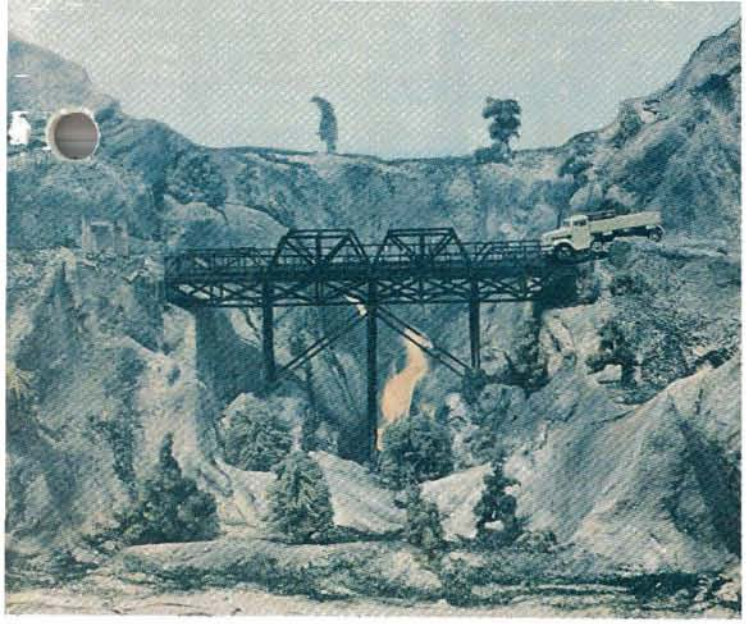
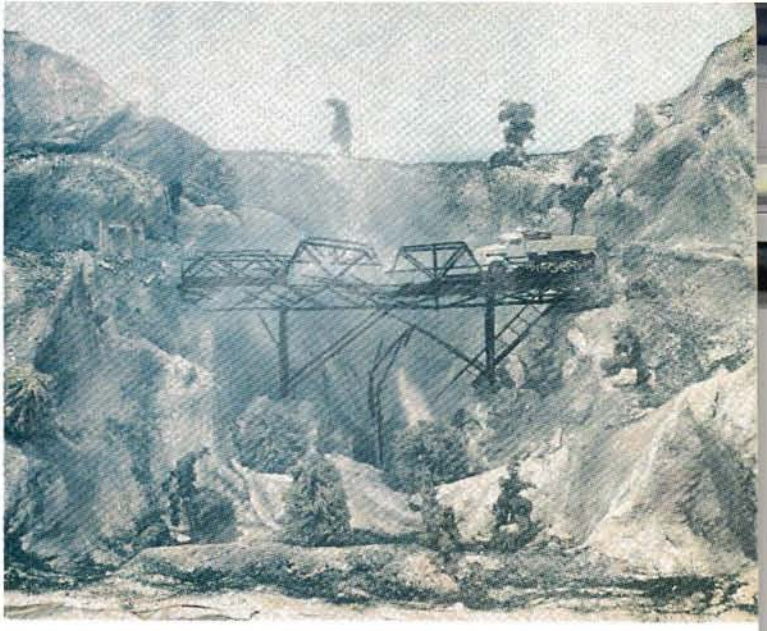
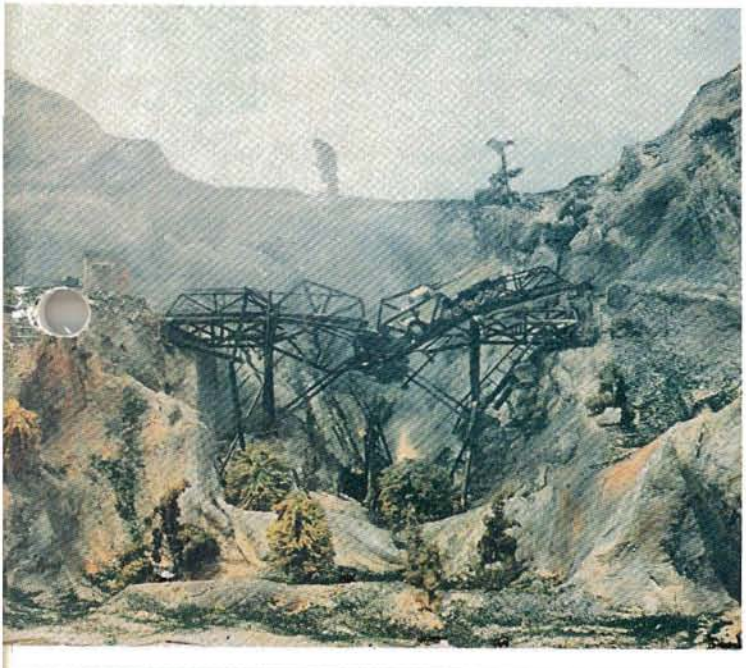
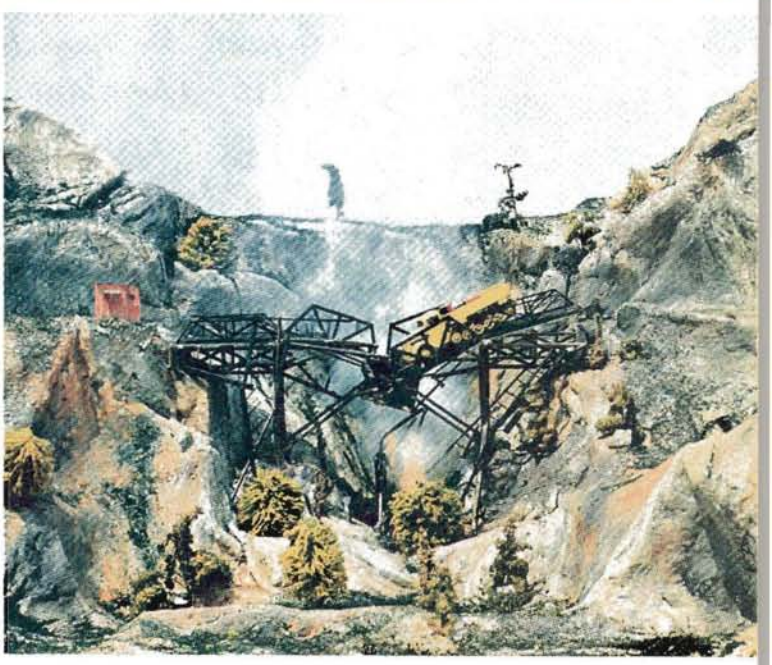
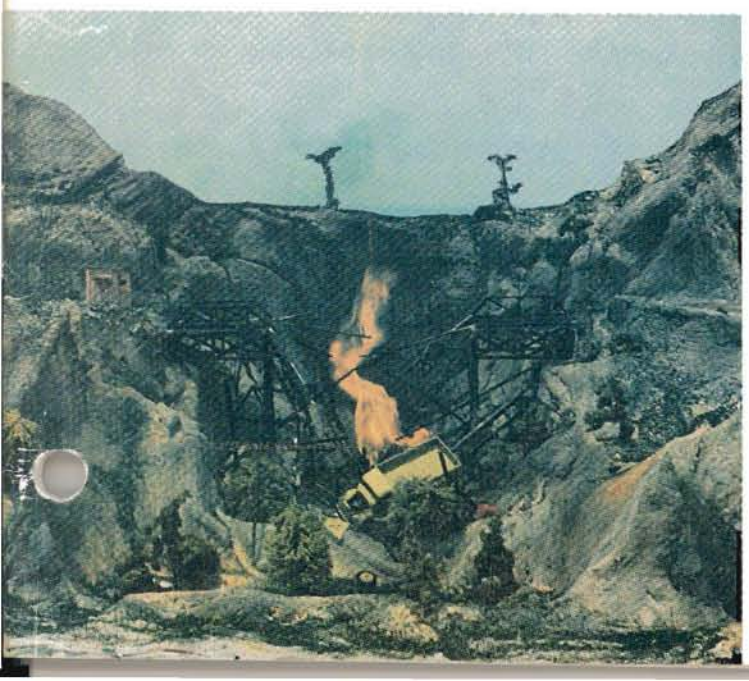
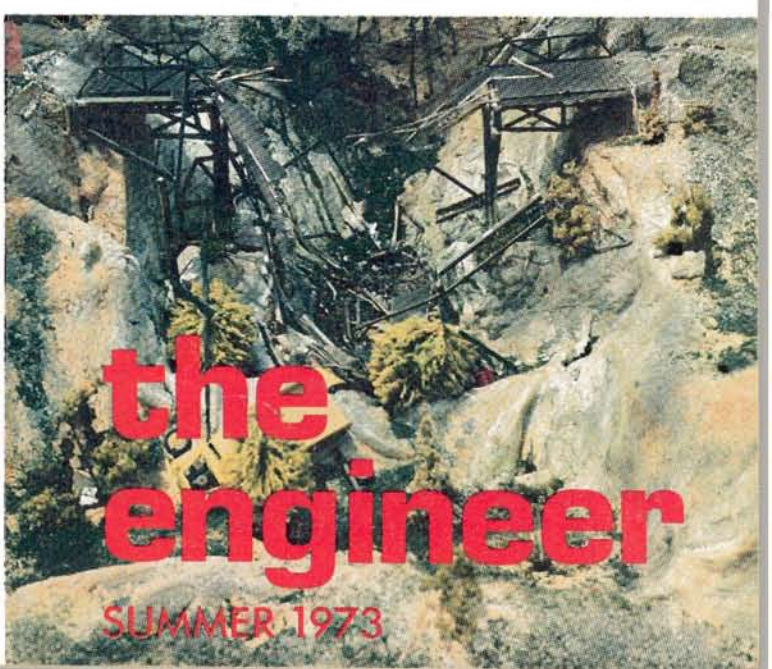







the engineer

SUMMER 1973

the engineer

SUMMER 1973 VOLUME 3 NUMBER 2

2 Pipeline / *News Items*
4 Stop-16 / *Letters to the Editor*
5 Demolition Support: "One Army Style" / *CPT John A. Stockhaus— CPT Guy Donaldson II*
8 New Engineering Techniques / *BG Ernest D. Peixotto*
11 Maintenance Syndrome / *CW4 Gene L. Derby*
14 Revised FM 20-32 / *Frederick A. Messing*
16 Training the Effective Sapper / *MAJ William L. Jones*
19 Bunker Hill: Anatomy of a Fire Base / *MAJ Peter J. Offringa*
26 Dynamic Training / *MAJ Don W. Barber— MAJ Matthew J. Jones*
35 You'll Get A Bang Out'a This / *SFC Charles T. Lewis*
36 Mine-Countermine Training / *COL Walter R. Hylander*
40 Contract Construction for a Troop Unit / *CPT Wardsworth A. Soders III*
44 Mine-Countermine Training Devices / *MAJ A. J. Christensen*
45 Bridging The Gap / *Career Notes*

DEPARTMENTS: Chief's Briefs / Pipeline / Stop-16 Dynamic Training / Bridging The Gap

CHIEF'S BRIEFS.....

Walker Keith Armistead, the U.S. Army's eighth Chief Engineer, was born in Virginia about 1780.

This former Chief of Engineers became a cadet in the old Corps of Artillerists and Engineers and continued as a cadet in the new Military Academy when the present Corps of Engineers was established in 802. Armistead was the third person to graduate from the newly constituted Academy at West Point on March 3, 1803.

He was appointed a second lieutenant in the Corps of Engineers upon his graduation from the Academy. Rising swiftly up the pro-tion ladder, Armistead reached the grade of lieutenant colonel during the War of 1812. During that war, Colonel Armistead held an assignment as the Chief Engineer of the Niagara Frontier and for the forces defending the Chesapeake Bay.

Before and after the War of 1812, the colonel served as Superintendent Engineer of various coastal defenses. He was promoted to the grade of colonel and subsequently was named Chief Engineer on November 12, 1818.

When the U.S. Army was reorganized in June 1821, Colonel Armistead was replaced as Chief Engineer by Major General Alexander Malcomb. He was reassigned as an officer in the 3rd Artillery.

The colonel was breveted a brigadier general in 1828. Back in combat again in 1840-41, General Armistead commanded the Florida Army and led it in the fight against the Seminole Indians. He also later commanded the 3rd Artillery.

General Armistead was the father of the gallant General Lewis Armistead of the Confederate Army, who was killed as he led Pickett's charge at Gettysburg.

Brigadier General Walker Keith Armistead died at Upperville, Virginia, October 13, 1845. e

designed for professionals

U.S. Army Engineer School
Fort Belvoir, Virginia

The Engineer is an authorized quarterly publication of the U.S. Army Engineer School. It is published to provide factual and in-depth information of interest to all Engineer units. Articles, photographs and art work of general interest may be submitted for consideration to: Editor, The Engineer, USA Engineer School, Fort Belvoir, Virginia 22060. Views and opinions expressed herein are not necessarily those of the Department of the Army. Use of funds for printing of this publication has been provided by Headquarters, Department of the Army, July 11, 1969.

Subscriptions to THE ENGINEER magazine are available through the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. Annual rates are 2.50 for mailing to a domestic or APO address and $3.25 for mailing to a foreign address. Individual copies of the magazine are $1.00 each. Checks should be made payable to the Superintendent of Documents.

ABOUT THE COVER

The late author Ernest Hemingway's classic story "For Whom The Bell Tolls" inspired Art Director John Savage, Jr., to build this diarama. In order to simulate the stop action photography seven separate powder charges were used. The vehicle is a 1.35 scale of an Opel "Maultier" that was used by both sides in the Spanish Civil War.

Pipeline

ENGINEERS USE FIBROUS MIX ON LIBBY DAM

The concrete deck of the Libby Dam Project visitor overlook facility, near Libby, Montana, had poor surface drainage and had become badly cracked.

Conventional removal and replacement of the deck would have been an awkward and expensive task.

A thin 1½ inch overlay of fibrous concrete was suggested by the Army Corps of Engineers' resident Office at the construction site and accepted by the Corps' District Office in Seattle as the repair action.

The deck was divided into three sections for a total of 2,000 square feet of surface area.

Improving drainages through grade control required variances in the overlay thickness of from 2¾ inches to less than 1 inch.

The overlay was accomplished in October 1972. It was decided to overlay some of the expansion joints that were in the original concrete surface. A metal manhole lid was also overlaid.

By placing a plastic sheet between the metal lid and the fibrous mix, a removable concrete disc was cast in place. A more architecturally pleasing surface resulted in the final overlay with only two expansion joints and no exposed metal.

The fibrous concrete was mixed and transported in eight cubic yard rotating-drum transit trucks from a local batch plant to the job site.

The concrete contained 1.19 percent steel fibers by volume. These fibers (.010" x 1") were added at the batch plant sprinkling them onto the aggregates as the conveyor belt filled the mixer trucks.

The cement, water, and air were simultaneously added and mixed.

After discharge from the truck, workmen used garden rakes and shovels to spread the mix. A vibrating screen was utilized to consolidate the mix and obtain the proper grade.

Standard construction techniques and tools were used to finish the slab.

The finished surface is skid-resistant and has virtually all fibers covered. There is no evidence of cracking, objectionable rust stains, bleeding, or fibers sticking from the surface. The 5.3 sack mix used contained 226 pounds of fly ash per cubic yard. Modulus of rupture at 28 days was 1290 p.s.i. with an average compressive strength of 6160 p.s.i.

Strengths at 90 days are expected to be 1700 p.s.i modulus of rupture and 8600 p.s.i. compressive strength.

All labor involved was union help and none of these men had previously been exposed to fibrous concrete.

A finishing foreman explained that although his men worked harder in order to handle the fibrous mix, the time involved was no different than would have been necessary with normal concrete. The cost to furnish, place, screen, finish, and cure the fibrous concrete and to install the necessary expansion joints was $1.22 per square foot. This cost includes labor, equipment, travel, and contractor profit.

Additional expenses for winter protection were incurred but are considered incidental to the actual overlay work.

84TH'S TROOPS GET GET SHOOK UP BY EARTHQUAKE

On the subject of pure terror, Mother Nature can often be the best teacher.

At least two dozen GIs from the 84th Engineer Battalion (Construction) received an unscheduled lesson on the subject when an earthquake rocked the Big Island of Hawaii beneath them and rumbled the other Hawaiian Islands.

The men, permanently stationed at Schofield Barracks on Oahu, were working on a civic actions project

involving the construction of a troop service building at Boy Scout Camp Honokaia near there when it hit. The camp is about 25 miles from the area the quake originated and because of its location, it, like other coastal areas, was especially hard hit.

Inside one of the two existing structures at the camp was Bravo Company's 1st Construction Platoon.

Using hand tools and their backs, the men joined county crews in clearing landslide-blocked Highway 24 going into Waipio Valley. It was opened early with their help to one-lane, four-wheel drive traffic.

The large quake, which measured 6 on the Richter Scale and lasted 15 minutes, was the climax following two or three smaller tremors earlier in the week. In fact, while attending a movie in town one evening, the engineers had to evacuate the theater during one of those tremors.

Following the major shock, too, there were several after-rumblings. One sent the construction crewmen running from their tents set up in a eucalyptus grove near the work site.

Another 75-man crew from the 84th was working on the construction of helicopter pads at the Pohakuloa Training Area when the earth started to rock. Nestled in the middle of the island and protected by 13,796-foot Mauna Kea, PTA was shaken, but not affected seriously, and work went ahead on schedule.

AIRFIELD MATTING IS AVAILABLE TO ENGINEER UNITS

The Army's Director of Military Engineering and Topography says he has found that airfield construction training is being hindered by a lack of airfield matting.

Brigadier General Wayne S. Nichols and his staff discovered the problem during recent training visits to engineer units.

He points out that the matting should not be too difficult to obtain and offers guidelines on how to get one of three available items: 1) Mat, Set, Landing XM19, LIN M15665, FSN 5680-089-5920; U/I Set; 2) Mat Set, Landing XM18, LIN M15665, FSN 5680-089-7260, U/I Set; and 3) Mat, Set, Landing, Nonperforated (M8-A1) LIN M15703, FSN 5680-782-5577, U/I Bundle.

Units can obtain matting for training, subject to item availability, on renewable loans for periods up to 180 days.

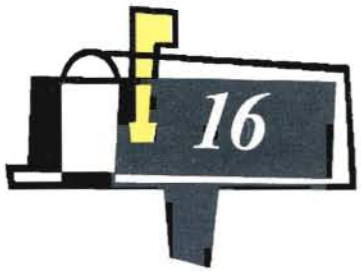
The requests and justification for the loans should be forwarded through command channels to HQDA (DALO-SMS-D) Washington, D.C. 20310.

Funds must be available to pay transportation costs, any costs incurred by the depot, and cost of replacing items damaged during training.

If less than a complete set of aluminum matting (VM18 or XM19), which contains 125,000 square feet of matting, is desired, the appropriate components listed in Chapter 5, SB 700-20, in the quantities needed, may be requested.

Units can obtain matting for airfield and heliport projects simply by submitting a requisition through normal supply channels. An approved project should be cited as justification.

Additional information on airfield matting may be obtained by contacting HQDA (DAEN-MEPO) Washington, D.C. 20314.



STOP-16

JUST COMPUTERIZED

Sir/I read with much interest the article titled "Combat Security-Camouflage" that appeared in the Winter 1973 issue of your publication.

There is a lot of good information but I do not go along with the computer color matching program it explains on page 20.

If you will check what this computer program does, you will find that it has not eliminated the inefficient, 'cut and try' process. It has just computerized it. It is still 'cut and try'--and still inefficient.

RAY K. WINEY
UNIROYAL
MISHAWAKA, IND

DRILL PAY

Sir/In the Winter 1973 Issue of the engineer on page 29 mention was made of '. . . paid time for training . . .,' and I would like to make the following recommendation. All officers, key NCO's and key enlisted personnel be authorized drill pay for voluntary attendance at Headquarters Planning Sessions. These sessions are now required by higher headquarters (brigade and division) SOP's and they are usually four hours in duration. It would provide great incentive for retention and motivation for advancement to higher grades.

Since the Vietnam War is partially over and required expenses have been reduced and the emphasis is leaning toward the Modern Volunteer Army, I feel the necessary funds should be allocated for this type of incentive. I would appreciate it if you could inform me if there are any other channels to which I can direct this recommendation.

ROBERT L. PATTWELL, JR.
CPT, CE, NY, ANG

Captain Pattwell/Congress, in passing the Fiscal Year 1973 Defense Appropriations Act, did provide funds for additional drills for staff officers, preparation of training, and other readiness training. The Army had requested $19.8-million for both Reserve Components for these drills, and the Congress appropriated $13.6-million.

With a greater strength in its Early Mission units, the Army National Guard was able to authorize additional training drills for those units only. The U.S. Army Reserve authorized pay drills for training for almost all of its units.

To date the following Engineer units in the USAR have been given DA approval for additional readiness drills: 411, 881, and 980 Engineer Battalions; HHC 315, and 493 Engineer Groups; 277 and 352 Engineer Companies.

The Department of the Army has recognized the value of the additional drills, which if judiciously used, should significantly improve readiness of the Reserve Components. The FY 1974 budget estimates now before the Congress again requested funds for this type of training.

This information was provided by the Office of Reserve Components, Department of the Army. rgm

MANY THANKS

Sir/As a Public Affairs officer engaged in the image building process of the Louisiana Army National Guard I would like to comment and commend the editor and staff of **the engineer.** The Fall 1972 issue of this publication was the first I had the occasion to review. The art work, layout, and contents were excellent and, in my opinion, represent expertise and professionalism.

ERNEST N. SOUHLAS
CAPTAIN, LaANG
NEW ORLEANS, LA

FORTS! FORTS! FORTS!

Sir/While on active duty in Europe I become acquainted with your publication and decided I would like to try and publish an article in it.

I am a professional city planner who served as Chief of Master Planning at HQUSAENGCOMEUR from June 1970 through July 1972. In that period, as an assignment and a hobby, I researched the 14 post-Napoleonic Forts which surround Ulm, Bavaria and found that they have been at least peripherally involved in wars from Napoleon through the Cold War!

I have written an article on the forts for your publication. Your magazine is an outstanding product and I would enjoy being part of it.

I left active duty as a captain in December, 1972 and am now both in the Reserves (in Buffalo, New York) and a Ph.D. candidate at the University of Waterloo, Ontario, Canada.

JOHN R. MULLIN
CAPTAIN, USAR
KITCHENER, ONTARIO
CANADA

Captain Mullin/We expect to run your outstanding article sometime in the future. the editor

DEMOLITION SUPPORT:

"ONE ARMY STYLE"

Captain John A. Stockhaus

Captain Guy Donaldson II

The "One Army concept" has been around for sometime but its thrust has never been stronger than at present. The mission of the Army and the resources required to accomplish that mission demands strong professional Reserve Components that are capable of shouldering part of the burden. "Mutual Support" is a facet of the "One Army Concept" that conveys current doctrine and technical expertise to the Reserve Components at their home station. This type of direct action benefits both Active and Reserve components.

A landmark of Mutual Support was the demolition of the Castle Bridge in Thomaston, Connecticut by the 242d Engineer Battalion, Connecticut National Guard, commanded by Lieutenant Colonel Harry T. Jarrett.

The Castle Bridge was an abandoned multi-span highway bridge located on the Naguatuck River in the impounded area of the Thomaston Dam. The demolition of this bridge was requested through the New England Division of the Army Corps of Engineers. Colonel Jarrett and his staff devised the demolition plan which called for the reduction of the bridge using high explosives. The bridge was to be reduced in such a manner that debris could be removed from the site by a contractor. The coordination of the project was no small task as it required approval from the state government, the New England Division Headquarters, First Army, and the Office of the Chief of Engineers. During this coordination, First Army requested the Engineer School to review and approve the demolition plan and provide on site representation to check charge placement, priming and firing, and to monitor the firing of the charges. The Instructors of the Demolitions Branch, United States Army Engineer School, were anxious to seize the opportunity as this task would provide a test ground for some new concepts, and depth of knowledge for the instructors. This project would benefit everyone involved.

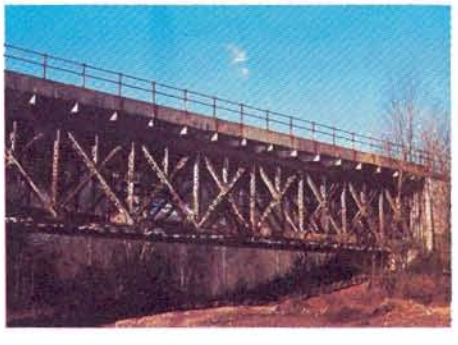
On the weekend of November 18-19, 1972, four Instructors traveled to Thomaston, Connecticut to participate in the demolition project. The first span would be cut and reduced to debris. Troops from the 242d received a field class in detonating priming while waiting for the explosives to arrive from the ASP. With the arrival of the explosives, the troops prepared the span for demolition. The efficiency of the placement operation was no fluke as the 242d had "dry run" the operation on previous weekends using homemade training aids.

Apparently Dynamic Training is alive and well in the Reserve Components. The size of the charges had to be limited to prevent damage to an occupied dwelling 1,100 feet from the bridge. Stringent safety precautions were implemented to prevent curiosity seekers from entering the target area. These procedures were planned and executed by the 242d. The charges were fired dropping the span, and troops contrived to reduce the span to the desired degree of breakage. The results of demolition were analyzed and the second span, over water, was demolished on the weekend of December 9-10, 1972.

Members of the 242d Engineer Battalion executed this operation under the watchful eye of the Adjutant General of Connecticut. Further reduction of the bridge was accomplished on subsequent weekends. The Mutual Support mission was a complete success.

The demolition of the Castle Bridge yielded many benefits beyond the scope of the project. Among the benefits was the fact that Reserve components are capably conducting excellent training for their troops, and that Reserve Components can provide needed support to active Army Agencies.

The participation of the Engineer School at Fort Belvoir, Virginia, is vital in projects of this type to check out concepts and doctrine in "Real World" situ-



ations and to provide school instructors with in depth knowledge that lends force and meaning to the instruction at the Engineer School. Mutual Support is one way to the "One Army Concept" that yields rich dividends for all participants.

The Demolitions Branch, Department of Applied Engineering, for instance, is often called upon to provide technical assistance and specialized training throughout the Continental United States to active Army units as well as Reserve and National Guard units.

In February 1973, the 76th Engineer Battalion (Construction) located at Fort Meade, Maryland, was assigned the mission of removing five pile bents from a river on the Fort Meade military reservation. The five pile bents had been left standing in the river after the super structure of the timber trestle bridge had been washed away by the flooding of Hurricane Agnes in June 1972. Each bent consisted of five timber piles, approximately 18" in diameter, the lateral bracing still intact.

Although the 76th was proficient in basic demolitions training, this mission required that the timber piles be cut level with the bed of the stream, thus requiring that the charges be placed under water varying in depth from four to eight feet. Realizing the requirement for special training in the use of special purpose demolitions charges under water, the 76th requested that technical assistance be provided by the Demolitions Branch of USAES.

After final coordination and specialized training had been completed, Captains Guy Donaldson II, and Jack Stockhaus, Demolitions Branch, and members of the 86th Engineer Detachment (Diving) arrived at Fort Meade on February 26, 1973 to provide assistance to the 76th in the actual accomplishment of the demolition mission.

To accomplish the mission individual ring charges were prepared on shore for each pile, utilizing overlapping sheets of M-118 Sheet Explosive taped together. Each individual charge consisted of three lbs of M-118 Sheet Explosive and was primed with detonating cord using the Uli knot. The individual charges were nailed in place on each timber pile by members of the 86th. Each charge was then tied into a detonating cord ring main and the system was then detonated utilizing an electrical firing system.

The results of the operation were outstanding in all respects. Each pile was cut completely right at the stream bed level. The cuts achieved on the timber piles were smooth and straight with a minimum of splintering. The piles and bracing were easily removed from the river by winching them on to shore with a bull dozer.

The benefits derived from each organization cooperating in this operation of "Mutual Support" were numerous. The Fort Meade military reservation had an obstruction removed from its waterway thereby rendering it open for future training and recreation; the 76th Engineers received demolitions training by actually performing a live demolition mission, the 86th Detachment received realistic diving training by working with live explosives, and the Demolitions Branch of the Engineer School received further opportunity to test special purpose charges in actual demolitions mission.

These concepts of "One Army" and "Mutual Support" between Active, Reserve, and National Guard units in the field of demolitions have helped to significantly raise the level of engineer training among all units, and have advanced the "State of the Art" of demolitions and explosives techniques throughout the military. ∈

Captain John A. Stockhaus, who is presently serving as National Guard Advisor in Fort Devens, Massachusetts, was an Instructor in the Department of Engineering Science and Branch Chief of the Demolition Branch, Department of Applied Engineering at the Engineer School at Fort Belvoir, Virginia, from 1971 until January 1973. Upon graduation from Norwich University in 1965, he attended the Engineer Officer Basic Course and Airborne School. A veteran of the Vietnam War, the captain served with the 864th Engineer Battalion and the 102d Engineer Company there in 1966. He also served there again as a Company Commander with the 8th Engineer Battalion in 1968 and with the 2d Brigade, 1st Cavalry Division in 1969.

Captain Guy Donaldson, II, currently Demolitions Branch Chief, Demolitions/Mine Warfare Division, Department of Applied Engineering, U. S. Army Engineer School, Fort Belvoir, Virginia, is a graduate of Auburn University and holds a masters degree from Purdue. He served with the 814th Float Bridge Company in Germany and in Vietnam as Assistant Subsection Advisor for Dinh Quan District and as Company Commander of D Company, 19th Engineer Battalion (Combat) between 1964-1970. He also has attended the Engineer Officer Basic and Advanced Courses and Airborne School.

New Engineering Techniques

Brigadier General Ernest D. Peixotto

The continued development of new weapons systems and doctrine has intensified the need for the development of improved military engineering techniques in an era of "instant" technology discovery.

The requirement to improve the Army's construction capability has never been more essential to ensure the necessary support for combat operations. Offensive operations require more roads, airfields, and helicopter facilities. Defensive plans emphasize the need for better protection of troops and equipment as well as better techniques to blunt the thrust of an enemy attack. The war in Vietnam emphasized the growing demand for engineer support on the modern battlefield.

The Army Material Command and the Corps of Engineers are attacking many of the basic requirements through several of the Army's research and development laboratories. The U. S. Army Engineer Waterways Experiment Station (WES) at Vicksburg, Miss., is responding to six major requirement areas thusly—

- The increased use of aircraft and airmobile tactics, while adding a new dimension and degree of mobility to the battlefield, has greatly increased the need for expedient airfields and helicopter facilities.
- The employment of more lethal direct and indirect firepower by the enemy requires major improvements in the design and construction of protective structures for troops and vulnerable high cost equipment in the combat zone.
- The increased threat of enemy armored mobility to strike cross-country demands better techniques for creating rapid barrier systems.
- Although our Army enjoys increased air and ground mobility, major combat units have greater requirements for the land line of communications (LOC).
- The development of strategic nuclear missiles and antiballistic missile systems demands improved techniques to ensure the protection of these systems from the threat of enemy nuclear attacks.
- The growing reliance on inter and intra theater airlift as well as close air support has increased the need to improve construction methods for major logistic and tactical airfields.

One of the more spectacular areas of progress by the WES is in the development of new expedient surfacing—landing mats, membranes, and dust control materials—for airfields and heliports. As an example, the Army greatly benefited from the timely development of the M8-A1 mat, T-17 membrane, and Peneprime which were used extensively in Vietnam.

The WES has developed a new heavy-duty membrane which is now ready to enter the supply system for use by heavy aircraft wherever soil conditions are suitable. The neoprene coating four-ply nylon fabric, 5/64 in. thick, is a major improvement over the less durable T-17 membrane used in Vietnam. The heavy duty membrane successfully passed rigid AMC Service Tests under heavy C-130 traffic for six months at Fort Bragg. It is anticipated that this heavy-duty membrane will be extensively used in the future for assault airfield surfacing even where previously the light-duty M8-A1 landing mat had to be used.

Two new landing mat systems are also nearing the completion of development by WES to provide a total of three types of mat to meet the official requirements for a light , medium , and heavy-duty landing mat. The requirements are based on the strength of surfacing required to meet the demands of varying sizes of military aircraft. For the foreseeable future the M8-A1 mat will serve adequately as the light-duty mat.

The new medium-duty landing mat, with an aluminum honeycomb core, has already met all structural and operational tests and should be accepted by the Army in the near future. This mat is available in 4- by 4-ft panels and weighs about 65 pounds per panel.

It will support operations of the aircraft.

The new heavy-duty mat, with an extruded aluminum truss core for extra strength, is near the end of the development cycle. Designed to meet the severe wheel loads of the heavy fighter bombers to include the F-111, this mat will undergo service testing during 1973. The mat is roughly equivalent to a 15-in. concrete runway, but this mat runway can easily be placed by troops in a couple of days as the 2- by 9-ft panels weigh only 110 lb each.

In addition to completing the development of medium and heavy-duty mats, a breakthrough has been achieved in waterproofing the system to protect the soil under the mats. This has been accomplished by use of a gasket that fits in the joints of the landing mat. While the mats are designed to support aircraft loads on a relatively soft soil, CBR-4, the collection of water under landing mats reduces the soil strength and ultimately causes a mat failure.

Barriers must be rapidly created by the engineer in support of tactical operations to stop or slow the advance of the enemy. New concepts and techniques are being studied using both nuclear and non-nuclear explosive techniques to produce obstacles such as large craters, destroyed bridges, highways, railroads and tunnels.

A new technique for destroying bridges over water is also under development. Current demolition techniques call for the placement of explosives on the bridge members to cut critical stressed members of the bridge and drop them into the water. A new concept involves the placement of explosives underwater, under the bridge deck. An underwater explosion generates a highly energetic water column above the explosion which is capable of exerting surprisingly large uplifting forces on the bottom of a bridge. These forces not only pick up the bridge deck and move it but as it settles back down it is overstressed and will suffer damage. Again this work is being performed on a scale model using scaled down explosive charges to generate a water column which is analyzed for the energy directed at the bridge. Once completed these studies will provide a means of predicting, for a given charge size at a given depth underwater, the uplift force generated above the water surface. This new concept in bridge destruction must be considered in our design of new bridge systems.

The atomic demolition munition provides the combat engineer with the greatest destructive power imaginable to create obstacles and barriers. The ADM is not new and much work has been performed in evaluating the use of the ADM as a means for establishing a barrier. Recently renewed interest has been placed on evaluating the effects of the ADM with the dual purpose of determining the smallest yield weapon possible to ensure an adequate barrier while also minimizing fallout and other detrimental effects from an ADM detonation. Experimental work is in progress to provide more precise information on the effects of an ADM at various depths of burial, and as used against targets such as bridges, tunnels, railroad yards, and airfields. Tests have been completed at Ft. Peck, Mont., and further tests will be conducted at Ft. Polk, La.

During the past four years a revolutionary concept in road building has evolved at the WES. The old expression taught at The Engineer School and to Combat engineers, "get the water off and the rock on," has been as sound advice as has ever been taught. The WES has now developed a road system that gets the water off but uses absolutely no rock. It can reduce the Army's need for rock quarries, heavy quarrying equipment, and dump trucks to haul rock from the quarry to the road or airfield site. In place of rock in road construction, the WES has developed a technique for using common garden variety fine grain clay soil. Techniques have been developed where this road can be built across soft marshy areas and support heavily loaded 5-ton truck traffic.

The road is constructed by first placing a plastic membrane on the subgrade. This is followed by placing clay material which can be moved from the shoulders or even from the original roadbed on to the lower membrane. It is spread and compacted controlling the water content to obtain near optimum strength of the soil. Depending on the nature of the subgrade material, a number of lifts of clay material can be placed and compacted to achieve the adequate strength for the traffic required. Once the clay has been compacted, graded, and crowned, an upper membrane is placed first by applying a asphalt emulsion, then covering the road with polypropylene material, and finally applying a second coat of emulsified asphalt on top of the polypropylene membrane. Sand is also placed on the asphalt to help blot the excess asphaltic material.

The design of military structures to withstand a nuclear blast is the subject of an extensive research program at WES. This research is carried out both in the field and in the laboratory at Vicksburg, Miss. In field tests, the WES is the primary Army participant in DOD joint exercises working with the Air Force and the Defense Nuclear Agency. The tests involve the detonation of large quantities of high yield explosives ranging up to 500 tons of TNT. During the past two years, several tests such as MIDDLE GUST, MIXED COMPANY, and DIAL PACK have been conducted. The field tests are model studies of the

blast effects of a nuclear weapon, placed as an air, surface or underground burst in connection with varying geologic conditions. The subsequent blast and shock effects on hundreds of kinds of experimental equipment arrayed around these blasts are examined. Resulting airblast and ground shock effects are measured through basic instrumentation and on actual military equipment and modeled facilities.

The construction of large airfields to sustain a considerable volume of heavy cargo aircraft and to support heavy tactical fighter and strategic bombers is a major engineering effort. Research to reduce the time and cost of these runways promises to be most rewarding. All facets of the problem are under study. The latest practices of the construction industry are being evaluated for military use. New design practices are being tested. The use of commercial construction equipment is being examined. The immediate goal of the pavement research project is to save over $20 million in a planned runway construction program.

Many new concepts for pavement designs are being evaluated. In the field of flexible pavements, the use of full depth crushed stone, full depth asphalt, and even the use of cement stabilization of the base course material are under test. Preliminary results indicate major savings can be achieved in the thickness required for the same design loading. The thickness savings can be translated into cost savings. In rigid pavements new techniques are being examined for continuous reinforcing of concrete, prestressed concrete pavements, and wire-fiber reinforcing, to name a few. The use of clay wrapped in a membrane is also being evaluated as a replacement for high cost crushed rock as a base course material. Pavement condition surveys are being made on military airfields across the country to analyze the traffic and weather effects on the pavements, their structural integrity, and maintenance costs. About 30 airfields overall are being studied.

Another change in concrete pavements may be possible through the use of fly ash and pozzolans to reduce cement requirements. Fly ash and pozzolans have been used by the Corps of Engineers in the construction of large concrete structures to reduce the cost of cement. In bituminous pavement, the use of asphalt, lime, and cement for stabilization may reduce overall thickness requirements and thus effect a savings in material and construction effort. Lower quality material can also be utilized to achieve another saving when stabilization is employed.

In examining construction practices for rigid pavements, the WES is evaluating the use of slip form pavement and the continuous reinforced pavements now quite common in the interstate highway systems. Fibrous reinforced pavements are also receiving considerable attention. Immediate adoption of these techniques is not possible under current military requirements. One of the disadvantages of slip form paving is the slump along the edge of the pavement which results as the form moves. This results in a groove down the pavement that does not meet the smoothness specification required to meet Air Force standards. These are among some of the many problems that are being evaluated as well as the key joint between slabs.

The present Corps of Engineers specifications do not provide guidance on many of the recent technological advances in bituminous pavement constructions. Particularly significant are advancements in pavement and compaction of depth lifts of paving mixes up to 8 in., the use of vibratory rollers, and the use of full width pavers of 30 ft or more in one pass. Again we are collecting data from equipment manufacturers, contractors, associations, and actual construction projects as well as our own test programs to evaluate these techniques and see if they meet the military airfield construction standards. Another area of improvement in specifications is the lengthy and detailed requirements in meeting quality control. Improved methods for the contractor providing quality control will also be incorporated.

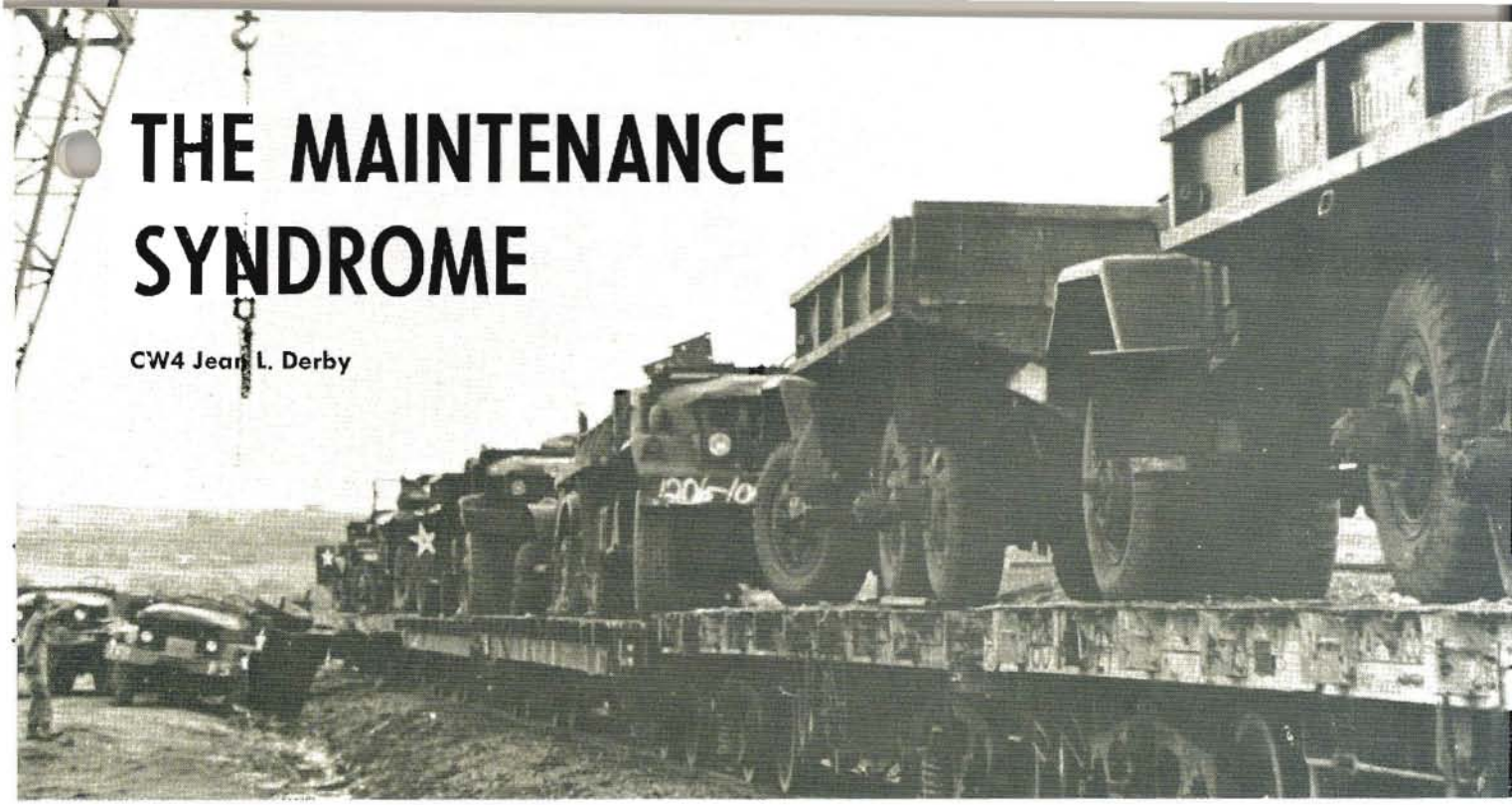
In all the future looks much brighter for the military engineer in the years just ahead. e

---

Brigadier General Ernest D. Peixotto is the new Assistant Commandant of The Engineer School at Fort Belvoir, Virginia. His last duty assignment was Director of the U. S. Army Engineer Waterways Experiment Station at Vicksburg, Mississippi. The general was commissioned in the Army Corps of Engineers in 1951 upon graduation from the U. S. Military Academy at West Point, New York. He holds a Master's Degree in Civil Engineering from Massachusetts Institute of Technology and is a graduate of The Engineer School, the U. S. Army Command and General Staff College, and the National War College. General Peixotto has held numerous top assignments in the U. S. and overseas during his military career. He served in Vietnam twice; the first time as the Engineer and Academic Advisor at the Vietnamese National Military Academy in Dalet in 1959 and later as the Commanding Officer, 86th Combat Engineer Battalion operating in the Mekong Delta in 1968. He has held positions in the Research and Development Directorate and as the Special Assistant for Plans and Policy for the Chief of Engineers. He also has served in Iran and in the Panama Canal Zone. The general is a registered professional engineer and a member of the Society of American Military Engineers.

THE MAINTENANCE SYNDROME

CW4 Jean L. Derby



When a weapon malfunctions or a piece of equipment is deadlined during combat, a number of things can happen. All of them are bad.

A soldier carrying that malfunctioning weapon could lose this life. And deadlined equipment means that some vital project—like construction of a fire base—cannot be completed before an expected enemy attack. This means the casualty figure would be much higher than it would have been if that fire base had been completed before the attack. Farfetched examples? Not hardly.

Deadlined equipment has been a major problem for engineers through the years. The primary cause behind delayed engineer construction projects and the resulting rise in construction cost is high engineer equipment deadline rates.

Over the years, engineer equipment has undergone many changes. Today's typical piece of equipment is a sophisticated, complicated machine which requires a well-trained operator and mechanic to keep it operational. The basic causes and the solutions that are necessary to prevent deadlined equipment are the same today as they were when machinery replaced the horse and wagon.

A recent survey and subsequent answers from more than 600 officers and noncommissioned officers at the U.S. Army Engineer School, Fort Belvoir, Virginia, showed that there are four major areas of maintenance effort which directly effect high deadline rates. They are:

- Nonperformance of organizational maintenance.
- Inefficient equipment operation and utilization resulting in abuse of equipment.
- Poor response from the repair parts supply system.
- Shortage of properly trained and motivated maintenance personnel.

Perhaps there are many solutions to deadline rates; some better than others. This article makes specific, and hopefully the best, recommendations on how to conquer the four problem areas.

Let us take them one at a time. The first area of ineffective maintenance has been identified as nonperformance of organizational maintenance. It can be controlled through well-supervised motor stables, scheduled preventive maintenance services and a training program for unit supervisory personnel which emphasizes the duties and responsibilities of the junior leader.

An effective preventive maintenance program like any engineer construction project must be based on a solid foundation. And the foundation of an engineer battalion's maintenance program is the unit motor stables.

Commanders and NCO's at all levels know and understand the importance of motor stables but frequently do not believe they can find time to make a personal check of the facilities during the day. Implementation of a good motor stables program depends on the personal effort of every officer and NCO in the battalion.

Motor stables supervision must start at the top. If the battalion commander and sergeant major make a daily check of the motor stables, staff members and

unit commanders will get the message as to the importance of the program.

Of course there are aspects other than maintenance that lend to the efficient operation of an engineer battalion. But, even so, commanders must insure that adequate maintenance is being performed on the unit's equipment while keeping abreast of the day-to-day battalion operations. The best way to do this is by personal supervision and participation in the battalion's maintenance program.

Motor stables are not the complete answer to the maintenance problem. Commanders also must initiate a maintenance training program within their battalions.

Logically, instructors should be the personnel who possess the most maintenance expertise and know-how in the battalion.

The maintenance warrant officers and NCO's should be motivated to provide dynamic on-the-job training to supervisory personnel during motor stables formations.

Senior maintenance personnel should schedule and present a series of formal classes on each type of engineer equipment. One of the most effective methods of getting the instruction across to a class is to use the equipment as a training aid and schedule the tutelage concurrently with maintenance activities. The commander can use this time to make a checklist of deficiencies that normally occur as a result of improper operator maintenance. Armed with this information, a senior commander can quickly impress his unit commanders with the importance he places upon the battalion maintenance program.

The second problem area—inefficient equipment operation and utilization—can be alleviated in part by the application of effective motor stables and training programs. Unless proper maintenance is being performed on engineer equipment, it will be abused from the instant it leaves the motor pool until the moment it returns. In addition, proper supervision through operator training and enforced licensing procedures will greatly reduce the misuse of equipment that is caused through ignorance of proper equipment handling techniques.

Operator morale is also a factor that can cause equipment abuse. Commanders should monitor the number of consecutive days an operator works on the same project. If an operator's morale is low, he may purposely deadline an item of equipment just to get away from the job for a few days.

Maximum utilization of assistant operators, rotation of equipment, and liberal pass policy during slack construction periods will go a long way toward improving the operator's morale and the way he uses his equipment.

The third maintenance problem area—response of the repair parts supply system—is directly related to the Direct Support maintenance capability. The value of any Direct Support maintenance capability is directly dependent upon the efficiency of the Direct Support supply section charged with maintaining the authorized stockage list. Many of the problems encountered with the repair parts system lie either at this level or at the company prescribed load list level where the Direct Support section has training and inspection responsibilities. Many times delay in the availability of repair parts can be directly attributed to organization supply procedures.

The most common causes for the delay in the supply of repair parts are: 1) improper identification of parts; 2) use of obsolete supply catalogs and erroneous stock numbers; 3) failure to forward parts requests immediately; 4) unauthorized use of higher category repair parts manuals at organizational level; 5) inadequate training of maintenance personnel in repair parts supply procedures and catalogs; 6) abuse of the issue priority system and; 7) failure to submit timely follow-ups on requisitions. Many of the causes of these delays are inherent in the table of organization and equipment that mans and equips the section.

An example of the manning and equipment problem is demonstrated in the organic Direct Support maintenance capability of the engineer construction battalion; surely the most valuable maintenance asset available to the commander.

The authorized repair parts specialist—an E-5 position—does not normally provide supervisory ability commensurate with the magnitude of the responsibility. This lower grade NCO is charged with the requisition, stock control, storage and issue of between 4,000 and 8,000 separate line items of repair parts.

This repair parts specialist must maintain liaison with maintenance support activities, provide inspection and training assistance to the units the section supports, transport parts from Direct Support/General Support facilities to the Authorized Stockage List (ASL), and supervise nine parts clerks to accomplish all of these functions.

Often the section is under-supervised and undermanned. To compensate, personnel are assigned from other Direct Support positions. A platoon leader Engineer Warrant Officer, or Ordnance Warrant Officer, often may find himself devoting considerable time to the ASL; a distraction that hinders the performance of his specialized functions. In addition, the section has three trucks and five trailers that are operated and maintained by the supply clerks. This secondary mission generally becomes a full time job, reducing the number of clerks available to perform the

primary mission. Three or four mechanics may be cross-trained to supplement any shortage in repair parts clerks and equipment operators.

All of the aforementioned factors affect the efficiency of the repair parts supply system. Many of these Direct Support problem areas can be resolved only by a concerned and informed commander.

Every commander should visit the ASL area frequently to get a first-hand look at the problem areas. Short question and answer sessions between the commander and the personnel operating the ASL area should quickly give an indication as to the responsiveness of the supply section. Although it is impossible for the commander to personally check the condition of each item of equipment in the battalion, a spot check of the demands on the company prescribed load lists and the demands on battalion authorized stockage lists will give a good indication of the quantity of scheduled maintenance that is being performed.

The fourth and last area of ineffective maintenance—described as a shortage or lack of motivation in maintenance personnel—can be alleviated through the proper assignment of individuals in this military occupational speciality. This is a command responsibility at all levels. Unit maintenance personnel can be found in supply rooms, orderly rooms, mess halls, and out in the field operating equipment.

Operational necessities frequently dictate that certain personnel be cross-trained or retrained in order to meet mission requirements. This sometimes creates a problem. It must be recognized that a potential morale problem can develop when personnel are used outside the field for which they have been trained. So the commander should periodically screen the records of his personnel to insure that maintenance-qualified personnel are being properly utilized. The senior commander also should make every effort to see that key warrant officers and NCO's are assigned at the organic direct support levels.

Of course, the maintenance responsibilities of the senior commander go beyond alleviating the four problem areas that have been discussed in detail. His responsibilities are not as clearly defined as those of the battalion maintenance warrant officer, maintenance NCO or unit commander. Generally the senior commander is charged with overall responsibility for the battalion maintenance program. It would be helpful for the battalion commander in the long run if he would define specific areas in his maintenance program, assume personal responsibility for these areas, and see that they are carried out. This is not to say that he must personally supervise every aspect of the battalion maintenance program. There are, however, several areas he could monitor that not only would keep him up to date on equipment status, but also would correctly demonstrate his personal interest in the program for the benefit of staff members and unit commanders.

These areas are referred to as the Seven Maintenance Factors at the Engineer School. They are–

- Command.
- Personnel.
- Facilities.
- Equipment.
- Publications.
- Repair Parts.
- Time.

The senior commander has many of the answers to the maintenance syndrome. To insure a low engineer equipment deadline, he must pursue an active and aggressive maintenance program. He must develop his ability to diagnose the cause and prescribe the prevention or cure. Of course, a commander's personal interest in his battalion maintenance program is certainly not a new a unique concept.

The unfortunate fact is that the senior commander's interest in maintenance sometimes begins and ends after he has scheduled motor stables on the battalion work/training schedule. Generally, maintenance is considered subordinate to production. However, the mission-oriented commander must realize that production is directly related to the quality and quantity of the maintenance services that are performed in his unit.

The commander who makes personal contact with his operators, mechanics, and parts clerks certainly increases the morale within his battalion. Also the commander who can diagnose equipment malfunctions, determine the status of maintenance and repair parts activities, and pinpoint ineffective or inefficient areas of the program, can be assured of a low equipment deadline rate.

Maintenance will never take a back seat to the construction mission in a first rate engineer battalion. Furthermore, a first rate maintenance program will guarantee a top-level production program.

CW4 Jean L. Derby is currently assigned to the U.S. Army Engineer School's Department of Mechanical and Technical Equipment as Chief, Systems Equipment Section. He has served in a variety of engineer maintenance assignments and is a combat veteran of Korea and Vietnam. He saw service in Korea with the 14th Combat Battalion and in Vietnam with the 103rd Construction Support Company and the 577th Construction Battalion in 1966 and 1969-70, respectively. This is Mr. Derby's third assignment as a member of the Engineer School faculty during a service career that has spanned 25 years.

REVISED FM 20-32

Frederick A. Messing

The many changes in doctrine and techniques of mine-countermine operations contained in the Mine-Countermine Study (MICMIS), the STANO Survey and Review (STASAR), Standardization Agreement (STANAG) 2036, and other documents pertinent to mine-countermine operations, necessitated an early revision of FM 20-32, Landmine Warfare, May 1971.

Accordingly, a revision of FM 20-32 was initiated in Fiscal Year 1972 with the express purpose of updating the manual in accordance with the referenced documents. As a point of reference and in accordance with the MICMIS, the term countermine has been redefined. "Countermine" is now defined as: "Tactics and techniques used to detect, avoid, breach, and/or neutralize enemy mines and the use of available resources to deny the enemy the opportunity to employ mines." This new definition was forwarded to the Adjutant General and is now included in the Dictionary of the United States Army (AD) and in the revised FM 20-32.

The MICMIS also contained a recommendation to: "Change the title of FM 20-32 from "Landmine Warfare to "Mine-Countermine Operations" to give more emphasis to the countermine portion of landmine warfare. This was done and the title of the new FM 20-32 will be "Mine-Countermine Operations."

Additionally, the MICMIS contained a recommendation to: Rewrite and reorganize the FM 20-32 to provide complete coverage of doctrine and operational concepts that apply to countermine operations and to eliminate or move to an appendix all technically oriented information. In line with this recommendation the manual was reorganized into three parts: Part One, Introduction; Part Two, Installation of Landmines and Minefields; and Part Three, Countermine Operations. Thus, the two essential functions have been separated by placing all information on Mining as practiced by friendly forces, in Part Two, and all information on Countermining, in Part Three. Insofar as possible, all technically oriented information in the manual was moved to the appendixes.

Simultaneously, Edition Number 3 of STANAG 2036, a source document for FM 20-32, was also reviewed. As a consequence of changes to the STANAG, changes in the Irregular Outer Edge (IOE) of the Standard Pattern Minefield and changes in the various reports (Intention to Lay, Report of Completion and

Report of Enemy Minefields) were made in the revision of FM 20-32. Added also, were changes concerning the direction in which minefields may be laid (minefields may now be laid from either right to left or left to right); the method of laying mines in the cluster (mines may now be laid on the circumference of the semicircle prescribed for pattern minefields) and permitting the use of barbed-wire concertina for minefield marking fences.

The Surveillance, Target Acquisition and Night Observation (STANO) Survey and Review (STASAR) contained recommendations that STANO equipment be used in countermine operations and counter-countermine operations. To comply with this recommendation, applicable STANO doctrine was extracted from various STANO documents and reports and included in the revision of FM 20-32. A chapter (chapter 10) on available STANO devices which can be used in countermine operations and an appendix (Appendix F) on the use of unattended ground sensors (UGS) to detect enemy engaged in mine laying, or breaching activities have been added.

To include information on scatterable mines, FM 20-32A, Landmine Warfare (Scatterable Mines) has been incorporated into the revision of FM 20-32 and will appear as Chapter 7. Upon publication of the new FM 20-32, FM 20-32A will be superseded.

Chapters on the "Countermine System," "Defensive Countermine Operations" and the "Historical Background of Mines and Mine Warfare" have been added. There are also new appendixes on "Minesweep Operations," Detector and Search Techniques for the Individual Soldier and the Unit" and the "XM57 Antitank Mine Dispensing System."

When the final draft manuscript was sent to the Adjutant General for printing, limited quantities were also sent to those agencies and units providing comments. Additionally, sufficient copies of the final draft were published to provide the Mine Warfare Branch of the Department of Applied Engineering of the US Army Engineer School an interim Training Text for School instruction.

The revised manual was scheduled to be distributed in August 1973, but publication is being held up to incorporate additional changes developed at a worldwide Barrier-Counterbarrier Conference held at Fort Benning in May.

These changes are being staffed as this issue goes to press, so they are not yet approved. They address the responsibilities of individuals and units, defining more clearly combat arms and engineer roles and introducing an engineer role for training of others. As now written (and subject to change) the new manual would read—

RESPONSIBILITIES:

- All troops, regardless of arm or branch, are responsible for individual countermine actions—visually detecting, avoiding, and reporting of mines and booby traps.
- Combat arms troops are responsible for employment of individual standard US AT&AP mines—arming, disarming, emplacing, and camouflaging—and for hasty neutralization of enemy mines—by detonation or by pulling out with rope or wire.
- Combat arms units are responsible for:
  Hasty breaching of barriers to include minefields.
  Emplacing and removing hasty protective minefields.
  Assisting engineers in deliberate barrier operations.
- Combat engineer units are responsible for:
  Deliberate breaching of enemy barriers to include minefields.
  Deliberate barrier operations, with assistance of combat arms units.
  Technical advice and assistance in barrier/counterbarrier operations.
  Providing training in barrier/counterbarrier operations.
- In accordance with an approved employment order, combined arms units are responsible for planning and conducting barrier/counterbarrier operations, with advice and assistance from supporting combat engineer units.

This added revision to FM 20-32 is more than just a clarification of language; it is a change of doctrine to make it conform more closely with real world practice and to emphasize the training responsibilities that derive from doctrine. Because of the importance attached to this shift of doctrine, publication of the new FM 20-32 will be delayed until early 1974.

Mr. Frederick A. Messing (LTC, CE Ret) was, before retirement from Civil Service, a writer-editor, GS 12, with the Department of Doctrine and Training Development, USAES. He recently completed the revision of FM 20-32, Mine-Countermine Operations.

TRAINING THE EFFECTIVE SAPPER

Major William L. Jones

Effective countermine training is almost universally accepted as being in about the same state as it has been over the past 40 years—unsatisfactory. This has created the MICMIS Study which has generated a need for a Sapper Military Occupational Specialty.

The design of a program of instruction supporting an MOS is normally done through a process called Systems Engineering. This involves three basic steps prior to developing the actual lessons. First, the job itself is examined and a list of tasks is prepared showing everything the specialist must be able to do. Second, these tasks are examined to determine where they can best be learned—service school, unit or On-The-Job-Training (OJT). Third, the tasks selected for training are each broken down further into knowledges that are then taught or trained as parts of specific lessons.

In evaluating a program to train an effective sapper, one task; that of finding a mine or boobytrap cannot be analyzed by listing knowledges because no matter what knowledges are listed, the graduate still will not be able to consistently find the mine or boobytrap. When this is the case, the task has not been trained. An easy path is to regulate the task to OJT but now as in the past, the price in combat is too high and the problem is not solved. The program of instruction under development must, therefore of necessity, include this task of finding mines as well as the remaining conventional MOS tasks. This article concerns itself with the training of the unique task of "finding mines and boobytraps."

Extensive attempts in recent years have been made to determine and analyze the human characteristics or traits which make up the outstanding patrol point men. Whatever enables them to find mines and boobytraps better than others has not yet been isolated. Some individuals are just better at finding mines and booby-traps than others. The real experts that have been interviewed and tested, learned their skills by living real live situations. Their skills were trained and sharpened to a fine edge through individual adaptation, much the same as a child's reflexes are automatically adapted to his environment. These specialists are not constant with each other when they explain why they are more skillful than their contemporaries.

Education of an individual takes many forms other than that normally found in the classroom. Reports by some of our most noted educators document that both humans and animals rapidly learn tasks on their own simply by being put in a situation where they

desire to do the task successfully and the means to do it are available. For a simplified illustration let us put a mouse at location X and food at location Y.

On the first trial the mouse takes an hour and one-half to find the food with obvious difficulty. Subsequent attempts shorten until the mouse learns this maze and gets the food within a few seconds. The mouse is next placed in a new maze. Does he completely start over?—No. The mouse has learned to learn. Experience is transferred and both his initial trial time and his total learning of the new maze are appreciably shortened. Now, if this trained mouse could talk could he really explain why he is faster now? Does he himself really know all the cues he acts upon when he moves through the maze? This principle of the mind automatically learning to adopt a new environment also works with humans, and although the cues providing stimulus are not always identified, learning still takes place.

This theory is currently widely used during military field training but success is dependent on rigid adherence to the following two factors—

- The student motivation must be very strong causing either a fervent desire to be successful or an equally strong fear of failure. The motivation should parallel as much as possible, that of the combat environment for which it is being prepared.
- The learning or training environment must be as close as possible to the real environment. This is difficult as conditions such as fear, fatigue, and time require very careful analysis and preparation and are essential if valid skill transfer is to take place. A seemingly minor compromise can sometimes destroy the environment sufficiently that effective learning transfer does not occur. The student learns to train but does not learn to accomplish the task. These principles can now be applied to the Countermine task "Find an Enemy Mine or Boobytrap."

Motivating men is a leardership problem that is always present in training both in units and at service schools. Most men attempt to do well, but need some inducement to sustain themselves if the environment becomes tough. Sapper training will be complex, physically demanding, and require a high efficiency with detailed accuracy under conditions of stress. The student must work hard to pass the instruction program and then be motivated sufficiently to maintain his skills and knowledge beyond graduation. One proposal is to authorize hazardous duty (Demolition) pay for sapper training, and continuously for sapper graduates who can maintain proficiency, regardless of their current assignment. Controlled testing with very high minimum standards would be required quarterly or semi-annually to include new information learned by individuals through self-study programs that each sapper needs to continue. These rigid standards, if maintained, will generate an espirit that will sustain the sapper corps—the hazardous duty pay will compensate for the real explosive hazards in this specialty plus provide the needed intense training motivation by providing a very real and tangible loss that will result from failure. I know of no other motivation that will provide the needed desire during and after the course that will provide the needed performance quality.

From the training viewpoint the best environment would be a real one; real mines employed by and against a real enemy using real weapons and ammunition. To save injuries, compromises have to be made, but each compromise must be seriously considered for necessity, and proper compensations. For example, when eliminating the mine itself a training aid must be substituted that looks, feels, and functions the same. The mine is replaced with a duplicate that does everything except injure men. This single substitution is serious. From the motivation point of view fear of failure, needless to say, is drastically reduced. Given the feverent desire to pass the course as outlined in the paragraph above, this compromise can be partly compensated by failing a student and dropping him from the program the fifth time he unsafely detonates a device regardless of the circumstances. This automatic negative motivator parallels closely the concern real mines cause. In theory the first accident should be grounds for failure but the loss of potentially good sappers would be too high. In combat men are hot, tired, and impatient. In training, hard physical requirements, long hours, tight schedules, and a strict cadre can reconstruct many of these hazardous distractors. A third environment pitfall is that individual consistancy in the work of the mine layer trains the countermine student in those specific consistencies. By having two or more teams of students, who do not meet, work against each other. Each will develop and employ improvisions based upon their analysis of other teams designed to deliberately deceive. This adds the challenges and diversity that are needed.

A side benefit is the discussion within an installing team analyzing if and how a system being employed could be countered. Thus it can be concluded that to

learn the task of finding a boobytrap it must be learned in the most dynamic realistic fashion possible. The course must be structured around a 24-hour day and be physically and mentally demanding.

In developing a Sapper course using the above ideas the problem of managing and controlling the students arises. To maintain realism the missions must be exceptionally clear with the instructors relegated to quietly grading leadership, evaluating Mine and Countermine techniques, and declaring casualties.

The missions will initially involve simple tasks but ultimately evolve to large area problems with many alternative solutions. The support requirements can be kept to a minimum as most preparation is done by two or more squad-sized student units continuously working against each other. Techniques will grow in sophistication as time passes.

A key reminder need be made at this point. Devices used for training must be installed and removed prior to real equipment failing; in this the installing squad will miss the major portion of the training potential. An example of one exercise toward the end of the course might be—

- SQUAD #1—Move from A to B (distance of six miles) between 6 am and 8:30 am tomorrow. Booby-traps are very likely to be about. This squad has the alternative of picking several routes, using trails or not.
- SQUAD #2—This squad must outwit Squad #1. Needless to say, the squad roles will soon be reversed. By designating squads or patrols as the basic school training units, graduates will live many examples of dynamic training and as a result will be able to take a wealth of training ideas to their future assignments.

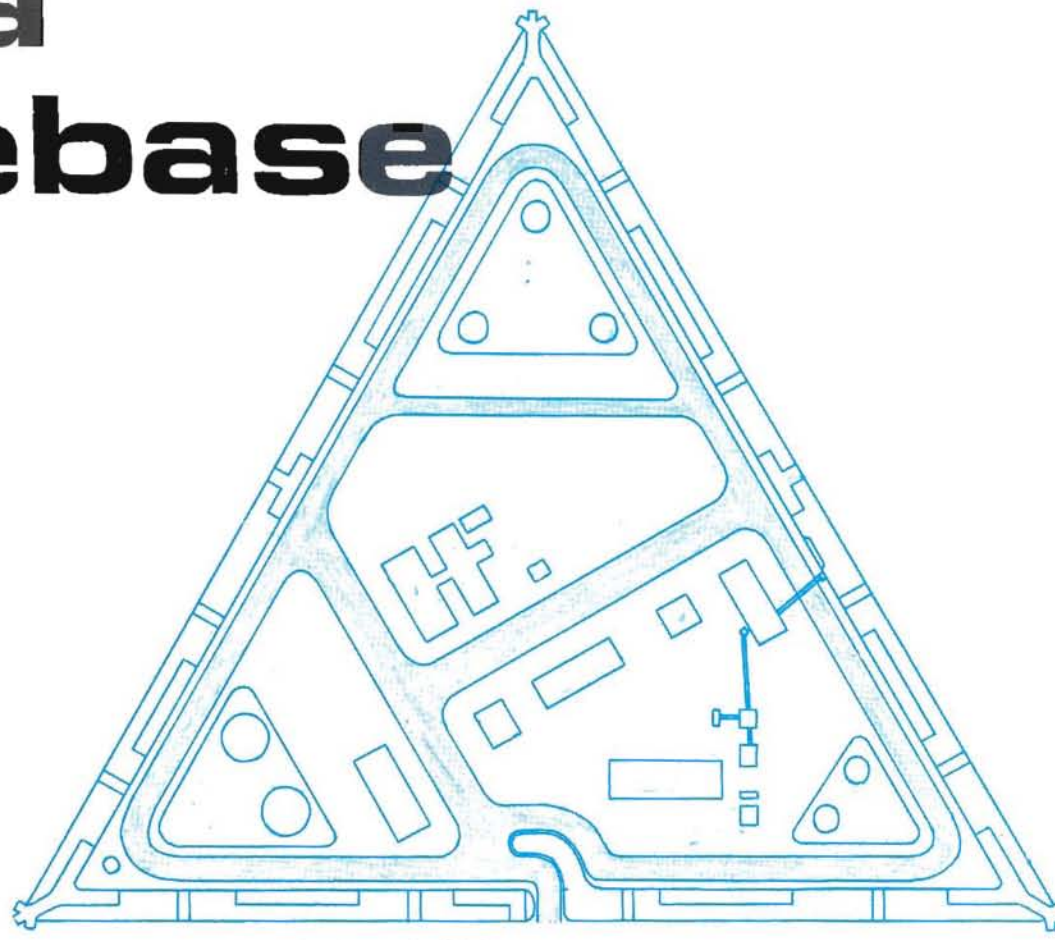
The Sapper program has the potential opportunity to develop a viable countermine plan. If all of the aforementioned constraints and conditions are met, the Army's new Sapper will have pride in his ability and sufficient confidence in his subject that he will become its advocate and inspire confidence wherever he goes.

Major William L. Jones, currently the Chief of the Demolition/Mine Warfare Division, Department of Applied Engineering, U.S. Army Engineer School, Fort Belvoir, Virginia, is a graduate of Norwich University and the University of Missouri at Rolla. He served as a Combat Engineer Company Commander in both the 12th Engineer Battalion, 8th Infantry Division in Germany and with the 27th Engineer Battalion in the Republic of Vietnam between 1964 and 1967. He also later served as the Battalion Executive Officer, 8th Engineer Battalion, 1st, Cavalry Division in Vietnam from 1970 to 1971.

SAPPER COURSE CONCEPT

The course will be of approximately 7 to 9 weeks in duration, rigorous both mentally and physically in its demands on the student. Input requirements and graduation/qualification standards will be very high since the graduate will be considered an expert in theory and practical application of combat demolition techniques, all phases of mine/countermine warfare, and to instruct troops of all arms in appropriate phases of demolitions and mine/countermine warfare. The first two weeks of the course will consist of demo/mine/countermine obstacle planning and design, methods of instruction and physical acclimation with emphasis on the student learning to teach his peers appropriate subject matter. The last weeks will be conducted in the dynamic training mode, and will concentrate on detailed use of all demo/mine/countermine hardware (including foreign materials) and intensive physical development. Throughout the course, the role of instructor will phase from that of the traditional instructor to that of monitor/supervisor; the last 1½-2 weeks of the course will be administered by students under instructor supervision. The use of live explosive/mines in practical exercises will also progress during the course. All students will employ and handle all available US explosives/mines and representative items from foreign nations. Maximum emphasis will continually be placed on stress situations, developing high skill/confidence levels, and producing a professional instructor expert. The major portion of this program of instruction will not be time structured to a 40 hour week but be continuous field training 12 hours per day, 6 days per week. Graduation will be a challenge requiring high motivation and aptitudes.

BUNKER HILL: anatomy of a firebase



Major Peter J. Offringa

The evolution of tactical concepts in Vietnam can be catalogued by the anatomy of the fire support bases associated with them. Overgrown circles, squares, triangles, and stars bear mute testimony to the changing tactics that forged them. Archeologists of the future, working Southeast Asian diggings may well ponder the implications of these oriental Stonehenges.

If there is any meaning in this almost infinite variation, it is the continuous search for the best means of combining flexibility in fire support with security.

The attributes of an ideal fire base would include protection against direct and indirect fire, in-depth defense against ground attack, durability when exposed to harsh weather, high standards of sanitation and troop comfort, ease of resupply, and facilities for recreation for the security troops.

In late February 1972, the 3d Brigade (Separate), 1st Cavalry Division (Airmobile), conducting the defense of the Long Binh, Saigon, Bien Hoa Complex, set about the task of constructing fixed fire bases to idealized specifications.

The Brigade had just been reduced in size from four manuever battalions to three and was tactically disposed in an arc roughly northeast of Saigon. To accomplish his mission, the Brigade Commander, Brigadier General James F. Hamlet, established a series of six mutually supporting and highly defensible fire support bases to provide an artillery fan over the rocket

belt and its approaches. Under this umbrella of steel, the highly mobile Cavalry companies conducted airmobile operations that kept the NVA rocketeers off-balance and in constant turmoil.

The keys to this operational technique were the fire support bases, which served as forward artillery positions, operations centers, and R&R sites for the infantry companies rotating in and out of the "bush."

Bunker Hill was one of these firebases. Located on a squat laterite hill, 17 miles northeast of Saigon, it was the home of the 1st Battalion, 12th Cavalry, commanded by Lieutenant Colonel W. S. Tyson,

The firebase construction team that cut the initial swath through the scrubby underbrush covering the hill was an amalgamation of the best engineering skills then available. Although the 3d Platoon, 501st Engineer Company had overall responsibility for the construction, earth moving equipment from the 557th Light Equipment Company and a verticle construction platoon from the 92nd Engineer Battalion were included in the task force.

The 557th had only 15 operational days remaining prior to standdown, so a crash program of earth moving was inaugurated. An average of four Caterpillar 830's hauled their 20 cubic yard loads from 7:30 a.m. to 5:30 p.m. hours for the next two weeks. For a three day period, four 'yellowbird' 10 ton dump trucks and a "Hough" six cubic yard loader from the 92nd Engineer Battalion also participated in the earth moving effort. The equipment began by stripping the scrub vegetation and forming the familiar triangular shape of another FIRST TEAM fire base. The 830's did the bulk of the heavy earth moving. The 'yellowbirds' were used in the corners and on the berm in places that were not suitable for the huge 830's.

The overall construction of the firebase was controlled by an initial survey and level run on the first day. The 830's dug the slots for living and fighting positions under the berm. D7 dozers were used to dig the slots for the tactical operations center, mess hall, ammunition storage area, S4 area, medical bunker, base defense/fire direction center and post exchange bunker.

The vertical construction Platoon built the framework for the Tactical Operations Center and the Mess Hall. They also supervised local nationals pouring the concrete floors for both structures.

The TOC was dug eight feet into the ground and covered by M8A1 matting and the equivalent of seven layers of sandbags. Its overall dimensions were twenty feet by eighty feet. The TOC consisted of twelve inch by sixteen inch footers and columns with four inch by twelve inch caps and twenty-four inch wide flange beam ceiling joints. M8A1 matting sides with four inch by twelve inch lateral bracing were used. The operations center was located in this building as well as the briefing room, offices, and living quarters of the Commanding Officer, Command Sergeant Major, the operations officer, and the ARVN liaison officer. An underground tunnel connected the TOC directly to the base defense/FDC bunker.

The Base Defense/FDC bunker, constructed of mempa's and conex containers, contained the artillery fire direction center, the mortar fire direction center, the base defense operations center, the base switchboard, the VHF facility and sufficient living space for personnel required to man the bunker. The combination of TOC and base defense/FDC enhanced the command and control of the firebase under all conditions.

The 105 mm Howitzers were placed on a 200 foot equilateral triangular pad raised six feet to provide direct fire over the berm.

The solid triangular pad had been laid by the 830's. A D7 with a sheepsfoot roller and a water truck provided compaction. This pad was more durable than the individual circular pads used previously. The 155 mm Howitzer pad was raised only one foot to facilitate drainage. The mortars were separated with two tubes in a corner by themselves and one in the corner with the 155's. This was done because of the possibility of a short round when firing directly over the firebase and because of falling canisters when illumination rounds were used.

All tubes were set in their own revetted positions with their basic load safely stored under the heavy cover of sandbagged bunkers. The individual mortar pits were sandbagged to a height necessary to provide cover for the crews against fragmentation. Slots were left in the parapet so as not to interfere with the use of aiming stakes or sighting devices.

The mess hall consisted of a 40-foot by 20-foot storage area and two 10-foot by 20-foot serving areas. By using a system of vents (M8A1 matting and 72 inch culverts) in the roof, the mess hall was well ventilated even though it was eight feet under ground. Troops were not exposed to hostile fire while they were getting their meals. Eating areas were dispersed throughout the firebase to avoid large concentrations of troops during regularly scheduled mealtimes.

The ASP was a 60-foot by 20-foot structure where 12 inch by 12 inch columns eight feet high were used. The roof was supported by 10 inch wide flange beams covering eight-foot open spans with eight inch by eight inch stringers on 30 inch centers.

The entire structure was covered by M8A1 matting. The two entrances were located on opposite ends of the building. The main entrance was a 10 foot wide

ramp with a minimum six foot height, running 30 feet to serve as a mule entrance. The secondary entrance was a combination of 72 inch culverts and eight inch by 12 inch side wall bents in the form of a ramp to serve as a walkway entrance. The floor was dirt and all storage was on wooden dunnage. The overhead cover was a minimum of three feet of soil on the M8A1 matting roof. The entire structure was water proofed with plastic, and the roof had cement coated with peneprime.

The 501st Engineers were responsible for construction of the structures under the berm. The basic design incorporated the majority of the living areas and fighting positions as part of the berm in order to take full advantage of the protection provided by the eight foot high triangular earth berm. A second advantage gained was a significant saving of space normally taken by troop living areas around the interior of the base. When areas must be provided for a minimum of three 105mm Howitzers, two 155mm Howitzers, and three 81mm mortars, and their accompanying fire control centers, interior space becomes extremely critical, especially, in the corners. Conex containers were used as living bunkers and had to be positioned in the trenches prior to the finalization of the berm.

Modular design was incorporated whenever possible to reduce supervision requirements and simplify the task of the individual squads. By letting one squad concentrate on one type of structure, time was saved and high quality work insured. Corner bunkers, corner positions and supplementary positions were each standardized and constructed alike. The modular concept and the diligent efforts of the 501st Engineers enabled the combat engineers to complete their berm work prior to the loss of the 557th's equipment.

The modular building practice was continued throughout the base. The TOC, Mess Hall, and ASP were all built with the same basic framework design. The remainder of the buildings utilized a four foot hallway with conexes facing each other. In all, there were 38 entrances with one set of stairs, and 14 entrances with two sets of stairs. Modular design was again used to simplicity and speed construction.

The living bunkers were ideal for the individual infantryman. The conexes, with doors removed, provided comfortable, dry places to live during heavy monsoon rains. This was a very important feature to a "grunt" who had been "beating the bush" in mud and rain. The bunkers also were ventilated by a 20-inch opening on the inside wall. Safety was excellent with five feet of dirt cover overhead and a minimum of five feet of dirt between the rear of each conex and the face of the berm. Comfort became an individual endeavor and troop ingenuity appeared almost immediately. Floors were painted, walls paneled and rugs added as personal touches to the conex quarters. The conexes were very adequate for two people to share. Malaria control was enforced by screening all quarters at the doors and windows. The fronts of individual conexes were screened as an added precaution.

Above the bunkers was the berm, reaching an overall height of eight feet. A row of concertina was on the apex. At the outside base of the berm was a row of triple standard concertina. Against the concertina a 10 foot wide stretch of tanglefoot was constructed. The 35 meter anti-sapper wire was a double apron fence with concertina crushed under the apron and backed by a second triple standard concertina barrier. The 100 meter anti-RPG fence was triple standard concertina. The wire obstacles were reinforced by claymore mines and fougasse (a combination of napalm and C-4 demolitions). Huesch flares were located at each corner and along the sides to mark the firebase perimeter for close air support. Numerous trip flares were incorporated within the outer wire.

The tactical wire was directly supported by seven fighting positions on each side. The design of the fighting positions maximized the principle of primary and supplemental bunkers and insured that the two personnel assigned to each position were not tasked with an area of responsibility greater than they could effectively cover. The main strength of a triangle lies in the corners, and by advancing the corner position out from each apex, mutually observed and supported fields of fire were gained between the corner bunkers. Conversely, the singular vunerability of a triangle is that the extended corner may also be attacked and possibly neutralized from three different sides—only one of which may be the side facing the principle direction of ground attack. To reduce this vunerability, the corners were constructed as a three unity module.

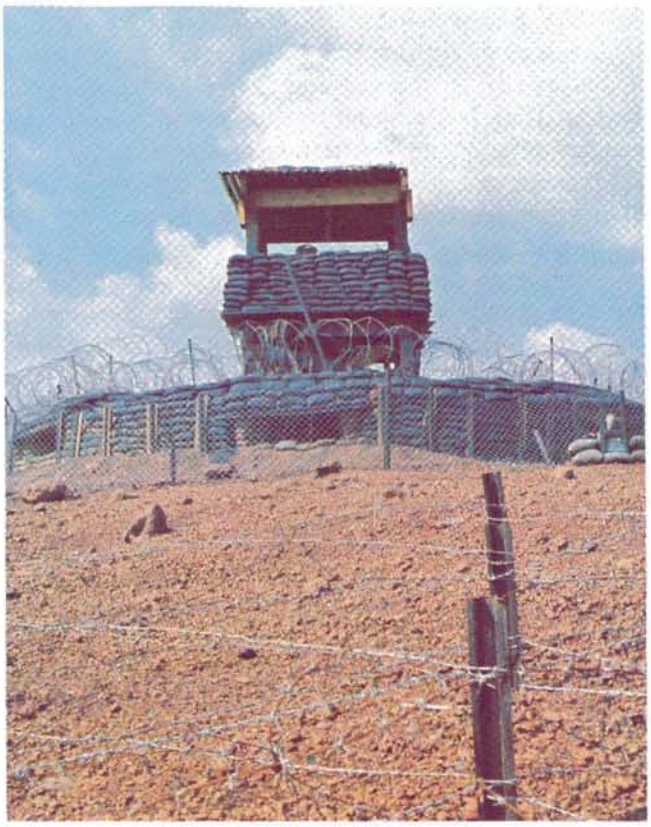
The center conex was oriented with the apex, and the units to its left and right were positioned to provide coverage both to the individual position's front and exposed flank. The conexes were set into the ground four feet, the space between them was backfilled, and the entire position was faced with four layers of sandbags and capped with a minimum of three feet of laterite and peneprime overhead cover. The supplemental positions were located immediately to the flanks of the primary and were constructed flush with the face of the berm so as not interfere with observation or fields of fire from the corner positions.

Above each corner, and connected by means of a ladder down into the position, was a 15-foot observation tower. The towers were eight feet on a side, faced and roofed with M8A1 matting and sandbags. They provided an uninterrupted view of all approaches to

Fire Support Base Bunker Hill is typical of the triangular firebases constructed by the 3d Brigade (Separate), 1st Cavalry Division (Airmobile).

The underground tactical operations center served as nerve center for combat operations of the 1st Battalion, 12th Cavalry during the period February thru June 1972.

In the safety of the underground FDC, artillerymen plotted fire missions. The FDC was connected to the TOC by an underground tunnel.



Wire, lights, and tanglefoot formed a portion of the perimeter defenses at FSB Bunker Hill. These were augmented with trip flares, claymore mines and fougasse.

BUNKER HILL: FORTRESS

The elevated 105 artillery pad provided good stabilization and a capability for direct fire across the eight foot high firebase berm.

This medical bunker is typical of the interior bunkers at the fire support base. Waterproofing was provided by roofing felt, soil cement, peneprime and treated sandbags.

The water from this purification system was pumped to a sixteen foot tower to provide central distribution for showers, drinking, mess hall and other uses.

The food preparation, storage, and serving areas were also underground. The gabled roofs cover the culvert and PSP ventilation system.

The outdoor stage served as movie theater, USO stage and briefing area. Dressing rooms are at left.

IN THE SUN

the base. The roofs provided an employment site for organic radar equipment. Because living space was contiguous to the fighting bunkers, troops could move from their quarters to assigned fighting positions without having to move across the exposed interior of the base.

The combination of bunkers and towers allowed the nightly guard commitment to consist of 12 to 15 men on watch during a given four, depending on cloud cover, moonlight, etc., and one man on a walking post inside the base. Under conditions of RED ALERT, 48 men were required to man the fighting positions.

For the relaxation of the troops, three temporary volleyball courts were erected. A permanent basketball/volleyball court was planned. The goals could be folded down and the posts removed so that the concrete slab could be used as an emergency medivac pad. Horseshoe pits appeared and football was played in the several open areas.

Bunker Hill served as a comfortable and efficient operating base for the 1st Battalion, 12th Cavalry until their standdown on 17 June 1972. There were many engineering lessons learned during the construction of this base. Some technical considerations and special engineering considerations inherent in underground construction in Military Region III are worthy of note—

- Salvage conexes are ideal for underground construction. They are strong, watertight and convenient. Additional strength is obtained by turning a conex up-side-down since the bottom is better constructed than the top. An ideal salvage conex is one that is in perfect watertight condition, but with a damaged door. If one attempts to use conexes with major faults such as bad skids or rust-outs an additional well planned program of bracing and waterproofing must be added to the basic work schedule. The over-all work control quality of base construction is greatly enhanced by careful inspection and selection of salvaged conexes.

- Backfilling is a most delicate operation when using conexes. A medium-sized boulder can send a conex skating for six or seven feet if it is allowed to drop against the side of the conex with uncontrolled velocity.

- The PSP roof should have an overhang of at least one foot. However, sandbagging should come flush to the outer edge of the PSP. If the sandbags are placed back from the edge of the overhang, water has a tendency to pool on the PSP and then work its way back into the bunker. This can be prevented in part by sloping the roof to the outside, but there is always some uneven settlement which will allow the water to run the wrong way.

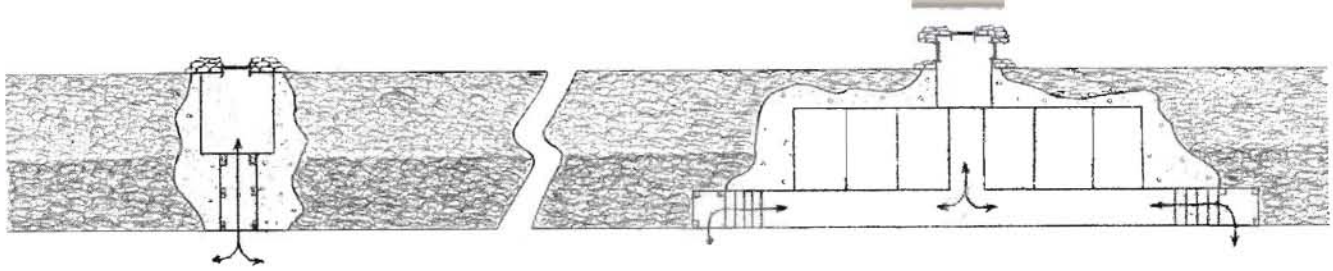
- Unless there is time to run a soil analysis and arrive at an acceptable spread footer design, one should always use a continuous footer. This will retard differential settlement to a great degree.

- If lumber is scarce, a planned utilization of bracing should be undertaken prior to backfilling of all major construction. If priority lists completion of the TOC first, lumber from the mess hall BOM should be used to add extra bracing to the TOC prior to its backfill. Backfill pressures at eight feet can run as high as 2000 psi. The most feasible solution was to use a Case 450 mini dozer and let the backfill material slide slowly down into position. Tamping was unnecessary due to the jetting effect of the rains.

- Around the living bunkers it was found that the best waterproofing was twelve foot wide rolls of plastic. One hundred foot lengths significantly reduced the number of seams. All seams were sealed using peneprime to glue the plastic together. Gluing vertical seams was an extremely dirty task. So reducing the number of seams benefitted the work force as well as improved the watertightness.

- The PSP roof was first covered by tar paper, then sealed with a coating of peneprime. The most constant problem encountered was voids along the edges of the conexes where the PSP and conex roof failed to match up properly. In these rough areas sandbags or dirt were used to level out the irregular surfaces. If the extra work wasn't done, then holes from either backfill or people walking were made into the otherwise watertight seal. The backfill of loose soil was then molded into a gable effect in order to enhance water runoff. The numerous people walking on or shoveling the loose soil yielded acceptable compaction. The soil was then stabilized using portland cement handraked into the soil. The cement was watered and allowed to set. A coating of peneprime was placed over the cement. A layer of peneprime-sealed, plastic was added. Peneprimed sandbags were used as a final cover. The sandbags must be the cloth type since the fiberglass type disintegrate rapidly when peneprime is placed on them.

- A road design which minimizes the number of culverts and good landscaping are the key to good firebase drainage. Culverts are a constant problem because large vehicles crush the ends of them and foreign matter continually clogs them. Culverts that were found necessary were designed to maintain a minimum flow of two feet per second or more where possible. The self cleaning properties of this velocity made the drainage system work efficiently. Where slope factors were unfavorable, open culverts were utilized to facilitate cleaning. A very essential part of keeping the culverts working is to protect their ends by some sort of culvert marker. This was accomplished by combining 155 canisters and 2x4s. A simple design such as this not only keeps the culverts open, but adds to



the esthetic value of the firebase. The cannisters were mounted on U shaped pickets so if hit by a vehicle they were simply knocked down. They could also be removed for road spraying and then easily replaced. This eliminated a constant need for repainting.

- An acetylene set is the workhorse of a conex firebase. Doors must be removed, windows cut, passageways fabricated, firing ports cut, PSP trimmed, and many other handyman jobs done. There are defication barrels, trash barrels and shower barrels to be cut. Pipelines to the showers must be braised, and barrels to be used as hand wash facilities must have vent/filling holes cut.

- To facilitate air traffic control and aid the pathfinders in their duties, the log pad, combat assault pad and VP pad were centrally located on one side of the firebase. This allowed the pathfinders to utilize one of the corner observation towers thus eliminating the need for an additional tower. The 35 meter fence was moved out to 50 meters to allow plenty of flying space for the combat assault and VIP pads and keep the troops inside the wire during combat assault operations. The log pad was located outside the 35 meter fence but inside the 100 meter fence. Locating the pads on one side of the firebase enabled the mess hall to be located as far as possible from the pads. The aid station was positioned close to the entrance to the base and convenient to the helicopter pads.

- The water distribution system was centralized. Showers were located where water runoff would travel the shortest distance to the outside of the berm. This minimized standing water from showers. The water point pumped to one main 16 foot high tower. Gravity fed distribution led to the showers, drinking water tanks, mess hall, and mess hall wash rack area. The need for continuous truck hauling on the firebase was minimized. The only remaining water haul was to fill the 55 gallon washing barrels that were maintained in the vicinity of the living and latrine areas for sanitation purposes. The distribution method incorporated at Bunker Hill was similar to a standard high rise water treatment plant. Instead of a heavy duty high lift pump, a small 50 gallon per minute pump and a two and one-half ton utility vehicle with two 600 gallon pods were used. Water was carried from the river to the firebase where it was treated and filtered. The security element was required only two hours each day. Water runs times could also be altered to minimize the enemy's chances for ambush.

- If at all possible, the latrines and showers should be prefabricated so that they can be set up and used early in the construction phase. They should be built with durable skids so that frequent movement will not ruin them.

- A grease trap should be installed in conjunction with the wash rack just inside the berm. This will aid in the sanitation program, since there will be no garbage inside the berm. A sanitary land fill should also be put into operation at some distance from the firebase.

- In the event the nine mile road from Bien Hoa to Bunker Hill was cut by the enemy or weather, and air traffic was grounded, storage facilities to sustain the base for up to five days were provided. Each fighting position contained a pre-positioned basic load of M79, M60, and 5.62 ammunition in addition to that stored in the ASP. All artillery pieces had their basic load stored on site in well sandbagged bunkers. The mess hall had 800 square feet of pure storage area, and the S4 had 1,200 square feet of storage. The medics used one complete conex for storage. Water tanks with 7,200 gallons of storage capacity were also located on the base.

Construction of a fire support base like Bunker Hill requires a significant investment in time, effort, and materials, but the result of the 35 day effort was a highly defensible, self-sustained, and efficient battalion-sized operating base.

While Bunker Hill will probably prove to be the last of the major United States fire bases constructed in South Vietnam, the lessons learned in its construction still have lasting validity.

Major Peter J. Offringa is currently attending the Command and General Staff College at Fort Leavenworth. He served as the Engineer for the 3d Brigade (Separate), 1st Cavalry Division (Airmobile) in Vietnam during the period that Bunker Hill was being built. He is a 1961 graduate of the United States Military Academy and later served there as an instructor in the Chemistry Department from 1968-1971. The major holds an MS degree from the University of California at Davis and is a registered professional engineer in the State of Pennsylvania.

DYNAMIC

Equation for Imp

Major Don W. Barber

Quality Control-Product Improvement! This rather simplistic equation is universally applicable to the production of any item. While the product of the military training and combat developments system is unique, nonetheless, its production is governed by the parameters of the same product improvement equation. The achievement of improved readiness, which depends upon both better training and viable combat developments, is contingent upon a thorough understanding of the parameters of the equation.

In an effort to make true readiness a reality for the Army's engineer, the USAES has embarked on an in-depth program for the quality control of its products. This program centers on one of the most important and unfortunately most often forgotten elements of the communication process—feedback. Our products are equipment, materials, organizations, doctrinal and training literature, training aids, and trained personnel. When properly prepared and built into a common system—military engineering—these products are capable of performing their readiness mission in superlative fashion. The caveat "properly prepared," is the fly in the ointment. Up to now the gauge for measuring the value of our products has been somewhat peremptory and at best cursory. In the past the USAES has relied upon mailed questionnaires to graduates of school courses and an occasional comment on a field manual by a few interested persons to evaluate our products. Responses to mailed questionnaires have been poor with less than a 30% return rate. Thus the data used for combat and training development was sketchy at best. Such a cavalier approach can no longer be tolerated. After an in-depth study, a system for data collection—The Field Feedback System—was established. It consists of the following elements: field visitation; debriefing of USAES staff and faculty; debriefing of student personnel; MOS test proficiency data; mailed questionnaires, to USAES graduates; and research feedback. Each of these elements is discussed below—

- Field Visitation Program. This program provides for annual visits to units which use the USAES mission products. These visits will be accomplished by a relatively small team (4-5 personnel) of representative specialists who will sample Army-wide users of the school's products with questionnaires and interviews. Their intention is to gather data on which to evaluate the worth of these products.

- Debriefing of Assigned Personnel. This data collection mode formalizes a previous informal practice by using the basic collection devices associated with the Field Visitation Program. It will assure the background and experience that an individual brings to the school on his assignment will be considered in the assessment of the USAES mission products. The mechanism for data collection is under development. Implementation is scheduled for 3rd Quarter FY 74.

- Debriefing of Student Personnel. This mode will insure that the experience and background of selected students are tapped in the collection of appropriate field feedback data. A pilot program was conducted with the current EOAC class.

- MOS Proficiency Test Data. The reports generated by the U. S. Army Enlisted Evaluation Center provide a valuable source of feedback and will be emphasized in the future implementation of the total Field Feedback Survey System. The data collection device is under development.

- Mailed Graduate Questionaire. Traditionally this data mode had been the sole collection device. Under the new Field Feedback concept, the mailed questionnaire will be a stand-by mode for use only as a supplement for specified reasons.

- Research Feedback. This mode uses the feedback data of other service schools having significant blocks of Engineer-related instruction in their curricula. Once implemented, the analysis of such feedback will complement the data received through other modes.

The major collection vehicle in the Feedback System will be the Field Visitation Program. For it is through direct, face-to-face communication that the most reliable data to be used both in the systems engineering of USAES curricula and training developments, and in combat developments will be accrued.

Systems engineering is a term that has recently

TRAINING

roved Readiness

Major Matthew J. Jones, Jr.

entered the lexicon of the service school staffs and faculties. In essence, it is an elaboration of the classic problem solving scheme—identify the problem, determine alternative solutions, and reduce or eliminate the problem through the application of the optimum feasible alternative solution. Systems engineering is being applied to all USAES courses and training developments. It consists of elements shown in Figure 1.

In training or in combat developments, quality control is fundamental to product improvement. Quality control cannot be effected without feedback. Therefore, feedback is essential to product improvement It must be a continuous process in order to keep pace with the dynamic training and combat development environment that surrounds the Army engineer in the field.

What Has Been Done? In order to obtain more reliable data from a more representative sample of product users, the USAES proposed the Field Feedback System. With concept approval from CONARC and OCE, the USAES fielded a pilot Field Visitation Program to survey 19 engineer units in Europe during March 1973.

The Field Visitation Team (composed of 5 personnel) visited two combat engineer brigade headquarters, an engineer group headquarters, seven engineer battalions, and five separate engineer companies. The team survey included questions pertaining to: MOS tasks for 24 of the 164 engineer skills; equipment usage; training literature usage; non-resident (correspondence) subcourse usage; a unit training survey about training problems (a follow-on to the Engineer Dynamic Training Survey of January 1972) and missions assigned to units; proposed assault engineer functions; and revision to the Career Management Fields (CMF) for engineer soldiers. Overall, the return rate for questionnaires was approximately 68%. The other 32% did not respond for various, reasons, viz, personnel not available at home station, the survey was too difficult or too long, shortages of surveyed MOS's, and five of the 1200 personnel surveyed just didn't give a damn.

While the data from USAREUR cannot be considered as totally representative of the training and combat development universe, several clues evolved on how to improve the visitation program, i.e., what questions to ask, how to ask them, and how to manage the volume of data gathered. This visit proved conclusively that the field has many lessons learned that need to be passed on and that these lessons are more likely to be transmitted to a person through direct communication than via a piece of paper to a faceless, nameless office an infinity away. An initial analysis has been made of the unit training portion and certain of the individual training portions of the USAREUR Field Visit. The results are summarized below:

- Unit Training. There were 245 Unit Training questionnaires sent to USAREUR. Approximately 60% (144) were returned, 51% (74) enlisted and 49% (70) officer. By unit, respondents were about equally divided between engineer combat and construction units. Highlights of the findings were:

—Drug/alcohol abuse and shortage of key MOS's were the major personnel obstacles impacting on training.

—It is also significant that enlisted personnel reported unit morale and discipline as verging on being a major problem.

—Significantly, neither the shortage of TOE, nor inoperative TOE, equipment was reported as creating a serious problem affecting training although combat units indicated a more severe problem (26%—major problem) than did construction units (13%—major problem).

—Demolition areas and quarry/borrow sites were reported in short supply with combat units having major problems in demolition training area availability (46%—major problem).

—Practice/inert mine availability was seriously degrading realistic mine-countermine training of combat engineer units.

—General construction materials such as plumbing and electrical supplies, and lumber were in short supply.

—Twenty-five percent indicated that local safety/environmental restrictions were major problems af-

fecting training. This response was primarily keyed to the range restriction for demolitions (maximum of 40 pounds per shot) and not being allowed to cut native timber.

—Many personnel indicated little or no knowledge of their unit Army Training Program and hence had no real concept of what to train or how to train —Only 23% had read ATP 5-35T, but of those who had 69% indicated that it was an improvement over the existing ATP.

—There was a wide divergence of opinion between officer and enlisted personnel regarding the value of the ATT'S/ORTT'S received in the past year. The officers believed that the ATT's were not a good test of mission, staff actions, logistics, and materiel readiness while the enlisted personnel, in the main, felt that the ATT's were excellent.

—There was little usage of non-MOS Army Subject Schedules.

—Over 33% of those responding had never participated in a test or exercise at the company, platoon, or squad level. Approximately 40% had never participated in a combined arms FTX and over 70% had never participated in engineer airmobile training.

—The training support from the next higher headquarters—scheduling of training facilities, guidance, etc—was rated as poor to fair.

—Approximately 36% indicated that mandatory subjects are a major impediment to unit training.

—On the average about 27 days/year were spent in field training near home station, 50 days in field training away from home station, and 15 nights in field training. Of particular significance, however, was the low average percentage of personnel available for such field training (over 43% indicated that only 60-75% of the troops were present for field training). Additionally, the average number of days spent in the field was indicated by construction unit project TDY and does not accurately reflect the actual time spent in the field by combat engineer units.

—Only 37% had heard of the Engineer Dynamic Training Council. A higher percentage 44%, had read the Dynamic Training Articles in **the engineer.** Magazine.

• Individual Training. The individual training surveys analyzed to-date pertain to combat and construction officer questionnaires. The objectives of these surveys were to: validate job task inventories for the 1328, 1330, 1331, and 1342 officer MOS's; determine on-the-job proficiency of USAES officer graduates in the above MOS's; assess the effectiveness of USAES teaching methods/media as a step in quality control of course design; obtain reactions to published training literature for the purpose of improving its utility to the user; and assess the effectiveness of USAES correspondence courses. Sixty-three combat engineer and 24 construction engineer officers responded to the questionnaire comprising a 66% and 61.5% return rate, respectively.

Figures 2 and 3 depict the tasks rated most difficult. Note in Figure 2 that only one task, No. 26, involved a knowledge of combat engineer expertise. Both Figures 2 and 3 show a great deal of agreement in tasks found difficult and their relative order of priority.

Most tasks found difficult were those that fall in the general area of *Leadership*. The preponderance of the remainder of the tasks in both Figures 2 and 3 pertain to deficiencies in *Training Management*.

Figures 4 and 5 show the most frequently done tasks and average frequency by functional area for combat engineer officers. These data show that combat engineer officers in USAREUR are spending relatively little time on combat engineer related tasks. This finding correlates with the data in Figure 2 and partially explains the dearth of combat engineer tasks found to be most difficult, since the level of difficulty will vary with the scope of tasks performed.

Figures 6 and 7 show the most frequently done tasks and average frequency by functional area for construction engineer officers. An analysis of these data show most construction tasks are vertical in nature and the preponderance were in the building renovation and self help categories. It appears that construction engineers in USAREUR do not extensively work on large scale, MCA type, construction projects. Other findings included:

—A suggested increase in EOBC instruction for company administration.

—A general acceptance of the adequacy of existing training aids and publications.

—Satisfaction with the technical content of USAES correspondence courses.

Reserve Components Feedback

The Field Visitation Program is a phased program. Phase I consisted of the pilot USAREUR study. Phase II will consist of visits to both Active Army and Reserve Component engineer units. In view of the increased emphasis being accorded the Reserve Componnts, the liaison subprogram of the USAES Expanded Reserve Component Support Program was seized on as an interim measure for soliciting feedback from the Reserve Components until phase II is initiated. The visiting team has been composed of officer representatives of the two Deputy Commandants of the USAES to insure full coverage of the two major aspects of

the USAES mission, viz., training and education, and combat and training developments. Units visited to-date include the 412th ENCOM (USAR), 416th ENCOM (USAR), 411th Engineer Brigade (USAR), 16th Engineer Brigade (OHARNG), and 168th Engineer Brigade (MSARNG). The feedback through this team has presented a generally consistent picture of the status of training within Reserve Component Engineer Units. This picture reveals the following:

—The morale and *esprit de corps* is high within those units visited.

—A positive desire to improve training was abundantly evident in all units visited.

—The constraints which act upon the Reserve Components are in many cases different from those which drive the Active Army with time being the principal constraint.

—By and large the Active Army is uninformed, or worse mis-informed, as to the Reserve Components.

—Training of construction units is progressing extremely well through a variety of site/installation and domestic action construction projects.

—Conversely, the over-commitment of combat engineer units to site/installation and domestic action projects is severely degrading combat engineer dynamic mission training.

—The lack of weekend IDT (Inactive Duty Training) sites to conduct realistic mission training is also severely degrading training, particularly for combat engineer units.

—The R.C. units need more assets in the way of training funds and/or training materiel, both consumable and non-consumable, to make training more dynamic.

—Training assistance can be met in many cases from resources close at hand such as increased use of USAR Schools, sharing of expertise and/or equipment among units in close proximity to one another both USAR and ARNGUS, and increased use of training institutions both public and private.

—Equipment availability varies among the units with steady improvement in program.

—There was an intense interest in the new ATP/ATT/N-MOS ASUBJSCD development using the systems engineering approach,—objective/task completion rather than the cyclic BUT/AUT approach.

—The R.C. units were most receptive to the Field Feedback Visitation Program and, indeed, anxious to participate and be given the opportunity to have a voice in the formulation of programs governing their training.

—Although there have been numerous obvious successes in improved/dynamic training, commanders recognize that much more needs to be done. A principal concern of the commanders and their staffs was the devising of some motivation/incentive which would stimulate interest in training. Personnel need to be stimulated to the point where they are eager to participate in and, indeed, look forward to realistic, hands-on, mission training during weekend MUTA (Multiple Unit Training Assemblies).

—Those units that have received additional paid drill time for training preparation have experienced a greater level of improved training than those units without such authorization.

—The **engineer magazine** is widely recognized as a useful media to share the wealth of training innovations being developed.

—A need is seen for larger unit exercises and development of CPX's to train and test major engineer headquarters.

In conjunction with the evaluation of selected Reserve Component unit annual training, a testing of questionnaires to be used for the Field Visitation Program during Phase II is being conducted.

What is Being Done Now? The USAES is currently analyzing the remainder of the myriad of data collected in Europe for MOS's. The major results from feedback received to date are being used for development of USAES and USATC-Engineer/Fort Leonard Wood curricula, MOS ASUBJSCD's, ATP's/ATT's/N-MOS ASUBJSCD's, and training literature such as the one stop MOS study guides.

What is Planned?

—Expansion of the Engineer School team visits, down to and including separate engineer groups.

—Implementation of Phase II of Field Visitation Program with visits by the selected specialist team to Reserve Component and Active Army units in the field.

Field Feedback is the principal element of the engineer training community quality control effort. It will be the major driving force in the continuing re-evaluation and updating of USAES products.

All commanders and staffs are urged to keep the USAES in their communication cycle as we try to keep you in ours. For it is only through dialogue (read that dual feedback) that Quality Control = Product Improvement. e

---

Major Matthew J. Jones Jr. is the Chief, Reserve Component Support Division, Department of Army Wide Training Support, U S Army Engineer School. Since his commissioning in 1962, he has served with the 326th Airborne Engineer Battalion, 8th and 2d Engineer Battalions, U S Army Support Command-Vietnam, MACV, and Test Command, Defense Nu-

clear Agency. He has a Masters Degree in civil engineering from Stanford University and is a graduate of the Engineer Officer Advanced Course and the Command and General Staff College.

Major Don W. Barber is the former Chief of the Unit Training Branch for the Deputy Commandant of Combat and Training Development at the Engineer School, Fort Belvoir, Virginia, and is a member of the Dynamic Training Council. Since entering the Army in 1962 and receiving an RA commission, he has served in a number of engineer assignments including Special Assistant to the Commandant of the USAES, Lieutenants Assignment Officer for the Engineer Branch, the U. S. Naval Support Force for 16 months in Antarctica on the ice, Construction Staff Officer in Vietnam, and with the 27th Engineer Battalion. He has attended the Engineer Officer Basic Course, and the Airborne and Ranger courses. The major also attended Graduate School at the University of Tennessee in 1966 and the Command and General Staff College in 1970-1971. A professional engineer, he is currently the S-3 of the 12th Engineer Battalion in Germany.

Figure 2

Most Difficult Tasks - Combat Officers
Sample Size = 48

	Task	# Diff	% Diff
1.	Develop responsibility in subordinates	27	56%
2.	Improve unit morale, esprit de corps, etc.	26	54%
3.	Handle disruptive influences	25	52%
4.	Motivate subordinates effectively	24	50%
5.	Improve personal qualifications to be better leader	22	46%
6.	Develop good human relations within unit	21	44%
7.	Conduct lawful search/seizure	19	40%
8.	Identify drug/alcohol abusers for disciplinary action	17	35%
9.	Evaluate unit for morale, exprit, etc.	17	35%
10.	Communicate effectively	17	35%
11.	Choose proper style of leadership	16	33%
12.	Identify peer group pressure within unit	16	33%
13.	Initiate elimination procedures	16	33%
14.	Prepare enlisted efficiency report	15	31%
15.	Use AR 635-206 and AR 635-212	14	29%
16.	Analyze time and resources for training	13	27%
17.	Prepare unit training schedule	13	27%
18.	Counsel subordinates	13	27%
19.	Enforce supply economy	13	27%
20.	Advise subordinates on service benefits	12	25%
21.	Interpret pay voucher	11	23%
22.	Evaluate unit training requirements	11	23%
23.	Supervise unit athletics	11	23%
24.	Check morning report for accuracy	11	23%
25.	Select training methods	11	23%
26.	Prepare demo target recon report/target folder	10	21%
27.	Develop unit training objectives	10	21%
28.	Prepare unit training directives	10	21%
29.	Support drug and alcohol abuse programs	10	21%
30.	Coordinate operator testing/licensing	10	21%

Figure 1. Systems Engineering Process

		Individual Training	Unit Training
Problem Identification	Step 1	Job Analysis	Mission Analysis
	Step 2	Selecting Tasks for Training	Selecting Tasks for Training
	Step 3	Training Analysis	Task Analysis
Alternative Solutions Determination	Step 4	Developing Training Materials	ATP/ATT/N-MOS ASUBJSCD Development
	Step 5	Developing Evaluation Materials	
Optimum Solution Application	Step 6	Conduct of Training	Conduct of Training
	Step 7	Quality Control	Quality Control

Figure 3

Most Difficult Tasks - Construction Officers
Sample Size = 21

	Task	# Diff	% Diff
1.	Develop responsibility in subordinates	11	52%
2.	Develop good human relations within unit	9	43%
3.	Improve personal qualities to be better leader	9	43%
4.	Identify peer group pressures within unit	9	43%
5.	Prepare enlisted efficiency report	9	43%
6.	Conduct lawful search/seizure	8	38%
7.	Improve unit morale, esprit de corps, etc.	8	38%
8.	Estimate compaction equipment requirements	7	33%
9.	Motivate subordinates effectively	7	33%
10.	Handle disruptive influences	7	33%
11.	Initiate recommendations for awards/decorations	7	33%
12.	Advise subordinates on service benefits	6	29%
13.	Perform activities in accordance w/professional ethics	6	29%
14.	Evaluate unit training requirements	6	29%
15.	Establish effective work relations w/subordinates	6	29%
16.	Establish effective work relations w/superiors	6	29%
17.	Direct EM to proper channel for assistance	6	29%
18.	Identify alcohol and drug abusers for disciplinary action	5	24%
19.	Plan vertical construction	5	24%
20.	Evaluate suitability of materials available	5	24%
21.	Analyze area being drained	5	24%
22.	Select training methods (incl dynamic training)	5	24%
23.	Instruct a class.	5	24%
24.	Counsel subordinates	5	24%
25.	Evaluate unit for morale, esprit, etc.	5	24%
26.	Select routes for unit movements	5	24%
27.	Check unit orders	5	24%

Figure 4

Most Frequently Done Tasks - Combat Officers
Sample Size = 48

	Task	# Done	% Done
1.	Prepare enlisted efficiency report	43	89%
2.	Direct EM to proper channel for assistance	43	89%
3.	Recommend individuals for promotion/demotion	42	87%
4.	Land Navigate	39	81%
5.	Perform duties as class A agent	39	81%
6.	Maintain personal physical fitness	37	77%
7.	Approve leave or pass requests	36	75%
8.	Use/supervise use of M16A1/M203	35	73%
9.	Use protective mask	35	73%
10.	Use tactical radio equipment	35	73%
11.	Inspect weapons	34	71%
12.	Use and Supervise use of .45 cal pistol	32	67%
13.	Supervise unit athletics	30	62%
14.	Serve as member of unit promotion board	30	62%
15.	Check morning report for accuracy	29	60%
16.	Check duty roster	29	60%
17.	Enforce supply economy	29	60%
18.	Supervise unit physical training program	28	58%
19.	Supervise unit movements	28	58%
20.	Check military correspondence	28	58%
21.	Perform unit mess sanitation insp	27	56%
22.	Analyze transportation requirements	27	56%
23.	Supervise use of equip operational rec	27	56%
24.	Evaluate physical security	26	54%
25.	Select transportation routes	26	54%
26.	Perform duties of convoy/serial commander	26	54%
27.	Inspect vehicles for proper loading	26	54%
28.	Insure proper use phonetic alphabet	26	54%
29.	Initiate recommendations for awards/decorations	26	54%
30.	Supervise use of DA Form 2408-14	26	54%
31.	Perform preventive maintenance operations	26	54%
32.	Obtain mil geographic documents for opn	25	52%
33.	Supervise use of dump trucks	25	52%
34.	Analyze transportation routes	25	52%
35.	Perform vehicle safety inspection	25	52%
36.	Enforce authentification procedures	25	52%
37.	Initiate elimination proceedings.	25	52%
38.	Supervise use equip maint records	25	52%
39.	Control platoon/company org maint	25	52%

Figure 5

Average Frequency by Functional Area - Combat Officers

Section	Avg % Done
1. Bridging	27%
2. Vertical Construction	19%
3. Horizontal Construction	6%
4. Utilities	4%
5. Geology and Quarrying	1%
6. Equipment Utilization	15%
7. Combat Construction Management	31%
8. Pipeline Construction	0%
9. Engineer Reconnaissance	31%
10. Explosives and Demolition	25%
11. Mine/Countermine Warfare	15%
12. Field Fortifications	8%
13. Camouflage	12%
14. Concrete	12%
15. Atomic Demolition Munitions	4%
16. Assault River Crossings	19%
17. Engineer Combat Support	23%
18. Rigging	4%
19. Environmental Considerations	10%

Figure 6

Most Frequently Done Tasks - Construction Officers
Sample Size = 21

Task	# Done	% Done
1. Esimate construction equipment requirements	17	81%
2. Maintain personal physical fitness	17	81%
3. Recommend individuals for promotion/demotinn	17	81%
4. Direct EM to proper channel for assistance	17	81%
5. Prepare enlisted efficiency report	16	76%
6. Evaluate suitability of materials available	15	71%
7. Initiate recommendations for awards/decorations	15	71%
8. Analyze construction directive	15	71%
9. Conduct investigation of work site	15	71%
10. Develop activities list	15	71%
11. Estimate resource requirements for an activity	15	71%
12. Estimate material requirements for an activity	15	71%
13. Estimate equipment requirements for an activity	15	71%
14. Estimate manpower requirements for an activity	15	71%
15. Estimate duration of an activity	15	71%
16. Estimate project duration	15	71%
17. Prepare construction schedule	15	71%
18. Revise construction schedule	15	71%
19. Use construction schedule	15	71%
20. Evaluate const site (subdiv/drng/eartwk)	14	67%

21.	Interpret specification/construction drawings	14	67%
22.	Inspect building construction	14	67%
23.	Estimate dump truck requirements	14	67%
24.	Prepare logic network	14	67%
25.	Approve leave or pass requests	14	67%
26.	Plan vertical construction	13	62%
27.	Plan site preparation	13	62%
28.	Inspect masonry construction	13	62%
29.	Supervise use of TOE construction tools	13	62%
30.	Plan renovations and remodeling	13	62%
31.	Inspect renovations and remodeling	13	62%
32.	Perform duties as class A agent	13	62%
33.	Supervise vertical construction	12	57%
34.	Supervise placement of concrete forms	12	57%
35.	Supervise renovations and remodeling	12	57%
36.	Prepare quality control plan	12	57%
37.	Implement quality control plan	12	57%
38.	Plan unit movements	12	57%
39.	Analyze transportation requirements	12	57%
40.	Allocate transportation assets	12	57%
41.	Plan masonry construction	11	52%
42.	Supervise placing/finishing/curing concrete	11	52%
43.	Conduct small scale renovation and remodeling	11	52%
44.	Check renovation/remodeling of building	11	52%
45.	Estimate scoop loader requirements	11	52%
46.	Administer physical proficiency tests	11	52%
47.	Use/supervise use of .45 cal pistol	11	52%

Figure 7

Average Frequency by Functional Area - Construction Officers
Sample Size = 21

Section		Avg % Done
1.	Bridging	5%
2.	Vertical Construction	40%
3.	Horizontal Construction	10%
4.	Utilities	10%
5.	Geology and Quarrying	1%
6.	Equipment Utilization	19%
7.	Construction Management	71%
8.	Pipeline Construction	0%
9.	Engineer Reconnaissance	5%
10.	Explosives and Demolitions	4%
11.	Mine/Countermine Warfare	3%
12.	Field Fortifications	1%
13.	Camouflage	5%
14.	Concrete	7%
15.	Atomic Demolition Munitions	0%
16.	Assault River Crossings	0%
17.	Engineer Combat Support	5%
18.	Rigging	1%
19.	Environmental Considerations	5%
20.	Soils Engineering	5%

YOU'LL GET A BANG OUT'A THIS

Sergeant First Class Charles T. Lewis

In ancient times, the term "explosives" meant only one thing: black powder, a mixture of potassium nitrate, sulfur, and charcoal. It was Roger Bacon who, in 1249, first published the formula to save himself from an accusation of witchcraft.

Of course, black powder continues to survive to this day but the commercial production of this first generation explosive by civilian manufacturers has had a rapid decline in recent years. The U.S. Army is currently the greatest single consumer of black powder, and during 1967 and 1968 the Army procurement was more than 4,000,000 pounds per year, and about 1,500,000 pounds in 1969, and about 800,000 in 1970.

The "boom" also has faded from the business of manufacturing and using dynamite a long and faithful workhorse for both civilian and military engineers. The DuPont Corporation, the giant of the industry, has closed down all but two of its dynamite manufacturing plants and the number of facilities owned and operated by other companies that remain so engaged has, in just the past 12 years, gone from 36 to only 14. Estimates are that dynamite will drop to five percent of the explosives market by 1890.

With the apparent passage of an explosive that has done a "bang-up" job for so many years, one must wonder what factors constribute to its demise. Safety is a definite factor but sophistication in the state-of-the-art has resulted in blasting agents which can do a better job, more efficiently, and are 80 percent less expensive than dynamite. One example is ANFO (Ammonium Nitrate/Fuel Oil). ANFO, as of 1971, has "blown-up" to the 70 percent mark on the scale that measures the nation's explosive market. A cost of from four cents to six cents per pound makes ANFO very attractive for large scale production blasting and earthmoving.

A second example of a blasting agent that has rapidly gained in popularity as a replacement for dynamite is an explosive closely related to ANFO called slurry. To comprehend fully the evolution of slurry explosives, one must start with the discovery that adding fuel oil to pelletized ammonium nitrate, (fertilizer), called prills, resulted in the making of ANFO.

Unfortunately, ANFO is not without several drawbacks, including its low density and ability to attract and absorb moisture. Paradoxically, it was found that through the addition of water, with suitable stabilizing agents, and, if desired, gelling agents, most problems could be overcome. Hence, slurry. And, as a bonus, handling of the explosive is simplified. Water-based slurries or gels vary in consistency from a heavy paste of jelly to a solid rubbery mass, depending on the gelling agents used, the most common being a type of gum. Gelling agents serve to insure a homogeneous consistency and facilitate handling.

It can be only too obvious, even to the casual observer, that the recent introduction of ANFO and slurries has already revolutionized construction blasting with the advantages of economy, safety, varied application, compatability with rock transmittal velocities, and rapid, voidless loading of holes. Unlike his civil counterpart, the military engineer is fortunate in that the conventional demolition-type explosives maintained in the Army's arsenal includes M-1 military dynamite, which because of the exclusion of nitro-glycerin in its make-up and its ready availability in the face of dwindling commercial dynamite sources, offers the user some of the advantages sought after, and obtained, from ANFO/Slurries. In a word, military dynamite, etc., provides a natural stepping-stone to that day in the future when ANFO/Slurries are in common usage by U.S. Army Engineers.

Just a little foresight allows one to visualize a mobile, pump-equipped, transit-mixer arriving at the construction Engineer Battalion's quarry, safely blending the slurry chemicals at the blast site to a variable, controlled density, and pumping it into a borehole all in a single, smooth operation.—Fire-In-The-Hole!

Sergeant First Class Charles T. Lewis entered the Army in 1961 and has served with the 17th Engineer Battalion, 2d A.D.; 11th Engineer Battalion, Korea; 78th Engineer Battalion, Germany; and the 65th Engineer Battalion, 25th Infantry Division in Vietnam. His military education includes graduation from the Combat Engineer Noncommissioned Officer Course in Germany, the Engineer NCO Course and the Engineer NCO Advanced Course at Fort Belvoir, Virginia. The sergeant is currently assigned as the senior enlisted Instructor of the Demolition and Mine Warfare Division, U.S. Army Engineer School at Fort Belvoir.

MINE-COUNTER

Colonel W. R.

Why can't the Army do a better job of training for mine-countermine (M/CM) operations? Is is because:

- Commanders are not concerned?
  TRUE FALSE
- Of poor guidance from the Pentagon?
  TRUE FALSE
- Of inadequate advice from Engineers?
  TRUE FALSE
- M/CM doctrine is wrong?
  TRUE FALSE

In my opinion, all are true. Commanders are not concerned—at least not enough. Current guidance from the Pentagon is poor, in part because it was based on inadequate advice from Engineers. Our mine-countermine doctrine is wrong, when it comes to who is responsible for what.

These views obviously do not represent an official position of the Army nor The Engineer School at Fort Belvoir, Virginia. They do, however, reflect a consensus of the Working Group on Training Chaired by (me) Colonel Hylander at a Barrier/Counterbarrier Conference held at Fort Benning in May 1973. As such they are causing a new look at a number of actions, and they should be of interest to trainers in the field.

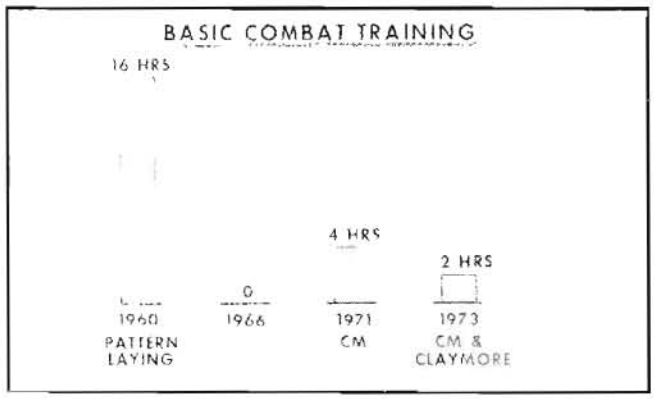
Mine and boobytrap personnel casualties, as percentages of total casualties, rose from three percent in World War II to 13 percent in Vietnam. Combat vehicle casualties, already high in World War II almost quadrupled in Vietnam. Commanders in Vietnam did get concerned, and in the late sixties that concern triggered studies by a board of general officers, by the Combat Developments Command, and by others. But it's now 1973, and let's look at that concern as it is reflected in mine-countermine training today.

In Basic Combat Training, trainees get only two hours (of a seven week, four day course); it is essentially an introduction to countermine warfare plus how to employ a Claymore mine. This is half what it was in 1971, but at least better than nothing in

(% OF TOTAL CASUALTIES)

	WWII	KOREA	VIETNAM
PERSONNEL	3	4	13
COMBAT VEHICLES	21	38	79

Mine and Boobytrap Casualties



Mine-Countermine Emphasis in Basic Combat Training

MINE TRAINING

Hylander, Jr.

1966. It is much less than the BCT trainee gets in First Aid, CBR, or guard duty, for example. In advanced Individual Training there are similar patterns: Infantry cut in half; Armor by 80 percent; Artillery to zero; and Engineer from 33 to 30 hours. This de-emphasis of mine-countermine training is also evident in NCO and officer courses. The reasons for these reductions are obvious: course lengths have been cut to save money and manpower; and mine-countermine training has suffered because it was not as important as other subjects.

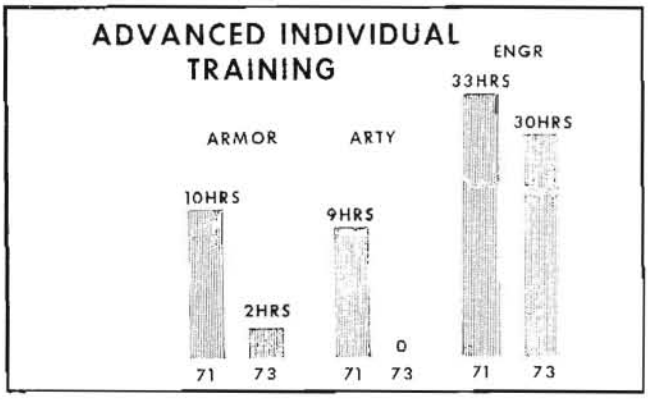
So the trainees are not getting taught much about mines and boobytraps, and—more importantly—the NCOs and officers who will have to teach them during unit training are not being adequately taught how to fill the gap. Are commanders concerned?

It should be noted that this does not necessarily condemn unit commanders for downgrading training conducted in their units. There is some good training at Fort Carson, where the 4th Engineer Battalion is giving mine-countermine and LAW training to all elements of the 4th Division. There is good mine-countermine training elsewhere, from our observations on liaison visits, but there is also poor training and none at all sometimes. If the shoe fits, you be the judge. I know it fits some commanders in the Engineers as well as the combat arms, in the Reserve Components and in the active Army.

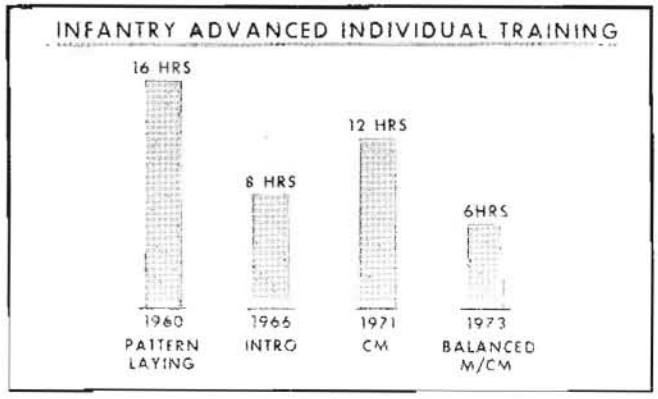
Let's look now at guidance from the Army Staff in the Pentagon, and at the Engineer advice upon which that guidance was based.

In 1971, the CDC Engineer Agency completed its Mine-Countermine Study (MICMIS), calling on the Army to:

- Increase emphasis on countermine and non-standard mine warfare, and including scatterable mines.
- Teach the total resource approach in all NCO, OCS, and officer school programs.
- Expedite boobytrap simulation devices.
- Establish mine-countermine experts in all combat



Mine-Countermine Emphasis in Advanced Individual Training



Mine-Countermine Emphasis in Infantry Advanced Individual Training

and combat support units, and teams on high staffs.

• Train these experts by quota and identify them by Special Qualifications Identifier (SQI) or prefix.

The Army Staff approved this study a year later, in 1972, but questioned the recommended density and location of mine-countermine experts, particularly those below battalion level. In 1973, still another year later, we are still trying to refine the requirements for these experts. Disagreements still exist, and we are a long way from seeing any of them appear in units.

The first three points above are motherhood. Nobody in his right mind would disagree. Nonetheless, we see no increase of emphasis, and I haven't been able to find out just what the "total resource approach" is. It isn't being taught, at any rate. The expediting of boobytrap simulation devices has hit some snags, too, that are covered in another article in this issue.

So let's examine the recommendations to establish mine-countermine experts in units, and to train them by quota and identify them by SQI or prefix.

The original MICMIS recommended density placed one enlisted specialist in each infantry and engineer squad, with others at platoon level. At company level there would be an M/CM NCO or officer, or both, and there would be an M/CM officer on the battalion staff (IN, AR, FA, EN, MP, MI). There would be teams of two to five M/CM experts on brigade and higher staffs. In an effort to refine this density downward to meet DA guidance, the Engineers proposed that there be one officer and one NCO on each battalion staff, the same teams at higher level, and two MOS-trained experts in each combat engineer squad. Combat engineer platoon leaders and NCOs would also receive special M/CM training as part of their regular training courses, with emphasis on their roles to advise, assist, and train others. Engineer experts would be identified by MOS; others by SQI or prefix; and all would be called "Sappers." This appeared to be a good compromise, but objections arose over two features:

• Units have too many special duty positions now. The infantry, in particular, objects to any new specialist tags. The Army is too short of manpower to add M/CM experts to TOEs, so the only recourse is to make it an additional duty for someone like an assistant S3, and to identify him and his position by a prefix. It is similar to the system for CBR specialists. All too often, the man becomes a part-time assistant S-3 and a part-time specialist, proficient in neither and not really his fault.

• A lot of people, myself included, believe that training by quota and identification by SQI are not really viable. To get an expert, a unit must obtain a quota, then send a man off and pay his TDY for several weeks, and then when he returns try to spread him over his normal job plus his added special duties. Even if a man already has the SQI or prefix added to his MOS, the Army's present computerized personnel replacement system just cannot identify him and get him to a unit where his skill is needed.

The Engineer School is designing a rigorous hands-on training course for enlisted mine-countermine experts, and other training for the combat engineer tracks of officer and NCO basic courses. We are also seeking to reach some solution to the problem of providing mine-countermine experts in the combat arms, and we hope by the time this issue of **the engineer** is published that problem will be solved.

In the meantime, however, this problem is with us because the Engineers gave poor advice to the Pentagon, and it resulted in equally poor guidance coming back from the Pentagon. One other part of that Engineer advice was a conclusion that mine-countermine doctrine is sound. The more we struggled with the training problem, the more I began to look into just how sound the doctrine was. I've become convinced it has some flaws.

FM 20-32 outlines mine-countermine responsibilities as follows:

• All troops are responsible for individual countermine actions.

• Combat arms and combat engineers are responsible for emplacing mines and for deliberate countermine actions. You should note that there is no difference between combat arms and engineer responsibilities here. You should also note that it doesn't specify whether they are individual or unit responsibilities or both—just "combat arms" and "engineers."

• Engineers also provide technical advice and assistance, and "participate" in the planning, coordination, and emplacement of large-scale barriers.

Elsewhere in the manual, the small unit commander is reminded that he is responsible for anything and everything to do with mine-countermine operations, but he's told very little about how to do it.

There are two flaws in this doctrine as it is currently stated. The first is that individual and unit responsibilities are not clearly spelled out—either for combat arms or engineers. As a result, mine-countermine responsibilities have not been picked up and carried over into MOS definitions nor TOE capability statements, except for combat engineers. In today's Army, with it's constraints on manpower and resources, individual and unit training is being very carefully analyzed

(systems engineered). Those subjects not clearly required by MOS duties or unit capability statements are being screened out of organized training and left up to the harassed unit commander to "insure proficiency." I believe this is the fundamental reason for the decreased emphasis described above; it has been systems—engineered out, in favor of other higher priority subjects.

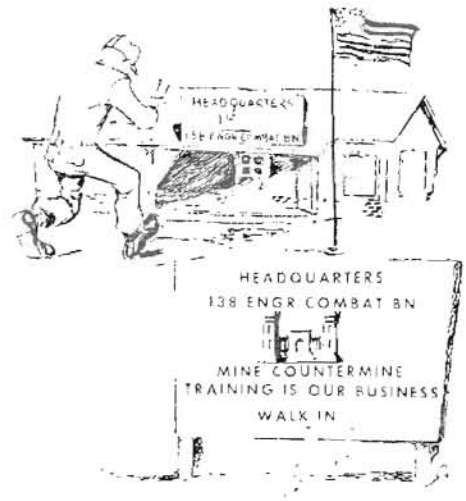
The other flaw concerns a gap between the responsibilities of combat arms and engineers. Both are really responsible for everything, but combat arms officers can look at the engineer's role for advice and assistance and decide very conveniently "I don't really have to train much for this; I can call on the engineers when I need them." Engineers, on the other hand, do almost no training for that advice and assistance role; they train themselves for employment in mine-countermine operations and decide, again very conveniently, "If I'm ever asked for advice, I'll give it; meanwhile we have a lot of other things to do." So this role rarely gets exercised in peacetime training. When the casualties start falling in wartime, each can point to the other and say, "It's your job, go out there and lay (or clear) those mines." It happened in Vietnam, and Korea, and in World War II. If you don't train for it before combat, you don't do it very well when the guns are going off.

In order to correct these doctrinal gaps, The Engineer School is proposing to rephrase the responsibilities of individuals and units, and of unit commanders. These are described in another article in this issue, and are intended to be in the 1974 edition of FM 20-32, Mine-Countermine Operations.

There is one additional combat engineer unit responsibility being considered for inclusion—to provide training in mine-countermine (a barrier/counterbarrier) operations. This is really the heart of the solution to the overall problem. If others habitually come to combat engineers for help in training, and if engineers are ready to provide it, then we will be practicing the way it ought to work in wartime. It's already happening at Fort Carson and a few other places, and it ought to be happening everywhere.

In addition to changes to the manual, The Engineer School has undertaken the following:

- TF 5-4256, Mine and Boobytrap Training. Released in 1972, this is a good color film aimed at the individual soldier.
- "Don't Get Blown Up", a confidence-builder cartoon pamphlet being developed jointly with the Combat Arms Training Board. It should be distributed this fall.
- A new mine-countermine manual, with an accompanying unit training kit, aimed at telling the small unit leader (of all arms) how to do it and how to train to do it. This is pictured as the future "Bible" for the combat engineer's advisory and training role.



- Actions to create a "Sapper" mine-countermine enlisted expert and to develop an MOS producing course.
- Changes to combat engineer officer and NCO MOSs, and training courses, to add more mine-countermine expertise.
- Adding the mine-countermine training role to the capability statements in combat engineer unit TOEs.

There are also actions to expedite the development of new training devices for boobytraps and scatterable mines, but these are outside the scope of this already lengthy article.

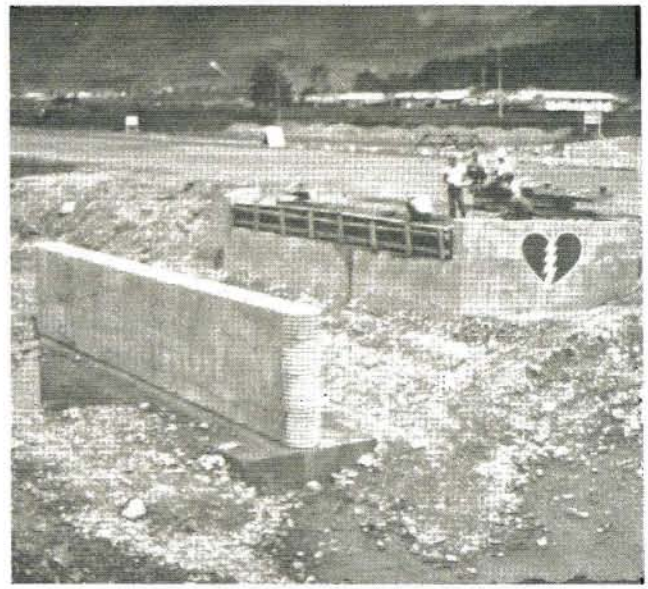
In summary, there is a lot that needs to be done to get the Army (and the Engineers) with the problem of mine-countermine training. Much of it is underway. If you have ideas about how we can do a better job, or do it more quickly, just let us know.

If you would like to know about the problems with camouflage training, go back through this article and insert "camouflage" wherever you see "mine-countermine."

Colonel Walter R. Hylander, Jr., Deputy Commandant for Combat and Training Development, at the Engineer School, has had tours with the 1st, 2nd, 3rd, 138th, and 288th Engineer Combat Battalions; the 487th Aviation Engineer Battalion (USAR), and at the Republic of Vietnam Armed Forces Engineer School. He holds a master's degree in Civil Engineering from M.I.T., and is a registered professional engineer in New York and a Fellow, American Society of Civil Engineers.

The Henry Larcom Abbot Award

Contract Construction For A Troop Unit



Captain Wardsworth A. Soders III

"To work on a multimillion dollar construction job." "To share the joy of participating in the construction of something BIG that will remain long after our lives have ended." Dreams of engineer soldiers of the seventies are written in those lines.

Only a small lot of us normally see the cement and aggregate of those dreams become concrete. Ordinarily, the joys of seeing such dreams become reality are reserved for those whose assignment darts pierce the Engineer District ring on OPO's big board. For the enlisted engineer soldier of the seventies; the dozer operator, or the carpenter who shares those dreams, the chance of awakening in his next assignment and finding them is slim, and more often than not, next to impossible. The average soldier reads about the big projects, or passes them on the highways and thinks to himself: "I surely would like to operate a pan on a big job like that", or "My squad could work rings around those guys", or maybe even, "What I wouldn't give to command an outfit on that kind of a job."

Recently, such a dream became a realistic challenge for one of the Army's construction battalions, and consequently, for many of the Corps' young officers and hundreds of its enlisted personnel. The project of projects came to life when directive for construction of the Chinhae Ammunition Storage Facilities Depot was received by the 44th Engineer Battalion (Construction), (THE BROKEN HEART BATTALION), 2d Engineer Group, Eighth United States Army, Korea.

The Depot comprises better than half of a multimillion dollar Military Construction project under supervision of the U. S. Army Far East Engineer District of the Pacific Ocean Division, and is the largest troop construction project in the world today. Included in the total project are a new port facility capable of handling oceangoing ships, and a facility to store and maintain large quantities of ammunition. Con-

struction of the port was contracted to a civilian firm, and the maintenance and storage facilities construction was divided between a civilian contractor and the 44th Engineers. In essence, the battalion is working as a constructing agency for the District.

The scope of work for the Depot includes construction of 26 earth covered, reinforced concrete Stradley ammunition storage bunkers, seven maintenance buildings of reinforced concrete and masonry construction, a railroad loading and off-loading facility, and construction of several miles of all weather access road to the above mentioned structures.

The average dimensions of each storage bunker are 25 feet wide by 80 feet long with a height of 18 feet. The configuration is that of a concrete shell arch 30 inches thick at the base and eight inches thick at the apex. Due to the continuous pour volume requirements of the bunkers and other buildings, their construction was let to the civilian contractor. This left the excavation of bunker sites, preparation of the maintenance building pads, construction of the access roads and parking areas, and construction of the railroad loading off-loading facility to the letter companies of the battalion. Companies "B" and "C" are accomplishing the major earthmoving task, while Company "A" provides maintenance, quarrying, and paving support. All roads and parking areas of the Depot will be paved.

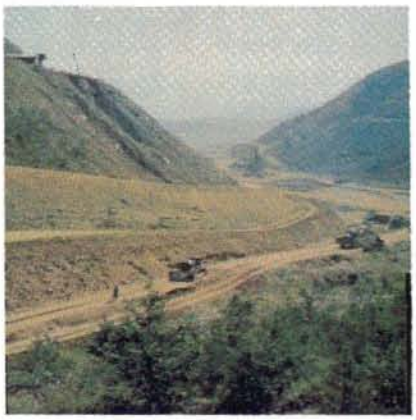
A typical bunker site is 50 feet above the toe of the slope of the mountains in which it is built, with a horizontal inset distance from the toe of slope of 150 feet. Such severe locations necessitated average vertical cuts of 30 to 40 feet through earth and rock with extremes of as much as 93 feet through solid rock in order to bring the sites to proper elevation for construction. Each bunker cavity requires a floor space of approximately 103 feet by 96 feet to allow proper orientation for construction of the critically spaced bunkers. Each bunker requires a horizontal distance of 180 feet at its closest points to adjacent structures. The tolerance in elevation between adjacent structures is 18 feet.

This critical layout in the rugged terrain of a South Korean mountain range was enough to keep at least two of the battalion's survey teams working continuously during that phase of the construction. Specifications required that the rock faces of the cavities be cut to given slopes, thereby producing a need for close coordination between the survey teams and the quarrying crews. Coupled with the tremendous volume of blasting work to cut the cavities was the requirement to crush the blasted rock for use in concrete and paving work. To keep up with these requirements, Company "A" operated four pneumatic track drills and a 75 ton per hour crusher seven days per week to keep on schedule during critical times. Frequent quality

control inspections were conducted by the battalion civil engineer section during this phase of the construction since failure to complete work meeting the required specifications on scheduled dates would result in delay of the contractors vertical work and substantial penalty cost.

The railroad loading off-loading facility consists of a one mile access spur and a platform capable of handling two bays of freight cars for loading or off-loading simultaneously. The entire railroad facility as well as five of the seven building pads and a large portion of the road network were built on rice paddy surface.

During the latter part of 1972, following a contract mixup, the battalion found itself having to construct an embankment approximately 80 feet high and 500 feet in length to provide road access to three of the 26 Stradley bunkers. Having this unforeseen require-



These five photos vividly show how engineers get their job done in any place where U. S. troops are stationed. Looking clockwise from top left: First photo—Five ton trucks haul fill that will be placed on a completed bunker by D-4 dozer. D-4 can be seen on the top of a bunker in the right center of the picture. Second photo—This road will be the same elevation as the bunker in the upper left hand corner when the massive fill job is completed. Third photo—Thousands of yards of fill will be needed to bring this road to final grade in front of the bunkers at the upper left and upper center of this picture. Fourth photo: A completed bunker awaits its turn for water proofing and back filling. Fifth photo: This bunker is ready for ammunition. Grass will be planted to prevent erosion of the backfill. Of course, all of these actions were completed —mission a success.

ment placed on them in addition to having to construct several protective berms in front of various structures, and being hampered by a long rainy season, the decision was made to augment the battalions earthmoving capability. This augmentation was accomplished by a platoon of earth movers from Company "B" of the 802d Engineer Battalion (Construction).

While the earth movers hammered out their work between rains, the concrete work on the bunkers was being finished. With the earth movers bogged down in work, the task of backfilling the completed bunkers was assigned to the vertical construction platoons of the battalion. This task was accomplished using five ton dump trucks, front end loaders, D-4 dozers, D-handle shovels and gasoline powered hand compactors.

From its beginning in late 1970, until its completion, the total volume of earth moved for this project will be in excess of 1.5 million cubic yards including the bunker site excavations and backfilling, the road network cuts and fills, the pads for the maintenance buildings, the railroad loading off-loading facility and the berms for protection of various structures in the complex.

To provide security for all of this, several small security buildings will be built by the battalion. Additionally, there will be fences built totaling approximaely three miles of triple standard concertina and one and one-half miles of chain link fence.

Naurally, no project of this magnitude could be undertaken without giving due consideration to adequate drainage. Moving as much earth as this project dictates constitutes a considerable change in the natural runoff of the area. Consequently some of the major vertical construction effort is being expended on drainage structures. These include a 45 foot span steel stringer, reinforced concrete deck bridge, a reinforced concrete double box culvert spanning a 30 foot stream, and a double barreled 72 inch reinforced concrete pipe culvert. Also being constructed as an intgral part of the drainage system is a 2,300 foot paved trapozoidal canal with varying bottom width.

When the Depot is completed, there will be an inherent danger of possible explosion from the ammunition stored there. For this reason, its location had to be an isolated one. Due to the isolation, the 44th Engineers were also tasked with construction and maintenance of a temporary cantonment to quarter themselves during construction. The battalion strength during the project has averaged 22 officers, 460 U. S. enlisted personnel, 340 Korean Augmentees to the United States Army, and approximately 200 Korean Nationals of the Korean Service Corps.

The camp built to house the soldiers contains some semi-permanent buldings that will be left for use by the units manning the Depot. The major shelters and other needed facilities of the camp however, are comprised of portable moduls called Porta-Kamps. These are 10 ft. by 30 ft. and 12 ft. by 30 ft. trailer house type structures mounted on skids which the battalion has found suitable for every practical purpose from sleeping quarters to supply and orderly rooms as well as day rooms and recreational clubs. The camp is completely self-supporting.

Soldiers of the battalion along with their Korean co-workers man a mini Facilities Engineer Shop for the camp. This has provided the opportunity for soldiers to install and maintain an electrical distribution system, a water purification and distribution system, and a limited sewer system. All of these systems were designed in the battalion civil engineer section. Even the electrical power distributed throughout the camp is produced by troops in the appropriate MOS.

The living conditions at the "Broken Heart Compound", as the camp is called by the members of the BROKEN HEART BATTALION, are not the best, and the soldiers often complain, but the morale is high when the work is good, and what better work is there for the engineer soldier than that contracted by a District Office of the U. S. Army Corps of Engineers?

Captain Wardsworth A. Soders III calls Marlin, Texas home. He is a graduate of Prairie View A & M College of Texas, with a BS Degree in Architectural Engineering. He was commissioned in The Corps of Engineers upon graduation in August, 1967 through the ROTC program. Military assignments have been: Platoon Leader, 497 Engr. Co. (PC), Vietnam, 68-69; Engineer Representative to the U. S. Army Military Police School, Ft. Gordon, Ga. 69-71; S-3 Officer, 44th Engineer Battalion (Const.); and Commanding Officer, Company C, 44th Engineer Battalion (Const.), 71-72. He is presently a student in the Engineer Officers Advance Course, class 1-73.

MINE-COUNTERMINE TRAINING DEVICES

Major A. J. Christensen

The best way to train a soldier in mine-countermine subjects is to train him using live mines and fuzes. Most Americans would disagree with this type approach and mothers would have apoplexy if they thought their sons were going to be trained in such a dangerous way. Since these situations exist, there have to be training devices available which can be used repetitively; which will assist in making the training effective, and which are of little or no danger to the trainee.

There are presently seven AP mines (non-chemical) in an inert or practice version listed in *Supply Catalog* 1340/98IL. Of the AP mines listed, there are existing stocks of the inert M18A1 and the practice M8 (components only).

The situation on AT mines is not much better. There are two practice versions listed in the supply catalog; however, only the M20 practice mine is available in any quantity. Since the practice and inert versions are not presently stocked in sufficient quantity for issue, there needs to be a rapid means available to make up a model mine that can be quickly and economically produced.

A plastic mine model approach has been taken by the Combat Arms Training Board (CATB) at Fort Benning, Georgia. Two AP and three AT plastic mines were produced for the CATB and tested at Fort Carson, Colorado by the 4th Engineer Battalion (C) and Infantry and Armored Units of the 4th Infantry Division (Mechanized). These plastic mines were very effective training devices. Other agencies have been working on a different approach.

A recommendation was submitted by the US Army Engineer School (USAES) to HQ CONARC for changing CTA 23-103. This change, if adopted, will authorize issue of practice or inert mines in sufficient types and quantities to allow Combat Engineer Battalions to install a 300 meter-front minefield with a 1-2-2 density using M20, M35 and M17 practice mines and for classroom hands-on instruction for a platoon-size class on the M2, M3, M16A1, M18A1, M26, M19, M21, M25, and M14 inert mines.

Foreign mines, both friendly nad enemy types, must also be duplicated in necessary quantities to enable them to be used for classroom instruction. These mines are essential for rounding out the mine-countermine training of the US Army. There also needs to be a method developed for adding realism to mine-countermine training.

An urgent requirement exists for more effective and realistic training in the detection, recognition and avoidance of mine antidisturbance devices. The need is for a modular device which provides stress and realism in mine-countermine training by simulating the characteristics and effects of existing service mines.

One solution is a universal scoring module (USM) which is now under development. Triggering of this device by personnel or equipment causes a noise and a spray of a nontoxic, easily removable, dye or powder which marks the triggering cause, if it is within the spraying pattern.

The proposed USM is compatible with M16, M16A1, M18A1, M14, M19, and M12 mines but it does add to the depth of cover required, and burying it in soil affects its performance.

Solutions to the current shortage of training devices must be arrived at as expeditiously as possible, but any solution must not sacrifice the ultimate goal of being able to conduct realistic and meaningful training.

Major A. J. Christensen is the Chief, Training Publications Branch, Doctrine and Training Literature Division, Department of Doctrine and Training Development, US Army Engineer School. He was with the Combat Developments Command Engineer Agency as Chief, Doctrinal Literature Branch, Organization and Doctrine Division for two years prior to the merger with USAES in March 1973. He holds a BS in Agricultural Engineering, MS in Mechanical Engineering and is a graduate of the Basic and Advanced Officer courses at Fort Belvoir, Virginia. The major has served with an engineer brigade in Europe, Construction battalions in CONUS and Thailand, as an advisor in Vietnam and as a Facilities Engineer.

Bridging the Gap

FIXED QUOTAS TO BE SET FOR MAINTENANCE WARRANTS NEW INTERMEDIATE COURSE IN FY 74

BEGINNING IN FISCAL YEAR 1974, fixed quotas will be established for those eligible individuals who desire to attend the new Maintenance Warrant Officer Intermediate Course. The course, comparable to an officer's advanced course, was launched last year through the combined efforts of the Ordnance and Engineer Schools. Those selected will be considered in light of manner of performance, potential value to the Army, education and type of assignments in which the officer has served. The course is conducted in two phases: the first, approximately 11 weeks in duration, consists of general military subjects and is taught at Aberdeen Proving Ground, Maryland, to both Ordnance and Engineer Warrant Officers; the second phase, lasting approximately five weeks for MOS 621A, consists of engineer technical subjects, and is taught at Fort Belvoir, Virginia. Since the entire course is less than 20 weeks duration, it must be funded as TDY from local training funds. To be eligible for consideration, an individual must have completed the Engineer Equipment Repair Technician Course and have between 5-13 years of warrant service. For those individuals who have not had the opportunity to attend the EERTC, there are quotas available that can be allocated on a TDY and return basis. The Engineer Branch will provide the quota, the individual's unit cuts the orders and funds the TDY. For EERTC quota information, call the Engineer Branch: AUTOVON 325-7434.

ENGINEERS MUST NOW REQUEST THAT NEW MAP READING HANDBOOK FROM AG PUBLICATIONS CENTER

THAT NEW DEPARTMENT OF THE ARMY Training Circular 21-26, "Don't Get Lost," a cartoon style pocket hand book that simplifies map reading for the individual soldier is going over big. Conceived by the U.S. Army Engineer School at Fort Belvoir, Virginia, and developed jointly with the Defense Mapping School and the Combat Arms Training Board, this new look in informal training literature will soon be followed by "Don't Get Shot" (Camouflage and Field Fortifications) and "Don't Get Blown Up" (Mines and Booby Traps). Engineer units that need copies should send their requests to the U.S. Army Adjutant General Publications Center, 2800 Eastern Boulevard, Baltimore, Maryland 21220. Earlier, Engineer units were requesting copies from the Combat Arms Training Board at Fort Benning, Georgia.

DA SELECTION BOARD PICKS THREE SFC'S FOR ATTENDANCE AT PHOTOLITHOGRAPHY NCO COURSE

THE ADVANCED COURSES of the NCO Education System (NCOES) were initiated in January 1972. These courses are designed to prepare personnel in grades E-6 and E-7 to perform duty as noncommissioned officers in grades E-8 and E-9. A DA Selection Board comprised of officers and noncommissioned officers selected a number of personnel to attend the advanced courses programmed for Fiscal Year 1973. Three Sergeants First Class Everett D. Bogle, Frederic M. Church, and Donald W. Koons were named to attend the Photolithography Chief NCO Advanced Course at Fort Belvoir, Virginia from April 22 through July 18 of this year.

THE CORPS OF ENGINEERS

They've a song about the Army,
The Navy and Marines;
They've got one for the Air Force,
The whole damned works it seems;

But they've never taken trouble,
Though we've served them all these years,
To even pen a line,
For the Corps of Engineers

We've built all their roads and airfields,
Their pipelines and their camps;
From underground munition dumps,
To concrete loading ramps;

Railroads, dams, and bridges,
Electric high power lines,
Canals and docks and harbors,
Even coal and iron mines;

But the Engineers aren't kicking,
For when those outfits do come in,
We know it's just another place,
Where we've already been;

Before they even got there,
We had to break the ground,
And build it all to suit their needs,
Solid, safe, and sound;

If the Army and the Navy,
Ever look on heavens scenes,
They may find that it is guarded,
By the United States Marines.

Now who will guard the streets up there,
We aren't disposed to say,
But we offer this suggestion,
If they look at things that way;

When the Marines have taken over,
In the land that knows no years,
We're sure they'll find—
It was all designed,
By the Corps Of Engineers.

H. W. Willhoite