Engineer

THE MAGAZINE FOR ARMY ENGINEERS

Summer 1982

BRIDGING THE TRAINING GAP

The Engineer Trainer's Workbook

Our cover art was designed by Janet Jurin to illustrate ARTEP tasks in the *Engineer Trainer's Workbook*.

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FEATURES

DEPARTMENTS

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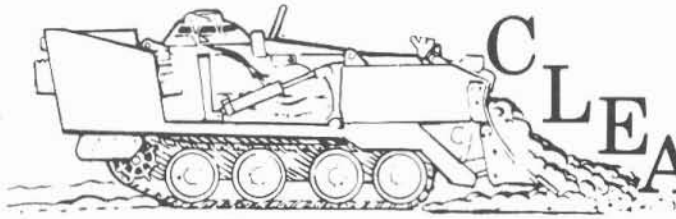


CLEAR THE WAY

by Maj. Gen. James N. Ellis

Three Key Activities

As the new Engineer School commandant, I welcome this opportunity to continue "Clear the Way." I think it is critically important that I continue the tradition of my predecessor, Maj. Gen. Max W. Noah, in providing you the School perspective on the many issues affecting the Engineer community.

I welcome your comments and will endeavor to highlight those issues most important to the military engineer. In future issues of ENGINEER, I will address matters with which we should share perspectives. These initial comments, however, reflect my personal support of three critical areas here at the School.

First, and I believe, one of the most significant activities at the Engineer School, is our Mission Area Analysis (MAA). This process began with a mobility-countermobility-survivability Systems Program Review (SPR) conducted at Fort Belvoir in April 1981. Maj. Gen. Noah reported to you on the SPR a year ago. During that review, Engineers assessed our concepts, organizations, training, and material needed to do our job. That was followed by an action plan which analyzed the shortcomings in our system and identified the means to correct them and to accomplish our job more effectively. Many of the items identified last fall in that action plan are now under way.

In November, we moved to the preparation of the formal MAA. The Engineer portion (one of eight analyzing the entire Army mission) is called Combat Support, Engineering and Mine Warfare. In this analysis, we shall break down every task and subordinate mission within the Corps of Engineers' responsibility and, again, in even more detail, assess our capability to accomplish those jobs. This is a very important effort from the standpoint of the time and number of people required to accomplish it. But more important is its significance to the character of the Engineer mission of the future. One can say, from a mission standpoint, in terms of our total relationship to the Army, this MAA may well be the most important project we will undertake in this decade.

A second very important activity here concerns the doctrinal literature program. The Army, as a whole, has reassessed how it is to fight in the future, based upon a modern concept called the Airland Battle. Stemming from that concept, a new keystone manual, FM 100–5, *Operations,* containing the basic doctrine for the future has evolved. We and the other TRADOC schools have reviewed that doctrine and are preparing first, our respective keystone and then, the supporting field manuals. The first field manual for combat engineers is FM 5–100, *Engineer Combat Operations,* which has been published in a coordinating draft for review by Engineers and other members of the combat arms team worldwide. It contains many changes from what we are familiar with in current manuals. We will next consolidate many of the other doctrinal manuals into seven or eight supporting manuals based on FM 5–100. I will keep you advised on the status of this important effort as it progresses, and I encourage you to consider this doctrine effective upon receipt of these new manuals.

The third critical activity demanding our attention is the responsibility for proponency. I am excited about this particular mission of the Engineer School because it is people oriented, and our involvement is essential to the total career development of Engineer soldiers. Accordingly, I believe a discussion of proponency in my first col-

umn would be appropriate and timely. This insight should serve to explain our present posture and future direction.

On October 1, 1981, the Engineer School became the specialty proponent for the Corps of Engineers. As commandant, I advise and assist the deputy chief of staff for personnel (DCSPER) and MILPERCEN on personnel management policies and programs affecting Engineer officers (SC 21 and 22), warrant officers (MOS 310A, 621A, 811A, 821A, 833A, and 841A), and enlisted personnel (CMF 12, 51, and 81).

The Engineer Proponency Steering Committee (EPSC) has been organized to assist me on policy recommendations. The EPSC reviews issues and provides recommended actions or policy changes. My recommendations are then forwarded to the appropriate office or agency; such as DA, DCSPER or MILPERCEN.

The Directorate of Evaluation and Standardization, currently the Directorate of Engineer Force Management (Provisional) (DEFM(P)), is the principal action agency for Engineer specialty proponency. The DEFM(P) prioritizes and evaluates proponency issues for the commandant and EPSC. They coordinate directly with TRADOC, MILPERCEN, OCE, Soldier Support Center, and ODCSPER. The DEFM(P) has its own evaluation teams and receives much of its information from the field.

Although the proponency mission is relatively new to the School, many issues are already being reviewed. Some of these include: professional development, force alignment, AERB requirements, educational requirements, accession/retention, combat exclusion policy for women, engineer and scientific continuation pay, and additional specialties for commissioned officers. Other issues are constantly surfacing for evaluation and appropriate action. The following highlights some of the issues:

The Engineer officer specialty code was restructured on March 1, 1982. All topographic Engineer officer positions were designated as SC 22—a new specialty code. New Special Skill Identifiers (SSI) were designated for the remaining SC 21 positions. The EPSC has expressed concern that the restructured SC 21 may require additional fine tuning to insure Engineer officers receive adequate professional development. Accordingly, development evaluations are currently underway to address this problem.

Another area of interest to officers is the engineering and scientific career continuation pay (ESCCP) which the Air Force requested from Congress. While DA endorsed the concept, the Army Officer Personnel Management System is not comparable to the Air Force's system. Since specific degrees are mandatory for most Air Force officer specialties, it is relatively easy to determine academic shortages. Due to the wide variety of degrees in any one Army specialty, implementation of a bonus program for the Army is not feasible at this time.

Force alignment has been in the news recently. Promotion policies are changing to facilitate aligning the force. The FY 82 E–7 selection board selected E–6 soldiers for promotion by MOS for the first time. The Army, with input from the Engineer School on Engineer MOSs, selected the number of soldiers necessary to fill known or anticipated Engineer job vacancies. Clearly, promotion opportunities for those in a critically needed skill, or MOS, were much higher than for soldiers in overage skills. By placing a direct correlation between the numbers of promotions given to the various MOSs, and the strength status of those MOSs, the Army has taken a giant step forward in aligning the total enlisted force. The after-action report from the board has been received by the School, and evaluation of the report and board results will determine which policy changes will enhance professional development and career potential for our enlisted soldiers.

The DA Women in the Army study group is conducting a total review of units and positions to determine where women can be effectively utilized. The physical demands of MOSs and the combat probability of a unit will be the basis of this determination. The Engineer School is developing the raw data for the study.

Most proponency issues are multifaceted. Education, specialty structure and professional development are all intertwined. Whenever a new material system is introduced, personnel requirements change. This, in turn, affects the structure of the specialty and makes demands upon the training system. In the past, the full personnel impact of new material introduction was often not apparent until years later. Specialty proponency provides discipline to the personnel process by insuring the system can support these changes.

Proponency is both a responsibility and an opportunity. As the new commandant, I accept the challenge of the responsibility and look forward to the opportunity for the positive change we can affect. Let us have your ideas, *"Clear the Way."*

JNE

News & Notes

A 9th Infantry Division soldier uses a UNIMOG to dig an individual defensive position during a Fort Lewis FTX.

UNIMOG IS TESTED AT FORT LEWIS

The UNIMOG is one candidate being tested as a small emplacement excavator (SEE). The UNIMOG has a German chasis with attachments added by Case Equipment, Inc. As part of the 9th Infantry Division's High Technology Test Bed, the UNIMOG is being rated on its ability to meet operational requirements. Its performance is being evaluated by the Army's Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir. According to MERADCOM, initial test reports have validated the concept of using a UNIMOG-type piece of equipment to dig small forward area emplacements.

OCAR REMINDS RESERVISTS: DRESS RIGHT!

The new decoration and service ribbons authorized by DA should be worn by qualified reservists, too, Office of the Chief, Army Reserve, reports.

The Army Service Ribbon is worn by all officers and enlisted personnel following successful completion of the resident basic/orientation course or initial MOS producing course.

The Army Achievement Medal may be awarded to all but general officers, for meritorious service or achievement. The NCO Professional Development Ribbon is awarded for successful completion of designated NCO professional development courses.

The Overseas Service Ribbon is awarded for successful completion of overseas tours with numerals used to denote second and subsequent awards. The OSR will not be awarded for overseas service already recognized with another service medal, such as the Vietnam Service Medal.

No orders will be published for these awards, so check AR 672–5–1 with changes or consult your unit personnel officer to make sure you're dressed right. You may also want to update your official photo.

92d TRAINS FOR JUNGLE

A detachment from the 92d Engineer Battalion (Combat) (Heavy), Fort Stewart, Ga., recently accompanied the 1st Battalion (Ranger), 75th Infantry, on a 21-day jungle training course in Panama.

The 92d, which supports the 1–75th in the event of the Rangers deployment, learned jungle tactics including training in water operations, jungle survival, placing booby traps and land navigation.

In addition to weapons maintenance classes and physical training, the soldiers received instruction in poncho flotation rafts; using rope bridges and in vertical extraction, an airborne operation that lifts up to four men, suspended by ropes, out of an area of helicopter.

FORCE ALIGNMENT EFFECTS REENLISTMENT

The Army's new Force Alignment Program may make it harder for some soldiers to reenlist. Recent success in meeting reenlistment goals has enabled the Army to look more closely at soldiers who reenlist and the skills for which they reenlist. Force alignment is designed to improve MOS balance, eliminate poor performers and to support modernization of the force.

Particularly effected are prior service enlistees who will be allowed to reenter only into critical skills. Additionally, soldiers must now be in grade E–4 or above to reenlist at all. Soldiers in grade E–5 and below at the time of reenlistment will be allowed to sign up for their present MOS or an understrength MOS only.

Commanders are advised by MILPERCEN to reenlist only those soldiers who will be productive in a changing Army, who are potential NCOs or senior technicians and those who are willing to serve where the Army needs them.

HAND-HELD CALCULATOR

Six combat planning tasks are being programmed into a new hand-held calculator for engineers. Classroom and field testing will be done during FY 83. The six programs are: minefield and wire obstacle logistics, demolitions and cratering calculations, bridge classifications, and the critical path method. To write software, first obtain documentation standards by writing to: U.S. Army Engineer School, ATTN: ATZA–TDC–A (Calculator), Fort Belvoir, Va., 22060.

ENGINEERS NEEDED AS GERMAN LINGUISTS

Staff Sergeants in MOS 51H30 (Construction Supervisor) or SFCs in MOS 51T30 (Technical Engineering Supervisor) are needed for assignments as German linguists. Interested NCOs who are *not qualified* linguists may apply if they score 89 or better on the Defense Language Aptitude Battery (DLAB) Test available at local education centers.

Applicants should submit their name, MOS and test results (if needed) to MILPERCENs Engineer Branch (DAPC–EPL–E), 2461 Eisenhower Ave., Alexandria, Va.

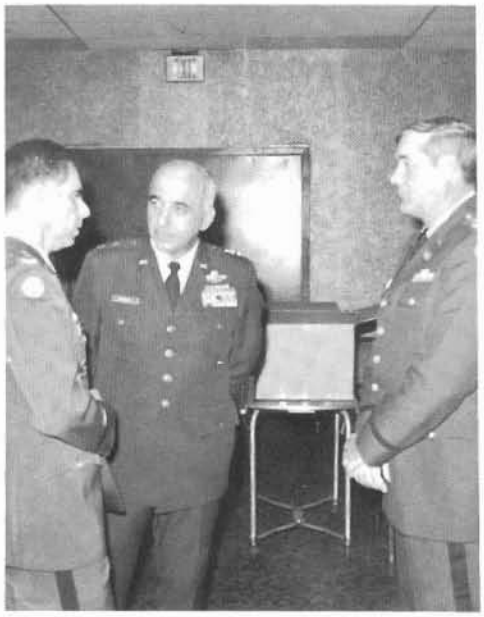
Selected NCOs will attend a nine-month German course at the Defense Language Institute Foreign Language Center, Monterey, Cal. Call Mrs. Scott at Engineer Branch for more information, AV 221-7710.

W. VA. GUARD GETS ENGINEERS

A new Army National Guard engineer detachment was recently formed at West Virginia's only military reservation. Camp Dawson, near Kingwood, W. Va., is now home for the 229th Engineer Detachment (Utility) commanded by Capt. David M. Davison. Senior detachment NCO is SFC Edward M. Gatens.

The 35-soldier detachment will provide maintenance, minor construction and rehabilitation of Camp Dawson facilities.

News & Notes



Chaplain (Capt.) Nicholas J. Kusevich, 17th Engineer Battalion, 2d Armored Division, conducts a field mass wearing olive drab vestments made from an Army parachute. Kusevitch is one of only 10 Eastern Orthodox priests in the Army. Developed in Eastern Europe, the religion includes Greeks, Ukrainians, Romanians, and Russians. There are over six million of the Eastern Orthodox faith in the United States. (Photo by Mark Vitullo)

CERAMIC ANODE IS BREAKTHROUGH FOR CERL

A breakthrough in corrosion-prevention technology has been made by the U.S. Construction Engineering Research Laboratory (CERL) at Champaign, Ill., with development of the ceramic anode.

The invention makes corrosion prevention available at one-fourth the cost and in a size reduction—500 times by weight—that permits installation in areas previously too small. Yet the ceramic anode has the same life as the relatively heavy and bulky silicon-iron or graphite anodes used in cathodic protection for the past 30 years. The ceramic anode is about the size of a dime.

The consumption rate of conducting ceramic materials such as ferrites is 500 times less than the currently used silicon-iron and graphite anodes. However, ceramics are extremely brittle and cannot be fabricated. To overcome these problems, CERL plasma-sprayed ferrite on valve metal (titanium or niobium) which can be fabricated to any shape. The niobium anode was designed specifically for salt-water use due to its resistance to pitting.

An application in civil works for the CERL ceramic anode will be on lock gates. At Army installations, the anode will be used on elevated water-storage tanks and underground pipes. Examples of potential use are with submarines and ships, and on off-shore structures such as oil-drilling platforms.

DA AWARD FOR ENGINEER TOPO LAB

The Engineer Topographic Laboratories (ETL), Fort Belvoir, Va., has received the 1981 Department of the Army Most Improved Laboratory of the Year Award.

Commended for the first successful interface between a photo interpreter analyzing high-resolution aerial photography and a digital computer supporting a geographic information system, ETL was selected for the award above 35 other Army labs.

ETL, the largest topographic research and development organization of its kind, specializes in mapping, geodesy, point positioning and military geographic information. The laboratory commander/director is Col. Edward K. Wintz.

PROFESSIONAL ENGINEER/ ENGINEER-IN-TRAINING ASSISTANCE

The U.S. Army Engineer School provides information regarding registration of military officers and DoD civilians as "Professional Engineers" and as "Engineers-in-Training." The School also provides study materials for PE and EIT exams. For more information on the PE and EIS programs, call Capt. Phil Jones or Mr. Bob Baldwin, (703) 664-2889/2527, FTS 554, AVN 354. Send written queries to: Commandant, U.S. Army Engineer School, ATTN: ATZA-DTE-RA (PE/EIT Coordinator), Fort Belvoir, VA 22060. If you are writing for study materials only, substitute attention line: ETM Division (Bldg. 215).

The Command Sergeant Major

by Gen. Bruce C. Clarke, USA (Ret.)

In the fall of 1940, the chief of the armed force sent a group of four officers to England to learn all they could about the actions in France by the British units that had recently escaped from Dunkerque. I was one of those officers and was assigned to the British 1st Armored Division which was re-equipping and retraining south of London.

In a couple of months, I learned to know the British concept of organization, training, command and leadership. I was impressed by the British regimental system, which seemed to rely little on the centralized control of personnel in the War Office. The key enlisted man of the regiment (our battalion) was the sergeant major.

He was a very imposing man and was the walking authority on the history, ethics, soldierly standards and information of the regiment. When a new recruit was ready to be taken before the sergeant major, he was well turned out and formally presented. The sergeant major sat very militarily behind his desk and the recruit stood at rigid attention. The sergeant major covered briefly the long, glorious history of the regiment. He then covered several things that all men in that regiment did, and several things that they didn't do. He informed the new soldier, still at rigid attention, that if he violated these rules a noncommissioned officer would speak to him; if he did it repeatedly, he would speak to him again himself. With that, the young soldier was dismissed.

This established the basic of peer discipline in the unit. No formal command instructions would take its place in its effect upon a new soldier. When Lt. Col. Creighton W. Abrams was commanding the 37th Tank Battalion in World War II, I heard one of his sergeants one day shout to a soldier who had violated some rule or order, "Soldier, you don't do that in Abe's battalion." This was prompt and adequate corrective action.

In 1949, Maj. Gen. I.D. White, the commanding general of the U.S. Constabulary in Germany, directed me, one of his brigade commanders, to create an NCO academy for the constabulary. With that, the present 7th Army NCO Academy was born.

It has had a profound effect on the Army's noncommissioned officer corps. Its duplicates have covered our Army and the Korean Army over the past 30 years. From this, has evolved the E–8 and E–9 ranks in our Army. The latter is the rank of command sergeant major; the top enlisted man in a unit in our Army.

Before the first class at the Constabulary NCO Academy, I made this statement, "There never has been a good Army without a good noncommissioned officer corps." I repeated it before a graduating class in November 1981, some 32 years later. If anything it is more important today in our Army.

When, soon after World War II, the Army deputy chief of staff for personnel presented the proposed post-war titles of the then seven grades of enlisted men to General of the Army/Chief of Staff Omar N. Bradley, he started with E–7 master sergeant; E–6 sergeant first class. When the chief of staff approved these, he then recommended that the E–5 be a sergeant second class. Gen. Bradley strongly disapproved, and directed that a new title be found. The title of staff sergeant was the result. Gen. Bradley then went on to say that he wanted no 'second class' sergeants in his Army. A command sergeant major has a lot to do to prevent this.

Over 30 years later we find our country with soldiers in Korea, in Europe and elsewhere supporting our national foreign relations programs by providing the basis from which our military and diplomatic efforts are carried on. Frederick the Great once said, "Diplomacy without the military is like an orchestra without instruments." This realistic concept makes every military man overseas an important person and an important member of our diplomatic-military team. The same goes for those who are prepared to augment and to support our forces overseas in an emergency.

The morale of a soldier comes from three things: A feeling that he has an important job to do, a feeling that he is trained to do it well, and a feeling that his good work is recognized and appreciated.

The command sergeant major is the principal enlisted staff assistant to his commander. As such, he makes suggestions and recommendations to his commander as called for and as is appropriate. But he is more; he sets the standards in leadership, performance of duty, conduct, discipline, morale and community relations for the noncommissioned officers of his unit.

His importance to his unit and to his commander is only limited by his ability, energy and imagination. His field of influence for good among the enlisted men in his unit knows no bounds.

AFGHANISTAN

The Soviet Experience

by James H. Hansen

After nearly two years of conflict in Afghanistan, there has been remarkably little public discussion of the Soviet methods for dealing with the Moslem insurgency there. This is indeed unfortunate, because the analysis of Soviet tactics in Afghanistan is a useful method of assessing the qualitative effectiveness of Soviet military forces. A study of Soviet tactics in Afghanistan indicates certain weaknesses in the Soviet military style, some of which Moscow's planners have tried to correct. It is now apparent that the Soviet military has adopted counterinsurgency as one of its permanent missions. Moreover, the U.S.S.R. is using Afghanistan as a test ground for new weapons, and much can be learned from a look at the arms which are in operational service now against the Moslem guerrilla forces.

The Application of Lessons Learned

Several months after the initial Soviet invasion of Afghanistan, Moscow's military planners recognized that their forces would have to adapt to the type of war being fought in that unforgiving theater. As early as March 1980, it was apparent that armored forces were generally useless against an enemy whose presence on the battlefield was sudden and fleeting. In general, Soviet ground forces were slow to react to rapidly changing tactical situations, and Soviet air power was used with little effect.

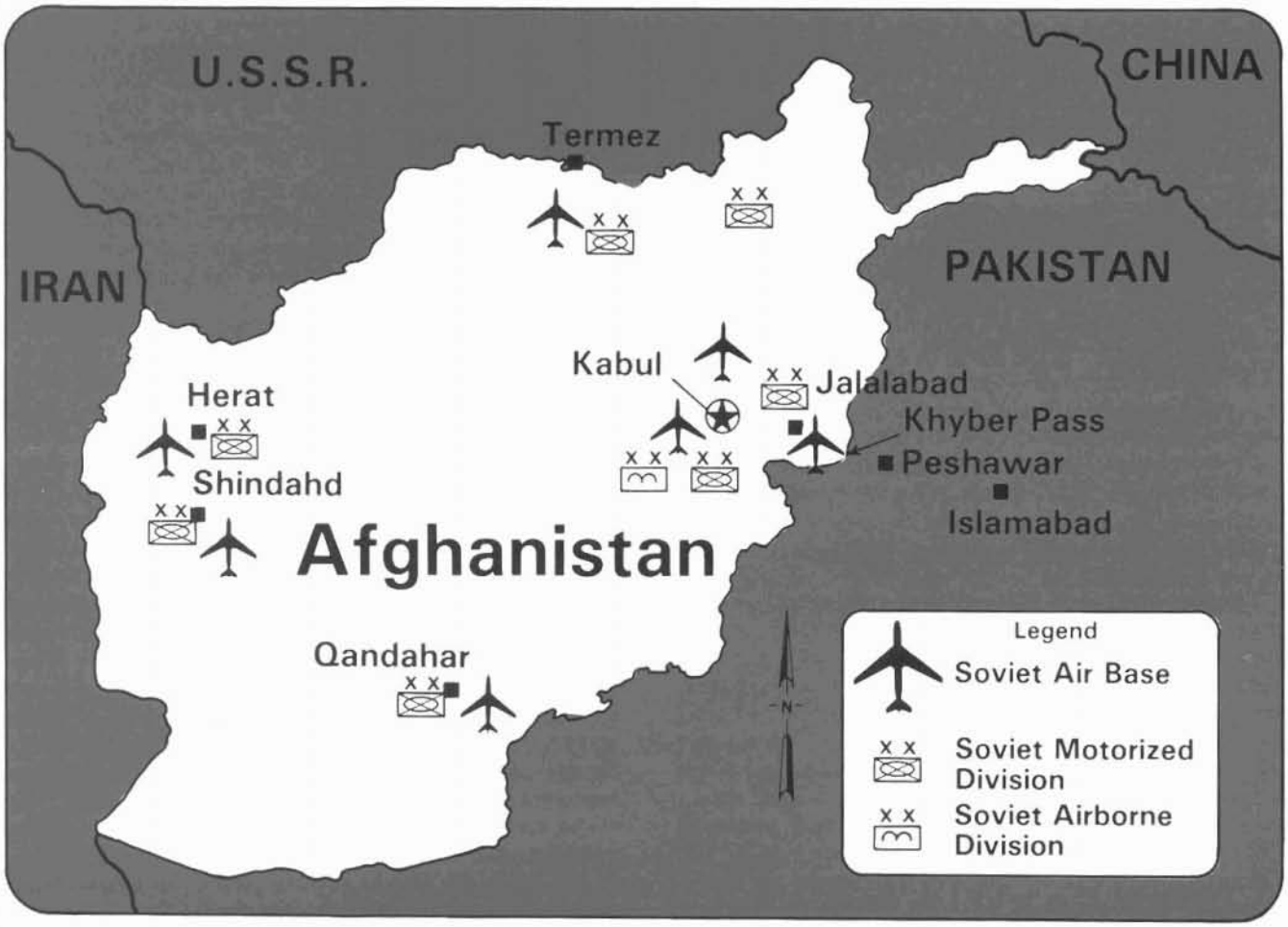
During mid-1980, however, a changeover in Soviet tactics was underway. The Soviet contingent in Afghanistan introduced armored fighting vehicles to replace many of the tanks. The Soviet forces now rely primarily on armored vehicles such as the BMP armored fighting vehicle, its airborne BMD cousin, the BRDM armored reconnaissance vehicle, and the ubiquitous BTR-60 armored personnel carriers. In addition, motorized rifle divisions were deployed in smaller maneuver units to pursue guerrillas with greater effect. Soviet divisions now frequently operate in brigade and battalion-sized units. The Soviet contingent in Afghanistan, moreover, has placed ever-increasing reliance on air power. The U.S.S.R. has now deployed a steadily increasing number of combat helicopters of all types.[1] The Soviet reliance on the helicopter is probably as great as the American reliance on the helicopter during the Vietnam war.

These tactical changes took place against a backdrop of a high-level military conference in Moscow in June 1980, when the progress in Afghanistan was doubtlessly scrutinized. Military leaders also decided to place greater emphasis on political education within the Soviet armed forces, presumably to ensure that enlisted troops were aware of the justness of the communist cause in Afghanistan.[2]

The changeover in tactics did not produce immediate results. In some respects, the Soviet position appeared to erode even further during the remainder of 1980. In August of that year, Herat and Jalalabad reportedly came under partial control of the rebel forces. In September, it was estimated that the Afghan Army strength had dwindled to some 30,000 loyal troops, from an original figure of about 100,000 men before the Soviet invasion. Also during that month, the Soviets withdrew from the Panjsher Valley after suffering considerable losses to the rebel forces. In October, some Islamic states supporting the Afghan rebels increased the level of the military aid they were sending. By year's end, alarming reports of discipline problems among Soviet troops in Kabul began to reach the West.[3]

During early 1981, the Soviet Union tried in many ways to enhance its position in Afghanistan. In February, East Germans were reported to be running police advisory programs for the Afghan government. (It had earlier been reported, inconclusively, that Cuban and Vietnamese counterinsurgency experts were serving in Afghanistan.) In March, Soviet units took over the mission of providing security for the Kabul area from four Afghan divisions. In April, there were reports of "crash improvement programs" in Soviet tactics.[4]

Soviet military doctrine has tried to keep pace with the combat developments. The October 1980 issue of *Znamenosets* (Flag-Carrier), the military periodical designed for reading by the NCO corps, was devoted almost entirely to mountain opera-



tions of all kinds: airborne operations, use of helicopters, motorized rifle company tactics, river crossings, cliff scaling techniques, etc. The Soviet aviation journal *Aviatsiya i Kosmonavtika* (Aviation and Cosmonautics) has featured summaries of operations in Afghanistan as well.[5]

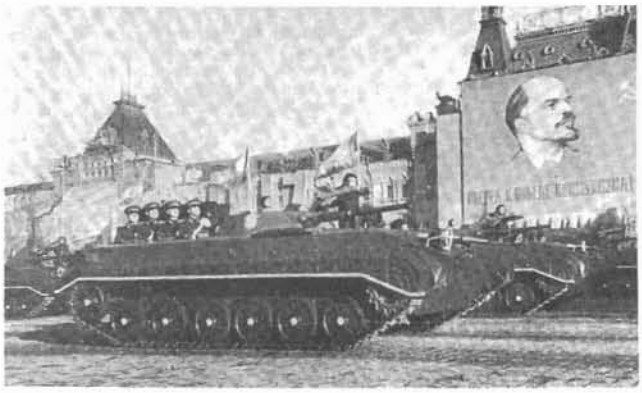
Tactical Trump Cards

Some of the more sensitive, and presumably effective, Soviet tactics do not appear in Russian-language military journals. Reference is made to the employment of chemical munitions as well as the use of special operations forces.

Reports of Soviet use of chemical weapons in Afghanistan predate the introduction of Soviet combat forces in December 1979. A U.S. State Department publication released in August 1980 noted that the Soviets have employed chemical weapons in half of Afghanistan's 28 provinces, largely those in the east where the most intense fighting has occurred.[6] So far three general types of chemical munitions are being used: a type of lethal chemical, which apparently is a nerve agent; a so-called "knockout" gas which leaves the victims unconscious for several hours, during which time Soviet troops land and conduct unopposed operations; and a concentrated CS tear gas, which appears to be the most widely used of all the Soviet chemical agents.[7] Chemical munitions could be very effective against guerrillas who are dug into mountainous areas and are difficult to dislodge with conventional firepower.[8]

The Soviets have also introduced significant numbers of elite special operations units into the campaign. These are called *spetsnaz* (for "special designation") units, forces which are roughly comparable to U.S. Army Ranger units. The U.S.S.R. appears to put a great deal of stock in such troops—to a greater degree than is commonly appreciated in the West.[9] These helicopter-borne commandos spearhead various types of counter-guerilla thrusts, and are backed up by columns of motorized rifle troops. Analysis of the Afghan campaign thus far suggests that motorized rifle units provide most of the "cordoning" forces in cordon-and-search operations, while the elite forces provide many of the effective hunter-killer units.

Soviet elite forces include the airborne units, which are heavily involved in the combat. The only major airborne force now believed to be in the country is the 105th Guards Airborne Division, which was one of the spearhead elements in December 1979. Analysis of the campaign suggests a pronounced qualitative difference between the



The Soviet BMP armored fighting vehicle, shown here in a Red Square parade, has been even more useful than the tank in Afghanistan operations.

combat performance of Soviet airborne units and the more pedestrian performance of motorized rifle divisions, of which seven remain in the country.

The Cost to Both Sides

The Soviet troops have paid a moderately heavy price since December 1979, as suggested by the preliminary analysis of available casualty figures. Based on American estimates of casualty figures, the monthly Soviet casualty rate (both dead and wounded) is running at several hundred men per month, with no more than 100 men killed each month on the average. This figure is scaled down from earlier estimates, and the rate will prove to be acceptable to Soviet planners, so long as Soviet forces continue to inflict several times as many casualties as they take.

The Afghan civilian population has paid a very heavy price, because Soviet tactical operations have been aimed increasingly at the population. This is suggested by reports of Soviet units leveling villages which are believed to harbor guerrilla fighters. In one two-week period in mid-1980, Soviet ground and air forces "reduced to rubble" some 50–60 Afghan villages.[10] As of mid-1981, about half a million Afghan citizens had been killed or wounded by Soviet military action, and over two million people have fled the country, according to a former Afghan government official.

In this context, the Afghanistan campaign has produced numerous atrocity stories, told by both sides. In this type of war, it is clear that Soviet commanders do not view atrocities as war crimes, but as calculated tactics in an ongoing effort to intimidate or coerce the population. In this category of "tactics," one must also include mass reprisals as well as institutionalized terror.

The Soviet counterinsurgency campaign should not be viewed in the military context alone. Instead one should examine all the other measures which the Soviets are employing in their effort to subdue the armed opposition. Soviet strategic doctrine recognizes that the military civilian effort should be interconnected, and population control is a critical element in the U.S.S.R.'s overall strategy in Afghanistan.

By now, the KGB apparently has penetrated the *Mujahideen* after stepping up its operations in Afghanistan.[11] Many KGB personnel there probably are associated with the Third Directorate, which is responsible for counterintelligence within the Soviet armed forces.

At the same time, the Soviet occupiers are also recasting the Afghan legal system after that of the U.S.S.R. The Afghan educational system is being transformed along Soviet lines as well. Many thousands of Soviet officials have entered Afghanistan to assist in the day-to-day functioning of Afghan government ministries.[12] The exact distribution of Soviet officials within the ministries remains unknown for now.

On the military side, many thousands of Afghan government troops are receiving training in the U.S.S.R.—now about 10,000 NCO's in the country for a six-month training period. The effort to reconstitute the pre-1978 Afghan armed forces is a major component of the Soviets' overall strategy, although Moscow probably is not banking on this program alone for the long-term stability of the country.

An Afghan People's Militia has been operating against the guerrillas since at least early 1980. This force appears to be the same type of paramilitary adjunct which has been established in other states after a communist takeover: in Ethiopia, to name one recent example. People's Militia battalions made up of young recruits are entrusted with maintaining law and order in the cities, and also with countering the rebels who are active on the highways. As such, the People's Militia battalions are tasked with escorting convoys between the cities.[13]

The U.S.S.R. is in the midst of a wide-ranging program to expand the lines of communication between Soviet Central Asia and Afghanistan, an effort which could greatly assist the overall Soviet logistics and resupply plan. One permanent bridge has been built over the Amu Darya (Oxus) River at Termez. A second permanent bridge is reportedly under construction across the same river. The Soviets are considering the construction of a rail line into Kabul which would link up with the Soviet railway system (there are currently no rail lines in Afghanistan). The U.S.S.R. also has ambitious plans to build air cushion vehicle cargo platforms

to link the Soviet river port of Termez with the Afghan cities of Shir-Kahn and Khayratan. The flotilla of air cushion vehicles, some with carrying capacities of up to 40 tons, will be built at a shipyard in Chardzou in the Soviet Turkmen SSR. In addition, the U.S.S.R. is upgrading some of Afghanistan's 36 existing airfields, and is constructing some new ones as well. One new military airfield has been built at Dasht-e-Atishan, some 40 kilometers east of the Iranian border in Herat Province.[14]

The Air War

Except for the assault helicopter's standout role, Soviet aviation fire support to ground forces has not been an important factor in the campaign against the rebels. One source notes that this aviation fire support (called *aviatsionnaya podderzhka* in Russian) has a "long way to go" before it can be considered effective.[15] This is largely due to three reasons. First, the Moslem rebels do not appear to be vulnerable to air operations. They are an elusive enemy for the Soviets, and any early warning of an impending air strike negates the effects of that strike. The second reason is that the mountainous terrain has inhibited the effectiveness of air-to-ground fire from jet aircraft. Air strikes in the desert regions of western Afghanistan would have more effect against the rebel forces, but most of the fighting has occurred in the eastern provinces adjacent to Pakistan. The third reason is that the Soviets have deployed few jet ground attack aircraft in Afghanistan. The overwhelming percentage of the Soviet tactical combat aircraft in the country are relatively old MIG-21's, which are best suited for air-to-air combat.[16] Soviet planners have thus far not perceived the need to deploy relatively advanced ground attack aircraft, such as the SU-24 Fencer or the MIG-27 Flogger D and J models.

On the other hand, the MI-24 Hind D helicopter gunship has proven to be a highly effective weapons platform. Its capabilities have been tested to the utmost: from transporting squad-sized units to dropping chemical bombs. By many accounts, the Hind D is the weapon most feared by the Moslem guerrillas, and its performance in combat has been described as "devastating."

The Soviets maintain a force of well over 200 assault helicopters in Afghanistan, reportedly split into small squadrons.[17] They often use two-ship or four-ship formations in combat, but elements of eight or more have been reported.

The assault helicopters, both the MI-24 Hind D/E series and the MI-8 Hip C/E series, represent the vital component of a new concept that is being tested in Afghanistan, the tactical airborne landing. In this maneuver, a motorized rifle unit, quite often a battalion of 400–500 men, is airlifted by helicopter to the enemy rear area where it operates in cooperation with the troops advancing from the front. A helicopter-borne assault may occur as far as 50 kilometers ahead of the front lines, although the linkup with the main body of troops should occur within two or three hours.[18]

Colonel M. Belov, perhaps the most tireless advocate of Soviet assault helicopter capabilities, has characterized this type of operation by its "strict coordination, surprise and dynamism of troop actions." Such operations are also known for their "fast overcoming of large distances, irrespective of natural obstacles and obstructions. . . ." Soviet military doctrine recognizes that the airborne force must be highly active and maneuverable in action, take the enemy by surprise, and show "resolve and daring."[19] It would first appear that only special operations *(spetsnaz)* forces and airborne troops are ideally suited to carry out such operations, but some regular motorized rifle battalions have also been trained for this type of mission.

If anything, Soviet units in Afghanistan have become overly dependent on helicopters. Whenever a Soviet troop column or supply convoy moves into guerrilla territory, it is accompanied by Hinds. While half of them remain overhead, watching for rebel activity, the others land troops in crests ahead of the advancing column. These troops provide security until the column has passed, after which time the process is repeated further along the route. This type of leapfrogging tactic generally would make it difficult for the Afghan rebels to halt Soviet offensives by striking at supply lines.

Ground Forces Structure

The Soviet ground troops have been split up into seven distinct commands. These areas are under the *de facto* control of Soviet generals, despite the presence of local Afghan political leaders. The exact boundaries between the seven commands have not yet been reported, but the number would correspond to the number of motorized rifle (MR) divisions believed to be in country, with each MR division having responsibility for certain territory.

If there are indeed seven fully manned MR divisions in Afghanistan, each with an average strength of 12,500 men, then total Soviet manpower there would be higher than the often-repeated figure of 85,000. The seven MR divisions alone would account for some 87,500 troops. The addition of a fully-manned airborne division, the 7,500-man 105th Guards Airborne Division, would bring total ground forces manpower to some 95,000. Headquarters and support units in the Kabul area could account for another 5,000 men. Moreover, at least 5,000 aviation personnel would be required to man and maintain the jet combat aircraft and helicopters in the country. This all suggests that total troop strength in Afghanistan would be over 100,000, provided that ground divisions there were manned to their authorized strength. Instead, it is likely that the Soviets have sent some nonessential divisional component units back to their garrisons in the U.S.S.R.

An examination of this troop strength reveals some surprising similarities between the Central

Group of Forces (CGF) in Czechoslovakia and the Soviet contingent in Afghanistan. The CGF was formed from the remaining units which invaded Czechoslovakia in 1968, and is comparable in size with the Soviet force in Afghanistan. There are some 73,000 ground troops in Czechoslovakia, along with about 150 combat aircraft, according to most accounts published in the West.[20] In the event of general war in Europe, the CGF probably would merge into a larger *front* (the largest type of Soviet military organization). Likewise, in the event of general hostilities in South Asia or the Persian Gulf area, the Soviet contingent in Afghanistan could also merge into a wartime *front,* in a force available for operations in the immediate area.

The Soviets were shuttling in elite units to give them maximum combat experience.

The Enduring Counterinsurgency Mission

A discussion of Soviet operations in Afghanistan strongly suggests that counterinsurgency has become a permanent mission of the Soviet armed forces. This is all the more apparent when one considers the continuing Soviet support to the pro-Communist pacification efforts in Angola and in Ethiopia. So long as Soviet and pro-Soviet forces continue to participate in local conflicts, it is likely that the U.S.S.R. will attain additional expertise in counterinsurgency.

There is further supporting evidence that the Soviets have adopted the counterinsurgency mission. In December 1980, reports reaching the West indicated that the Soviets were shuttling in elite units in order to give them maximum combat experience in Afghanistan. In January 1981, Soviet military spokesmen noted that the scale of tasks being undertaken by the Soviet General Staff has "expanded," thus suggesting that counterinsurgency is becoming an increasingly fashionable career field within the Soviet military structure.[21]

Soviet military doctrine has also evolved over the past few years. One major change is a greater emphasis on civil wars and on national liberation struggles, as well as a stated willingness to assist in "defensive" campaigns in order to counter pro-Western efforts to restore capitalism in newly-established socialist nations. Colonel K. Vorobiev, for example, has stated that wars in defense of nations which are building a socialist system are considered just by Soviet military spokesman, and may be fought by Soviet troops. Vorobiev has stated that this force can be employed because "it is derived from the ruling class, and based on the higher principles of socialism." Such force can be justified if it "overcomes the resistance of reactionary forces and promotes the progressive development of society."[22] Colonel Vorobiev subsequently noted in January 1980 that "only" by using armed forces can one defend the revolutionary conquests from the imperialist interventionists, suppress the attacks of the enemies of social progress, and "assure the development of a country proceeding on the socialist path."[23] This concept is broader in scope than the orthodox Marxist-Leninist interpretation of civil wars, and fits the Soviet concept of events in Afghanistan over the past few years.

Test Range for Weapons

After the casualty figures on both sides have been tabulated and the doctrinal justifications repeated for a seemingly infinite number of times, Afghanistan remains as a superb test-bed for an entirely new array of Soviet weapons. Soviet weapons being combat-tested in the fighting there include the T-72 main battle tank, the BMP armored fighting vehicle and its variants, the BMD airborne fighting vehicle, and small-unit weapons such as the AGS-17 "Plamya" (flame) automatic grenade launcher and the AK/AKS-74 5.45mm assault rifle. Lesser-known weapons include the PFM-1 antipersonnel minelet, an air-dropped drum-contained incendiary weapon with a large number of so-called "fire sticks," cluster bomb units, and the various types of chemical weapons discussed earlier.[24]

Soviet troops have introduced a number of new ordnance innovations, and have modified equipment to suit local conditions. They have, for example, mounted the AGS-17 grenade launcher on the BMP armored fighting vehicle: the marriage of two highly successful weapon systems. The employment of assault helicopters to drop antipersonnel mines and chemical bombs is also an innovation peculiar to Afghanistan.

Perhaps the underlying reason for the use of Afghanistan as a test-bed is the need for Soviet planners to conduct a *proverka* (checkout) of these weapons under realistic combat conditions. The Soviets recognize that their weaponry will receive a more thorough and conclusive *proverka* under the unforgiving conditions of actual combat than in field training exercises in the U.S.S.R. Indeed, some Soviet doctrinal writers have lamented the fact that their field training exercises often lack the requisite degree of realism.

A compelling need exists for a thorough evaluation of this new Soviet weaponry, because some of

this equipment, as well as the associated tactics, could eventually be used against U.S. or NATO forces in the future. The U.S.S.R. closely monitored U.S. military operations during the Vietnam conflict, and drew its own conclusions with the goal of enhancing the potential effectiveness of Soviet forces should they ever directly face American combat units. There is a paramount need for the U.S. to do the same vis-a-vis the Soviet campaign in Afghanistan. Indeed, the Soviet *proverka* in Afghanistan should not be viewed through a narrow and cloudy window. American fighting men have too much to lose if the Soviets apply their new weapons and "lessons learned" against them at some time in the future, without some foreknowledge on our part.

As a final observation, the analysis of the Soviet approach to the counterinsurgency campaign in Afghanistan occasionally reminds one of earlier campaigns against outgunned tribesmen, at a time when the issues all seemed much simpler. In the mid-1930's, Vittorio Mussolini was candid enough to give his eyewitness account of the Italian effort against the Ethiopians:

I still remember the effect I produced on a small group of Galla tribesmen massed around a man in black clothes. I dropped an aerial torpedo right in the center, and the group opened up like a flowering rose. It was most entertaining.[25]

Footnotes

1. Zalmay Khalilzad, "Soviet-Occupied Afghanistan," *Problems of Communism,* November-December 1980, p. 32. See also *Aviation Week & Space Technology,* September 7, 1981, p. 29. The number of helicopters varies over time.
2. Alfred L. Monks, *The Soviet Intervention in Afghanistan* (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1981), p. 41.
3. Stuart Auerbach, "Soviets in Kabul Said to Sell Arms On Black Market," *Washington Post,* February 6, 1981, pp. A1, A26. Soviet troops are also using hashish in place of vodka, which is relatively scarce.
4. David C. Isby, "Afghanistan's Winter War," *Soldier of Fortune,* April 1981, p. 43.
5. Colonel A. Khorobykh, "V Nebe nad Gindukushem" (In the Sky over the Hindu Kush), *Aviatsiya i Kosmonavtika,* No. 8, 1980.
6. U.S. Department of State, *Reports of the Use of Chemical Weapons in Afghanistan, Laos and Kampuchea,* August 1980, p. 5.
7. *ibid.,* passim. See also Isby, *op. cit.,* p. 44.
8. Very early during the post-invasion campaigns in 1980, it appeared that the Soviets were going to employ chemical weapons on a fairly wide scale. See James Hansen, "USSR–Afghanistan: Perspectives on the Conflict," *Military Intelligence,* April-June 1980, p. 43.
9. See Frederick Wiener, *The Armies of the Warsaw Pact Nations.* Second Edition. (Vienna, Austria: Carl Ueberreuter Publishers, 1978).
10. Stuart Auerbach, "Soviet Strikes Reportedly Level Afghan Villages," *Washington Post,* July 15, 1980, p. A8.
11. Isby, *op. cit.,* p. 43.
12. Donald E. Fink, "Afghan Invasion Linked to 1968 Action," *Aviation Week & Space Technology,* July 14, 1980, p. 23. The population of the Soviet civilian enclave in Kabul is said to have jumped from 1,800 before the invasion to between 6,000 and 7,000.
13. "Pravada Reports Afghan Militia Operations," *FBIS Daily Report* for U.S.S.R., July 10, 1981, p. D1.
14. See Khalilzad, *op. cit.,* p. 33, concerning the bridges. See also "Air Cushion Freighters to Service Afghan Route," *FBIS Daily Report* for U.S.S.R., July 24, 1981, p. D6. See also "USSR Troop Increase on Afghan-Iranian Border Noted," *FBIS Daily Report* for China, July 25, 1981, p. F3, concerning the new airfield.
15. Galen L. Geer, "Prayers Replace Pushups," *Soldier of Fortune,* November 1980, p. 42.
16. Khalilzad, *op. cit.,* p. 32.
17. "Armed Forces," *U.S.S.R. Facts & Figures Annual* (Gulf Breeze, Florida: Academic International Press, 1981), p. 74.
18. U.S. Army Intelligence and Threat Analysis Center (ITAC), *Soviet Army Operations.* IAG–13–U–78, August 11, 1978, pp. 7–6 to 7–8.
19. Colonel Yu. Chernyshov, "A Tactical Airborne Landing," *Soviet Military Review,* No. 5, 1980.
20. Lothar Ruehl, "The Slippery Road to MBFR," *Strategic Review,* Winter 1979–1980, p. 28. See also Weiner, *op. cit.,* passim.
21. Colonel P. Mochalov and Engineer-Colonel B. Lyapkalo, "Improving Command and Control," *Krasnaya Zvezda,* January 7, 1981.
22. Monks, *op. cit.,* p. 42.
23. *ibid.,* p. 42.
24. See *Soldier of Fortune* for September 1980, October 1980, November 1980, April 1981, and May 1981 for reports of various types of weapons being used in Afghanistan.
25. Henry Davidoff, *The Pocket Book of Quotations* (New York: Simon & Schuster, 1942), p. 424.
26. The map is taken from Khalilzad, *op. cit.,* p. 25. Sincere thanks to *Problems of Communism* for permission to use the map in this publication.

James H. Hansen is an employee of the BDM Corporation of McLean, Va., where he leads and participates in research projects relating to Soviet/Warsaw Pact military capabilities. He served in the CIA until 1978. He is a frequent contributor to National Defense and to other defense and foreign policy publications. The CIA has reviewed this article to eliminate classified information, but that review neither constitutes CIA authentication of factual material nor implies its endorsement of the views expressed.

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Recovery of Flight 90

An Engineer Battalion's Contribution

by Capt. David R. Gallay

Less than a minute after becoming airborne during a Washington, D.C., snowstorm, January 13, 1982, Air Florida Flight 90 lost altitude, struck five cars and a truck on the 14th Street Bridge and crashed into the icy Potomac River. Aboard the Boeing 737 were 74 passengers and a crew of five, bound from Washington's National Airport to Tampa, Fla. Five persons survived the crash.

Within minutes of the accident, the Federal Aviation Administration implemented its airport disaster plan. At Fort Belvoir, Va., one of the first activities alerted was the 30th Engineer Battalion (Topographic) (Army), Engineer Center Brigade. Its two attached diving detachments, the 86th and 511th, were placed on standby, and a two-week operation that affected nearly every man and woman of the 30th began.

Early January 14th, Engineer Center Brigade units were set to support recovery and salvage operations. Their mission focused on recovery of the flight and voice recorders, recovery of bodies and salvage of the aircraft. Battalion divers entered the water for the first time late the morning of the 14th.

As the diving situation developed, the battalion sought additional ways to contribute to the operation. The 30th's 584th Engineer Company (Cartographic), for example, took an old copy of a U.S. Department of Transportation pictomap and produced a line map that was subsequently used for site planning. The cartographers also enlarged and printed an existing map of the area on a clear film base. This map was particularly useful to the District of Columbia's Metropolitan Police in planning and controlling rerouted automobile traffic near the cash site.

"Underwater visibility was frequently less than 30 centimeters."

Additionally, surveyors of the battalion's 82d Engineer Company (Survey) were needed to fix the locations of buoys set out by divers marking pieces of wreckage. The surveyors also sited the navigational aids used by remote sensing technicians of the Corps of Engineers' Cold Regions Research Engineering Laboratory (CRREL). These technicians scanned the river bottom by radar and developed profiles indicating wreckage locations (Figure 1). To assist in plotting debris locations, the 584th placed a grid and scaled drawing of the downed aircraft onto the original line map.

At the end of each day, divers, surveyors, CRREL technicians and cartographers, gathered in the 30th's on-site reproduction van to compare notes. There, an updated situation map was prepared and reproduced for use in planning and controlling subsequent dives.

The divers were central to the operation. The battalion's 18 divers, working alongside Coast Guard, Navy and D.C. police divers, recovered all victims and essential wreckage despite extremely adverse weather conditions. Air temperatures were nearly always below freezing and ice in the Potomac had to be cleared daily. Underwater visibility was frequently less than 30 centimeters. Incredibly, over the course of the 10-day operation, the average dive lasted 65 minutes and the longest was 141 minutes.

The 30th performed many missions it would typically perform in their battlefield support role. The headquarters provided staff coordination, maintenance and logistics support; the cartographic company prepared, reproduced and distributed quick-response graphics and maps; the survey company established and extended survey control; and the two diving detachments performed underwater salvage.

Though the recovered wreckage will never provide the complete story, it has already yielded information which may deter similar accidents. Working under tragically difficult circumstances, the men and women of the 30th Engineer Battalion provided key assistance and expertise to the recovery of Air Florida Flight 90.

Capt. David R. Gallay is operations officer of the 30th Engineer Battalion, Engineer Center Brigade, Fort Belvoir. He is a graduate of the U.S. Military Academy, the Command and General Staff College and has a master's degree in engineering from Purdue University and a master's in management from the University of Southern California. Capt. Gallay has commanded companies in Korea and Europe and is a registered professional engineer in Virginia.

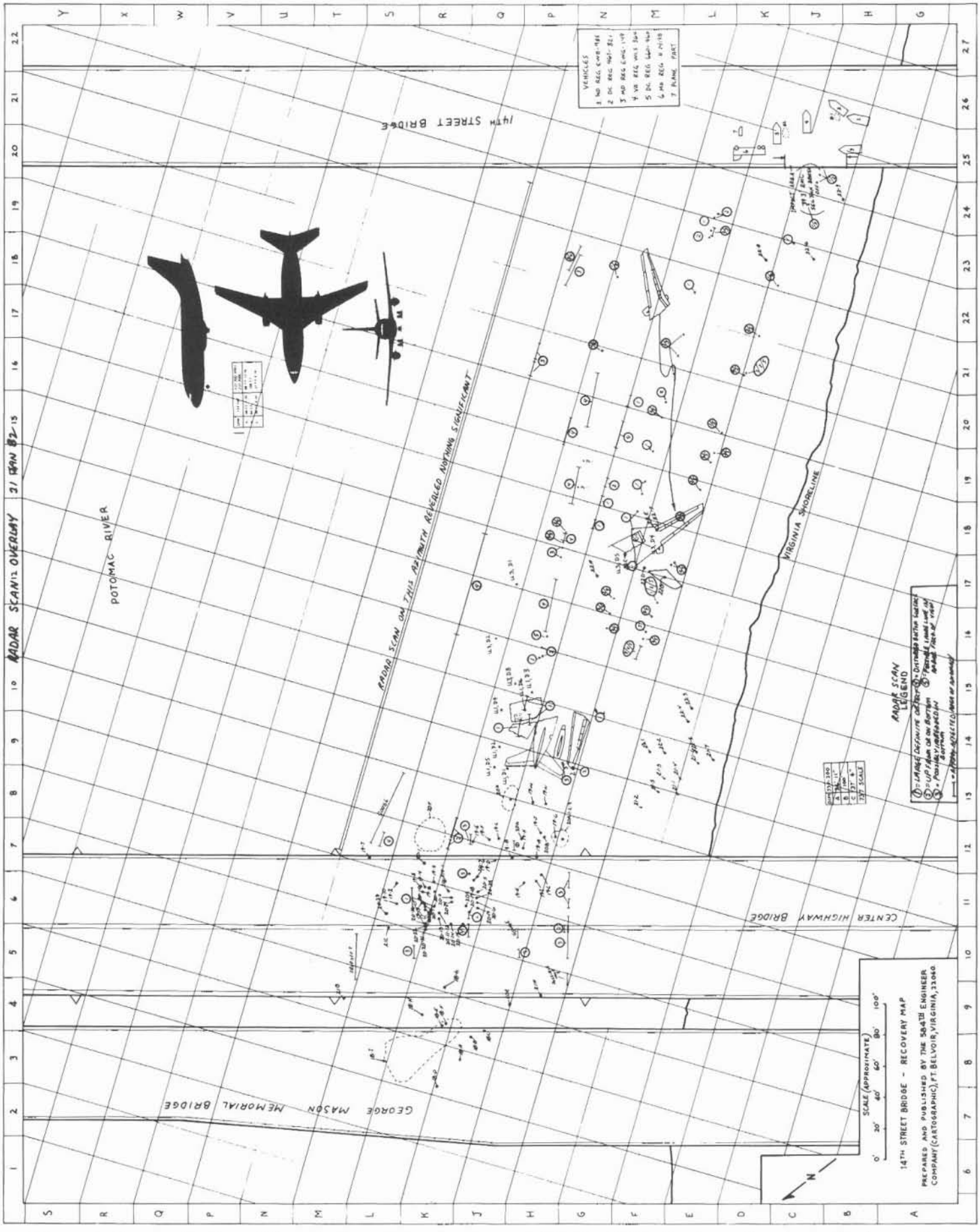


Figure 1. A reproduction of the actual recovery map prepared by the 854th Engineer Company (Cartographic)

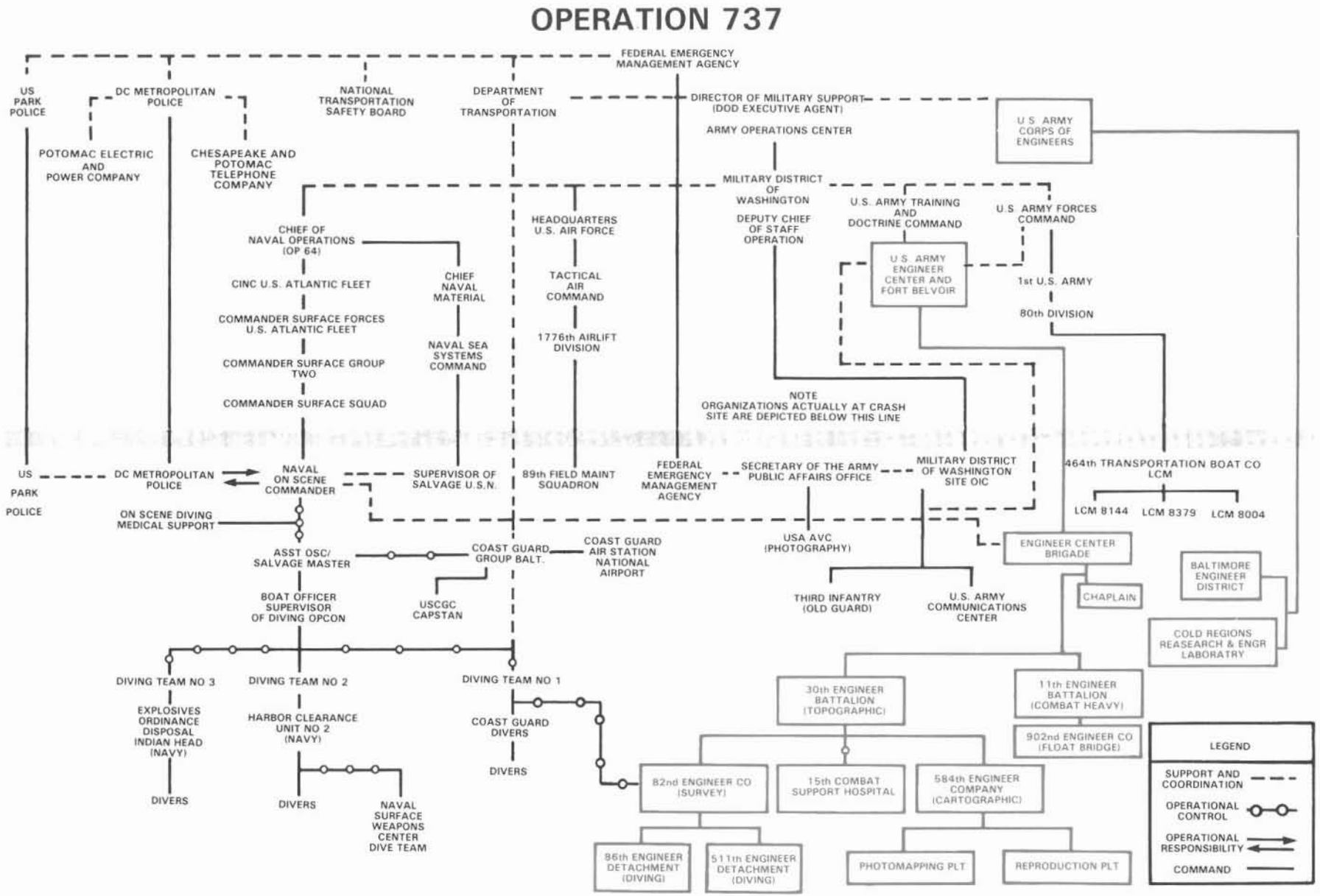


Figure 2. The recovery effort organizational chart documents the complexity of the operation.

Computer Graphics For Automated Drafting

Huntsville revolutionizes designing, planning and mapping

by M. R. Stevens

In the old days, it might take an architect-engineer or draftsman 20 hours to draw or design a project on a drawing board, depending upon the difficulty of the design. However, with today's modern technology of computer graphics, the same job can be done in just five hours.

The Office of the Chief of Engineers (OCE) has been using computer graphics for several years, but the Huntsville Division and the St. Louis District pioneered development of automated drafting for the Corps. While all three organizations have implemented large, turnkey computer graphics systems for automated drafting and computer-aided design and drafting (CADD), this article features the Huntsville operation.

During a nine-month survey by the Huntsville Division, automated drafting outperformed the manual method four-to-one. During the study, engineers using automated drafting produced 1,521 drawings in only 2,863 manhours. The same drawings produced manually would have required 12,697 manhours.

While automated drafting covers a broad spectrum of applications, at the Huntsville Division, primary interest is in civil design; management, project planning and scheduling; and in mapping. Huntsville has been using automated drafting units since 1978.

Civil design using computer graphics was used recently by Huntsville personnel at the North and South Sinai Peacekeeping Camps. Engineers were provided "as built" drawings of existing facilities, such as utilities, roads, buildings, structures and topographic features drawn on a skewed (not accurate) metric scale. To manually convert the drawings to the English units used by American contractors would have taken approximately four weeks, however, using CADD through automatic-electronic tracing at a computer graphic work-station, the job was completed by a single technician in just 24 manhours.

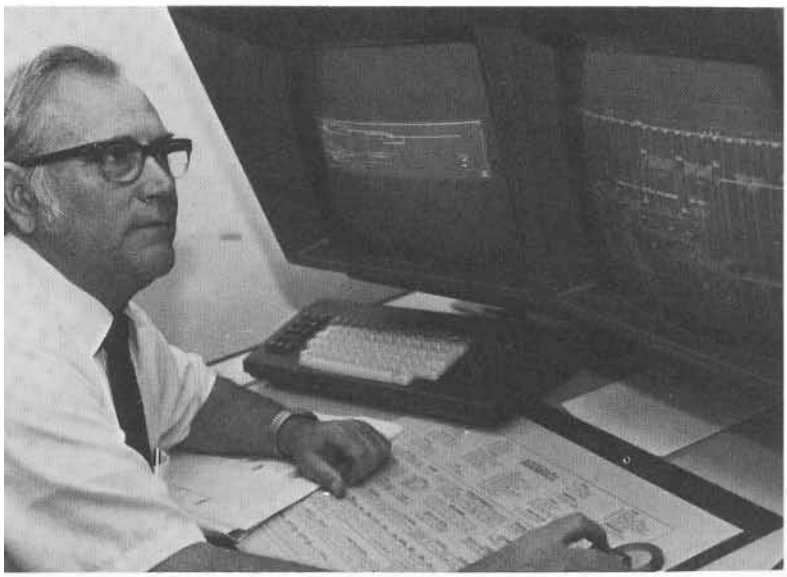
Within the Huntsville Division, one of the most important uses of computer graphics is in management, project planning and scheduling. Using the critical path method (CPM) and the data management retrieval system (DMRS), project managers are able to set up the system to produce complete packages in a fraction of the time it takes to do the same job manually.

Using the manual method, an engineer makes original drawings, encoding the activities for key punching so a "batch process analysis" can be performed by conventional computer. Any changes in tasks or times would mean more drawings to reflect the changes. With computer graphics, however, the engineer can time-scale his network drawing. He can draw a chart that shows months of the year and the period during which each task should be performed. He can even color-code the schedules to make it more comprehensive for the project manager. If there is a change in task or schedule, he does not have to start over as the draftsman does; he can make corrections or edit the plot on the computer graphics screen. Should there be a change in design, he can retrieve the plot from the data retrieval system and draw the change into the original plot in a matter of minutes. He can edit, change schedules, make additions or correct mistakes as they occur.

Once the package is completed, it remains in the computer disk file for retrieval or update, or it can be put on a small reel of tape and stored for future use. This is a real advantage, considering the large amount of space it takes to store manually produced drawings. It is also possible to telephonically transfer entire packages to other divisions or districts with comparable computer systems.

In mapping, computer graphics is used to update maps in the central file, thus eliminating many errors that occur when updates are made on one document but not on others.

With manual systems, the length of time it



Civil engineer Dale C. King uses a computer graphics terminal and the critical path method to prepare time scheduling charts. (Photo by M.R. Stevens.)

takes to get up-to-date copies of maps or specific areas is a frequent problem. Now, however, one can pick areas and boundaries to be mapped as well as the level of detail required. Once the information is specified, the system selects appropriate data from the file to produce an up-to-date, hardcopy map. Manually changing the scale of maps has always presented problems, too, because the maps usually have to be redrawn. But with computer graphics, scales can be changed almost instantaneously. The entire base map is displayed on the graphics screen, an area is magnified and the operator selects the desired detail. Once detail and scale are established, a hardcopy of the map can be automatically reproduced.

Using computer graphics, information and related data from maps is readily available and the job of manually reviewing maps is eliminated. Engineers list the information needed and the system scans the map file, printing requested information to the engineer's standards. In addition to providing quick and accurate reports, the system automatically revises the map file when maps are updated.

Map revision is a time consuming task for draftsmen or engineers because it involves overlays, notes, insertions and deletions that tend to clutter the original, and, if the revision has errors, it must be corrected again. With computer graphics, the map is displayed on the screen so engineers or draftsmen can make direct changes. Specific areas or whole sections can be changed, rearranged or corrected on the screen which eliminates redrawing. Map revision can be completed in a fraction of the time it takes to make changes manually. Computer graphics can also be used to standardize the shape, size and symbols used on maps.

While the Huntsville Division currently uses computer graphics in only three major areas (civil design; management, project planning and scheduling; and mapping) the system can be expanded as the Corps becomes involved in new and different projects. As more personnel are trained in the use of computer graphics, potential for standardization between divisions and districts becomes more attainable. And, while Corps-wide standardization is still in the future, for the organizations using computer graphics now, the future is today.

Writer's Guidelines

In response to queries from prospective authors, we pass along the following ENGINEER writer's guidelines:

TOPIC—Although our focus is upon combat engineering, any subject of professional interest to the Corps is welcome. It is always best to query first since an article similar to yours may have appeared already or may be scheduled for a future issue. Please title your article.

LENGTH—Length is not as important as content. Let your subject matter dictate length. Most ENGINEER articles range from 1,000 to 3,000 words. One caution, however: if it appears your article will be exceptionally lengthy, please call or write so we can let you know if sufficient space will be available.

PHOTOGRAPHS AND ARTWORK—Photos and drawings strengthen your article, and in some cases are vital graphic aids to conveying your message. Photos should be black and white, glossy, and, preferably, at least 5″ × 7″. Drawings must be legible but need not be "camera ready."

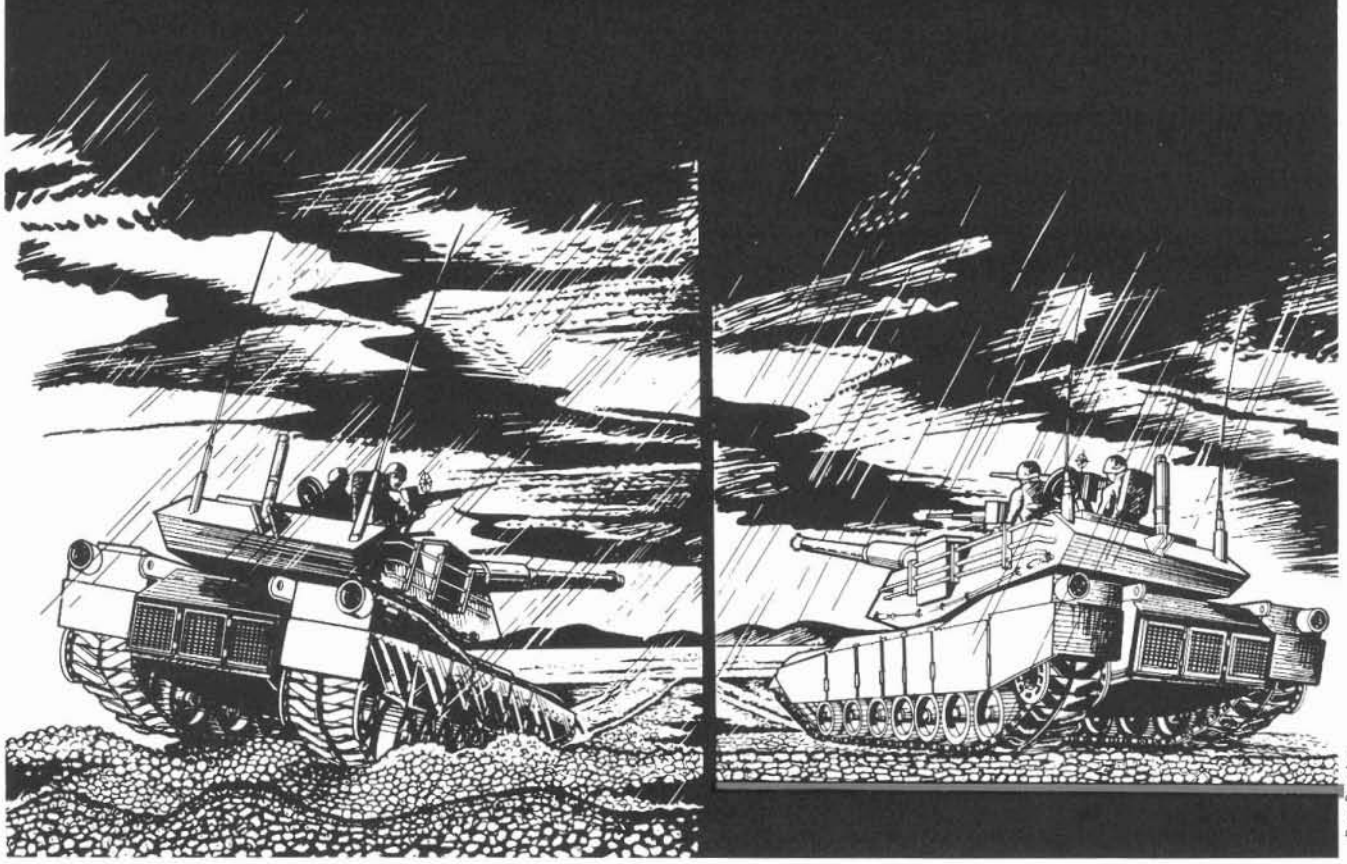
COVER LETTER—Please include a cover letter with your name, address, a phone number at which you can be contacted, a brief (one or two paragraph) description of your article, and biographical data on yourself.

NEWS & NOTES—We're always looking for contributions here, especially those with photographs. Your TASC or public affairs officer will be able to provide you photographic support.

Finally, we'll work with you on polishing your writing skills. The most important criteria for an ENGINEER article is the story it tells and the professional growth it stimulates in your fellow Engineers.

We look forward to seeing your article in a future issue of ENGINEER.

Geofabrics in Military Construction



Without Fabric

With Fabric

by Capt. Stephen L. Gerecke
and Capt. Philip M. Jones

Geotextiles and geomembranes (both called geofabrics) have gained wide acceptance in civilian construction practice. They are employed in a number of methods to take advantage of their structural properties. Those methods most applicable to the military engineer are:

Reinforcement—spreads a vehicle load over a larger area, "bridges over" soft spots, and slows development of ruts.

Separation—prevents intrusion and mixing at the interface of the base aggregate and subgrade, and the resultant loss of strength.

Drainage—allows removal (passage) of water without the build up of high pore pressure and the resultant loss of soil strength.

Reinforcement may be further defined as:

Subgrade restraint—the prevention or reduction of soil movement and strain by fabric confinement.

Earth reinforcement—the use of a fabric to increase the strength of a soil-fabric system.

This paper will address subgrade restraint and soil reinforcement of roads leading to tactical bridges, stream crossings, fording sites and other areas where poor trafficability exists. Consideration is given to the

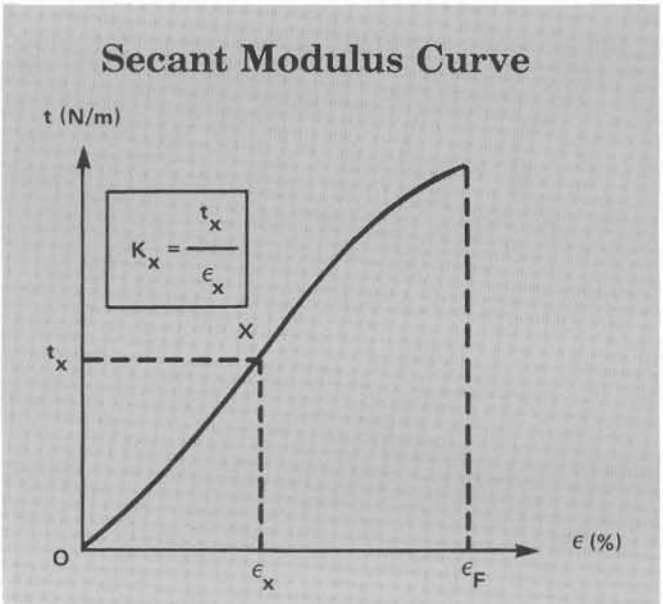


Figure 1—Typical tension-elongation curve of geotextile (E_F = elongation at failure; E_x = elongation at point x; t_x= tension at point x; and K_x = secant modulus at point x).

construction fabrics normally available to theater of operations engineers and to conservation of time and materiel.

Military Use of Construction Fabrics

The trafficability of soils near tactical bridges and stream crossings is often a problem, particularly after repeated passages of military vehicles. The in-place California bearing ratio (CBR) value may be as low as five to 15 percent prior to any traffic, providing the soil and root mat are undisturbed. However, once vehicle traffic begins to churn and blend the cover material, the CBR value may drop below one percent.

The standard solution is to remove the mud and replace it with dry, trafficable materials (usually crushed stone). However, the next rain will probably reduce the area to its original condition if traffic continues. This is true regardless of the type of cover material used, unless excessive quantities are placed.

Adequate drainage is needed, plus something to keep the poor quality subgrade from mixing with the better quality cover material. This is where the geofabric is most valuable. The quantity of aggregate needed to support traffic over low strength subgrades can be reduced by up to 50 percent through the use of a fabric interface.

Geofabrics are composed of two types of materials, *geotextiles* and *geomembranes*. The most basic difference between them is that geotextiles are permeable, while geomembranes are impermeable. Both may be either woven or non-woven, however, the geomembrane will have a second layer of impervious material bonded to the fabric base to prevent passage of fluids.

There are presently hundreds of fabrics on the commercial market. The profusion of these products and the manufacturers' claims about them make it difficult to judge their usefulness. However the "secant modulus" seems the best method for comparison of different fabrics.

The secant modulus is a key property of geofabrics designed for soil reinforcement. The modulus is the ratio of the tension on the fabric to the elongation of the fabric caused by a standard test load. A high modulus means a low stretch while a low modulus would indicate more stretch, thus less ultimate strength.

The modulus of a fabric is determined by plotting the amounts of elongation and the tensile force used to effect that elongation (strain). A sample curve showing the secant modulus, K, is given. The value of K is generally taken at elongations of ten percent. While the ten percent value is not by itself significant, its use does allow for ready comparison with other fabrics.

Results of tests have shown that geofabrics under a loaded surface will significantly reduce elongation at the interface of the aggregate and the subgrade. This reduction results from the geofabrics confinement of both the soil and aggregate. The reduction is greater with higher values of secant moduli. A high modulus fabric is easier to roll out, walk on, and will carry a higher traffic load than a fabric of lower secant modulus. (Reference 1).

It has also been found that the tensile/elastic modulus of the geofabric has a pronounced effect on the strains within the aggregate layer above the fabric. The greater the fabric's resistance to deformation, the lower the strains will be in the aggregate layer above the fabric. The greater the fabric's resistance to deformation, the lower the strains will be in the aggregate layer above the fabric. This results in lower stress being passed to the subgrade and less rutting of the road. (Reference 2).

Using the secant modulus, K, for comparing fabrics is difficult since there is currently no industry standard for reporting the modulus of the fabric. Table 1 gives K values for the more common fabrics. Depending upon fabric construction, i.e., woven or nonwoven, spun bonded, needle punched, etc., it may have different elongation properties in different directions. A manufacturer may choose to report the stronger of the two moduli for directional fabrics, the weaker, or the average. Published literature is generally nonspecific about the direction of the test, or the type of test done on each fabric. (Reference 3). There are two test methods for use with directional and non-directional fabrics: the uniaxial for woven fabrics, and the biaxial for nonwoven fabrics. The results obtained from a uniaxial test for a woven fabric are not much different from those using a biaxial test. However, with nonwoven fabrics the difference is important, and the biaxial test is strongly recommended. A review of Table 1 shows the increased value for K using the biaxial test for nonwoven fabrics. (Reference 4).

Data published by manufacturers often has information on grab tensile strength and elongation. However, to permit accurate comparisons the results listed must state the test method used and the percent elongation at which the measurements were taken. The preferred elongation for secant moduli data is ten percent.

Design Using Geofabrics

Extensive work by the Woodward-Clyde consultant firm and the Corps of Engineers' Waterways Experiment Station (WES) at Vicksburg, Miss., has resulted in the development of a very useful graph. Given the anticipated vehicle requirements and the available materials, e.g., number of passages of vehicles, in-place CBR of the soil and type(s) of fabric(s), the reduction of the cover aggregate can be determined for that section of road. The reduction is relative to the same

Fabric Trade Name and Secant Modulus Values

Fabric Trade Name	*Woven (W) or Nonwoven (N)*	*Uniaxial Text* kN/m	*Biaxial Text* kN/m
Bay Mills 196–380	W	700	
Nicolon 66475	W	633	
Polyfilter–X	W	180	
Advance Type I	W	188	
Nicolon 66186	W	190	
Permealiner M–1195	W	124	
Bidim C–42	N	39	198
Advance Type II	W	126	
Terrafix NA 330	N/W	85	
Polyfilter–GB	W	72	
Bidim C–38	N	24	122
Filter–X	W	60	
Bidim C–34	N	18	97
Lotrak 16/15	W	64	
Nicolon 66530	W	60	
Typar 3601	N	68	64
Bidim C–28	N	12	76
Stablienka	N	48	
Supac	N	13	
Monofelt N–5500–01	N	13	
Bidim C–22	N	16	54
Typar 3401	N	39	44
Mirafi 140	N	26	
Stabilenka	N	30	
International Paper 503	N	12	
Stabilenka T–80	N	12	
Enkamat 7020	N	5	
Enkamat 7010	N	1	
All of the above were tested at 10% elongation. The two listed below were tested at the percent elongation shown (%).			
Reeves T–16	W	200	(10%)
Reeves T–17	W	426	(15%)

All uniaxial tests are in the warp (long direction) plane, and all values are given in kilo-Newtons per meter.
(1 lbf/in = 0.175 kN/m)

Table 1

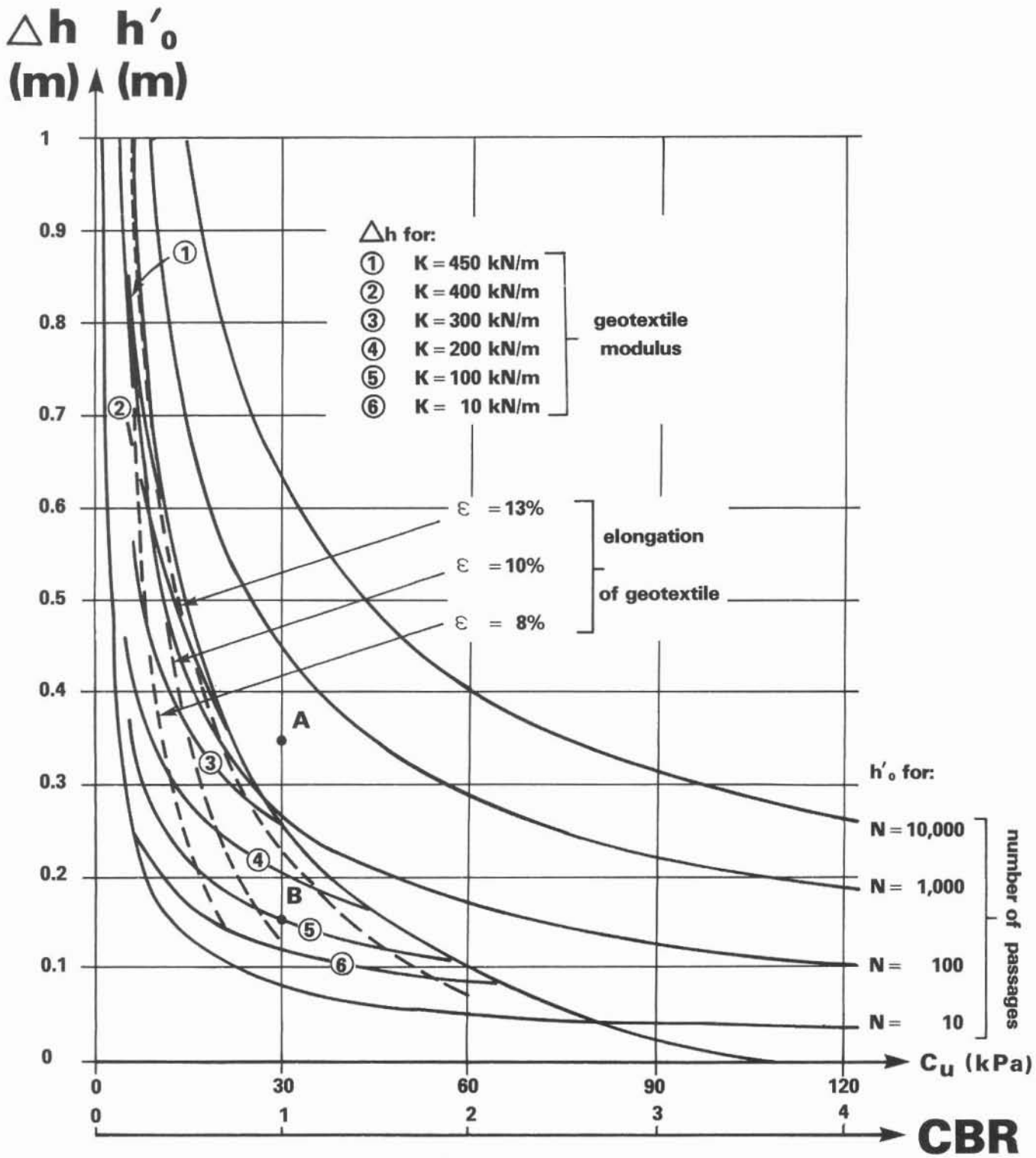


Figure 2. Aggregate thickness h'_o (case without geotextile when traffic is taken into account) and possible reduction of aggregate thickness $\triangle h$ resulting from the use of a geotextile vs subgrade soil cohesion.

road without fabric. The key to determining that reduction is the K value of the fabric placed between the in-place soil and the cover aggregate. The graph, shown on page 22, was developed through numerical analysis which correlated the following factors: soil strength, wheel loads, fabric strength and the soil-fabric system. Two facts were used to minimize the number of variables and charts. The first was that the thickness of the aggregate using CBR and number of passages does not depend upon the fabric to be used. On the graph, this value is represented as h_o'. The second fact was that the reduction of cover aggregate does not depend upon the traffic. This value is represented by Δh. These two facts permitted both h_o' vs CBR and Δh vs CBR to be plotted on the one graph. Both curves are actually families relating various vehicle passages and geofabric moduli, respectively. (Reference 4)

The graph was set up for a standard 18 kip single-axle, dual wheel load and the formation of all 11 inch deep rut. It appears to be in general conformity with test results generated by WES and will assist military engineers in the trial design and aggregate reduction determination of theater of operation roads.

The following is a sequence of steps to determine the aggregate reduction using a geofabric.

1) Evaluate the CBR value of the subgrade at the anticipated time of construction. This should include any degradation caused by prior traffic and construction equipment. The cone penetrometer and airfield index may be used to find this value.

2) Estimate the number of passages, in equivalent 18 kip single-axle vehicle units (see Figure 3).

3) Using Table 1, find the value for secant modulus for the fabric on hand, or select best if several are available. If the fabric is not listed on the table, its value of K may be calculated from the manufacturer's data.

4) Enter the graph (Figure 2) at the in-place CBR value and read up to the number of passages. Read to

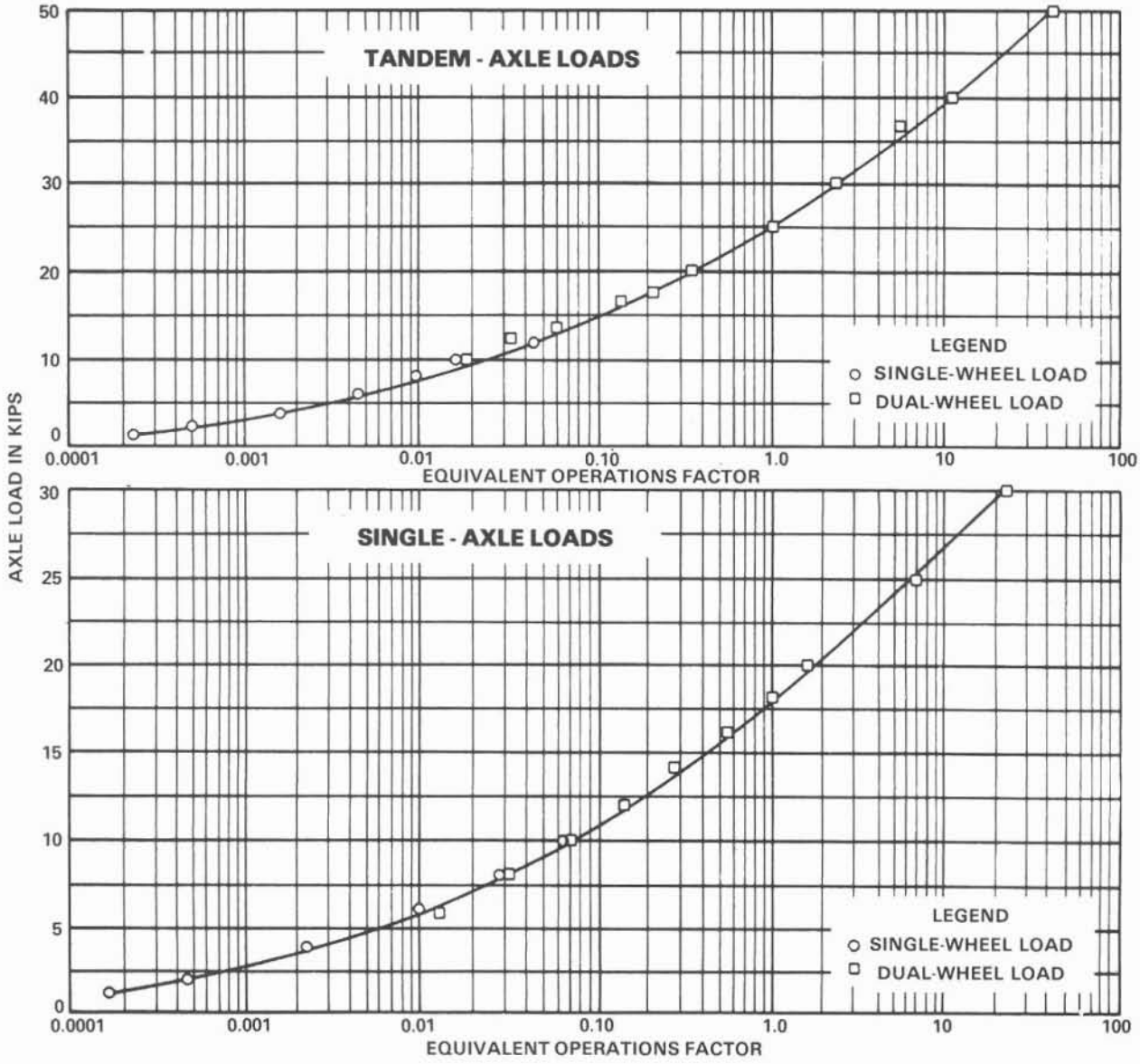


Figure 3. Flexible pavement design curves for roads, equivalent operations factor for tandem-axle and single-axle loads. Taken from TM5-330/AFM 86-3, Vol II.

the left, the thickness of aggregate required, H_o', without fabric. Record and save for step 6.

5) Enter the graph (Figure 2) at the in-place CBR value and read up to the approximate K value of the fabric, in kN/m. Read to the left the Δh value for reduction of aggregate.

6) Subtract the value found in step 5 from that found in step 4. This is the required aggregate depth when the fabric is first placed on the subgrade. As traffic passages accumulate, it may be necessary to add aggregate to weaker portions of the road as spot fill.

Equivalent 18 kip single-axle vehicle passages can be determined through the use of Figure 3, *Equivalent Operations Factor*. This procedure equates all vehicles to an equivalent vehicle for use on the aggregate reduction graph, Figure 2. The anticipated traffic is estimated by type and load, and an equivalent operations factor is selected from Figure 2. The sum of the daily traffic equivalent operations is multiplied by the planned life of the road in days. This will give the total vehicle passages for the planned road.

Example

a. Equivalent vehicle passages

Given: vehicle load, operations per day and planned life of the road; the operation factor, equivalent operations per day and the total passages may be calculated.

Axle or gross load in pounds	*Type vehicle by axle*	*Operations per day*
1,000	single	200
5,000	tandem	175
10,000	single	100
10,000	tandem	200
20,000	tandem	90

Planned life of road is 26 weeks.

Axle or gross load (pounds)	*Operation factor (from Figure 3)*	*Operations per day*	*Equivalent operations per day*
		Single-axle	
1,000	0.00016	200	0.032
10,000	0.007	100	0.70
		Tandem-axle	
5,000	0.003	175	0.5295
10,000	0.024	200	4.80
20,000	0.360	90	32.40
Total equivalent operations per day (EO/D)			38.4615.

Planned life of road, 26 weeks with 7 days per week.
Total passages = (weeks) × (days/week) × (EO/D) i.e., (26) × (7) × (38.4615) = 6,999.99 ∅ 7,000.

b) *Aggregate Reduction*

Given: vehicle passages = 7,000,
In-place CBR = 1%,
Fabric: Reeves T–17 w/k = 426 kN/m.*

*Reeves T–17 is currently available in the military supply system.

Enter Figure 2 at the bottom with the CBR value of 1 percent. Read up to the point of passages, then read to the left the value for h_o' of 0.57 m. For the fabric enter the figure at CBR of 1 and read up to the K value of 426 kN/m, read to the left the Δh value of 0.25 m. The required thickness is 0.57—0.25 m giving 0.32 m or approximately 12½ inches. The savings is approximately 10 inches , or 44%.

c) To calculate the secant modulus of a fabric

Given: grab tensile strength of 102.8 lbf/in at 10% elongation. Secant Modulus = (gbs) ÷ (el), thus K = (102.8) ÷ (0.10) = 1028 lbf/in.

To convert to SI units, 1 lbf/in = 0.175 kN/m, so (1,028 lbf/in) × (0.175) = 179.9 kN/m. This value may be used to enter Figure 3 to determine aggregate reduction.

The aggregate reduction example showed a savings of about 10 inches. If this were a T/O road 23 feet in width and one mile in length, the aggregate saved would be approximately 3,750 cubic yards. Additional savings would be realized through reduced maintenance of that section of road.

It has been suggested by both Mr. Giroud, (Reference 4) and Mr. Webster, (Reference 1), that a fabric with a very high secant modulus would make possible a limited passage road with *no* cover aggregate. This could be applicable for a hasty road with planned low traffic volume and a very short term requirement.

Table 1 lists some of the geofabrics that are, or have been available commercially, as well as two (Reeves T–16 and T–17) which are available in the military supply system. The values shown were derived from a variety of sources, and may not reflect the current products on the market today. The K value will assist in selecting either the best fabric from those on hand, or in ordering one which will suit the requirements for the project. The table will also permit the determination of the aggregate reduction for that fabric.

Installation

Installation of geofabrics is not a difficult task but should be done with care to avoid tearing the material. There is also a requirement to overlap the ends and/or sides at joints. The five steps below will assist in the proper placement of fabrics for road and airfield use:

1) The area to be covered should be cleared of all sharp objects which might tear the material. Any large objects which might cause deformations in the material as fill is placed should be removed.

2) If possible, the site should be rough graded and compacted. A significant increase in strength will result when the subgrade is compacted even marginally.

3) The fabric is almost always supplied on rolls. This permits the fabric to be unrolled over the area to be covered. This may be done either by hand or machine, depending upon the subgrade. In cases where the subgrade is covered by a mud blanket, the fabric should be only partially unrolled. As fill is placed on the fabric it will cause the mud to push out ahead of the fabric. The

object is to avoid trapping pockets of mud under the fabric. When using equipment to spread the roll, it is best to operate the machinery directly on the subgrade and not on the fabric. This will help in preventing tears in the fabric.

4) At the end of each roll, and if two sections are placed side by side, an overlap must be made. The amount of overlap is dependent upon the subgrade, the expected traffic, the depth of fill and the fabric being used. As a general rule, the following overlaps are recommended, based on the CBR of the in-place soil:

CBR, percent	20	15	10	8	6	4	2
Overlap, percent of roll width	10	12	14	15	18	22	25

(Reference 5)

The use of fabrics will not cure a poor design, nor will their employment turn soup into concrete. The minimum CBR value which will support an aggregate-fabric system has not yet been determined and is beyond the scope of this article. However, fabric without aggregate covering has been used successfully in some cases. It is noteworthy that the value of fabrics drop considerably with CBR values above five percent. The higher strength soils will be aided by the separation action of the fabrics, and their use for that function may be cost justified.

There are other areas of fabric properties that may affect field performance which have not been discussed in this article. The use of the secant modulus and the graph developed by Mr. Giroud (Reference 7) will establish a base for fabric performance through K values.

The military engineer can now design a theater of operations road over a low strength soil with reasonable confidence in the performance of the end product and can now work towards the full utilization of his limited construction materials.

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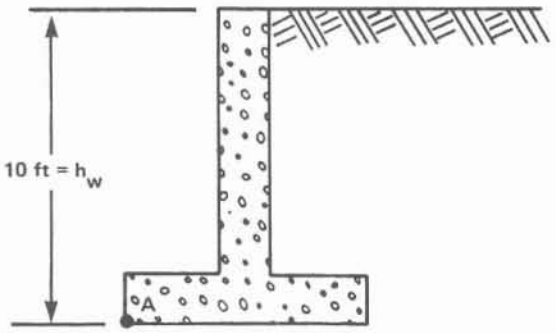
Capt. Philip Jones is a senior instructor of soils and equipment utilization for the Roads and Airfields Branch, U.S. Army Engineer School, Fort Belvoir, Va. He is a graduate of the U.S. Military Academy and has served as S-3, 565th Engineer Battalion and as commander of A Company, 78th Engineer Battalion. He has a master of science degree in civil engineering from the University of California at Berkeley.

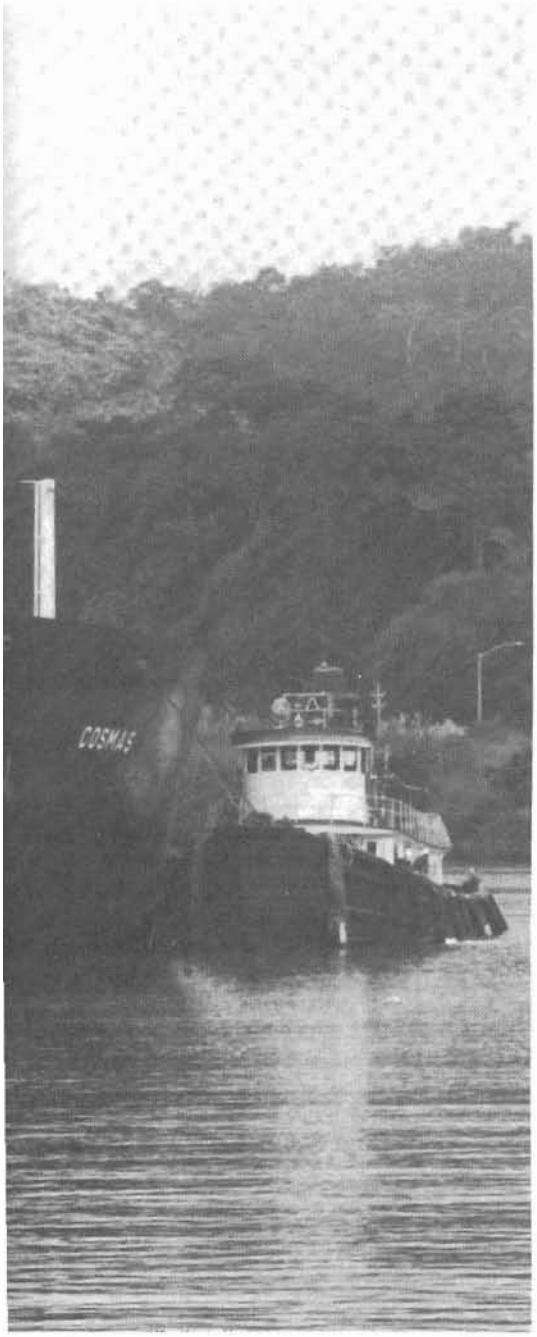
The ENGINEER Problem



A retaining wall is to be constructed as shown. What resisting moment must be developed per foot of the wall to keep it from overturning about point A? The density of the soil (γs) is 130 lbs/ft^3 with an internal angle of friction ($\emptyset$) of 33.5. There will be no traffic on top of the wall or the soil.

PANAMA
Keeping the Canal on Track

by Capt. Frederick R. Ferrin



A crew works to expose rail soon to be replaced using the "alternate tie" method. Until now, the Panama Canal's tow track system has had few improvements since its installation in 1913. (Photos by Capt. Frederick Ferrin.)

One of the Army's smallest and most unique units is the U.S. Army Element, Panama Canal Commission. A company grade officer's assignment to the Commission is normally an advanced civil school utilization tour, and from the moment your sponsor tells you to leave your uniforms in storage and to stock up on light clothing, you know this will be no ordinary assignment.

History

The U.S. Army Corps of Engineers' long and illustrious history in Panama began before the year 1900, when various Engineer officers, including the Chief of Engineers, were appointed to investigative committees evaluating the feasibility of excavating a canal across the Isthmus of Panama. The Corps' legacy continued with the appointment of Lt. Col. George W. Goethals, an Army Engineer who replaced chief engineer John Stevens under whose masterful direction the first phases of canal construction were completed. Two other Engineers, Maj. David D. Gaillard and Maj. William Sibert, once roommates at West Point, were chosen to direct the most difficult construction efforts of the Panama Canal—the 100,000,000 cubic yard excavation between Lake Gatun and the Pacific entrance, and the massive concrete structures of Gatun Dam and Gatun Locks.

After the canal opened in August 1914, George Goethals remained as governor of the Canal Zone, and until the zone ceased to exist (by order of the Panama Canal Treaty of 1979) the position of governor was traditionally a Corps of Engineers assignment.

The duty environment at the canal is unique because of its tropical setting, unusual political status and because the canal itself is so unusual. Officers assigned to this project gain experience few others share. Americans and Panamanians, military and civilian; each doing their part to keep the canal open to world shipping. Additionally, most officers acquire a working knowledge of Spanish in order to effectively communicate with their Spanish-speaking co-workers.

The U.S. Army Element, Panama Canal Commission, is currently comprised of four Engineer officers commanded by Maj. Michael Bates. The commander also serves as director of the Engineering and Construction Bureau, which employs 2,480 civilians within its five divisions of engineering, electrical, maintenance, dredging and industrial.

In January 1981, the maintenance division began renovation of the ship tow track system at the three sets of canal locks. The project, expected to be completed by 1985, will possibly be one of the last, major in-house projects undertaken by the commission before transfer of the canal to the Republic of Panama in the year 2000.

Few improvements have been made to the original tow track system, installed circa 1913 during construction of the locks. Much of the system has become badly worn, and the weight of today's powerful towing locomotives and the lateral loads induced by larger ships have dramatically increased stresses to the system.

The towing system consists of two 90-pound crane rails, a continuous slotted rack with which the towing locomotive's quill gear meshes and a 440-volt conductor slot which provides power to the locomotives.

The track renovations call for repair or replacement of system components as necessary; and at a minimum, the 90-pound rail closest to the lock chamber must be replaced with 105-pound rail and new, high-strength attachment hardware will be installed.

The most important criterion of the project is that replacement of the rail system must not effect normal canal operations. Any disruption of this strictly programmed and vitally important commercial enterprise causes worldwide repercussions in the shipping industry. The project engineer, therefore, must make maximum use of the time between the passing of each day's last and first ships. It is only during this daily "window" that rail may actually be removed. However, if a lane at one of the locks is placed out of service for routine or planned maintenance, the track renovation engineers will use the time to accelerate the normal renovation schedule.

Unique Repair Method

The method currently used to repair the locks' tow track system was developed several years ago by the engineering division of the Panama Canal Commission. The procedure, dubbed the "alternate tie method," is novel in that it can be performed during regular towing operations without adverse effect upon freshly placed concrete.

The towing locomotive rails are supported every eighteen inches by alternating short and long ties. A long tie supports both the waterside and landside rails, passing below the slotted rack between the rails. The short ties are, as the name implies, much shorter and support only one rail. Both the long and short ties rest on and in concrete.

Renovation begins when the concrete encasing the ties is demolished down to the ties' bottom flange. A 2½ inch hole is drilled into the concrete at the waterside end of each long tie, and a 2 inch schedule 80 pipe, driven into the hole until refusal, is then welded to the long tie. This pipe provides temporary support to the long tie as concrete below the long and short ties is demolished. The short ties are removed and repaired, and the old 90-pound rail is replaced by new 105-pound crane rail. The repaired short ties are returned

A test run over new track at Pedro Miguel Locks.

and high-strength attachment hardware is used to connect the new rail to the ties. Concrete is placed below and around the short ties and the temporary shims are removed, allowing rail loads to be transferred entirely onto the long ties while the concrete encasing the short ties is curing. Once this encasement has attained a compressive strength of 3,000 psi, the short ties are permanently attached to the track and the temporary shims between the long ties and the rail base are removed. At this point the load has been effectively transferred and is being carried entirely by the short ties. Concrete is placed below and around the long tie, up to the top flange. After 24 hours, or when the concrete has attained a compressive strength of 3,000 psi, final connections between rail and tie are made with a precision track gauge and calibrated torque wrench. The final step is placement of a broom-finished, concrete cap over the ties and around the new rail and attachment hardware.

In performing their work on the tow track system, Engineer officers assigned to the Panama Canal Commission are not only gaining valuable experience, but also contributing to the successful operation of the canal while continuing the Corps' proud and historic tradition in Panama.

Capt. Frederick R. Ferrin is a project manager for the Panama Canal Commission and directs work at the Atlantic and Pacific-side locks.

NCO Training For German Engineers

by SGM Dieter Helmig

Noncommissioned officer training and advancement in the West German Army is quite unlike the typical NCO paths in the American Army, and, as one would expect, these variations reflect some of the cultural differences of our two countries. In Germany, for example, all men from the ages of 18-28 may be drafted. Women serve in the German Army only as medical doctors, pharmacists or dentists.

After finishing intermediate school (at age 15 or 16), both male and female students receive vocational training to qualify them for their later career. This training lasts two-to-three and one-half years and could be in any skill from salesman to mechanic. By law, vocational training ends with a formal, state examination.

In the German Army, soldiers enlist in two ways—as volunteers through recruiting offices or as draftees who wish to enlist for longer terms; draftees have the opportunity to enlist anytime during their 15 months of active service. Although soldiers enlist for various terms, they may reenlist—extend their enlistment—at any time. All German soldiers fit into one of three categories. He is either a draftee, a short-term volunteer (2-15 years) or career soldier.

If an enlistee desires to serve as an NCO, he is tested before he enlists. If he passes the test, he is identified as an NCO candidate and takes basic training for three months along with draftees and those identified as officer candidates.

In the German Army, basic training is given by the division to which the soldier will be assigned. After basic, the NCO candidate, draftee and officer candidate begin six months of advanced training. In the case of engineer soldiers, common military skills are covered, as is engineer training. If he is doing excellent work, the advanced training graduate is promoted to GEFREITER (private E-2). At this point, he has been on active duty for nine months.

The NCO candidate now attends UNTEROFFIZIERGRUNDLEHRGANG TEIL I & II (NCO Basic Course Part I & II) for a total of six months. The NCO Basic Course II for engineers is given in Munich, Bavaria, and trains the soldier to be a leader, a supervisor, a specialist with expert knowledge, and an instructor. If the NCO candidate had enlisted for at least four years, he will also attend for one month a supplementary course emphasizing principles of human leadership.

After completing the NCO Basic Course and supplemental course (if applicable), the candidate must pass a test consisting of written, oral and practical portions. The test is required by German law. After returning to his unit, the successful NCO candidate is promoted to UNTEROFFIZIER (sergeant).

The German sergeant serves as a squad leader and instructor. The requirements for the sergeant grade are high, and he must be able to lead, to motivate, and to train his squad using all the principles of modern leadership.

The Senior NCO

In the German Army Corps of Engineers, many platoon leaders are senior NCOs with the rank of HAUPTEFELDWEBEL (master sergeant or sergeant major). The engineer platoon is the smallest independent element in the company, and, especially in the armored engineer company, it has a high degree of autonomy. Accordingly, it is vital that the platoon leader be able to accomplish assigned missions using his own judgment and initiative. He must be able to follow the reasoning of his superiors. He has command authority and must not wait for orders if a situation demands immediate action. It should be noted that in the German Army, commanders at all levels are given considerable latitude on *how* to accomplish a mission. When the company commander assigns his engineer platoon leader a mission, the platoon leader determines *on his own* the method and resources required to accomplish the task.

To assist him the NCO platoon leader normally has another senior NCO or deputy, and three jun-

German engineers are identified by this badge worn on a red beret.

ior NCO squad leaders. How is the NCO platoon leader prepared to be an instructor, superior and leader? The answer is through the FELDWEBELLEHRGANG (Advanced NCO Training Course). To attend the course, an NCO must: be a STABSUNTEROFFIZIER (staff sergeant), have at least four years of service, have enlisted for at least eight years, and meet specified physical fitness and professional skill levels.

The Advanced NCO Course lasts 16-23 weeks. The NCOs receive training as an instructor and are placed in command positions. Sand table instruction is an important part of this course. A large part of the course is devoted to leadership training and to civic education. After completing the course, the NCO has mastered:

- the principles of command and control
- command organization
- command and control
- logistics

All graduates are licensed to perform demolition work and to act as demolition OICs. NCOs going to ribbon bridge, AVLB or CEV platoons become licensed examiners and are authorized to issue operator permits for all engineer equipment in their platoon. To graduate, all NCOs must pass a written, oral and practical exam, as required by German law.

After the NCO Advanced Course, the NCO returns to his unit and serves an "internship." When his probationary period is over (that is dependent upon his supervisor's evaluation), he is promoted to FELDWEBEL (sergeant first class).

Completion of the NCO Advanced Course gives him the credits required to become a career NCO (who stays on active duty until age 53) or to be selected to be a FACHOFFIZIER (specialist officer)* in his seventh year of service.

* The fachoffizier is similar to the U.S. Army's warrant officer, but there are important differences. A fachoffizier, for example, may command a specialized unit; a U.S. warrant officer does not serve in command positions.

Advanced Technical Training

Every NCO, by law, has the right to advanced technical training in the knowledge and skills of a civilian occupation. All soldiers who enlist for at least four years are given an assignment pattern called a "training package." In the Corps of Engineers, this is used primarily for the main construction tracks of bricklayers, concrete laborers, carpenter, and so on.

If the NCO successfully completed vocational training and has enlisted for eight years, he receives advanced technical (vocational) training.

Most technical course graduates acquire the status of "master craftsmen" in their skill during a six or nine month course. This is called Level A. Other NCOs become qualified "clerks of works master builders" or "certified technician for construction engineering" from a two-year study course. This is Level B. All vocational training ends with a state exam.

NCO Options

During the NCO's seventh year of service, if he has graduated from the NCO Basic and Advanced Courses and performed well in a troop unit, he has to make a decision. He will either leave the army after 12 or 15 years service, become a career NCO until age 53, or apply to become a specialized officer (FACHOFFIZIER).

A soldier may also leave the NCO career field at any time and attempt to qualify as a commissioned (line) officer. Although few NCOs pass the very high officer qualification standard, those that do become the best officers in the Corps of Engineers.

This, briefly, is the process through which German engineer NCOs are trained and advanced through the ranks. All NCOs complete basic and advanced training courses, serve as squad and platoon leaders in troop units, and receive advanced technical training.

This combination of intensive training and practical experience produces the best NCO corps in the German Army.

SGM Dieter Helmig has been assigned to the U.S. Army Engineer School as German liaison NCO since 1978. He entered the Army in 1960 and has served as a platoon leader and engineer senior NCO. He was promoted to sergeant major in 1971, and is a certified technician for construction engineering in the German Army.

The Engineer Workbook

Bridging the Training Gap

by John Florence

"It is the most outstanding training management method I've ever seen. It does more to help the unit commander than any training document I've come across," says Col. Claude W. Biehn, former deputy director, Training Management Study of the Reserve Components, Office of the Deputy Assistant Secretary of Defense.

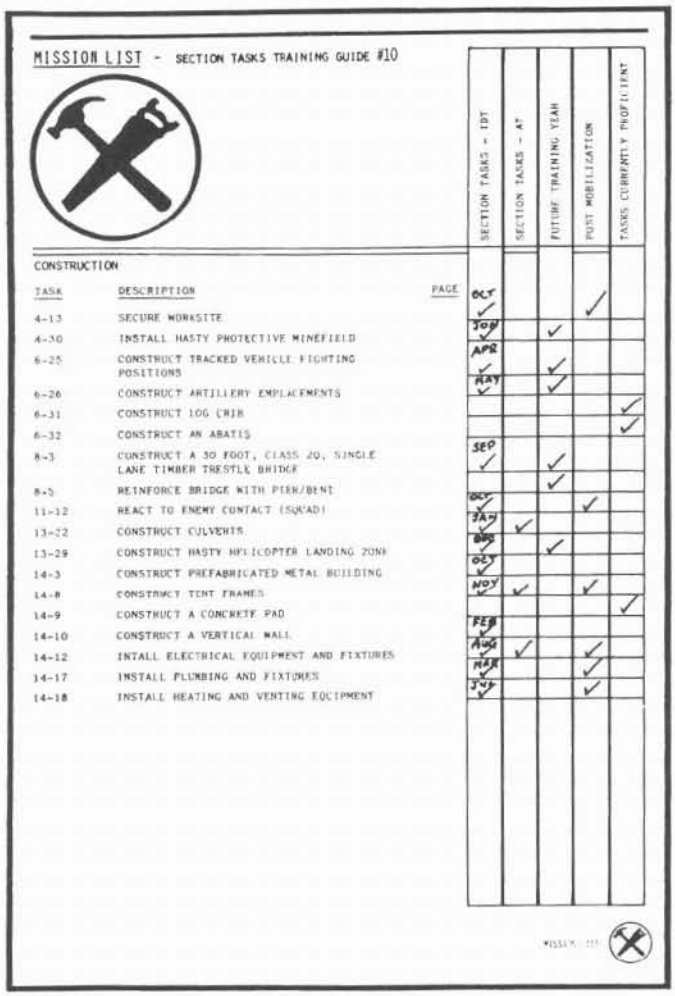
Indeed it is an impressive document. In 1,058 pages, the new *Engineer Trainer's Workbook* defines training objectives *and* supplies complete ARTEP training plans; training evaluation standards; and a plenary, Army-wide reference listing for all engineer ARTEP missions. The prodigious workbook is the culmination of a six-year effort by the 579th Engineer Battalion (Combat) (Corps), California Army National Guard, to produce explicit guidelines implementing the philosophy of the Battalion Training Management System (BTMS).

The document is being published by the U.S. Army Training and Doctrine Command (TRADOC) and distributed by late spring to all active Army and reserve component combat engineer battalions. The workbook will be bound as a loose-leaf document to encourage trainers to use it for its intended purpose—as a *work*book. Appropriate pages can be easily removed for reference or photocopied and used by trainers for planning or recording training notes.

Background

The version of the workbook distributed by TRADOC traces its lineage back to 1976 when its originators, Maj. Jerrald Jurin and Capt. Jim Combs set out to upgrade unit training.

Combs at the time was commanding B Company and Jurin recently finished his command time in A Company (where Combs had served as a platoon leader). The two men shared a desire to ameliorate training quality by providing better training guidance to their NCOs. "If our training guidance is vague or shallow," Combs says, "then


MISSION LIST - SECTION TASKS TRAINING GUIDE #10

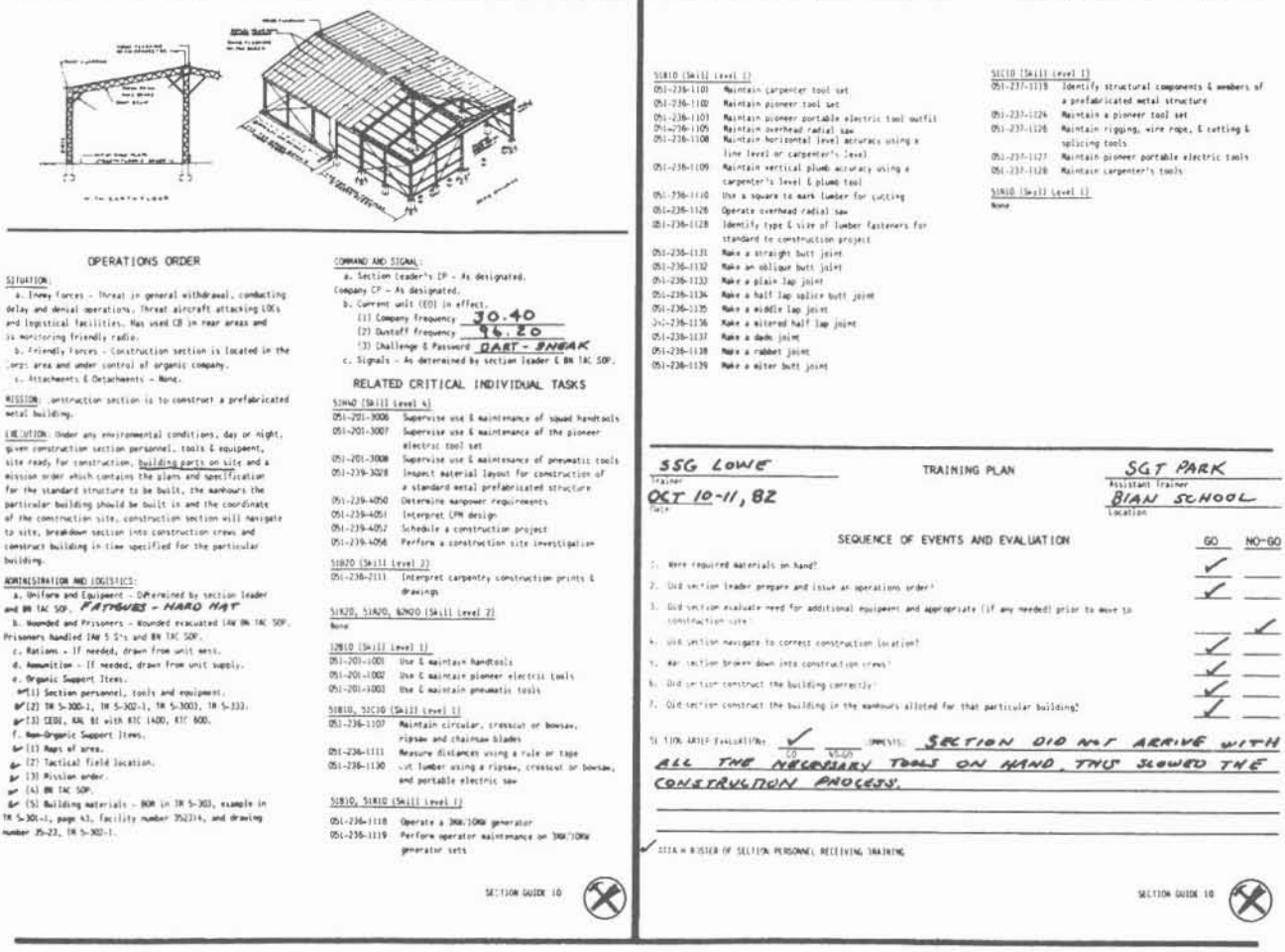
CONSTRUCTION

TASK	DESCRIPTION	PAGE	OCT	JAN	APR	MAY	SEP	OCT	JAN	DEC	NOV	FEB	AUG	MAR	JUN	SECTION TASKS - IDT	SECTION TASKS - AT	FUTURE TRAINING YEAR	POST MOBILIZATION	TASKS CURRENTLY PROFICIENT
4-13	SECURE WORKSITE																		✓	
4-30	INSTALL HASTY PROTECTIVE MINEFIELD			✓														✓		
6-25	CONSTRUCT TRACKED VEHICLE FIGHTING POSITIONS				✓	✓												✓		
6-26	CONSTRUCT ARTILLERY EMPLACEMENTS					✓												✓		
6-31	CONSTRUCT LOG CRIB																			✓
6-32	CONSTRUCT AN ABATIS																			✓
8-3	CONSTRUCT A 30 FOOT, CLASS 20, SINGLE LANE TIMBER TRESTLE BRIDGE						✓											✓		
8-5	REINFORCE BRIDGE WITH PIER/BENT																	✓		
11-12	REACT TO ENEMY CONTACT (SQUAD)							✓											✓	
13-12	CONSTRUCT CULVERTS								✓								✓			
13-29	CONSTRUCT HASTY HELICOPTER LANDING ZONE									✓								✓		
14-3	CONSTRUCT PREFABRICATED METAL BUILDING										✓									
14-8	CONSTRUCT TENT FRAMES											✓					✓		✓	
14-9	CONSTRUCT A CONCRETE PAD																			✓
14-10	CONSTRUCT A VERTICAL WALL												✓							
14-12	INTALL ELECTRICAL EQUIPMENT AND FIXTURES													✓			✓		✓	
14-17	INSTALL PLUMBING AND FIXTURES													✓					✓	
14-18	INSTALL HEATING AND VENTING EQUIPMENT													✓					✓	

Figure 1. ARTEP tasks are grouped into mission lists to aid planners in preparing training forecasts.

results are the same. As managers, we (the officer corps) have been very effective at setting training goals, but very ineffective at providing trainers the vehicle needed to arrive at those goals."

So six years ago, Combs devised his own train-



CONSTRUCT PREFAB METAL BUILDINGS — CONSTRUCTION ARTEP TASK 14-3

OPERATIONS ORDER

SITUATION:
a. Enemy forces - Threat in general withdrawal, conducting delay and denial operations. Threat aircraft attacking LOCs and logistical facilities. Has used CB in rear areas and is monitoring friendly radio.
b. Friendly Forces - Construction section is located in the corps area and under control of organic company.
c. Attachments & Detachments - None.

MISSION: Construction section is to construct a prefabricated metal building.

EXECUTION: Under any environmental conditions, day or night, given construction section personnel, tools & equipment, site ready for construction, building parts on site and a mission order which contains the plans and specification for the standard structure to be built, the manhours the particular building should be built in and the coordinate of the construction site, construction section will navigate to site, breakdown section into construction crews and construct building in time specified for the particular building.

ADMIN/LOGISTICS:
a. Uniform and Equipment - Determined by section leader and BN TAC SOP. FATIGUES - HARD HAT
b. Wounded and Prisoners - Wounded evacuated IAW BN TAC SOP. Prisoners handled IAW 5 S's and BN TAC SOP.
c. Rations - If needed, drawn from unit mess.
d. Ammunition - If needed, drawn from unit supply.
e. Organic Support Items.
(1) Section personnel, tools and equipment.
(2) TM 5-300-1, TM 5-302-1, TM 5-3003, TM 5-333.
(3) CEOI, KAL 81 with KYC 1400, KYC 600.
f. Non-Organic Support Items.
(1) Maps of area.
(2) Tactical field location.
(3) Mission order.
(4) BN TAC SOP.
(5) Building materials - BOM in TM 5-303, example in TM 5-301-1, page 43, facility number 352314, and drawing number 35-23, TM 5-302-1.

COMMAND AND SIGNAL:
a. Section Leader's CP - As designated.
Company CP - As designated.
b. Current unit CEOI in effect.
(1) Company frequency 30.40
(2) Dustoff frequency 96.20
(3) Challenge & Password DART - SNEAK
c. Signals - As determined by section leader & BN TAC SOP.

RELATED CRITICAL INDIVIDUAL TASKS

51M40 (Skill Level 4)
051-201-3006 Supervise use & maintenance of squad handtools
051-201-3007 Supervise use & maintenance of the pioneer electric tool set
051-201-3008 Supervise use & maintenance of pneumatic tools
051-239-3028 Inspect material layout for construction of a standard metal prefabricated structure
051-239-4050 Determine manpower requirements
051-239-4051 Interpret CPM design
051-239-4052 Schedule a construction project
051-239-4056 Perform a construction site investigation

51B20 (Skill Level 2)
051-238-2111 Interpret carpentry construction prints & drawings

51K20, 51A20, 62N20 (Skill Level 2)
None

12B10 (Skill Level 1)
051-201-1001 Use & maintain handtools
051-201-1002 Use & maintain pioneer electric tools
051-201-1003 Use & maintain pneumatic tools

51B10, 51C10 (Skill Level 1)
051-236-1107 Maintain circular, crosscut or bowsaw, ripsaw and chainsaw blades
051-236-1111 Measure distances using a rule or tape
051-236-1130 Cut lumber using a ripsaw, crosscut or bowsaw, and portable electric saw

51B10, 51K10 (Skill Level 1)
051-236-1118 Operate a 3KW/10KW generator
051-236-1119 Perform operator maintenance on 3KW/10KW generator sets

SECTION GUIDE 10

CONSTRUCT PREFAB METAL BUILDINGS — CONSTRUCTION ARTEP TASK 14-3

51B10 (Skill Level 1)
051-236-1101 Maintain carpenter tool set
051-236-1102 Maintain pioneer tool set
051-236-1103 Maintain pioneer portable electric tool outfit
051-236-1105 Maintain overhead radial saw
051-236-1108 Maintain horizontal level acturacy using a line level or carpenter's level
051-236-1109 Maintain vertical plumb accuracy using a carpenter's level & plumb tool
051-236-1110 Use a square to mark lumber for cutting
051-236-1126 Operate overhead radial saw
051-236-1128 Identify type & size of lumber fasteners for standard to construction project
051-236-1131 Make a straight butt joint
051-236-1132 Make an oblique butt joint
051-236-1133 Make a plain lap joint
051-236-1134 Make a half lap splice butt joint
051-236-1135 Make a middle lap joint
051-236-1136 Make a altered half lap joint
051-236-1137 Make a dado joint
051-236-1138 Make a rabbet joint
051-236-1139 Make a miter butt joint

51C10 (Skill Level 1)
051-237-1119 Identify structural components & members of a prefabricated metal structure
051-237-1124 Maintain a pioneer tool set
051-237-1126 Maintain rigging, wire rope, & cutting & splicing tools
051-237-1127 Maintain pioneer portable electric tools
051-237-1128 Maintain carpenter's tools

51K10 (Skill Level 1)
None

SSG LOWE — Trainer
TRAINING PLAN
SGT PARK — Assistant Trainer
OCT 10-11, 82 — Date
BIAN SCHOOL — Location

SEQUENCE OF EVENTS AND EVALUATION	GO	NO-GO
1. Were required materials on hand?	✓	
2. Did section leader prepare and issue an operations order?	✓	
3. Did section evaluate need for additional equipment and appropriate (if any needed) prior to move to construction site?		✓
4. Did section navigate to correct construction location?	✓	
5. Did section breakdown into construction crews?	✓	
6. Did section construct the building correctly?	✓	
7. Did section construct the building in the manhours allotted for that particular building?	✓	

SECTION ARTEP Evaluation: ✓ (GO) ___ (NO-GO) COMMENTS: SECTION DID NOT ARRIVE WITH ALL THE NECESSARY TOOLS ON HAND. THIS SLOWED THE CONSTRUCTION PROCESS.

✓ = NAME OF SECTION PERSONNEL RECEIVING TRAINING

SECTION GUIDE 10

Figure 2. Every engineer ARTEP task is presented in an operations order format, followed by a list of related tasks, a training and evaluation plan and (not shown) a list of applicable training references.

ing vehicle, the "packet training program," which proved successful at company level and was adopted by the battalion. But while it was a significant improvement to the 579th's training program, it still was not the single-source training document Combs and Jurin envisioned.

Jurin and Combs set out to simply revise the packet training program, but their three-year effort proved so extensive that an entirely new document emerged. Jurin during this time was battalion XO and was employed in a full-time manning position at the battalion headquarters at Santa Rosa. Combs quit his successful scuba diving equipment sales job to also accept a full-time manning slot at the battalion, reasoning that he could then more conveniently collaborate with Jurin on the workbook. Because their technician jobs kept them busy during the day, efforts on the workbook were reserved for nights and weekends. In February 1981, TRADOC learned of the project, provided $14,000 in funding and asked for the completed document by March 1982.

Jurin and Combs launched a whirlwind effort to complete the workbook within the 13 month suspense. Janet Jurin, Maj. Jurin's wife and a graphic artist, worked on the project full-time without pay for those 13 months, purchasing out-of-pocket most of her equipment and supplies. Often working as much as 16 hours a day, she created from scratch a readable and functional design for the workbook, procured or prepared illustrations, and researched and designed a system of logos graphically identifying each of the mission areas in the workbook. She prepared all the dummy pasteups, all camera ready pasteups and handled other production duties.

Other key personnel assisting Combs and Jurin were SSG Peggy Custer of the 579th and SFC Ronald Wiese, the battalion's active Army training advisor. By the time the workbook was ready to go to TRADOC, in just 13 months over 2,600 documented volunteer manhours had been contributed to the project. Over a four-year term,

14TH ENGINEERS

Patrons of the Engineer Workbook

According to the 579th Engineer Battalion (Combat) (Corps), California Army National Guard, the keystone in their ability to produce the *Engineer Trainer's Workbook* was the strong support of Lt. Col. Clair F. Gill and his 14th Engineer Battalion (Combat)(Corps) at Fort Ord, Calif.

The 579th-14th Engineers nexus is the Reserve Deployment Enhancement Program (RDEP). The 14th Engineers is the only active Army unit having direct experience with the workbook. Because of their affiliation under RDEP, the two units frequently train together and cooperate on jointly beneficial projects, such as the recent coproduction of the new battalion tactical SOP now used by both units.

Regarding the *Engineer Trainer's Workbook,* the 14th supported the Guardsmen with advice, manpower and served as a test bed for certain portions of the workbook. 14th Engineers making significant individual contributions to the workbook include 1st Lt. Thomas Curran who spent three months at 579th headquarters in Santa Rosa. Curran was praised by Gill and by the 579th for his long hours of painstaking research in producing reference lists for every ARTEP mission in the workbook. SFC Thomas Austin also assisted the 579th from Fort Ord as a program writer-developer.

According to Gill, 80 percent of the workbook is directly applicable to active Army engineer battalions. Gill says that so far, the workbook has been most beneficial to the 14th in preparing the training and evaluation outlines required under the Battalion Training Management System (BTMS) prior to conducting ARTEPs. Maj. Donald Holzwarth, S–3 for the 14th, cites preparation of last October's four simultaneous, company-sized, external ARTEPs as an example of the workbook's value.

Using a draft copy of the workbook, Holzwarth says his office prepared the ARTEPs in *one-fifth* the time normally required. Personnel from the 7th Infantry Division's 13th Engineer Battalion served as ARTEP evaluators and, according to Gill, "they were ecstatic" over the convenience and utility of the evaluation forms with which they were provided. The forms came from the *Engineer Trainer's Workbook.*

Although the workbook will be helpful to training planners at all levels, Gill says the primary trainer, the squad leader, will ultimately benefit most because the workbook will provide him a complete list of references for each ARTEP task. "In the past", Gill says, "we had so many references in so many different places, that it took a magician to pull them together."

If the *Engineer Trainer's Workbook* lives up to its billing, it will add its own magic to engineer training.

$22,185 of personal funds were spent on the program, most of it contributed by Combs and the Jurins.

A key supporter who Jurin credits with injecting sustaining lifeblood into the endeavor was Lt. Col. Clair F. Gill, commander of the 14th Engineer Battalion (Combat) (Corps), Fort Ord. The 14th and the 579th are linked under the Reserve Deployment Enhancement Program, and, accordingly, the two battalions often train together.

Gill provided advice, personnel, and the 14th field tested specific training programs described in the workbook. (Details on the 14th's contributions to the workbook are noted above).

COMPOSITION OF THE WORKBOOK

The workbook is divided into four chapters:

- *Chapter One* includes an introduction, general workbook overview and chapter index.
- *Chapter Two* contains key training documents including mission lists, operations orders, training plans, and a consolidated reference list for each mission area.
- *Chapter Three* is a complete training program for the headquarters company and headquarters platoons. Included are documents to plan, resource, conduct and to evaluate common task training, section training and MOS training.
- *Chapter Four* supplies professional development training plans for officers and NCOs in mission related leadership tasks and administrative duties.

The utility of the Engineer Trainer's Workbook begins with preparing annual training forecasts. Each mission category (construction, for exam-

ple) is covered by a "training packet." The first page of the training packet is the *mission list* showing the task number, title, and page location of each ARTEP task described within the packet. The mission list serves as an important planning tool since it identifies the applicable task level (squad-platoon-company) and provides space for the training planner to indicate when the unit will train in each skill area (see Figure 1). For example, referring to the construction mission list, a National Guard company commander might schedule Task 13-22, *Construct Culverts,* to be covered during annual training; Task 4-3, *Secure Worksite,* might be planned for a weekend drill, and Task 14-17, *Install Plumbing and Fixtures,* may be programmed for post mobilization. Tasks at which the unit is already proficient are also noted. According to Jurin, by using the workbook, the 579th's yearly training forecast can be completed in three-to-four hours; preworkbook planning required entire drill weekends for several months.

Using the mission list and accompanying training packet, planners can review, in a single source, all pertinent information about training a particular task, then decide the most appropriate time to conduct the training. To benefit the primary trainer, every training packet contains a complete list of applicable references ranging from manuals to TV tapes to correspondence courses.

Critics have suggested that such extensive training assistance stifles trainer initiative and denies to them the experience of fully preparing their classes. Jurin and Combs strongly disagree, saying that the trainer's mission is to present high quality training, not to become a part-time librarian prospecting for suitable reference material. In a National Guard or reserve unit, Combs notes, time is an especially precious quantity. Unit training must be prepared quickly, accurately and presented professionally.

Op Order Format

Along with the mission list and reference inventory, each training packet presents an ARTEP task as an operations order. Jurin says they departed from the usual BTMS task-conditions-and standards format because the workbook offered a valuable opportunity to encourage troop and trainer familiarity the operations order. According to Jurin, "The operations order is a proven document; it works. We want it so ingrained in our people, that they're always thinking in terms of op orders."

Following the operations order, is the *training plan* which includes a sequence of tasks for trainees to perform and a section for the training supervisor to list a go/no-go status. There is also space to indicate a pass/fail status on the overall task, an area to record the names of attending personnel and room for remarks regarding individual strong or weak points (see Figure 2).

In the three years that the 579th has been using exclusively the concepts in the trainer's workbook, Combs says that unit training quality has markedly improved and has manifested in measurably better performance during annual training. Col. Biehn, now with the Office of Policy and Liaison, National Guard Bureau, says that during his visit to the 579th last year, NCOs had high praise for the workbook. Combs says the 579th's improved training quality has led to higher unit morale and carried the battalion's retention rate to third best in the California Army Guard.

The *Engineer Trainer's Workbook* was written for reserve component engineer battalions, but active units can easily perform the minor changes necessary to make the workbook fully suited to their needs. The book should be a boon to planners, to trainers and ultimately to the troops themselves as they benefit from better planned, better organized training programs.

As Jurin says of the workbook, "I like to think of this as a life insurance policy for the soldier."

Platoon Inventory

by Maj. Curtis R. Rogers

After meeting his commander and receiving a briefing on the unit, a newly assigned lieutenant faces his first real challenge—conducting a 100 percent inventory of his platoon's equipment. His signature on that inventory will mark the final step in his full assumption of responsibility for his platoon, and he should take care to do it right.

His first step in the inventory process should be to get together with the experts—the battalion S4 or the property book officer, the company executive officer, and the company supply sergeant. Thirty minutes with an expert can unravel what at first may look like an insurmountable problem. During the discussion, he should ask them about any recent change or problem that could affect the inventory.

At the same time, he should obtain from them the current technical manuals, supply bulletins, supply catalogs, and any other publications he will need to conduct the inventory. In addition, he must make certain that the appropriate TM for each piece of equipment, along with its publication date, appears on the master hand receipt.

These publications are essential; without them an inventory is a waste of time, because they describe the equipment through photographs and equipment listings. The major components of the equipment must be reviewed with reference to both the descriptive pictures and the BII (basic issue items) list.

This advice cannot be stressed too strongly. Failure to use the current publications in the inventory process is probably the most common mistake a new platoon leader makes, and the most costly. He should therefore follow the rule: "If you ain't got the book, don't look."

Once he is satisfied that he is sufficiently educated and equipped, the lieutenant can begin the formal inventory process.

A change of command inventory is a joint mission. It should be done with both the outgoing and the incoming officers present; it should not be conducted if one or the other is absent. A sufficient amount of time should be set aside for the inventory, and the entire process should be well organized. Unrelated tasks must be set aside until the inventory has been finished.

All items that are to be inventoried—that must be counted—should be put out in the open where both parties can see them. The front of the company's area is probably as good a place as any. All of the platoon's equipment must be made available; otherwise, those taking the inventory will spend a lot of time trying to chase down the missing items.

When physically counting equipment, both platoon leaders must be certain of the actual accountable quantity. For example, a unit may have been issued or may have turned in items since its last master hand receipt was made. (If the unit is using the division logistics systems (DLOGS), a computerized list will be provided.) Normally, the master hand receipt is updated before the inventory, and this should eliminate any need to review "sub-hand receipts." But a platoon may have equipment signed out to its members; if so, it must be turned in before—not during—the inventory and then re-issued. This simple formula can be used to insure a correct balance sheet: Hand receipt count, plus issues and minus turn-ins, minus equipment in maintenance, equals the accountable quantity.

One critical aspect of accounting for the equipment that is in maintenance is to make sure the complete item is turned in. Although this is normally required, sometimes components are turned in but not some of the other end items.

The identification of equip-

Supply discipline is a high priority . . .

ment may be difficult, too, but the new platoon leader must stick with it. He may even have to measure, weigh, and compare certain items carefully. Above all, he must be certain of the presence and composition of every item of his equipment.

During the inventory, equipment should also be checked for its serviceability. If it is badly worn and a replacement can be ordered, it should be done at that time. Any missing items should be reported immediately to the commander and to the S4 or property book officer, and supply actions should be started to remedy the shortages. This equipment should not appear on the hand receipt.

At the same time, any excess equipment must be turned in to the supply people; this is as much a moral problem as it is a physical and monetary one. It may be found, also, that certain items no longer serve a purpose within a unit, and with the commander's approval, they should be turned in as well.

If any problem arises during the inventory that seems impossible to resolve, the platoon leader should go back to the experts and insist on a detailed explanation. Often the problem will turn out to be simple administrative errors on hand receipts—even experts can make mistakes!

Finally, the new platoon leader should be sure that the master hand receipt he signs reflects things as they really are. To discover otherwise later can be professionally and financially devastating.

After the new platoon leader has signed for his platoon's equipment, he should make it a point to continue to inventory and inspect that equipment throughout his tenure in that unit. In fact, the semi-annual inventory is as important as the initial one. He must pay special attention to any items that might be added to the BII after his initial inventory and see that they are put on the hand receipt.

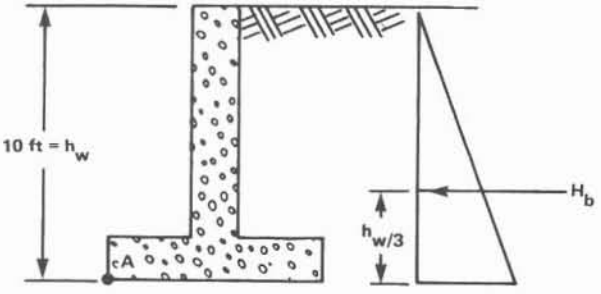
At the end of his tour, he must conduct a final 100 percent inventory with his successor.

Supply discipline and equipment accountability are high priorities for today's unit leader. A 100 percent inventory may not be as exciting as a combat patrol or a platoon raid, but it is at least as important. And any platoon leader—either a new one or an old one—owes it to himself to do it right. (Reprinted from *Infantry Magazine.*)

Maj. Curtis R. Rogers was commissioned through Officer Candidate School in 1969 and served as a rifle company commander and a battalion S4 with the 193d Infantry Brigade in Panama. He is a 1977 graduate of the University of Tampa and recently completed the Foreign Area Officer Course. He is now assigned to the Rapid Deployment Joint Task Force at McDill Air Force Base, Fla.

The ENGINEER Solution

The horizontal force of the backfilled soil (H_b) varies proportionately with the depth of the soil. The loading diagram is shown below. The entire loading system can be resolved into one force H_b. Its point of application divides the loading triangle into equal halves. This occurs at 1/3 its height (hw/3) or 10/3 feet from its base.



The force created by the soil is proportional to the density, the internal angle of friction and the height of the wall.

$$H_b = (Ka \cdot \gamma s \cdot hw)\ hw/2$$

where Ka = the coefficient of active earth pressure

$$Ka = \tan^2 (45 - \emptyset/2) = \tan^2 (45 - 33.5/2) = .289$$

H_b = (.289) (130) (10) (10/2) = 1879 lbs per foot of wall

The moment arm about point A is hw/3 or 3.33 feet. Therefore, the wall must create resisting moment of M = 1879 (3.33) = 6257 ft-lbs clockwise.

APPLE TO THE RESCUE

No Seeds. No Pits. No Errors.

Since adding an Apple II Plus microcomputer to their maintenance shop, the 14th Engineer Battalion (Combat) (Corps) at Fort Ord is producing maintenance reports and other documents in only a fraction of the time previously required. According to CW2 Steven Gardner, battalion equipment repair technician, a single Apple operator now completes in less than an hour deadline reports that used to take four TAMMS clerks an entire day.

Besides saving time, Gardner says the computer printouts are virtually error free and not being handwritten, are always legible.

Genesis of the program was Gardner and then Battalion Motor Officer Capt. Richard H. MacCombie deciding that their maintenance management system needed streamlining. When the decision was made to computerize, MacCombie moved his personal microcomputer, a TRS–80 Model I, into the maintenance shop. Gardner then determined which tasks most needed attention, and MacCombie did the programming.

Meanwhile, Battalion Commander Lt. Col. Clair F. Gill formally requested a microcomputer system from FORSCOM. MacCombie's replacement, 1Lt. James Roberts, kept the pressure on FORSCOM until the 14th finally received an Apple II Plus with Monitor III display screen and Epson MX–80 F/T printer.

The battalion currently uses the Apple to prepare daily (and other periodic) company and consolidated deadline reports directly onto DA Form 2406, *Material Condition Status Report*. The computer is also used to prepare printouts of the battalion's scheduled maintenance reports, and Gardner plans to add replacement parts record keeping to the Apple inventory since the 14th is under SAILS (Standard Army Intermediate Level Supply Subsystem).

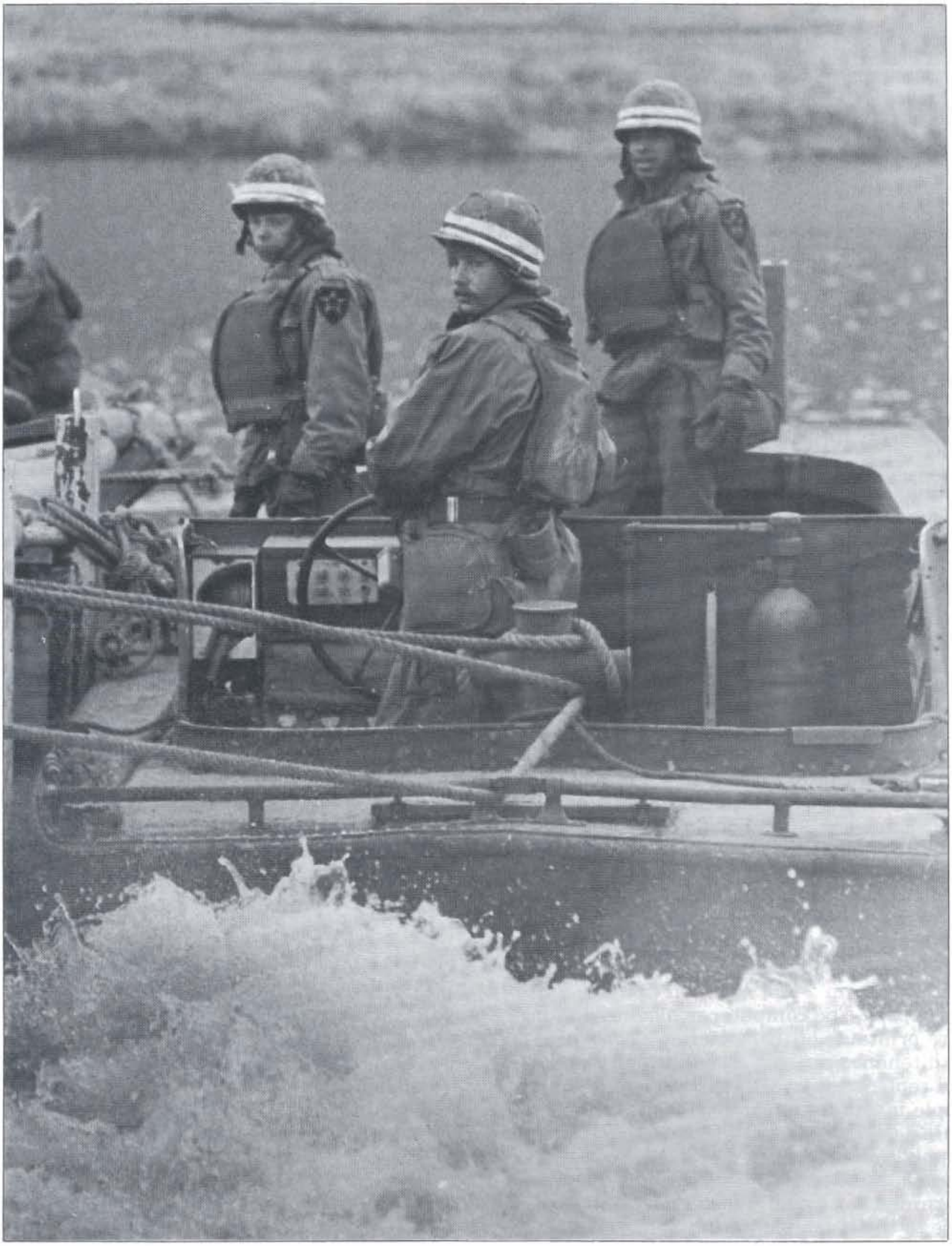
In the case of daily deadline reports, each morning the company motor sergeants provide to the battalion maintenance shop vehicle and equipment status reports. The Apple operator then adjusts the previous day's deadline report according to the new information, receives a printout, and an hour later the motor sergeants pick up their copy of the revised document. The company reports are consolidated for the overall battalion picture with all reports including a final percentage figure showing the amount of mission essential equipment operational.

The Apple system is also used for selected administrative tasks, specifically for the battalion's "good guy", "bad guy" reports.

PFC Se Ho Kim prepares a maintenance report on the 14th Engineers' Apple II microcomputer.

Battalion maintenance personnel routinely conduct spot vehicle inspections in the motor pool and battalion area. If his vehicle and log book are in proper condition, the operator receives, through his company commander, a letter from Gill acknowledging the good performance. If his vehicle fails the inspection, the operator receives a less cheery epistle. In either case, the Apple operator simply enters the vehicle driver's name and unit, and the Apple prints a programmed letter onto a DF ready for Gill's signature and the company commander's endorsement.

The 14th offers to assist other engineer units desiring to computerize maintenance operations by supplying to them copies of the paperwork required to secure the computer. The 14th will also transfer programming if they are supplied a blank 5/4-inch floppy diskette. The program will be compatible only with another Apple II Plus, 48K. For more information call CW2 Steven Gardner at (408) 242-2050, AV 929.—*John Florence*



A 27-foot erection boat pulls a ribbon bridge built by Company E, 2nd Engineer Battalion, 2nd Infantry Division, during Team Spirit exercises in the Republic of Korea.
(Photo by David Polewski)