers and appropriate captions, for ready reference.

University of North Carolina at Chapel Hill

School of Public Health

Department of Environmental Sciences and Engineering

To all persons to whom this writing may come, Greeting:

Be it known that in recognition of the completion of the course of study in the

International Program In Sanitary Engineering Design,

we confer upon

_____

this Certificate of Achievement

This day of 19

_____
Dean, School of Public Health

_____
Head,
Department of Environmental
Sciences and Engineering

_____
Director, International Program
in Sanitary Engineering Design

University of North Carolina at Chapel Hill

School of Public Health

Department of Environmental Sciences and Engineering

To all persons to whom this writing may come, Greeting:

Be it known that

_____

has satisfactorily completed the academic phase of the

International Program In Sanitary Engineering Design

This day of 19

Dean, School of Public Health

Head,
Department of Environmental
Sciences and Engineering

Director, International Program
in Sanitary Engineering Design