

DOCTOR OF ENGINEERING INTERNSHIP AT  
THE U. S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION

An Internship Report

by

GEORGE CHARLES HOFF

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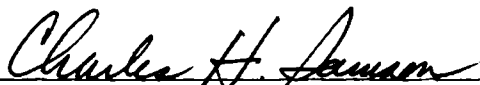
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Dr. William B. Ledbetter, Committee Chairman  
Department of Civil Engineering



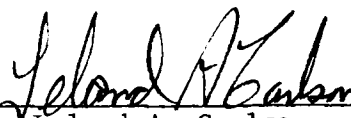
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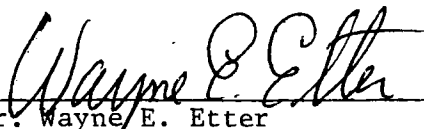
Dr. Charles H. Samson, Jr.  
Interim President, Texas A&M University  
Departments of Aerospace Engineering and Civil Engineering



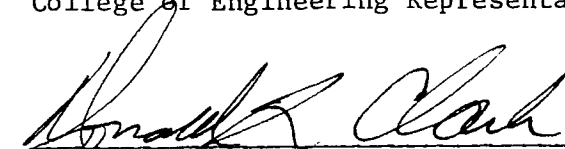
Dr. Charles A. Rodenberger  
Department of Aerospace Engineering



Dr. Leland A. Carlson  
Department of Aerospace Engineering  
College of Engineering Representative



Dr. Wayne E. Etter  
Department of Finance



Dr. Donald L. Clark  
Associate Dean, College of Education  
Department of Industrial Education  
Graduate College Representative

November 1981

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## ABSTRACT

The nine-month internship was accomplished as a first-line supervisor in a major Federal Government engineering research and development laboratory. The objectives of the internship were to develop and improve skills in the management of technical work groups, project development, technology transfer, and professional development.

A number of observations and recommendations for improved management operations at the internship facility occurred during the internship. Formal financial management training should be provided to all technical personnel dealing with the management of resources that result in fund expenditures. Periodic reviews by top level management of communication channels are essential to insure that all technical personnel get the information needed to function effectively. Preparation by management for labor-management consultations should be extensive and carefully coordinated to expedite problem solutions. The effectiveness of Equal Employment Opportunity (EEO) activities and programs and their financial impact on the organization should be periodically reviewed, evaluated, and modified to achieve a proper cost-benefit balance. Project managers should put considerable effort into providing work justifications and project need requirements to higher levels of management. All management decisions involving resolution of work problems should be expeditiously made and implemented. Technology transfer through industrial education should be designed to also benefit the instructor by real-world feedback from the students. Professional development through participation in technical, scientific, and professional meetings is essential for the technical staff of a Government research facility. The development of technical managers

should be accomplished through formal education in financial and management areas outside those associated with the development of technical skills and expertise. On-the-job training to accomplish this is not wholly satisfactory.



## CHAPTER 1

## INTRODUCTION

## 1.1 GENERAL BACKGROUND

My internship was served as the Chief, Materials Properties Branch (MPB), Engineering Mechanics Division (EMD), Structures Laboratory (SL), U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The WES laboratory complex is the principal research, testing, and development facility of the U. S. Army Corps of Engineers. Its mission is to conceive, plan, and execute engineering investigations, and research and development studies, in support of the civil and military missions of the Chief of Engineers and other Federal agencies, through the operation of a complex of laboratories in the broad fields of hydraulics, soil and rock mechanics, concrete, expedient construction, nuclear and conventional weapons effects, nuclear and chemical explosives excavation, vehicle mobility, environmental relationships, engineering geology, pavements, protective structures, aquatic plants, water quality, and dredged material. On a reimbursable basis, the Waterways Experiment Station performs, on an extensive world-wide and national scope, basic and applied research in these and related fields, develops methods and techniques, tests materials and equipment, and provides consulting services in its specialized fields of competence. At the completion of the internship period, the WES personnel strength consisted of 1501 civilian and 17 military (12 officers and 5 enlisted personnel). The civilian staff included 287 engineers, 194 scientists, and 335 technicians. The Structures Laboratory had 171 employees.

My introduction to the field of engineering began while attending a technical high school. During this time I had part-time and summer jobs

as a draftsman doing structural steel detailing, concrete formwork design, and primary road (highway) drafting. Upon completing high school I attended the University of Illinois at Urbana graduating in 1961 with a B.S. degree in Civil Engineering and went to work for the Cook County, Illinois (Chicago area) highway department as an expressway designer. After 13 months employment, I was conscripted into the Armed Forces and after basic training was assigned to the Concrete Laboratory of WES in April 1962 under the Army's Engineering and Scientific Program for Enlisted Personnel to function as an Assistant Civil Engineer. Upon completion of my military obligation in February 1964, I was given a job as a GS-9 Civil Engineer in that laboratory and continued the same responsibilities and project work that I had as a military engineer. In the time period from 1964 to the start of the internship program, I was assigned at different times to the General Investigation Section, Grouting Section, Structures Section, and the Materials Properties Section of the Concrete Laboratory. The latter became a Branch and during that progression, I advanced to the job grade of GS-13 receiving that pay grade in 1972 when I became chief of the Materials Properties Branch (MPB). Also during that time period I earned graduate course work credit from Mississippi State University through the WES graduate center and completed a M.S. degree in Theoretical and Applied Mechanics in 1969 from the University of Illinois at Urbana as a full-time student under the Corps of Engineers Advanced Study Program for Scientists and Engineers. My participation in the Doctor of Engineering Program at TAMU is being sponsored under the same program and began with the 1977 Fall semester with the internship beginning with the 1978 Fall semester.

A copy of the official duties of my assignment as Chief, MPB, is presented in Appendix A. These duties require that I function as both a

supervisor and a part-time project manager in the field of engineering materials and concrete construction.

## 1.2 OBJECTIVES OF INTERNSHIP

The principal objectives of the internship assignment were: (1) to develop the managerial skills necessary to function more effectively in my present position as well as in management areas of greater responsibility; (2) to develop and successfully complete technical research programs and aid in the solution of immediate technical problems; (3) to transfer my technical expertise to practicing engineers and inspectors through lectures at various training schools conducted at WES; and (4) to participate in national and international technical organization meetings and seminars for the purpose of maintaining the leading edge in technical expertise. A copy of my internship objectives as approved in November 1978 is presented in Appendix B.

## 1.3 DETAILS OF POSITION

Functional organization of the WES at the start of the internship period is presented in Appendix C. Four engineering laboratories, the Hydraulics, Geotechnical, Structures, and Environmental Laboratories, have vested responsibility for accomplishment of the overall mission in their respective fields of endeavor. Other elements provide essential technical support in instrumentation, electronic computation and data processing, special library services, technical report preparation and publication, etc., and perform additional work for the Corps within their capabilities. The Engineering and Construction Services Division provides utilities and light and heavy construction support, plus mechanical shops facilities.

The functional organization is completed by the presence of all normal administrative services. This concept provides for operational

flexibility and most effective use of staff capabilities and, by centralization of common-use support facilities, avoids costly duplications of equipment and personnel.

The organization of the Structures Laboratory, the Engineering Mechanics Division, and the Materials Properties Branch (MPB) are also presented in Appendix C. The MPB is shown as having three engineers and two technicians plus myself as supervisor. During the internship period, a GS-7 civil engineer and a GS-3 engineering aid were added to this group. As the Chief of the MPB, I worked under the direct supervision of John M. Scanlon, Chief of the EMD. Mr. Scanlon was also the Industrial Advisor for this internship.

As the Chief of the MPB, I was responsible for all activities of the Branch including the performance of research, analytical, and testing work, plus all administrative functions necessary for operation of the Branch, to include financial management, recruitment and staffing, discipline, and employee performance ratings. The specific requirements of the job are shown in Appendix A. Unlike many internships which involve the beginning of a new job, this internship was the return to a previously occupied position but with expanded duties and responsibilities. The major portion of this internship report will deal with these additional items which were new to me and which were meant to contribute to my professional and managerial development.

From a technical standpoint, the staff members of the MPB perform two functions: (1) they do routine testing of engineering materials in accordance with prescribed procedures in order to develop engineering data and information needed for quality control and acceptance or to support research programs; and (2) they perform evaluations and research involving the use of new materials to solve old engineering problems and the

use of both new and old materials to solve new engineering problems. The first item is done principally by the technician staff with guidance and direction provided by the engineering staff. In these matters, the Chief, MPB, is the initial point of contact for this work who then assigns and schedules work, provides guidance during the evaluations, manages the costs associated with the work, and reviews all results. The second item is principally done by the engineering staff under the general supervision of the Chief, MPB. The Chief is responsible for identifying potential research areas, problems, and sponsors, then pursuing the leads through personal contacts and research proposals to finally arrive at obtaining funded research. He is assisted by the senior members of the Branch in these efforts. Once this work is obtained, it is assigned to various engineers for completion with the Chief providing guidance and direction commensurate with the experience and ability of the staff member assigned the work. The Chief reviews all technical work and reports for technical accuracy and competence.

## CHAPTER 2

## FINANCIAL MANAGEMENT

## 2.1 BACKGROUND

No appropriation is made in the Federal Government for the operation of the Waterways Experiment Station even though it is considered a Federal laboratory. Consequently, it serves the Corps of Engineers on a reimbursable basis, with the sponsoring offices of all work done at the laboratory paying all costs of the work involved. Its capabilities are available on the same basis to other Federal and Defense agencies and, when certain specified conditions are met, can be used by State agencies, foreign governments, and private concerns. Much of the work done at WES is obtained because of its unique research capabilities established over a 50-year period and its excellent reputation in the engineering community. In other instances, work must be actively pursued through the preparation for and submittal of proposals to prospective sponsors, often in a competitive atmosphere.

As Chief of the Materials Properties Branch, I was responsible for insuring that sufficient funds were available to meet all of the expenses of that Branch with respect to salaries, travel, supplies, and overhead. Since first becoming a WES supervisor in 1972, I received no formal training in financial management. To my knowledge, no WES supervisor receives such training at my pay grade and position. The knowledge of how to meet and manage the financial responsibilities of the job are learned on the job by trial and error and the reading of routine memoranda and regulations. In order to become more proficient in the management of funds within the government structure, one of the goals of the internship was to make a detailed review of financial management scheme at WES and relate that knowledge to the operation of my Branch.

The internship period began with only a month or so remaining in Fiscal Year 1978 and ended two-thirds of the way through Fiscal Year 1979. This was very beneficial in the planning of budgets for inclusion in the Internship Report but did not allow for a complete analysis of the budget year. The remainder of this chapter deals with my review and understanding of the WES financial system and its application to my Branch.

## 2.2 OBJECTIVE

As I had never received any formal training as a supervisor in financial management at WES, the objective of this portion of the internship was to require an in-depth review of the methods, procedures, policies, and regulations associated with financial management at WES and its relationship to the Corps of Engineers and the Federal Government.

## 2.3 ADMINISTRATIVE CONTROL OF FUNDS

The Commander and Director of WES is responsible for administrative control of WES funds and has delegated such control to the Chief of the Resource Management Office (RMO). This control has been further redelegated to the Chiefs of the Laboratories and Separate Staff Elements. The Chief of the Structures Laboratory has further delegated this responsibility to the Division, Branch, or Group Chiefs, and all individuals having project or program manager responsibilities. This last assignment of responsibilities included my position during the internship period.

As Chief of the Materials Properties Branch, I was responsible for management and control of all funds allotted or otherwise made available and approved for the operation of the Branch. "Funds allotted" means those funds for which actual advices of allotment or suballotment have been received irrespective of source. "Funds otherwise made available" means funds furnished by the various funding media provided for financing

intragovernmental transactions. These include Intra-Army Orders for Reimbursable Services (DA Form 2544), Advice of Obligation Authority (DA Form 3971), Military Interdepartmental Purchase Requests (DD Form 448), Project Orders, citation of funds, and others.

All personnel involved in the authorization or incurrence of obligations or expenditures of appropriated funds, both civil and military, are required to familiarize themselves with the provisions of Section 3679, Revised Statutes (31 USC 665), as implemented by references contained in WES Station Regulation No. 37-1-16, Administrative Control of Funds, dated 28 Dec 1978. I completed this familiarization during the second half of the internship. What, in essence, the statutes and regulations say is that no obligations will be created or otherwise incurred which are in excess of funds allotted or otherwise made available at the installation level where accounts are maintained, or, more specifically, at WES. They further state that any officer or employee found to be in violation will be subject to appropriate administrative disciplinary action for inadvertent violations or the penal provisions of Section 3679, Revised Statutes (31 USC 665) for willful violations. In order to carry out the provision of the statutes, the Commander and Director of WES is responsible for reporting all violations, even though inadvertent, to the Comptroller of the Army and to take correction action to preclude recurrence of the problem.

For the purposes of control of costs all supervisory personnel are required to rigidly adhere to the principles of cost control in administering work for which they are responsible. To accomplish this, the costs of operations should be constantly scrutinized for the purpose of



- a. holding costs to the lowest possible level,
  - b. keeping costs within established estimates or available funds,
- and
- c. where circumstances necessitate exceeding the original estimate, requesting additional authority or funds in sufficient time to prevent cost overruns.

#### 2.4 MANAGEMENT OF FUNDS

To accomplish the responsibilities associated with the administrative control of funds, the manager must have access to status reports on funds/limitations utilizations, contractual obligations, and fund availability certification. The principal tool for accomplishing this form of financial management at WES is the Management Information System (MIS). The MIS is an integrated computerized system which provides, through a common data base, a means of securing information pertaining to budgeting, programming, actual progress, and management resources in a variety of presentations. The system is built around a Master File of Accounts with the capability, through various coding devices built into the Master File of Accounts, to access information upon demand from stored information compiled from daily input. The Master File of Accounts is simply an updated computer random access disk file of all WES job numbers keyed to a coding system which permits extraction of all input information in such a way as to satisfy the requirements of the MIS. The capabilities of the MIS include providing weekly, biweekly, monthly, quarterly, and annual technical, manhour and fiscal progress reports tailored to the needs of each level of management. Actual progress is compared with scheduled progress, and provision is made for reporting on the above items on an exception or actual basis.

The basic information on the MIS capabilities and procedures for entering, correcting, and modifying the Master File of Accounts for the MIS as well as information on the computer print-outs available and remote access procedures are contained in WES Station Regulation No. 18-1-1, Army Automation; WES Management Information System; Policy, Objectives, Procedures, and Responsibilities. The actions taken to enter, correct, and modify the Master File of Accounts on behalf of my Branch are done by the staff of the Management Support Group of the Structures Laboratory at the request of myself and the other professional people in the Branch.

Every hour of every working day of each employee must be accounted for in some manner. If an employee is on some form of leave, this must be identified. If an employee is working on specific projects or involved in general administrative matters, appropriate charges for the cost of that employee's labor must be made against some approved funding authorization. This is done on daily basis on a Daily Labor Report (ENG Form 1A) by listing the employee and the actual time of the employee allocated against various job numbers. These job numbers are described in Section 2.5.1. The information from these labor reports is entered into the Master File of Accounts from which it may be extracted in a variety of forms. The MIS will provide 39 different computer print-outs on a regular basis. Some of these are very specialized for particular organizational elements or levels of management. Of specific interest to a manager at my level are MIS Report 10, Detail Cost Listing, and Report 12, Subfeature Cost Status Report. The Detail Cost Listing is available weekly and contains a descriptive listing of base cost, burdens, and total cost for each cost transaction plus all commitment and unliquidated obligations. The descriptive nature of the listing includes dates incurred, manhours,

expended, daily labor report, organization element, identification codes, and base salaries. It also gives the balance of funding remaining in each subfeature providing a transaction of any type occurred in that subfeature during the reporting period. The total balance in the feature account is also given. The Subfeature Cost Status Report is available twice monthly and provides a listing of each subfeature with scheduled cost, cost-to-date, cost this month, committed, unliquidated obligations balance, with subtotals by feature. Using these two reports, a first-time manager can rapidly be apprised of the funding balances for all or part of any job and also determine how the money is being spent. Comparing this to the rate at which work is actually progressing allows the manager to adjust resources or take other appropriate actions to ensure timely completion of all work.

The effective use of the MIS computer print-outs for managing funds is often constrained by the delays associated with inputting to the Master File of Accounts, correcting any errors in the input information, and printing out the reports and distributing them. Delays of ten days to two weeks are common. There appears to be no practical way by which this process can be speeded up. One alternative to getting information faster is to use a WES remote computer terminal to gain access to the MIS data base via time sharing at any time desired. Using a special MIS program entitled Workpackage Inquiry, information on subfeature and job number fund balances can be obtained but without the detailed information contained in the other MIS reports. In general, this information is only a few days old but is subject to change as adjustments and corrections are made to erroneous input data. If the manager needs to know exactly how much money remains on the day of his interest, the more recent

expenditures must be added by the manager to the latest posted information coming from the MIS.

## 2.5 ACCOUNTING CLASSIFICATIONS

2.5.1 Feature and Subfeature Accounts. The coding system for the MIS Master File of Accounts described in Section 2.4 consists of identification, by alpha-numeric characters, of job numbers composed of both feature account and subfeature account components. Each job number is distinguishable from all other job numbers carried on the MIS Master File of Accounts.

The feature account is a four-digit alpha-numeric number assigned by the laboratory or staff elements having managerial responsibility assigned on a Work Order/Completion Report (ENG Form 3013) for identification and control purposes. In this instance, the term "managerial responsibility" includes both technical and administrative management. Each number identifies the work/job order, and the responsible organizational element, and also indicates the numerical sequence of the work unit for finance and accounting purposes. The feature account system for the Structures Laboratory is as follows:

<u>Feature Account Number</u>	<u>Type of Order</u>
S001 through S999	Work Orders
SA01 through SA99	Proposed Work
SB01 through SB99,	Reimbursable Job Orders
SE01 through SZ99	
SC01 through SC99	Deferred Job Orders
SD60	Departmental

Variations of this system exist for other WES organizational elements and are described in Appendix F of Station Regulation No. 18-1-1.

The subfeature account is a six-character alpha-numeric number used in conjunction with and following immediately after the four-digit feature number in a job number. This is the lowest subdivision of a feature job

account for the recording, planning, and progress monitoring of a finite element of work necessary for efficient management of the total work unit. Its purpose is to identify the cost applicable to various subdivisions of a work unit, to control charges to the work unit and its subdivisions, and to provide historical data for estimating the cost of future similar work. In this system subfeature numbers can also be used to identify the dollar value and manhours of effort to be contributed by each major WES organizational element to the completion of the total work unit or project. The subfeatures are also used to reduce the technical plan for accomplishment of a work unit to its most significant subdivisions and to provide information as to the actual cost on those same subdivisions on a work package (milestone) basis.

The subfeature system provides current information by fiscal year as to the work load of each major WES organizational element by indicating the time frame and dollar value of the work

- a. for which the element has managerial responsibility.
- b. each element will perform in-WES and the dollar value of the work to be performed by contract and others.
- c. for which an organizational element has managerial responsibility that will be performed by each other major WES element.
- d. that each major organizational element is assigned by each other element.

It also indicates the actual fiscal and technical progress (on a subfeature and milestone basis) being made in accomplishing the work unit. The above information is accumulated on a quarterly scheduled basis with weekly, semimonthly, and monthly progress reports on the actual completion of the scheduled program.

No active job can be accommodated in the system without at least one subfeature. Work package groupings determine the necessary minimum number. A work package is a subdivision of a work unit by laboratory or technical program management to provide effective local technical control and supervision, and is technically distinguishable in scope and objective from other scientific or technical efforts with which it may be aggregated for financial or administrative purposes. Work packages may be further subdivided by the use of subfeatures to identify each significant item of effort, and the organization providing the effort, that contributes to the accomplishment of the work package. Each principal investigator, project engineer, or program manager is responsible for determining the number of work packages and other subfeatures he or she deems necessary for the project.

The principal investigator, project engineer, or program manager must also ensure that appropriate subfeatures identifiable to the performing organizational element are established for each support element when their support on a work package is estimated to exceed \$500. Appropriate subfeatures must also be established to accept charges for contract procurement and audit when either involves four or more hours of labor or any travel costs.

As an example of the feature and subfeature accounts, the following job number can be used. It was in existence when the internship began and was brought forward into FY 79. It was for a project sponsored by the Omaha District, CE, entitled Alternate National Military Command Center (ANMCC) Improvement Project. The job number existed as

<u>Job Number</u>	<u>Subfeature Title</u>
S722.19SC31	Testing Systems
S722.19SC41	Thermal Studies
S722.19SC3R	Texas A & M Contract

The feature account is described by S722 where S represents the Structures Laboratory and 722 identifies the Work Order/Completion Report (ENG Form 3013) which contains all other pertinent administrative and financial information relating to the project.

The subfeature accounts are described by the remaining six alphanumeric combinations following the decimal point (e.g., .19SC31). The first space in the example, the 1-----, is used to indicate the work package or group to which a subfeature is assigned. This job only has one work package. A zero is never used. The second space in the example, the -9-----, is used to indicate the fiscal year in which funds available will be expended. In this example, it means FY 79. The third through the fifth spaces in the example, the --SC3-, are used to indicate the organizational element assigned responsibility for accomplishing the subfeature. The SC represents the Engineering Mechanics Division (EMD) of the Structures Laboratory. Other organization (office) symbols are used for other WES elements and can be found in the WES phone book. The numeric character 3 represents the Materials Properties Branch. In the second subfeature, the numeric character 4 represents the Structures Branch of the EMD. The other branches and divisions of the Structures Laboratory each have their own set of identifying symbols. These three characters are important to laboratory elements which provide a great deal of support such as my branch. It is the method by which that portion of the branch work load is determined. The sixth space in the example, the -----1, is used to indicate the numeric sequence of the subfeature and the fact that the work will be performed in-WES by the responsible element. The sixth space is also used to designate work to be performed in report preparation and work to be performed by contract or others (non-WES) under

the supervision or management of the responsible element. In these instances various alpha characters are used such as the R for the TAMU contract. The assignment of these alpha characters is described in Appendix G of Station Regulation No. 18-1-1.

Each research project or testing job assigned to the Materials Properties Branch (MPB) is identified by a job number as described above. MPB subfeatures for feature accounts belonging to other organizational elements are usually provided for the support work done by the Branch. The MPB also makes extensive use of Deferred Job Orders for routine materials testing and these are handled by what is commonly referred to as a "pool account" as described in the following Section.

2.5.2 Pool Accounts. Deferred job orders or pool accounts are accounting classifications for which there is no funding authority against which charges can be made. They never have any funds assigned to them but will accept charges thus creating a negative balance in that classification at all times. These charges can be transferred at any time from the pool account and assigned to an accounting classification with authority and funds thus causing the amount of funds in that authority to be reduced by the amount of the transfer.

From an accountant's or auditor's standpoint, pool accounts are an abomination as direct costs cannot be tied specifically to particular activities. From a manager's standpoint they greatly expedite his billing procedures and simplify the record keeping. For small job testing, the costs using pool accounts are about one-half of what they would be by direct billing because of the reduction in paperwork and subsequent reduction in manpower requirements.

The MPB maintained four pool accounts:



- a. Air-Entraining Admixture (AEA) Pool.
- b. Waterstop Testing Pool.
- c. Riprap Testing Pool.
- d. Branch Account.

The AEA pool account was established to simplify the billing procedures for a materials testing arrangement the Corps of Engineers maintains with the Hunts Process Corporation of Ridgeland, Mississippi. Hunts Process Corporation is one of the major producers and suppliers of chemical admixtures for concrete in the South and its products are used on numerous Corps of Engineers jobs. Normally, the chemical admixtures used on Corps jobs would be subjected to acceptance testing on each job. Because of the large volume of Hunts Process air-entraining admixture used by the Corps, Hunts Process produces large quantity batches of the product solely for Corps use. These batches are sampled and tested for compliance with Corps specifications by MPB personnel. Upon sampling, the AEA is sealed in large tanks with a government seal. The cost of this sampling and testing is assigned to the AEA pool account. When a purchase is made of the AEA for a Corps job, MPB personnel break the seal on the storage tanks, observe the transfer of AEA to the shipping trucks or drums, obtain a check sample, and reseal the tanks. The Corps office which is responsible for the job on which the AEA is to be used then reimburses WES and the MPB an amount equal to the number of drums purchased times a fixed cost per drum. Once these funds are received and an accounting classification established for them, a transfer of charges is made from the AEA pool account to the new classification in an amount such that all of the funds are expended. The AEA pool account reflects not only labor charges but charges for replacement supplies and equipment and any maintenance costs on equipment used for AEA testing. These costs are thus prorated among all users.

The waterstop and riprap testing pools were established to avoid the paperwork associated with having small funding residuals or cost overruns after completion of the testing and to replace or repair equipment and purchase materials unique to that type of test. The acceptance testing associated with these materials does not cost much. A complete acceptance test of a waterstop has a fixed cost of \$450. The effective hourly cost of the technician conducting the testing (see Section 2.6) is almost never in an increment which divides evenly into the \$450 dollars. Depending on the amount of difficulty encountered in testing, it may cost slightly less or slightly more than \$450 to complete the test. The man-hours (and their cost) required to keep up with these small differences and the costs of the paperwork to obtain additional funds if the funding authorization is exceeded is prohibitive compared to the amount of money in question. By charging all testing to a pool account and then transferring charges from that account to cause the actual funding authorizations to become zero eliminates this expense and smoothes out small variations in testing costs. The accumulation of a surplus of funds using this approach is offset when it occurs by the purchase of equipment and supplies needed to perform the testing and maintenance of the existing equipment. For riprap testing, a new saw blade costs \$3000, and when a blade wears out and is purchased with the residuals in a pool account, the cost of that blade is effectively prorated to all the organizations whose testing helped to wear the blade out.

The Branch Account is essentially a "cupboard account" to be used for the purchase of expendable items used in the day-to-day operation of the Branch such as special sands, chemicals, bottled gas, etc. Labor can also be charged to this account when it has to do with maintenance and repair of the equipment used in the Branch. By routinely transferring small

amounts of charges on a timely basis from this account to the major funding authorizations of the Branch, the Branch Account is kept in balance and provides for the general well-being of the daily operation of the laboratory.

## 2.6 BUDGET PLANNING

Budgeting forces the manager or supervisor to think ahead and anticipate and prepare for changing conditions. In the case of the Materials Properties Branch (MPB), it is accomplished in general terms and does not include formal statements of expected income, balance sheets, statements of cash receipts and disbursements, and supporting schedules. The approach used is to develop adequate sources of funding to be balanced against the costs of labor, other direct costs, and contractual obligations. Ideally, it is a zero-based budget, beginning with no funding and ending the same way. Realistically, funding overlaps do occur. Because a significant portion of the actual work done by the MPB during a fiscal year is support work and acceptance testing, it is usually not readily identifiable until just before it occurs. Estimates of the magnitude of this work are usually based on amounts of such work done in previous years. This can create some problems because of intervening changes in economic conditions, technology, politics, personnel, etc., which may be different from year to year. The MPB budget is, in reality, a continuous, flexible budget, which requires continual adjusting as the work year progresses. The following sections show the approach I used in ensuring the financial solvency for the MPB for the 1979 fiscal year.

2.6.1 Expected Income. When the Internship began, the 1978 fiscal year had but one more month left. With some exceptions, most of the work in my Branch would have to be completed and all funds expended by 30 Sep 1978. The exceptions could have the remaining FY 78 funds carried

over for use in FY 79. Fortunately, the carry-over funding was substantial enough to alleviate any crisis situation that might have resulted from my inactivity in project and fund procurement while at TAMU for the previous 12 months. The carry-over projects and funds were as follows:

a. Testing of Riprap and Aggregate Samples (New Orleans District, CE)	\$117,474
b. Preparation of Design Memorandum No. 12, Sources of Construction Materials, Lake Pontchartrain Control Structure (New Orleans District, CE)	16,168
c. Preparation of Design Memorandum, Cooper Dam, Sources of Construction Materials (New Orleans District, CE)	8,925
d. Testing Backpacking Candidate Systems for the Alternate National Military Command Center (Omaha District, CE)	63,425
	<hr/>
Carry-Over Total	\$206,000 (approx)

The various activities of the MPB are shown below along with the FY 79 funding either known to be available or with a 90 percent probability of being available (estimated) as of 1 Oct 1978. The estimated funding for testing and support work is based on the average testing work loads for the previous three years. The estimated funding for project work is based on confirming discussions with the project sponsors but without having the funds in hand.

a. <u>Acceptance Testing</u>	
(1) Waterstops, Gate Seals, Joint Materials	\$ 20,000 (est)
(2) Air-Entraining Admixtures	3,000 (est)
(3) Riprap (for Lower Mississippi Valley Division (LMVD) Districts)	10,000 (est)
(4) Firebrick (Cape Kennedy, NASA)	7,400
(5) Miscellaneous Materials (bricks, steel, sandbags, polymers, etc.)	10,000 (est)
Subtotal	<hr/> \$ 50,400
b. <u>Special Test Programs</u>	
(1) Soil Cement (Tulsa District, CE)	2,300
Subtotal	<hr/> \$ 2,300

c. <u>Manuals and Handbook Preparation</u>		
(1)	EM 1110-2-Draft, Fiber Reinforced Concrete (OCE)	\$ 12,000
(2)	TM 6-370, Aggregate Data Compilation	<u>5,000</u>
	Subtotal	\$ 17,000
d. <u>Inspections</u>		
(1)	Lower Mississippi Valley Division (LMVD) Districts	5,000
	Subtotal	<u>\$ 5,000</u>
e. <u>New Projects</u>		
(1)	Evaluation of Brick Deterioration (Tulsa District, CE)	22,150
(2)	Evaluation of the Rapid Analysis Machine (RAM) for Determining the Cement Content of Freshly Mixed Concrete	3,000
(3)	Cold Weather Concrete Construction-Heat Transfer Studies (Cold Regions Research and Engineering Laboratory (CRREL)	12,000 (est)
(4)	Materials for MOBA Training Villages (OCE)	150,000
	Subtotal	<u>\$187,150</u>
f. <u>Continuing Projects</u>		
(1)	Repair and Rehabilitation of Paved Surfaces (OCE)	10,000
(c)	Carry-over work noted above	<u>206,000</u>
	Subtotal	\$216,000
g. <u>Schools</u>		
(1)	WES Training Courses (OCE)	<u>4,000</u>
	Subtotal	\$ 4,000
h. <u>Support to Other Structures Laboratory and WES Elements</u>		20,000 (est)
	Subtotal	<u>\$ 20,000</u>
	Total Funds on Hand	\$426,850
	Total Estimated Funds	<u>\$ 75,000</u>
	Grand Total Anticipated Funds	\$501,850

The total expected income for the MPB in FY 79 is \$501,850. The possibility on new, additional work developing also exists. Descriptions of project and funding procurement are contained in Chapter 4.

2.6.2 Expected Disbursements. The elements of cost that compose the total cost of a job include:

- a. Labor costs of personnel required.
- b. Paid overtime, if any.
- c. Rental plant to be used.
- d. Travel and per diem costs.
- e. Value of materials and supplies required.
- f. Computer costs.
- g. Contractual cost including cost of procurement and audit of certain lengthy contracts.
- h. Services to be rendered by other agencies.

When planning the budget for the coming year, the cost of labor is the simplest item to deal with as the number of employees one is responsible for and their salary rates are readily identifiable. Of the other items, contractual costs may also be identifiable in some instances. It is difficult to estimate the magnitude of the remaining elements because they are usually tied to specific activities of projects and testing which may not be identifiable until just before their occurrence.

For each rental plant item of equipment there is established an hourly or daily operating rate that includes depreciation, insurance, plant replacement, repairs, maintenance, gas (fuel) and oil costs. Operator's salary is not included except in the case of chauffeur-assigned autos. In estimating rental plant costs, the planned number of hour/days of operation is multiplied by the rate for the equipment. These rates are provided by the particular WES elements responsible for the plant item of equipment in question. In estimating materials and supplies, a mark-up percentage is applied if the materials are issued directly from the WES warehouse. An example of such a material would be lumber. The mark-up varies from time to time but was 15 percent at the time of the

internship. If materials are purchased and delivered directly to the job (no warehousing involved), a lesser mark-up rate is applied to the first \$2500 of each delivery. The rate during the internship was 3.1 percent. The rates in effect at any given time appear in WES Station Regulation 37-1-3. Paid overtime, travel and per diem costs, computer costs, and support work done by others are related directly to the individual circumstances of each project.

Labor costs reflect some direct costs plus all indirect costs and general overhead costs. The direct costs applicable to labor include the base charges for labor plus all burdens directly related to all other elements of cost. Specifically, these burdens can be described as follows:

- a. Leave Burden-Effective Time. When an employee is on annual, sick, or military leave, the salary is not charged to the job. This requires that the salary be burdened or marked up by a percentage which will compensate for these absences which are then chargeable to funds reserved in a leave account.
- b. Government Contributions. Employees pay a percentage of their salary for retirement, insurance, etc., and the Government matches these amounts. The cost of matching these funds is chargeable to the work.
- c. Tools and Equipment (T&E Burden). The costs of amortization of tools and equipment (the work tool and equipment category being limited generally to \$1000 per item) and their maintenance and repair are distributed as a percentage burden on labor.
- d. Research Center Costs (RCC). To defray the cost of the Research Center Library, information services, and publication distribution services furnished to civil and military jobs, a percentage is applied to the effective item (base plus leave burden) of all labor excluding labor costs being defrayed by the RCC burden.

All expenses which cannot be initially allocated equitably to a specific job or test are considered indirect costs. These are the charges made to the departmental account of each operating laboratory/element, consisting of such items as (1) laboratory and division supervisory and administrative salaries, (2) travel not relatable to specific jobs, (3) procurement and audit costs of lengthy contracts that benefit a laboratory as a whole and cannot be feasibly charged to a particular project, (4) pro rata share of utility services, (5) pro rata share of depreciation, maintenance, insurance, and plant replacement costs of buildings and utility systems, (6) depreciation, maintenance, insurance, and plant replacement cost of all laboratory equipment assigned to the laboratory/element, and (7) administrative materials and supplies. Departmental expense is distributed to work performed by the laboratory/element by application of a percentage to the direct labor costs of that laboratory/element. The percentages for distribution of departmental expense are predetermined and adjusted periodically to avoid excessive balances.

General overhead costs include all functional expenses of a general nature such as executive office, resource management office, office services, personnel, procurement and supply, public affairs, security guards, safety, general maintenance and depreciation of administrative buildings, utilities, and upkeep of grounds. Procurement or audit time involving four or more hours labor on a specific contract and any travel expenses incurred in connection with audit of a contract is considered a direct cost and is not charged into general overhead. A percentage for general overhead is applied to the effective time (base plus leave burden) of all labor excluding that charged into general overhead.

The percentages of mark-up for all burdens, indirect costs, and general overhead costs are determined by the Finance and Accounting Branch



of WES and appear in 37-series of the WES Station Regulations, being adjusted from time to time as needed. One set of mark-up percentages was in effect when the Internship began and was used in estimating the needed funding for FY 79. After the first quarter of FY 79 some of these mark-up rates were adjusted thus causing the original estimate to be low.

These rates were as follows:

<u>Burden</u>	<u>Percentage Rates</u>	
	<u>As of 25 Jul 78</u>	<u>As of 15 Jan 79</u>
1. Leave burden	19.1	19.1
2. Government contributions	10.0	10.0
3. Tools and equipment	4.0	4.0
4. Departmental expense (indirect costs)	35.0	47.0
5. Research Center costs	1.4	1.4
6. General overhead expense	10.0	12.0

The manner in which these mark-ups are used to determine the anticipated labor costs for the fiscal year is described in the following paragraphs. At the start of FY 79, the MPB had four engineers including myself and two technicians assigned to it (see Appendix C). The job titles and base labor cost per annum for these employees at the start of the Internship were as follows:

<u>Position and Pay Grade</u>	<u>Per Annum Cost</u>
Supervisory Research Civil Engineer, GS-13/6	\$32,028
Materials Research Engineer, GS-12/9	\$29,247
Materials Engineer, GS-12/2	\$23,857
Civil Engineer, GS-9/2	\$18,575
Materials Engineering Technician, GS-8/6	\$16,814
Physical Science Technician, GS-7/7	\$16,615

When any of these employees works full-time for the entire year, the annual cost for all the work done by that employee is computed as follows using the 25 Jul 78 mark-ups and my salary as an example:

\$32,028.00 plus 10.0% (Gov't. contributions)	=	\$35,230.80
\$35,230.80 plus 4.0% (Tools and equipment)	=	\$36,640.03
\$36,640.03 plus 35.0% (Departmental expense)	=	\$49,464.04
\$49,464.04 plus 1.4% (Research Center costs)	=	\$50,156.54
\$50,156.54 plus 10.0% (General overhead)	=	\$55,172.19

Leave burden is ignored on the assumption that all leave earned will be granted. This may not necessarily be the case for newer employees who tend to save their leave while older employees such as exist in the MPB have accumulated their leave to the maximum ceilings and must take off all the annual leave they earn. The leave burden calculation should be entered into the above calculations as the very first step considering the total cost of new employees. The job cost factor for my salary is 1.72 times my base salary. If the leave burden calculation were included, it would increase the factor to 2.04.

Applying the above methodology to the entire Branch for initial planning purposes, it would require approximately \$236,230 to pay salaries in the MPB in FY 79. Assuming that the other direct costs not included in labor charges would not exceed 25 percent of the total cost of salaries, the total initial estimate of monies required to operate the MPB in FY 79 is \$295,300 (approx). There is no basis for using a 25 percent value for additional direct costs other than historical significance.

2.6.3 Budget Balancing and Adjustments. Initially the expected income for FY 79 (\$501,850) exceeded the expected disbursements (\$295,300) by a considerable amount. This suggested that at the present level of effort we would not be able to accomplish all the tasks agreed to and anticipated.

When the first quarter ended (31 Dec 78), the MPB had expended \$63,400 of its resources. This was less than anticipated and was attributed to the fact almost all MPB personnel used quite a lot of leave time during the holiday season and thus were not directly affecting cost balances. If the expected income estimates were realized, this could result in an even larger surplus at the end of the fiscal year. However,

the funding level of the MOBA project was reduced by \$25,000 during the first quarter to satisfy the funding requirements of an emergency research effort and this reduction would more than offset the increased surplus.

As noted above, the mark-up percentage rates for both departmental expense and general overhead expense were increased on 15 Jan 79 from 35.0 to 47.0 percent and 10.0 to 12.0 percent, respectively. For the example shown in Section 2.6.2, my actual per annum labor cost would increase from \$55,172.19 to \$61,168.68 with the new job cost factor being 1.91. When leave burdens are included, the new factor would be 2.27. Adjusting the budget estimate for the MPB to reflect this increase after the first quarter at old mark-up rates increased the total monies needed for the last three quarters (including other direct costs) by \$24,000 (approx). This increase would be partially offset by not spending the anticipated amount in the first quarter.

In March 1979, a GS-3/1 Engineering Aid was hired for MPB and in May, a GS-7/1 civil engineer was also added. At per annum salaries of \$8,952 and \$18,101, respectively, these two new employees would add an additional cost of \$28,975 (approx) to the expenses of the MPB during FY 79.

Not all the funding of the MPB will be spent on MPB salaries or other direct costs. Some funding will also be spent by other support elements at WES such as the shops or clerical and typing help. These costs are hard to determine much in advance of when they will be incurred.

The internship ended four months before FY 79 ended and at that time the projections for the estimated funding appeared to be realistic with the exception of riprap testing which had not developed as in the past. No riprap had yet been received. Four or five riprap evaluations in the last quarter would be necessary to reach the \$10,000 estimate. This was

possible but not probable. In the last week of the internship a new project developed for the Nuclear Regulatory Commission involving an inspection and review of all concrete evaluation procedures at the Marble Hill Nuclear Facility in Indiana. This would involve about two man-months of work to be done in June 1979. Funding requirements were not yet established when the internship ended but were estimated to be between \$15,000 and \$20,000.

All of the modifications and adjustments noted above show why the MPB budget must be both continuous and flexible. Adjustments must be made every month as changes and actual expenditures accumulate. At the completion of the internship, budget projections indicated that a surplus of funding of approximately \$100,000 would exist at the end of the fiscal year.

## 2.7 INTERNSHIP PERSPECTIVE

The review of the methods, procedures, policies, and regulations associated with financial management at WES was extremely beneficial and somewhat disturbing. It was beneficial from the standpoint that an understanding of the WES financial accounting system and how it could be applied to work planning and program management was obtained. The full significance of how the MIS could be used by management was not appreciated prior to the internship. The review was disturbing from the standpoint that there was no formal, structured training provided at WES for both new and experienced managers in an area as critical as this. To my horror, the realization came that I had been essentially operating the MPB on intuition and the minimal official guidelines I received but without any appreciation of the ramifications of my actions or decisions. I didn't know enough about the system to know whether there were better ways to accomplish my objectives than the approaches I was presently using. My long service at WES

has taught me not to rely on the responses to inquiries made of management support elements and financial management is no exception. Unless exactly the right question is asked, the answer will not be satisfactory for one's needs. If you know and understand the subject area to which you direct the question, the response will usually be usable. Again, financial management is no exception.

The major perspective gained during this part of the internship was that there is a definite need to provide formal financial management training to WES personnel whose responsibilities include that requirement. The training could be as brief as a few hours and should be presented by the technical sector that has to use it rather than the financial sector that has to administer it. The financial sector could be available for special problem considerations, however.

A good example of how such training might be useful pertains to cost overruns. Every manager has been advised by routine circulars and pamphlets that there shall be "... no obligations created or otherwise incurred which are in excess of funds allotted or otherwise made available." For the most part this is followed. What most managers are not aware of is that even inadvertent violations of the above statement are subject to appropriate administrative disciplinary actions. This type of information together with many other subtleties associated with financial accounting and management should be assembled with various schemes on how to apply the MIS to the projects done at WES, and presented, in the form of a short training course, for all principal investigators, project engineers, program managers, and other managers.

Another example of how some formal training in this area would have had immediate utility in the MPB is the work package concept. Within a feature account, the work package may represent:

- a. Milestones of orderly progression from one step of performance to the next.
- b. A series of tasks to be performed within the total authorization.
- c. Groupings structured to meet progress reporting required by a sponsor or by WES management.
- d. Reports scheduled for preparation and publication.

Most work done in the MPB does not involve more than a single work package or milestone. Even when more than one identifiable milestone may be involved, there has been a tendency to ignore all but the completion of the entire project as the only milestone. By doing this, there is only one job number and one subfeature that must be remembered and accounted for by the engineer, technicians, laborers, and the timekeeper. The multiplicity of work packages, even when established, has not been used properly in the past in the MPB for analyzing work progress and work distribution. Of principal concern has been the bottom line with respect to funding balance. The variations that occur within the multiple work packages have been generally ignored except when the organization element assigned responsibility for a particular work package is different than the organizational element or individual having overall responsibility for the entire project.

The work package concept has not been effectively used in the MPB. The principal reason is that until this information was reviewed for the internship, I was not aware of what the concept was or its significance in work unit planning. A crude, self-generated scheme for work planning was being used in the MPB by myself at the start of the internship. By fragmenting the planning and progress on a feature account into manageable segments above the subfeature level and grouping together all the subfeatures pertaining to a particular segment, work packages can be established which will be very useful in planning and managing a project.

Some other aspects of work packages must also be considered. For work unit planning and the establishment of appropriate milestones or events to be effective, a joint effort will be required among the key personnel of each organizational element involved in the work unit. Selection of milestones on too broad a scale, such as is presently done in the MPB, will defeat the system. At the other extreme, selection of milestones on too fine a breakdown will overload the system and be meaningless to the individual(s) controlling the project. The time frame established for a work package or milestone by input of estimated beginning and ending dates can only produce a realistic managerial report to the extent that these dates are valid. The same applies to establishing the desired rate of fund expenditures over a project.

The information contained in this chapter represents a synthesis of what each project engineer should be aware of to effectively administer his/her jobs. My plans are to develop this chapter further for presentation to and use by the MPB staff.

## CHAPTER 3

## MANAGEMENT MEETINGS

## 3.1 GENERAL

To aid in the development of managerial skills, the planning of the internship included participation in a number of management meetings outside the scope of what might normally be considered as normal activities for a laboratory Branch Chief. These meetings were to include:

- a. Labor-Management consultations
- b. Equal-Employment Opportunity meetings
- c. WES top level management staff meetings.

The internship was also to include any management workshops and short courses that might occur during the internship period. All of these objectives were met and are described in the following sections.

## 3.2 LABOR-MANAGEMENT CONSULTATIONS

3.2.1 Background. On 31 Oct 1969, President Richard Nixon signed Executive Order (EO) 11491, "Labor-Management Relations in the Federal Service," giving official recognition to labor organizations of Federal employees. This Order was the keystone of the Federal Labor Relations Program. Under the General Provisions of that Order

Each employee of the executive branch of the Federal Government has the right, freely and without fear of penalty or reprisal, to form, join, and assist a labor organization or to refrain from any such activity, and each employee shall be protected in the exercise of this right. Except as otherwise expressly provided in this Order, the right to assist a labor organization extends to participation in the management of the organization and acting for the organization in the capacity of an organization representative, including presentation of its views to officials of the executive branch, the Congress, or other appropriate authority. The head of each agency shall take the action required to assure that employees in the agency are apprised of their rights under this section, and that no interference, restraint, coercion, or discrimination is practiced within his agency to encourage or discourage membership in a labor organization.



On the strength of EO 11491 and EO 11616 entitled "Amending Order for Labor Management Relations in the Federal Service, dated 28 Aug 1971, attempts were made by several different unions to organize both professional (scientists and engineers) and nonprofessional employees of WES. After several unsuccessful yearly attempts, the effort to unionize the professionals was abandoned, being overwhelmingly defeated (95 percent against) in the first attempt. The unions then concentrated their organizing efforts on the Wage Grade (WG) nonprofessional employees. These employees were generally assigned to the support elements (shops, maintenance, construction) of WES. The American Federation of Government Employees (AFGE), Local 3310, won an election at WES on 3 Oct 1973 by a simple majority of those individuals who went to vote. As a result, the Director of WES issued a letter granting exclusive recognition to that union, hereafter known as the "Union," on 19 Oct 1973.

Acknowledgment, by management, to a duly elected union, that it has been given exclusive recognition gives that union the right to be the sole representative of the employees in the unit it sought to represent. The unit at WES consists of all nonsupervisory General Schedule (GS) and Wage Grade (WG) employees. Excluded from the unit are professional employees, management officials, supervisors, guards, and employees engaged in Federal personnel work in other than a purely clerical capacity. At the beginning of the internship, WES had 205 WG employees and 628 GS employees in the unit. The exact number of these employees that actually belonged to the Union is not known, as the Union does not disclose its membership.

During the one year following recognition of the Union, a Labor-Management Agreement was worked out between WES management and the Union. The Agreement set forth the respective roles and responsibilities of the

Union and WES, and identified the policies, procedures, and methods that are to govern their working relationship. It was then and is still the intent of the Agreement to establish a basic understanding relative to and provide employees an opportunity to participate in the formulation and implementation of personnel policies and practices affecting conditions of their employment, and to provide means for effective cooperation through amicable discussion and adjustment of matters of mutual interest at WES. In the administration of all matters covered by the Agreement, officials and employees are governed by existing or future laws and the regulations of appropriate authorities, including policies set forth in the Federal Personnel Manual, by published agency policies and regulations in existence at the time the Agreement was approved, and by subsequently published agency policies and regulations required by law or by the regulations of appropriate authorities, or authorized by the terms of a controlling Agreement at a higher agency level.

The passage of the Civil Service Reform Act of 1978 (Public Law 95-454, Oct 13, 1978) and Title VII, "Federal Service Labor-Management Relations," of that Act brought the Federal Labor Relations Program under law. In effect, Title VII, Subpart F, Chapter 71, replaced EO 11491, as amended, which previously was the authority for the program. Title VII continued to protect the basic rights of management. However, it recognized that collective bargaining is necessary for an efficient Federal service and provides Federal Labor Relations the stature and stability of law.

Upon completing the first draft of the Agreement, management distributed it to all WES supervisors for review and comment. I participated in this review. All comments and suggestions were considered in

arriving at the final document. In a four-hour session, the WES Personnel Office then presented and discussed the final Agreement with all WES supervisors, myself included, and pointed out all the significant areas of impact along with highlighting the "do's and don'ts" of administering the Agreement. In the four years that elapsed from this session to the start of the internship the only exposure and contact I had with union activities at WES was through unscheduled Labor Relations Bulletins issued over the Personnel Officer's signature and distributed to all supervisors. These bulletins provided definition of terms, case studies of complaints, notice of Agreement changes, and listing of the officers and stewards of the Union.

3.2.2 Objective. With the passage of time from the first Agreement, the level of activity between labor and management was gradually increasing as the simple problems were resolved and the more complex problems were being addressed. In anticipation of having me participate in more labor-management activities in the future, the Industrial Advisor requested that I participate as an observer in labor-management consultations as they occurred during the internship in order to get a better understanding of the mechanics of the process and the nature of the matters being considered. Approval to do so was obtained from the Personnel Officer. Only one labor-management consultation occurred during the internship period and I did participate in it. Details of that consultation are described in the subsequent paragraphs.

3.2.3. Meeting Review. The consultation session was called by the Union to discuss alleged hazardous duty conditions at the Havasu City, Arizona, test site. The Union was interested in obtaining hazardous duty pay for its members who were sent from WES to work at that location.

Management was represented at the session by the Personnel Officer, the Chiefs of the Management-Employees Relations Branch, and the Position and Pay Branch of the Personnel Office. The Union was represented by the Acting President of the Union and three Union members from the Instrumentation Services Division. The WES Project Engineer from the Havasu City site was also present.

The Union began the session by describing the conditions at the test site. The chief concern was that a severe dust problem existed which was compounded by very high temperatures. The nature of the dust was such that it did not settle rapidly and was easily stirred up. Air temperatures averaged 119<sup>o</sup> F with ground temperatures approaching 140<sup>o</sup> F. The physical conditions of the area, that is a valley completely surrounded by mountains, caused a temperature inversion which prevented the dust from dissipating. Visibility was very poor owing to the dust and was highlighted by two motor vehicle accidents where the drivers could not see each other. The combination of dust and the temperature inversion in the morning tended to hold the dust down in the morning to a layer approximately 15 to 20 ft high, thus resembling a fog. As the day heated up, the dust settled out. Slides were shown by the Union of the enormous clouds of dust surrounding the work site. The number of WES employees at the site varied from 4 up to a maximum of 20 with some employees remaining as long as 4 months.

The Project Engineer confirmed that, in general, the conditions described by the Union were accurate. The Union inquired if the WES Safety Officer had inspected the work site or been made aware of the problem. The Project Engineer stated that the Safety Officer of the sponsoring agency, the Defense Nuclear Agency, was on site and responsible for

all on-site safety, hence the WES Safety Officer was not involved. He also noted that dust respirator masks were available to all workers but that they were not explicitly instructed to wear them. The Union observed that the respirator masks did not work because the perspiration caused by the high temperatures made the masks wet and then the dust plugged them up. The workers could not and did not wear the masks.

Management stated that the conditions described by the Union did not match any condition for which hazardous pay was authorized under Subchapter 9, Federal Personnel Manual, Supplement 990-II. Provisions for reduced visibility do exist, however, with Wage Grade (WG) employees being eligible for environmental differential pay and General Schedule (GS) employees being eligible for hazardous duty pay. Because there were no pay provisions and the fact that safety measures were provided, even if not used, Management felt that no claims could be paid. It would be very unusual for the Army to pay for something that wasn't covered in the regulations.

The Union then requested that Management officially consider the problem they presented, read the regulations and other appropriate documents, and respond to the Union. Management stated that it had done these things prior to and during this meeting and the official response was that there could not be any environmental differential or hazardous duty pay for dust and outside temperature problems. This is not to say that it should or should not be paid, but only that it is not covered in any regulation and hence does not meet any criteria for even being considered. The Personnel Officer asked the Union to write its request for hazardous duty pay; that it be written specifically citing details and conditions and also suggesting that the slides be included. After this

was received, Management would review the situation and forward the request to the Department of the Army, either with a management concurrence or with no concurrence for their consideration. The Union indicated that the request would be sent in within the next 2 weeks.

3.2.4 Management Review. After the consultation adjourned, the management representatives met to discuss the consultation and determine what actions, if any, needed to be taken. There was a mixed opinion on the options available to Management. Two representatives felt that the Union request must be forwarded to the Department of the Army whether or not Management agreed with it. The other representative argued that the Union contract did not apply to anything that was discussed at the consultation because hazardous duty pay is covered by Army Regulations that supercede the contract. The Union contract covers environmental differential pay which can be obtained by Wage Grade (WG) employees. It does not cover hazardous duty pay which can be obtained by General Schedule (GS) employees. The argument was that if the Union contract didn't include it, Management didn't have to consider it. After considerable discussion, it became obvious that Management wasn't going to consolidate its position without further examination of the regulations and the Union contract. The only point agreed to was that if a finding for hazardous duty pay resulted, it should only be for this job and not a blanket policy for all jobs and employees. Management then adjourned to research the problem.

No action was ever taken because the Union failed to follow up on submitting the request.

3.2.5 Internship Perspective. From an observer's standpoint, the consultation was conducted in an atmosphere conducive to a free exchange

of information. The Union was well prepared with facts and supporting documentation but was unsure of whether they had a legitimate claim or not. Management was cordial and sought out all the information it felt it needed to make a reasonable evaluation. Unfortunately, it also was unsure of the legitimacy of the request. Management could have been better prepared to respond to the Union on this matter. In fairness, however, they did not have all the details of the request until the consultation occurred, so additional preparedness may not have been possible. The entire proceedings were very informative and beneficial to the author.

### 3.3 EQUAL-EMPLOYMENT OPPORTUNITY MEETINGS

3.3.1 Background. The policy of the Federal Government guaranteeing equal employment opportunity to all persons without regard to race, color, religion, sex, national origin, or age is contained in Public Law 92-261, "Equal Employment Opportunity Act," 24 Mar 1972. The distillation and administration of this Law to the working level at WES is contained in the following series of documents:

- a. Federal Personnel Manual (FPM), Chapter 713, Equal Employment Opportunity, 30 May 1972, and FPM Supplement 900-1, Part 713, Equal Opportunity, Inst. 167, 28 Jun 1977.
- b. Civilian Personnel (Army) Regulations (CPR) 700, Personnel Relations and Services (General).
  - (1) Change 5 (C5), 713.D, Appendix D, Department of the Army Equal Employment Opportunity Program, 1972.
  - (2) Change 13 (C13), 713.2, Subchapter 2, Equal Opportunity Without Regard to Race, Color, Religion, Sex, or National Origin, 10 Nov 1972.
  - (3) Change 27 (C27), 713.Z, Department of the Army Equal Employment Opportunity Plan of Action, 4 Feb 1977.
- c. Engineer Regulation (ER) 690-1-2, Corps of Engineers Equal Employment Opportunity Program, 1 Oct 1977.
- d. WES Regulation No. 600-1-17, Equal Employment Opportunity Program, 5 Dec 1977.

In a condensed form, the policy that emerges from the above list of documents is that all persons will receive full and impartial consideration for initial employment; possess equal standing and security as employees; and will have equal opportunity to receive training, develop skills, and advance from a job and career standpoint. Such opportunities are limited only by the needs of WES and the individual's own capacity and effort. Also, the policy states that all activities, facilities, services, and training programs operated, sponsored, or participated in by WES will be made available to all employees. Furthermore, individuals who believe they have been subjected to discrimination may use the complaint procedure within the framework of the WES regulation without fear of coercion or reprisal.

The responsibility for the implementation of the Equal Employment Opportunity Program extends from the Secretary of the Army through the chain of command to the WES Commander and Director, EEO program officials, managers, and supervisors at all levels. Within the WES organization, the following job positions and assignments are directly tasked to accomplish the program:

- a. Commander and Director.
- b. Equal Employment Opportunity Officer (EEOO).
- c. EEO Specialist (EEOS).
- d. Federal Women's Program Manager (FWPM).
- e. Hispanic Employment Program Manager (HEPC).
- f. Personnel Officer and Personnel Staff.
- g. Equal Employment Opportunity Action Officer (EEOAO).
- h. Equal Employment Opportunity Counselors (EEOC).
- i. Equal Employment Opportunity Advisory Council.



j. Managers and Supervisors.

k. EEO Coordinators.

The duties and responsibilities associated with the above positions are described in WES Station Regulation 600-1-17.

As a manager and supervisor, I have the responsibility for the basic implementation of affirmative actions in the EEO program. This includes providing encouragement, assistance, and training opportunities to all employees so they may utilize their potential to the fullest extent, plus being responsible for fairness in making selections and recommending promotions, fair and equal treatment of all employees, encouraging and recognizing employee achievements and applying equal penalties for equal offenses. If requested, I am also expected to provide input to that portion of the WES EEO Plan of Action that pertains to my Laboratory Element, in coordination with the EEEO.

3.3.2 Objective. Prior to the Internship, my only organized involvement with the EEO program was attendance at a 2- to 3-hr presentation on EEO-related matters given once a year by the EEO Officer. The objective of my participation in EEO meetings was to further expand my EEO awareness during the internship period so that it would supplement my managerial experience in the future. To accomplish this objective, I was allowed to attend a meeting of the WES EEO Advisory Council Meeting in January 1979.

3.3.3 Meeting Review. The purpose of the EEO Advisory Council is to advise the Commander and Director and management on matters concerning EEO and assist in developing, executing, and evaluating the WES EEO Program. The Commander and Director, with the advice of the EEO Officer and the Personnel Officer, selects the membership of the Council. The membership, in general, consists of the following:

- a. Commander and Director who will serve as Chairman.
- b. Four representatives of the community.
- c. Community Relations Council representative.
- d. Federally Employed Women, Inc., representative.
- e. Two women employees.
- f. Two minority group employees.
- g. Personnel Officer.
- h. Two employee supervisors.
- i. Equal Employment Opportunity Officer.
- j. Federal Women's Program Manager.
- k. Hispanic Employment Program Manager.
- l. Two Equal Employment Opportunity Counselors.
- m. Equal Employment Opportunity Action Officer.
- n. Chief, Training and Development Branch.
- o. AFGE Local 3310 representative (nonvoting).

The term of membership is supposed to be 1 year.

The meeting was chaired by the Commander and Director and had 17 members in attendance. The Council mix consisted of nine women and eight men with two blacks being represented in each category. The Hispanic representative was absent. Under the heading of Old Business, a discussion about having a central bulletin board on which to post housing availability lists for minorities was continued. Because of the broad geographical basing of WES, the utility of a central bulletin board was questioned because the majority of personnel would never get to see it. A suggestion to post such lists on the bulletin board in the Personnel Office area received favorable comments. No final decision was reached. Also under Old Business, a Career Awareness Program which was tied into

the Vicksburg High Schools was reported on. The program is designed to encourage youngsters to consider engineering and the sciences as a career. No contacts had been made with elementary or junior high school to establish similar programs. Three counselors from Vicksburg High School and two from Warren Central High School recently visited WES as part of the program.

Under the heading of New Business, the Community Relations Council of Vicksburg reported on its Upward Mobility Goals for FY 79. The goals were restricted by a hiring freeze that was in effect and an average grade point ceiling that had been imposed by the Office, Chief of Engineers. A lengthy discussion of the Upward Mobility Program, its responsibilities, and the establishment of upward mobility positions in certain job categories then developed. No immediate action items resulted from this discussion. Very brief reports were also given by a representative of each of the following committees:

- a. Federal Women's Program Committee.
- b. Communications Committee.
- c. Recruiting and Information Committee.

The function of the Federal Women's Program Committee is to advise the EEO Advisory Council on the special concerns of women and to assist in the development, implementation, and maintenance of the Federal Women's Program at WES. The committee also assists in devising activities which will provide program visibility such as Sandwich Seminars, a Women's Week, and a Woman of the Year Award. The purpose of the Communications Committee is to advise ways and means of establishing better communications among WES minority groups, women, and management, and with Vicksburg and other surrounding communities. The Recruiting and Information Committee has the responsibility to keep the community informed of the WES EEO

policy, program requirements, objectives, and achievements. Special efforts are made to improve minority and female employment eligibility. The committee provides information concerning employment procedures at WES to interested community organizations and to local academic, trade, and vocational schools. The meeting concluded after approximately 1 hr.

3.3.4 Internship Perspective. The entire concept of EEO is difficult for managers to accept when it constrains the performance of their assigned responsibilities. It is often perceived as doing that particularly in the arena of promotions. The old adage that "all men are equal but that some men are more equal than others" seems to apply whenever quotas are assessed. There are no quotas in the Federal system. There are goals, however, which carry the weight of quotas when achievement of the goals is accomplished in a manner inconsistent with the overall mission of the organization. In my judgment, that means that productivity is sacrificed for sociological considerations and this is difficult to explain to paying customers.

The first impression of the EEO Advisory Council meeting raises that question. Approximately 2-1/2 to 3 man-days of productive work were lost (if you don't subscribe to the EEO concept) because of the attendees coming to, attending, and going from the meeting. In a monetary sense, this represents \$500 to \$600 per meeting or approximately \$6000 to \$7000 per year with monthly meetings. The items discussed and reported on at the meeting would have no obvious effect on the quality of the technical work at WES and, in fact, may drain both financial and manpower resources away from such work. Is it really worth it? Based on personal considerations, the answer is always a subjective one depending on what you are trying to accomplish. As a government manager, the answer is always "yes." What

the government manager must do is to balance the demands of both productivity and social consciousness to the satisfaction of both parts and integrate them whenever possible. The employment practices at WES are based on the concept of equal opportunity for all employees and job applicants. This requires not only nondiscrimination in hiring and promotions but also a strong affirmative action effort to assure that all individuals can compete on a fair and equal basis for employment and advancement. The EEO Advisory Council is a part of this affirmative action effort and therefore requires the support of all levels of management.

Attendance at the meeting made me aware of several community relations efforts that WES had that I had never heard of before. I also came away with the feeling that the EEO efforts and programs being pursued by the Council did not progress at a very rapid pace. This may be indigentous to the entire concept, however.

### 3.4 INTRAMANAGEMENT COMMUNICATIONS THROUGH STAFF MEETINGS

3.4.1 Background. Federal Personnel Manual (FPM), Chapter 251, defines an effective intramanagement communications system as one that allows all levels of management to:

- a. participate in developing and implementing policy,
- b. communicate management objectives, decisions, and viewpoints to subordinate employees and managers,
- c. communicate subordinates' views to higher level management.

During the internship period, the WES official communications philosophy was that the better managers and employees were informed, the higher their morale and contributions would be toward WES objectives. Maximum lateral communication within, between, and among laboratories and special staff elements was also encouraged. Unfortunately, this philosophy was not actively pursued in practice at most levels of supervision and was almost

never followed in lateral lines of communication. The reasons for the lack of communications were complex and for the most part, unintentional. Within the technical structure of WES, vertical communications were often inadequate because of the dual responsibility of both technical competence and administration that most supervisors have. As most WES supervisors come from the technical ranks with only cursory management training, they tend to give precedence to what they know best, i.e., technical problems, and procrastinate on administrative matters. As the technical problems provide the income by which WES operates, there is an argument for that approach. Lateral communications between some technical elements were often constrained because of the competitive nature of fund procurement and the "gray areas" of research and development in which these elements compete.

The Department of the Army (DA) recognized a need within all of its elements for a closer relationship with management groups to afford supervisors at all levels the opportunity to consult with higher management and each other in the decision-making processes. During the internship period, the DA directed each of its agencies to establish a system for effective communications among managers. This was accomplished at WES by the Management-Employee Relations Branch which conducted personal interviews with 20 randomly selected managers and supervisors at various levels in laboratories and separate staff elements to gain insight into WES' intramanagement communications climate. The results of that survey were used in the preparation of Station Regulation No. SR 600-1-65, Intra-management Communications, which was issued on 17 Aug 1979, a few months after the completion of the internship period.

The format for WES staff meetings during the internship period was that the WES Commander and Director would have a staff meeting which

included all Laboratory Chiefs and representatives of the support elements such as the Resource Management Office, Administrative Office, Personnel Office, Contracts and Purchasing, Construction Services, Instrumentation Services, Office of Technical Plans and Programs, Publications and Graphic Arts, Safety, and EEO. These representatives would then, in turn, have meetings with their own staff for the purposes of disseminating information from the first meeting. Within the Structures Laboratory, this meant a meeting of the Division Chiefs and separate staff elements. Often these second level meetings did not occur and when they did, it was doubtful that a third meeting at the Division level would ever occur. Since the internship period, this system of meetings and information dissemination has greatly improved within the Structures Laboratory with Division level meetings being held on a routine basis.

3.4.2 Objective. The objective of attending a top level management meeting during the internship period was to provide me with some insight as to how management approached the overall process of running WES and how the lines of communication flowed from the top level of management to the organization.

3.4.3 Meeting Review. Despite the need for improved communications and the DA directive, it was difficult for me to pursue the matter of attending a staff meeting of the top levels of WES management. An initial request to the Commander and Director's Office to attend such a meeting as an observer was unequivocally denied. A follow-up second request with a detailed explanation of the internship program and its objectives coupled with some personal intercession by a top level manager resulted in my being allowed to observe the proceedings of a top level staff meeting but not from the conference room in which the meeting was held. I

observed the meeting from a dark projection booth adjacent to the conference room so as not to detract from the demeanor of the meeting.

The meeting was held on 29 Sep 1978 and was chaired by the Commander and Director. The specific details of the meeting are not germane to the intent of this report. However, the particular items that were discussed are as follows:

- a. Guidelines on how to handle carry-over funding into the next fiscal year.
- b. An update on the status of the Military Appropriations Bill.
- c. Guidelines on end-of-the-year contracts.
- d. Review of WES-taught training school costs.
- e. Description of the new Video Tape capability and the new Word Processing capability.
- f. Update on the WES movie.
- g. Establishment of a self-development course program with a local junior college.
- h. Proposed visit of a Red Chinese delegation.
- i. The 50th Anniversary of WES celebration and its promotion.

Of the above, only items (d), (f), and (h) would have no direct impact on the day-to-day management of my group. Written information on items (e), (g), and (i) was forthcoming later from separate WES staff elements.

Items (a), (b), and (c), which directly affected all project work that I was responsible for, never filtered down to the project engineer level but became the exclusive information of the Management Support Group of the laboratory and had to be individually extracted by each engineer who had a need to know.

3.4.4 Internship Perspective. Two salient impressions were received by attending the staff meeting. The first was that the Commander and Director, a military man, had very rigid ideas on protocol. Using old



clichés, there should be no Indians at a Chief's meeting, despite the fact that nothing requiring secrecy or moderate disclosure was on the agenda and everything was open and aboveboard. Another Commander and Director at another time might have taken an exactly opposite approach. In reflecting on the initial denial, the Commander and Director may have tempered his decision with painful experiences from previous situations of a similar nature. He has no guarantee that his staff meeting will run smoothly and with accord. The strong personalities associated with top level management can conflict in a heated manner on differences of opinion and, while the rest of the experienced staff will ignore it, the novice manager such as myself may go away with a sense of disruption and foreboding about the future of the organization. This misinterpretation, disclosed to others, would be counterproductive to the welfare of WES. It is not known what the reasons were for the initial denial but all aspects of the situation must be considered before judging the decision.

The second impression was that, for the most part, the information presented at the staff meeting was passed along to at least some individuals at the lower levels of management. It was at these lower levels that apparent breakdowns in communications occurred. This type of problem could be alleviated if managers were more specific in who they wanted to ultimately receive the information that they passed along.

### 3.5 WORKSHOP ON RACISM AND SEXISM

3.5.1 Background. During the past decade significant changes have occurred that are altering the relationships of women and men, minority and nonminority persons, and the relationship of the impact of an individual to that of an organization. These changes are affecting professional roles and management decisions. New diagnostic tools and renewed

efforts are needed to continue to work against prejudice and discrimination, but especially to understand the work against racism and sexism as they appear in their evasive yet powerful institutionalized form.

In support of the internship program, I was one of three supervisory people from the Structures Laboratory selected to attend a Workshop on Racism and Sexism for first-line supervisors. The purpose of this workshop was to provide assistance in understanding the ongoing changes in attitudes, policies, and laws and how they would affect the supervisors' responsibilities.

3.5.2 Objective. The objective of my attendance at the workshop was to provide me the opportunity to examine racism and sexism and to explore how supervisors may be sustaining (often unintentionally) racism and sexism.

3.5.3 Workshop Review. The 2-hr workshop was held on 19 Sep 1978 as a part of the WES Fourth Annual Women's Week. The workshop was held previously at a national meeting of the Federally Employed Women (FEW) and had received high recommendations by members of the local Vicksburg FEW Chapter who attended the national meeting. The same workshop leader who presented the FEW workshop was retained for the WES workshop. He was an active duty Army officer who was also a minority.

The workshop leader presented many of the time-worn arguments for racial equality but did not delve deeply into sexual equality. The implication was that both racism and sexism had the same underlying causes and could be attacked in the same manner. The significant points the workshop leader chose to emphasize are as follows:

- a. Don't ask job applicants direct questions related to their color, sex, qualifications, experience, and education. Ask them to tell you something about their background that may adversely affect their performance.

- b. People between the ages of 40 and 70 are protected by law. Never mention age as it relates to job performance.
- c. Many minorities cannot perform well on tests owing to many factors such as poor early nutrition. Only a small emphasis should be put on minority test scores.
- d. Married people are not necessarily stable nor are all youth unstable with respect to job accomplishment. Inconvenienced people (handicapped) are usually very stable.
- e. Don't ask who is qualified for the job but ask instead who is the best candidate for the agency.
- f. You need to recruit in areas where minorities are available to fill jobs. It is no good to find qualified people for a job if you have not looked in every area where they might be.
- g. All employees must have the same opportunities for training, travel, and promotion.

He also briefly reviewed sexual harassment as a violation of Title VII of the 1964 Civil Rights Act.

3.5.4 Internship Perspective. The workshop was adequate but was not tailored to the needs and problems of supervisors. No solutions were offered. Only a restatement of philosophy was made. Much of what was said could be perceived differently by different people with correspondingly different responses. Some of the items noted above are not in agreement with my perspective on accomplishing my responsibilities. This does not mean I am right and the policies are wrong or vice versa. Common sense in all these matters is the essential ingredient. The workshop served as a good EEO refresher course.

## CHAPTER 4

## PROJECT SOLICITATION, PROCUREMENT, AND IMPLEMENTATION

## 4.1 GENERAL

One of the managerial skills objectives of the internship was the developing and obtaining sources of funding to meet budget requirements. This included both writing research proposals and personal contacts. In my position as Chief of one of the technical branches of the Structures Laboratory, this is a continuing task with a constant view toward the long-term well being of the unit. Some funding comes unsolicited because of its routine nature and our capability to do the work economically. In other instances, competition for funds must be done in the same arena with other government laboratories, private concerns, and universities. Each effort to obtain research and development monies is unique in the approaches used and the level of effort required. A good reputation for satisfactory performance within time and fiscal constraints is essential. Some luck is also very helpful.

The following sections of this chapter describe the development of a research and development program which came into existence during the internship because of efforts prior to and including the internship period. It was selected because it touches on most aspects of fund procurement and project implementation. Other efforts begun during the internship period would not have demonstrated the entire spectrum of managerial skills needed as they would not have been brought to completion during the internship. The pursuit of this research and development program represented an expansion of my skills in obtaining funds as I had never previously been associated with the Technology Units of the Corps of Engineers that provided the funds for the work.

Another of the internship objectives was to prepare and implement research plans for which I would serve as either program manager or assist those to whom I had assigned the project. The opportunity to do this presents itself very often and can vary in detail from very small investigations of a few hundred dollars where a single action by a lone individual will produce the desired result to very large programs, such as that described in the following section. A program of this type will extend for several years and involve many people both at WES and away from WES. As in the case of fund procurement as noted above, the development of research plans for the program described below represents an expansion of my skills into an area I have not been involved with before, namely Military Training and its requirements. A description of my thought processes and reasoning in preparing the basic research plan and work initiation document for this particular effort are included in this chapter. The other programs I dealt with during the internship period were not as explicit as the one described and were not included in any detail in this report.

#### 4.2 MILITARY OPERATIONS ON URBANIZED TERRAIN (MOUT)

Increased population and the acceleration of the trend toward the growth of cities have made the problems of urban combat and battle in urbanized terrain more pressing than ever for the Army in almost any conceivable theater of war. Cities, towns, and villages will be significant features of the battlefield, if not because of their importance as communication centers, then certainly because of their relationship to the surrounding terrain. Urban areas are, in fact, instant fortifications or barriers. They also represent the national assets of the country involved and, either in defense or attack, they are the real objectives.

In urban combat the infantry is, beyond question, the most active and important arm of the battle. The existing posture of the military at

the time of the internship was that problems associated with military operations in built-up areas or urbanized terrain should be left for the infantryman to solve. The Army also recognized that it had a pressing need for better training of its infantry as a vital and essential element of combat preparedness. The Army has not emphasized this type of training, however, since World War II. Military Operations on Urbanized Terrain (MOUT) operations are addressed in Army Field Manuals (FM) FM 71-1, The Tank and Mechanized Infantry Company Team, FM 71-2, The Tank and Mechanized Infantry Battalion Task Force, and FM 7-7, The Mechanized Infantry Platoon/Squad. FM 90-10, Military Operations on Urbanized Terrain (MOUT), published in draft form in June 1978, outlines current concepts and doctrine for MOUT, but was notably deficient of specifics in the "how to train" section. It focused on how to plan major MOUT operations in large urban centers, a task most leaders at company level and below will not be required to perform.

This lack of appropriate doctrine for training was being resolved by the military in a disorganized and uncoordinated manner with many different elements of the Army each doing it themselves to satisfy their immediate priorities. One of the alternatives under consideration by several Army elements at the time of the Internship was the development of training facilities resembling European cities which could accommodate MOUT live fire training exercises. While nonlive fire training facilities are adequate for teaching the fundamentals of MOUT, it was felt that only live fire facilities would give the small unit infantry leader an idea of the fire control, and command and control problems in a MOUT environment.

The WES is not in the business of training soldiers for combat but does contribute to the overall combat mission through its various research programs. The following chronological development tracks the path I

followed in initiating a major research and development effort in support of live fire training facilities. Although a portion of the effort precedes the internship period, the internship objective of developing and obtaining sources of funding to meet budget requirements is demonstrated with the conclusion of the effort during the internship with a research and development award of \$275,000 over a three-year period. The effort included writing proposals and personal contacts. The internship objective of preparing and implementing research plans is also demonstrated as the work effort was initiated: As the entire program will take several years to complete, only those actions occurring during the internship period are discussed.

4.2.1 Background. In June 1967, at the request of the U. S. Air Force (AFOCE-KC), the WES initiated an investigation that would use the extensive background I had developed with energy absorbing characteristics of cellular concrete and evaluate the fragment energy transmitted from munitions explosions and barricade spalls to simulated acceptors. This effort was a portion of a larger program to evaluate revetment walls to be used around helicopter parking areas in Viet Nam for the ability of the walls to withstand the fragments from cased munitions going off either purposely or accidentally adjacent to the walls. The results of both a laboratory and field evaluation phase were reported in the two reports I authored.<sup>1,2</sup> The conclusions reached were:

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1. "Project BIG PAPA, Phase III, Cellular Concrete Fragmentation Acceptors," Waterways Experiment Station Miscellaneous Paper, MP 6-973, Vicksburg, Miss., Feb 1968, 60 pp.
  2. "New Applications for Low-Density Concrete," American Concrete Institute Special Publication, SP-29, Lightweight Concrete, Detroit, Mich., 1971, pp 181-220.

- a. A correlation between depth of fragment penetration and impact velocity for a fragment of a given size, shape, and orientation impacting on a cellular concrete of a given design can be made.
- b. Cellular concrete, as demonstrated in the laboratory, has the desired physical characteristics necessary for a suitable acceptor material and can be impacted and penetrated by a moving projectile with little or no resulting rebound, cracking, or splitting.
- c. Cellular concrete can be easily fabricated for and placed in field acceptor blocks. The field control ... can be achieved with the proper equipment.

To my knowledge, no additional acceptors of this type were ever built by the Air Force.

In May 1976, an inquiry was received from the Training Developments Test Directorate (TDTD), MASSTER, U. S. Army, Ft. Hood, Texas, about the possibility of using lightweight aggregate concrete as a target material on tank and armored personnel carrier (APC) gunnery training ranges. The concrete, when of sufficient thickness, was expected to completely capture bullets up to 50 caliber in size fired against it and do so without spalling or ricochets. The TDTD had previously attempted to examine a lightweight aggregate concrete product from England called SLABCON for this purpose. SLABCON had been reported by various sources as being successfully used in live-fire training facilities of the British. The TDTD had brought the British manufacturer's representatives to the U. S. and had then attempted to duplicate their product with U. S. materials. After several months time and great expense, the effort was abandoned without making any concrete. The TDTD request for assistance from WES was a belated attempt to obtain some product of substance that could be fired upon to obtain some meaningful, reportable information prior to exhaustion of the funds for this effort and thus avoid the embarrassment of having no results for the monies expended.

The amount of money available and time available (approximately 90 days) precluded any development work. Based on my previous work on



cellular concrete fragment acceptors and extensive additional work with both cellular concrete and fiber-reinforced concrete, I concluded that a reasonable product could be produced by combining the matrix strength of the cellular concrete, its void space for accommodating a projectile, and fibers to prevent spalling and crumbling. With no development work, several trial batches of the composite were made to establish if the material could be successfully mixed and placed. After a few minor adjustments in the proportions, a final mixture was decided upon. No laboratory tests of its capability for the intended purpose were made.

In July 1976, a WES crew went to Ft. Hood, and using the modified mixture, built several one-half scale mock-ups of tanks complete with turret and cannon. A few mock-ups were cast with the same cellular concrete mixture but with no fibers in order to compare the effectiveness of the fibers. When the fiber-reinforced cellular concrete tank targets were four weeks old, they were set out on the range and fired upon by APC's at a distance of 500 meters. The fiber-reinforced targets still presented a suitable profile after receiving 645 impacts of 50-caliber bullets and 1870 impacts of 7.62-mm bullets. The no-fiber targets disintegrated badly at a lesser number of impacts. The depth of penetration of the 50-caliber rounds was 6 to 8 inches while the 7.62-mm rounds penetrated only 1-1/2 to 3 inches. By turning the targets around, the other side could be used for continued firing. All damaged areas could be repaired by reforming and additional casting of new materials.

The fiber-reinforced cellular concrete, which was dubbed WESCON by TDTD, did perform exceptionally well against the larger caliber bullets. The TDTD then fired full-size tank rounds at the targets and blew them apart. This was to be expected. No further exploitation was made of

this new development by TDTD but they recommended additional development work.

In early September 1976, a Memorandum for Record, subject:

"General DePuy's Debrief at Training and Doctrine Command (TRADOC) Headquarters, Monday, 16 Aug 1976, 1330 to 1830 Hours," dated 17 Aug 1976, prepared by the Commander, U. S. Army Engineer Center and Ft. Belvoir, Virginia, was received at WES. In the Memorandum it notes that:

General DePuy wants a (concrete) village built at Fort Benning. He directed that the Engineer School work very closely with Fort Benning for the design and construction of the village. He refers to the village as the "slab-con" village, which can be put together using slabs of concrete on the "erector set" principal. The design should be such that it would be easily constructed by any engineer battalion and be able to be built in any training area. It should be of anti-ricochet material, should be relatively easily repaired, it should be of a quality for anti-deterioration, etc.

Within a few weeks period of that Memorandum, WES received inquiries from both the U. S. Army Combat Arms Training Board and the U. S. Army Infantry School at Ft. Benning, Georgia, and the Department of Military Engineering, Structures and Utilities Branch, Ft. Belvoir, Virginia, about using WESCON in the construction of live-fire training villages.

As the Ft. Hood tank target tests did not have a controlled test environment, all that could be concluded was that WESCON appeared to work well for larger caliber bullets fired from long distances. In order to develop a better understanding of the materials behavior, several test panels of WESCON were then cast using mixtures similar to that of the Ft. Hood tests. A rapid hardening, high early strength cement (Reg Set) was used as the binder with glass fibers. The panels were tested when they were 7 days old by firing an M-16 weapon (rifle) at the panels from a distance of 40 ft and at angles of incidence of 90, 45, 30, 15, and 10 degrees. A total of nine shots were fired at each of two panels.

The concrete performed exactly as hoped with no penetration through the panels and no ricochets, or spalling. Based on these results, the interested parties at both Ft. Belvoir and Ft. Benning were informed that WESCON could probably be used as the principal material in the training village but would have to be developed further.

Using that information the U. S. Army Infantry School conceptually designed a training facility which represented a two city block area of a West German town complete with buildings, streets, sewers, churches, and a park and cemetery. The entire complex was to be built with WESCON. The U. S. Army Engineer School evaluated the design and established the expected costs of construction. They concluded that just the cost of concrete and steel exceeded the \$400,000 Department of Defense Urgent Minor Construction Project approval authority. The entire complex would be considerably more (approximately \$2.5 million) and therefore the funding would require congressional approval under the Military Construction Army (MCA) appropriations bill. As this facility was not already on the current list of MCA projects, it would probably take several years before it would be funded. The Engineer School also recommended further development of the WESCON for applications of this type.

In late January 1977, the U. S. Army Training Support Center, Fort Eustis, Virginia, hosted an Army-Wide Target Conference. Of specific interest with respect to applications for WESCON was a concept entitled Military Operations in Built-Up Areas (MOBA). The U. S. Army Engineer School presented a briefing on MOBA which included the conceptual ideas for the training facility proposed by the Infantry School. I presented a review of WESCON describing the tank target tests and the potential of WESCON for many targeting uses including the construction of live-fire

training facilities. As a result of that presentation, inquiries were received over the next few months from the following organizations about using WESCON.

- a. Naval Civil Engineering Laboratories, Port Hueneme, California.
- b. Tactical Air Command (TAC), Langley AFB, Virginia.
- c. 18th Airborne Corps, Ft. Bragg, North Carolina.
- d. U. S. Army Readiness Command, Rock Island, Illinois.
- e. Directorate of Plans, Training and Security, Ft. Drum, New York.
- f. 9th Division Training Facility, Building and Grounds Division, Ft. Lewis, Washington.

Information was furnished to all of the above with follow-up actions to see if any reimbursable work by WES was possible.

The inquiry having the most promise was from the 18th Airborne Corps at Ft. Bragg. Ft. Bragg had already entered the Military Construction Army appropriations bill machinery in November 1976 (FY 77) with a request for \$2.864M to build a facility in which the members of the 18th Airborne Corps could train in the tactics and techniques required for Military Operations in Built-up Areas (MOBA). Funding was anticipated in FY 79 or FY 80. The facility was to consist of eighteen (18) concrete block buildings with continuous concrete footers and dirt floors. Two buildings were to have basements with concrete floors and a concrete pipe passage between two buildings. A mock water tower would also be constructed. The use of WESCON in this facility would allow live-fire in training whereas the proposed concrete block buildings would not. The monies that would be available to Ft. Bragg were for construction and not research and development, hence any support forthcoming from WES would have to be funded independently. Ft. Bragg would be available for any prototype testing, however.

To accomplish the support necessary to use WESCON in the Ft. Bragg facility, I entered a request through the Assistant Chief of Engineers, Washington, to the Chief of the Research and Development Office, Office of the Chief of Engineers, Washington, for Category 6.2, Exploratory and Development Money. The funding request was approved and initiated under the Office Chief of Engineers Project Number 4A762719AT40, Mobility, Soils and Weapons Effects Technology, to begin in FY 79 at a first year cost of \$150,000. Funding in the amounts of \$95,000 and \$30,000 had also been requested in FY's 80 and 81, respectively. The funding was received and work authorized to proceed in November 1978. This coincided with the internship period. The official title of the research work unit was Materials for MOBA Training Village Construction. Its official documentation form is contained in Appendix D. In a reprogramming exercise by the WES Technical Director in December 1978, the funding level was reduced by \$25,000 in order to support a new high priority work effort which had been unfunded at the start of the year.

Sometime in late 1978, the Army phased out the program name of Military Operations in Built-up Areas (MOBA) and replaced it with Military Operations on Urbanized Terrain (MOUT). The reasons for the change were never apparent to me. The designations of MOBA and MOUT were both continued in use interchangeably by most personnel, however, and are so used in the remainder of this text.

4.2.2 Technical Objective. The objectives of the research program were to (a) develop the materials that could be used most effectively in the construction of a mock village to support troop training for Military Operations in Built-Up Areas (MOBA), and (b) develop a typical design for the training village which permits its construction by an Engineer Battalion at any location desired by the Army. The development was necessary

to insure that adequate urban warfare training facilities could be made available to the military forces, both reserve and active, to meet training requirements under present and future doctrines.

4.2.3 Approach. The overall approach to the program as noted in Appendix D was to first determine the training needs and facility requirements that the new materials must satisfy. This information, tempered with realistic structural criteria, would be used to develop the actual materials to be used in constructing a MOBA/MOUT training facility. A typical design meeting the structural criteria and technical objective would then be developed. In support of the efforts of the Engineer Battalions, construction techniques to build the training facilities would also be developed.

Only two aspects of the program would be attempted the first year of funding. This included defining the training needs and facility requirements plus beginning development of the actual construction materials. Only the last seven months of the internship period included this effort. The training needs and facility requirements were to be determined in accordance with the present doctrine in MOBA/MOUT warfare and suitable facilities for any future doctrine. The building types, structural equipments, street arrangements, and special training needs (e.g., barricades and scaling walls) were to be identified. The development of construction materials for the training facilities, which must have high kinetic-energy absorption capacity, do not cause ricochets, and do not disintegrate from repeated hits or are easily repairable, would be standard and include establishing those properties needed in the design of the actual structures. All other efforts involving the program would be completed the following two years culminating with a final report in the form of a Technical Manual (TM) which would include all aspects of design criteria,

design methods, typical design drawings and details, and construction methods for the training facilities.

4.2.4 Training Requirements. With the initiation of work, contacts were made with various Army agencies who were known to have an interest in MOBA/MOUT training. Although the Engineer School had been involved in the previous MOUT/MOBA reviews, no one at the Engineer School could be identified as having direct MOUT responsibility. Their primary interest was in the conduct of MOBA/MOUT for doctrinal publications on mine warfare and barrier and denial operations and as such had only a passing or peripheral interest in the WES effort. If an interest in MOBA/MOUT training villages did develop at the Engineer School, it would come under the Combat Developments Division. They did request to be kept informed of any developments, however.

After establishing who was interested in having some input to our effort, I convened a meeting on 8 Jan 1979 at Ft. Eustis, Virginia, of all interested parties to solicit their response. In attendance were representatives from the U. S. Army Infantry School (USAIS), 18th Airborne Corps, U. S. Army Forces Command (FORSCOM), Army Training Support Center (ATSC), and the U. S. Army Training and Doctrine Command (TRADOC). The purpose of the meeting was to gather information on training requirements and establish the ways the WES effort could complement the needs of the above agencies in training facilities. In general what was learned was that the entire facility must be capable of training units from battalion size down to platoon or squads. Individual structures needed to support the general principles of training for a small unit (as described in FM-90-10 or Student Text ST-90-10), e.g., entry of building other than the ground floor, room-to-room combat, roof assaults, ascension of stairs, etc. The weaponry would be basically that restricted to a platoon. There

was a difference of opinion as to whether hand-grenades were to be included. The facility must also have an acceptable level of maintainability and training of field personnel in maintenance must be provided.

Two related points of interest that were also discussed at the 8 Jan 1979 meeting were plastic bullets and the Multiple Integrated Laser Engagement Systems (MILES). Plastic bullets have been around a long time and are used for training in Europe. Their use in the U. S. has been restricted by the U. S. Army Armament Board until their safety in training can be established. Approval was not imminent. The bullets which were being considered for MOUT training were evidently temperature sensitive and would "cook-off" if a round is left chambered in a hot weapon. There were also problems at temperatures near 20<sup>0</sup> F with the round shattering in the barrel of the rifle. They also cost more than a regular bullet. The MILES was in the development stage and would allow realistic combat training without the use of live ammunition. Soldiers equipped with MILES can engage other soldiers and determine casualties by sensors on a harness worn by each man. Blank ammunition is used with this system. The contention was offered that both plastic bullets and MILES provide the same capabilities as live-fire training with far less danger. The argument for a live-fire training was that neither of the other systems is presently available and may never be implemented. Their adoption, however, may eliminate any need for a WESCON type material in training villages.

I pointed out to all the parties in attendance, that even though I had some funding available for MOBA/MOUT training facilities material development, it could be withdrawn if I could not show that there was any serious interest in the work by any of the proponent agencies. The funds had already been reduced by \$25K in only the first two months of the effort. I requested that any of the interested organizations provide me with a



requirements document of some type so work could continue.

The Infantry School undoubtedly should be the TRADOC proponent for the evaluation of a MOBA/MOUT training facility, but Ft. Benning had no approved MCA program to build any MOBA/MOUT facility. Ft. Bragg did have an approved concept although it really could not be considered as a proponent agency. The 18th Airborne requested a subsequent meeting with WES to work out a mutually compatible effort by which we could build something that needed live-fire testing, and they would use it for live-fire training thus evaluating it for us. The Infantry School was very interested in establishing a working agreement with WES where they could get a training facility built that could be evaluated for the safety aspects of live-fire training.

On 16 Jan 1979, I met with the 18th Airborne Corps at Ft. Bragg, North Carolina, to discuss their ideas of the 8 Jan 1979 meeting. Ft. Bragg had received some MCA money for their training village but it was only \$1.528M rather than the \$2.864M they had requested. The local Corps of Engineers support elements required approximately \$200,000 of that money for design and engineering the facility. That only left \$1.328M for construction. The Commanding General at Ft. Bragg was reluctant to use the money to build a training facility he felt would only be one-half of what was required for minimal training. The general feeling of the Staff Officers at Ft. Bragg was that he would return the funding. As a hedge against not having any live-fire training, the Airborne Corps was interested in having WES build a few primitive structures on one of their live-fire ranges so they could attack it. The intent was that the local Engineer Unit would build the structures using WES money but under the direction and guidance of WES personnel. These structures would be single-story with door and window openings and would only be attacked

from the outside. Construction would begin in late FY 79 after all the summer training of National Guard and Army Reserve units was completed and the local Engineers were available. As this type of evaluation would be useful to our overall effort, I agreed to the project with details to be worked out over the following months.

On 14 Mar 1979, I met with the Ft. Benning personnel to coordinate efforts toward developing an Infantry School need for a feasibility test of WESCON. At Ft. Benning, the Doctrine and Literature Directorate is responsible for development of MOBA/MOUT doctrine. The MOBA/MOUT project officer is assigned to the Collective Training Design Branch, Training Developments Division of the Infantry School. That Branch was working on a facility design and training program for users of a dry-fire facility. Ft. Benning was also the home of the U. S. Army Infantry Board which did have resources available to conduct, monitor, and evaluate any tests we might initiate. The attendees at the meeting agreed to seek a favorable decision for the conduct of a WESCON feasibility test at Ft. Benning.

The actions to be taken included:

- a. Establishing a Memorandum of Agreement (MOA) between the U. S. Army Infantry School and WES for a MOBA/MOUT live-fire training facility.
- b. Conducting tests of WESCON in accordance with the objectives and phases of the WES program.
- c. Test coordination to support the overall Infantry School MOBA/MOUT facility development plan as determined by the Infantry School MOBA/MOUT Coordinating Committee.
- d. The U. S. Army Infantry Board would be the best agency because of demonstrated testing expertise.

The responsibility for initiating all actions was given to the Directorate of Training Developments at the Infantry School.

Additional contacts were made with the 34th Engineer Battalion at Ft. Riley, Kansas, to review their new training facility and its

requirements. The facility consisted of 13 wood buildings made out of framing lumber and plywood. There were five two-story buildings with the rest being one-story structures. Initial contacts were also made with the U. S. Army Research and Standardization Group (Europe) which is based in London, England, to see if information could be obtained on the British training requirements and facilities and to enter a request to visit such facilities.

On 16 May 1979, another coordinating conference was held at Ft. Benning, Georgia, for the purposes of discussing possible Ft. Benning support/participation in the MOBA/MOUT project being conducted at WES. The Infantry School did not actively pursue their effort and very little had been done to initiate the agreed upon actions. A considerable discussion developed about the weapons to be used in training and the basic training needs and was very productive from the standpoint of program development. Ft. Benning personnel noted that FY 82-83 would be the earliest they could begin to build a MOBA/MOUT facility although the Infantry Board would have money available in FY 80 to instrument any facilities WES might be willing to construct. Ft. Benning had prepared a draft of a Memorandum of Agreement between WES and the Infantry School on constructing and evaluating a MOBA/MOUT facility and this was discussed in great detail. The draft of that document is contained in Appendix E and contains many of the training requirements that were desired.

The information derived from the above referenced meetings and the Memorandum of Agreement, plus two Infantry School manuals; Student Text 31-50-171 FY 73, Combat in Built-Up Areas Handbook, and Student Text 90-10, An Infantry Commander's Guide for Military Operations on Urbanized Terrain (MOUT), November 1978, indicated that the following training

considerations should be used to develop the initial design parameters for both basic and advanced training facility:

#### Basic Facility

- a. Provide training for high level entry to roofs and windows using grappling hooks and ropes.
- b. Provide training for low level entry into windows.
- c. Permit the use of training hand grenades as a minimum, since use of grenades is basic to MOUT doctrine.
- d. Consist of three to five buildings of which one or two should be two stories.
- e. Accommodate firing two types of infantry anti-tank weapons called the LAW and the VIPER from within rooms. For LAW this requires 4-ft clearance to back wall, 7-ft ceiling, and 20 sq ft of vent area.
- f. Accommodate troops ascending and descending by rope (rappelling) from second-story roof.

#### Advanced Facility

- g. Accommodate service, subcaliber, training, or plastic ammunition from the following weapons:
  - M-16 rifle
  - M-60 machine gun
  - Cal .50 machine gun
  - M-203 grenade launcher
  - M-72 LAW and VIPER
- h. Include sewer tunnels and fences.
- i. Include buildings with internal halls and rooms to allow training in room clearing techniques.
- j. Include buildings with stairways to allow training on booby trap detection and clearance.
- k. Include provisions for creative firing ports (loopholes) for defensive training.
- l. Permit the use of flame weapons.

#### Maintenance Requirements

- m. Repairable by Engineer troops using standard equipment.

- n. One day of maintenance for every 15 days of training for the basic facility.
- o. One day of maintenance for every four days of training for the advanced facility.

A new summary document on MOBA/MOUT training objectives and techniques has been scheduled to be printed by the Infantry School but is not expected to change the above considerations.

In the last month of the internship, arrangements were made to visit the Cinque Porte Firing Ranges at Hythe, Kent, in the United Kingdom in early August 1979. This was accomplished as scheduled. The primary objective of the training conducted in these facilities is to prepare British soldiers for small unit actions against terrorists in an urban environment. The facilities are subjected to live fire and are built out of SLABCON. Additional information on training considerations, facilities design, and materials performance was derived from this visit.

4.2.5 Materials Definition. The reasoning and methodology used in developing the types of materials to be evaluated and the methods of evaluation are contained in the following paragraphs. This exercise resulted in the preparation of WES Memorandum For All Concerned No. 2068, subject: Casting of MOBA Test Panels, dated 27 Apr 1979, which is contained in Appendix F. The actual testing of all panels and casting of some panels occurred after the internship period ended.

4.2.5.1 Test Conditions. Ideally, the concrete to be used in a prototype facility would have to resist complete penetration by the projectiles fired from the types of weapons used by an infantry platoon. These included the M-16 rifle, M-60 machine gun, .50 caliber machine gun, the M-203 grenade launcher, and the M-72 (LAW and VIPER). Previous experience with WESCON had demonstrated that sufficient thicknesses of the material

would accommodate the rifle and machine fire but nothing was known about the effects of a grenade launcher. The M-72, which can penetrate reinforced concrete, was out of the question. Grenade fragments would be accepted by the material but the explosive effect of the grenade would have to be evaluated. Once the limitations of the WESCON were established, recommendations as to selected use of weapons could be made. For purposes of refining material selection, it was determined that only the M-16 rifle would be used. The materials which best resisted M-16 bullet penetration with minimal spalling and no ricochets could then be evaluated for the larger and higher volume weapons.

Military operations in urbanized terrain are characterized by close infantry combat in concrete canyons with ranges of 100 to 175 feet; violent small unit actions for the penetration and possession of individual buildings and concealed means of communication such as sewers and tunnels, without the usual supporting weapons available when fighting in open terrain. This means weapons will be fired at close range with the projectiles possessing kinetic energies associated with short distances from the muzzle of the weapon. For a realistic evaluation of WESCON, the firing distances from the M-16 rifle to the test material should be kept reasonably short.

In an actual combat situation, the angle of incidence between a flat surface and the impacting bullet can vary from very small to 90 degrees. The smaller the angle of incidence, the greater the probability of a ricochet. In a training situation, the layout of the training facility could be designed in a manner that most targets would be attacked from a frontal assault, thus producing generally large angles of incidence upon impact and hence few, if any, ricochets. For the purposes of evaluating WESCON, a range of small to large angles of incidence should be considered to cover all possibilities.

Based on the above considerations, the test conditions for material selection must be the use of the M-16 rifle fired at short distances and varying angles of incidence. The selected distances from muzzle to target were chosen as 10, 25, and 40 feet. These distances might represent firing the M-16 in rooms and across streets. The angles of incidence selected were 10, 45, and 90 degrees. Initially, only an angle of 90 degrees would be used as that angle presented the worst case for depth of bullet penetration and thus would aid in material thickness determinations.

4.2.5.2 Materials Considerations. The WESCON tests at Ft. Hood indicated a definite need for fiber reinforcement to reduce the amount of spalling and damage associated with the projectile impact. Only alkali-resistant glass (ARG) fibers were used in that program. This type of glass fiber was necessary so that alkalis in the portland cement did not dissolve the glass thus rendering the fibers ineffective. Other types of fibers, namely steel and polypropylene, are also widely used in concrete for improved impact resistance. All three types are commercially available and need no development work. To see which type was most effective for the problem at hand, all three were included in the evaluation.

There was no special requirement for the portland cement except that it meet Corps of Engineers specifications and be compatible with the foaming agent used in making cellular concrete. Type I portland cement was deemed to be satisfactory.

Each mixture contained some sand to help reduce the amount of cement in the mixture and assist in the mixing action necessary to blend fibers into the mixture. Laboratory stock manufactured limestone sand was selected for use although natural sand would have been a viable substitute.

The penetration of a projectile must be accommodated by void space in a brittle, nonyielding matrix such as portland cement. The previous

work with WESCON dealt solely with cellular concrete where the void space was provided by large volumes of entrained air which is introduced into the matrix in the form of a preformed foam resembling shaving creme from an aerosol can. Void contents up to 75 or 80 percent can be achieved in this manner. The voids are very small, however, each being a separate cell surrounded by a layer of cement paste and separated by sand grains when they are present. Much larger voids can be incorporated in a cement matrix by the addition of expanded polystyrene beads of the same type used to make styrofoam picnic coolers and the like. Commercially available beads have a limited gradation and as such cannot be packed in the concrete in a manner that would achieve the same high volume of void space achieved with preformed foam. A combination of the two, however, should work very well in optimizing void contents. For the purposes of this evaluation, both small void size material (cellular concrete) and large void size material (expanded polystyrene concrete (EPS)) were evaluated. Each type was evaluated both with and without fibers.

Previous experience with the WESCON had been confined to a very limited range of densities and hence void contents. There had been no attempts to explore the acceptable density range for these concretes. It was determined that for the cellular concrete, densities of 50, 70, and 90 lb/cu ft would be evaluated while the EPS concrete would be evaluated at densities of 40, 55, and 70 lb/cu ft. Because of proportioning differences necessary to keep the very light polystyrene beads in suspension in the mixture, the three densities of EPS concrete were anticipated to produce comparable compressive strengths to the three densities of cellular concrete, respectively. While the fibers were not expected to contribute significantly to the compressive strength, increased flexural strength was expected.



4.2.5.3 Test Panel Size Determinations. The Ft. Hood experiment indicated that 50 caliber bullets would penetrate 80 lb/cu ft (approx) cellular concrete to a depth of 6 to 8 in. The small test panels evaluated at WES indicated a 1-1/2- to 3-in. penetration of M-16 rifle rounds at the same concrete density as the Ft. Hood. As the testing would initially all be done with the M-16 rifle and many of the densities being evaluated were less than those previously examined, it was felt that nominal thicknesses of 5-1/2 and 7-1/2 in. would be suitable beginning points. These thicknesses resulted from the dimensions of the forming lumber. At a thickness of 7-1/2 in. with a square foot of surface area, the worst case (90 lb/cu ft) with respect to test panel weight would be 56-1/4 lb for that volume of concrete. An increase of test panel surface area to 4 sq ft would increase the panel weight to 225 lb which would still be something workers could handle and erect without major lifting equipment. A 2-ft by 2-ft panel would satisfy this requirement. To fire three rounds of ammunition into each panel at a 90° angle of incidence for each age requirement (7, 28, and 60 days) and impact distance (10, 25, and 40 ft) would require 27 impact points which could be readily accommodated on a 2-ft by 2-ft surface at a spacing of approximately 4 in. in both directions for most impacts.

4.2.5.4 Strength Considerations. From a performance standpoint, the final composition of the WESCON must not only capture a projectile, have minimal spalling and no ricochets, but must have sufficient structural strength to support any loads applied to it. These could vary anywhere from just the dead load of the structure to additional superimposed live loads associated with soldiers entering the building and moving to second and third floor levels either by stairs or climbing (rappeling).

These load requirements have not yet been established. It is entirely possible that the loading may be so severe for the type of material being considered, that the material could only function as a cladding system to a more substantial structural support system. The load considerations will be established in a later phase of the program and compared to the physical properties of the concrete selected based on live-fire considerations. The decision to build entire structures or just clad them with the material will be made at that time. The ease of maintenance and repair will also be a factor in that decision.

There is little, if any, information available on the properties of fiber-reinforced, low-density concrete, so it was essential to make at least some compressive and flexural strength determinations of the concrete for future data correlation and analysis plus design work. As concrete strengths can be age-dependent, evaluations should be made over a sufficient time period to obtain any indications of whether the increased strength is going to affect the penetration, spalling, and ricochet characteristics of the material. Standard concrete test ages of 7, 28, and 90 days were selected.

4.2.6 FY 80 Planning. The casting and testing of the WESCON panels were expected to take up the remainder of FY 79. Along with those tests, the plans and details for constructing some primitive structures at Ft. Bragg and the development of the plans for a prototype training facility at Ft. Benning were accomplished. The effort in FY 80 is as follows:

<u>Task</u>	<u>Time Frame</u>	<u>Monies \$K</u>
Examine test data	Oct 79	2
Selection of final candidate materials	Nov 79	1
Further study of materials	Nov 79 to Apr 80	27
Development of repair procedures	Nov 79 to Mar 80	10

<u>Task</u>	<u>Time Frame</u>	75 Monies \$K
Mass fire tests	Dec 79 to Mar 80	18
Development of design criteria	Jun 80 to Oct 80	10
Selection of most durable material	Apr 80 to May 80	2
Refine mixture parameters	Jun 80 to Jul 80	10
Determine effects of larger caliber weapons	May 80 to Oct 80	10
	Total	<u>\$90K</u>

The further study of materials included weather considerations, automatic fire or multiple hits, saturated panels, low angle of incidence, bond characteristics, compressive and tensile strength, shear capacity, modulus of rupture, and stress-strain relationships. The development of design criteria included serviceability, safety requirements, reinforcement requirements, and connection details. The mass fire tests were accomplished at Ft. Bragg on the primitive structures. All of these additional tasks were further refined during FY 79 and implemented in FY 80.

4.2.7 Internship Perspective. The MOBA/MOUT project encompassed most facets of research development including a somewhat serendipitous beginning that was expanded and applied to a real world problem. From a conceptual idea which I widely promoted, a substantial amount of funding was obtained from a new source (for my group) to accomplish, at completion of the effort, both new materials development and design procedures for that material which will be new additions to the state of knowledge. Several new liaisons were established for my group and thus supported the Corps of Engineers goal of total Army support.

There always exists the possibility that the MOBA/MOUT effort I began will never be completed. Two major obstacles exist. One is the lack of an official MOBA/MOUT training doctrine. Although the WES effort has defined what we believe to be the training considerations needed in a training facility, funding to build such a facility will never be authorized

without the WES findings being authenticated by TRADOC in official doctrine form. During the last month of the internship, TRADOC established a Coordinating Officer for Ranges and Targets (CORAT) whose mission includes the development of the needed doctrine. Initial contacts with the CORAT suggest we will be faced with the "not-invented here" syndrome which means if the CORAT did not think of it, it is probably not any good. That approach can delay prototype evaluation past the point where we can justify program expenditures.

The second major obstacle is in-house. The Technical Director of WES has the authority to move funding around in the Office, Chief of Engineers' Research, Development, Test and Evaluation (RDT&E)-AT40 program in order to satisfy changing priorities. The RDT&E program is an element of the Five-Year Defense Program of the Office of the Secretary of Defense. It is approved by Congress at the program element level with funding authority issued to the Army at the same level. Despite the substantial need for the technology we are proposing to develop, he is not convinced of its worth and has repeatedly attempted to withdraw funds from the effort for reassignment to other programs. A continued battle to maintain the present level of effort is expected.

Both of these obstacles point out the importance of key personnel who operate on the fringes of the project but who are in a position to scuttle the entire effort for reasons the project engineer feels are less than satisfactory. The identification of these individuals at the start of a project of the type described above and their subsequent education through a concerted effort with regard to the impact of the project and its benefits should be a planned part of the project. This may not always be possible, however, as in the case of the CORAT who just appeared on the scene.

#### 4.3 OTHER INTERNSHIP PROJECTS

Other than routine testing and support work only two additional projects were begun in the MPB during the internship. These were a study of facing brick deterioration and the preparation of an engineering manual for fiber-reinforced concrete. All other ongoing project work in the MPB other than MOBA/MOUT had carried over from the previous fiscal year.

In May 1978, at the request of the Tulsa District, CE, one of the MPB engineers made an inspection of the facing bricks on five navigation lock control houses under the jurisdiction of the District. The bricks were experiencing distress which was characterized by a layer approximately 1/8 inch in thickness of the face of the brick spalling off and thus giving rise to further deterioration of the brick. The spalling ranged in intensity from an intact small separation to a complete loss of the face of the brick. The problem was suspected to be freezing and thawing damage on bricks which were not properly fired. To verify this and to provide some guidance on how the life of the remaining good bricks could be extended, a research proposal was prepared and submitted to the Tulsa District in September 1978. The proposal was accepted and funded in the amount of \$22,150 with work to begin in November 1978. The project would involve the joint efforts of the chemists, petrographers, and personnel of the MPB with only one-half the money to be spent by the MPB. Work was scheduled for completion in September 1979 with a report to follow.

The second project was the initiation of an Engineering Manual (EM) on Fiber-Reinforced Concrete. At the time of the internship, the Corps of Engineers was the largest single user of steel fibers in concrete with most of it being used in the repair of hydraulic structures and military airfields. However, no unified guidance existed within the Corps on the use of the material and its limitations. A considerable number of trial

and error applications were occurring. In an attempt to avoid some of these problems in the future, the Office, Chief of Engineers, through the Publications Unit of the Engineering Division, authorized the MPB \$12,000 to begin preparation of an EM on how to prepare and use fiber-reinforced concrete with special emphasis on where it should and should not be used. The project was not specifically solicited but came to the MPB because of its accumulated expertise on that subject. Work on the manual was scheduled to begin in January 1979 and be completed in FY 82. The actual need for the project was initiated in the Corps Districts.

## CHAPTER 5

## OTHER INTERNSHIP ACTIVITIES

## 5.1 GENERAL

This chapter includes all of my other activities of the internship. They were minor activities but not in their importance or in their contribution to overall management effectiveness. They were minor only in relation to the amount of time they occupied during the internship. These activities included: input to policies and guidelines; reorganization of the Concrete Laboratory; training school teaching; participation in technical and professional meeting; and the preparation of technical reports and papers.

## 5.2 POLICIES AND GUIDELINES INPUT

5.2.1 Background. A continuing problem existed at WES on how to compensate employees while in travel status and in particular whether this compensation involves overtime pay. Entitlement to overtime pay for travel is treated differently for employees who are entitled to payment of overtime under the provision of the Fair Labor Standards Act (FLSA) and those who are exempt from the provisions of this act. In general, most professional employees are exempt from this act while most nonprofessional job categories are not. Procedures for scheduling travel for all employees are contained in Station Regulation SR 600-1-53, Scheduling Travel During Official Duty Time, dated 24 Jan 77. During the internship period, exempt employees were supposed to receive no compensation for travel during non-duty hours while nonexempt employees should have been compensated. Exceptions to both were frequently occurring because of different individual interpretations of the existing paying policy.

Several supervisors at WES were asked to provide comments and suggestions to a proposed set of guidelines for resolving the confusion. In support of my internship objectives, I was requested by the Technical Services Branch of the Personnel Office to be one of those reviewing supervisors. The proposed guidelines were an undated memorandum entitled "Travel While on Temporary Duty to Perform Field Tests at Remote Sites" and are contained in Appendix G.

My response for input and comments is contained in Appendix H on the Disposition Form DA 2496 entitled "Compensation for Exempt and Nonexempt Employees," dated 11 Dec 78. The information contained in my response reflected my review of the WES Union Contract, interviews with other employees, and my own personal feelings on the matter. As of the time of preparation of this internship report, no response was received to my comments, and no official guidelines on the problem have been issued.

5.2.2 Internship Perspective. The continuing problem described above was still continuing in June 1981 when I was asked by the auditors to modify the timekeeper's reports for four employees who were paid for travel time they were not supposed to receive. Future paychecks will be docked and four people will be very unhappy. They were paid for the travel time because neither they nor the project engineer who authorized paying them knew what needed to be done.

The lesson to be learned from this internship activity is that matters which affect procedure and, in particular, when those procedures impact directly on an employee's nonwork time and paycheck, should not be allowed to "fall through the crack" but should be formalized as quickly as possible and be made known to all personnel responsible for their implementation.



### 5.3 REORGANIZATION OF THE CONCRETE LABORATORY

5.3.1 Background. During my attendance on-campus at Texas A&M University (TAMU), the WES had begun a major reorganization effort of its technical laboratories. The intent was to consolidate its six major laboratories (Concrete, Soils and Pavements, Hydraulics, Weapons Effects, Mobility and Environmental, and Environmental Effects) into four, more functional, laboratories. Based on criteria contained in a Disposition Form DA 2496 issued by the WES Resource Management Office, subject "Development of Detailed Organizational Structures for WES Technical Laboratories and the Resource Management Office (RMO)," dated 31 Oct 77, a new Structures Laboratory was proposed in a Disposition Form DA 2496 from the Management Analysis Branch of WES, subject "Analysis of Proposed Structures Laboratory," dated 14 Feb 78. The proposed Structures Laboratory reflected a relatively straightforward realignment between the Concrete Laboratory, Weapons Effects Laboratory, and the Soils Dynamic Division of the Soils and Pavements Laboratory. The Soils Dynamic Division performed work on buried structures. In theory, the new laboratory structure was to reflect current Corps priorities while being sufficiently flexible to meet future changes and provide improved efficiency by reducing mission overlaps and interface problems between laboratories.

The Structures Laboratory was officially established with an interim structure by General Orders issued on 30 Mar 78 with an effective date of 16 Apr 78. Further General Orders dated 27 Sep 78 and effective on 15 Oct 78 reorganized the Structures Laboratory to consist of the following Divisions: Construction Materials; Engineering Mechanics; Engineering Sciences; Geomechanics; Structural Mechanics; Explosion Effects; and

Explosive Excavation. The Laboratory would also have a Program Management Group, a Management Support Group, and a Concrete Technology Information Analysis Center.

My previous assignment before attending TAMU had been as Chief of the Materials Properties Branch of the Engineering Mechanics Division. As of 16 Apr 78 this assignment and all other assignments in the old Concrete Laboratory had not changed with the formation of the new Structures Laboratory. Upon returning to WES for my internship, my job and position were the same as when I had left with the exception that special assignments and responsibilities were added to meet the objectives of the internship program. One of these assignments was to assist in the evaluation of the functional responsibilities of the existing branches of the old Concrete Laboratory from the standpoint of how these responsibilities could be grouped or rearranged consistent with the existing physical facilities to provide the most efficient organization of activities in the new Laboratory. The evaluation was to establish alternatives to be considered by top management regarding transferring of functions, equipment, floor-space, and personnel within the confines of the building presently occupied by the personnel and facilities of the old Concrete Laboratory. This assignment was contingent upon the many decisions to be made by top management regarding reorganization and no firm timetable could be established.

With almost one-third of the Internship period gone (Oct 1978), the old Concrete Laboratory still retained its previous structure and no upper level management actions had been officially taken to further restructure the group. The major delay was attributed to the disposition of personnel throughout any new structure. The reorganization was not supposed to adversely affect the status of WES personnel with respect

to grade and salary. Any consolidation of management responsibilities would result in a surplus of managers and consideration had to be given to how this surplus could be integrated back into the organization. Tentative resolution of this problem by upper management did not occur until June 1979, one month after the internship period had ended. It was therefore not possible to perform the evaluation of the functional responsibilities for the new organization as provisionally planned for within the time frame of the internship.

On 18 Sep 79, General Orders were issued abolishing the Construction Materials Division, Engineering Mechanics Division, and Engineering Sciences Division and forming a new Concrete Technology Division consisting of the following Groups:

Research Group

Concrete and Grout Group

Materials and Concrete Analysis Group

Evaluation and Monitoring Group

Cement and Pozzolan Group

The Materials and Concrete Analysis Group was a composite of my previous branch, the Materials Properties Branch plus the X-Ray and Petrography Branch and the Chemistry and Plastics Branch. I remained as the Chief of the new Group with both previous Branch Chiefs becoming technical specialists in the new Group.

5.3.2 Internship Perspective. Although the opportunity to participate in the reorganization effort did not present itself, the procrastination and delay associated with management decisions in reorganizing provided a daily workshop in human behavior under an unusual stress. Reorganization of a major laboratory such as the old Concrete Laboratory

would be a simple business if management was willing to accept adverse actions regarding their personnel. In a research and development organization, however, where it often takes years to acquire the specialized expertise needed to function effectively, management is and was correct in trying to maintain the effectiveness of its capabilities through staff integrity. Observations of the reorganization effort suggested to me that there should be limits to how accommodating management should be, however. The large unknown of future job assignments and how it was perceived by the professional employees tended to bring out their worst behavior with respect to their associates who they felt were either competing with them or had a perceived advantage over them. Rumors were common. A considerable amount of written and verbal demands were being made to management as to who the demander wanted to be their supervisor. Unfortunately, attempts were made to pacify most demanders and this resulted in further delays. There is no guarantee that the final organization was any better after all the commotion, stress, and hard feelings which will not go away, than if management had just dictated the format and allowed the individuals to work out their differences on their own. With the latter approach, the reorganization may have proceeded more expeditiously and, I believe, the resiliency of human nature would have presented minimal personnel problems. Overall, just being an observer in the reorganization process was a valuable learning experience for use in future management situations.

#### 5.4 TRAINING SCHOOL TEACHING

5.4.1 Background. During the internship, I participated as an instructor in eight training schools conducted at WES. These included the following courses by name (and their frequency). The subject material presented in each course is also shown:

- a. Advanced Concrete Technology School (one).
  - (1) Polymers in Concrete.
  - (2) Aggregates and Riprap.
  - (3) The Rapid Analysis Machine (RAM).
- b. Concrete Construction Inspection School (three).
  - (1) Waterstops.
  - (2) Aggregates.
  - (3) Aggregate Testing.
- c. Pavement Construction and Maintenance School (two).
  - (1) Fiber-Reinforced Concrete.
  - (2) Fast-Setting Cements.
- d. Drilling Inspection and Grouting School (one).
  - (1) Expansive Cements.

Prior to the internship, I had previously given lectures on aggregates and waterstops to the various WES training schools. The additional subject matter and schools shown above represent a major expansion in my teaching assignments during the internship. In all cases, I was required to prepare formal Instructor's Lessons Plans and documented narratives for inclusion in the students' notebooks. The lesson plans are included in Appendix I along with the narrative portion for the lecture on Polymers in Concrete. This narrative is typical of the type of information given to the students. The other narratives are not included as they would only inflate the size of this report without making any other significant contribution to the intent of this report.

The training courses taught at WES originate at the Office, Chief of Engineers (OCE) and are tailored to meet the needs of the field elements

of the Corps. The decisions as to subject matter and who teaches the material are made at OCE. The Training Division of the Huntsville Division of the Corps of Engineers conducts most of the administrative functions associated with the schools. They survey all Corps elements for interest and attendees, conduct registration, and issue completion certificates. The WES is responsible for the physical arrangements of having the school, that is classroom set-up, materials, transportation, etc. WES also makes all arrangements with the instructors including what to pay them. Most of the instructors come directly from the WES staff although other Corps personnel from field offices and non-government technical specialists are sometimes used.

5.4.2 Internship Perspective. The training courses provide a unique opportunity to both transfer some knowledge to the students and also get some useful feedback from their widely diversified field experience. Too often the information given the students is in its simplest and ideal form. The experienced students are quick to inform you and the rest of the class of all the real-world variations that exist for that information. This is extremely useful in broadening my own knowledge base for use in future training courses and also in solving the day-to-day field problem inquiries received at WES.

Depending on the school, the personnel attending will vary from new inspectors (GS-4) to experienced resident engineers (GS-13). Often this range will occur in the same class thus making it very difficult to present material that will be both understandable but not trite to all members of the entire class. This forces the instructor to continually modify the subject material and its delivery thus not getting caught in the trap of a dull, recited, canned lecture. Each subject and its instructor are critiqued by the entire class so the deficiencies in and relevance of

the lectures are called to the instructor's attention very quickly. This continual adjustment and modification of the lectures also helps develop a self-assurance in the instructor with regard to the subject matter plus a general confidence in being able to relate to all levels of technical competence.

From an administrative standpoint, teaching in the training courses has a definite financial advantage in that the time spent preparing to teach and the actual teaching does not have to have project monies to cover the instructor's daily costs. The cost of the school including the cost of the instructors is borne by the organizations of the participants. During the internship period, this amounted to almost \$4000 of funding that I did not have to seek elsewhere.

## 5.5 PARTICIPATION IN MEETINGS OF TECHNICAL, SCIENTIFIC, PROFESSIONAL, AND OTHER ORGANIZATIONS

5.5.1 Background. The participation of WES personnel in meetings of technical, scientific, professional, and other organizations is, for the most part, controlled by the requirements contained in WES Station Regulation (SR) No. 1-1-13, of the same title as this section. In general, the primary consideration for authorizing military and civilian personnel to attend meetings of private organizations at Government expense is the assurance of overall benefits to the Department of the Army and the Corps of Engineers. Attendance merely for the purpose of personal education or enhancement of the employee's professional development does not meet the requirements as stated in the Engineer Regulation 360-1-1, Public Affairs, upon which SR 1-1-13 is based. It must be shown that there is a tangible contribution to assigned WES missions or programs before approval to attend can be obtained.

More specific criteria for attendance state that the personnel selected must be active participants in the meeting, i.e., member of a working committee or group, presenting a paper or actively participating in discussions. Even with that level of participation, the number of representatives is supposed to be restricted to the essential minimum. Attendance of more than one representative is supposed to be approved only when it is shown to be clearly beneficial to the Corps of Engineers. The approving official for meetings held in the continental United States (CONUS) is the Deputy Commander and Director of WES. For meetings outside continental United States (OCONUS) must be approved by the Office, Chief of Engineers (OCE). Restrictions are generally not imposed upon attendance at meetings where WES employees will receive reimbursement from the technical organization conducting the meeting.

During the internship period, I participated in the following technical and professional meetings:

- a. Served as chairman of a session on "Polymer-Impregnated Concrete Applications" at the Second International Congress on Polymers in Concrete held in Austin, Texas, 25-27 Oct 1978.
- b. Attended the American Concrete Institute Fall meeting in Houston, Texas, from 29 Oct 1978 to 3 Nov 1978, where I participated as:
  - (1) Chairman, ACI Committee 523, Insulating and Cellular Concretes.
  - (2) Chairman, ACI Chapter Activities Committee.
  - (3) Secretary, ACI Committee 223, Expansive Cement Concrete.
  - (4) Symposium Chairman and Member, ACI Committee 548, Polymers in Concrete.
  - (5) Subcommittee Chairman and Member, ACI Committee 544, Fiber-Reinforced Concrete.
  - (6) Member, ACI Convention Committee.



- c. Attended the American Concrete Institute Annual Meeting in Milwaukee, Wisconsin, from 18-23 Mar 1979, where I participated in all capacities as noted in 2. above plus functioning as the Chairman of ACI Tellers Committee for the Annual election.
- d. As Chairman of the ACI Chapter Activities Committee, I conducted the following regional and local meetings for officers of local ACI chapters:
  - (1) Northwest Regional Roundtable in Jackson, Wyoming, from 25-27 Sep 1978.
  - (2) Midwest Regional Roundtable in Detroit, Michigan, on 13 Feb 1979.
  - (3) During the period 22-29 May 1979, conducted organizational meetings in Bogata, Colombia; Quito, Ecuador; and La Paz, Bolivia; and presented technical lectures on fiber-reinforced concrete and expansive cement concrete at each location.
  - (4) Organizational meeting of the Minnesota-Iowa Chapter in Minneapolis on 11 Sep 1978.
  - (5) Organizational meeting of the Tennessee Chapter in Nashville on 12 Sep 1978.
- e. Participated in the FY 79 Corps of Engineers First General Concrete Conference in Pittsburgh, Pennsylvania, on 14-15 May 1979, where I presented two talks on Fiber-Reinforced Concrete and Polymers in Concrete.
- f. Presented a talk on the Use of Polymers in Concrete at the ACI Midsouth Chapter Educational Seminar on Repair of Concrete held in Jackson, Mississippi, on 8 May 1979.

Most of my participation in the activities of the American Concrete Institute have some foundation in my actual project work. Both Committees 523, Insulating and Cellular Concrete, and 544, Fiber-Reinforced Concrete, have direct bearing on the MOBA/MOUT project. The information derived in Committees 223, Expansive Cement Concrete, and 548, Polymers in Concrete, helps keep the information given the students in the WES training courses on the leading edge of current technology. All of this committee participation provides a constant exchange of ideas and information which can be applied to the solution of a wide variety of Corps of Engineers concrete problems. Information on fiber-reinforced concrete,

expansive cements, and polymers in concrete is needed on almost all air-field and hydraulic structure rehabilitation and repair work the Corps is involved with. In accomplishment of committee assignments during the internship, I prepared two first draft documents entitled "Recommended Practice for Insulating and Cellular Concrete Roof Decks," and "Recommended Practice for Handling, Mixing, and Placing Fiber-Reinforced Concrete." These were submitted to ACI Committees 523 and 544, respectively, for review and further work.

My work with all of the ACI chapters, while not of a technical nature, has good public relations value and high visibility for the Corps and WES. It is also condoned because the ACI pays all my expenses except salary for this work.

Also during the internship period, I was appointed to Task Force 20 of the Subcommittee on New Highway Materials of the Joint AASHTO-AGC-ARTBA Committee. This was to be principally a correspondence committee. Its first task was to write its own mission and functions statement which was in preparation when the Internship ended.

5.5.2 Internship Perspective. The WES can be described in textbook terms as a technology-dominated mixed organization, that is, one major part of its structure has hierarchical characteristics, with some degree of rigidity, and the other part is less tightly structured. This combination often presents problems in establishing good relationships between the "bureaucrats" and the "professionals." Resolution of disagreements between the two elements by using the position authority of higher management is usually ineffective, since the individuals in the managerial hierarchy are viewed as being lacking in understanding to the problems and needs of the technical sector and therefore are not considered acceptable

to the professionals. This occurs despite the fact that many of top level managers had their origins in the technical ranks. The view is that they have strayed from technical competence by not practicing their scientific and engineering profession. The professionals are often likely to react negatively to administrative decisions.

The manner in which participation in technical, scientific, and professional meetings is handled is a classic example of a somewhat unresolvable difference of opinion between management and the technical sector. A large portion of the technical professionals have high needs for achievement, high initiative, and low needs for a structured work environment. They have spent years attaining their competency and thus their work becomes an important aspect of their psychological makeup. They often have high intrinsic motivation to do well as a group and motivation is usually not a critical problem. When individuals can see the relationship between effort and results and between results and rewards, whether the rewards are based on organizational payoffs or on professional recognition, the organization will usually operate with a high degree of efficiency. The lack of management to provide opportunities for professional development as noted in SR 1-1-13 and ER 360-1-1 tends to lead to goal blockage and frustration with subsequent demotivation by the individual. In technology-dominated organizations such as WES, the most effective way to improve performance is to raise ability levels, since the personal motivation is already there. Competence is increased through additional training and education. Again SR 1-1-13 and ER 360-1-1 note that meeting participation shall not be for the purposes of education. Although WES provides opportunities for its personnel to go back to school, not everyone can make that type of commitment nor does everyone have the same opportunities.

My personal view on participation in technical, scientific, and professional meetings is that it is absolutely essential for the well-being of an organization such as WES and should be encouraged at all levels. From a management standpoint, this is easier said than done. Of the 287 engineers at WES at the start of internship, approximately 225 were Civil Engineers. If even a small percentage wanted to attend meetings of the American Society of Civil Engineers (ASCE) and participate in committee work, the financial impact on WES would be great and subject to criticism from both sponsors and auditing agencies. The fact that each participating engineer might be involved in a different aspect of his vocation (e.g., soils, hydraulics, structures, materials) with no repetition of effort between engineers would have little bearing on the practical significance of letting, for example, 20 people travel across the country to attend the same week-long general meeting with specialized committee meetings. An action of this sort would most certainly be perceived by many as waste-in-government. The standard management solution is to greatly restrict participation by only approving a few individuals to attend. This solution would be acceptable to most of the technical sector except that in many cases the chosen attendees are not from the technical sector but are senior managers whose technical expertise has waned and is not comparable to that of many other people desiring to participate. In these instances, both the input to the profession suffers and the knowledge gathered for dissemination back at WES is perhaps not what it should be and WES suffers. Morale suffers and the gap between management and the technical sector widens. Neither the Army nor the Corps get the benefits they are seeking. Some managers view their attendance at annual or semiannual meetings of technical or professional organizations as a "right and privilege."

Because of their specialized personal technical interests or social interests, what they accomplish at the meetings is to the exclusion of all but these special interests.

The problem of getting more engineers and scientists at WES involved in technical and professional meetings and organizations has many sides to it and will not be easily resolved. Many WES engineers and scientists are just not interested in doing anything but their immediate jobs with the knowledge and skills they already possess. This is probably a universal problem in most technical organizations. Others will not take any actions that will cause them to spend their own money. If the Government will not pay for it, they will not do it. For example, WES will give any engineer who asks for administrative leave to participate in activities of the National Society of Professional Engineers (NSPE), permission to do so but the engineer must pay his or her own expenses. Few, if any, take advantage of this. Professionalism is not promoted on the organization level except in the gathering of statistics as to how many registered professional engineers are employed. Those WES individuals who have worked themselves into positions of responsibility and respect in technical and professional organizations did so mostly without organizational encouragement because they personally recognized the advantages to themselves of such involvement.

A first step to improve overall professional development would be the identification and compilation of the various technical and professional meetings that WES personnel attend along with a historical record of who at WES attended these meetings. Subsequent matching of the regular attendees' WES responsibilities (specific and not general) to the purpose and function of such meetings would allow a gradual culling of the less

productive attendees thus making room for younger engineers and scientists to expand their professional horizons while assuring maximum benefits for the Army and the Corps. As noted earlier, this is easier said than done and would require a commitment by top management to accomplish.

## 5.6 TECHNICAL REPORTS AND PAPERS

The final product associated with most activities of the MPB and most other technical elements of WES is a written report. These can vary from simple letter reports transmitting acceptance test results or other testing data to very comprehensive, detailed, bound technical reports containing the efforts and results of major research and development programs. Often the findings of these major programs are also presented in fractional or synthesized forms as technical papers at various meetings, seminars, or symposia. Occasionally, these smaller papers are also published as WES Miscellaneous Papers.

Every member of the MPB writes reports of some kind. The technicians report all test results and prepare the transmittal letters. The engineers prepare technical reports for the sponsors on their work. I review all of these reports for technical accuracy and format. I also prepare technical reports on many of the joint research efforts by the MPB staff and others. Prior to attending TAMU, I had published 45 reports and papers. While at TAMU, no attempt was made to prepare any technical reports or papers other than those required for class work requirements although research was done and information gathered to prepare a paper entitled a "Historical Perspective on Reinforced Masonry and Concrete." Upon leaving TAMU and beginning the internship back at WES, I had no active WES research which was going to result in the preparation of a technical report or paper prior to completion of the internship. I had, however, been collecting source material for several years on fiber-reinforced cement and concrete

and I assembled these into a bibliography, submitting it for publication during the internship. The information was published as WES Miscellaneous Paper C-76-6, "Selected Bibliography on Fiber-Reinforced Cement and Concrete, Supplement No. 2," July 1979, with funds provided by the U. S. Army Material Development and Readiness Command through the WES Concrete Technology Information Analysis Center (CTIAC).

This bibliography supplement was prepared from source material that was provided to me and that I obtained during the normal conduct of business at WES. The initial publication of this bibliography<sup>1</sup> and its first supplement<sup>2</sup> included a total of 811 references pertaining solely to fiber reinforcement of cement and gypsum matrices, mortar, and concrete. This supplement provides 471 additional references of which approximately 80 percent were published outside the United States and 29 patents on the subject. Many of these were published in English, however. Major contributions from Japan, Sweden, United Kingdom, and Russia are included. The references were compiled from publications available directly to me and from bibliographies existing in other published works on the subject. In general, papers solely on the theory of fiber reinforcement and composite materials which did not explicitly include fiber reinforcement of cements and concretes were not listed. Additional supplements are planned on an irregular basis if there are sufficient publications to warrant spending the money to reproduce them. The actual report (MP-76-6) was

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1. G. C. Hoff, C. M. Fontenot, and J. G. Tom, "Selected Bibliography on Fiber-Reinforced Cement and Concrete," Miscellaneous Paper C-76-6, June 1976, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.
  2. G. C. Hoff, "Selected Bibliography on Fiber-Reinforced Cement and Concrete, Supplement No. 1," Miscellaneous Paper C-76-6, September 1976, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

not included in the Internship Report because it would not add anything to the intent of the report.

While at TAMU, I began the gathering of information from the TAMU library pertaining to the history and development of reinforcements for masonry and concrete. Upon returning to WES, I reviewed all the pertinent information I could find in the WES library but it was somewhat limited because the older engineering texts and manuals had been destroyed in a fire in 1961. With each trip I took to Washington, D. C., I would spend several hours at the Patent Office reading old patents on reinforcing bars and systems. Near the end of the internship period, I assembled all the information I had gathered into a rough outline and first draft of a paper on the subject. My intent is to fill out the paper with additional information as I can locate it. As this is an unfunded item, its completion will be determined by my ability to work it into my normal schedule.

As a member of several American Concrete Institute (ACI) Technical Committees, I routinely input into the needs of the committees by providing written portions of the various consensus standards and other reports the committees prepare. During the internship period, I prepared two first drafts for two of those committees. The drafts were "Recommended Practice for Insulating and Cellular Concrete Roof Decks" and "Recommended Practice for Handling, Mixing, and Placing Fiber-Reinforced Concrete." These documents will undergo several years of modifications and expansions before reaching a final ballot and eventual publication. The background for these reports came from WES related experience. Both documents were presented to the responsible committees of the ACI at its Fall 1978 meeting in Houston, Texas.

If any perspective is needed regarding technical reports and papers, it is that they are the final product of our labors and as such are a



reflection of our ability to remain on the leading edge of civil engineering technology. They must be accurate, concise, timely, readable, and address the problem to the best of our ability. They are what the sponsor gets for his money so they must be the best that WES can offer.

## CHAPTER 6

## CONCLUSIONS AND RECOMMENDATIONS

## 6.1 CONCLUSIONS

6.1.1 Financial Management. Based on a thorough review of the WES financial management program, I concluded that the WES Management Information System (MIS) has the flexibility to provide a first-line technical supervisor all of the information necessary to financially operate and manage a technical group. However, the lack of a formal education or training program at WES in the area of financial management built around the MIS causes many of the WES first-line supervisors to perform in a less than optimal manner regarding budget planning and cost control. Because of the continual changes in income, many of which occur without prior knowledge of the supervisor, I also concluded that a continuous and flexible budget was the only format which could be successfully used in managing the Materials Properties Branch (MPB).

6.1.2 Management Meetings. My review of the origin of the WES Union and its function leads me to the conclusion that if the WES Personnel Office and management had been performing satisfactorily initially, the employees would not have felt a need for the Union. Once established, however, the Union has apparently administered satisfactorily to the needs of its members by protecting their well-being in areas either ignored or overlooked by the personnel office and management or in areas where there is a question of jurisdiction or unfair actions or practices. Participation in a WES labor-management consultation helped me conclude that the Union played a necessary role in the operation of WES because the employees who belong to the Union perceive that they receive personal attention for their problems and are treated fairly and equally.

A different perspective was obtained when I attended the Equal Employment Opportunity (EEO) Advisory Council meeting. The conclusions drawn from the meeting were that a council like this was self-perpetuating, that is, it announced the problem, force-fed it, and then attempted to present solutions to it, when in fact the problem, if it even existed, did not warrant the level of attention it was getting. Attendance at the Workshop on Racism and Sexism only reinforced this conclusion.

My attendance at the WES staff meeting led to the conclusion that a reasonable effort was being made by WES top management to provide effective communications to WES employees at all levels but that the communication channels were breaking down at lower levels and, in particular, in the WES elements normally labeled as management support groups. Communications appeared to flow better in the technical sector channels.

6.1.3 Project Solicitation, Procurement, and Implementation. The procurement of research funds is essential to the continued operation and success of WES. This activity will occupy a major portion of the first-line technical manager's work time. Based on the experiences encountered in the development of the MOBA/MOUT program, I concluded that WES manager must not only solicit new work but must occasionally function as the focal point in pulling together the various elements of the Army which all have a common need. I also concluded that in broad based areas of interest, such as training, there is little communication between the various proponents of the Army because each proponent feels that they can do it better and address their problems more specifically. A final conclusion resulting from the MOBA/MOUT program is that military projects of this type need to be brought to completion very quickly in order to avoid the pitfalls of changing military personnel, changing priorities, and a funding

authority which can be changed at the local level by top management without concern for the requirements and ultimate objectives of the project.

6.1.4 Other Internship Activities. The conclusions reached for the activities involving policy and guidelines input, the teaching of training courses, and professional development through meeting attendance are as follows:

- a. Management decisions leading to policy that affect procedure, and in particular, when those procedures impact on an employee's nonwork time, status and paycheck, if not reached quickly and made known to all personnel responsible for its implementation, will adversely affect the morale of the organization and reduce its effectiveness.
- b. The teaching of training courses by the technical staff benefits both the instructor and the organization by effective two-way technology transfer and high visibility necessary for procuring future work.
- c. The approach to professional development used by the Army, the Corps, and WES is not satisfactory. More emphasis needs to be placed on professional development through participation in technical, scientific, and professional meetings.

6.1.5 Doctor of Engineering Program. The Doctor of Engineering program is ideally suited for first-line supervisors in a technically dominant organization such as WES. These supervisors have highly qualified technical people in their work group and should rely on those individuals to satisfy the technical accomplishments of the organization. Based on my work assignments, I concluded that the technical supervisors should concern themselves with administrating the group from routine matters, to personnel problems, policy making, financial management, and other nontechnical areas keeping a technical perspective at all times.

## 6.2 RECOMMENDATIONS

In accomplishing the objectives of the internship, conclusions were reached that lead to the following recommendations:

- a. Formal financial management training should be provided to WES personnel whose responsibilities include that requirement. It is further recommended that this training be provided by the technical sector (users) rather than the financial sector (administrators).
- b. Periodic checks should be made by top level management to determine whether the information dissemination channels are continuing to function through all levels of management. Special consideration should be given to apparent dead-ending in management support elements with appropriate actions taken to correct this problem.
- c. Management should attempt to be better prepared for labor-management consultations than they were for the consultation actually observed. The management team should present a unified response (if at all possible) in all matters dealing with the Union.
- d. The effectiveness of the EEO Advisory Council and its financial impact on the organization should be periodically assessed and evaluated. To optimize effectiveness and minimize costs, consideration should be given to reducing the Council's size and altering its composition.
- e. Technical managers should include the education of all individuals who can adversely affect the funding base with regard to the technical importance of the work and the impact its completion will have on the Army mission. Continual updating of a program's status to these individuals is also recommended.
- f. All management decisions involving resolution of work problems should be expeditiously made and implemented.
- g. The lectures given in training courses should be designed to gather as much information from the students as possible on the subject of practical work examples and problems. This new information should be applied to the everyday WES operations.
- h. The overall WES participation in technical, scientific and professional meetings should be reviewed and assessed and recommendations made for a participation program that would maximize benefits to the individuals and WES.
- i. To acquire the skills necessary to be a technical manager, it is recommended that individuals in engineering who do not plan to climb the technical ladder in government service, be encouraged to avail themselves of the Doctor of Engineering program. It is further recommended that the duration of an internship taken in a government facility such as WES should be adjusted to conform with the government's fiscal year, that is from October 1 to September 30. As most projects or efforts are tied to fiscal year funding and a 12-month duration, the present internship period truncates many meaningful, long-term objectives of an internship and they cannot be analyzed fully.

### 6.3 CONCLUDING REMARKS

After completing the on-the-job objectives of the internship and realizing how the accomplishment of these objectives improved both my overall understanding of how WES operated and my work effectiveness, I sincerely view the internship as a vital part of the Doctor of Engineering program. It presents an immediate opportunity to apply the classroom knowledge obtained during the on-campus portion of the program to actual work environment situations. The success of such applications depends on the type of organization and how the management of that organization views the development of future managers. In a technically oriented organization such as WES, the improvement of technical skills occupies a more prominent position with respect to training and development. In this and similar instances elsewhere, a concerted effort must be made by the Doctor of Engineering program participant and his/her Industrial Adviser to overcome local prejudices as to the desirability of having "trained" technical managers rather than "evolved" technical managers.

When returning to the same work environment previously occupied before doing the Doctor of Engineering on-campus work, such as I did, there is a tendency to resume old work habits which are familiar and hence easier rather than attempting to apply the newly gained knowledge to the old problems. Contributing to this tendency is the problem that the bureaucratic functions of the organization are rather inflexible and not receptive to new ideas thus making any attempts at what is perceived as improvement very difficult. To make even minor changes, the existing system and the people who run it must be fully learned and understood, and then probed in the more receptive areas. This will require a continuing dedication on the part of the Doctor of Engineering student.




Also, when returning to the same job, there is an expectation, even if inadvertent, that you will continue to perform all the duties you previously had. This coupled with the fact that in many areas you may now be at least a year behind or so because of your absence while at TAMU and must, in turn, spend additional time catching up, makes any work time you can find for achieving the objectives of the internship very valuable. Again this will require a continuing dedication on the part of the Doctor of Engineering student and cooperation from the Industrial Adviser.

The overall content of the D. Engr. program is useful in many other areas than just engineering. The course work in financial management and economics is equally applicable to my job at WES, in the operation of my home, and in any other business ventures I may be involved in. The same applies to the course work in work planning and the management of people and resources. The entire Doctor of Engineering program was well suited for what I view as being essential in operating any business or performing any job.

The internship, for the most part, went very smoothly. The cooperation from my Industrial Adviser and from my committee chairman was excellent.

**APPENDIX A**  
**JOB DESCRIPTION**



<b>DEPARTMENT OF THE ARMY JOB DESCRIPTION</b>		<b>1. INSTALLATION OR HEADQUARTERS OFFICE</b> U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi		<b>2. JOB NUMBER</b> 5368-s	
<b>3. CITATION TO APPLICABLE STANDARD AND ITS DATE OF ISSUANCE</b> CSC Position Classification Standards, GS-410-0, dtd Dec 64 & The Research Guide			<b>4. TITLE</b> Supervisory Research Civil Engineer		
<b>5. PAY SCHEDULE</b> GS		<b>6. OCC. CODE</b> 810		<b>7. GRADE</b> 13	
<b>8. EVALUATION APPROVAL</b> Title, pay schedule, code and grade of this job have been fixed in accordance with Department of the Army official policy and grade level standards.			<b>SIGNATURE</b>  G. A. WILKERSON		<b>DATE</b> 13 Jul 73
<b>9. SUPERVISORY CONTROLS, DUTIES, AND WORKING CONDITIONS (Indicate percent of time for each duty, where pertinent.) (Continue statement of duties, etc., on reverse side if necessary.)</b>					
<u>SUPERVISORY CONTROLS</u>					
Works under general supervision of Division Chief. Programs and projects are developed by concerted action of official superiors, co-workers, and incumbent. Incumbent develops and formulates plans of work on own initiative, using judgment and making decisions based on prior knowledge and experience together with technical literature and contacts other experts in the field. Superior and other officials are kept informed of important developments for administrative and technical purposes. Work is reviewed for conformity with limited controls established and for validity of decisions made and actions taken independently. This position serves the Waterways Experiment Station, the Corps of Engineers, and the field of concrete technology generally. Accomplishments are, therefore, of note and must have general acceptance in the engineering profession nationally and internationally.					
<u>MAJOR DUTIES</u>					
1. As Chief of the Materials Properties Branch is responsible for all activities of the Branch. This includes conducting research and analytical work for the development of improved testing methods and apparatus, the evaluation of testing methods, procedures, and techniques as established in ASTM (American Society for Testing and Materials), guide manuals, and as conducted by other agencies (e.g., National Bureau of Standards, American Concrete Institute), the provision of technical guidance and reviewing services on engineering and scientific problems encountered in Civil Works and Military research development programs and investigations related to mass and reinforced concrete structures and structural elements, and conducting basic and applied theoretical and analytical research on construction materials, requiring originality and creativity leading to the development of new avenues of approach and new techniques and improvements in the state-of-the-art or the extension of the boundaries of existing knowledge. Utilizes the results of testing and research programs in the preparation of technical reports and for					
<b>10. JOB CONTENT APPROVAL (Complete on organization file copy only.)</b>					
<b>ORGANIZATION LOCATION</b> Concrete Laboratory, Engineering Mechanics Division, Materials Properties Branch					
<b>THIS STATEMENT ACCURATELY DESCRIBES THE WORK REQUIRED IN ONE POSITION OR IN EACH OF A GROUP OF POSITIONS IN THE ABOVE ORGANIZATION.</b>			<b>THE ABOVE DESCRIPTION, WITH SUPPLEMENTAL MATERIAL, IS ADEQUATE FOR PURPOSES OF EVALUATION.</b>		
<b>SIGNATURE OF APPROVING SUPERVISOR</b> 			<b>SIGNATURE OF ANALYST</b> 		
<b>11. REAUDIT APPROVAL</b>					
<b>DATE</b>					
<b>SUPERVISOR'S APPROVAL</b>					
<b>ANALYST'S SIGNATURE</b>					

publication in scientific literature and/or presentation before scientific organization. Conducts operations through the use of the complete facilities of OCE concrete laboratories and in close association with various committees engaged in the field of work, keeping abreast of developments in the field of work and providing an information service to OCE offices on these developments, taking initiative in establishing and maintaining a foremost laboratory with regard to equipment, processes and techniques.

2. Is a specialist in materials research and physical testing programs. Is responsible for activities in connection with research projects such as rheology of mortars and concrete including methods of mixing, time of set, and bleeding; theories of failure of plain, prestressed, and reinforced elements; nature of bond; fatigue and vibration response; response to static and dynamic loadings; and creep behavior. Carries out programs of physical testing for mixture design, petrographic or chemical analysis, and other purposes. Testing includes sieve analyses, specific gravities, sulfate soundness tests, unsound particle determinations, strength tests, absorption tests, heavy media separations, specific surface determinations, alkali-aggregate reaction tests, cement soundness tests, waterstop and joint seal testing, riprap testing, etc. Testing procedures involve the use of extremely delicate and precision instruments which require special knowledge and skills when calibrated and used. Supervises and conducts research on materials other than portland-cement-based materials, such as steel, fiber glass, plastics, rubbers, dredged materials, and others. Supervises and assists personnel engaged in project and research testing of the physical properties of cements, aggregates, slags, admixtures, other concrete materials, and concrete itself.

3. Attends conferences both inside and outside the WES. Presents findings, recommendations, and conclusions on various aspects of the work program which may have direct effect on subsequent research work and the development or revision of design and operational criteria.

4. Maintains permanent and work sheet data for evaluation of all phases of testing methods. Makes data compilations for reports; drafts qualitative results and/or computes quantitative results of the combined test data. Prepares drafts of reports of conclusions reached in the programs and prepares reports of all activities pertinent to the work assigned.

5. Supervises both professional and nonprofessional workers as necessary to perform the work required. Plans or assists in planning organizational structure and staffing needs, assigned duties to positions, participates with Personnel Office in preparing job descriptions, reviews and approves same. Requests recruitment assistance from Personnel Office and interviews and selects employees. Determines and provides necessary on or off the job training; establishes performance requirements, makes career or other performance appraisals. Receives complaints or grievances; resolves those within scope of authority, refers others to higher authority with appropriate recommendations. Takes or recommends necessary disciplinary actions. Maintains effective two-way communications with employees to insure that they understand and support policies, procedures, personnel and other management initiated actions; obtains suggestions from employees, etc.

6. Is responsible for knowledge and enforcement of all safety rules and regulations as they apply to the work described.

Performs other duties as assigned.

**APPENDIX B**  
**INTERNSHIP OBJECTIVES**

19 October 1978

Objectives of the  
Doctor of Engineering Internship  
for  
George C. Hoff

The internship will be done as the Chief, Materials Properties Branch (MPB), Engineering Mechanics Division (EMD), Structures Laboratory (SL), U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. The official job description for that position is attached as Incl 1. The job title and names of the Branch and Division may change before the internship is complete but the responsibilities should remain essentially the same. In this capacity, Mr. Hoff will function both as a supervisor and part-time program manager.

The primary objective of the intership is to develop the managerial skills necessary to function effectively in the present position as well as in management areas of greater responsibility. These include:

- a. Managing both professional engineers and laboratory technicians from both the administrative and technical standpoints.
- b. Developing operating budgets for the working group.
- c. Developing and obtaining sources of funding to meet budget requirements. This includes both writing research proposals and personal contacts.
- d. Financial management of funds received.
- e. Preparing and implementing research plans for which Mr. Hoff will serve as either program manager or assist those to whom he has assigned the project. This includes work scheduling and resource allocation.
- f. Participating in or observing the conduct of the following types of management meetings:
  - (1) Labor-management consultations.
  - (2) Equal-Employment Opportunity meetings.
  - (3) WES top management staff meetings.
  - (4) Management workshops and short courses.

Participation in (1) through (4) is contingent upon their occurring during the internship and also whether or not the materials and matter discussed are of such a nature that outside observers are allowed.

In addition to the managerial aspects and areas related to management noted above, the assignment also involves some technical work which includes:

- g. Data analysis and preparation of technical reports and papers.

h. Preparation of lecture plans and the presenting of lectures on construction materials and their proper use to eight training schools conducted at WES. These include the following courses by name (and their frequency):

- (1) Concrete Construction Inspection (three).
- (2) Advanced Concrete Technology (one).
- (3) Pavement Construction and Maintenance (two).
- (4) Drilling Inspection and Grouting (two).

Depending on the course, the personnel attending will vary from new inspectors to experienced resident engineers.

i. Participate in national or international technical organization meetings and seminars. This includes any committee or task group work that may be associated with the organizations.

In addition to the above objectives for the intern period, Mr. Hoff has been given a special assignment pertaining to the present on-going major reorganization of the WES. This reorganization includes reorganizing six technical laboratories into four new organizational elements. Mr. Hoff's previous assignment was in the Engineering Mechanics Division (EMD) of the Concrete Laboratory. This laboratory has been combined with other functional elements to form the new Structures Laboratory (SL). The EMD is to be combined with another division, Engineering Sciences (ESD), to form a new group called the Construction Materials Division (CMD) (this name is tentative, however). These two divisions formerly comprised the entire Concrete Laboratory and occupied a single building. The new division, CMD, along with the executive office of the new laboratory (SL), will occupy the same facilities.

As part of the DE Internship, Mr. Hoff will assist in the evaluation of the functional responsibilities of the existing branches of the old Concrete Laboratory from the standpoint of how these responsibilities can be grouped or rearranged consistent with the existing physical facilities to provide the most efficient organization for the new division (CMD). The evaluation will result in the establishing of alternatives to be considered by upper management regarding transferring of functions, equipment, floor space, and personnel within the confines of the new Construction Materials Division. This assignment is contingent upon many decisions to be made by upper management and no firm timetable exists for these decisions. It is possible that all of the evaluations may not be complete by the end of the internship period. If not, only those which are complete will be included in the Internship report.

The final objective of the internship is to prepare an Internship Report which will summarize Mr. Hoff's experience and document the work performed so that it can be established that the objectives of the internship have been met. The report will satisfy the requirements of the College of Engineering with regard to format, mechanics, and submission of file copies.

The internship will run for nine months from August 1978 to May 1979 over a two-semester period. A letter-type progress report will be furnished to the Committee Chairman by two weeks prior to the close of each semester.

Respectfully submitted,

GEORGE C. HOFF .

Approved:

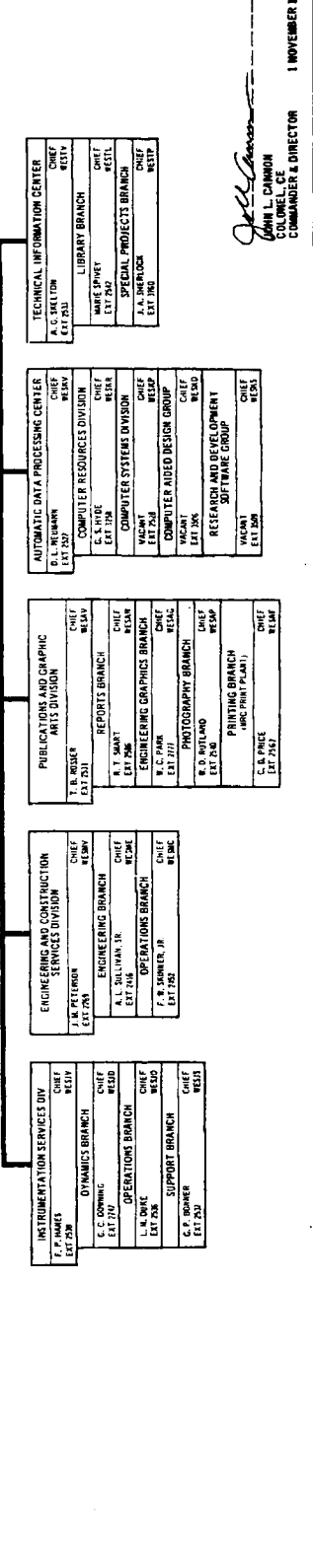
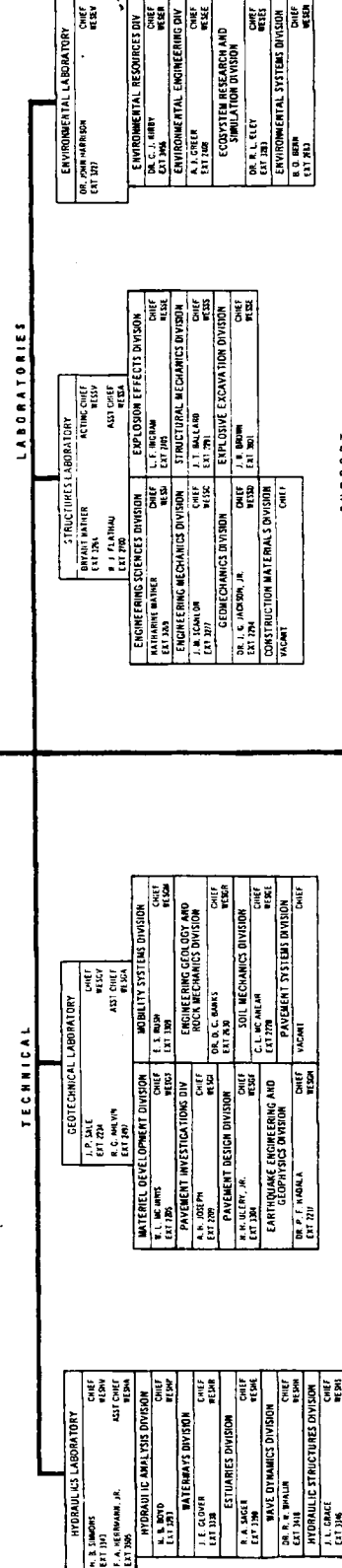
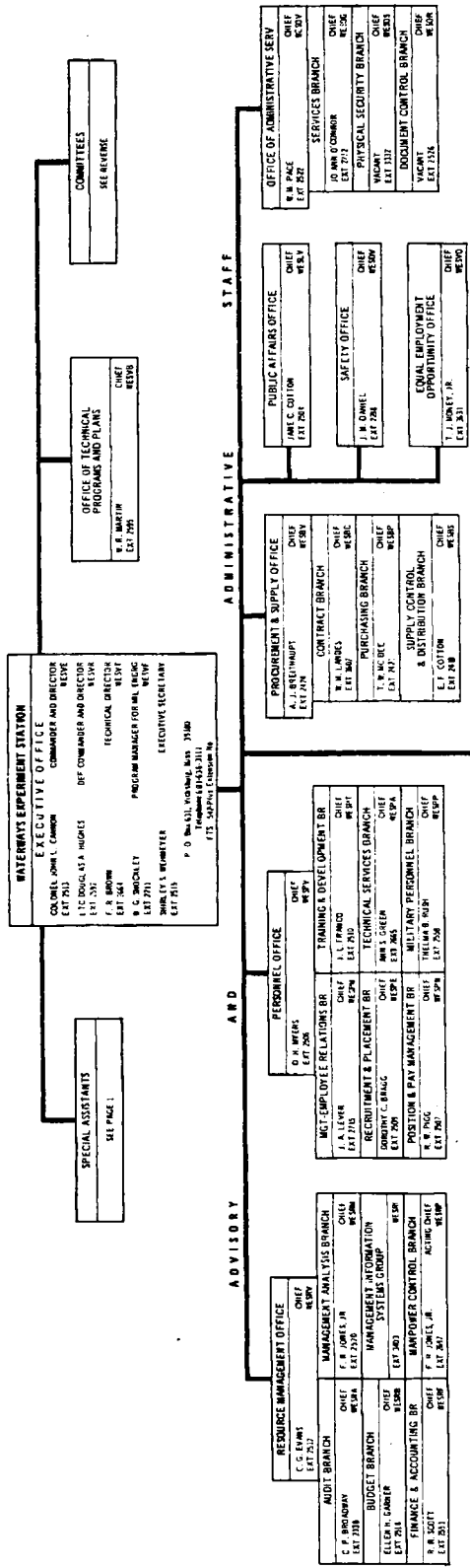
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JOHN M. SCANLON  
Industrial Advisor  
Chief, Engineering Mechanics Division  
Structures Laboratory  
U. S. Army Engineer Waterways Experiment  
Station

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WILLIAM B. LEDBETTER  
Committee Chairman  
Professor and Head  
Construction Division  
Civil Engineering Department  
Texas A & M University

APPENDIX C  
ORGANIZATION CHARTS  
FOR  
THE WATERWAYS EXPERIMENT STATION  
AND  
THE STRUCTURES LABORATORY

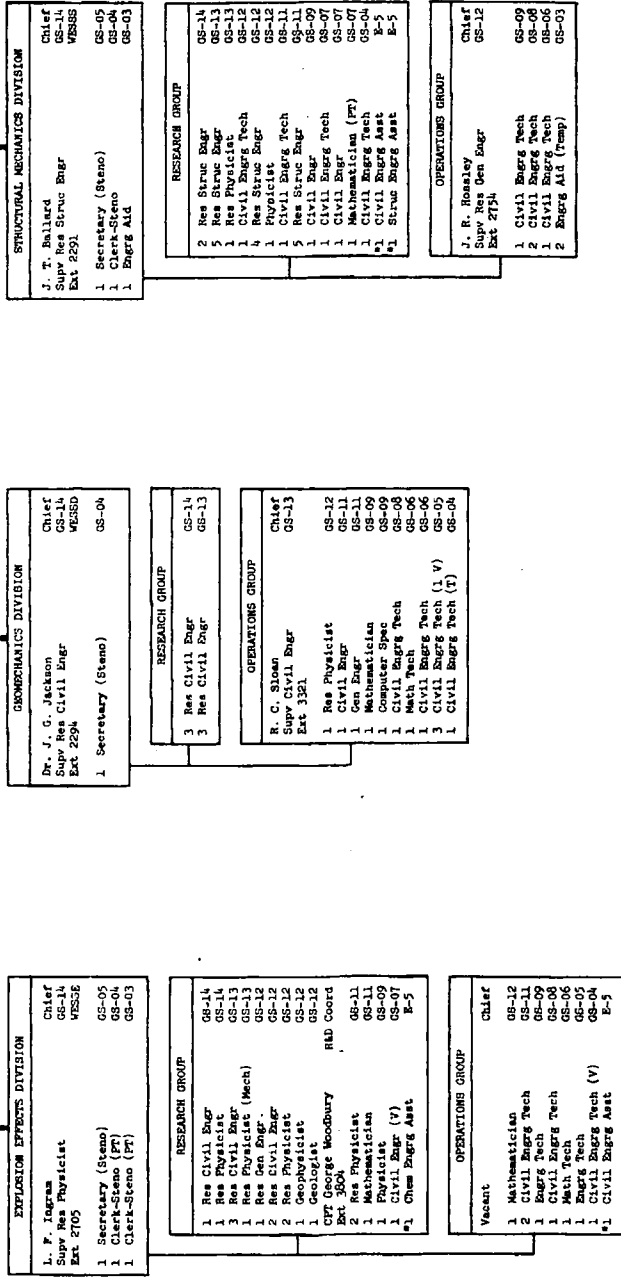


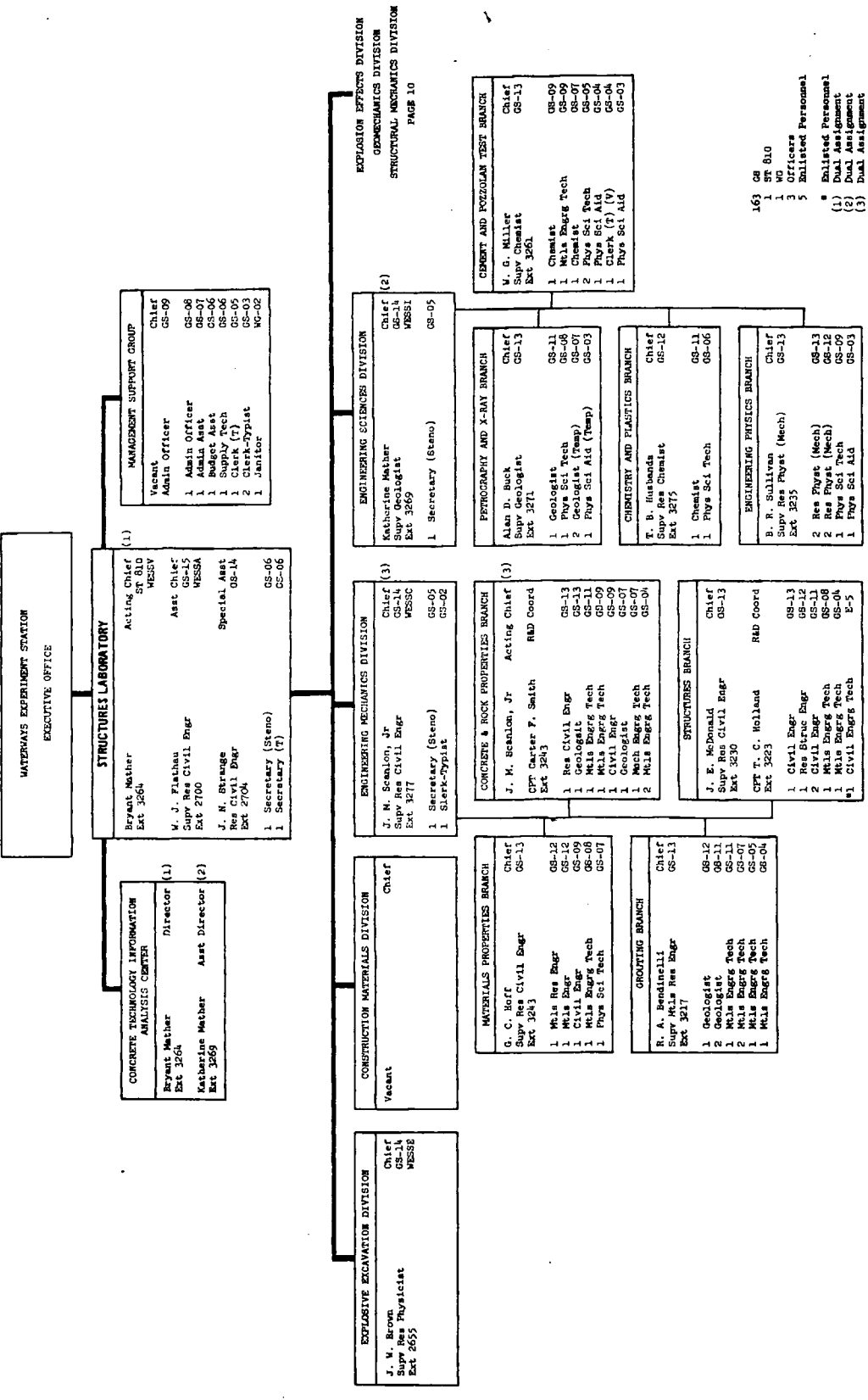


WATERWAYS EXPERIMENT STATION  
EXECUTIVE OFFICE

STRUCTURES LABORATORY

Continued from Page 9





1 NOVEMBER 1978

## APPENDIX D

RESEARCH AND TECHNOLOGY  
WORK UNIT SUMMARY  
(DD FORM 1498):  
MATERIALS FOR MOBA TRAINING  
VILLAGE CONSTRUCTION

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY				1. AGENCY ACCESSION <sup>a</sup>	2. DATE OF SUMMARY <sup>a</sup>	REPORT CONTROL SYMBOL	
					78 07 01	DD-DR&E(AR)636	
1. DATE PREV SUMMARY	4. KIND OF SUMMARY	3. SUMMARY SCTY <sup>a</sup>	5. WORK SECURITY <sup>a</sup>	7. REGRADING <sup>a</sup>	8. DIS'N INSTR'N	9b. SPECIFIC DATA - CONTRACTOR ACCESS	9. LEVEL OF SUB
	A NEW	U	U		NL	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	A. WORK UNIT
10. NO./CODES: <sup>a</sup>	PROGRAM ELEMENT	PROJECT NUMBER		TASK AREA NUMBER	WORK UNIT NUMBER		
a. PRIMARY	62719A	4A762719AT40		BO	019		Q6
b. CONTRIBUTING							
c. CONTRIBUTING	STO 79-9.1.1						
11. TITLE (Precede with Security Classification Code) <sup>b</sup>							
(U) Materials for MOBA Training Village Construction							
12. SCIENTIFIC AND TECHNOLOGICAL AREAS <sup>b</sup>							
010300 Miscellaneous materials; 011800 Operations, strategy, and tactics							
13. START DATE		14. ESTIMATED COMPLETION DATE		15. FUNDING AGENCY		16. PERFORMANCE METHOD	
80 10		81 09		DA		C In-House	
17. CONTRACT/GRANT				18. RESOURCES ESTIMATE		19. PROFESSIONAL MAN YRS	
a. DATES/EFFECTIVE:		EXPIRATION:		PRECEDING		b. FUNDS (in thousands)	
b. NUMBER: <sup>a</sup>		NA		FISCAL YEAR		78 0.0 00	
c. TYPE:		d. AMOUNT:		CURRENT		79 2.5 150	
e. KIND OF AWARD:		f. CUM. AMT.					
19. RESPONSIBLE DOD ORGANIZATION				20. PERFORMING ORGANIZATION			
NAME: <sup>a</sup> U. S. Army Engineer Waterways Experiment Station ADDRESS: <sup>a</sup> P. O. Box 631 Vicksburg, MS 39180				NAME: <sup>a</sup> U. S. Army Engineer Waterways Experiment Station ADDRESS: <sup>a</sup> P. O. Box 631 Vicksburg, MS 39180			
RESPONSIBLE INDIVIDUAL				PRINCIPAL INVESTIGATOR (Furnish SSAN if U.S. Academic Institution)			
NAME: Mather, B.				NAME: <sup>a</sup> Hoff, G. C.			
TELEPHONE: 601 636-3111, Ext 3264				TELEPHONE: 601 636-3111, Ext 3243			
21. GENERAL USE				SOCIAL SECURITY ACCOUNT NUMBER:			
Foreign Intelligence considered M				ASSOCIATE INVESTIGATORS			
				NAME:			
				NAME: POC:DA			
22. KEYWORDS (Precede EACH with Security Classification Code)							
(U) Concrete; (U) Structural Design; (U) Training Facility; (U) Construction Method							
23. TECHNICAL OBJECTIVE, <sup>a</sup> 24. APPROACH, 25. PROGRESS (Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)							
23. (U) The objectives of this investigation are (a) to develop the materials that can be used most effectively in the construction of a mock village to support troop training for Military Operations in Built-Up Areas (MOBA), and (b) to develop a typical design for the training village which permits its construction by an Engineer Battalion at any location desired by the Army. This development is needed to insure that adequate urban warfare training facilities are available to the military forces, both reserve and active, to meet training requirements under present and future doctrines.							
24. (U) The training needs and facility requirements will first be determined. Based on the facility requirements, structural criteria and material requirements will be developed. A typical design meeting the structural criteria and technical objective will be prepared. Construction techniques to build the training facilities will be developed							
25. (U) None.							

\*Available to contractors upon originator's approval.

DD FORM 1498  
1 MAR 68

PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. DD FORMS 1498A, 1 NOV 65 AND 1498-1, 1 MAR 68 (FOR ARMY USE) ARE OBSOLETE

Project/Area/Work Unit No. 4A762719AT40/B0/019

Date of Submission 78 07 01

26. OCE Technical Monitor(s): MCE-D

27. Overall Plan: The overall plan for this program is as follows:

a. Determine the training needs and facility requirements. The training needs and facility requirements will be determined in accordance with present doctrine in MOBA warfare and suitable facilities for any future doctrine will also be determined. The building types, structural equipments, street arrangements, and special training areas (e.g., barricades and scaling walls) will be determined.

b. Develop construction materials. The construction materials for the training facilities, which must have high kinetic-energy absorption capacity, do not cause ricochets, and do not disintegrate from repeated hits or are easily repairable, will be developed. The material properties necessary for the design will be determined.

c. Develop design and construction documents. Design criteria for the training facilities will be developed. Architectural and engineering designs will be performed. Typical design drawings, construction methods, and recommended construction specifications will be prepared. Methods for repair and/or replacing damaged structures after training exercises will also be developed.

d. Final report. A final report which includes design criteria, design methods, typical design drawings and details, and construction methods for the training facilities will be prepared and published.

<u>Milestone</u>	<u>Estimated Completion Date</u>
Define training needs and facility requirements	Jul 79
Design criteria	Sep 79
Preliminary design	Feb 80
Develop construction materials	Sep 80
Final design	Feb 81
Construction documents	Feb 81
Final report	Sep 81

Project/Area/Work Unit No. 4A762719AT40/B0/019

Date of Submission 78 07 01

28. Work to be Accomplished:

a. Work to be Accomplished in FY 79: The training needs and facility requirements will be developed. Design criteria for the training facilities will be developed. Development of construction materials will be initiated.

b. Work to be Accomplished in FY 80: The optimum construction material for constructing the training facilities will be determined. The material properties necessary for the design will be developed. The preliminary architectural and engineering designs will be completed.

29. Funding Summary:

Commitment	FY 79	FY 80	FY 81
	<u>BFY-1</u>	<u>BFY</u>	<u>BFY+1</u>
In-House	100	70	30
Out-of-House	<u>50</u>	<u>25</u>	<u>0</u>
TOTAL	150	95	30

30. Technology Transfer:

a. Lab end product and when available: Final technical report, Sep 81.

b. Final end product and when available: Input for new TM on materials and designs for training facilities for MOBA.

c. Transfer responsibility (other than Tech Monitor):

(1) POC-Name-Phone No.:

(2) Organization: U. S. Army Engineer School

d. Primary User(s): TRADOC

e. Other User(s): FORSCOM (Combat Arms)

APENDIX E

DRAFT OF  
MEMORANDUM OF AGREEMENT  
BETWEEN THE  
U. S. ARMY INFANTRY SCHOOL AND  
THE WATERWAYS EXPERIMENT STATION

MEMORANDUM OF AGREEMENT  
BETWEEN  
U. S. ARMY INFANTRY SCHOOL AND WATERWAYS EXPERIMENT STATION

SUBJECT: Feasibility Testing of Shock-Absorbing Concrete

1. PURPOSE. To establish responsibilities in the development and testing of materials, design, and construction characteristics of a prototype MOUT live-fire training facility at Fort Benning, Georgia.

2. REFERENCES.

a. USAIS letter (BG Rogers) dated 8 June 1979, subject: Feasibility Test of Shock-Absorbing Concrete (TAB B).

b. Memorandum, Directorate of Training Developments, dated 9 August 1979, Subject: Meeting of MOUT Representatives to Finalize Memorandum of Agreement for Development of Shock-Absorbing Concrete (TAB C).

3. PROBLEM. The U. S. Army must insure that its forces are effective in the inevitable role of urban combat. To do this it must develop a training facility that simulates the flavor and challenges in this style of combat. While non-live fire training facilities provide some aspects of MOUT familiarization, only a live-fire facility will give the small unit infantry leader an idea of the magnitude of fire control and leadership problems in urban combat. A need, therefore, exists to develop a material capable of accommodating live-fire training with minimal risk of ricochet and spalling.

4. SCOPE. The Infantry School, working with the Waterways Experiment Station, will conduct a three-phase test of target surfaces with various types of ammunition to determine the optimum prototype live-fire training facility. Alternatives to be considered, but are not limited to:

a. The use of ammunition in a facility constructed of or surfaced with shock-absorbing concrete.

b. The use of rimfire or plastic munitions in a facility constructed of or surfaced with shock-absorbing concrete.

5. AGREEMENTS, SUPPORT, AND REQUIREMENTS.

a. Agreement: The development and evaluation of a shock-absorbing concrete will occur in the FY 80-82 time frame and will generally follow three phases:

Phase I - Testing of ammunition against target material slabs.

Phase II - Testing of target materials to determine construction characteristics.

Phase III - Construction and testing of a two-story facility for live-fire evaluation.



b. Support: Waterways Experiment Station will provide technical advice and FY 80-82 funds for Phases I, II, and III. USAIS will provide test personnel, range, weapons, and ammunition for Phases I, II, and III. The design of the Phase III test structure will be jointly accomplished between USAIS and WES.

c. Requirements: The constructional properties and structural design must meet the following minimum requirements:

- (1) Accommodate live fire with minimal risk of ricochet or spalling.
- (2) Accommodate those basic principles of European urban combat outlined in FM 90-10 and USAIS ST 90-10 and USAIS ST 90-10 (e.g., upper level entry).
- (3) Adaptable for use of E and F type pop-up targets.
- (4) Support the weight of maneuvering troops and the use of common MOUT special equipment (e.g, grappling hooks).
- (5) Accommodate firing of service, subcaliber, training, or plastic ammunition from the following weapons:

M16 Rifle  
 M60 MG  
 Cal .50 MG  
 M203 GL  
 M72 (LAW and VIPER)

d. Issues of Concern:

- (1) What special safety and range control requirements will the facility generate? (USAIS responsibility)
- (2) What training benefits/constraints will result? (USAIS responsibility)
- (3) How much of the training year will be lost to maintenance? (WES)

6. EFFECTIVE DATE: Upon signatures.

---

NELSON P. CONOVER, COL, CE  
 Commander/Director  
 USAE Waterways Experiment Station

---

JOHN E. ROGERS, BG, USA  
 Assistant Commandant  
 U. S. Army Infantry School

## APPENDIX F

MEMORANDUM FOR ALL CONCERNED NO. 2068  
SUBJECT: CASTING OF MOBA TEST PANELS



DEPARTMENT OF THE ARMY  
 WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS  
 P. O. BOX 631  
 VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO:

WESSC

27 April 1979

MEMORANDUM FOR ALL CONCERNED NO. 2068

JOB NO. 441-S540.19SC31

SUBJECT: Casting of MOBA Test Panels

1. Authority. Advice of Authorization and/or Allotment Directive No. EC 79-1, dated 26 October 1978, with modification by DF from Fred Brown dated 15 December 1978, subject, AT40 Funds for Tunnel Detection Work.

2. Objective. The test panels described in this memorandum are to be tested with live fire from an M-16 weapon to determine effects of such variables as materials properties and distance from target.

3. Work to be performed. Twenty-four panels and supporting test specimens are to be made by the Materials Properties Branch (MPB) as noted in the following paragraphs.

a. Panel casting and curing. The panels shall be a nominal 2 ft by 2 ft in area with thicknesses of 5-1/2 and 7-1/2 in. as indicated for each panel. Area dimensions can be adjusted slightly to maximize the use of the forming lumber. The panels shall be cast horizontally on a plywood surface. The sides will be formed from standard 2- by 6-in. and 2- by 8-in. lumber. All surfaces will be treated accordingly so as to prevent bond to the concrete. Care should be taken to insure that the exposed concrete surface is screeded and finished to as uniform a flat surface as possible. After casting and initial setting of the material, all panels will be covered with wet burlap and cured under wet burlap for 7 days. The remainder of the curing period until tested shall be in air under ambient laboratory conditions. The panels can remain in the forms until tested. The perimeter lumber can remain in place even during testing to facilitate handling.

The following nominal 2- by 2-ft panel will be cast.

<u>Material</u>	<u>Type of Fiber</u>	<u>Panel Number</u>	<u>Required Density pcf</u>	<u>Panel Thickness, in.</u>
Cellular Concrete	None	1	50	7-1/2
Cellular Concrete		2	70	7-1/2
Cellular Concrete		3	90	5-1/2
Cellular Concrete	Steel	4	50	7-1/2

WESSC

27 April 1979

SUBJECT: Casting of MOBA Test Panels

<u>Material</u>	<u>Type of Fiber</u>	<u>Panel Number</u>	<u>Required Density pcf</u>	<u>Panel Thickness, in.</u>
Cellular Concrete		5	70	7-1/2
Cellular Concrete		6	90	5-1/2
Cellular Concrete	AR Glass	7	50	7-1/2
Cellular Concrete		8	70	7-1/2
Cellular Concrete		9	90	5-1/2
Cellular Concrete	Polymeric	10	50	7-1/2
Cellular Concrete		11	70	7-1/2
Cellular Concrete		12	90	5-1/2
EPS Concrete	None	13	40	7-1/2
EPS Concrete		14	55	7-1/2
EPS Concrete		15	70	7-1/2
EPS Concrete	Steel	16	40	7-1/2
EPS Concrete		17	55	7-1/2
EPS Concrete		18	70	7-1/2
EPS Concrete	AR Glass	19	40	7-1/2
EPS Concrete		20	55	7-1/2
EPS Concrete		21	70	7-1/2
EPS Concrete	Polymeric	22	40	7-1/2
EPS Concrete		23	55	7-1/2
EPS Concrete		24	70	7-1/2

The water-cement ratio (by weight) for all panels will be 0.50. The sand-cement ratio for all panels will be 2.50. Nine 6- by 12-in. cylinders and two 6- by 6- by 36-in. flexural test specimens should be made from each batch.

b. Mixtures and batching. Sufficient expertise exists for the proportioning and batching of both cellular and EPS concrete that trial mixtures should be minimal. In all cases the freshly mixed density requirements noted in this memorandum are the densities of the material prior to the addition of the fiber. That is to say, a cellular concrete mixture requirement of 50 pcf may weigh as much as 57 pcf after steel fibers are added.

The batching procedure will be to add all the ingredients except fibers together in the proper sequence, mixing them until the concrete is satisfactorily batched. The mixer will be stopped and a freshly mixed density check made. All densities shall be within +2 pcf of the required density. If acceptable, the unit weight will be recorded and contents of the unit weight bucket returned to the mixer with mixing being resumed. From a preweighed amount of fibers, fibers will then be added slowly to the mixing concrete until the mixture just begins to become harsh in appearance. Fiber additions will then stop with the batch being allowed to mix two additional minutes. The unit weight of the concrete with fibers will then be determined and recorded along with the amount of fiber used (to the nearest 0.1 lb). The contents of the unit weight bucket will then be returned to the mixer and remixed for 1 minute. The test specimens will then be cast.

WESSC  
SUBJECT: Casting of MOBA Test Panels

27 April 1979

c. Materials. The cement shall be Type I cement purchased locally and shall be given a RC identification number along with a standard chemical and physical test. Approximately 35 bags of cement will be required for the casting. The sand will be manufactured limestone sand and will be available from the carload of such sand to be delivered to SL in April 1979. If the physical characteristics of the sand such as specific gravity, absorption, and gradation are not available, they should be determined prior to using the sand.

The AR glass fibers are manufactured by Owens-Corning Fiberglas and are 1 in. long. Approximately 320 lb of these fibers are available in the southwest environmental control room of the MPB. The steel fibers are manufactured by US Steel and are 0.010 by 0.022 in. in cross section and 1 in. long. Approximately 400 lb are available on a pallet at the northwest corner of the main laboratory of Building 6000. The polymeric fibers have yet to be identified and located. When this occurs, an amendment to this memorandum will be issued.

The expanded polystyrene beads are to be BASF Styropor beads. Gradations of the actual beads used should be determined. This may require special procedures. The use of the beads will be complemented with the two-component epoxy wetting agent, CSC-10 Underlayment 101, normally used with Styropor beads. It is estimated that approximately 45 lb of beads will be required for the casting.

The foaming agent used for the cellular concrete fabrication shall be Cellufoam, manufactured by Waukesha.

4. Schedule. All materials should be located and procured if needed and all forms built as soon as possible. The first casting of panels should be on 22 or 23 May 1979 with subsequent castings on the Mondays and Tuesdays of all following weeks. As many panels as possible should be cast on a given day. As 7-day tests will be run on each panel, casting days which would result in testing on a holiday should be avoided.

5. Report. George Hoff is the project manager for this RDTE unit and prepared this memorandum. All pertinent information and test data should be forwarded to Bob Denson and CPT Al Monahan who will analyze and document it.

6. Laboratory notebook. This work does not involve patentable work, therefore a laboratory notebook will not be maintained for it.



BRYANT MATHER  
Engineer  
Acting Chief, Structures Laboratory

CF:

B. Mather	G. Hoff
W. Flathau	T. Liu
J. Scanlon	J. McDonald
CPT Monahan	OTP&P
R. Denson	

## APPENDIX G

MEMORANDUM ENTITLED  
"TRAVEL WHILE ON TEMPORARY  
DUTY TO PERFORM FIELD TESTS  
AT REMOTE SITES"

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SUBJECT: Travel While on Temporary Duty to Perform Field Tests at Remote Sites

1. Travel from the Waterways Experiment Station to temporary duty stations and return and payment of overtime for travel of employees from lodging places to job sites while on temporary duty to perform field tests at remote sites is an area of primary concern of employees and, therefore, of WES Management.

2. The following provisions apply in regard to travel of this type and the entitlement to the payment of overtime.

a. Entitlement to overtime compensation for travel is treated differently for employees who are entitled to payment of overtime under the provision of the Fair Labor Standards Act and those who are exempt from the provisions of this Act. The statute that governs the payment of overtime for all employees is Title 5, U. S. Code. To the extent that the Fair Labor Standards Act would provide a greater benefit to a nonexempt employee (e.g. a higher overtime rate or larger number of hours worked) than the benefit payable under Title 5, the nonexempt employee is entitled to the FLSA benefit. If Title 5 provides a greater benefit, the employee would receive that benefit.

b. Overtime entitlement under the FLSA does not begin to accrue until the employee has completed 40 hours of actual work in a week. For example, an employee who has any paid time off during the week (holiday, annual leave, sick leave, or any excused absence with pay) will not accrue any entitlement to overtime pay under the Fair Labor Standards Act until additional actual work exceeds the paid hours of nonwork and is in excess of 40 hours of actual work in the week.

c. To the maximum extent practicable and reasonable, official travel from the Waterways Experiment Station to the temporary duty station and return will be scheduled within an employee's regularly scheduled hours of duty. When such scheduling is not possible and an employee is required to travel outside his/her regularly scheduled tour of duty under circumstances which are not compensable, the project engineer will record his/her reasons for ordering the travel and upon the request of the employee, furnish him/her a copy.

d. Time spent in traveling from WES to TDY point is considered as hours worked for nonexempt employees under the Fair Labor Standards Act, if it is performed between 8:00 a.m. and 4:30 p.m. on Saturday and Sunday. Payment for travel during other hours for nonexempt employees (between 4:30 p.m. and 8:00 a.m. on regular work days) is not considered hours worked and, therefore, not compensable unless it involves the performance of actual work while traveling (driver of vehicle carrying supplies, etc.) or is incident to travel that involves the performance of work while traveling.

SUBJECT: Travel While on Temporary Duty to Perform Field Tests at Remote Sites

e. Time spent in traveling on a direct route from the nearest authorized place of lodging (as determined by the project engineer) to the job site minus thirty minutes (average amount of time required for travel from home to work) and the time of return less thirty minutes is considered "hours worked" for nonexempt employees and is used in the computation to determine if work in excess of 40 hours has been performed to entitle employee to overtime compensation.

f. Time spent in traveling on direct route from the nearest authorized place of lodging (as determined by the project engineer) to the job site and return is not considered as hours of work for exempt employees nor for non-exempt employees who have worked less than 40 hours during a week, unless the travel involves the actual performance of work while traveling (driver of vehicle carrying tools and equipment, passengers, etc.)

3. Supervisory personnel will familiarize themselves with the above provisions so that all laboratories and other separate staff elements will comply with the Civil Service regulations and uniformly schedule and compensate employees for travel.



## APPENDIX H

DISPOSITION FORM DA 2496  
ENTITLED "COMPENSATION FOR  
EXEMPT AND NONEXEMPT EMPLOYEES,"  
DATED 11 DECEMBER 1978

**DISPOSITION FORM**

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL  WESSC	SUBJECT  Compensation for Exempt and Nonexempt Employees		
TO Ann Green, Technical Services	FROM C/Mtls Prop Br	DATE 11 Dec 78 HOFF/aj/	CMT 1
<p>1. In reference to your undated memorandum entitled "Travel While on Temporary Duty to Perform Field Tests at Remote Sites," I believe a compilation of guidelines such as those you've noted is necessary, but I don't agree with all of the items noted. My comments and philosophy which follow will be limited to my exceptions.</p> <p>2. TDY at Remote Sites is generally assumed, by those people who do not participate in it, as being fun, lucrative, and generally a boondoggle. For most of those who do participate in it, it is in fact, inconvenient, expensive, and generally an unpleasant but necessary ordeal. It is not pleasant to be away from home, family, and friends for extended periods of time; to live in hotels and motels by yourself; do your own laundry; eat in second-rate restaurants because that's all your per diem will allow; and be stranded in small, out-of-the-way places where you are staying every night and on weekends because regulations prohibit the use of government or rental vehicles for personal use such as sightseeing. People who have never been on a remote TDY job at the working level will think that is an overexaggeration; but if they are rational and blessed with common sense, they should be able to envision the problems they would have if they were suddenly removed from their present life style for 4 to 6 weeks and put in a more austere environment. Having been on many remote TDY assignments over the last 17 years, I can honestly state that I don't look forward to them, for the reasons stated.</p> <p>3. With that view in mind, it seems incongruous to ask an exempt employee to expect to be paid less than a nonexempt employee when both are putting in the same hours on the same job under the same adverse conditions. This will occur when para 2e and 2f are applied. When it does happen in actual practice, a lot of hard feelings develop with subsequent loss of initiative and productivity by the employee who feels he has been done an injustice. Back in 1965 and 1966 when I operated three crews out of our field office in Mercury, Nevada, I was instructed by my supervisor to initiate a policy similar to those of para 2e and 2f but where employees got paid for driving to work from their place of lodging but not back to it. There were no "official" exempt and nonexempt employees and no FLSA at that time. Because people chose to live different places because of their particular situations and station in life, some people got paid one hour per day more than others. This discrepancy led, in part, to a formal complaint that went all the way to DA for resolution. It never was resolved because the complainant left the DA family in a job change. The complaint was precipitated by hard feelings over exactly what para 2e and 2f will produce. It will probably happen again. It has also been my experience at WES that, in general, when employees feel they have been dealt with unfairly regarding compensation, they will get it back one way or another through less than honest or unofficial means outside the scrutiny or control of management. There is no gain to the government because of a loss of the spirit of cooperation from the disgruntled employee coupled with the fact that the employee will now tend to work outside or around the official prescribed system for such matters.</p> <p>4. It is my opinion that a lot of future problems will be eliminated if para 2e and 2f were eliminated and replaced with a provision that said something to the effect of:</p>			

WESSC

11 Dec 78

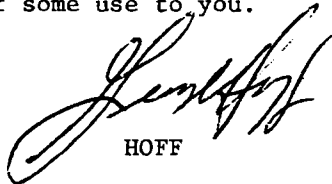
SUBJECT: Compensation for Exempt and Nonexempt Employees

"Hours worked for both exempt and nonexempt employees will be determined from the time an employee reports to an assembly area so designated by the project engineer until he leaves the same area at the end of the work day with appropriate adjustments for meal periods."

This wording makes the provision consistent with the current WES labor contract (Article 12, Section 3). It should be further noted that para 2e is in direct conflict with Article 12, Section 3 of the already binding union contract. On a field job where nonexempt employees are participating, the assembly area is the closest available adequate lodging. It should also be the same for exempt employees participating on the same job. If only exempt employees are on the job, the project engineer could designate some other point of assembly if he or she so desires. The assembly points should not vary on the same job, however, for different classes of employees.

5. I also obtained input from the three other exempt employees in my group regarding your inquiry. Most object to being classified as exempt just because they are professionals. The general feeling is that they are considered professionals when somebody wants to club them on the head with a regulation or policy (such as the subject item) and are not considered professionals when it is to their advantage such as attending professional meetings and in the matter of having to sign in and out (which is not professional at all). They also feel that if they are required to travel on weekends against their wishes, they should be paid for it in the same manner as nonexempt employees.

6. I hope the comments will be of some use to you.



HOFF

CF:

J. A. Lever

Management-Employee Relations Branch

## APPENDIX I

## INSTRUCTOR'S LESSON PLANS

## ADVANCED CONCRETE TECHNOLOGY SCHOOL

1. POLYMERS IN CONCRETE (WITH INSTRUCTOR'S NOTES)
2. AGGREGATES AND RIPRIP
3. THE RAPID ANALYSIS MACHINE (RAM)

## CONCRETE CONSTRUCTION INSPECTION SCHOOL

1. WATERSTOPS
2. AGGREGATES
3. AGGREGATE TESTING

## PAVEMENT CONSTRUCTION AND MAINTENANCE SCHOOL

1. FIBER-REINFORCED CONCRETE
2. FAST-SETTING CEMENTS

## DRILLING INSPECTION AND GROUTING SCHOOL

1. EXPANSIVE CEMENTS

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Polymers in Concrete		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 55 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Advanced Conc Tech
PLACE: Waterways Experiment Station		NO. ASSTs:
TRAINING AIDS: Blackboard, 35-mm slides		
OBJECTIVES: To introduce the student to the technology of polymers in concrete for the purposes of improving the properties and characteristics of hardened concrete		
INSTRUCTOR REFERENCES: Chapter 10, FWHA Report RD-77-110, Identification of Candidate Zero Maintenance Paving Materials (1977) by Hoff, et al.		
STUDENT REFERENCES AND HOME WORK: Polymers in Concrete notes in class notebook		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<p><u>INTRODUCTION</u></p> <p>Polymer portland cement concrete and polymer concrete have been investigated in various countries since the early 1950's. Large-scale research on polymer-impregnated concrete was undertaken in the United States in 1966. Study and/or use of concrete composites which contain polymers now involve a large number of government agencies, industrial institutions, universities, and private commercial firms around the world. The rapid advancement of technology in the field of concrete composites which contain polymers is continually producing refinements in components and processes used and in the understanding of properties and performance of the composites. Applications for the composites are expanding at a particularly rapid rate. The objective of this lecture is to introduce you to the use of polymers in concrete by describing what they are, how they are made, their properties and performance, and their use.</p>	
0002	<p><u>DEVELOPMENT</u></p> <p>1. Description of Materials</p>	<p><u>LIGHTS OFF</u></p> <p>Slides 1, 2, 3</p>
0004	<p>2. Polymer-Impregnated Concrete (PIC)</p> <p>a. PIC Fabrication</p> <p>b. Concrete Drying Requirements</p> <p>c. Monomers</p> <p>d. Additives and Modifiers</p> <p>(1) Plasticizers</p> <p>(2) Cross-linking agents</p> <p>(3) Flame retardants</p> <p>(4) Silane coupling agents</p> <p>e. Monomer Saturation Techniques</p> <p>(1) Full impregnation</p> <p>(2) Partial impregnation</p>	<p>Slides 4, 5</p> <p>Slide 6</p> <p>--</p> <p>Slide 7</p> <p>Slide 8</p> <p>Slide 9</p>

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
	f. Polymerization (1) Thermal-catalytic (2) Promoted-catalytic (3) Radiation	Slide 10
0015	3. Dworshak Dam Stilling Basin Example of PIC a. Overview, bulkheads b. Heating elements before impregnation c. Spray-bar for distributing monomer d. Steam generating unit for polymerization e. Completed PIC section	Slide 11 Slide 12 Slide 13 Slides 14, 15 Slide 16
0021	4. Polymer Concrete (PC) a. PC monomers and resins b. PC additives and modifiers (1) Plasticizers (2) Flame retardants (3) Silane coupling agents c. PC polymerization d. PC fabrication	Slides 17, 18 Slide 19 Slide 20  Slide 21
0028	5. Polymer-Portland Cement Concrete (PPCC) a. Polymer latexes b. Water-soluble polymers c. Liquid resins d. PPCC preparation (1) Latex-modified concrete (2) Water-soluble polymer concretes	Slides 22, 23 Slide 24 Slide 25 Slide 26 Slides 27, 28
0035	6. Summary of Performance a. Ease of construction b. Ease of maintenance c. Availability and cost	<u>LIGHTS ON</u>
0040	<u>SUMMARY</u> 1. Types of Concrete Containing Polymers. 2. Drying and Polymerization Techniques. 3. Relationship of Cost and Benefits.	
0045	<u>QUESTION PERIOD</u>	

LECTURE A33POLYMERS IN CONCRETEINTRODUCTION

POLYMER PORTLAND CEMENT CONCRETE AND POLYMER CONCRETE HAVE BEEN INVESTIGATED IN VARIOUS COUNTRIES SINCE THE EARLY 1950's. LARGE-SCALE RESEARCH ON POLYMER-IMPREGNATED CONCRETE WAS UNDERTAKEN IN THE UNITED STATES IN 1966. STUDY AND/OR USE OF CONCRETE COMPOSITES WHICH CONTAIN POLYMERS NOW INVOLVE A LARGE NUMBER OF GOVERNMENT AGENCIES, INDUSTRIAL INSTITUTIONS, UNIVERSITIES, AND PRIVATE COMMERCIAL FIRMS AROUND THE WORLD. THE RAPID ADVANCEMENT OF TECHNOLOGY IN THE FIELD OF CONCRETE COMPOSITES WHICH CONTAIN POLYMERS IS CONTINUALLY PRODUCING REFINEMENTS IN COMPONENTS AND PROCESSES USED AND IN THE UNDERSTANDING OF PROPERTIES AND PERFORMANCE OF THE COMPOSITES. APPLICATIONS FOR THE COMPOSITES ARE EXPANDING AT A PARTICULARLY RAPID RATE.

SLIDE 1DESCRIPTION OF MATERIALS

THE UTILIZATION OF MONOMERS AND POLYMERS IN CONCRETE IS DONE FOR THE PURPOSE OF SUBSTANTIALLY ALTERING SOME PROPERTY OF THE FINAL HARDENED CONCRETE MATERIAL. SMALL QUANTITIES OF POLYMER ARE SOMETIMES ADDED TO MODIFY THE PROPERTIES OF FRESH CONCRETE. THESE MATERIALS ARE MORE COMMONLY REFERRED TO AS CHEMICAL ADMIXTURES AND ARE NOT CONSIDERED IN THIS PRESENTATION.

SLIDE 2

THE CONCRETES WHICH UTILIZE POLYMERS TO FORM COMPOSITE MATERIALS HAVE BEEN GENERALLY CATEGORIZED AS POLYMER-IMPREGNATED CONCRETES (PIC), POLYMER-PORTLAND CEMENT CONCRETE (PPCC), AND POLYMER CONCRETE (PC).

SLIDE 3

THE TERM POLYMER CEMENT CONCRETE (PCC) HAS ALSO BEEN USED IN THE LITERATURE TO REFER TO THIS SAME MATERIAL DEFINITION, BUT THE PCC TERM IS ALSO COMMONLY USED IN HIGHWAY WORK TO DESCRIBE A PORTLAND CEMENT CONCRETE PAVEMENT. PPCC IS THE PREFERRED TERM FOR POLYMER-PORTLAND CEMENT CONCRETE.

SLIDE 4POLYMER-IMPREGNATED CONCRETESLIDE 5

POLYMER-IMPREGNATED CONCRETE. POLYMER-IMPREGNATED CONCRETE (PIC) IS A PRECAST PORTLAND CEMENT CONCRETE IMPREGNATED WITH A MONOMER WHICH IS SUBSEQUENTLY POLYMERIZED IN SITU.

PIC FABRICATIONSLIDE 6

THE BASIC METHOD OF PRODUCING PIC CONSISTS OF THE SELECTION OF THE MONOMER, FABRICATION OF PRECAST CONCRETE SPECIMENS, OVEN-DRYING, SATURATION WITH MONOMER, AND IN SITU POLYMERIZATION.

NO SPECIAL PROCEDURES ARE NECESSARY FOR THE PREPARATION OF CONCRETE FOR IMPREGNATION. ALL TYPES OF AGGREGATES, CEMENTS, AND ADMIXTURES THAT CAN BE USED IN MODERN CONCRETE TECHNOLOGY CAN BE USED FOR PIC. SIMILARLY, CURING PROCEDURES FOR STRENGTH DEVELOPMENT ARE NOT CRITICAL. IT APPEARS PREFERABLE TO START WITH A GOOD QUALITY DENSE CONCRETE, AS THE POLYMER LOADING FOR FULL IMPREGNATION IS MUCH LOWER THAN FOR THE MORE POROUS POORER QUALITY CONCRETE.



## CONCRETE DRYING REQUIREMENTS

THE STRENGTH AND DURABILITY PROPERTIES OF PIC ARE STRONGLY AFFECTED BY THE FRACTION OF THE POROSITY OF THE CEMENT PHASE WHICH IS FILLED WITH POLYMER. IF MAXIMUM IMPROVEMENTS ARE DESIRED, IT IS NECESSARY TO REMOVE AS MUCH WATER FROM THE PRECAST SPECIMENS AS POSSIBLE PRIOR TO IMPREGNATION IN ORDER TO MAXIMIZE THE AVAILABLE POROSITY.

DRYING TEMPERATURES UP TO 750F HAVE BEEN EVALUATED. THE AMOUNT OF WATER REMOVED IN A GIVEN CONCRETE SPECIMEN IS A FUNCTION OF BOTH DRYING TIME AND TEMPERATURE. RECENT WORK INDICATES THAT A DRYING TEMPERATURE OF 230F MAY NOT BE HIGH ENOUGH TO REMOVE ALL THE WATER. A DRYING TEMPERATURE OF 302F SEEMS TO BE OPTIMUM.

## MONOMERS

### SLIDE 7

THE SELECTION OF SUITABLE MONOMERS FOR PIC IS BASED UPON THE IMPREGNATION AND POLYMERIZATION CHARACTERISTICS, AVAILABILITY AND COST, AND THE RESULTANT PROPERTIES OF THE POLYMER AND THE PIC. MOST MONOMER INVESTIGATIONS HAVE BEEN WITH VINYL MONOMER SYSTEMS. UNDER NORMAL CONDITIONS OF TEMPERATURE AND PRESSURE, MONOMERS CAN BE EITHER GASES (E.G., VINYL CHLORIDE), LIQUIDS (E.G., METHYL METHACRYLATE), OR SOLIDS (E.G., ACRYLAMIDE). LIQUID TYPE MONOMERS ARE MOST ADAPTABLE TO IMPREGNATION OF PRECAST CONCRETE, ALTHOUGH GASEOUS MONOMERS HAVE BEEN USED.

## ADDITIVES AND MODIFIERS

### SLIDE 8

VARIOUS COMONOMERS AND OTHER ADDITIVES TO THE MONOMER SYSTEM ARE FREQUENTLY USED TO MODIFY OR PRODUCE DESIRED CHANGES IN THE PROPERTIES OF THE POLYMER.

PLASTICIZERS. PLASTICIZERS ARE COMMONLY ADDED TO MONOMERS TO IMPROVE THE FLEXIBILITY OF INHERENTLY BRITTLE POLYMERS SUCH AS POLY(METHYLMETHACRYLATE) AND POLYSTYRENE (PS).

CROSS-LINKING AGENTS. CROSS-LINKING BY MEANS OF THE ADDITION OF AN APPROPRIATE BIFUNCTIONAL OR POLYFUNCTIONAL MONOMER INCREASES THE RIGIDITY OF THE POLYMER, ITS RESISTANCE TO THE ACTION OF SOLVENTS, AND ITS SOFTENING POINT.

FLAME RETARDANTS. ALL POLYMERS WILL BURN, PYROLIZE, OR CHAR IN CONTACT WITH A FLAME SOURCE. IT IS KNOWN, HOWEVER, THAT COMPOUNDS CONTAINING CERTAIN ELEMENTS SUCH AS CHLORINE, BROMINE, PHOSPHOROUS, ANTIMONY, BORON, AND NITROGEN WILL RETARD OR INHIBIT COMBUSTION. THE DEGREE OF FLAME RETARDANCY DEPENDS MAINLY ON THE AMOUNT OF THE FLAME-RETARDING ELEMENTS IN THE COMPOSITION. FLAME RETARDANTS ARE DIVIDED INTO TWO GENERAL CLASSES: REACTIVE ADDITIVES WHICH BECOME PART OF THE POLYMER STRUCTURE, AND INERT ADDITIVES. THERE IS NO SIGNIFICANT DIFFERENCE IN EFFICIENCY BETWEEN THE TWO TYPES, THE DOMINANT FACTOR BEING THE CONTENT OF FLAME-RETARDING ELEMENT. CONVENIENCE, AVAILABILITY, AND COST AND DEGREE OF FLAME RETARDANCY ARE FACTORS THAT DETERMINE THE MOST ADVANTAGEOUS TYPE.

SILANE COUPLING AGENTS. SILANE COUPLING AGENTS ARE MONOMERIC, SILICON CHEMICALS USED TO CHEMICALLY BOND ORGANIC POLYMERS TO INORGANIC MATERIALS SUCH AS SAND, ROCK, GLASS, AND METALS. COUPLING AGENTS HAVE BEEN USED OCCASIONALLY IN PIC AND MORE COMMONLY IN PC FOR IMPROVEMENTS IN STRENGTH AND FOR RETENTION OF AGGREGATE BOND IN LONG-TERM EXPOSURE TO MOISTURE.

#### MONOMER SATURATION TECHNIQUES

#### SLIDE 9

FULL IMPREGNATION. EXPERIMENTS TO DETERMINE THE CONDITIONS REQUIRED TO FULLY IMPREGNATE CONCRETE HAVE SHOWN THAT PROCESS PARAMETERS SUCH AS DEGREE OF DRYNESS AND VACUUM, SOAK PRESSURE, AND SOAK TIME, ALL HAVE AN EFFECT ON THE

STRENGTH OF PIC. COMPLETE SATURATION OF CONCRETE USING MODEST PRESSURES (10 PSIG) IS ACCOMPLISHED ONLY AFTER PRIOR EVACUATION. WITHOUT EVACUATION, SOAK PRESSURES OF 100 PSIG ARE REQUIRED IN ORDER TO APPROACH SATURATION IN A SHORT PERIOD OF TIME ( 60 MIN.). STUDIES HAVE SHOWN THAT GOOD RESULTS CAN BE OBTAINED ON GOOD QUALITY DENSE CONCRETE SPECIMENS HAVING A CROSS SECTION OF UP TO 12 IN.

PARTIAL IMPREGNATION. SOAKING UNEVACUATED SAMPLES AT ATMOSPHERIC PRESSURE RESULTS IN PARTIALLY SATURATED SPECIMENS AND THEREFORE, SOMEWHAT LOWER STRENGTHS.

TECHNIQUES FOR THE PARTIAL IMPREGNATION OF CONCRETE INCLUDE COMPLETE IMMERSION IN MONOMER AND APPLICATION OF MONOMER TO JUST ONE SURFACE. THESE IMPREGNATIONS HAVE BEEN WITH SOAKING UNDER PRESSURE AND SOAKING AT ATMOSPHERIC PRESSURES. ATMOSPHERIC SOAKING WITH LOW VISCOSITY MONOMERS HAS PRODUCED FAIRLY GOOD RESULTS WITH IMPREGNATION DEPTHS OF UP TO SEVERAL INCHES. PRESSURE SOAKING PRODUCES BETTER RESULTS WITH DEEPER IMPREGNATION AND HIGHER POLYMER LOADINGS.

### POLYMERIZATION

#### SLIDE 10

THERE ARE THREE GENERAL METHODS FOR THE BULK POLYMERIZATION OF MONOMERS CURRENTLY BEING USED IN PIC. THESE ARE THE RADIATION, THERMAL-CATALYTIC, AND PROMOTER-CATALYST TECHNIQUES. THE SELECTION OF A PARTICULAR PROCESS WILL DEPEND ON ITS PARTICULAR ADVANTAGES FOR A SPECIFIC APPLICATION AND EVALUATION OF THE EFFECTS OF (1) DRAINAGE AND EVAPORATION LOSSES FROM THE CONCRETE DURING THE POLYMERIZATION; (2) SAFETY PROBLEMS ASSOCIATED WITH THE STORAGE AND REUSE OF LARGE QUANTITIES OF MONOMER AND CATALYST; AND (3) THE ECONOMICS OF THE ENTIRE PROCESS.

THERMAL-CATALYTIC. THE SIMPLEST METHOD IS THERMAL-CATALYTIC POLYMERIZATION THROUGH THE ADDITION OF SMALL AMOUNTS OF A COMPOUND WHICH WILL GENERATE FREE RADICALS ON HEATING (ORGANIC PEROXIDES).

THE THERMAL-CATALYTIC PROCESS HAS BEEN USED EXTENSIVELY FOR PREPARING PIC AND APPEARS THE MOST PRACTICAL FOR PRESENT-DAY USE. THE PROCESS CAN BE PERFORMED IN AIR OR UNDER WATER. SEVERAL CATALYSTS MENTIONED ABOVE HAVE BEEN USED IN THIS METHOD. THE PRIMARY ADVANTAGE OF THE THERMAL-CATALYTIC POLYMERIZATION METHOD IS THAT THE POLYMERIZATION RATES ARE VERY RAPID AND, THEREFORE, PROCESSING TIMES ARE SHORT. RELATIVELY SIMPLE ELECTRIC OVENS, WATER, OR RAW STEAM CAN BE USED AS A HEAT SOURCE. A DISADVANTAGE IS THAT THE CHEMICAL INITIATOR MUST BE DISSOLVED IN THE MONOMER PRIOR TO INTRODUCING THE MIXTURE INTO THE CONCRETE. IN A COMMERCIAL OPERATION OF ALMOST ANY SIZE, THIS WILL INVOLVE STORING AND HANDLING OF LARGE BATCHES OF MONOMER CONTAINING CHEMICAL INITIATOR WHICH ARE POTENTIALLY DANGEROUS.

PROMOTED-CATALYTIC. DECOMPOSITION OF ORGANIC PEROXIDE CATALYSTS CAN BE INITIATED BY PROMOTERS OR ACCELERATORS INSTEAD OF TEMPERATURE. THESE COMPOUNDS ARE REDUCING AGENTS WHICH INDUCE THE DECOMPOSITION OF THE PEROXIDES. THUS, POLYMERIZATION REACTIONS CAN TAKE PLACE AT AMBIENT TEMPERATURE.

RADIATION. THE PRODUCTION OF FREE RADICALS DURING INITIATED POLYMERIZATION CAN ALSO BE ACHIEVED BY THE USE OF IONIZING RADIATION SUCH AS GAMMA RAYS EMITTED BY COBALT-60. ABSORPTION OF THE RADIATION ENERGY BY THE MONOMER RESULTS IN SECONDARY PROCESSES INCLUDING THE PRODUCTION OF FREE RADICALS.

THE RADIATION-INDUCED POLYMERIZATION OF MONOMERS IN CONCRETE HAS BEEN PERFORMED IN AIR AND UNDER WATER. THE PRINCIPAL ADVANTAGE OF THE PROCESS IS THE ELIMINATION OF A CATALYST WHICH THEREFORE ALLOWS ESSENTIALLY UNLIMITED STORAGE AND REUSE OF MONOMER. ALSO, THE POLYMERIZATION CAN BE INITIATED AT ROOM

TEMPERATURE AND AT A UNIFORM RATE WITHIN RELATIVELY THICK CONCRETE SECTIONS. DETRIMENTAL FEATURES INCLUDE THE HIGH COST OF RADIATION SOURCES, THE NECESSITY OF MASSIVE BIOLOGICAL SHIELDING, AND THE LOW POLYMERIZATION RATES. THE LATTER, WHEN COMBINED WITH THE RADIATION ATTENUATION DUE TO THE THICK SECTIONS AND HIGH DENSITY, RESULTS IN LARGE RADIATION REQUIREMENTS AND LONG PROCESSING TIMES.

#### DWORSHAK STILLING BASIN EXAMPLE

SLIDE 11 OVERVIEW, BULKHEADS

SLIDE 12 HEATING ELEMENTS BEFORE IMPREGNATION

SLIDE 13 SPRAY BAR FOR DISTRIBUTING MONOMER

SLIDE 14 STEAM GENERATING UNIT FOR POLYMERIZATION

SLIDE 15 STEAM PIPE FOR POLYMERIZATION

SLIDE 16 COMPLETED PIC SECTION AFTER POLYMERIZATION

SLIDE 17 POLYMER CONCRETE

SLIDE 18

POLYMER CONCRETE IS A COMPOSITE MATERIAL CONSISTING OF A POLYMER MATRIX AND PARTICULATE FILLERS, PREPARED BY THE INTEGRAL MIXING OF A POLYMERIZABLE MATERIAL (SUCH AS MONOMER OR RESIN) AND AGGREGATE. POLYMERIZATION IS USUALLY OBTAINED THROUGH A CATALYST-PROMOTER SYSTEM WITHOUT THE INTRODUCTION OF RADIATION OR THERMAL ENERGY. VARIOUS POLYESTERS, EPOXIES, FURANS, AND PMMA HAVE BEEN USED AS THE MATRIX OF PC BECAUSE OF THE REASONABLE COMPROMISE BETWEEN RELATIVE EASE OF POLYMERIZATION AND DESIRABLE PROPERTIES.

#### PC MONOMERS AND RESINS

SLIDE 19

MOST OF THE WORK ON PC HAS BEEN CHIEFLY WITH POLYESTER-STYRENE RESIN SYSTEMS, AND TO A LESSER EXTENT WITH FURAN AND EPOXY AND VINYL ESTER RESIN SYSTEMS.

THE POLYESTER RESINS ARE ATTRACTIVE BECAUSE OF MODERATE COST, AVAILABILITY OF A GREAT VARIETY OF FORMULATIONS, AND MODERATELY GOOD PC PROPERTIES. THE FURAN RESINS HAVE BEEN INVESTIGATED IN EUROPE AND ARE LOW COST AND HIGHLY RESISTANT TO CHEMICAL ATTACK. THE EPOXY RESINS ARE GENERALLY SOMEWHAT HIGHER IN COST, BUT MAY OFFER SOME ADVANTAGES SUCH AS ADHESION TO WET SURFACES WITH SPECIALLY FORMULATED EPOXIES.

LOW VISCOSITY MONOMERS, SUCH AS MMA AND STYRENE, HAVE BEEN ALSO INVESTIGATED. THEY ARE EASILY MIXED WITH AGGREGATES, GIVING A MIX WHICH CAN BE READILY COMPACTED INTO A DENSE PC OF LOW POROSITY AND RELATIVELY LOW POLYMER CONTENT. THE LOW VISCOSITY MONOMERS ALSO PENETRATE FRACTURES AND VOIDS IN THE AGGREGATE PARTICLES.

#### PC ADDITIVES AND MODIFIERS

##### SLIDE 20

PLASTICIZERS. PC HAS A GREATER DUCTILITY THAN EITHER PIC OR CONVENTIONAL CONCRETE. NEVERTHELESS, EFFORTS HAVE BEEN MADE TO FURTHER INCREASE THE DUCTILITY OF PC THROUGH THE ADDITION OF A PLASTICIZER TO THE MONOMER.

FLAME RETARDANTS. SINCE A RELATIVELY SMALL AMOUNT OF POLYMER IS ACTUALLY PRESENT IN PC, THE COMPOSITE IS NONBURNING OR SELF-EXTINGUISHING BY STANDARD FLAMMABILITY TESTS. IT IS PROBABLE THAT THE LOSS OF STRUCTURAL INTEGRITY IN PC EXPOSED TO FIRE CONDITIONS MAY BE MORE IMPORTANT THAN QUESTIONS CONCERNING THE FLAMMABILITY OF THE MATERIAL. PC APPEARS TO BE ESSENTIALLY SELF-CHARRING AND FLAME RETARDANTS PROBABLY ARE NOT NECESSARY, BUT NEVERTHELESS CAN BE USED AS IN THE CASE OF PIC.

SILANE COUPLING AGENTS. ONE OF THE MOST BENEFICIAL MODIFICATIONS TO PC IS THE ADDITION OF SILANE COUPLING AGENTS TO THE MONOMER SYSTEM. THE COUPLING AGENT SERVES TO INCREASE THE INTERFACIAL BOND BETWEEN POLYMER AND AGGREGATE

AND HENCE INCREASE THE STRENGTH OF THE COMPOSITE. SEVERAL TECHNIQUES HAVE BEEN USED FOR APPLYING SILANE COUPLING AGENTS TO PC COMPOSITES. THE MOST PRACTICAL TECHNIQUE IS TO ADD THE COMPOUND DIRECTLY TO THE MONOMER SYSTEM PRIOR TO MIXING, BUT THE GREATEST STRENGTH IS OBTAINED WHEN THE AGGREGATE IS PRETREATED WITH THE COUPLING AGENT.

### PC POLYMERIZATION

#### SLIDE 21

MOST OF THE MONOMER AND RESIN SYSTEMS FOR PC ARE POLYMERIZED AT ROOM TEMPERATURES. THE VINYL MONOMER SYSTEMS CAN BE POLYMERIZED WITH A VARIETY OF CATALYSTS, BUT ARE MOST COMMONLY POLYMERIZED USING BENZOYL PEROXIDE WITH AN AMINE PROMOTER. THE POLYESTER-STYRENE SYSTEMS LIKEWISE ARE POLYMERIZED WITH A SIMILAR VARIETY OF PROMOTER-CATALYST SYSTEMS.

THESE SYSTEMS POLYMERIZE SATISFACTORILY AT ROOM TEMPERATURES AND THE APPLICATION OF HEAT IS NOT ESSENTIAL. A FINAL HEAT TREATMENT MAY BE USED, HOWEVER, TO ENSURE THAT THE HIGHEST DEGREE OF CONVERSION IS OBTAINED. OTHER ROOM TEMPERATURE SYSTEMS INCLUDE AMINE CURING AGENTS FOR EPOXY RESINS.

GAMMA RADIATION FROM A COBALT-60 SOURCE ALSO CAN BE USED FOR POLYMERIZATION, AS IN PIC, BUT THIS METHOD IS LESS LIKELY TO FIND FAVOR BECAUSE OF THE AVAILABILITY AND INITIAL COST OF RADIATION SOURCES AND THE HAZARDS INVOLVED IN FIELD APPLICATIONS.

### PC FABRICATION

THE BATCHING, MIXING, AND PLACING TECHNIQUES FOR PRODUCING PC ARE LARGELY BASED ON ADAPTATION OF EXISTING EQUIPMENT AND METHODS FOR PRODUCING PORTLAND CEMENT CONCRETES. A KNOWLEDGE OF POLYMER CHEMISTRY IS HELPFUL BUT NOT

ABSOLUTELY ESSENTIAL, AS DIRECTIONS FOR CURING MIXES ARE READILY AVAILABLE FROM THE RESIN MANUFACTURERS AND FROM THE PUBLISHED LITERATURE.

SLIDE 22 POLYMER-PORTLAND CEMENT CONCRETE

SLIDE 23

POLYMER-PORTLAND CEMENT CONCRETE. POLYMER-PORTLAND CEMENT CONCRETE (PPCC) IS A PREMIXED MATERIAL IN WHICH EITHER A MONOMER OR POLYMER IS ADDED TO A FRESH CONCRETE MIXTURE IN A LIQUID, POWDERY, OR DISPERSED PHASE, AND SUBSEQUENTLY CURED AND IF NEEDED, POLYMERIZED IN PLACE.

SLIDE 24

POLYMER LATEXES

A LATEX CONSISTS OF VERY SMALL (0.05- to 1.0- $\mu\text{m}$  DIAMETER) SPHERICAL PARTICLES OF POLYMERS HELD IN SUSPENSION BY THE USE OF SURFACE-ACTIVE AGENTS. THE POLYMER LATEX IS USUALLY FORMED DIRECTLY BY EMULSION POLYMERIZATION OF THE MONOMER AND TYPICALLY CONTAINS ABOUT 50 WT PERCENT SOLIDS. POLYMER LATEXES ARE GENERALLY COPOLYMER SYSTEMS OF AT LEAST TWO OR MORE MONOMERS WITH A POSSIBLE ADDITION OF A PLASTICIZER AND OTHER MODIFIERS. EXAMPLES OF POLYMERS USED IN LATEXES ARE POLY(VINYL ACETATE) (PVAc), POLYSTYRENE, POLYVINYL CHLORIDE, NATURAL RUBBER, AND POLYBUTADIENE.

SLIDE 25

WATER-SOLUBLE POLYMERS

BOTH THERMOSETTING AND THERMOPLASTIC WATER-SOLUBLE POLYMERS OF VARIOUS KINDS HAVE BEEN ADDED TO FRESH CONCRETE. THE THERMOSETTING POLYMERS INCLUDE EPOXIES, AMINO RESINS, POLYESTERS, AND FORMALDEHYDE DERIVATIVES. THE THERMOPLASTICS INCLUDE POLYVINYL ALCOHOL AND POLYACRYLAMIDES.

SLIDE 26



## LIQUID RESINS

THE USE OF EPOXY IN CONCRETE HAS BEEN THE SUBJECT OF MORE RECENT RESEARCH AND DEVELOPMENT IN SEVERAL COUNTRIES. WATER-SOLUBLE EPOXY RESINS HAVE BEEN DEVELOPED IN THE USSR, WHILE WATER-DISPERSIBLE EPOXY RESINS HAVE BEEN PATENTED IN JAPAN AND HAVE RECENTLY BEEN DEVELOPED IN THIS COUNTRY. THE RECOMMENDED LOADING OF 10 TO 20 PERCENT BY WEIGHT OF CEMENT AND PARTIAL REPLACEMENT OF EPOXY BY OTHER THERMOSETTING RESINS, SUCH AS PHENOLICS, IS POSSIBLE.

A POLYESTER FORMULATION HAS BEEN USED IN ENGLAND TO PRODUCE "ESTERCRETE." A POLYMER/CEMENT RATIO OF 0.3 OR HIGHER WAS USED TOGETHER WITH A WATER-SOLUBLE REDOX CATALYST FOR THE CONDENSATION REACTION. WHEN THE SYSTEM IS MIXED WITH WATER, THE CATALYST IS ACTIVATED, POLYMERIZATION OCCURS, AND CEMENT HYDRATES. SUCH SYSTEMS ARE VERY RAPID SETTING, BUT WITH THE HIGH POLYMER LOADINGS THE SYSTEM CAN BE REGARDED AS POLYESTER FILLED WITH HYDRATED PORTLAND CEMENT AS WELL AS HYDRATED PORTLAND CEMENT PASTE FILLED WITH POLYESTER.

POLYURETHANES HAVE BEEN INVESTIGATED FOR USE IN PORTLAND CEMENT CONCRETE AND FORMULATIONS HAVE RECENTLY BEEN PATENTED BUT NOT YET DEVELOPED COMMERCIALY.

### SLIDE 27

## PPCC PREPARATION

### SLIDE 28

THE FABRICATION OF PPCC IS VERY SIMILAR TO THAT OF CONVENTIONAL PORTLAND CEMENT CONCRETE. ORGANIC MATERIALS IN EITHER A POWDERY OR DISPERSED FORM ARE ADDED TO THE MIXTURE DURING MIXING. BECAUSE MOST ORGANIC POLYMERS AND THEIR MONOMERS ARE INCOMPATIBLE WITH A MIXTURE OF PORTLAND CEMENT, WATER, AND AGGREGATE, A REVIEW OF PPCC FABRICATION IS IN LARGE MEASURE AN EXAMINATION OF HOW THESE BASIC INCOMPATIBILITIES ARE OVERCOME. EXTENSIVE FIELD EXPERIENCE HAS

BEEN GAINED WITH PREMIX POLYMERIZATION (POLYMER LATEX). THE PROBLEMS ANTICIPATED FOR POSTMIX POLYMERIZATION SYSTEMS SHOULD BE OF A SIMILAR NATURE, HOWEVER.

LATEX MODIFIED CONCRETE. THE MATERIALS USED IN PPCC ARE THE SAME MATERIALS USED IN REGULAR CONCRETE WITH THE ADDITION OF THE LATEXES THEMSELVES.

ANY PORTLAND CEMENT CAN BE USED IN LATEX PPCC INCLUDING MODIFIED CEMENTS SUCH AS WHITE PORTLAND CEMENT, WATERPROOF PORTLAND CEMENTS, AND SHRINKAGE COMPENSATING CEMENT. HOWEVER, IN NO CASE SHOULD AIR-ENTRAINED PORTLAND CEMENT OR AIR-ENTRAINING AGENTS BE USED SINCE POLYMER LATEXES ALREADY ENTRAIN CONSIDERABLE AMOUNTS OF AIR. IN FACT, ANTIFOAMING AGENTS ARE GENERALLY RECOMMENDED TO CONTROL EXCESSIVE AIR ENTRAINMENT. LATEXES ARE NOT VERY EFFECTIVE IN LEAN CONCRETE MIXTURES WHICH CONTAIN 500 LB OR LESS OF PORTLAND CEMENT PER CUBIC YARD OF CONCRETE. NORMALLY, LATEXES ARE USED IN MIXTURES CONTAINING ANYWHERE FROM 564 TO 846 LB OF PORTLAND CEMENT PER CUBIC YARD OF CONCRETE. THE MAJOR DIFFERENCE IN THE MIXTURE PROPORTIONS OF LATEX CONCRETE OR MORTAR MIXES IN COMPARISON TO STANDARD MORTAR AND CONCRETE MIXES IS THAT THE WATER CONTENT OF THE MIXTURE IS REDUCED ON A VOLUME BASIS BY THE ABSOLUTE VOLUME OF POLYMER THAT IS ADDED TO THE MIXTURE. POLYMER LATEXES GENERALLY ACT AS WATER-REDUCING AGENTS.

THE SAME BATCHING, MIXING, AND PLACING EQUIPMENT USED FOR CONVENTIONAL CONCRETE CAN BE USED FOR PPCC. GOOD FORM RELEASE AGENTS ARE NECESSARY BECAUSE LATEX MODIFIED CEMENT SYSTEMS ADHERE WELL TO MOIST SUBSTRATES INCLUDING CONCRETE, WOOD, STEEL, ETC.

THE OPTIMUM CURING OF LATEX PPCC IS DIFFERENT THAN THAT OF ORDINARY CONCRETE. IN NORMAL CONCRETE, MAXIMUM PROPERTIES ARE OBTAINED BY MOIST CURING THE CONCRETE FOR AS LONG A PERIOD OF TIME AS POSSIBLE UP TO 28 DAYS. THIS IS DETRIMENTAL IN LATEX PORTLAND CEMENT SYSTEMS. BY THE INCORPORATION OF LATEXES IN THESE SYSTEMS, A MATERIAL IS ADDED WHICH REQUIRES A DIFFERENT CURING MECHANISM WHICH IS BEST ACHIEVED UNDER THE ENVIRONMENT OF LESS THAN 100 PERCENT RELATIVE

HUMIDITY. THE OPTIMUM PROPERTIES IN LATEX-MODIFIED PORTLAND CEMENT SYSTEMS ARE OBTAINED BY MOIST CURING THE RESULTING CONCRETE FROM ONE TO THREE DAYS FOLLOWED BY DRY CURING THE CONCRETE AT AMBIENT CONDITIONS.

WATER-SOLUBLE POLYMER CONCRETES. AS THE NAME IMPLIES, THESE POLYMERS ARE ADDED TO THE MIXTURE IN THE FORM OF A WATER SOLUTION DURING THE MIXING OPERATION. NORMAL MIXTURE PROPORTIONING AND BATCHING PROCEDURES CAN BE FOLLOWED. THE MECHANISM OF COMBINATION OF THE WATER-SOLUBLE POLYELECTROLYTES AND LIQUID RESINS WITH CEMENT DIFFERS FROM THAT DESCRIBED FOR LATEXES IN THAT MOST OF THESE POLYMERS ARE THERMOSETTING. THE EXCEPTION IS POLYVINYL ALCOHOL WHICH IS A THERMOPLASTIC. CURING FOR THE CONCRETE USUALLY INVOLVES SOME PERIOD OF STANDARD MOIST CURING FOLLOWED BY CURING AT ELEVATED TEMPERATURES. THIS CAN BE ACHIEVED BY HOT AIR, HOT WATER, OR STEAM AT EITHER LOW OR HIGH PRESSURES.

#### SUMMARY OF PERFORMANCE

EASE OF CONSTRUCTION. OF THE THREE TYPES OF CONCRETE CONTAINING POLYMERS, THE PPCC APPEARS TO BE THE SIMPLEST TO PRODUCE AND PLACE, FOLLOWED IN ORDER OF DIFFICULTY BY PC AND PIC. WITH THE EXCEPTION OF TAKING SPECIAL PRECAUTIONS WITH BOND BREAKERS, PPCC CAN BE MADE AND PLACED AS SIMPLY AS CONVENTIONAL CONCRETE USING THE SAME EQUIPMENT. PC OFTEN NEEDS SPECIAL BATCHING AND MIXING EQUIPMENT AND ALWAYS REQUIRES A TECHNIQUE TO CAUSE POLYMERIZATION. PIC REQUIRES THE ACTUAL CONSTRUCTION OF THE CONCRETE ELEMENT FOLLOWED BY THE DRYING OF THE ELEMENT. IT IS THEN IMPREGNATED BY VARIOUS MEANS WITH A MONOMER AND THEN POLYMERIZED. THE ENTIRE OPERATION IS QUITE TIME-CONSUMING BUT HAS BEEN SUCCESSFULLY DONE IN BRIDGE DECKS AND IN PAVEMENT-LIKE SURFACES IN A DAM SPILLWAY.

EASE OF MAINTENANCE. CONCRETE MADE OF PIC, PC, OR PPCC SHOULD BE NO MORE PROBLEM TO REPAIR THAN CONVENTIONAL CONCRETE EXCEPT THAT IN THE PIC AND PC

ELEMENTS, SPECIAL EQUIPMENT MAY BE NECESSARY TO MANUFACTURE THE CONCRETE SO IT CONFORMS EXACTLY TO THAT OF THE ELEMENT BEING REPAIRED.

AVAILABILITY AND COST. AVAILABILITY OF POLYMERS AND THE ADDITIVES AND MODIFIERS FOR USE IN CONCRETE GENERALLY SHOULD NOT BE A PROBLEM, ALTHOUGH FLUCTUATIONS IN THE PETRO-CHEMICAL INDUSTRY IN THE PAST HAVE RESULTED IN TEMPORARY SHORTAGES. THE COST WILL ALSO VARY DEPENDING ON AVAILABILITY AND MARKET FLUCTUATIONS AND CAN BE EXPECTED TO CONTINUE TO INCREASE WITH TIME. ALL OF THE POLYMERS ARE EXPENSIVE AND INCREASE THE COST OF CONCRETE SIGNIFICANTLY EVEN WHEN USED IN SMALL AMOUNTS.

#### TABLES

TABLES A33.1 THROUGH A33.13 CONTAIN DATA ON POLYMERS IN CONCRETE.

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Aggregates and Riprap		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 90 minutes		FILE NO.:
TYPE OF LESSON: Lecture w/Questions		COURSE: Advanced Concrete
PLACE: Conference Room, Structures Laboratory, WES		NO. ASSTS: Technology
TRAINING AIDS: Pictures, Handouts, Samples, Vu-Graph, Blackboard		
OBJECTIVES: To show importance of aggregates to concrete and their effects on concrete properties. Also to review riprap selection and evaluation.		
INSTRUCTOR REFERENCES: ASTM STP 169B, Handbook for Concrete and Cement, Engineer Manual 1110-2-2000, CE 1308		
STUDENT REFERENCES AND HOME WORK: Aggregates and riprap notes in class notebook and take-home grading problem		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION - AGGREGATES</u> Investigation and Selection Aggregates make up about 75 percent of concrete. Why do we use them? Show cost difference between a ton of aggregate and a ton of portland cement as dollar basis for use of aggregates. Point out that cement paste changes volume 10 times as much as concrete and 3 times as much as mortar in response to temperature or moisture changes. Therefore, use aggregates to minimize $\Delta V$ .	Chap. 2 of Standard Practice for Concrete, EM 1110-2-2000  Necessity of use of aggregate
0010	<u>EFFECT OF AGGREGATE PROPERTIES ON CONCRETE</u> 1. Cost - possible future use of recycled concrete as aggregate 2. Gradation 3. Frost-resistance 4. Absorption 5. Coatings 6. Particle shape 7. Chemical reactivity Screening system	Is a factor important? Why? What test is needed? Show pictures of frost damage. Show pictures of damaged concrete. Question: If aggregate is said to be reactive, where go as next step in consideration of use? Ans., Appen. B, C, of EM 1110-2-2000
0040	<u>SUMMARY</u> 1. Use of aggregates is necessary. 2. Several aggregate properties may have direct effect on quality and life of concrete. 3. There is need for laboratory testing.  CLOSE - Laboratory tests of aggregates should be considered as long-range economy rather than immediate expense.	

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0045	<u>INTRODUCTION - RIPRAP</u> The protection of slopes and channels from the action of flowing water is often accomplished by the use of a layer of stone called riprap. On Corps of Engineers projects, all stone for this protection work is submitted to the Contracting Officer or, more commonly the Resident Engineer for approval prior to delivery of any such material to the site of the work. The responsibility for determining its acceptability then becomes a part of your job. The objective of this portion of the lesson is to familiarize you with the procedures of riprap selection and testing, both of which furnish information necessary for determining whether stone is suitable for use as riprap.	
0050	<u>RIPRAP REQUIREMENTS</u>	Vu-Graph
0055	<u>SAMPLE SELECTION</u>	Blackboard Student Check Vu-Graph
0065	<u>LABORATORY TESTING</u> 1. Freezing and thawing 2. Wetting and drying 3. Specific gravity, absorption, unit weight 4. Los Angeles abrasion 5. Petrographic description	Samples Blackboard
0090	<u>SUMMARY</u>	Handout  Erase blackboard

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Rapid Analysis Machine (RAM)		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 45 minutes		FILE NO.:
TYPE OF LESSON: Lecture w/demonstration		COURSE: Advanced Concrete
PLACE: Waterways Experiment Station		NO. ASSTS: Technology
TRAINING AIDS: Blackboard, view-graphs, demonstration using the actual machine		
OBJECTIVES: To acquaint the student with a mechanized technique for determining the cement content of freshly mixed concrete as a means of quality control of concrete.		
INSTRUCTOR REFERENCES: Operation Manual for the RAM		
STUDENT REFERENCES AND HOME WORK: Rapid Analysis Machine (RAM) notes in class notebook.		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<p><u>INTRODUCTION</u></p> <p>The increasing awareness of the need for more effective standards of quality control and quality assurance on site, and the problems often associated with site-cast concrete test specimens, have focused attention on the need for alternative methods of acceptance. In certain areas work has been done on the analysis of freshly-mixed concrete to determine its cement content. If it is known by preliminary testing that a specified batch of concrete has sufficient cement in it to give adequate strength, concrete may be more effectively controlled by analysis than by testing site-cast specimens and in the event of noncompliance, the concrete can be rejected with minimum cost and delay. The objective of this lecture is to acquaint the student with a mechanized technique for accomplishing this analysis by using the Rapid Analysis Machine (RAM).</p>	
0002	<p><u>DEVELOPMENT</u></p> <p>1. RAM Nomenclature.</p> <p>a. Dimensions.</p> <p>b. Electrical Requirements.</p> <p>c. Water Requirements.</p>	<p><u>LIGHTS OFF</u></p> <p>Viewgraph 1</p>
0004	<p>2. RAM Operation.</p> <p>a. Loading Elutriator Tube.</p> <p>b. Scrubbing Cycle.</p> <p>c. Sampling Channels.</p> <p>d. Conditioning Vessel.</p> <p>e. Flocculant Closing.</p> <p>f. Stirring.</p> <p>g. Vibrating.</p> <p>h. Siphoning.</p> <p>i. Weighing.</p>	Viewgraphs 2 and 3
0010	<p>3. Calibration Charts.</p> <p>a. Calibration Graph.</p> <p>b. Silt Correction Graph.</p> <p>c. Chart for Blended Cements.</p>	Viewgraph 4 Viewgraph 5 Viewgraph 6.

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0015	4. Sources of Error in RAM Test.	Viewgraph 7
0017	5. Precision of RAM Test.	Viewgraph 8
0020	<u>QUESTION PERIOD</u>	<u>LIGHTS ON</u>
0025	<u>MOVE TO MAIN LABORATORY FOR DEMONSTRATION</u>	
0030	<u>BEGIN DEMONSTRATION</u>	
0045	<u>END DEMONSTRATION</u>	



INSTRUCTOR'S LESSON PLAN		
SUBJECT: Waterstops		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 45 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Concrete Inspection
PLACE: Waterways Experiment Station		NO. ASSTs:
TRAINING AIDS: Blackboard, 35-mm slides, waterstop samples		
OBJECTIVES: To acquaint students with types of waterstops, their method of selection and use, testing requirements, methods of installation and splicing techniques		
INSTRUCTOR REFERENCES: Corps of Engineers Manual No. 1110-2-2102, Waterstops		
STUDENT REFERENCES AND HOME WORK: Waterstop notes in class notebook and test report handout		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION</u> The principal function of a waterstop is to serve as a barrier to the passage of water through, across, or along a construction joint in a concrete structure exposed to water on one or more surfaces. Such structures include dams, locks, power plants, pumping plants, and canal linings. As inspectors of concrete construction, you need to be aware of what they are, how they work, how to properly install them, and what can go wrong with them. The objective of this lecture is to introduce you to all of these aspects of waterstops and their use.	
0001	<u>DEVELOPMENT</u> 1. Types of waterstops a. Materials b. Shapes	<u>LIGHTS OFF</u> -- Slide 1 Slide 2 <u>LIGHTS ON</u> Pass samples of waterstops around the classroom.
0007	2. Use of waterstops a. Selection requirements  b. Installation procedures (1) Formwork considerations (2) Fastening to rebar (3) Joint clean-up	<u>LIGHTS OFF</u> Slides 3, 4, 5 Ref: EM 1110-2-2101 -- Slides 6, 7, 8, 9 Slides 10, 11, 12 Slide 13 STUDENT CHECK
0020	3. Splicing Techniques a. Equipment b. Butt splices c. Complex splices	-- Slides 14, 15 Slide 16 Slides 17, 18, 19, 20

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0025	4. Performance Requirements a. Waterstop specifications b. Testing equipment c. Test reporting	-- Slide 21 Slides 22, 23, 24 <u>LIGHTS ON</u> HANDOUT
0030	<u>SUMMARY</u> 1. Types and shapes of waterstops 2. Do's and don'ts of installation 3. Field sampling procedures	
0035	<u>QUESTION PERIOD</u>	

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Aggregates		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 75 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Concrete Inspection
PLACE: Waterways Experiment Station		NO. ASSTs:
TRAINING AIDS: Blackboard, 35-mm slides		
OBJECTIVES: To acquaint the student with aggregates and their importance. Descriptions include types and classifications, methods of sampling, and characteristics to consider when using aggregates.		
INSTRUCTOR REFERENCES: Handbook for Cement and Concrete; Technical Memorandum No. 6-370, Aggregate Compilation; Bureau of Reclamation Handbook for Concrete		
STUDENT REFERENCES AND HOME WORK: Aggregate notes in class notebook		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION</u> Aggregates generally occupy 60-80 percent by volume of concrete and hence their quality is of considerable importance. Aggregates may limit the strength of concrete and can also affect its durability and structural performance. They are cheaper than cement and therefore it is more economical to put more aggregate in a mixture and less cement. They also provide more volume stability and improved durability than cement paste. Many different things can be used as aggregate in concrete. This lecture is limited to sand, gravel, and crushed stone. It is not intended to cover blast-furnace slag, lightweight aggregate, or special heavy aggregate. The objective of this lecture is to acquaint the student with aggregate types, sources, sizes, methods of sampling and considerations in selecting aggregates for use in concrete.	
0002	<u>DEVELOPMENT</u> 1. Aggregate classifications	<u>LIGHTS OFF</u> Slide 1
0003	2. Sources of aggregate a. Natural deposits (sand and gravel) (1) Stream beds (2) Glacial deposits (3) Alluvial fans (4) Talus accumulations (5) Windblown material b. Production of sand and gravel deposits c. Crushed stone (1) Crushed stone production (2) Types of crushers and granulators	Slide 2 Slides 3, 4, 5  Slides 6, 7  Slides 8, 9, 10 Slide 11

INSTRUCTOR'S LESSON PLAN (Continued)

TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0014	3. Classification of rocks and aggregates a. Geological classification b. Petrological basis c. Basis of use d. Size classification	Slide 12 Slides 13, 14  Slides 15, 16, 17, 18, 19
0021	4. Selection of suitable sources a. Survey investigation b. Definite project studies	Slide 20
0025	5. Corps of Engineers aggregate compilation	Slides 21, 22 TM 6-360
0030	6. Aggregate sampling a. Source sampling (1) Sand and gravel deposits (2) Quarries and undeveloped rock formations (3) Processed aggregate b. Sample labeling	Slide 23 Slide 24  Slides 25, 26 Slide 27
0040	7. Aggregate characteristics which must be considered. a. Absorption b. Specific gravity c. Gradation d. Aggregate strength e. Particle shape and texture f. Aggregate-matrix bond g. Abrasion resistance h. Deleterious substances i. Soundness j. Alkali-aggregate reactivity	Slide 28 Slide 29 Slides 30, 31 Slides 32, 33 Slides 34, 35 Slides 36, 37, 38, 39 Slide 40 Slides 41, 42 Slides 43, 44 Slides 45, 46 Slides 47, 48, 49, 50
0060	<u>SUMMARY</u> 1. Principal types of aggregates based on source 2. Size distinctions between coarse and fine aggregate 3. Methods of sampling sand and gravel sources 4. Locations for sampling processed aggregate	Slide 51 Slide 52 Slide 53 Slide 54 <u>LIGHTS ON</u>
0065	<u>QUESTION PERIOD</u>	

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Aggregate Testing		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 60 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Concrete Inspection
PLACE: Waterways Experiment Station		NO. ASSTS:
TRAINING AIDS: Blackboard, 35-mm slides		
OBJECTIVES: To acquaint the student with the tests that are used to determine the various characteristics of aggregates and how they will influence the decision whether or not to use the aggregate in concrete.		
INSTRUCTOR REFERENCES: Handbook for Concrete and Cement		
STUDENT REFERENCES AND HOME WORK: Aggregate Testing notes in class notebook		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION</u> In the previous lecture on <u>Aggregates</u> , the importance of obtaining representative samples of aggregates was emphasized. The characteristics of the aggregates and how these characteristics influence the selection of aggregates for use in concrete were also described. The objective of this lecture is to describe the various tests which are used to determine these characteristics. The proper conduct of these tests is very important as poorly run tests give nonrepresentative information which can adversely affect the decision making process. Representative samples are also necessary for all tests.	
0002	<u>DEVELOPMENT</u> 1. Recommended aggregate tests	<u>LIGHTS OFF</u> Slide 1
0004	2. Petrographic examination	Slide 2 CRD-C 127
0006	3. Specific gravity a. Definition b. Example c. Typical values	CRD-C 107, C 108 Slide 3 Slide 4 Slide 5
0010	4. States of moisture a. Schematic diagram (1) Oven-dry (2) Air-dry (3) Saturated-surface dry (4) Damp or wet b. Surface moisture (1) Method of determination (2) Equipment c. Absorption	Slide 6 Slide 7  CRD-C 111, C 112, C 113 Slide 8 Slide 9 Slide 10 CRD-C 107, C 108

## INSTRUCTOR'S LESSON PLAN (Continued)

TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0020	5. Gradations <ul style="list-style-type: none"> <li>a. Sieves and sieve sizes</li> <li>b. Guide Specification requirements for fine aggregates</li> <li>c. Shakers</li> <li>d. Typical graded sand</li> <li>e. Guide Specification requirements for coarse aggregates</li> <li>f. Grading example</li> <li>g. Fineness modulus</li> </ul>	CRD-C 103 Slides 11, 12, 13  Slide 14 CE 1401.01 Slides 15, 16 Slide 17 Slide 18 CE 1401.01 Slide 19 Slides 20, 21, 22 CRD-C 104
0030	6. Abrasion resistance <ul style="list-style-type: none"> <li>a. Definition</li> <li>b. Test equipment and procedures</li> </ul>	CRD-C 117, C 145 Slide 23 Slides 24, 25
0033	7. Organic impurities	Slides 26, 27 CRD-C 116, C 121
0036	8. Freezing and thawing durability <ul style="list-style-type: none"> <li>a. Equipment and procedures</li> <li>b. Durability factor (DFE)</li> <li>c. Aggregate quality based on DFE</li> </ul>	Slide 28 CRD-C 20, C 114, C 115 Slides 29, 30, 31, 32, 33, 34 Slide 35 Slide 36
0042	9. Soundness <ul style="list-style-type: none"> <li>a. Definition</li> <li>b. Test requirements</li> </ul>	CRD-C 137 Slides 37, 38 Slide 39
0045	<u>SUMMARY</u> <ul style="list-style-type: none"> <li>1. Petrography</li> <li>2. Specific gravity</li> <li>3. Absorption</li> <li>4. Gradations and fineness modulus</li> <li>5. Freeze and thaw durability</li> <li>6. Other factors</li> </ul>	Slide 40 Slide 41 Slide 42 Slides 43, 44 Slide 45  <u>LIGHTS ON</u>
0050	<u>QUESTION PERIOD</u>	

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Fiber Reinforced Concrete		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 60 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Pavement Construction
PLACE: Waterways Experiment Station		NO. ASSTS: and Maintenance
TRAINING AIDS: Blackboard, 35-mm slides, samples of fibers		
OBJECTIVES: To introduce the student to fiber reinforced concrete and show how they have been successfully made and used in pavement applications.		
INSTRUCTOR REFERENCES: Chapter 9, FWHA Report RD-77-110, Identification of Candidate Zero Maintenance Paving Materials (1977) by Hoff, et al.		
STUDENT REFERENCES AND HOME WORK: Fiber Reinforced Concrete notes in class notebook.		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION</u> The concept of fiber reinforcement of a brittle matrix to improve the performance of the composite dates back to Biblical times. Patents on the use of discrete pieces of metal in concrete for improving its behavior began to occur in the late 1800's. In the 1960's, steel fibers for use in concrete went into commercial production and were immediately introduced into the paving market. The largest singular use of steel fibers today is in paving and overlay applications. The objective of this lecture is to acquaint you with the concept of fiber reinforcement, the types of materials available, fibrous concrete production and installation, and show some examples of fiber reinforced concrete pavement construction.	
0002	<u>DEVELOPMENT</u> 1. Fiber strengthening mechanism 2. Effect on cracking behavior 3. Physical properties improvement	<u>LIGHTS OFF</u> Slide 1 Slide 2 Slide 3
0005	4. Available fibers a. Various materials b. Sizes and shapes c. Methods of packaging	-- Slide 4 Slide 5 Slide 6
0007	5. Inspection of fiber types	<u>LIGHTS ON</u> Pass samples around class and describe production methods. <u>LIGHTS OFF</u> Change emphasis to steel fibers.
0012	6. Mixture proportioning	Slide 7

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
	7. Production problems	--
	a. Balling	Slides 8, 9
	b. Fiber loading	--
	c. Aspect ratio	--
	8. Methods of fiber introduction	Slides 10 through 16
0020	9. Batching	--
	10. Placing	Slides 17, 18, 19
	11. Finishing	Slides 20, 21, 22
	12. Curing	Slide 23
0027	13. Design procedures	--
0028	14. Full thickness pavement examples	Slides 24, 25
0030	15. Overlay examples	
	a. Airfields	Slides 26, 27, 28
	b. Pavements	Slides 29, 30
	c. Parking areas	Slides 31, 32
	d. Bridges	Slides 33, 34
0040	16. Railroad crossing examples	Slides 35, 36
0042	17. Quality control and sampling	<u>LIGHTS ON</u>
0045	<u>SUMMARY</u>	
	1. Fiber types for pavements	
	2. Economic considerations	
	3. Long-term performance	
0050	<u>QUESTION PERIOD</u>	



INSTRUCTOR'S LESSON PLAN		
SUBJECT: Fast-Setting Cements		INSTRUCTOR: George C. Hoff
TIME OF LESSON:		(IF APPLICABLE)
TIME PERIOD (TOTAL): 35 minutes		FILE NO.:
TYPE OF LESSON: Lecture with questions		COURSE: Pavement Construction
PLACE: Waterways Experiment Station		NO. ASSTS: and Maintenance
TRAINING AIDS:		
OBJECTIVES: To provide the student with a brief overview of available fast-setting cements along with their advantages and limitations.		
INSTRUCTOR REFERENCES: <u>Admixtures for Highway Concrete</u> , HRB Report, 1965		
STUDENT REFERENCES AND HOME WORK: Fast-Setting Cement notes in class notebook		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<p><u>INTRODUCTION</u></p> <p>The Engineering and Construction Industry magazines always contain promotional information for "miracle" cements, those wonderful commercial products full of magical or secret ingredients which make them superhard, superstrong, and superexpensive. If you can afford these products, they are all generally pretty good providing they are used in a manner specified by the producer. The objective of this lecture is to provide a brief overview of the more common varieties of fast-setting cements so the student will gain some understanding of their advantages and limitations.</p>	Write types of fast-setting cements on blackboard.
0002	<p><u>DEVELOPMENT</u></p> <p>1. Fast-setting portland cement</p> <ol style="list-style-type: none"> <li>a. Effect of compositional changes</li> <li>b. Addition of set accelerators</li> <li>c. Fineness of cement</li> <li>d. Temperature effects</li> </ol>	
0007	<p>2. Regulated-set cement</p> <ol style="list-style-type: none"> <li>a. Differences from portland cement</li> <li>b. Calcium fluoroaluminate</li> <li>c. Citric acid retarders</li> </ol>	
0012	<p>3. Calcium sulfate cements</p> <ol style="list-style-type: none"> <li>a. Commercial gypsum cements <ol style="list-style-type: none"> <li>(1) Hydrostone</li> <li>(2) IP cement</li> <li>(3) Hydrocal white</li> <li>(4) Ultracal "30" and "60"</li> </ol> </li> <li>b. Fast-fix cements</li> </ol>	
		Show formulations of fast-fix types on blackboard

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0017	4. High alumina cements a. Composition b. Trade names c. Set times d. Mixtures with portland cement e. Thin concrete road patches	
0023	5. Cement fineness 6. Accelerating admixtures	
0026	<u>SUMMARY</u>	
0030	<u>QUESTION PERIOD</u>	

INSTRUCTOR'S LESSON PLAN		
SUBJECT: Grouting Materials		INSTRUCTOR: George C. Hoff
TIME OF LESSON: Expansive Cements		(IF APPLICABLE)
TIME PERIOD (TOTAL): 45 minutes		FILE NO.:
TYPE OF LESSON: Lecture/with questions		COURSE: Grouting School
PLACE: Waterways Experiment Station		NO. ASST:
TRAINING AIDS: Blackboard, 35 mm slides, expansion bar molds and test specimens		
OBJECTIVES: To acquaint students with expansive cements, the mechanism of expansion its measurement, and the factors that affect it.		
INSTRUCTOR REFERENCES:		
STUDENT REFERENCES AND HOME WORK: Expansive Cement Notes (Handout)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0000	<u>INTRODUCTION</u> The use of expansive cements deserves consideration in many grouting jobs because they can be an effective means for tightly sealing voids and developing excellent bond between grouts and casings, anchor bolts, pre- and post-tensioned tendons, instrumentation, and foundations. As potential users of expansive cement grouts, all people in this class should be aware of what these cements are, their availability, their properties and characteristics, and the things that affect their behavior. The objective of this lesson is to introduce you to expansive cements and their behavior. The lesson on <u>Expansive Grouts</u> will describe the use of these cements in grouts.	
0001	<u>DEVELOPMENT</u> 1. Definition of expansive cement. 2. Review Cements a. Types b. Grades c. Grouts d. Availability	<u>LIGHTS OFF</u> Slide 1 Slide 2
0005	3. Why do expansive cements expand? a. Formation of Ettringite b. Volume behavior c. Expansion specimens and equipment  D. Expansion Measurements	Slide 3 Slides 4, 5 Slides 6, 7 <u>LIGHTS ON</u> Molds & Bars Blackboard STUDENT CHECK
0015	4. Factors Affecting Expansion a. Cement Manufacturer b. Grout supplier and user c. Fineness of cement d. Cement content e. Aggregate Type f. Water-cement Ratio g. Curing	<u>LIGHTS OFF</u> Slide 8 Slide 9 Slide 10 Slide 11 Slide 12

INSTRUCTOR'S LESSON PLAN (Continued)		
TIME	LESSON OUTLINE	KEY POINTS/AID CUES
0025	<ul style="list-style-type: none"> <li>h. Temperature</li> <li>i. Mixing Time</li> <li>5. Properties of Expansive Cement Grouts               <ul style="list-style-type: none"> <li>a. Unhardened grouts</li> <li>b. Hardened grouts                   <ul style="list-style-type: none"> <li>(1) Strength</li> <li>(2) Modulus of Elasticity</li> <li>(3) Shrinkage</li> <li>(4) Durability</li> </ul> </li> </ul> </li> </ul>	Slide 13  <u>LIGHTS ON</u>
0030	<u>SUMMARY</u> <ul style="list-style-type: none"> <li>1. Types and Grades of Cement</li> <li>2. Expansion due to Ettringite</li> <li>3. Review of factors affecting expansion</li> </ul>	
0035	QUESTION PERIOD	

VITA

1. Name: George Charles Hoff
2. Date of Birth: September 7, 1938
3. Place of Birth: Chicago, Illinois
4. Names of Parents:
  - a. Father: George Lawrence Hoff
  - b. Mother: Lorraine Genevive Hoff
5. Name of Spouse: Caroline Marie Hoff
6. Names of Children:
  - a. Son: George Charles Hoff, Jr.
  - b. Daughter: Jennifer Marie Hoff
7. Home Address: 250 Saddlewood Lane  
Jackson, Mississippi 39209
8. Educational Experience:
  - a. B.S. in Civil Engineering, University of Illinois, 1961
  - b. M.S. in Theoretical and Applied Mechanics, University of Illinois, 1968
  - c. Additional graduate work at Mississippi State University
9. Engineering Work Experience:
  - a. Structural Steel Detailer, 1955-56, Columbia Engineering, Chicago, Illinois
  - b. Formwork Designer, 1956, Superior Concrete and Accessories, Franklin Park, Illinois
  - c. Highway Designer, 1961-62, Cook County Highway Dept., Chicago, Illinois
  - d. Research Civil Engineer, 1962 to present, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. Present Position - Chief, Materials and Concrete Analysis Group, Structures Laboratory
  - e. Consultant (Self-employed) on construction materials problems. Done on a continuing part-time basis
10. Publications, Papers, Patents:
  - a. Publications and Papers: Authored or co-authored sixty technical papers and publications plus two books
  - b. Patents: None
11. Military Service:
  - a. Active Duty, Corps of Engineers, February 1962 to February 1964, Honorable Discharge
  - b. Army Reserve, February 1964 to February 1968
  - c. Officers Precommission Course, Ft. Benning, Georgia, 1963
12. Internship Report Typist: Ann Johnson