Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

Joint Engineer Training

Headquarters, Department of the Army

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CLEAR THE WAY

By Major General Joe N. Ballard
Commandant, U.S. Army Engineer School

This issue of *ENGINEER* centers on "jointness"—the ability of U.S. Army engineers to train and conduct operations with our sister services. On the surface, operating in a joint environment seems simple enough; after all, these are other Americans whose language we speak and whose uniforms look somewhat familiar. In practice, however, jointness is very difficult. Even the professional terminology, the jargon, can be baffling. Each service has a host of minor differences in terms of training, equipment, organizations, and doctrine. The additive effect of these differences can be disruptive enough to halt operations until specific arrangements can be put into place. An ancient military toast went, "Confusion to the Enemy!" and glasses were emptied of spirits. Confusion is as debilitating as panic and, above all, we must not confuse ourselves. The true test of jointness is smooth operations from the very start with engineer units of any service who may be conducting operations together for the first time. The great cartoon military strategist, Pogo, once observed, "We have met the enemy and he is us." We cannot afford such a self-made enemy.

Our National Defense Strategy has been recast from the basis of containment of a hostile, ideologically polarized, global threat with the demise of the Soviet Union toward a "more historically normal" condition of protecting American interests on a regional basis. The work to redefine the missions of the U.S. Army and to recast the internal organization of the Army for this role is, as yet, incomplete. The engineer force structure in both the combat and construction engineering missions is subject to restructuring and downsizing. Because it is not clearly understood outside the engineer community, the construction mission is especially vulnerable to well-meaning but unwise external restructuring efforts. Engineers must not be resistant to change or hold on to cherished but obsolete policies. On the other hand, we must guard against "hollowing-out" of capabilities that history and our experiences tell us are essential. On 3 January 1914, seven months before the start of World War I, David Lloyd George, a future prime minister of Great Britain, was quoted in a London newspaper. In the interview, Lloyd George denounced the folly of expenditure on armaments and declared that the state and prospects of the world were never more peaceful. During the current recasting period in American military history, the responsible policy can only be to clearly and consistently articulate our professional judgement. Engineers must be especially clear about operational-level engineering missions, joint and combined considerations, and notional force designs.

"Training is the glue that holds the Army together." Not an original thought on my part or the first time this observation has been made, but it is constantly being proven by events in places that seemed far away from American interests just a few years ago: Somalia, Rwanda, and Haiti. Engineer soldiers must be well-trained and confident in themselves, their buddies, and their leaders to perform and survive in the diverse settings so common in today's world. In some ways a soldier's profession is more hazardous now than it was at the height of the Cold War. Since the end of the Cold War, some 700 American soldiers have received Purple Heart medals for wounds received during foreign operations.

A major "growth industry" within the military services these days is predicting the future. Many very bright people are extending the past into the future. That's always a risky business at best because only the shadows of future great events are cast into the present. "Scientific predictors" generally have a similar record as the ancients who based their statements on the behavior and entrails of birds and goats. Thinking about the future and planning for arriving at a future condition is prudent management. Basing conclusions on the certainty of a future state is imprudent and, even worse, dangerous.

In summary, exciting times. . . no doubt about it! Times filled with the innovative thinking of creative men and women and tempered by the training of engineers, who understand how the laws of physics and the strengths of materials affect human endeavors. We must learn how to achieve synergy, not rivalry, with our sister services; study our profession; and understand the political processes of our powerful democracy, while acknowledging the continuities of history. Essayons!

Engineer

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Cover photo: *Army and Marine soldiers train together on surveying techniques at Fort Leonard Wood, Missouri. Photo by Jim Anderson.*

FEATURES

DEPARTMENTS

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Photo by Jim Anderson

Joint Civil/Construction Engineer Training: It's A Reality

By Connie S. Welch

Major changes affecting engineer training are sweeping through the Department of Defense. Since August 1993, Army, Air Force, Navy, and Marine Corps personnel have worked closely to design more efficient and cost-effective ways to train initial entry service members in common civil and construction engineer (C/CE) skills. As a result of their efforts, consolidated and collocated engineer training is scheduled to begin at various locations in fiscal years (FY) 95 and 96.

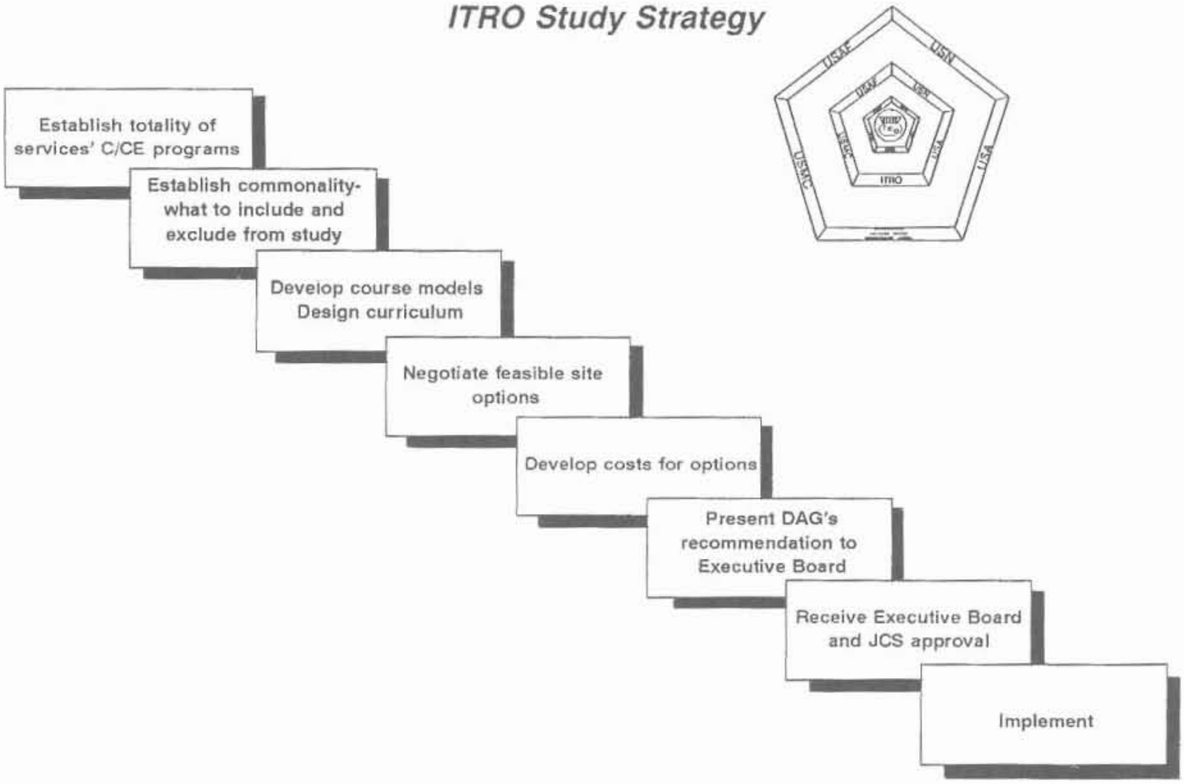
The Interservice Training Review Organization (ITRO) anticipates that benefits resulting from interservice training will include multiservice appreciation for different tactics, techniques, operating procedures and engineer equipment in addition to significant cost savings. Appreciation for other services' engineer capabilities will lead to improved interoperability and may stimulate joint construction equipment and repair parts acquisition programs.

This is a "good news" story for military engineering and our nation's defense. The complex ITRO process and program strategies described in this article are followed by the personal perspectives of committee representatives from the other services.

Changes began in August 1993, when the Civil/Construction Engineer Interservice Training Review Organization's Detailed Analysis Group (DAG) was formed at the mandate of the Joint Chiefs of Staff (JCS). The purpose of the DAG was to review the C/CE functional areas of all four services to determine if there were cost savings or training efficiencies that could be realized through consolidation or collocation. While some consolidated engineer training among the services has occurred for many years, this is the first initiative that includes all four services in common skills training.

DOD leaders realized that military reductions and diminishing resources provided the ITRO

ITRO Study Strategy



study team an opportunity to design programs and train all service members with common engineer skills while attaining efficiencies and savings. The mandate by the Joint Chiefs and the ITRO Executive Board, therefore, was to expand study areas and work toward definite "go" decisions. "Make it happen!" was the edict.

The Army was designated to chair the C/CE DAG. First, Brigadier General Robert Flowers and then Brigadier General Phillip Anderson, the prior and current assistant commandant, U.S. Army Engineer Center and Fort Leonard Wood, met the challenge of this complex project with zest and a strong will to succeed.

The tone of the study was set early. Each services' representative (voting member) was empowered to make decisions and plan for their service. DAG members included Captain John Lehman, Commanding Officer, Naval Construction Battalion Center, Gulfport, Mississippi; Lieutenant Colonel Scott Smith, Commander, 366th Technical Training Squadron, Sheppard Air Force Base, Texas; Lieutenant Colonel Charles Rivenbark and (now) Lieutenant Colonel Mark Jennings, Headquarters, U.S. Marine Corps, Washington, D.C.; and Lieutenant Colonel David Boothe, Director of Department of Construction Engineering, U.S. Army Engineer School, Fort Leonard Wood, Missouri. These individuals bought into the project and led the way in making the study a success. They recognized the many benefits to be derived from consolidating or collocating engineer training, over and above the obvious possibility of cost savings:

- Cross fertilization of engineer operating procedures.
- Standardization of training techniques.
- Standardization of equipment for future acquisition and commonality.
- Improved effectiveness of repair parts when operating in a joint environment.

The DAG developed a strategy (above) to accomplish the study and mapped a course of action that included a detailed flowchart with milestones. The approach used to develop course models in the joint arena is similar to that used in a college or university. A student (service member) decides on a major (MOS), and then selects, takes, and passes certain courses to be granted that degree (certificate).

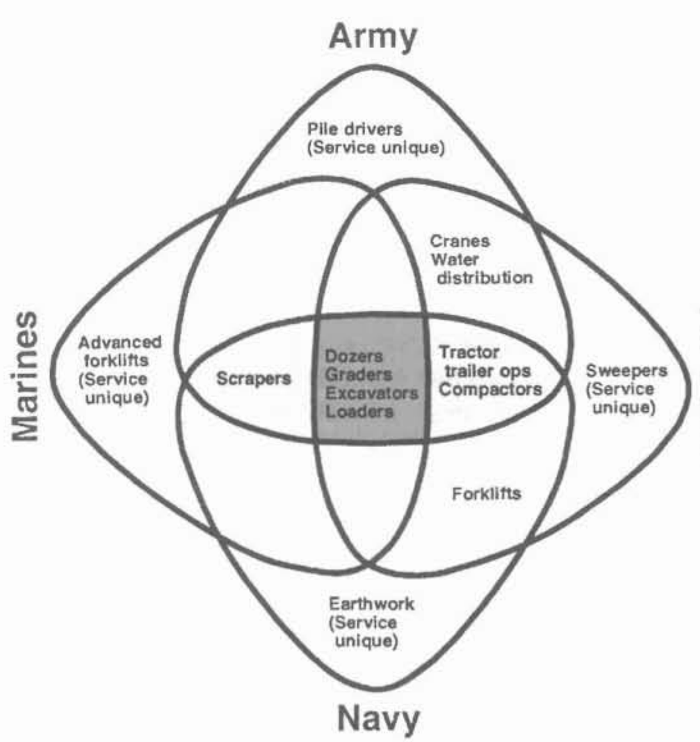
An airman, for example, must successfully complete certain training modules to become a certified equipment operator, plumber or structure specialist. As shown in the equipment operators' course model, page 4, an airman takes about six weeks of common core subjects (graders, loaders, dozers, and excavators) with the other three services. He takes tractor-trailer and compactor operations training with the Army and Navy, forklift training with the Navy, and crane and water-distribution training with the Army. Finally, the Air Force has a service-unique track only for airmen, where he trains on sweepers. The end product is a well-trained Air Force equipment operator, who has received a large part of his or her training in classes with soldiers, sailors and marines.

Approved Study Results for Civil/Construction Engineers

Type	Current Location	Joint Training Location
Equipment Operators	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Camp LeJuene, NC Fort Leonard Wood, MO	Fort Leonard Wood, MO
Engineer Technicians	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Fort Leonard Wood, MO	Fort Leonard Wood, MO
Construction Mechanics	Gulfport, MS Port Hueneme, CA Camp LeJuene, NC Lackland AFB, TX Fort Leonard Wood, MO	Fort Leonard Wood, MO Port Hueneme, CA
Structures (Carpenters)	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Fort Leonard Wood, MO	Gulfport, MS
Plumbers	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Fort Leonard Wood, MO	Sheppard AFB, TX
HVAC/Refrigeration	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Camp LeJuene, NC Aberdeen Proving Ground, MD	Sheppard AFB, TX Aberdeen Proving Ground, MD
Electrician	Gulfport, MS Port Hueneme, CA Sheppard AFB, TX Camp LeJuene, NC Fort Leonard Wood, MO	Sheppard AFB, TX Fort Leonard Wood, MO Camp LeJuene, NC
Firefighter	Goodfellow AFB, TX Memphis, TN	Goodfellow AFB, TX

The DAG met its milestone of making a recommendation for approval to the ITRO Deputy Executive Board by 15 December 1993. The recommended strategy was approved by the ITRO Executive Board and the Assistant Chairman of the Joint Chiefs on 31 March 1994.

Equipment Operators' Course Model



The DAG is now plunging into the implementation process. This difficult part of the ITRO process promises to be especially challenging because of the continually shrinking DOD budget. The major portion of the curriculum development (i.e., course design, programs of instruction, and lesson plans) has been completed and coordinated between services. Curriculum products are now moving forward for approval from each service.

In the year since the study began, much time and effort have gone into changing the joint training concept into reality—and to its current state. The approved study, now ready for implementation, will require extensive planning, coordination, and attention to detail as DAG members hammer out the many issues yet to be resolved. To prepare for full implementation next year, the DAG must resolve some complex issues, including:

Facilities

- Determine billeting standards.
- Allocate specific buildings for administration, maintenance and training that meet each service's requirements.
- Determine standards for training facilities.

Army and Air Force students extinguish a simulated aircraft crash fire at the DOD Fire Protection School.

Equipment

- Identify equipment to be shipped from one training site to another.
- Determine condition standards for equipment being shipped from one training site to another.
- Determine the most effective time to ship equipment.
- Resolve maintenance issues.

Instructor Training Courses/Certification

- Determine content and location of instructor training.
- Determine standards for instructor certification.

Performance Rating Process

- Establish an instructor rating chain. For example, determine how a Navy instructor working for an Air Force course chief will be rated on an Army post.

At this point, implementation milestones have been set and responsibilities assigned. The plan of action is aggressive and will require the continued cooperation, coordination and dedication that have gotten the DAG and its supporting cast to its current state. The end state is that joint training for engineers will begin in October 1995.

The benefits of joint training to the Army and the Engineer School are evident. As a result of this study, Fort Leonard Wood's average daily population will increase by approximately 277 students, instructors, and support personnel, and about $800,000 will be added to the annual operating budget. Additionally, ITRO brings a diverse mission to the post. Joint C/CE training provides both a one-time and recurring DOD cost savings. More importantly, the joint training process will produce the same highly trained Army soldier in every case—and in some cases a better technically trained soldier.

The ITRO study has been a great opportunity. It has allowed members of the working group to join with sister services in a common endeavor to gain engineer training efficiencies and savings. Additionally, it will place all services' engineers in a training posture that mirrors probable joint operations of the future. Actions such as ITRO are vital if the U.S. military is to train to standard within limited resources. Results of this study provide an avenue to do business better in the Department of Defense—and to provide our nation with highly skilled, capable engineers trained to operate in a joint environment.

Connie S. Welch is executive officer for the Civil/Construction Engineer DAG Chairman and technical director for the Department of Construction Engineering, U.S. Army Engineer School. She previously served as technical director for the Engineer School's Department of Instruction. Mrs. Welch holds a bachelor's degree from Southwest Missouri State University.

An Air Force Perspective

By Lieutenant Colonel Scott L. Smith

Under the auspices of the Interservice Training Review Organization (ITRO) and the Military Training Structure Review (MTSR) project, each of the military services tasked their respective civil/construction (C/CE) functional communities to participate in a Detailed Analysis Group (DAG) study. The purpose of the study was to conduct a top-down review of C/CE technical training to assess what opportunities existed to consolidate the training presently being conducted by all branches of the armed forces. The key objective of this assessment was to determine, where feasible, how DOD could consolidate C/CE training and conserve resources to the maximum extent possible. In striving to achieve this objective, the DAG was also responsible for improving training effectiveness, maintaining or improving combat readiness, and eliminating or reducing infrastructure. This whole top-down review/study effort, from my perspective as the Chief of the USAF team component of the DAG, has been and continues to be a once-in-a-career opportunity and challenge. Read on if you are interested in knowing why.

Electrical systems apprentice training at Sheppard Air Force Base.

I have had great opportunities in my career to serve at field, major command and Air Staff levels. The icing on the cake has been the chance to serve as a squadron commander two times and for two totally different kinds of squadrons—a civil engineer squadron in an operational flying wing, and a civil engineer technical training squadron in Air Education and Training Command's largest wing. Just about the time I thought I'd been given far more opportunities to make a difference than most at my grade and experience level, I was given the task to spearhead the USAF team on the DAG.

When handed this tasking, I must admit I was a tad pessimistic. The reason was my concern about really being able to achieve "jointness." Although I had just finished the USAF 10-month Air War College resident course, where jointness was a daily motto, and although I personally think jointness is absolutely critical to DOD's success in the future, I had reservations about being able to make it happen. My main teacher over the last 20-plus years, Professor Experience, had virtually convinced me there are far more roadblocks than alternate routes available to achieve the lofty and right goal of jointness. Nonetheless, after recovering from the initial shell shock of the tasking, I could see that this was a once-

Structures training at Sheppard Air Force Base.

in-a-career opportunity. I could help breach a myriad of roadblocks and, where necessary, help build routes to take the Air Force and other services' C/CE training where it needed to go to achieve success in the 21st century.

I also knew that getting this done would be a big, big challenge! It would take a lot of smart, open-minded, nonparochial folks working together to get the job done and done right. It would also require some tough decision making by the senior leadership in all services. Last, but certainly not least, it would create demands for some choice cuts out of the sacred, shrinking money cow to really make it happen.

At the time of this writing, I am elated to report that, with the outstanding help of my counterparts in the other services and the DOD senior leadership, we have successfully seized the opportunity and we are meeting the challenge. The arduous time and effort expended by the DAG has resulted in recommendations that will consolidate and/or collocate training in the following specialties: fire protection; heating, ventilating, air conditioning and refrigeration (HVAC); electrical; utilities, structures, pavement and equipment operations; engineering assistance; and construction equipment mechanics. Training for these specialties is targeted to be spread across seven DOD installations, where the best capability and capacity already exist to accommodate them: Fort Leonard Wood, Missouri; Aberdeen Proving Ground, Maryland; Camp Lejeune, North Carolina; Sheppard Air Force Base (AFB), Texas; Goodfellow AFB, Texas; Gulfport, Mississippi; and Port Heuneme, California.

The DAG referred these recommendations to the ITRO Deputy Executive Board (DEB) early in 1994, and the DEB approved them. The recommendations were forwarded to the ITRO Executive Board, which gave its approval. As a result, the DAG is now posturing to prepare the implementation plan. In this massive undertaking, the DAG will determine how to make the training moves happen as effectively and efficiently as possible. As the DAG works through this process, I am optimistic that we will sustain the extraordinary cooperation that has made our efforts highly successful so far.

From my viewpoint, when all is said and done with this ITRO/MTSR project, all of us in the C/CE business will reap significant benefits from the long overdue initiative to train jointly. For example, we will all gain a much better perspective of what each service's C/CE folks are tasked to do and why. By training together, we will be much more ready and able to fight together when the time comes. We will make strides toward standardizing our equipment and operating techniques, which in turn will save time and money. These benefits, as well as many others, will set us—and those who follow us—up for success in the future. I challenge everyone in the C/CE business to help make this success a long-term reality by building on the jointness foundation the ITRO initiative is putting in place.

Lieutenant Colonel Smith serves as commander of the 366th Technical Training Squadron, Sheppard Air Force Base. He holds masters degrees from Texas A&M University and the University of Wyoming and is a graduate of the Air War College.

A Navy Perspective

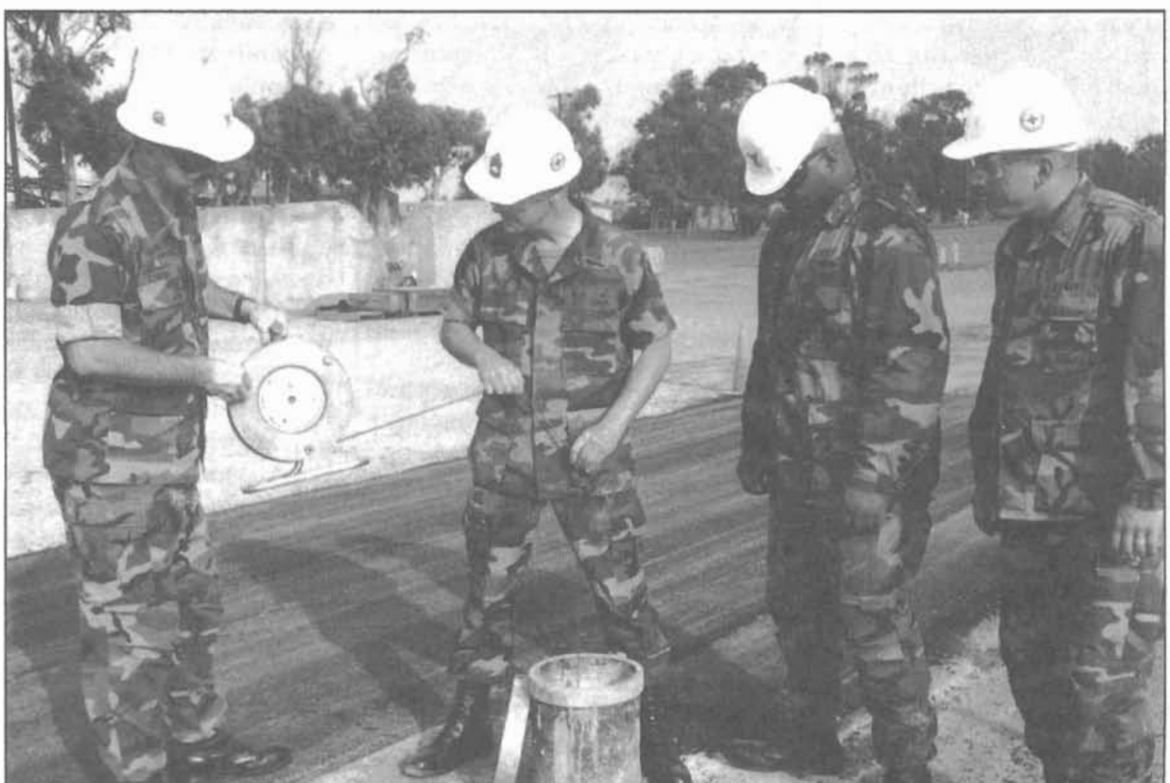
By Captain John Lehman

When selected as the Navy's lead for the Interservice Training Review Organization (ITRO) study on construction engineer training, I am sure that I had the same concerns and questions as my counterparts from the other services. I knew what the Seabees of the Navy could do and how they were trained, but I knew very little about the engineering capabilities of the other services. Although I had seen some of their equipment and had met some of their officers (usually at SAME conferences), I was not familiar with their training methods or technical capabilities.

The letter of appointment from the Chief of Naval Education and Training said my goal was to "improve the cost effectiveness of training" by consolidating or collocating training with other services. By doing so, we could eliminate duplication and reduce the amount of equipment and training aids required.

The letter appointed three other knowledgeable members to our team: two officers who were directly involved in Seabee training and a third, a retired Seabee master chief, who headed the Seabee Doctrine and Policy Branch at our headquarters in Washington, D.C. Fortunately, two of these team members had previous experience with the Navy's zero-based training and education review, which like ITRO, was aimed at eliminating waste and duplication within the training process.

At our first all-service Detailed Analysis Group (DAG) meeting at



Instructors check a water-depth gauge during joint Army/Navy well-drilling training at Port Hueneme, California.

Fort Leonard Wood, in September 1993, several things surfaced. First, each service had different titles for their specialty skills. Some of the "engineer" functions we identified were not accomplished by construction engineer units in other services; instead, they were accomplished by other groups, such as transportation. Each service had a foreign language of acronyms and course numbers, which frequently required translation. We each felt that our service had the "best" training program, equipment and facilities. And, all participants were willing to talk about their strengths, but nobody mentioned their training weaknesses.

After comparing student numbers, course lengths, curricula, and possible training locations, we learned that we could adjust curricula to improve the quality of training, and everyone felt more comfortable. Then came the first real test: to have our subject matter experts, all top-notch E6s through E8s who were proud of what they taught, hammer out a program that outlined which training objectives were common and which were service unique. We assumed that we could identify a core curriculum for each skill that would apply to all students. But we also knew there would be some service-unique curricula that would benefit only a single service. Questions had to be answered: Could we use the same curriculum if some services use a brand "X" bulldozer and others use a brand "Z" bulldozer? Will the ITRO courses provide enough operational "stick" time in the field? Can we do this or that?

After much discussion, all committee members were confident that the answer to these and similar questions was, "Yes, we can." Additionally, under ITRO students will receive some training on simulators or equipment that all services do not have now but expect to receive in the future. As our meetings progressed, the rationale for "why we can't" soon became opportunities to enhance training—"why we must!"

Costs were a major factor we had to consider, and we had many questions. Do we need more equipment, new training aids, more facilities, or more instructors or support facilities? What will be the one-time set-up costs for each scenario and which service will pay? Will training spaces or barracks need to be expanded? Can any of the services avoid constructing a facility they were planning to build? Will the recurring annual costs for the 13-week entry-level classes increase or decrease?

Equipment was another concern. Two services use mostly tactical equipment while the other two use mostly commercial equipment. Therefore, we had to decide if we should split the training in half or force-fit the four services together. Training together could result in more service-unique courses than common core courses and could ultimately increase costs.

The ITRO process continued and things seemed to fall into place. By December 1993, the DAG had costed, recosted, adjusted curriculum, and settled on one of twelve alternatives as the most cost effective. Under the recommended alternative, Navy Seabees will receive quality entry-level training at four centers of training excellence: the Seabee Centers at Gulfport, Mississippi, and Port Hueneme, California; Sheppard Air Force Base, Texas; and Fort Leonard Wood, Missouri. The executive board approved our alternative in March 1994, and ITRO was on its way.

Next came an even tougher challenge—implementation. Where would we start the move? This was a major decision because, in many cases, we needed to move *out* at one site in order to accommodate a move *in* from another site. Our challenge was to decide which domino to play first. Moving the administrative and instructor organizations to a base belonging to another service requires that local detachments be established, permanent change of station orders be cut, memoranda of understanding be drafted and interservice support agreements be effected with the hosts. We are making these decisions and implementing required changes now.

Just yesterday someone asked me, "Besides saving money, what will be gained from ITRO?" I didn't have to think long to reply: Since Desert Storm, the U.S. military has operated as a joint force in nearly every significant operation—whether it was a regional contingency, humanitarian relief, disaster recovery or nation assistance scenario. After the services implement ITRO, military engineers will know that each technician, carpenter, electrician, equipment operator, mechanic, plumber, engineering aid, steelworker, and fire fighter received the same basic training, regardless of their service. In the future, as the services move to a standard fleet of military tactical vehicles, we will be able to reduce parts support in the field and work more closely together. Even though each service still has its own missions and functions to perform, each service can better contribute to the overall missions of the Department of Defense because we better understand the capabilities of all the services. After all, we will all have trained together since 1996.

Captain John Lehman serves as commanding officer, Naval Construction Regiment, Gulfport, Mississippi. He holds a master's degree in civil engineering from the University of Texas, Austin, and is a registered professional engineer in Pennsylvania.

A Marine Corps Perspective

By Lieutenant Colonel Charles R. Rivenbark (Retired)

The Marine Corps considers the Military Training Structure Review (MTSR) process, as performed under the current Interservice Training Review Organization (ITRO), as an opportunity to accomplish several goals:

- Reduce our training costs without sacrificing training quality. There should be no noticeable difference between the Marine a unit receives from the Marine Corps Engineer School and one received from the joint school.
- Use the infrastructure available at other service's facilities to reduce the Marine Corps' investment in the training effort. By making more effective use of existing facilities, we can avoid the construction of additional facilities.
- Capitalize on existing training organizations to reduce our manpower investment while training the same number of Marines.

Interservice training is not a new concept for the Marine Corps. We have been involved in consolidated and collocated training for several years. Long before the Joint Chiefs mandated the current round of consolidation efforts, Marine Corps engineers were conducting consolidated and collocated training. We conduct consolidated bulk fuel training at the Army Quartermaster Center and conduct consolidated drafting and surveying training at the Army Engineer Center. Marines now participate in consolidated explosive ordnance disposal training at Indian head, Maryland, and Eglin Air Force Base, Florida. Our crash, fire, and rescue training is collocated with the Naval Aviation Schools at Naval Air Station, Memphis. In addition, we participate, on a quota system, in other training and education, such as the Army Engineer Officer Advanced Course, materials testing course, and advanced petroleum courses.

Throughout the MTSR process, our instructions were to search for reasons to consolidate rather than to search for reasons to remain separate. The Marine Corps' engineer philosophy was that each basic course consolidated must then collocate with the associated journeyman (NCO) course. Therefore, when our engineer equipment basic courses were determined to be compatible for consolidation, we planned to collocate our NCO, senior NCO and warrant officer courses with them. The end result will be that the entire block of engineer equipment training for both operators and mechanics will be either consolidated or collocated with the other services. The alternative would be to consolidate only our basic operator and mechanic courses, leaving the remainder of the training at the Marine Corps Engineer School.

The beauty of the new ITRO procedure is the manner in which course models are constructed. Subject matter experts from all services have equal status when they create a course model. This ensures that the unique needs of each service are identified and satisfied.

In the new engineer equipment course model, the Marine Corps anticipates providing to the Fleet Marine Force equipment operators who are even more qualified than today's course graduates. As a result, the load now shouldered by individual Marine engineer units to upgrade operator licensing will be reduced. Let me explain why this will occur. Unlike the Army, the Marine Corps has only one military occupational specialty for operators of all our engineer equipment (MOS 1345). Current Marine Corps training does not license basic engineer operators at school; instead, students are licensed after they join their new unit. We use this system because the individual organizations (Marine Wing Support, Force Service Support Group, and Division) use different types of heavy equipment. After the new course model is implemented, Marine students will receive training on several types of equipment not included in our current program. Because students will learn to operate more types of equipment under the joint training concept, Marine units will have more time to concentrate on preparing for deployment and increasing readiness.

Although the "bottom line" was the primary reason for the training reviews, common sense was the rule we used during every decision-making session. Joint engineer training, as recommended during the MTSR process, will truly assist in training Marines for the Marine Air-Ground Task Force.

Lieutenant Colonel Rivenbark (retired) was the Marine Corps representative for the Civil/Construction Engineer Detailed Analysis Group. He last served as the head, Real Property Maintenance Activity Policy Section and MOS Specialist for Utilities and Engineers, Headquarters, U.S. Marine Corps. He is a registered professional engineer in Virginia and North Carolina.

Navy Seabees and the Civil Engineer Corps:
Providing Skills to the Joint Environment

By Rear Admiral Jack E. Buffington, CEC, USN, and
Lieutenant Commander Michael Bowers, CEC, USN

In today's climate, military numbers and assets are decreasing, missions are becoming more diverse, reliance on reserves in war plans is increasing and joint operations are commonplace. As this trend continues, military professionals must learn about and work with their counterparts in fellow services. This article introduces the Naval Construction Force component of joint service engineering and contingency construction.


Seabees constructing a K-Span building during Desert Shield/Storm.

Civil Engineer Corps Officers

Since 1867, Civil Engineer Corps (CEC) officers have been responsible for building and maintaining the Navy's shore establishment. For the past 52 years, CEC officers have led Seabee construction battalions in a multitude of missions. Through the years, these men and women have been recognized by the Navy and Marine Corps as engineering professionals. Today, all CEC officers have a bachelor's degree in engineering or an engineering-related field, and more than half of them have earned graduate degrees, primarily through Navy-funded postgraduate school. Additionally, professional registration is a key milestone for promotion to senior ranks within the CEC. Overall, 42 percent of active duty officers are registered professional engineers or architects, while 90 percent of O5s (commanders) and 100 percent of O6s (captains), O7s and O8s are registered.

Civil Engineer Corps officers serve in a variety of billets around the world. Analogous to some aspects of the Army Corps of Engineers, most of our officers are dedicated to stateside or overseas base facility maintenance and repair functions, or they supervise

Seabee Enlisted Ratings

Equipment Operator (EO)	Operation of construction equipment, transportation, blasting/rock crushing, well drilling, and paving.
Construction Mechanic (CM)	Construction and automotive equipment maintenance, repair, overhaul, and management.
Builder (BU)	Carpentry, masonry, reinforced concrete, and interior finish work.
Steelworker (SW)	Welding, structural steel erection, sheet metal and ductwork fabrication.
Construction Electrician (CE)	General electrical, telephone systems, and power generation and distribution.
Utilitiesman (UT)	Plumbing, air conditioning systems, water production and distribution, sanitary and waste disposal.
Engineering Aid (EA)	Engineering technician, drafting and surveying, and soils and material testing.

In a Seabee battalion, tradesmen are organized in companies by related skills. Equipment operators and mechanics, as well as the battalion's complement of vehicles and equipment, form one company. The camp maintenance/utilities construction company consists of construction electricians and utilitiesmen. Builders and steelworkers, who are vertical construction tradesmen, generally are organized together in one or two companies, based on their mission and the number of detachments. Engineering aids form part of headquarters company in the operations department.

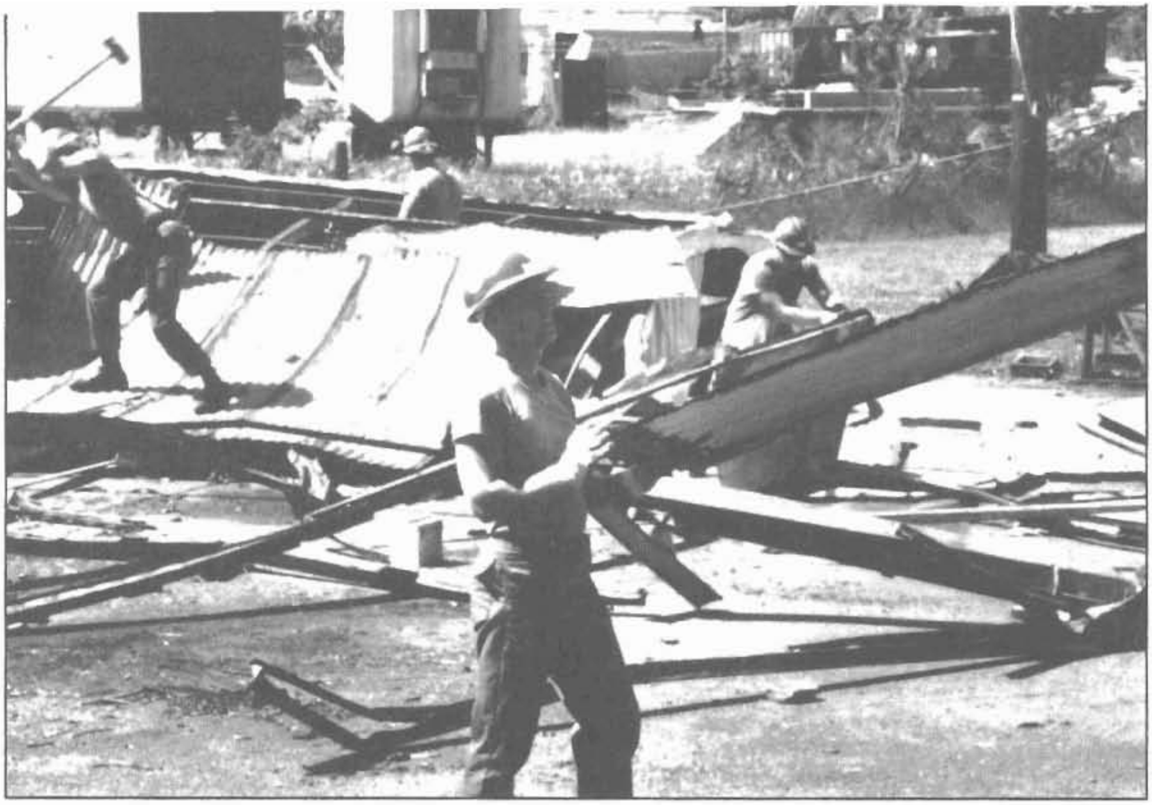
the construction of shore facilities by independent contractors through Resident Officer in Charge of Construction offices. One-fifth of our officers serve in staff billets assigned to the Naval Facilities Engineering Command (NAVFAC) headquarters in Alexandria, Virginia; the Pentagon; or fleet or Marine Corps shore and operational commands. Thirty-four staff billets are designated as "joint" duty. There, CEC officers become familiar with engineering practices; contingency construction techniques; warfare doctrine; and philosophies and objectives of the Army, Air Force, and Marine Corps, as well as host nations. Through these educational and challenging assignments, officers digest what it means for our military services to be "interoperable."

At any given time, about 100 officers are attending graduate schools or joint service schools or serving as instructors or staff at the Naval Civil Engineer Corps Officer School and the Naval Facilities Contracts Training Center (both in Port Hueneme, California) or the Naval Construction Training Centers in Port Hueneme and Gulfport, Mississippi. The remaining 10 percent of our officers are serving in a variety of operational components of the Seabees.

Seabees

Naval Construction Battalions - the Seabees - were established in 1942. The Seabees have established a "can-do" reputation based on their motto: *construimus, batuimus:* "we build, we fight." During World War II, from Guadalcanal to Okinawa, they went ashore with U.S. Marines to build airstrips and bases. In Europe, they took part in amphibious invasions from Sicily to Normandy. Since the 1960s, Seabee civic action teams have been invited to developing nations to build and repair schools, hospitals, orphanages, utilities, roads, and bridges. Seabees in Vietnam built bases from the Mekong Delta to the demilitarized zone. In the 1970s, Naval Mobile Construction Battalions (NMCBs) began to expand a communications station on the island of Diego Garcia, in the Indian Ocean. Eleven years later, with the help of civilian contractors, Diego Garcia had evolved into a large naval facility capable of supporting both ships and aircraft.

Seabees recently participated in Somalian relief efforts and in a variety of other independent and joint service contingencies and disaster-recovery operations. During Operations Desert Shield and Desert Storm, Seabees built aircraft hangars and taxiways, ammunition supply points, perimeter defenses and camps for thousands of troops—primarily Marines. Recently, Seabees have helped in recoveries from earthquakes in California, monsoon floods in Bangladesh, hurricanes in the



Nearly 800 Seabees were involved in recovery efforts in the wake of Hurricane Andrew. Here, they are cleaning up a neighborhood in Dade County, Florida.

Caribbean and a major volcanic eruption in the Philippines.

Some 325,000 Seabees and CEC officers served in World War II. Currently 10,000 Seabees and 1,375 CEC officers serve on active duty, while an additional 1,200 officers and 16,000 reserve Seabees are integrated into Navy/Marine Corps warfighting doctrine. Until 1993, women were excluded from operational components of the Seabees. This year, however, both officer and enlisted women are being fully integrated into all Naval Construction Force (NCF) units.

Seabee Mission

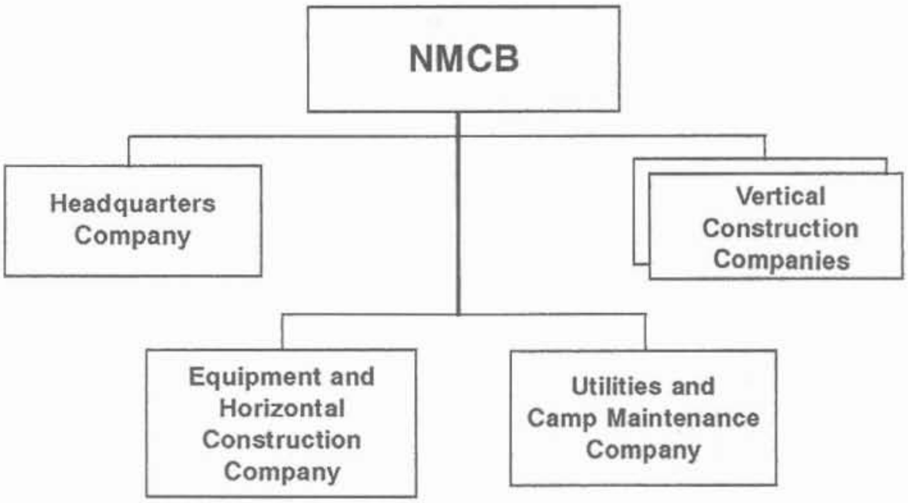
Based on current doctrine, the Seabees provide the following support to the U.S. Navy and Marine Corps and, when directed, to other services and agencies of the government:

- Responsive military advanced base construction support, including operational, logistics, underwater, shore, and deep ocean facilities construction, maintenance and operation.
- Military construction in support of Marine Air-Ground Task Force (MAGTF) operations.
- Capability to defend projects, camps and convoys.
- Amphibious assault and ship-to-shore construction support.
- Battle damage repair operations.
- Disaster control and recovery operations.
- Civic action employment.

The Seabees usually are linked with Marine Corps contingency plans, providing the Fleet Marine Force and MAGTFs extensive construction capabilities not inherent to Marine engineer forces. For example, the Seabees provide ammunition supply points, expeditionary airbases, operations buildings, port improvements or construction, warehouses, paved roads, and high voltage electrical distribution. Typical NCF projects also include follow-on enhancement work, which may have been initiated by other engineer units such as Marine Engineer Support Battalions, Combat Engineer Battalions, or Marine Wing Support Squadrons. Enhancement projects include constructing gravel or paved roads from pioneered lines of communication, completing expeditionary airfields installed by other engineer units, and installing permanent bridges to allow reuse of expeditionary bridges in the forward areas.

While working on projects, NCF units provide onsite defense for their construction sites or they join with other units as part of a perimeter defense force. NCF personnel, however, are not trained or equipped for all combat support tasks. Unlike Army and Marine Corps combat engineer units, explosive breaching of obstacles; minefield installation, marking or clearing; explosive ordnance disposal; and other combat engineer support tasks associated with direct support to ground combat elements are not normally executed by NCF units. In contrast, NCF units are highly skilled construction specialists, capable of executing general engineering (general combat service support, sustainment engineering, and survivability

Naval Mobile Construction Battalion Organization



enhancements) that exceeds the current capabilities of many other engineer units.

Seabee Organization

Naval Construction Brigade (NCB). Two NCBs are under the operational control of the Commanders in Chief of the Atlantic and Pacific Fleets. The 2nd NCB is located in Norfolk, Virginia; the 3rd NCB is located in Pearl Harbor, Hawaii. As higher echelon commands, the brigades normally are not deployed. Exercising administrative and operational control over regiments operating within their geographical area of responsibility, an NCB acts as the direct coordinator and technical advisor to fleet and component commanders desiring or requiring Seabee support.

Naval Construction Regiment (NCR). A deployed regiment directs the distribution of battalions and other NCF assets in theater, monitors task progress and quality of construction, and reviews ongoing planning and operations. During peacetime, two active training regiments are responsible for the readiness of NMCBs. They are located at the construction battalion centers at Gulfport and Port Hueneme. In addition to the two training regiments, two active duty and four reserve regiments are available to deploy to regional conflicts.

Naval Mobile Construction Battalion(NMCB). Eight active duty and 12 reserve battalions form part of today's NCF. Composed of 24 officers, 745 enlisted personnel and 230 pieces of construction equipment, an NMCB is capable of self-sufficient deployment by air or by sea within six days of notification. For rapid deployment, each battalion is equipped with an air detachment (AIRDET) of 89 men and supporting civil engineer support equipment. The AIRDET is capable of deploying independently to an austere environment on Air Force

Seabees performing runway repairs in Somalia.

Naval Construction Force		
Unit	Active	Reserve
Naval Construction Brigade	2	-
Naval Construction Regiment	2	4
Naval Construction Regiment (Training)	2	-
Naval Mobile Construction Battalion	8	12
Naval Construction Force Support Unit	-	2
Construction Battalion Maintenance Unit	-	2
Underwater Construction Team	2	-
Construction Battalion Unit	19	-
Naval Beach Group		
Amphibious Construction Battalion	2	-

transport aircraft within 48 hours notice. The battalion is also capable of forming task-oriented detachments up to one-half the size of the battalion, which operate independently in combat or low intensity conflict environments.

Adding to the self-sufficiency of the battalion, NMCBs are manned with several officer and enlisted ratings besides Seabees and CEC officers. They include: corpsmen, dental technicians, mess specialists, supply officers and various supply personnel, personnelmen, yeomen, gunners mates, postal clerks, and disbursing personnel; plus a doctor, dentist, chaplain, legalman, photojournalist, and a Marine Corps senior enlisted advisor. The battalion also has a team of skilled individuals certified in sea embarkation and air embarkation through a joint service or Air Force school.

Amphibious Construction Battalion (PHIBCB). Deployed with amphibious readiness forces, the mission of the two PHIBCBs is to provide immediate "over-the-beach" support to Marine forces. They provide a logistics link between ship and shore during amphibious operations. Personnel in an amphibious battalion are skilled in floating and elevated causeway construction, installation and operation of ship-to-shore fuel systems, and assembly and operation of self-propelled pontoon barges for cargo/equipment transfer operations. The 53 officers and 991 enlisted personnel assigned to a PHIBCB provide necessary beach improvements and camp support for the Naval support element of a joint operation.

Underwater Construction Team (UCT). The two UCTs are self-sustaining construction diving units that consist of six CEC officers and 99 enlisted personnel. They provide a wide range of underwater construction capabilities, including construction, inspection and repair of ocean and waterfront facilities, underwater battle damage assessment/repair, and underwater construction support of amphibious operations. Each UCT has three active and two reserve air-deployable diving teams plus a shore support component. UCT ONE is located in Little Creek, Virginia, and UCT TWO is in Port Hueneme.

Construction Battalion Unit (CBU). Nineteen CBUs are located at bases in the United States. Each unit is composed of one officer and 44 enlisted personnel. Peacetime employment of a CBU centers on construction and repair of shore facilities at installations where they are assigned. The CBU contingency mission, however, is to provide construction, operational, and maintenance support of rapidly deployable 250-bed or 100-bed combat-zone, disaster-relief, or low intensity conflict hospitals. When necessary, two CBUs are combined to support a 500-bed or larger fleet hospital construction mission.

Reserve Units

Construction Battalion Maintenance Unit (CBMU). Two CBMUs manned by reservists are available for recall. A CBMU consists of 7 officers and 329 enlisted personnel. Their mission is to provide maintenance (public works/minor construction) support to a forward base before or after construction has been completed. This plan allows NMCBs actively engaged in a conflict to redeploy to more forward battle areas or to another geographical region, if necessary. A CBMU also provides limited defensive warfighting capability, eliminating the need for civilian construction personnel in a combat zone.

Naval Construction Force Support Unit (NCFSU). The reserve NCFSU includes 12 officers and 202 enlisted personnel. It provides logistical and engineering support to multiple NMCBs in

"Despite the forces at work diminishing our assets and manpower...we must strive to build interservice relationships on common ground."

theater by augmenting the following mission areas: design, planning and estimating; construction material expediting/delivery; heavy equipment maintenance and repair; and long-haul transportation, paving, and concrete placement.

Peacetime Operations

Seabee battalions operate on a rotation cycle that has them operationally deployed for seven months outside the continental U.S., followed by seven months of home-port duty for training and refitting. During a 7-month deployment, battalions embark to forward deployment sites in Guam, Okinawa, Spain, and Puerto Rico. While overseas, the NMCB functions independently, under the auspices of the area commander, performing preplanned on-site construction. Projects include construction of permanent paved roads, replacement of electrical distribution systems, construction of new buildings and utilities, rehabilitation of barracks, or other such construction. On deployment, a battalion typically will send detachments on various construction missions within the operating theater. Between 13 and 100 personnel, led by senior enlisted Seabees or junior officers, deploy directly to sites such as Honduras, Panama, Cuba, Japan, Korea, and several islands in the South Pacific. On deployment, battalions emphasize construction training, command and control skills, safety, and autonomous operations. Frequently, battalions on deployment also participate in area joint exercises, such as Team Spirit in Korea and Joint Chiefs of Staff/ NATO joint-combined exercises in Europe.

Recent Joint Operations

Seabees have participated in a variety of joint service operations in the past few years. Recent examples of NCF elements in the joint arena follow:

Operation Desert Shield/Storm, 1990-91. One regiment, four battalions, one tailored NCFSU, two CBUs and one UCT deployed in support of Navy and Marine forces. In Southwest Asia, the Seabees constructed 4,750 buildings (some K-Span), aircraft hangars, six million square feet of aircraft parking aprons, 14 galleys to feed 75,000 people, and a 40,000-man enemy POW camp. They also maintained 200 miles of unpaved desert four-lane divided highway as main supply routes, erected fences and steel security towers, installed major electrical distribution systems and sanitation facilities, constructed thousands of meters of concrete decks and walls, and fabricated mock artillery pieces and tank turrets.

Hurricane Andrew Recovery, Florida, August 1992. Working with the Army Corps of Engineers and Joint Task Force (JTF) Andrew, the equivalent of one Seabee battalion from several units assisted in the recovery effort. Under the JTF, the Seabee effort was concentrated on restoring 278 schools damaged by the hurricane. In 13 days, Seabees repaired roofs, insulation systems, air conditioning, and electrical power in nearly 200 schools—the equivalent of more than $2 million in repair work.

Operation Restore Hope, Somalia, 1993: One regiment and two battalions deployed, attached to a Marine expeditionary unit commander. The Seabees worked hand-in-hand with coalition engineering units and Army, Air Force, and Marine engineers to construct encampments and repair roads, bridges, airfields and other facilities in country. CEC officers managed construction contracting support by Brown and Root via a Corps of Engineers logistics contract.

Deployed Medical Facility, Zagreb, Croatia, 1994. Since March, 34 Seabees have provided public works and minor construction support to the contingency hospital, originally set up and operated by the Army and Air Force. Due to their embark skills, a team of five Seabees are assigned to the United Nations airfield to coordinate flight-line operations. These equipment operators act as a cargo handling and manifesting unit, loading and unloading U.S., Russian, and other forces' transport aircraft.

Operation Sea Signal, Guantanamo Bay, Cuba, 1994. Two Seabee AIRDETs worked closely with an Air Force RED HORSE unit, Army Logistics Task Force 64 personnel, an Air Force Prime BEEF unit, and Marine engineers to construct migrant camps, security, and sanitation facilities for more than 40,000 Cuban and Haitian refugees.

Restore Haiti, 1994. An amphibious Seabee battalion deployed in support of a potentially aggressive over-the-beach invasion, which was diplomatically averted. Several CEC officers have mobilized for logistics contracting needs in Haiti. CEC

Navy Seabees worked diligently with the Army, Air Force, and Marine engineer units to construct tent camps at Guantanamo Bay, Cuba, for Haitian and Cuban refugees. Seabees erected additional refugee camps in Panama and on the island of Grand Turk.

officers and a UCT team, under the direction of the JTF engineer, inspected port facilities, piers and harbor cranes to determine the extent of repairs required for continued operation support.

Joint Initiatives

Joint Publication 1, released in 1991 by the JCS, is a capstone document that guides joint warfare concepts. As stated in this publication:

"Service skills form the very core of our combat capabilities. Joint warfare does not lessen Service traditions, cohesion, or expertise. Successful joint operations are impossible without the capabilities developed and embodied in each service..."

This document further embraces the importance of interservice "team building." Fully involved in interservice teamwork, the Seabees are supportive of several initiatives aimed at improving service interoperability.

Perhaps the greatest area in which to exploit improvement is the training environment. Specifically, progress to date by the Interservice Training Review Organization (ITRO) has been promising. Soon, our construction engineer technicians will be trained at five consolidated training centers of excellence. The Seabees will host training for carpenters, builders, structures (Air Force carpenters) and steelworkers at Gulfport and mechanics at Port Hueneme. Equipment operators and engineering aids are scheduled to attend training by the Army at Fort Leonard Wood, while the Air Force is planning to train electricians, plumbers, and utilitiesmen at Sheppard Air Force Base, Texas.

More importantly, it will be increasingly crucial that our engineering officers, who will be placed in strategic positions of responsibility at unified commands, gain greater exposure to engineers of other services. Two ways in which this can be accomplished is through improved officer billet exchange programs and guest seminars at advanced engineer officer courses. Further, by participating in activities sponsored by the Society of American Military Engineers (SAME) and by developing a strong joint professional reading program, our officers will gain tremendous insight into views expressed by their counterparts and the JCS.

We must also place more emphasis on procurement and logistics. Weapons systems, communications equipment, and other equipment and parts compatibility in the field must be optimized. Interservice and theater-level working groups should continue to plan service responsibilities for long-haul transportation, chemical-biological detection and decontamination, bulk liquids storage and transfer, and development of water resources. Moreover, associating together on research and development issues offers unique economies of scale.

The Future

Joint efforts create a common perspective from which to plan and operate. Ultimately, unified operations fundamentally shape the way we think about and train for war. And despite the forces at work diminishing our assets and manpower, ostensibly making each service fight for its own resources, we must strive to build interservice relationships on common ground. We must understand each service's mission and capabilities and create doctrine for effective operations. Collectively, we need to further improve in many engineering areas—and the Seabees stand ready to move forward with the other branches of our joint team!

Rear Admiral Jack E. Buffington, CEC, U.S. Navy, is the Commander, NAVFAC, and the Chief of Civil Engineers. In April 1994, he became the president of SAME.

Lieutenant Commander Bowers serves in the Seabee Division of NAVFAC.

Avoiding

The Mine-Clearing Line Charge (MICLIC)

An Engineer's Nightmare

By Captain Frank T. Akins

10 November 1994, 1005 hours: It was a hot morning—even for Africa—and the on-going war was heating up. Lieutenant Colonel Ross Chamberlain, engineer battalion commander, received a FRAGO for the next day's mission from the brigade task force commander. According to intelligence, the enemy had emplaced a 150-meter-deep mine-and-wire obstacle directly in the path of the task force, and a bypass was out of the question. LTC Chamberlain was directed to task organize into the task force breach team and to conduct a deliberate breach in support of the brigade's offensive mission. Preparation went as planned, and every engineer company commander reported their engineer systems to be fully mission capable. The OPORD was received at 1800 hours, and checks and rehearsals were executed to standard. Simulated MICLIC firings occurred during rehearsals at a secure location that closely resembled the anticipated enemy obstacle. Wake-up was at 0245 hours, and the task force was moving by 0350 hours. When the anticipated obstacle was encountered at 0730 hours, the task force suppressed, obscured, and secured the intended breach site. Enemy forces were held at bay by well-coordinated direct and indirect fires. LTC Chamberlain's blood boiled, and he could already taste unequivocal victory. Every available MICLIC was moved forward—but they failed to fire! The task force lost momentum and began to receive withering direct and indirect fire. "We're dying out here!" gasped the task force commander over the radio. Then...silence.

LTC Chamberlain awoke in a cold sweat. On leave with his family in Maine, he knew he had to go back to the battalion and take care of the "MICLIC nightmare" while there was time—before the upcoming National Training Center rotation. "We must have an effective program enforced by my chain of command to make those things work," he thought. Then he drafted this outline:

- Maintenance and Training Program
- MICLIC Malfunctions
- Tactical Assembly Area Checks
- Assault Position Checks

LTC Chamberlain drove back to his unit and called a meeting with the company commanders, the XO, the S3, the S4, the command sergeant major, and the maintenance technician, and presented his maintenance and training concept. The company commanders admitted that they lacked in-depth knowledge of the MICLIC and were not satisfied with current MICLIC training. An effective training program definitely was needed.

The battalion maintenance technician had recently called Rock Island Army Depot and had a draft maintenance plan ready for review. He reported that the MICLIC had technical malfunctions that could be reduced but not always eliminated. He would review an after-action report on the MICLIC from Operations Desert Shield/Desert Storm to ensure that all problems identified in it were addressed in his plan. The S3 would give professional development classes to officers and NCOs on the operation of the MICLIC and work with the maintenance technician to synchronize maintenance and training. The S4 ensured that the inert and live charges were ordered. He recommended that the M68 inert line charge containers remain with the unit rather be returned to the ammunition supply point because these containers have electrical connectors that can be reused for set-up and prefire checks. After several days of planning and consultation at the user level, their program was ready for trial.

Maintenance and Training Programs

The maintenance technician reported that, during motor stables, launcher and trailer maintenance were ignored until the line charge was needed. Squad leaders did not have the necessary technical manual (TM 9-1375-215-14&P, 1992 issue) or technical bulletin (TB 43-0001-36-5, 1 January - 31 March 1994 reporting period). In addition, critical parts were missing on MICLIC launchers and trailers. He called the battalion publication NCO to order the manuals. Then he met with the S3, and they agreed on the following program:

Maintenance Program

- Develop routine command-enforced maintenance checks for the launcher and the trailer, including systematic checks with an inert line charge or empty inert charge container.
- Involve leaders directly to ensure that maintenance deadline deficiencies are corrected.

Training Program

- Focus the officer and NCO professional development classes on MICLIC operation.
- Ensure that live and inert line charges are available for training; obtain empty M68 inert line charge containers to use during set-up and prefire checks.
- Reserve the range for live MICLIC training after everyone can correctly perform set-up and prefire checks.
- Develop internal checklists and closely monitor on-site maintenance and training events for the MICLIC:
  - Perform preventive maintenance checks and services (PMCS) of the launcher and trailer "by the book."
  - Use TM 9-1375-215-14&P and TB 43-0001-36-5 in garrison and the field, and perform follow-up checks to ensure that deficiencies are corrected.
  - Perform prefire checks in the tactical assembly area and in the assault position; use inert and live line charges in training.

MICLIC Malfunctions

The battalion maintenance technician called Rock Island Army Depot and reviewed the Desert Storm MICLIC after-action report, all material work orders, and TM 9-1375-215-14&P and TB 43-0001-36-5. Then he compiled the following list of known MICLIC malfunctions that he wanted to curtail or prevent:

- The arresting cable breaks when the rocket reaches its apex.
- The rocket does not fire, or it fires but does not travel far enough.
- The rocket fires but does not leave the launcher.
- The launch arm is damaged when the MICLIC is towed over rough terrain.
- The launch arm alignment pins are damaged when the MICLIC is towed over rough terrain.
- The rocket does not fire even though preliminary checks show that the entire electrical firing circuit is good. The rocket is labeled "MISFIRE" according to procedure and is shipped back to the factory; there, the rocket is tested and fires.
- The neutral safety switch gives false readings.
- The neutral safety switch plug wires are easily damaged.
- The cable routing from the MICLIC to the towing vehicle degrades the vehicle's nuclear, biological, and chemical (NBC) capability.
- The trailer is damaged when it is towed at speeds exceeding 15 mph.
- The trailer's quick-release mechanism malfunctions when it is dusty.
- The firing and rocket systems lack sufficient redundancy.
- The MICLIC cannot be fired unless the trailer is on relatively level and stable ground.
- The M34 blasting machine tests "GO" yet lacks enough voltage to fire the MICLIC.
- The fuze malfunctions.
- The safety switch assembly is cross-wired from the factory (wires are not color coded), yet checks indicate "GO."
- The entire electrical system cannot be tested without live or training linear charges.

The following checklists were developed to reduce the number of MICLIC malfunctions. The checklists, however, do not replace TM 9-1375-215-14&P, TB 43-0001-36-5, or common sense.

Tactical Assembly Area Checklist

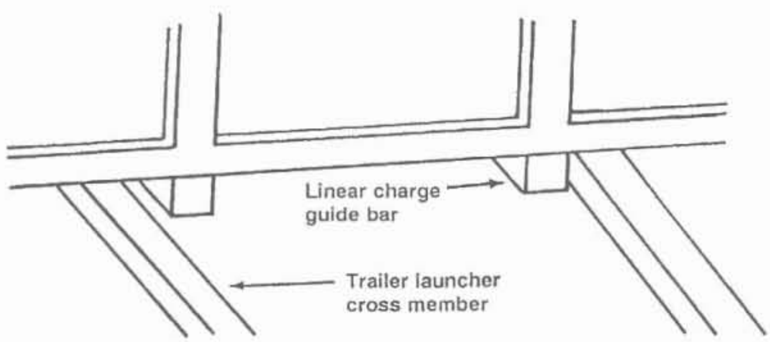
1. Obtain the appropriate manuals:
(a) TM 9-1375-215-14&P (The 1992 issue is current).
(b) TB 43-0001-36-5 (1 January - 31 March 1994 reporting period). It has electrical check information not found in the current technical manual.
2. Configure the launcher and trailer as follows:

Launcher/NSN	Authorized Trailer
MK155 MOD 0/1055-01-203-5883	M353 only
MK155 MOD 1/1055-01-281-2770	M353 or M200A1
MK155 MOD 2/1055-01-340-6084	M353 only
MK155 MOD 3/1055-01-327-3106	M353 or M200A1

The launcher and trailer must be "married up" correctly and the turnbuckles must be secure and tight. Otherwise, the charge will jump around during towing and deployment, possibly causing a misfire. Items 4 and 5 give the correct procedure.

The M200A1 trailer must be modified; TB 9-2330-323-30 contains the necessary instructions.

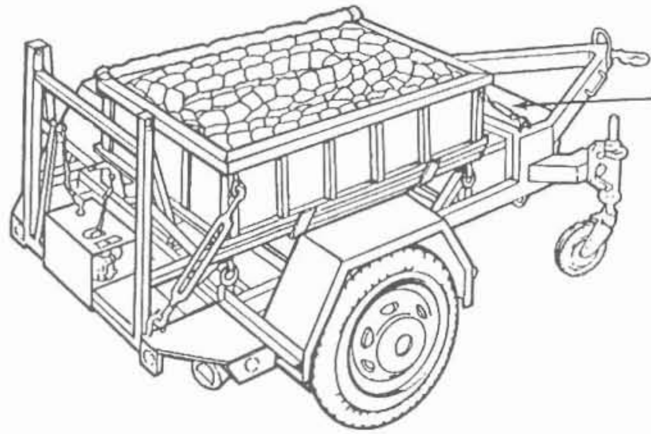
3. Position the linear charge on the launcher so the guide bars of the linear charge are between the cross members of the launcher, as shown:



4. Bolt the launcher tightly to the trailer with flatwashers, lockwashers, 15/16-inch nuts, and U-bolts.

5. Secure the linear charge to the trailer's lifting rings with all four turnbuckles. Tighten the turnbuckles, then use a 1 1/8-inch open-end wrench to tighten the locknuts on the turnbuckles. The open face of the turnbuckles should point away from the container.

Caution: Do not secure the linear charge container to the launcher or the charge may not fire correctly (see the following illustration).



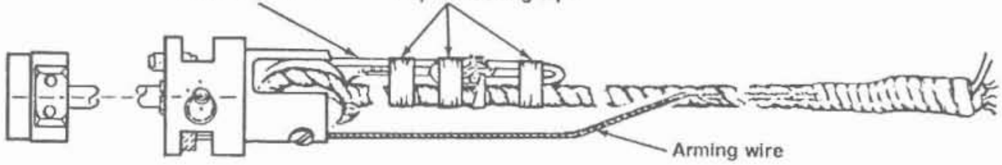
6. Check the fuze installation by feeling through the nylon sock after the launcher is on the trailer. Ensure that the electrical wires running under the sock are taped on one side of the arresting cable and that the arming wire is on the opposite side. If the electrical wires are not taped separately from the arming wire, then complete the following steps:

(a) Remove the hose clamp.

(b) Pull back the nylon sock.

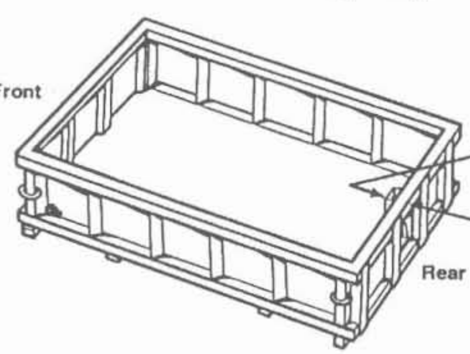
(c) Align the electrical wires on the side of the arresting cable that is opposite the arming wire, and secure the electrical wires with masking tape.

Caution: Use paper masking tape, which will break away (not stretch) during deployment. Never use electrical or "100 mph" tape because it will stretch during deployment (see the illustration below).



7. Avoid pulling on the arresting cable when working with the fuze. Pulling may damage the shorting loop built into the end of the arresting cable. The shorting loop is a system safety feature that prevents accidental detonation of the line charge.

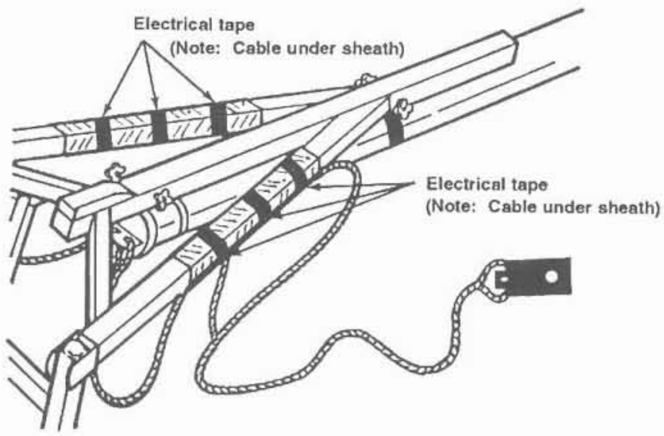
8. Secure the fuze in the fuze holder after completing the fuze installation procedure, as shown:



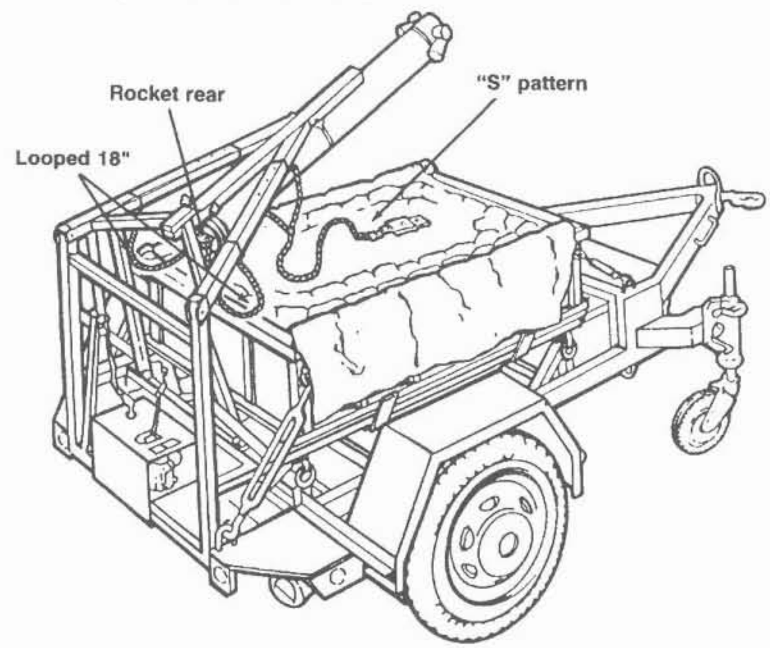
Caution: An unsecured fuze may be damaged when the line charge is deployed and result in a misfire.

9. Position the protective nylon cover on the linear charge container after the assembled fuze is installed in the fuze holder. The protective nylon cover must be peeled back from the center to install the rocket motor. The nylon cover, part of the basic issue items, should be in the launcher storage compartment. It protects the charge from dirt.

10. Loop the rocket bridle cables 18 inches and insert them under the cable sheath on the launch rail during the rocket motor installation. Use electrical tape to secure the cable under the cable sheath in three locations, as shown:



Ensure that the cable on top of the linear charge is in an "S" pattern from the rear to the front of the linear charge container. The cable sheath helps the charge deploy. Point the rocket harness connector forward (toward the minefield) and position it toward the front of the linear charge container to achieve the "S" pattern. This pattern minimizes whipping action during deployment, which may cause a misfire (see the illustration).



Caution: Handle the MK22 Rocket Motor with extreme care because the electrical lead at the rear of the rocket motor breaks easily. Always lift the rocket from the box by placing your hands around the rocket tube. Do NOT lift the rocket by the bridle cables or the electrical lead.

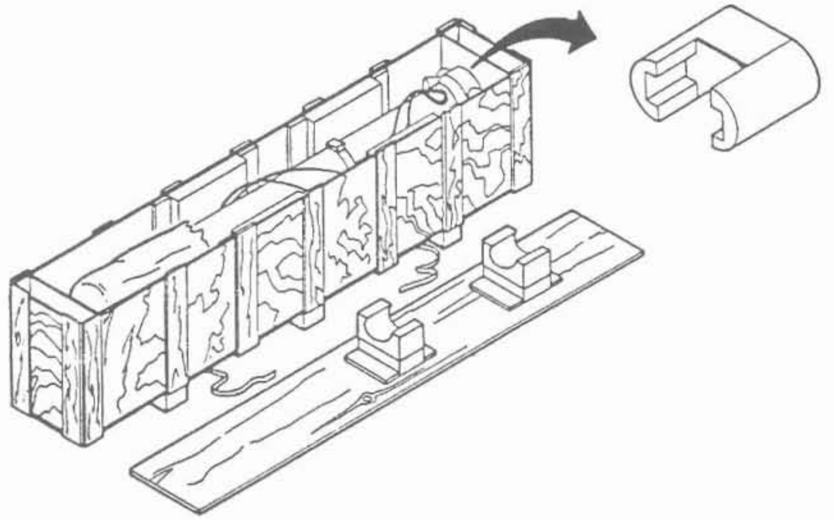
To prevent a misfire, position the rocket motor electrical lead over the end of the linear charge container; do not tie, secure, or tangle the lead to the launcher. Do NOT throw lead wires over the launching rail.

11. Protect the rocket from road shock if the MICLIC must be towed before it is fired.

(a) Lower the launch rail as far as possible to take pressure off the hydraulic system.

(b) Insert the ball lock pins in the lock position.

(c) Use the foam packing insert from the rocket motor shipping box/container to protect the motor during transport, as shown in figure below:



(1) Trim an inch from the bottom of the foam insert so it will fit between the rocket motor and the linear charge.

(2) Place the insert under the rocket motor headcap. This allows the rocket motor to rest on the foam insert instead of on the linear charge container.

Do not allow the rocket motor to hit the front of the linear charge container when the launch rail is lowered. If it does, the charge container is installed incorrectly. Refer to item 3 and reinstall the linear charge.

To avoid internal damage to the MICLIC, tow it over smooth roads whenever possible. Do not exceed 15 mph if the MICLIC must be towed over rough terrain. In wet conditions, check the brake drums for internal buildup of mud and debris. The quick-release mechanism must be free of dust and dirt to function properly.

12. Ensure that at least two M34 blasting machines are in the vehicle that will tow the MICLIC at the time of firing. As stated in TM 9-1375-203-15, Change 1, depot and division personnel must test the blasting machines before deployment to ensure that they deliver the correct amount and duration of voltage. This complete check will ensure the blasting machines function when needed.

Assault Position Checklist

Double-check the MICLIC after it is prepared for firing if it was towed. The MICLIC must be in a covered and concealed position during the check.

1. Place the ball lock pins in the raised position and put the launch rail in the firing position.

2. Open the protective cover. Allow the cover to hang over the sides of the container, but ensure that it does not interfere with the linear charge.

3. Ensure that no part of the linear charge or rocket bridle cable hangs out of the container.

4. Ensure that the rocket bridle cable is under the cable sheath.

5. Ensure that no more than 18 inches of bridle cable is looped up from the rocket motor to the cable sheath.

6. Ensure that the bridle cable lays in an "S" pattern on top of the linear charge.

7. Ensure that the fuze is securely installed in the fuze holder.

8. Insert the firing pin in the rocket motor headcap.

Reporting MICLIC Malfunctions

If the MICLIC malfunctions after performing all of the checks, report the equipment malfunctions to Armament, Munitions, and Chemical Command (AMCCOM) Rock Island, Illinois, as described in AR 75-1. As a minimum, call Mr. Eyskens, AMCCOM, at: DSN 793-7535; commercial (309) 782-7535. Or use the E-mail address: QAS1C-@RIA-EMH2.ARMY.MIL. The datafax number is: DSN 793-7136 or commercial (309) 782-7136. If AR 75-1 is not available, check with the MOS library, the ammunition supply point, or the battalion S4. If not available from those sources, call the Army "Publication Hotline": (410) 671-2533/3775. Call only when absolutely necessary.

After Preparation and Training

LTC Chamberlain pressed his commanders, and MICLIC training became systematic and effective. On 15 January, the battalion went on alert for a possible deployment to the Middle East. "It looks as if our training just might save our hides," LTC Chamberlain exclaimed to the S3. "Yes, sir!" responded the S3. "But you should see the poor performance of the field sanitation teams and the ragged condition of the mobile kitchen trailers." LTC Chamberlain glared and then roared to the S1, "I want to see those company commanders in my office now!" "It never ends," he thought as he heard boots pounding up the hall to his office. "We correct one problem and then there are two more. Just another day in the Corps."

Captain Frank T. Akins serves as Chief of Demolitions at the U.S. Army Engineer School. He is a graduate of the Engineer Officer's Advanced Course and CAS3 School.

Letter To The Editor

Reference: "Advances In Mine Warfare: Antitank Mines," by William C. Schneck, Malcolm Visser, and Stuart Leigh, ENGINEER *magazine, November 1993.*

Gentlemen:

I read your subject report "Antitank Mines" with great interest. As the chief of the German Mine Documentation Center, I am very interested in this subject area. Included in our mission is the documentation of all worldwide produced mines.

In order to prevent the dissemination of inaccurate information, permit me to make some remarks regarding the German mines and mine system.

1. Table 1: The Antitank (AT) Mine FFV-028 is produced in Sweden and was introduced into use by the Swedish Army. That mine, when introduced in the German Army, was designed as antitank mine DM 31. It is a further development [upgraded version] of the FFV-028. The difference in the DM 31 is a self-safety mechanism, seen on its exterior through a red marked casing, that is pushed out after expiration of the mine effectiveness, thereby signing the safe-state of the mine. Contrary to the FFV-028, the DM 31 can be reactivated by mine experts after the expiration of the safe-state. . A differentiation of both of these mines is, therefore, necessary and worthwhile.

2. Table 2: The AT mine PM-60 is a mine of the former National Peoples Army (East German Army - NVA) that was not taken into the permanent inventory of the Bundeswehr. All stocks will be destroyed and it should not be in your documentation.

3. Table 3: In addition to the two mentioned delivery systems, the Bundeswehr has the rocket launcher LARS (range 8 - 14 km, 180 miles) and MARS (range 40 km, 336 miles), both of which can shoot the AT mine AT-2. The documentation should be expanded to include these two systems.

With friendly greetings,

Potocnik, Captain, German Army.

Authors' Reply

The information provided by Captain Potocnik of the Bundeswehr on the DM-31, PM-60 and the German mine delivery system is most welcome. The sharing of such information between allies is important for ensuring interoperability and thereby success in future operations.

However, we believe the East German manufactured PM-60 antitank mine should remain on the list of mines that may be encountered by U.S. (and allied) forces in future contingency operations. Even though the Federal Republic of Germany is destroying the stockpile of PM-60s inherited from East Germany, this mine may still be encountered in parts of Africa and Southeast Asia, where it was exported by the communists during the Cold War.

William C. Schneck

Malcolm Visser

Stuart Leigh

Lessons Learned: Working with the M9 ACE

By Peggy McAvenia, Sergeant First Class Tommy Simmons, and Sergeant First Class William Whitacre

The following lessons apply to U.S. Army and Marine Corps engineer units that are authorized the M9 Armored Combat Earthmover (ACE). The lessons are based on a post-fielding training effectiveness analysis (PFTEA) survey performed by the Directorate of Evaluation and Standardization in the fall of 1993.

Fielding of the ACE, which began in 1988, has been completed for most Active Component (AC) Army units and is still under way for Reserve Components (RC) units. Many units have experienced maintenance and operation problems with this vehicle. To confirm information reported by field commanders, Engineer School leaders requested that a PFTEA be performed before fielding was completed. Therefore, AC units that had employed the ACE in training or in combat for a year or more were surveyed in September 1993. The issues identified in that survey are summarized under Doctrine, Training, Leadership, Organization, Materiel, and Soldiers (DTLOMS) headings.

Doctrine

ISSUE: In the field, the ACE is being used primarily for survivability tasks, such as digging fighting positions.

DISCUSSION: The ACE was designed primarily to support mobility operations and some countermobility missions. In the field, however, engineer units use the vehicle primarily for digging fighting positions during survivability operations.

Photo courtesy of United Defense

Soldiers use a pair or ACEs to construct an antitank ditch.

FUTURE RESOLUTIONS: To decrease the amount of time maneuver units need to construct fighting positions using the ACE, the Engineer School has developed a modified (hasty) two-tiered fighting position. (See article, page 29). The school has also revised work-rate planning factors for the ACE to more accurately reflect the vehicle's diverse capabilities. The revised factors will appear in FMs 5-71-2 and 5-71-3, which are scheduled for publication in fiscal year (FY) 95. Until then, information about the planning factors will appear on the Engineer Bulletin Board System (EBBS) and in the PFTEA report. If your unit needs access to EBBS, call (314) 563-0131, extension 3-5305, for information on securing a systems operation disk.

Training And Leadership

ISSUE: Maneuver units operate the ACE beyond its capabilities.

DISCUSSION: Since bulldozers have been removed from the table of organization and equipment (TOE) of engineer support units, maneuver commanders often request that support units use the ACE to perform mobility, countermobility and survivability tasks formerly performed by dozers. Some maneuver unit commanders ignore the blade capabilities and digging sites recommended by their engineer officers. Instead, they request that operations be performed in soils or rocky terrain that exceed the capabilities of the ACE. The result is damaged vehicles and, sometimes, injured personnel.

Survey results show that many ACE operators travel with the blade in the lowered position because of the time required to fold the blade. This practice must stop! It is a serious safety hazard and may also cause extensive damage to the blade. At Fort Leonard Wood, operator training for the ACE has stressed the need to travel with the blade in the folded position since 1990. At that time, the lowered blade was identified as a factor that contributed to the deaths of two soldiers involved in a training accident.

RECOMMENDATIONS:

- Engineer officers and noncommissioned officers (NCOs) must ensure that the ACE is employed properly within its capabilities and limitations.
- ACE operators must travel with the blade in the folded position. Until an automatic blade folder is installed, units must allow for a delay of 20 to 30 minutes to fold the blade.
- Unit leaders and equipment operators must be trained to employ the equipment properly. At the Engineer School, leadership training on the ACE has been added to the Basic and Advanced Engineer Officer Courses and to the Basic NCO Course. It will soon be added to the Advanced NCO Course.

FUTURE RESOLUTION: The Engineer School should develop guidance on the types of soil and terrain where the ACE can and cannot operate safely.

ISSUE: There is a direct relationship between a unit's organizational readiness rate (ORR) and its level of operator and mechanic experience, sustainment training and degree of supervision.

DISCUSSION: Unit leaders expect to receive fully trained, journeyman-level operators from the Engineer School, who do not need supervision when they operate the ACE. They also expect to receive mechanics who are well versed on repairing ACE-specific problems. This level of training is not possible, given the time restrictions and additional training requirements in the MOS 12F and 62B Advanced Individual Training (AIT) courses. Survey results show that units with short train-up times and limited supervision of ACE operators have low ORRs. Inadequate supervision also contributes to increased accident rates. The average experience level of ACE mechanics is less than one year. While that experience level is typical for newly fielded equipment, sustainment training in the unit is required to achieve and maintain high ORRs.

RECOMMENDATION: To improve ORRs for the ACE, unit leaders must establish sustainment training programs for both operators and mechanics. They must also establish dig sites for operator sustainment training. New operators must be closely supervised for at least one or two years, depending on the frequency of task performance on the vehicle.

ISSUE: Units must provide more opportunities for operator training on the ACE.

DISCUSSION: Survey results show that 78 percent of the ACE operators have one year of experience or less in performing tasks with the equipment. The lack of operator experience results in high levels of vehicle maintenance. In the PFTEA survey, all units with short train-up times or limited training opportunities for their ACE operators had high maintenance levels.

RECOMMENDATION: It is critical that units act aggressively to develop training opportunities for their ACE operators. By doing so, they will increase their level of expertise and significantly reduce maintenance costs.

ISSUE: ACE operators who are separated from their units need close supervision by engineer leaders.

DISCUSSION: Few new ACE operators receive close guidance or supervision when they are sent to

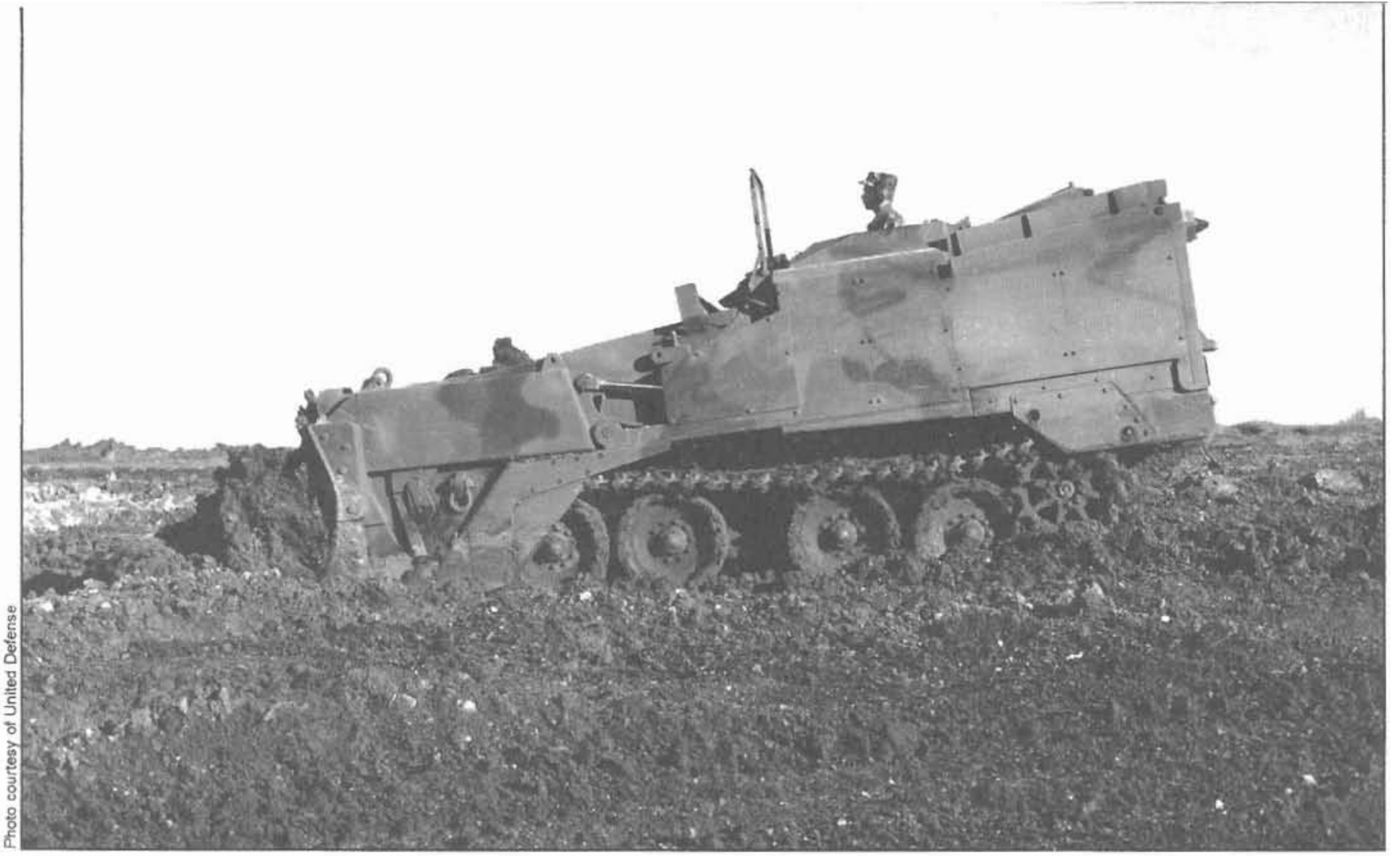


Photo courtesy of United Defense

The M9 ACE is used to dig a vehicular fighting position.

support maneuver units. The primary reason for close supervision is to prevent accidents and misuse of the equipment by the supported unit. New operators usually lack the seasoned judgement of their supervisors and may force the ACE to perform beyond its capabilities or cause damage while operating the equipment in difficult soil conditions.

RECOMMENDATION: To ensure proper procedures are followed when the ACE is separated from its engineer unit, the equipment operator must be supervised by senior career management field (CMF) 12 personnel. The supervisor should serve as the control or point of contact for the engineer unit and the maneuver commander.

Organization

ISSUE: Efficient use of MOS 12F personnel.

DISCUSSION: Survey results show that most units use E4-grade soldiers to operate the ACE. However, when the ACE is to be separated from the engineer unit or when one ACE is operated by itself, commanders prefer to use E5-grade soldiers as the operator. Higher grade soldiers are preferred because of the degree of responsibility and experience required in those situations.

RECOMMENDATION: For more effective ACE operations, unit leaders should consider the operator's experience level when assigning personnel to engineer equipment. Use the most experienced sergeants as ACE operators. Use less experienced operators for the AVLB and CEV.

ISSUE: Table of organization and equipment (TOE) deficiencies.

DISCUSSION: ACE operators currently are assigned to combat engineer company line platoons. Because training resources are limited, they usually are not cross-trained in their MOS 12F tasks to operate the CEV and AVLB. The lack of qualified supervisors and experienced operators in line platoons adversely affects unit readiness for ACE operations.

RECOMMENDATION: Engineer commanders consolidate their ACEs in garrison to maximize the effectiveness of equipment training and maintenance.

FUTURE RESOLUTION: Engineer School leaders are studying the feasibility of consolidating the ACEs in the assault and obstacle platoons. Consolidating them in one location may facilitate effective cross training and enhance maintenance management and the employment of engineer equipment and personnel.

ISSUE: Engineer companies lack the organic capability to maintain the ACE properly.

DISCUSSION: Fielding of the ACE has increased the maintenance problems that engineer companies encounter with their combat engineer vehicles. The number of mechanics authorized to engineer companies was not increased when the ACE was fielded, which added to an already heavy maintenance requirement. Also, MOS 62B mechanics attending AIT are trained on maintenance systems not specific vehicles, such as the ACE. In spite of these limitations, engineer companies must be innovative in solving their maintenance problems. For example, units might consider consolidating their ACEs at the garrison level.

RECOMMENDATION: Units should consider using Logistics Assistance Office (LAO) technicians, who are available on most AC Army installations, to help solve maintenance problems on the ACE. Units may also consider hiring civilian mechanics to maintain this vehicle. To ease the pressure on engineer unit mechanics, assign the most experienced mechanics to the ACE. Unit leaders must support sustainment training for both ACE operators and mechanics because training is key to improving maintenance levels.

ISSUE: An alternate operator is required to safely perform some tasks with the ACE.

DISCUSSION: Survey results suggest that an alternate operator is required when the ACE is operated continuously and when the tracks and road wheels are changed.

RECOMMENDATION: Units designate and train an alternate operator to assist during continuous operations and some maintenance operations.

Materiel

ISSUE: Materiel improvements are needed for the ACE.

DISCUSSION: The ACE is now in phase III of its Systems Improvement Plan (SIP). Most of the materiel issues revealed in the PFTEA are being resolved by the SIP. Brief descriptions of materiel improvements included in phases III and IV of the SIP follow:

- Hydraulic troubleshooting: Completely rewrite all procedures.
- Final drive redesign: Redesign the oil fill indicator and improve the output shaft seals.
- Automatic track tensioner: Develop a system to automatically adjust the track tension when the operator switches between sprung and unsprung modes.
- Hub redesign
- Hardened track pin
- Automatic blade folder: Enables the operator to remotely fold and unfold the dozer blade from the crew compartment.
- Steel dozer blade
- Actuator mounting rings: Provide a stronger mounting point.
- Bowl floor access plates: Provide better access to front actuators for troubleshooting and maintenance.
- Hydraulic test points: Reduce the need to connect and disconnect hydraulic lines when troubleshooting problems. Move the test points to more accessible locations.

RECOMMENDATION: The Engineer School continue to implement the SIP program. The Tank Automotive Command continue to develop an updated logic tree hydraulic troubleshooting chart.

ISSUE: ACE operators and maintenance personnel lack reference materials for the vehicle.

DISCUSSION: The current (1986) 12F STP does not contain tasks for the ACE. Other publications frequently are not distributed at the operator and maintainer levels, where the work is performed.

RECOMMENDATIONS: Leaders must provide ACE operators and mechanics access to current manuals. Also, units must provide copies of publications such as the M9 ACE *News and Views* to operators and mechanics.

FUTURE RESOLUTION: The Engineer School is developing a new MOS 12F Soldiers Training Publication (STP), which is scheduled for publication in the 1st quarter of FY 96. Sections of the draft publication pertaining to the ACE will be placed on the EBBS by December 1994.

Soldiers

ISSUE: The ACE lacked developmental considerations for Manpower and Personnel Integration (MANPRINT) issues.

DISCUSSION: The ACE was developed before the MANPRINT program was implemented; however, future modifications of the vehicle will address new and unresolved MANPRINT issues. Some examples are described in the previous Materiel section.

FUTURE RESOLUTION: Issues identified during this PFTEA survey indicate that problems arise when aggressive user input and front-end analysis of potential MANPRINT-related concerns are lacking. The PFTEA also clearly shows the value of the MANPRINT program. Future acquisitions must identify and resolve MANPRINT issues early in the materiel-acquisition process.

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Sergeant First Class Tommy Simmons is a combat development NCO with the Directorate of Combat Developments, USAES.

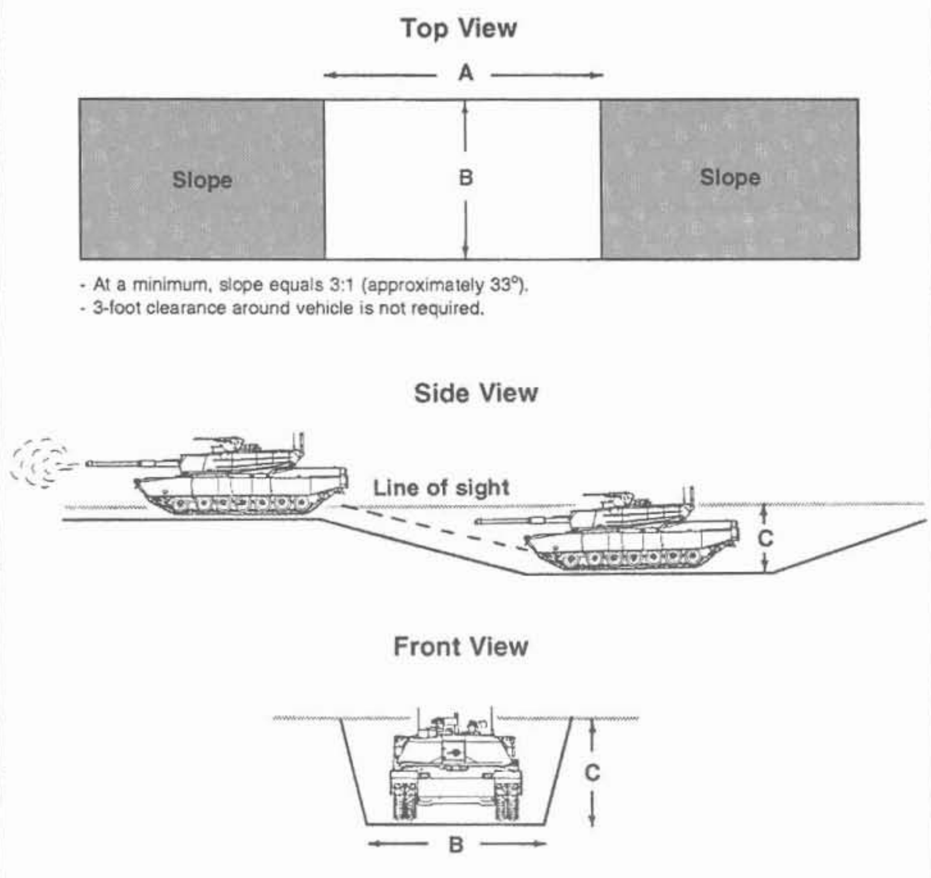
Sergeant First Class William Whitacre is a senior training developer with the Directorate of Training, USAES.

ENHANCING SURVIVABILITY OPERATIONS

By Major George DeMarse

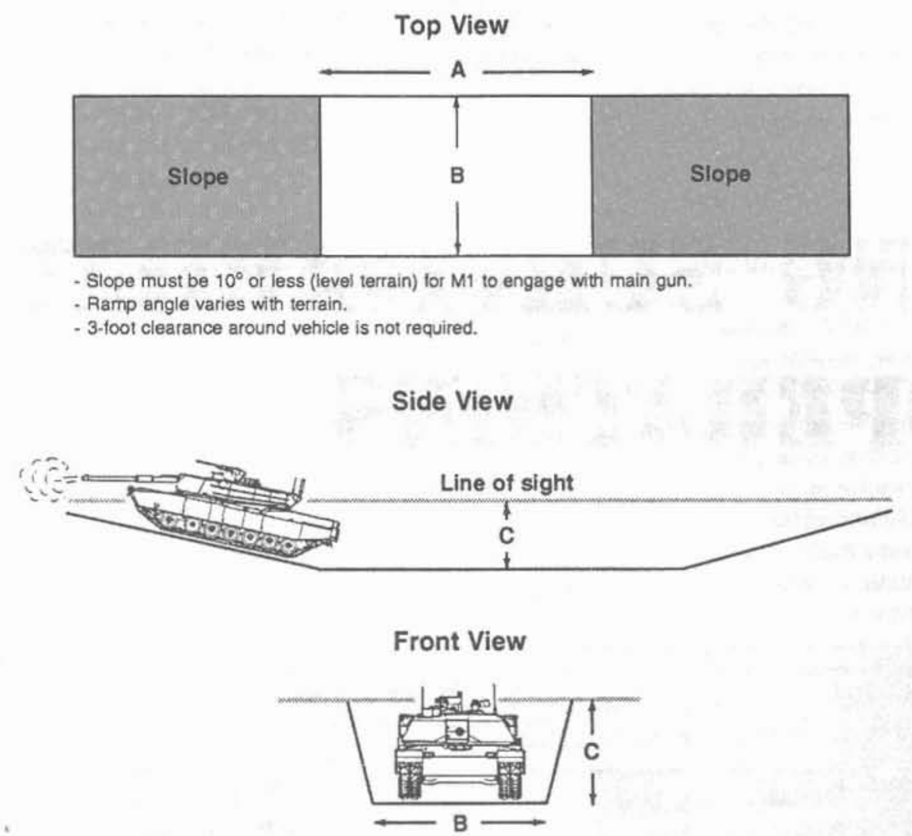
Current Army doctrine stresses the importance of having balance and a range of options to be successful on the battlefield. As battles are fought, combatant forces are required to attack or defend in a deliberate or hasty fashion. The engineers' ability to support the maneuver mission is primarily influenced by this basic nature of combat—attack or defend. Regardless of the engineer function, our ability to contribute to the maneuver mission hinges on the ability to provide options that maximize our engineer capabilities.

The following information explains and clarifies recent changes in U.S. Army survivability doctrine. To provide additional flexibility in survivability operations, the Engineer School has developed two hasty fighting positions (Figures 1 and 2). In developing these positions, the primary intent is to enhance engineers' contribution to defensive operations and to best utilize survivability assets on the battlefield.



	Dimensions (feet)		
	A Length	B Width	C Turret Depth
M2	26	16	10
M1	32	18	9

Figure 1. Modified Two-Tiered Hide Position



	Dimensions (feet)		
	A Length	B Width	C Turret Depth
M2	26	16	10
M1	32	18	9

Figure 2. Modified Two-Tiered Fighting Position

In combat, time is critical, and planners template it based on predictions concerning the terrain and enemy and friendly forces. Defensive operations require the defender to predict where and when he expects to encounter the attacker. Battlefield preparations in the defense follow an evolutionary process. As time permits, units conduct defensive preparations and continue to improve their battle positions. Vehicle fighting positions evolve from hasty to deliberate as the situation develops.

As a unit transitions to a defensive operation, the engineers usually begin to construct hasty positions in preparation for counterattacks and unexpected enemy actions. Combat engineers support this phase of the defensive operation primarily by concentrating their effort on the enemy's most likely avenue of approach. Initially, M9 ACEs (ACEs) are used to construct hasty positions forward. Combat engineers concentrate on preparing hull defilade and modified two-tiered hide and fighting positions, which are constructed based on METT-T.

For example, a task force commander decides to array his forces as depicted in Figure 3, page 31. Based on METT-T, he positions a maneuver company team on the southern flank to overwatch the engagement area. The task force engineer recommends that company teams in the south and the center (A and B) receive priority for survivability support. Therefore, the ACE operators begin to construct hide positions to protect those units from indirect fires and observation. The task force staff war-games the engagement area fight and expects it to last about 4 minutes. The company team in the south initially fights from their modified two-tiered hide and fighting positions, maintains a proper stand-off, and subsequently fights in sector until the enemy is destroyed. It is given specific engagement and target criteria to take the best advantage of the modified two-tiered positions. The commander designates a break line to prevent a decisive engagement.

The company team in the north (C) has suitable natural cover and concealment; it requires minimal blade effort. The company in the center requires extensive survivability effort. They need ACEs to construct modified two-tiered positions for temporary protection until dozers arrive from corps to complete the deliberate positions. Based on the war game, the company in the center can expect to receive the brunt of the attack. Those soldiers are expected to maintain the fight while the other companies maneuver and fight the enemy in depth.

An important consideration for the commander is the interrelationship between the fight and the survivability plan. Time is always a constraining factor. If soldiers can save 30 minutes or more on constructing each vehicle position, or if they can take advantage of the terrain and eliminate the need to construct some positions, then they can maximize their ability to survive and fight in a mobile or area defensive battle.

The modified two-tiered hide and fighting positions are

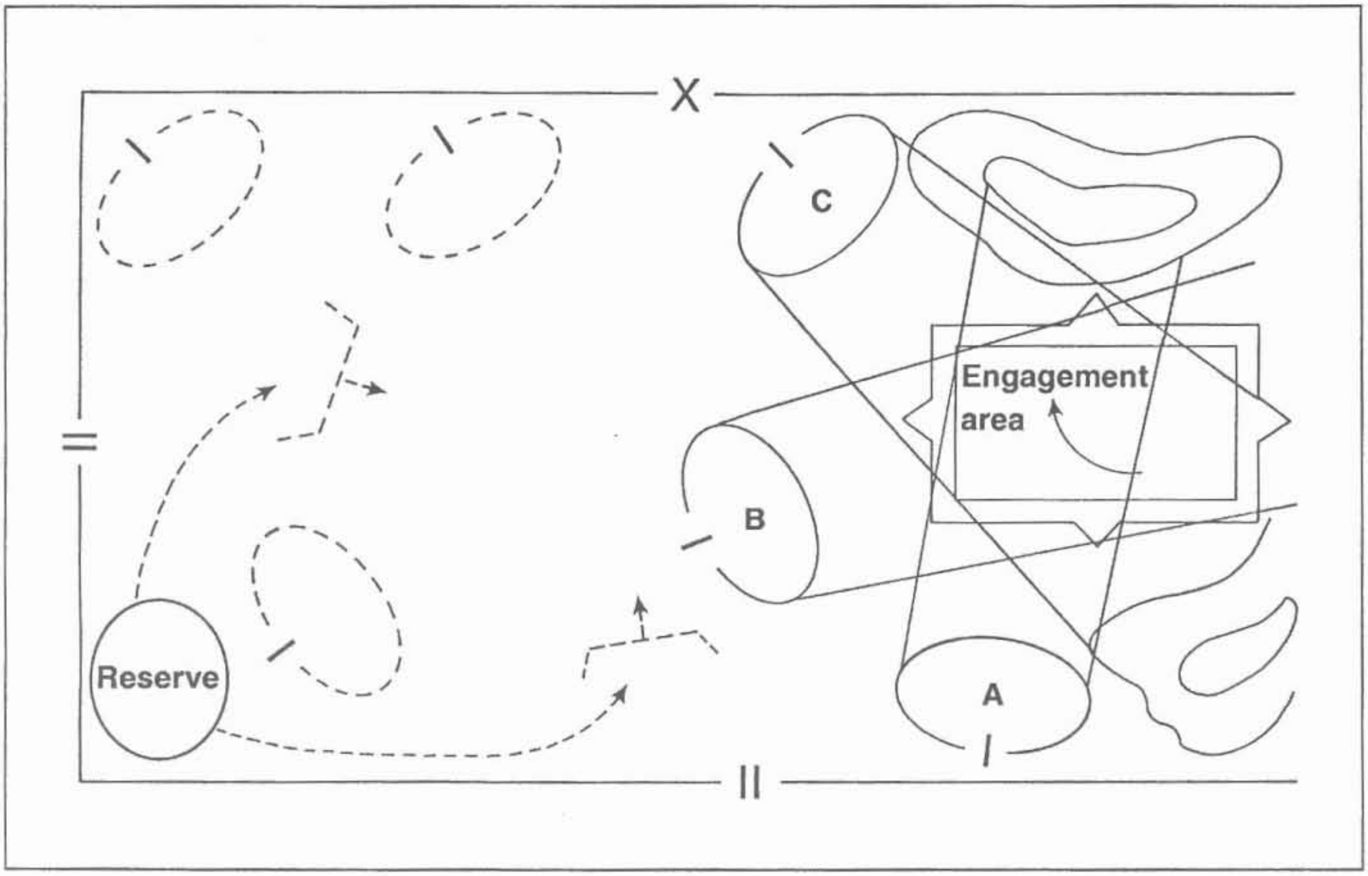


Figure 3. Task Force Defense

designed to help units take maximum advantage of the time and equipment available to them. **The hide position** (Figure 1) is most useful in situations where the friendly vehicle can engage the enemy from a flank or inconspicuous position. It is not designed to protect the vehicle while it fires. As the crew acquires the target, the vehicle moves out of its hole to engage the enemy target. When the engagement is finished, the vehicle can either return to its hide position or maneuver against the enemy.

The modified two-tiered fighting position (Figure 2) provides both a hide position and a fighting position for the vehicle. This position is most useful where the natural slope of the terrain allows the vehicle to effectively engage its target. The vehicle remains in the hide position until the target is acquired; then it moves to the forward slope of the position to engage enemy targets.

Engineers cannot rely completely on two-tiered, deliberate fighting positions while preparing for defensive operations. The modified two-tiered positions described above provide options that take advantage of the terrain and are well suited for an engagement area fight. Engineers must understand the capabilities of the ACE and employ it accordingly. The ACE is best suited to construct hasty fighting positions. Dozers, provided by corps, will come forward and construct deliberate fighting positions. As defensive preparations mature and evolve, engineers must construct and improve survivability positions by employing a combination of dozers and ACEs.

Engineer survivability doctrine, like defensive operations, evolves to create the best conditions for success on the battlefield. Engineer soldiers and equipment are fully capable of executing the overall engineer mission. Engineer leaders must consider the aspects of METT-T, recommend appropriate options, position engineer assets at the right time and place, and supervise execution of the plan. By employing the added survivability positions described above on the battlefield, engineers can provide options that better support the defense as it progresses from a hasty to a deliberate operation.

Major George DeMarse is the senior writer/instructor at the Engineer School. He previously served as a task force engineer trainer and engineer battalion staff trainer at the National Training Center. Other assignments include platoon leader, executive officer, and company commander in the 4th Engineer Battalion, Fort Carson; and assistant S3, 23rd Engineer Battalion, 3rd Armored Division. Major DeMarse holds a masters degree in business and is a graduate of the Command and General Staff College.

Maintenance Operations:

Triumphant March or Swan Song?

By Sergeant First Class Thomas Moeller

Maintenance is easy. Maintenance operations are difficult! The first rule of maintenance is - "If it's not broke, don't fix it." Maintenance operations have no simple rules, only complex solutions. Maintenance is performed on equipment—trucks, tanks, radios, weapons, and aircraft. Maintenance operations include every soldier, every activity, and every asset of the unit. They are affected by every environmental factor imaginable—time, money, personnel, weather, facilities, command climate, etc.

Effective maintenance operations begin with a plan that incorporates doctrine, training, leader development, organization, material, and soldiers (DTLOMS) to the fullest extent to reach specific objectives. The plan becomes dynamic and evolutionary. It begins with soldiers and requires each soldier's willingness to do what is right for the unit. The commander's most important roles are to create that willingness and to focus the will of the entire unit on maintenance.

Thomas Peters and Robert Waterman, in their best-selling book *In Search of Excellence*, identified one characteristic common to successful companies: All members of the organization understood what the company, as an organization, valued. Arguably, what is valued in an engineer organization could be many things. I submit that for engineer units to accomplish their mission (their reason for existence), properly performed maintenance is of the most value. Maintenance in some units is like a bad habit—everyone seems to be trying to break it! In other units, soldiers try to forget it exists. But in units that have good maintenance values, mission accomplishment is easily achieved.

Soldiers

Today's maintenance soldier has a more demanding job than ever before. Fielding new equipment, aging on-hand equipment, fewer dollars, fewer personnel, and fewer units are facts of life. The current focus on deployability has become a driver not a goal. New personnel arrive with fewer basic skills. The complexity of new diagnostic equipment means on-the-job retraining for the "old hand." CD-ROM manuals and ULLS computers create a "future tech" environment that is conducive to instant information but not instant maintenance. And equipment readiness rates must be maintained or commanders and units are subject to pressures not experienced since the days of Zero Defects. "We've done so much for so long with so little, we can do anything with nothing!" Have you ever heard that before? As a saying it is cute. As an attitude it is revealing. As a commander's expectation it is unrealistic.

There are deeper problems in that philosophy than unrealistic expectations. It assumes that maintenance is only the motor sergeant's responsibility. It does not support an equal distribution of work. It causes serious morale problems. And, it usually interferes with maintenance plans. Good maintenance isn't something that happens during the night, after all the troops go home (night shifts are seldom effective), nor does it happen overnight (unlike UPS deliveries).

Maintenance is a full-time mission and should not be attacked without an OPORD or maintenance plan. A proper mental attitude—knowing what is valued—is necessary when preparing for any mission.

Attitude adjustment begins with leaders. Their willingness must be apparent and contagious, and their values must coincide with those of the unit. Attitudes are reflected in words: Mechanics are not "grease monkeys." The motor pool is not a "shade tree operation." Nor is it the local auto dealership with drop-it-off-by-9-and-its-ready-by-4 service. Attitudes are also reflected in actions: The motor pool is the place where a unit is built and trained while maintenance is performed. Each task is an intrinsic part of a complex and comprehensive maintenance plan (OPORD), designed to have everyone contributing, with specific phase lines to cross at directed times. It is everyone's mission to keep the world's best equipment running and ready.

Training

Unit personnel must work as a team to keep their equipment operational. That includes all equipment, from the smallest hand tools to the largest rolling stock, from shovels and wheelbarrows to dump trucks and cranes. When equipment is due a scheduled service, the entire team must be involved to ensure that it is completed on time and to standard. Each soldier plays a vital part in the overall scheme. Maintenance is everyone's job, not just the equipment operator or personnel in the motor pool.

The equipment operator must participate at the scheduled service to ensure that "his" equipment receives the best service possible. The newest team member is there to assist and learn, so that one day he or she can become a top-notch, maintenance-conscious operator. Other team members are there because their presence builds pride and esprit de corps. Leaders are there to ensure that everything runs smoothly and to teach and set an example. Good maintenance can't be performed from the platoon command post or the snack bar; it requires every leader's presence. Everyone needs to crawl under, over, and around the equipment.

The most demanding PT I ever experienced was an activity called *The Maintenance Derby.* We crawled under, over, and around every piece of equipment in the motor pool. We had to locate certain U-joints, bleeder valves, grease fittings, frame members, and the like on every piece of equipment in the unit, and we were timed and scored in the process. The results opened some eyes!

Maintenance is training and must be conducted the same way: focused, interesting, challenging, and free from distractions. Every soldier must be trained on the new equipment. The current levels of sophistication found in on-board computers and diagnostics, "smart" engines, and other state-of-the-art automotive features make equipment training a challenge. Units must invest in training opportunities seldom envisioned before. Leaders should consider innovative incentives, such as allowing mechanics to wear ASE certification patches on coveralls worn in garrison.

Maintenance takes a lot of effort. It's not magical! It's not an illusion, and it doesn't happen with smoke and mirrors. Motor sergeants keep nothing up their sleeves, nor can they pull rabbits out of their BDU caps. Maintenance activities, from daily PMCS sessions to periodic services, must be scheduled and religiously followed. If other missions must take priority, they must be the exception because, sooner or later, the absence of proper maintenance will tell the tale.

Leader Development

If ingrained maintenance values are the foundation of any program, then leader development is the cornerstone. Did you ever see a sergeant carrying around the last three years' issues of *PS Magazine* during motor stables? No, of course not! But, did you ever see an NCO with articles on every piece of team equipment, clipped from the last three years' worth of *PS Magazine*, neatly indexed in a dog-eared, well-worn pocket guide? And he was using the guide to supplement maintenance being performed by team members gathered around the equipment. Did you ever see an NCO pull out an electronic notebook and refer to it for maintenance tips he had cached in digits for display on a backlighted LCD screen? If you have, then you've seen leadership you should emulate.

Training, seminars, and conferences conducted (often free of charge) by commercial manufacturers provide access to new ideas and techniques. Attending a local trade show or reviewing the latest trade magazine may reveal techniques of significant importance and result in saving time and money. Maintenance seminars should be offered at functions like the Senior Engineer Leader Training Conference (SELTC), and special seminars should be conducted during warrant officer and advanced NCO courses.

Organization

Fixing the number of mechanics authorized in a unit is an impossible task for a commander, even if that piece of our organization is broken. That task must be performed by the Engineer School leadership. But, commanders can supplement their maintenance organization, ensure that operators are qualified on equipment as a part of unit licensing procedures, and prevent operator hopscotch—the senseless moving of operators from one piece of equipment to another.

Materiel

Maintenance plans must integrate the operational use of supporting elements—wreckers, welders, contact trucks, and common tool sets. In addition to securing and using tools provided for maintenance,

(Continued on page 43)

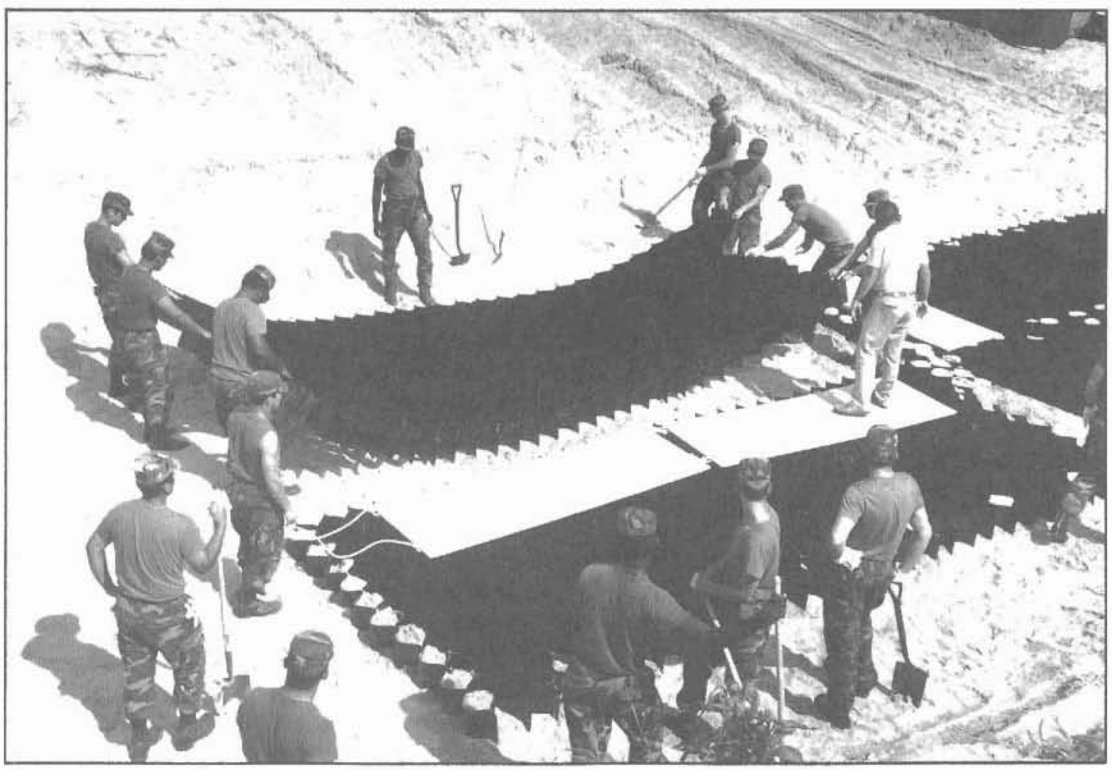
Sand Grid: A Multipurpose Construction System

By Sergeant First Class Donald H. Purinton and Sergeant First Class Roger L. Harrison

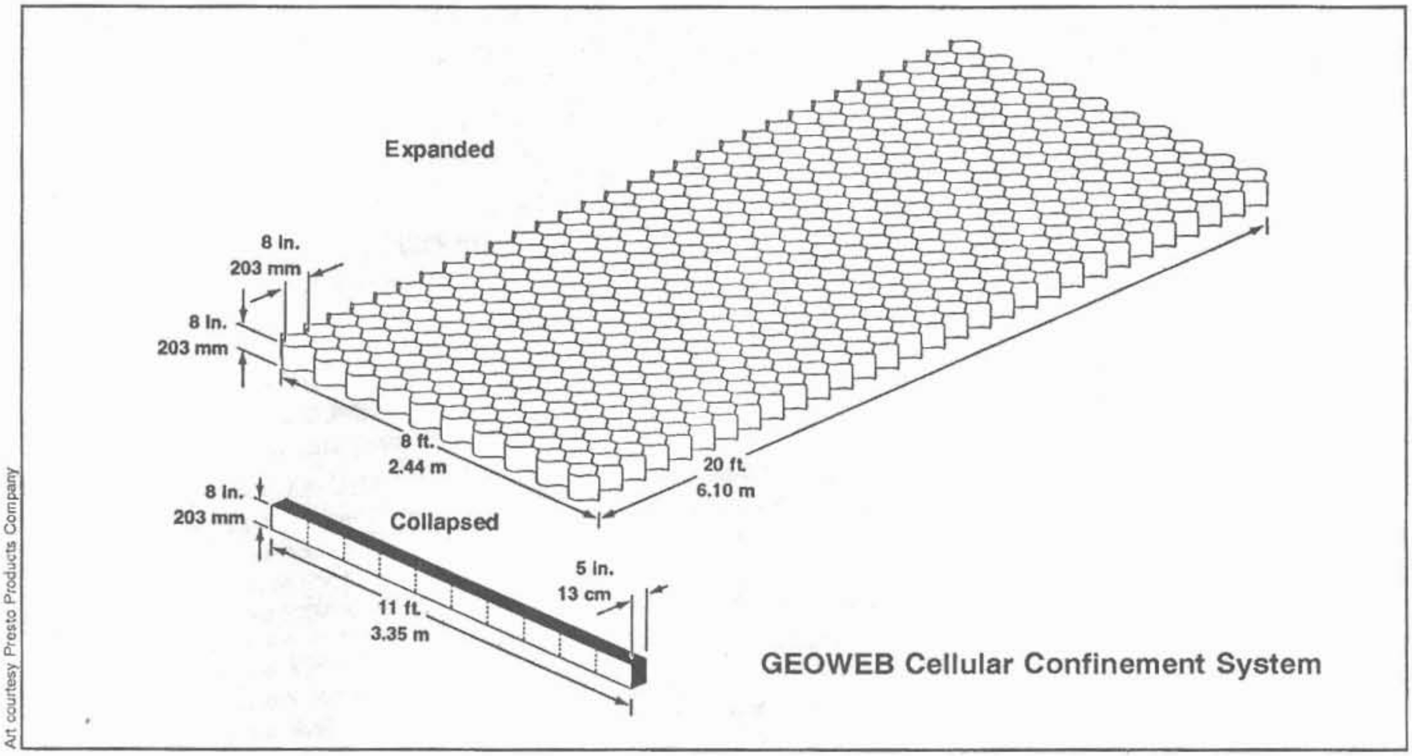
Military engineers build many types of structures. While a wide variety of construction materials are available, a geosynthetic called *sand grid* has been the most tested and proven. Although often overlooked by Army engineers, sand grid is an excellent method of field-expedient construction. It is made from high-density polyethylene and is used to confine and compact granular soils such as sand during the construction or repair of roads, airfields, field fortifications and other expedient structures.

Development

Sand grid, known commercially as Presto GEOWEB Cellular Confinement System, was developed at the U.S. Army Waterways Experiment Station (WES), Vicksburg, Mississippi, during the late 1970s in a cooperative research effort between the U.S. Army Corps of Engineers and the Presto Products Company, Appleton, Wisconsin. The original concept involved confining and compacting sand or sandy soils in interconnecting cellular elements, called grids, to produce a load-distributing pavement base layer. The resulting design is honeycomb-like in appearance. When filled with sand, the grid can be used to expediently construct pavement structures in areas with poor trafficability. The fill material can be in-place or locally borrowed, poorly graded sands found almost anywhere in the world.



Road construction with sand grid proceeds quickly. Here, soldiers are expanding and emplacing sand-grid sections at Fort Story, Virginia.



Availability

Sand grid sections (National Stock Number 5680-01-198-7955) are expendable Class IV supply items that cost $181 each. The plastic grids are available in 11-foot by 8-inch by 5-inch collapsed sections that weigh 110 pounds each. When fully expanded, the sections measure 20 feet by 8 feet by 8 inches. Sand-grid construction is very economical, costing about $1.50 per square foot.

Sections of sand grid are palletized for deployment and are delivered in 3,000-pound pallets that contain 25 collapsed sections. One M872A1 40-foot trailer load of pallets contains enough sand grid to construct one-half mile of 16-foot-wide road. The sections are easily dismantled and collapsed for reuse.

Uses

Sand grid is easy to use. And the basic construction procedures are the same for all of its many uses: expand and emplace sections, fill with soil, and compact.

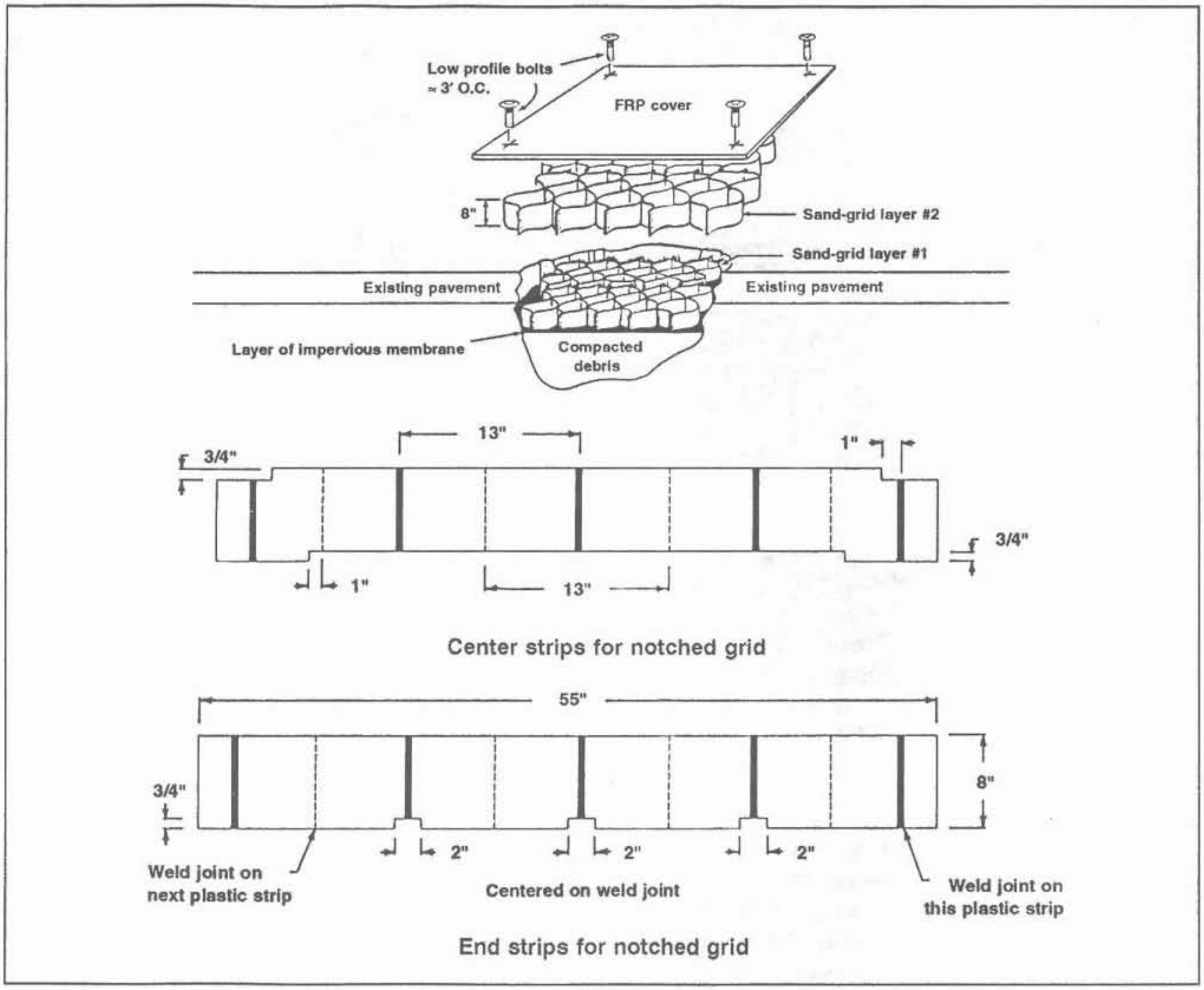
Expedient Road Construction. Theater-of-operation road construction initially provides only a trafficable surface. These roads are built to accomplish a specific mission in the most direct and efficient manner possible. Designs are simple, require minimum skilled labor and use local materials whenever possible. In many theater situations, sand grid meets these construction requirements.

Sand-grid road construction greatly improves wheeled vehicle trafficability over sand and sandy soils. A squad-sized work crew can quickly construct a sand-grid road using scoop loaders, light bulldozers and vibratory compaction rollers. The use of rough-terrain forklifts; water distributors; asphalt distributors; long-handled, round-point shovels; and 8-foot by 4-foot by 3/8-inch sheets of plywood can increase the effectiveness and speed of construction.

Sand grid does not hold up well under tracked vehicle traffic. Tracked vehicles, however, have good trafficability through loose or cohesionless soils and can use shoulders outside of the staked right-of-way. To allow for tracked vehicle traffic, mark off a lane parallel to and near the sand-grid road. If tracked vehicles must cross the sand grid, protect it by placing a layer of gravel at the crossing.

Airfield Damage Repair. Following enemy attacks, engineers must repair airfields quickly, using the most expedient methods of airfield damage repair (ADR). The sand-grid method, using the GEOWEB Cellular Confinement System with a fiberglass reinforced polyethylene (FRP) matting cover, provides a suitable runway surface. It enables engineers to repair bomb-damaged runways quickly and efficiently.

The ADR kit used to repair bombed runways measures 18 1/2 feet by 7 feet by 19 1/2 inches. It contains eight 20-foot by 8-foot by 8-inch sand-grid sections, weighs about 5,310 pounds, and contains enough materials and equipment to repair a 25-foot bomb crater. The kit is air-transportable and can be air-dropped. Repair crews can adjust sand grid to crater dimensions simply by cutting and piecing



sections together. Sand grid with an FRP matting cover can withstand 500 F-15 sorties, 200 C-141 sorties, or 300 C-130 sorties.

The resources required for ADR depend on the amount and type of damage, equipment and personnel available, materials on hand, and soldier expertise. As a general rule, one platoon-sized work crew for each bomb crater can quickly and efficiently repair a damaged airfield.

Field Fortifications. Survival on the battlefield depends on the quality of protection provided by fighting and protective battlefield positions. Field fortifications are designed to protect personnel, weapons systems, vehicles and equipment while deceiving the enemy.

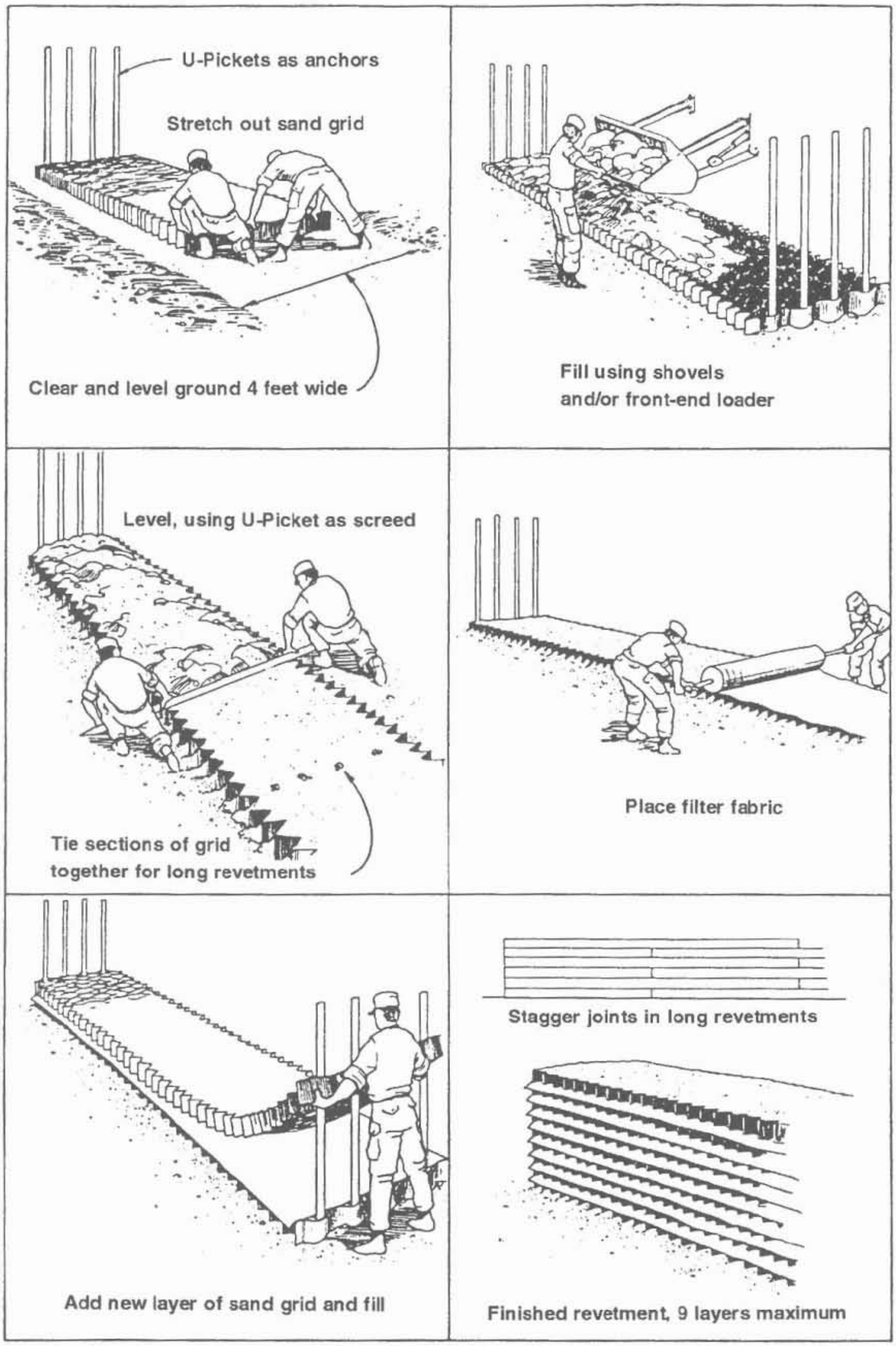
Two types of sand-grid sections are available for constructing field fortifications:

- Standard sections are essentially the same as those used in roadway construction but are narrower.
- Notched sand grid is a standard section that has been modified to allow revetment construction with complete sand and soil confinement on the sides. It eliminates the need for a filter fabric between layers of sand grid and allows multiple layers to be filled. Notched sand grid can be constructed more rapidly than standard sand grid.

Sand-grid sections for field fortifications are manufactured in black, green and tan. Camouflage paint can be added to protect them from ultraviolet degradation and to reduce enemy detection. The sections are used to construct artillery positions, helicopter revetments, overhead protection, blast and fragmentation protection and bunkers. Sand grid is effective against small-arms fire up to .50-caliber and near-miss artillery rounds.

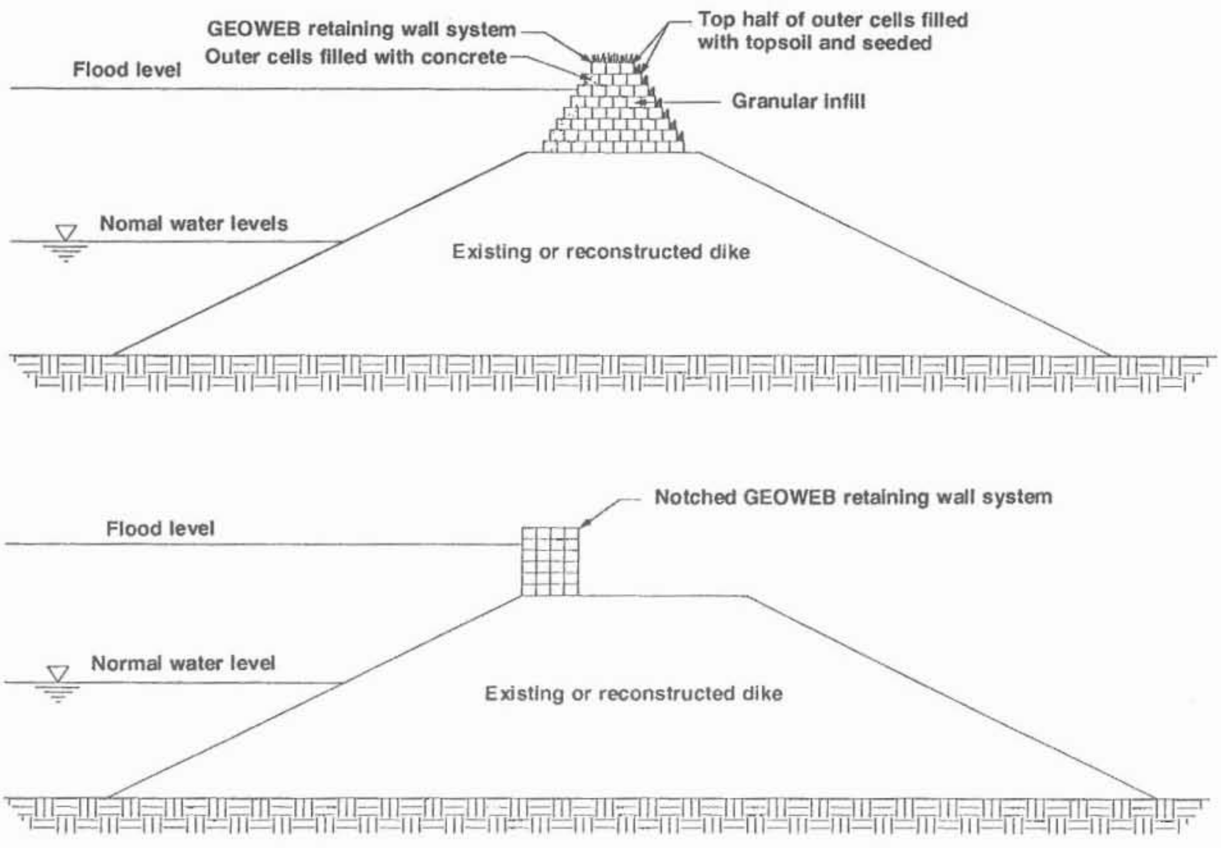
Many advantages can be realized by using sand grid to construct field fortifications. For example, field fortifications made with sand grid—

- Cost 28 percent less than those made with sandbag revetment materials.
- Occupy 50 percent less space than those made with sandbags, although they weigh 15 percent more.



Construction of standard sand-grid revetment

Artwork from *Expedient Field Fortifications Using Sand-Grid Construction*



Fortifications of dikes and levees using standard and notched sand grid. These methods replace sandbags and allow rapid construction to increase the height of a structure.

Art courtesy Presto Products Company

- Are more durable than those made with cloth sandbags and have a longer life expectancy. Some revetments made with sand grid are in good condition three years after construction, while sandbag revetments may require repair after only six months.
- Require from 40 to 70 percent fewer man-hours to construct than those made with conventional sandbags.
- Take half the time to construct and yield the same amount of protection as an overhead protective cover system made with standard sandbags and loose earth.

Other Expedient Structures. In addition to the uses already described, sand grid can be used for earth-retaining walls; drainage-channel linings; slope erosion control and stabilization; and river fords, dikes, and levees. Some examples follow.

Sand grid can be used as protection for drainage channels. The St. Louis Metropolitan Sewer District (MSD) decided to use it as an alternative to reinforced concrete and concrete slab channel linings. They chose sand grid because it offered significant cost-savings benefits. By using sand grid, they eliminated the need to construct concrete formwork and the need for reinforcing steel and expansion joints. The sand grid provides a permanent, flexible form and acts as a series of expansion joints when filled with concrete. A cost-saving feature is that no overfill is required over the depth of the cells, which makes it easy to calculate the amount of concrete required. Since 1987, the St. Louis MSD has used sand grid filled with concrete for channel protection. They estimate that sand-grid construction costs about 30 to 40 percent less than traditional concrete construction.

The U.S. Forest Service used sand grid filled with coarse aggregate to construct a 16-foot-wide by 40-foot-long river ford in the Chattahoochee-Oconee National Forest to replace a log stringer bridge. Replacing this bridge before sand grid was available required the construction of an 8-inch-deep by 14-foot-wide mesh-reinforced concrete ford, which cost from $6,000 to $12,000. The ford made with sand grid costs about $3,000.

The great flood of 1993 will be remembered for many years. We all witnessed the destruction that took place as river waters crested and overtopped protective dikes and levees. The flood caused an estimated $20 billion in damages. The U.S. Army Corps of Engineers distributed in excess of 31 million sandbags to hold back flood waters. Most of the dikes and levees were reinforced with sandbags, and filling and placing them was time-consuming and required thousands of people.

It is possible to fortify dikes and levees with sand-grid construction. Using sand grid requires less time and fewer personnel than other methods, and it allows workers to rapidly increase the height of a dike or levee to prevent overtopping. Because of its load-support capabilities, sand grid can be built with heavy construction equipment, which significantly increases the construction rate. When sand grid is used to construct temporary dikes and levees, the structures also function as a temporary dam. WES evaluated a sand-grid system under conditions of varying water levels and wave actions to prove its usefulness. They concluded, "This type of structure, either temporary or permanent, holds promise as an expedient alternative to sandbag structures."

Synopsis

Sand grid is a multipurpose construction system. It is an economical, effective and often overlooked resource that can be adapted to a wide variety of construction applications. Sand grid is available to military engineers and can be easily transported and installed. It requires less time, effort and maintenance than conventional construction materials. For more information on the uses of sand grid, call the Department of Construction Engineering, U.S. Army Engineer School, at (314) 596-0131 (Extension 3-7620/7610) or (Defense Switched Network) 676-7620/7610; or write to Commander, U.S. Army Engineer School, Attention: ATSE-T-CT-H, Fort Leonard Wood, Missouri 65473.

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SFC Harrison is an instructor/writer for the Engineer School's Department of Construction Engineering. He previously served as platoon sergeant, 568th Engineer Battalion (Combat) (Heavy), and as a senior instructor for the General Construction Equipment Course. SFC Harrison is a graduate of ANCOC and holds an associate's degree in construction management from Park College.

Additional Reading

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Harvesting A Partnership:

A Captain's Perspective

By Major Brian Loggins

District assignments with the Corps of Engineers can be both challenging and rewarding for military engineers. My experience at the Fort Knox Area Office in 1992, as a captain, is a case in point. During this assignment, I was introduced to "partnering," which was then a new concept in the Army's commitment to Total Quality Management.

As the lone "green suiter" and the newest guy in the Fort Knox Area Office, I was not surprised to learn that I would be the project engineer for renovation of the Fort Knox commissary. At $1.6 million, the Corps of Engineers considered the renovation a small project; and I assumed a few renovations to a grocery store would be easy. However, examination of the project drawings and specifications showed that the project would be more complex than I initially thought. In fact, it had the potential to be a nightmare. It was a major overhaul that included everything from replacing the lighting, refrigeration equipment, and heating and air-conditioning units to constructing a new manager's office and a breakroom for the grocery baggers. All of this, and more, must be done while the commissary remained open for its nearly 2,000 customers per day—with business as usual!

The district commander suggested that we partner the project. Knowing little about this concept, I did some research and learned that its goal is to bring the key players of a project together as a team, working for the good of the

The contractor coordinated his schedule with the store manager on a weekly basis to minimize inconveniences to shoppers. Here, work progresses while the store is closed.

project and for customers satisfaction, as opposed to working for individual goals. Partnering improves product quality and produces win-win solutions to problems.

This project was well suited to a partnership. It was a complex undertaking that would require difficult decisions and safety considerations. Coordination, teamwork, flexibility, and open communications with everyone involved were essential. A partnership would ensure that these requirements were met.

The contractor immediately said "yes" when asked if he would be interested in partnering the project. That simple agreement set the partnership in motion. The next step was to present a workshop where we would form a team and set project goals.

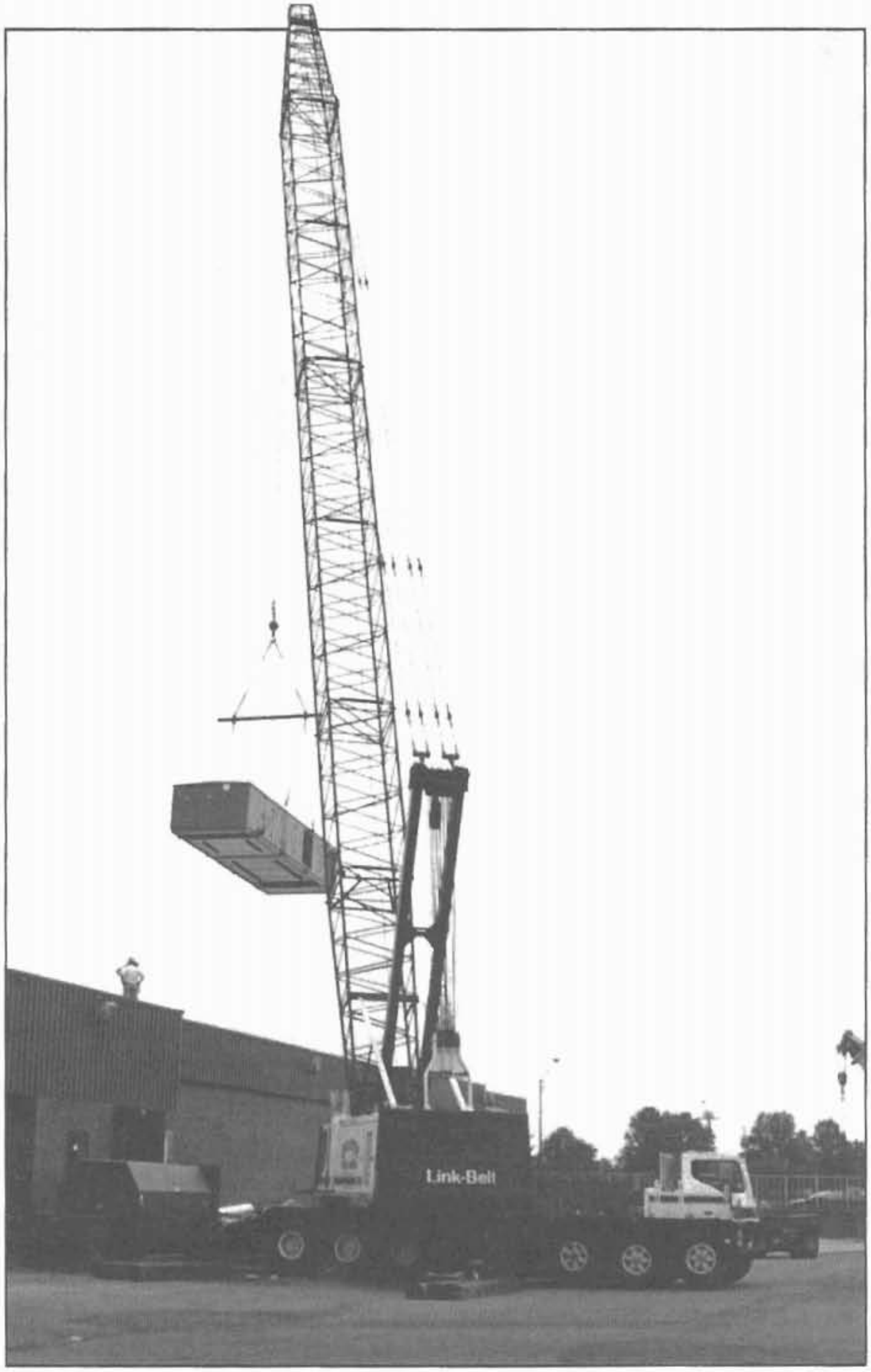
The Workshop

The workshop, held on 7-8 December 1992, was attended by all of the project's key players: the Corps, the contractor, the commissary manager, the Fort Knox Directorate of Public Works, and the architect-engineer. Attendees included everyone from field representatives to the senior leadership of those organizations. Their participation was critical and demonstrated a high level of commitment to the partnership.

The workshop was professionally facilitated by an "outsider" from New Mexico, whom we hired from a list maintained by the district office. He was worth every cent. Having an impartial, skilled facilitator ensured that everyone had an equal voice. The team-building exercises helped us relax, generated open communications, and kept the group focused on setting goals and having fun. At this point, everyone was totally committed to the project.

After we became a team, we developed goals and objectives. To maintain open communications, we decided to meet weekly to share progress reports and monthly to discuss and assess the partnership.

We also chose a partnership logo and motto. The cornucopia and the motto, "Harvesting Partnership" seemed most fitting for a commissary project. To announce the partnership, the contractor added a brightly colored sign depicting the logo to a sign in front of the commissary.



The team approach to problem solving proved successful, especially during complicated and hazardous operations such as lifting air conditioning units onto the roof.

The Partnership

After the workshop, the project picked up momentum.

PARTNERING AGREEMENT
FOR
THE CONSTRUCTION MANAGEMENT TEAM FOR THE FORT KNOX COMMISSARY RENOVATION
FORT KNOX, KY

Mission Statement

We will work together in an open, cooperative and professional manner to provide a safe, high quality Fort Knox Commissary renovation, with minimal disruption to the customer.

Goals and Objectives

Cooperative Relationship

- Open communication
- Team approach to decision making/problem solving * monthly (Field) * 5 May 93 (All)
- Flexibility among all partners
- Focus on project - not personalities
- No formal disputes
- Minimize written correspondence
- Have lots of FUN!

Customer Satisfaction

- Minimize "store" inconvenience
- Provide accessible equipment
- Provide maintainable equipment
- Provide prompt response for critical equipment service
- Meet equipment installation schedule
- Minimize and coordinate utility interruptions
- Establish acceptable job sequence

On Schedule

- Mutually agreed master schedule
  - Address schedule weekly with two week look ahead
  - Achieve mutually established milestones
- Timely resolution
  - Two day maximum (on site)
  - One week maximum (field)
  - Thirty days for change orders requiring more funds
- Jointly established priorities
  - Team concurrence at weekly meetings
  - Flexibility to accommodate each others priorities

Quality

- Build without rework (assumes effective QA/QC)
- Meet or exceed requirements (K Specs)
- Meet or exceed customer expectations
- Identify and discuss key submittals before submitting to achieve correct submittals on a first time basis
- Develop and maintain DECA as an equal partner

Safety

- No lost-time accidents
- No public/customer accidents
- Conduct thorough Activity Hazard Analysis (AHA)
- Conduct thorough safety indoctrination and weekly toolbox meetings - Discuss AHA daily
- Comply with Accident Prevention Plan

Within Budget

- Fair profit to Contractor (including Sub-contractors)
- Contain total cost growth to within 5%
- Proactively pursue savings through V/E process

Gary L. Graney
Dennis R. Kelly
John Trinkle
Joe M. Kitts
J. Darrell Nation
Michael A. Pangini
Robert W. Passalacqua
Robert E. Bakits
Gary Sinke
Jack Pfeifer
George D. Henry
H.B. Fagin
Tom Malton
Jim Bass
David L. Wills
David A. Corbin
David K. Klinster
Michael Winston
Lewis H. Graham
Dennis J. Kampfer
James R. Linder

We brainstormed and solved all issues and potential change orders as a team. And, because the contractor was involved in the problem solving, his price proposals for changes were usually very reasonable.

At first everything went well. Then, within a few days, we experienced two on-the-job safety problems. The contractor agreed with us that while neither incident was very serious, a pattern seemed to be developing. He and his staff immediately took corrective action and briefed all of their employees. The next day he informed us that one individual had been fired and a foreman replaced. While this initially seemed extreme, I was impressed with the contractor's commitment to safety and to the partnership. His action was effective—no more safety problems occurred.

At the weekly progress meetings, the project manager for the prime contractor briefed the schedule for the next two weeks, and the subcontractors briefed the status of their work. This kept everyone informed and prevented unwanted surprises. All issues raised were discussed openly among team members. The commissary manager was especially pleased with the progress and the quality of work performed.

Each month we met to discuss and assess the partnership. These meetings allowed the field representatives to evaluate how the partnership was working. There were rarely any negative comments.

As the work progressed, a high level of trust and confidence developed among the partners. Of the many examples of cooperation, professionalism, and teamwork that occurred, two were especially significant:

- While the contractor was replacing the front door to the commissary, a temporary entrance was made for customers. As Memorial Day weekend approached, the commissary manager realized that the temporary entrance would be inadequate for the large crowd expected. When alerted to the problem, the contractor voluntarily modified his schedule and installed the new door in time for the weekend.

- When the contractor needed to remove an old refrigerated case ahead of schedule and on very short notice, the commissary manager came to his aid. He quickly gathered some of his employees from their scheduled tasks to empty produce from the case.

These examples illustrate the partners' commitment to the project and to customer satisfaction, and they underscore the value of the partnering concept.

Assessment

Partnering is similar to what we experience daily as soldiers. We are all members of a team, whether it's a battalion staff, a squad, or "this" project team. During the renovation project, I learned the importance of developing trust and team spirit among team members. If team spirit is not developed, team members may concentrate on their hidden agendas instead of on team goals. The power of a team, when individual skills and resources are combined, is enormous.

At Fort Knox, forming a partnership was the key to the success of this project. And now, because we harvested a partnership, the commissary and its customers are reaping the benefits.

Major Brian Loggins is director of quality for the Louisville District, Corps of Engineers. He formerly served as chief of quality assurance at the Fort Knox Area Office. Major Loggins is a graduate of Vanderbilt University.

(Personal Viewpoint, continued)

soldiers must be trained in *tool maintenance!* The plan must outline priorities and procedures for obtaining repair parts. Leaders must listen! Soldiers know what is needed to perform maintenance. Encourage suggestions, innovations, and time-saving techniques.

Doctrine

Maintenance plans must embrace every asset, every resource, every bit of expertise, and every communication channel to which the unit can gain access. Channels include logistic assistance offices (LAOs); IDEAS, TIPS, and SMART programs; contemporary maintenance publications (*PS Magazine*); standing operating procedures from other units; the exchange of ideas and policies throughout the command; project manager and item manager offices; and civilian manufacturing publications. The list is endless and is limited only by imagination and drive. Once in place, those channels must be maintained if they are to be worthwhile.

My challenge to you is this: How good is your maintenance operation? Has the commander identified the organization's values? Is your maintenance plan realistic, goal oriented, value reinforcing, well coordinated, and fully supported? Does each team member have a vital part to play in executing the plan? Is each maintenance session conducted as leader-supervised team training? Will your maintenance operation be a triumphant march or a swan song?

SFC Moeller is a Force Integrator/Force Readiness NCO with the Directorate of Combat Developments, U.S. Army Engineer School. He will retire from the Army with more than 20 years of service as an engineer equipment repairer in January 1995.

HEAVY DIVISION ENGINEER COMMANDER'S HANDBOOK

"A combat engineer company, structured to operate at the FEBA, focuses on mobility, countermobility, and survivability operations. It is the lowest engineer echelon that can plan and execute 24-hour operations in support of maneuver forces."

Field Manual 71-123

By Captain David Brinkley

Your heavy division engineer company has realigned into a new force structure, but there is no doctrine to help you, the engineer company commander, understand the employment, capabilities, and limitations of the company in its new structure. FM 5-71-100 describes the division's combat engineer brigade but is not very useful at task force level and below. FMs 71-2 and 71-123 still refer to pre-restructured engineer organizations and capabilities. Here is the good news—help is on the way! The U.S. Army Engineer School is producing doctrinal manuals for the divisional engineer battalion and company that are scheduled to be released as coordinating drafts in FY 95. The following information provides some interim guidance to alleviate misconceptions and to serve as an employment guide until the doctrine is published. The information, work rates, and capabilities highlighted are based on an 18-month study completed at the National Training Center (NTC) from March 1992 through August 1993. Restructured divisional and corps combat engineer companies that supported 18 mechanized infantry task forces were included in the study.

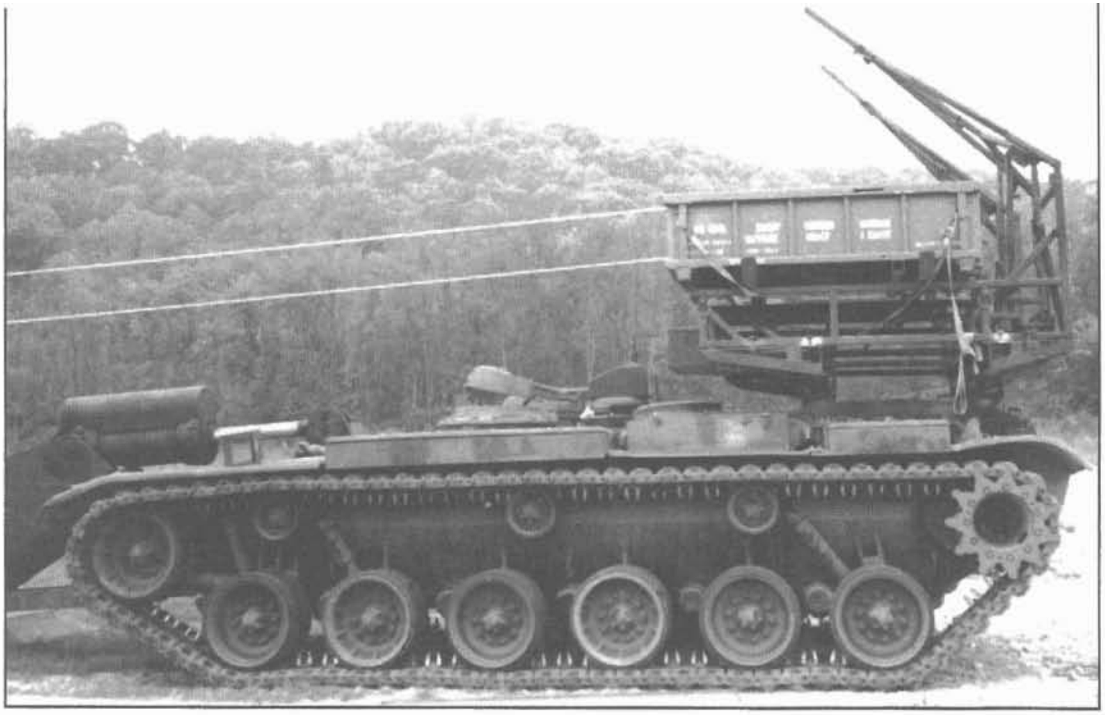
Under the new structure, the major missions for divisional engineers—mobility, countermobility, and survivability (M/CM/S)—have not changed. However, to effectively support the task force, commanders must understand their roles and responsibilities under the engineer restructure concept. (For more information about the restructure concept, see two articles in the August 1994 issue of *ENGINEER*, beginning on page 40.)

Command and Control

The engineer company normally provides the task force with a planning cell that consists of the engineer company command post and is capable of 24-hour operations. This mobile planning cell usually operates out of an armored personnel carrier (APC) or a HMMWV. It is generally led by the engineer company executive officer (XO), who acts as the task force engineer plans officer and provides the task force with an experienced engineer leader in the tactical operations center (TOC). The cell includes the company operations sergeant, the driver, and the NBC and communications sergeants as shift NCOs.

Engineer Cell Functions

- ☐ **Prepare a detailed terrain analysis of the task force area of operations. The XO works with the task force S2 section to develop this analysis.**
- ☐ **Evaluate the enemy's M/CM/S capabilities for integration into the task force situation template.**
- ☐ **Recommend M/CM/S capabilities for use during the task force tactical decision-making process.**
- ☐ **Track engineer operations within the task force area of operations and participate in the task force planning process.**



This prototype AVLM was designed by the Directorate of Combat Developments at the Engineer School. The prototype is currently undergoing testing and evaluation by the Army Materiel Command. Type classification of the design is anticipated by October 1996.

Mobility

The modern, heavy task force, with its associated engineer company, has twelve times the mobility capability of the heavy task force a decade ago. Although this represents a quantum improvement in capability, it has created an equally large challenge in planning and correct usage. The engineer planning cell must estimate how many breaches the task force can perform, based on the depth and width of each lane and the proposed breaching technique. For example, assuming that lanes are to be 4 meters by 100 meters (this constitutes a one-way, vehicular lane), a balanced task force with all organic and attached assets should be able to breach—

- Two dismounted lanes or one lane per engineer platoon.
- Six lanes with tank plows or one lane per operational tank plow combination.
- Four lanes with line charges or one lane per MICLIC.
- Four 17-meter gaps or one gap per operational AVLB.

A unit's lane-making capability is constrained by several factors. A major factor is the operational readiness of the breaching systems, which are often combinations of a vehicle and a breaching system. For example, a unit's M1A1 tank may be operational, but its attached mine plow may be inoperable. Or the MICLIC may be operational, but its conveyance system may be inoperable. In both cases, maintenance problems degrade the lane-making capability of the task force.

The density, design, and location of enemy minefields and other obstacles are also important when calculating lane-making capability. For example, the presence of a 200- by 800-meter, artillery-delivered FASCAM minefield will effectively double the breaching equipment required to create a lane. Similarly, the presence of antitank ditches, which require specialized equipment to breach, will affect the number of lanes a task force can create.

Terrain is another factor that affects breaching capability. For example, the task force can create lanes in rough terrain with dismounted engineers; in rocky terrain with explosive line charges; and in smooth, cleared soil conditions with tank plows. The engineer planning cell should recommend a breaching technique based on terrain and the types

Mobility Planning Checklist

- ☐ Determine the breaching capacity of the task force based on standard 4- by 100-meter lanes.
- ☐ Constrain the breaching capacity by 4 meters through the expected enemy minefield depth.
- ☐ Determine which of these breaching assets are available:
  - Tanks and plows
  - MICLIC and carrier
  - AVLB and carrier
  - Engineer squad carriers and squads
  - CEV and M9 ACE
- ☐ Choose the breaching method based on terrain conditions.
- ☐ Determine the amount of marking material required to mark potential lanes.
- ☐ Constrain for 50- to 100-percent redundancy.

Obstacle Construction Capability Per Engineer Company		
Obstacle	*Capability*	*Remarks*
Hand-emplaced minefield	200 meters per hour	100 meters per hour per platoon
Antitank ditch	50 meters per hour	A two-ACE team is required to construct one antitank ditch
Volcano	555 meters per 15 minutes	Construction time for a blocking obstacle
GEMSS minefield	500 meters per 15 minutes	
Artillery-delivered minefield	1 or 2	Engineers plan location

Table 1

of obstacles to be breached. The Engineer School recommends that a task force have 50- to 100-percent redundancy of breaching assets for any breaching operation. This limitation constrains the number of lanes a task force can effectively create.

The task force is capable of crossing gaps with its AVLBs, CEVs, or M9 ACEs (ACEs). It can bridge four 17-meter gaps. The CEV or ACE can fill small gaps such as antitank ditches and road craters. Most units in the NTC study converted one or two AVLB carriers into armored vehicle-launched MICLIC (AVLM) vehicles and used them to carry the MICLIC. This conversion should be a METT-T decision based on an analysis of the potential gaps to be crossed. (Note: Currently, DA has issued a safety-use message restricting use of AVLMs pending approval of a standardized design. A design submitted by the Engineer School is now under study by the Army Materiel Command (see photo, page 45.)

Countermobility

Unlike mobility, most of the countermobility effort available to the task force comes from the engineer company. Because it now has one less platoon, the new engineer company may appear to have less countermobility capability than it had prior to restructuring. However, the new mine and mine-dispensing systems enable the engineer company to exceed their previous countermobility capability. Table 1 shows the capabilities of the engineer company to create obstacles and planning factors for obstacle construction.

The engineer planning cell must provide the task force S3 with an estimate of the number and types of tactical obstacles that the engineer company can provide to support the direct-fire weapon systems. The initial estimate should be simple and definable

The M9 ACE was designed to be the primary earthmover for the heavy division engineer company. However, many combat engineer companies will have the D7 bulldozer in lieu of the ACE.

The dismounted combat engineer continues to bring versatility to the battlefield through his adaptability and flexibility. This is particularly important given today's complex engineer mission requirements.

and state the number of obstacles that can be constructed. It should include an NLT start time and an estimate of materials required.

Obstacles should be designed according to FM 20-32 and should be described as *turning, fixing, blocking, or disrupting* to avoid confusion in obstacle placement or design. Most engineer companies in the NTC study group used the fixing obstacle as their "base" obstacle when developing an estimate of obstacle capability. During the war-gaming session, the staff will use the obstacle estimate to develop obstacle groups and the obstacle overlay.

The number of obstacles a company creates is a function of their construction rate, constrained by obstacle design and time lost to travel, preparation, equipment maintenance, crew rest, and resupply. The training level of the engineer unit significantly impacts their ability to produce obstacles and construct fortifications. Also, the time spent constructing antitank ditches reduces the amount of time available to construct fighting positions. The average engineer company in the study group emplaced approximately 200 meters of obstacle frontage per hour and 50 meters of antitank ditch per hour. For planning purposes, the Engineer School recommends a planning factor of 10 hours for obstacle construction. This figure is constrained for the obstacles listed in Table 1. The remaining 14 hours a day are used for movement, mine-dump preparation, maintenance, and resupply and refitting.

Engagement area planning must be completed before effective countermobility work can begin. Without a plan, the task force will not realize any enhanced combat potential from the obstacle emplacement effort. Nevertheless, the length of time required for the maneuver company/teams to develop a direct-fire plan and to build the engagement area results in more engineer work delays than any other factor. Engineers can start work before the engagement area has been completed, but they cannot always do so productively until the direct-fire plan is developed and the weapon systems are sited.

Countermobility Planning Checklist

- ☐ **Determine how many obstacles are potentially available.**
- ☐ **Determine when the engineers can begin work.**
- ☐ **Determine when the task force will be ready for the engineers to begin work.**
- ☐ **Ask when the maneuver company/teams will have their respective engagement areas sufficiently developed to incorporate countermobility efforts.**
- ☐ **Determine the amount of Class IV and Class V materials available for preparation of the defense.**
- ☐ **Ask if the task force maneuver company/teams will emplace obstacles and where this additional effort will be used.**
- ☐ **Determine obstacle restrictions.**

Survivability

The engineer company is equipped to construct vehicle and crew-served positions for the task force. The planning cell normally provides the task force S3 with an estimated number of positions that can be dug, based on engineer equipment and time available. The estimated number is constrained

Work Rates and Planning Factors (Assume all equipment is available)				
Equipment	*Number of Two-Tiered Fighting Positions*			
	24 Hours	*36 Hours*	*48 Hours*	*60 Hours*
2 Dozers	12	18	24	32
7 M9 ACEs	12	19	25	32
3 SEEs*	30	45	60	75

* Crew-served weapons positions

Table 2

by movement requirements, construction rates, equipment availability, operator proficiency, and soil or terrain conditions. The planning cell should recommend where positions can be built for maximum advantage and where positions are not feasible because of soil conditions. Ultimately, the number of positions that can be built is determined by the direct-fire plan. Unless the direct-fire systems are properly sited, position construction for these elements may be wasted or misdirected effort.

The task force generally takes several hours to plan the defensive battle, reconnoiter the engagement area, and develop direct-fire plans at the maneuver company/team level. The NTC study showed that engineer equipment is usually stationary and unemployed during that time. However, commanders must maximize engineer equipment time without wasting the unit's effort. Air defense artillery, mortars, TOC, and combat train areas often receive no survivability effort because work priority is allocated to direct-fire systems.

One alternative is for engineer units to fortify the indirect, air defense, and combat support systems during that time. These positions require less precise ground positioning and are less time-consuming to construct than direct-fire positions. This engineer effort will increase the overall survivability of the force without degrading the direct-fire system fortifications.

Doctrinally, an engineer company can prepare 12 two-tiered fighting positions and 30 crew-served weapons positions in a 24-hour period. For planning, the Engineer School recommends a factor of 15 hours per blade team per day for fighting position construction. The remining 9 hours are used for maintenance, repair, refueling and travel. Table 2 shows work rates and planning factors for the engineer company to construct two-tiered fighting positions.

Survivability Planning Checklist

- ☐ **Determine how many positions can be built.**
- ☐ **Determine which type of position is recommended.**
- ☐ **Determine if there are any digging restrictions.**
- ☐ **Ask when the equipment will be available.**
- ☐ **Ask when the maneuver company/teams will be ready to start position construction.**

Limitations

The NTC study compiled data for 18 force-on-force operations and identified several limitations. The following limitations have since been mirrored in operations at other combat training centers:

Logistics. The most significant limitation facing the engineer company is its austere logistical organization. The company has no organic maintenance, Class IX material, recovery, or medical evacuation capabilities. These assets are consolidated with the engineer battalion. This is a significant change from the previous engineer organization.

Communications. The engineer company may experience extended lines of communication with the engineer battalion. Engineer battalion trains are normally found in the brigade support area. Generally, when the engineer company is working well forward, the task force combat trains are between the engineer company and the engineer battalion trains. All engineer companies in the NTC study ultimately became attached to their respective task forces because of extended distances to the engineer battalion trains.

Maintenance. The engineer battalion is authorized three maintenance support teams (MSTs) in the headquarters maintenance section. An attached engineer company should come with an MST from the engineer battalion, but there are only three MSTs to support three engineer companies and the HHC. This places a burden on the task force because most engineer-specific equipment is low-density, high-maintenance, and specialized. The task force does not normally maintain the PLL required for equipment in the engineer company, nor does it have the expertise or the experience to properly repair this equipment. Also, engineer battalions generally have a consolidated

PLL, which makes it difficult to prepare Class IX packages for each attached engineer company. The engineer battalion should receive an MST from the forward support battalion to facilitate speedy battlefield repair. Future battalion organizations will have modular CSS functions that will better support separate company operations.

Recovery Assets. The engineer battalion maintenance section does not provide for recovery assets within each company. The two recovery vehicles (M88s) allocated to the engineer battalion must support the entire engineer battalion across the maneuver brigade sector. The engineer commander must plan for self-recovery during combat. Frequently, companies in the study group used AVLBs for ad-hoc recovery.

Special Tools. The engineer company has several specialized pieces of equipment. The M9 ACE, SEE, M728 CEV, and M48A5/60 AVLB all require special maintenance skills and special tools. The engineer battalion MTOE authorizes only a single special tool for some equipment, such as SEE and ACE special tool sets. Because these sets must be shared by three companies, the engineers are severely limited in their ability to fix forward or quickly repair the specialized equipment. This issue may be alleviated when the battalion support platoon is redesigned (currently under way) to support modular, separate operations.

Medics. The engineer company generally receives two medics from the HHC. Because no ambulances are authorized for the engineer battalion, the company must use organic, soft-skinned, or combat vehicles to evacuate the wounded. This additional burden on the task force medical platoon limits their ability to support the engineer company on an area basis. The commander must understand the medical support plan in order to evacuate engineers quickly and efficiently.

Operational Readiness. Data compiled during the NTC study showed that, when in direct or general support (DS or GS), engineer companies waited extended periods of time to receive repair parts, supplies, and Classes IV, V, and IX material during their NTC rotations. Many of the DS companies in the study group suffered operational readiness rates ranging between 20 and 50 percent after five days of combat operations, without any combat losses. Combat Maneuver Training Center Hohenfels reports similar trends. In the NTC study, readiness rates were directly related to operator training and leader involvement in operator supervision, especially for low-density engineer equipment like the ACE.

Equipment Recovery. Companies that are DS or GS must recover damaged or repairable equipment past the task force UMCP and field trains to the engineer battalion UMCP in the brigade rear. These distances may be extensive and overburden an already austere organization. Until changes to the organization are approved, the engineer company must plan for self-recovery to a maintenance collection point.

Command and Control. Command and control (C2) are also potential shortcomings for the engineer company. Most engineer companies lack a dedicated C2 vehicle for the company command post. The company XO and commander share an M998 and an M113A2, and the mission dictates which vehicle supports the engineer planning cell. Because neither is adequately configured to be a command post vehicle, the engineers are limited in their ability to effectively integrate into the task force TOC. The M577 is the preferred vehicle for the engineer command post and should be included in future force structure changes. Until then, integrated engineer command post and task force TOC operations will be limited.

Looking Forward

The new divisional engineer organization provides a modernized task force with superior breaching capability, better engineer C2, and increased survivability and countermobility potential. These improvements greatly enhance the mobility of the force and its ability to defend and survive on the modern battlefield. The increased capability has been accomplished with a smaller, better-equipped force structure that has some limitations, mostly in the logistical arena. Even better force mobility and protection will be provided as the Volcano and wide-area mine (WAM) systems, M1-based breacher and bridger, and improved engineer squad carriers are fielded. As the engineer company structure changes, doctrine will evolve to support that change. In the meantime, the guidance in this article should fill the void in doctrine and assist you and your company as it supports the maneuver force. The engineers now have a force structure that can fully and adequately support the heavy task force any place and any time.

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Auftragstaktik: Mission-Based Leadership

Brigadier General Karl Hoffman, German Army Corps of Engineers, spoke to U.S. Army Engineer School staff in October 1994, concerning his views on independent mission analysis and military leadership.

Today I will speak about *auftragstaktik*, which means mission-type orders. I will try to explain what the word implies and whether this important leadership concept can be revitalized.

Command and control of mobile formations on the modern battlefield is a challenge. For decades, all forces have been looking for command and control procedures that are appropriate for this challenge. In the 1970s, Colonel T. N. Dupuy, a leading American military historian, made a survey of Prussian-German command and control procedures used during the 19th and the 20th centuries. Dupuy found that from 1807 to 1945, Prussian-German armies had been consistently superior to their opponents in terms of quality, command and control procedures. The results of Dupuy's research were supported by a follow-up study conducted by Martin van Creveld, a Hebrew military historian. Accordingly, experts, first from the U.S.A., soon demanded that German procedures (called auftragstaktik) be adopted.

One point is evident: If it is true to say that the German combat effectiveness was superior, we must examine the reason why. It was certainly not a higher degree of braveness that led to this superiority. Many nations have put forces of admirable braveness on the battlefield. And there is nothing like an innate German superiority in combat effectiveness. Numerous wars have shown how quickly the quality of a nation's military forces can change. For example, in the middle of the 18th century, Prussians and Hanoveranians defeated French forces without much effort, even when the latter were clearly superior. In 1806/07 the French defeated the Prussians whenever they met. In 1813/15 it was again the Prussians who defeated the French, except when Napoleon held the French command.

Apparently, units from all nations fight bravely if some basic requirements are met: a convincing reason to wage war; an internal bond, keeping the soldiers together; the presence of officers and NCOs the soldiers trust; and a sufficient supply of arms.

Roots of Combat Effectiveness

Those are reasons why soldiers fight. But it is not enough to have soldiers fight effectively. In many cases, a high degree of combat effectiveness may be the result of superior tactics. But tactics are not the only root of a high degree of combat effectiveness. This is shown by the battle for Crete, in 1941.

In that battle, the Germans had air superiority. But the British-Greek defenders had more and much better trumps to play. They ruled the ocean. They were overwhelmingly superior by numbers. They held prepared positions. At that time, paratroopers and airborne troops could carry little more than their handguns; their first assault echelons had only a few light mortars and a few radio sets, at best. Only after an airfield had been seized was it possible to send in light cannons. It was impossible for the Germans to supply tanks, armored infantry fighting vehicles or trucks, although those vehicles were available to the defending units. Even worse, the defending units knew the German radio code. So they were familiar with every detail of the German plan of attack, including the time of attack and landing zones.

Using parachutes and gliders, the attacking German units landed literally within the positions of vastly superior defending forces, who knew exactly when and where the Germans would attack. Nevertheless, the attacking forces were successful. They seized an island of strategic

East end of Remagen railroad bridge which collapsed 17 March 1945, spilling several hundred engineers into the Rhine River at Remagen, Germany. By waiting for orders to seize the bridge, the U.S. lost the initiative. German forces were able to reinforce their troops and finally destroy the bridge. While the U.S. ultimately succeeded, immediate action according to the Auftragstaktik principle might at least have saved many lives.

importance and caused casualties in the enemy lines that exceeded the number of their casualties many times over.

It was not superior tactics that brought about the victory. Under the described conditions, German tactics were soon reduced to a desperate struggle for survival, performed by small, isolated units. The attacking forces never had a chance to perform a planned combined arms battle or tactically employ their units and formations.

So, there existed another significant factor besides tactics. This factor was so strong that it offset the terrible disadvantages with which the German paratroopers and mountain troopers had to struggle. In searching for this factor, we turn to Field Marshal Lord Carver, the former British Inspector General. During the Second World War, he participated in many German-British combats as a front-line soldier in Africa, Italy, northern France and Germany. In his book *Dilemmas of the Desert*, Lord Carver wrote that time and again British units were defeated because they failed to move; instead, their unit leaders waited for orders or for approval of their intentions. This implies that forces will fight effectively if the soldiers' braveness is supplemented by two factors: good tactics and initiative (enterprise)—or the willingness of officers, NCOs and enlisted men to act independently and, if need be, even contrary to their obsolete mission.

The importance of acting independently results immediately from the characteristics of war. War is the domain of uncertainty, friction and, often, sheer chaos. It will remain so because war is not waged by machinery but by soldiers operating machinery. So, war is a fight between opposing forces of will and mind. Soldiers' reactions in the face of danger and death, however, are unpredictable. Managerial planning and careful realization of detailed plans may not show soldiers the way through uncertain situations, frictions and chaos.

When the unexpected occurs, those waiting for new orders will lose. But those who react faster than their opponents will win. They will act like a chess player who moves two pieces at a time while his opponent moves only one. If history is not misleading, auftragstaktik is one way to call forth this quick and independent action.

History

Unfortunately, few books or articles provide information on the history and origin of auftragstaktik. Yet this concept is an important and sententious phenomenon. Those who have developed auftragstaktik and have applied this system for the first time appear to have considered it something ordinary, which did not require any special explanation, theory or terminology. Even the term is quite new: It was used commonly only after the Second World War, when what it defined no longer existed.

Anglo-Americans use the term "mission-type orders" for auftragstaktik. This implies that the essence of auftragstaktik is to give the subordinate commander a general mission, while leaving him much liberty in terms of executing the mission. If you adhere to this interpretation and then compare Allied and German combat orders written during the war, you will find surprisingly few differences and not find anything to explain differences in the forces' combat effectiveness. Commanders who commanded their troops from the front lines did this not to have a better view, but to have the ability to intervene quickly and immediately with subordinate formations in executing the mission. Changing only the wording of operation orders will, therefore, not make it possible to revitalize or adopt auftragstaktik.

Contemporaries Evaluate Auftragstaktik

In the mid-19th century, Prussia already looked back on a long tradition of unusual devotion to the profession and duty. The tradition of respect for the subordinate's dignity, which was uncommon at that time, was just as long. That tradition was the basis for the natural development of auftragstaktik. The command and control procedures were not created at that time, nor were they conscientiously developed from a philosophy or by necessity. Instead, they evolved by themselves and were considered normal and natural. This conclusion is evident in documents written by authors from four nations:

- Prince Friedrich Karl, field marshal not only by rank, but soldier and military leader, wrote: "All in all, the Prussian officer corps, unlike any other forces, seem...to have developed an unusual longing for independence from superiors and a willingness to assume responsibility...This attitude also had an undisputable impact on our battle tactics. Prussian officers do not tolerate any restrictions by regulations and schemes, as is the case in Russia, Austria, the United Kingdom ... We give ... free rein to the ingenuity of the individual soldier, perform our arts more easily and support any successful action independently, even when this may be contrary to the intentions of a military leader."
- Thirty years later, an Englishman made the following judgement in what he explicitly called a "critical study" of imperial Germany: "Nowhere in the world, independent thinking and liberty of action is fostered and promoted as much as in the German forces, from the commanding general down to the last NCO."
- A Russian general, who had acted as an observer during the entire German-French war in 1870/1871, concludes his two-volume report as follows: "Actually, the eventual success of the Germans was obtained due to an incredible extent of independent enterprise by the lower-ranking leaders on all levels down to the lowest one, which was displayed on the battlefield and outside of it."
- Shortly after the German-French war, an officer presented a speech at the Ecole Superieur de Guerre—without exception, all course participants had fought in this war. He said: "A common characteristic of all German officers was the firm determination to keep the initiative by all means ... while the soldiers were incited to devote themselves completely and to act autonomously, and while all soldiers were obliged to think, to check and to create their own conceptions ... The NCOs were the backbone of the Prussian forces ... a precious support of the officers. Their special responsibilities, backed by a respect which was unknown in other armies, guaranteed them to hold an honorable and envied position. The Prussian forces were proud of them."

"When the unexpected occurs, those waiting for new orders will lose. But those who react faster . . . will win."

These writings indicate that the command and control procedures of auftragstaktik had not been grafted on an optional basis. Rather, auftragstaktik was founded on many decades of national education, respect of the person, and the dignity of lower-ranking officers, NCOs and enlisted. Last but not least, auftragstaktik was the result of constant observation and promotion of professional skills over decades, which resulted in self-assuredness and self-confidence.

One facet was very important, even crucial: Foreign observers recognized that the high degree of independence was not restricted to the battlefield. They noted that it existed "on the battlefield and outside of it." They perceived independence and self-confidence not only among officers but also among NCOs and enlisted.

These observations show to what extent liberty of action (i.e., execution of a mission by its *sense* not by its *wording*) was part of a general style of living. That style of living is not promoted or revitalized by merely changing the wording in item 3b and following the Operational Command STANAG 2024, describing the execution of the mission (or any order).

Prussian Command and Control Procedures

At first glance, the Prussian command and control procedures may appear to be the same as the procedures of other forces: The officer assessed the situation, made a decision, developed an operation plan and, based on that plan, set up the missions for subordinate units. The subordinate was given his commander's intent and orders, assessed the situation, made a decision, and so on—down to the level of the squad leader. These procedures were the same in all armies; but in the Prussian-German forces, the emphasis seems to have been shifted: The mission embraced in the statement of the commander's intent had higher priority than any detail of the execution process.

This fact may seem to be insignificant but it is not. For, if an unexpected situation developed, it was easier for German commanders to question the validity of the then-obsolete mission and act independently instead—as long as they followed the intention of their next superior.

Thus, if there is a characteristic feature, essence or substance of auftragstaktik, it is not a definite extent (listing) of details or how to execute the mission. The characteristic feature is the clear emphasis on the *intention* of the next superior—and a corresponding reduction in the importance of the mission received. When Field Marshal Prince Friedrich Karl reproved a major, in about 1860, the latter justified his action by replying that he had executed a strict order. Then the Prince rebuked him: "The King has turned you into a major because he thought you knew when not to obey an order." Such anecdotes (this one seems to be true, by the way) belong to the standard repertoire of some forces.

Remarkably, this story was referred to many times, even in semi-official publications of the Prussian forces. So it is no surprise that a military leadership regulation in 1906 included a passage which obliged officers to verify that the mission received was still appropriate in view of the situation and the intention of the next superior.

Revitalization of Auftragstaktik

Whatever was left of auftragstaktik vanished after the breakdown of Germany in 1945. Many years later, interest in auftragstaktik rose again. Perhaps it arose because NATO member nations were looking for a way to balance the high Warsaw Pact superiority in terms of quantity by establishing higher quality in terms of command, control and leadership. Or perhaps there was another reason: A future conflict between high-technology forces may be dominated as much by electronic warfare as forces in the Second World War were dominated by armored vehicles. In the future, military commanders will face quickly changing situations (i.e., obsolete missions). They will be unable to turn to superiors because radio connections will be jammed. Initiative and independent action will, therefore, be even more important in a future war than they were in former conflicts.

This brings about much more than just the question of how operational orders are worded. Wording is important. Yet, another issue needs to be addressed: Are the officers, NCOs and enlisted soldiers in the armed forces capable of implementing auftragstaktik?

What does that mean? It means that the military needs soldiers from all ranks who, upon facing an unexpected situation, start to think automatically: "When my superior gave me this mission he (or she) could not foresee this situation; so I will not follow the obsolete mission but will follow the intention of my superior." If the situation has changed completely and not even the superior's intention and operation plan are appropriate for the new situation, our soldiers must think: "When my superior developed this intention and operation plan, he could not foresee this situation. Therefore, I must consider the mission and my superior's operation plan obsolete. Instead, I must do what my superior would have ordered if he had faced this situation."

Such command and control procedures will result in chaos if those involved are not excellently trained or are not experts in their fields. Independent action can be the rule only if it is based on excellent professional skills. That is the first requirement of auftragstaktik.

The second requirement is a high degree of self-confidence. Independent action, (i.e., auftragstaktik), will develop only if—

- Soldiers consider themselves experts in their fields.
- Commanders are proud to be part of the military.
- NCOs and officers prefer their military leader assignment to anything else (and do not secretly long for an assignment in the headquarters—next to the almighties with the red general's collar patches, if possible).

The third requirement of auftragstaktik is especially difficult to meet. It concerns the superiors—up to those who personify the primacy of politics. For them, it will be possible to support (or revitalize) auftragstaktik only if they accept having subordinates who act differently from what they may have expected. If superiors intervene too often, too early or too forcefully, they may prevent a few mistakes from happening. But they will blunder because they will prevent independence from growing. Independence is the root of high combat effectiveness in a force.

Superiors must understand that, apart from lack of discipline, there is only one reason for reprimanding subordinates: inactivity or waiting for orders to come from the top. That is easier said than done. But support for or revitalization of auftragstaktik means, first, to educate superiors not to act on subordinates. It is easier to herd sheep than lions—but lions act stronger against the enemy.

The last requirement of auftragstaktik is the prevailing leadership style within the forces. For many military units, everyday business is ruled by SOPs, statistics, inspections and tests; activities are predetermined by regulations, rules and instructions. Allegedly, many military leaders are fully occupied with evaluating statements and statistics provided by subordinates, and with compiling new statistics, statements and reports. They have little time left for their most important job—to visit their troops. These visits should not be to monitor and check their troops once again but to watch and listen and learn. Officers who live in a permanently monitored environment will not develop the braveness and willingness to take the risks associated with independent action, nor will they rely on their own judgement first if this is suddenly required.

Military leaders who want their soldiers to take risks and act independently, those who want, in effect, to introduce auftragstaktik, must support its development during peacetime. They must select, promote and educate appropriate personnel and maintain an adequate level of professionalism. Military leaders who do that will obtain the desired results. They will achieve auftragstaktik, which is the willingness of soldiers to act independently and the ability to do this in a reasonable way.

Those who think auftragstaktik is nothing but a way of wording operation orders have missed the point. Those who think they can introduce auftragstaktik from above or order it to be fostered within units are like the farmer who sows wheat in the desert. There is only one way to achieve auftragstaktik: You must ignore it. Instead, you must concentrate on building forces that are intrinsically characterized by independence, maximum professional skills and confidence. In such forces, independent action will be a matter of course.

Thank you.

For more information about the concept of auftragstaktik, readers are invited to call LTC Reinhold Hocke, German liaison officer at the Engineer School, at (314) 563-4029.

Light Engineers in Urban Cordon and Search Operations

By Major Martin N. Stanton

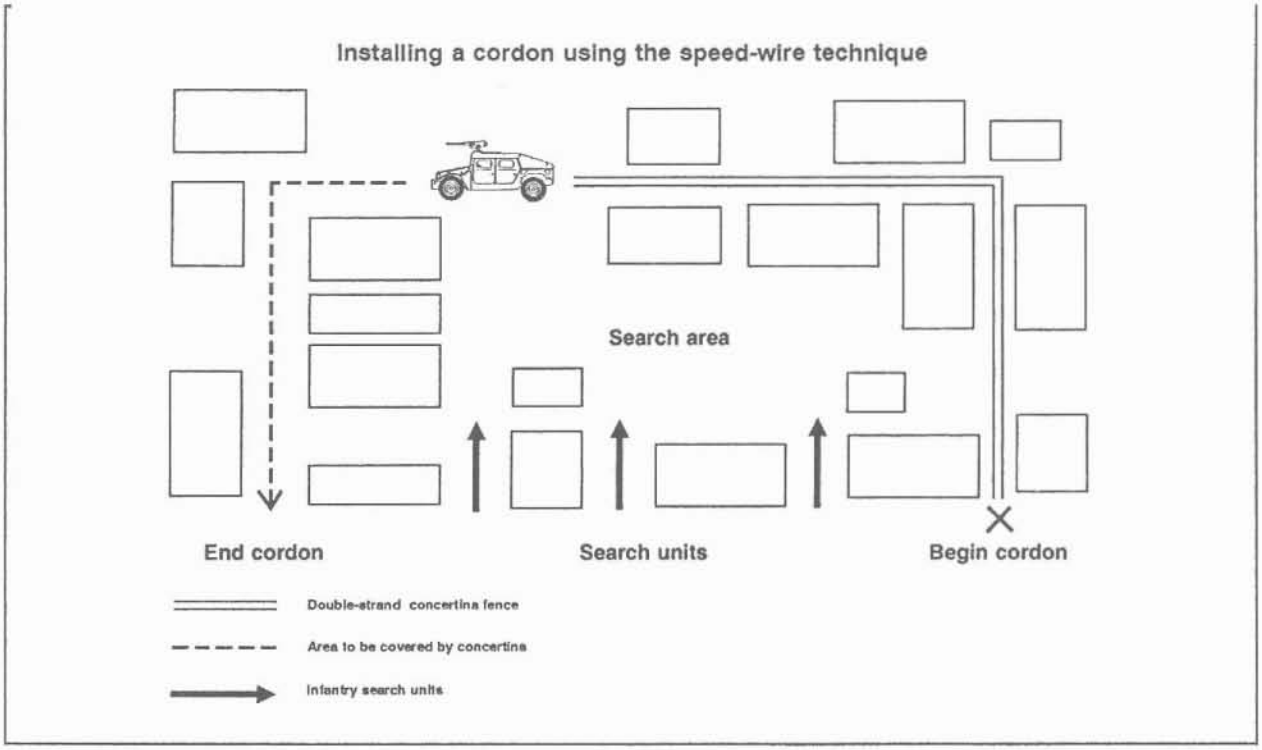
Low intensity conflict and operations other than war (LIC/OOTW) offer many opportunities for employing engineer units in innovative and unusual ways. An effective action in Somalia was the employment of a platoon from the 41st Engineer Battalion (Light) in a cordon and search operation in the town of Kismayu in February and March 1993. The platoon was attached to Task Force (TF) 2-87 Infantry.

The Situation

In a cordon and search operation, a perimeter (cordon) is emplaced around an area to prevent the escape of individuals or groups, who are the target of a search. TF 2-87 found it difficult to restrict pedestrian movement between parts of the city that had been searched for weapons and those that had not. To search the city "one bite at a time," the engineers first had to control pedestrian traffic. The rules of engagement (ROE) allowed them to fire without warning on people with visible weapons; all others had to be challenged and apprehended. Because of the large population of Kismayu (over 60,000), it was difficult to do this with the limited number of troops available (less than one battalion of Belgian paratroops and TF 2-87 Infantry). For example, while soldiers stopped one person crossing a street, a hundred others could walk by—it was not possible to stop them all. The many narrow, twisting streets in Kismayu also made it a challenge to keep people from slipping through the cordon with weapons hidden in their clothing.

The Operation

TF 2-87's solution was a technique called "speed wiring." The intent was to rapidly establish a concertina fence around the area to be searched. By creating a substantial but nonlethal obstacle, the engineers could delay the Somalis long enough to conduct a weapons search. When



constructing the obstacle, the engineers relied on the following tenets:

- Stealth (to allow unobtrusive emplacement).
- Speed (to prevent the Somalis from reacting to it).
- Reinforcement (to improve its obstacle value).
- Security (to prevent intentional or unintentional breaches).

The battalion operations order provided the engineer platoon leader with the boundaries for the search area and the type of obstacle to be installed. Engineers loaded trucks with enough concertina wire to create an obstacle several kilometers long. Infantry soldiers established a cordon around the search area just before daylight, and the engineers began to emplace the speed-wire obstacle.

Speed wiring required that trucks move down the road at a walking pace, while soldiers threw concertina strands out at intervals of 25 to 50 meters. Engineers walking behind the trucks spread the concertina and linked the strands together. Working quietly, they established the initial half-mile-long, side-by-side, double-strand fence in less than 15 minutes. Then, they pounded pickets in the dirt road and placed one strand of the wire on top of the other. They established exits through the fence at 250- to 300-meter intervals and posted soldiers by them to check people who tried to leave. Much like a fisherman's net, the wire obstacles allowed soldiers time to search people and to apprehend and disarm those with weapons. The engineers and an infantry platoon patrolled the fence to provide security and prevent a breach.

The wire fence was a complete success the first day it was used. Since it had been constructed quietly during the night, the Somalis within the cordon awoke to find a battalion of Belgian and a battalion of American soldiers preparing to conduct a detailed search of their neighborhood. Many of them tried to flee but were stopped by the wire. Rather than try to go through the fence, many armed young men returned to the cordoned off area to hide their weapons. The few who attempted to breach the fence were halted by engineer and infantry guards. Occasionally, donkeys or other animals became entangled in the wire and had to be cut free. The engineers watched closely to ensure that unattended children were not caught in the wire.

Associated Tasks

Search for Weapons. When searching for hidden weapons, the engineers used tools in their pioneer kits to smash locked doors and search under floorboards and above rafters. To breach doors and walls, they used the winch on their HMMWV, or they attached one end of a chain to the HMMWV's towing pintle and the other end to the door. Chain saws would have been useful to cut through doors and walls, but they were not available. A lesson learned is that units should take chain saws when they deploy on a cordon and search operation.

The engineers also used mine detectors to locate weapons hidden under piles of refuse, in dung heaps, or in fresh graves. Somalis rarely buried people with metal objects, so if the mine detectors indicated that there was metal in a fresh grave, it was almost always a weapon. The Somalis often hid weapons in such unsavory sites, hoping that the searching troops would be too squeamish to look for them. By

Task Force 2-87 captured more than 300 weapons in the cordon and search operation. The weapons reflected 50 years' of small arms development and ranged from M16s and AK47s to Bren guns and Lee Enfield rifles. They included 50-caliber machine guns, bolt-action rifles, hand and rocket-propelled grenades, mines, and mortar rounds. Some of the weapons were in good condition; others posed a greater danger to their owners than to us.

the end of the first day, the combined US/Belgian force had found almost 100 small arms and several crew-served weapons, as well as various types of grenades, mortar bombs, and antitank rounds.

Destroy Captured Weapons. The engineers used demolitions to safely destroy the weapons, explosives, and ammunition that they captured. Because the explosive ordnance disposal (EOD) personnel were occupied with more complicated demolitions or bomb disposal, the engineers were called upon to destroy captured weapons. They used demolitions to safely destroy the weapons, explosives, and ammunition that had been captured.

Construct Detainee Compounds. As armed civilians were detained, TF 2-87 planned to construct a detainee compound at the airfield base camp, thinking they would have to guard and provide for prisoners. Fortunately, the Belgians relieved the task force of this responsibility. Although the engineers did not build a compound in Kismayu, the ability to quickly erect a detainee facility is essential in this type of operation. Detainee compounds need a more secure fence than those erected for a cordon and search operation, usually one made of triple concertina or, as a minimum, double concertina intertwined with tanglefoot.

Assessing the Results

By establishing a cordon along the streets in Kismayu, TF 2-87 effectively sealed off the area to be searched. Local conditions made it easier to establish a cordon in that city than in many other urban areas: The buildings were too far apart to allow civilians to escape across rooftops, and there were no sewer systems or other subterranean avenues of escape. In urban environments with these escape routes, accurate maps are critical if the cordon is to be effective. Guarding each possible exit requires many soldiers, but if a military intelligence sensor team is available, sensors may be used in the sewers or on the out-of-the-way overhead avenues. Then the commander can maintain part of his reserve forces as a "sewer reaction force" to move to and intercept escape attempts detected by the sensors. In most urban areas, soldiers need to build nonlethal obstacles and provide security for them. These obstacles can be built with a mix of concertina, CS powder, broken glass or metal caltrops, trip flares, or even welded bars, grates, or doors. Use of lethal obstacles such as land mines is normally governed by ROE.

Making the Difference

Engineers were a key combat multiplier to TF 2-87 during the demanding cordon and search mission in Kismayu. Using limited resources, they were able to assess situations and devise plans to successfully use traditional obstacles in innovative ways. The Kismayu experience shows that leaders at all levels must be aware of engineer capabilities and constantly search for ways to use them as a combat multiplier. In Kismayu, effective employment of engineers made a significant difference in the success of the cordon and search mission.

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Managing Risks Associated with Engineer Equipment

By Mark Totzke

The M9 Armored Combat Earthmover (ACE), like any new system, is being fielded with design characteristics that may pose risks to operators and equipment maintainers. Due to resource constraints, no system can be designed for perfectly safe operation under all conditions or operate in all environments and against all threats. The following information describes possible safety risks associated with the ACE and how to reduce them.

M9 ACE Accidents

As with other engineer equipment, the overall number of reported accidents involving the ACE has been low. This is because the Engineer School and most engineer units adhere to high training standards and have implemented effective risk-management programs.

Since the ACE was first fielded in 1988, several equipment operators and maintainers who failed to follow the established procedures have been involved in accidents. For example, a soldier recently had a foot amputated after it was crushed while he performed maintenance in the bowl of an ACE. He and the operator had apparently confused some prearranged hand signals, and the blade was lowered on his leg.

The possible occurrence of this scenario was identified during the development process for the ACE. Rather than redesign the system, however, decision makers determined that risks to soldiers would be minimized by requiring that the blade be locked in the "up" position before anyone worked in the bowl.

There are other similar, although less serious, incidents where soldiers found established procedures inconvenient and developed their own methods. For instance, soldiers often travel with the blade of the ACE down and ignore the caution to raise the blade in rough or uneven terrain. Training documents highlight this requirement, and it is reinforced in ACE training. As the post-fielding training effectiveness analysis (PFTEA) survey reveals, however, the time required to lock the blade in the up position takes from 20 to 30 minutes. This delay creates an inconvenience to mission accomplishment and the urge to take unacceptable risks. Traveling with the blade down may cause the operator to lose control of the vehicle and has raised the overall fleet costs for the ACE because of equipment damage. ACE operators and maintainers must use risk management before they deviate from the established procedures and standards, especially in this period of shrinking resources.

Risk Management Process

The key to successful risk management is to identify and implement suitable countermeasures for hazards and, for high-level risks, to allow the decision to be made by a higher authority. In the accident described earlier, the soldiers should have contacted their chain of command; then they probably would have been required to perform the operation according to established procedures.

Fort Leonard Wood's risk-management program has served as a model for use at other TRADOC schools. It combines the common sense of engineer soldiers with a systematic method to identify hazards and prevent accidents. The program enables personnel to recognize hazards in a fast-changing environment, develop appropriate countermeasures, and carry out risky operations safely.

When operated according to standard, the M9 ACE is a safe and effective piece of equipment. Here, an operator is not using the M9 ACE according to standard; he did not fill the bowl with dirt for ballast.

When developing equipment such as the ACE, the Engineer School actively participates in a system safety design effort to identify and eliminate the most serious deficiencies that may create hazards for operators and maintainers. It is a continual give-and-take process between contractors, system safety engineers, and decision makers. For nondevelopmental (off-the-shelf) materiel acquisitions, engineers conduct a market investigation to carefully compare the safety characteristics of all candidate systems. The result of the acquisition process is equipment that can complete the mission but still has inherent design flaws. Engineers compensate for these flaws through a risk-management training program that aggressively addresses all aspects of the flaws and how to overcome them.

Long before the ACE was fielded, hazards that could not be designed out of the system were translated into "Caution" and "Warning" statements in the training literature. Programs of instruction and lesson plans were developed to ensure that trainees become familiar with the equipment and have the knowledge to do their job safely. Training programs at Fort Leonard Wood are designed to ensure that soldiers are well-versed in the techniques of risk management.

Accidents involving Army personnel (military and civilian), now drain the budget of nearly $1 billion per year. In an era of shrinking resources, it is imperative that everyone learn and use risk-management procedures during their daily activities.

Readers are encouraged to call the Engineer Branch Safety Office and relate their experiences with the ACE and other engineer equipment. We want to learn about incidents that could help improve training or identify a previously unknown system deficiency. To obtain a copy of Fort Leonard Wood's risk-management regulation, write to: Commander, USAES, Attn: ATSE-CDC-S, Fort Leonard Wood, MO 65473; or call (314) 563-0131, extension 3-7346. Use the risk management process to increase the realism of training in your unit while minimizing risks to personnel!

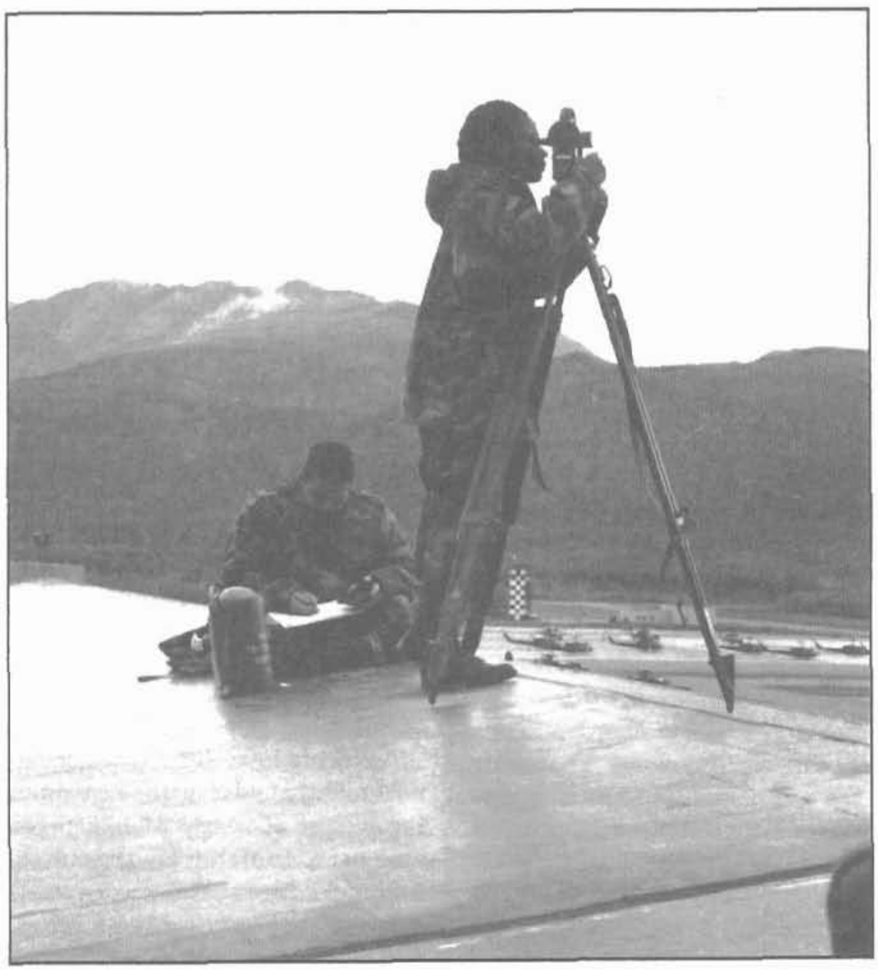
Mr. Totzke is a systems safety engineer with the Directorate of Combat Developments and the Engineer Branch Safety Office, U.S. Army Engineer School. Mr. Totzke holds bachelor's degrees in mining and general engineering from Southern Illinois University and the University of Illinois.

Engineer Support to Theater Aviation

By First Lieutenant Amy Klopotoski and Sergeant First Class Timothy J. Funk

Topographic surveyors deploying to the battlefield provide precise-positioning data (latitude, longitude and elevation) to many users. Army users of topographic information include Command and Control, Field Artillery, Air Defense Artillery, Signal, Military Intelligence and Army Aviation.

The survey platoon from the 29th Engineer Battalion in Hawaii is the only Active Component topographic survey unit in the Pacific theater. The platoon focuses on wartime missions and technical readiness through varied training exercises. Once each quarter it deploys with division artillery units to practice quick-response, precise-positioning skills.



SPC Gatling observes an angle while PFC Gambos records the angle from high atop a hanger at Bryant Army Heliport, Fort Richardson, Alaska.

The platoon's most recent challenge was a two-month deployment to Alaska. It's mission was to complete safety and navigational aid (NAVAID) surveys for three U.S. Army airfields: Allen Army Airfield at Fort Greely, Wainwright Army Airfield at Fort Wainwright, and Bryant Army Heliport at Fort Richardson. On the surveys, the platoon positioned the airfield's NAVAIDs, identified nearby obstructions and established the airfield elevation. This was done to comply with a Federal Aviation Administration (FAA) requirement that safety and NAVAID surveys be conducted on all U.S. airfields every five years.

Although the deployment was projected to last three months, the survey platoon completed the job in two months, at a considerable cost savings. Support received from organizations throughout Alaska contributed to the mission's success.

Using military personnel to do the three surveys cost about $90,000. In comparison, hiring an outside contractor would have cost about $200,000 for each airfield. Compared with the cost of hiring contractors, deploying Army topographic surveyors for the mission was a minimal expense, and the experience provided outstanding training for soldiers.

The Alaska project offered the survey platoon an opportunity to simulate a real-war mission combined with real-deployment considerations. One month before the platoon deployed, a reconnaissance (recon) team was sent to the three airfields. It determined the scope of required support, including billeting and transportation. The recon team also located existing survey control points on and around the airfields. These were points where the horizontal and vertical positions were determined to a high degree of accuracy. Data for these points exist in files called *trig* lists; they include station description cards and survey control schematic diagrams.

During the recon, the team requested trig lists from many sources, including the Army Corps of Engineers, Alaska District; the State Bureau of Land Management; and the University of Alaska-Fairbanks. The trig lists described where to locate the points using local reference marks such as roads or buildings, many of which were established in the early 1940s. At Fort Greely, a rural undeveloped area, the surveyors found the points relatively easily. However, at the other two airfields, located near the growing cities of Fairbanks and Anchorage, some points were difficult to find.

Upon arrival at Allen Army Airfield, the surveyors task organized into two crews: the level crew and the Global Positioning System (GPS)/observation crew. Crew members rotated to different jobs on each airfield to gain experience in different surveying skills.

The level crew recovered and verified vertical control points (benchmarks). Before using a control point in a survey, the surveyors checked the trig data to ensure that the point had not shifted since it was emplaced. Then, they used differential leveling methods to determine the elevation of various points on the runway. Starting at one benchmark, the level crew ran a continuous level line through the airfield and closed on a second benchmark. They established the elevation on each end of the runways and every 100 feet down the centerline of the runways. They ran spurs off the main level line to establish elevations on the three airfields' barometers.

The GPS/observation crew recovered and verified horizontal

Imaginary Surfaces

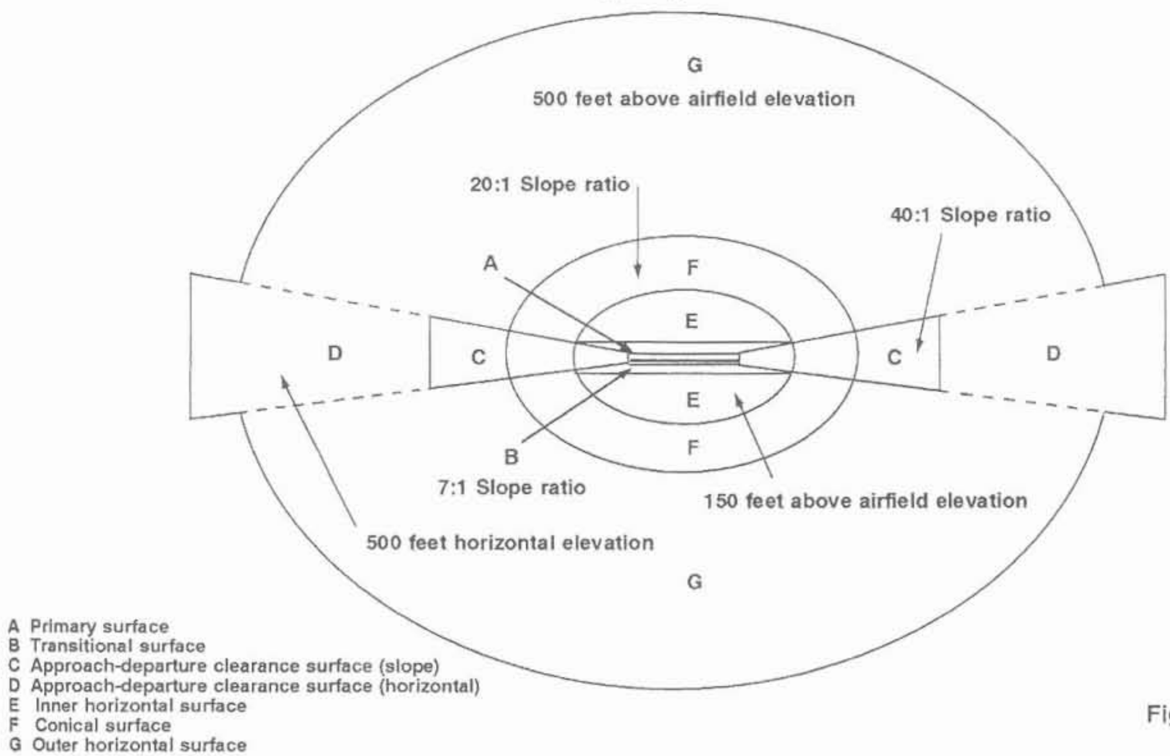


Figure 1

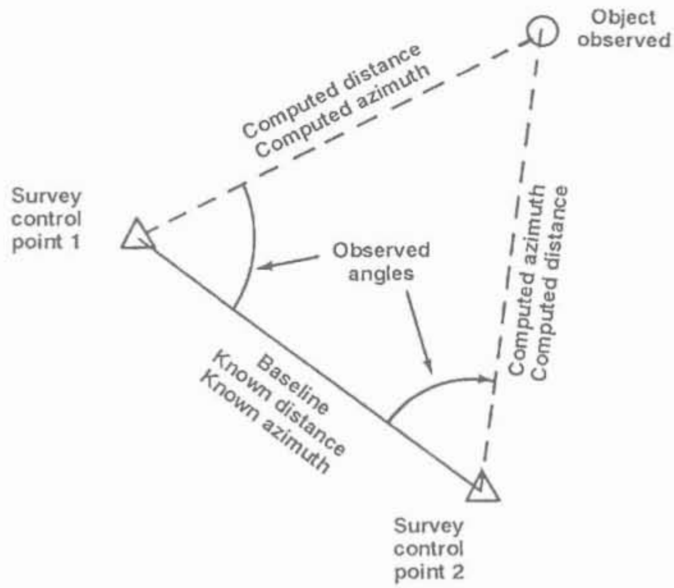


Figure 2. Intersection

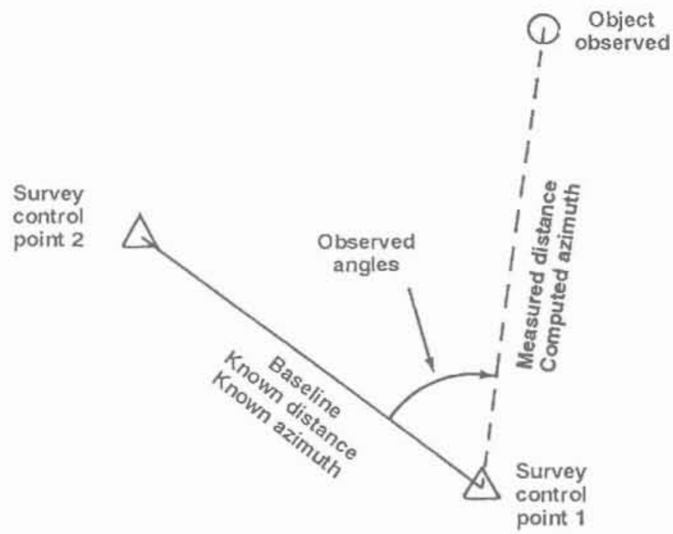


Figure 3. Sideshots

survey control points. Verification of the points was accomplished using the static GPS surveying method (see insert) to determine the position; then the points were compared to data in the trig list. After verifying three horizontal points, they used the points to establish more control points on the airfield. The crew observed all of the airfield obstructions and NAVAIDs at those control points. They determined airfield obstructions by drawing imaginary surfaces on a topographic map at various heights above the airfield elevation, as shown in Figure 1. The surfaces extended approximately 10 nautical miles in all directions from the airfield runways.

After establishing control points with geodetic-quality GPS receivers, the GPS/observation crew used conventional surveying methods to provide precise horizontal positioning for the obstructions and NAVAIDs. The two methods used to determine positioning were intersection and sideshots (Figures 2 and 3).

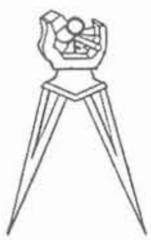
On two of the airfields, the surveyors employed a third method of positioning, using a GPS surveying method called *pseudo-kinematic surveying and processing.* The GPS receivers employed the method in a rapid surveying mode. Keeping two receivers on known positions and the third receiver roving from point to point, the surveyors quickly positioned many NAVAIDs on the airfields. Then they positioned the roving receiver directly over the NAVAID and collected data for 8 to 10 minutes at each position. They repeated the process one hour later.

The airfield surveys were time consuming and occupied several sites on each airfield, including the runways. The airfields could not shut down during the survey, so the survey team chief maintained constant coordination with the survey teams, airfield operations and the control towers. When a control tower was closed, the surveyors kept one eye looking through their instruments and the other eye on the sky because they usually shared the runways with C-12 aircraft or helicopters.

After the field data were collected, the surveyors converted their field notes to abstract sheets, which they used for position computations. The surveyors used a computer program that calculated positions faster than they could have calculated them manually. These programs were written by Sergeant Terry Klock, a topographic surveyor formerly assigned to the 29th Engineers.

Back at Fort Shafter, the surveyors compiled the data and created an airfield Obstruction Chart (OC), the final product. It was sent to Army Aviation at Cameron Station, Virginia, for approval. While drafting the OC according to specifications can take as long as the field work, a computer-aided design system (CADS) speeded up the drafting process by allowing them to store the drawing digitally. The automated database they created for each airfield now can be updated easily every 5 years.

The Alaskan project was cost effective and it allowed soldiers to receive intense training in both satellite and conventional surveying methods. The soldiers' enthusiasm and up-to-date techniques helped them achieve accurate results and complete the surveys ahead of schedule. In light of budget reductions and downsizing, providing soldiers opportunities to work in their trained areas benefits both the soldiers and the Army.



Surveying with the Global Positioning System

Most soldiers in the Army use GPS receivers to assist them in navigating from one point to another. Only a few soldiers know they also can use geodetic-type GPS receivers to determine the position of any point on the earth's surface within millimeters.

To use the method, called static GPS surveying, the antenna of a geodetic-type receiver is plumbed over a known control point, and two or more other receivers are plumbed over the points to be established. All of the receivers then simultaneously collect data for one to two hours from at least four satellites. The collected data from all of the receivers are downloaded into a computer; and the azimuth, the distance and the difference in elevation (baseline vectors) are computed between the stations using GPS data processing software. These vectors are applied to the known position and then adjusted using "least square" adjustment software. This software produces an adjusted position relative to the known position that is based on the user's requested datum. (Datum is the point-of-origin and orientation on an ellipsoid for a specific set of survey control.)

By using the GPS method, topographic surveyors can locate positions more accurately and in a fraction of the time it would take using conventional surveying methods.

SGT Long checks the placement of a Global Positioning System antenna positioned on an approach light at Wainwright Army Airfield. The surveyors used pseudokinematic surveying procedures to determine the precise position of the lights.

References

Field Manual 5-232, *Topographic Surveying*, 1989.

Technical Manual 5-232, *Elements of Surveying*, 1971.

Department of Defense Publication *Glossary of Mapping, Charting and Geodetic Terms*, 1981.

U.S. Army Corps of Engineers Publication, *NAVSTAR Global Positioning System Surveying*, Engineer Manual 1110-1-1003, 14 June 1993.

Federal Aviation Administration Publication 405, *Specifications Airport Obstruction Chart and Related Products*, February 1986.

First Lieutenant Amy Klopotoski is the executive officer for Headquarters Company, 29th Engineer Battalion. She previously served as survey platoon leader, 29th Engineer Battalion. 1LT Klopotoski is a graduate of the Engineer Officer Basic Course and the Mapping, Charting and Geodesy Officer's Course. She holds a bachelor's degree in journalism from Syracuse University.

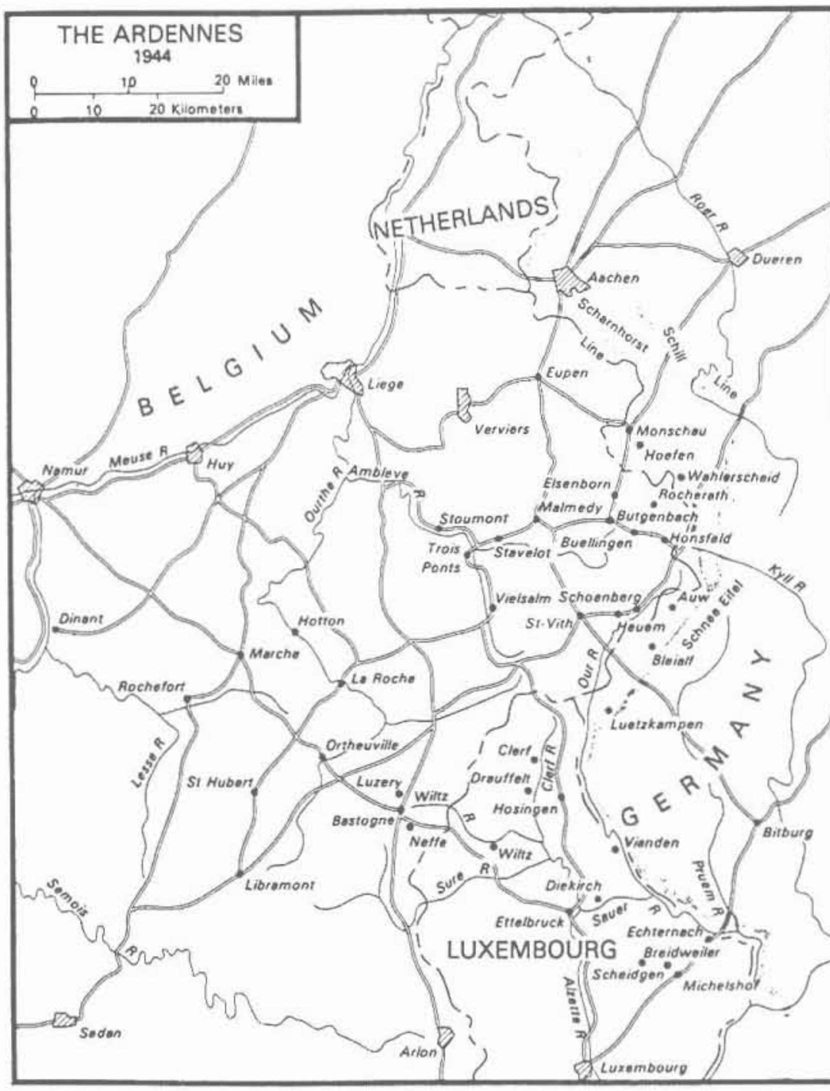
Sergeant First Class Timothy J. Funk is a training developer at the U.S. Army Engineer School, Fort Leonard Wood. He served as the platoon sergeant of the survey platoon, 29th Engineer Battalion, and led his squad in the first use of GPS surveying in combat during Operation Desert Storm. SFC Funk is a graduate of the Advanced Noncommissioned Officer Course and holds an associate's degree from Hawaii Pacific University.

Engineers and the Battle of the Bulge

By William C. Baldwin

December 1994 is the 50th anniversary of the Battle of the Bulge. During that battle, American and Allied forces turned back Hitler's last great offensive in western Europe. Often fighting as infantry in desperate circumstances, engineers played a critical role in the early days of the offensive. One of their major contributions was to delay German armored columns long enough for Allied units to set up defensive positions. The engineers' experience in the Bulge demonstrated that engineers must always be prepared for any unexpected missions a combat situation may thrust upon them.

Although D-Day landings on June 6, 1944, gave the western Allies a beachhead in northern France, it took almost two months of bitter fighting to break out of Normandy's hedgerows. After the breakout, Allied armies raced across France, liberated Paris and headed toward the German frontier. The severe strain that the rapid advance placed on Allied logistics, along with bad weather and stiffening German resistance, eventually slowed the offensive. By mid-December 1944, American armies had reached the Roer River inside Germany and the West Wall along the Saar River in eastern France. Between these two fronts lay the Ardennes, a hilly, densely forested area in eastern Belgium through which the Germans had attacked France in 1940.



Five American divisions and a cavalry group held the 85-mile-long Ardennes front. The difficult terrain and the belief that the German army was near exhaustion convinced the Allied commanders that the Ardennes sector was relatively safe. Thus, three of the divisions were new, and the other two were recuperating from heavy losses suffered in the Huertgen forest.

After months of retreat, Hitler decided on a bold gamble to regain

Engineers sweep for mines in the snow during the Ardennes campaign.

the initiative in the west. Under the cover of winter weather, the Germans massed large forces opposite the Ardennes. They planned to crash through the thinly held American front, cross the Meuse River and drive to Antwerp. Before daybreak on December 16, the German army launched its last desperate offensive and completely surprised the Allies.

As the American front in the Ardennes collapsed, the Allies redeployed their forces to fill the gap. While these troops were moving into position, the Army had to rely on rear area troops already in the Ardennes. Many of those units were corps and Army engineer battalions that were scattered throughout the area in company-, platoon- and even squad-sized groups. Engineers who had been engaged in road maintenance and sawmilling operations suddenly found themselves manning roadblocks and preparing defensive positions in the face of powerful German armored columns. Many engineer units played important roles in the Battle of the Bulge, but the following vignettes show how those engineers imposed critical delays on the offensive forces, whose only hope for success lay in crossing the Meuse River quickly.

Lieutenant Colonel Joachin Peiper, a Nazi SS officer, led one of the armored columns. His route went near the town of Malmedy and toward the villages of Stavelot and Trois Ponts. The headquarters of the 1111th Engineer Combat Group was in Trois Ponts, and one of its units, the 291st Engineer Combat Battalion, had detachments working throughout the area. When he learned on December 17 of the German breakthrough, the commander of the 1111th Group sent Lieutenant Colonel David E. Pergrin, the 27-year-old commander of the 291st, to Malmedy to organize its defense.

Although most of the American troops in the area were fleeing, Colonel Pergrin decided to hold his position in spite of the panic and confusion. He ordered his engineers to set up defensive positions around the town. During the afternoon of the 17th, engineers manning a roadblock on the outskirts of Malmedy heard small arms fire coming from a nearby crossroads. Then terrified American soldiers staggered up to the roadblock. They brought word of the Malmedy massacre, in which Peiper's troops murdered at least 86 captured American soldiers.

Bypassing Malmedy, Peiper headed toward Stavelot, where Colonel Pergrin had sent another detachment of the 291st. Equipped with some mines and a bazooka, the engineers and some armored infantry soldiers delayed the German column for a few hours, but the small American

A soldier from the 51st Engineer Combat Battalion checks a TNT charge on a tree during the Battle of the Bulge.

force was no match for the panzers. Peiper's column pushed through the village, and its lead tanks turned west toward Trois Ponts.

Shortly before the Germans broke through the roadblock at Stavelot, Company C of Lieutenant Colonel Harvey Fraser's 51st Engineer Combat Battalion, also part of the 1111th Group, received orders to defend Trois Ponts. Reinforced by an antitank gun and a squad of armored infantry, the company prepared bridges for demolition. When Peiper's tanks came into view, the engineers blew up the main bridge leading into the village.

By the evening of December 18, the small American force at Trois Ponts had come under the command of Major Robert B. Yates, executive officer of the 51st, who had come to the village expecting to attend a daily staff meeting. Fearing that the Germans would discover the weakness of his force, Major Yates tried to deceive the enemy. During the night, the engineers repeatedly drove the company's six trucks into Trois Ponts with their lights on and drove out with their lights off to simulate the arrival of reinforcements. They put chains on their only four-ton truck and drove it back and forth through the village to create the impression that they had tanks. An American tank destroyer, which had slipped into the river a few days earlier, provided the artillery. It caught fire and its shells exploded at irregular intervals throughout the night. The ruse apparently worked, because the Germans never launched a determined attack on the village.

On December 20, the 82nd Airborne Division, which was trying to block the German penetrations, learned of the small force holding Trois Ponts. When the paratroopers moved into the village, Major Yates greeted their commander with, "Say, I'll bet you fellows are glad we're here!" American troops eventually destroyed Peiper's armored column.

Farther south, engineers were also caught in the massive German attack. On December 17, the VIII Corps commander ordered his 44th Engineer Combat Battalion, under Lieutenant Colonel Clarion J. Kjeldseth, to drop its road maintenance, sawmilling and quarrying operations and help defend the town of Wiltz, in Luxembourg. The 600 men of the 44th joined a ragtag force consisting of some crippled tanks, assault guns, artillery and divisional headquarters troops. Attacked by tanks and infantry on December 18, the engineers held their fire as the tanks roared by and blasted the German infantry following behind. Forced to retreat by the weight of the German attack, the defenders moved back into the town and blew up the bridge over the Wiltz River. By the next evening, the small American force was surrounded and running low on ammunition. The soldiers attempted to escape but few made it back safely. Among the heavy American casualties was the equivalent of three engineer companies dead or missing. The defenders of Wiltz, however, had slowed the German advance and given other American troops time to rush to the defense of a critically important crossroads some 10 miles to the west—the town of Bastogne.

With the American defenses west of Bastogne collapsing, the corps commander ordered the last of his reserves to defend Bastogne until reinforcements could arrive. The reserves included the 35th Engineer Combat Battalion, a corps unit, and the 158th Engineer Combat Battalion, an Army unit which happened to be working in the area. On the morning of the 19th, German tanks attacked an engineer roadblock in the darkness. Unsure of his target in the gloom, Private Bernard Michin waited until the German tank was only 10 yards away before firing his bazooka. The explosion knocked out the tank and blinded him. As he rolled into a ditch, Private Michin heard machine gun fire close by. He threw a grenade at the sound, which ceased, and struggled back to his platoon. Private Michin, who regained his sight several hours later, received the Distinguished Service Cross for his bravery under fire. During the evening of the 19th and the morning of the 20th, the 101st Airborne Division, which had rushed to the defense of Bastogne, relieved the 158th and the 35th Engineer Combat Battalions. German panzers and troops continued to push west and north of Bastogne, and eventually surrounded the American defenders in the town.

Throughout the Ardennes, divisional, corps and Army engineer units participated valiantly in a sometimes desperate attempt to stem the tide of the unexpected German counteroffensive. Relying on their initiative and training in defensive operations, Army engineers established roadblocks with whatever troops and weapons were at hand. They blew up bridges, planted minefields and succeeded, often at the cost of heavy casualties, in delaying the powerful German armored columns. The delays that the engineers helped to impose gave the Allies time to bring in reinforcements and seal off the German penetrations. The Battle of the Bulge demonstrated that engineers could make a major contribution to the outcome of an important campaign.

William Baldwin is a historian in the Office of History, Headquarters, U.S. Army Corps of Engineers, Alexandria, Virginia.

ENGINEER UPDATE

Commercial numbers are (314) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Directorate of Training (DOT)

Environmental Handbook and Video. Two new tools have been developed to assist company-level leaders with environmental responsibilities. Training Circular (TC) 5-400, *Unit Leaders' Handbook for Environmental Stewardship*, was distributed in September 1994. The handbook contains recommendations to ensure compliance with Army environmental goals and policies, as well as federal, state, and local laws and regulations. Called the "Dash 10" manual, it delineates before, during and after checks for units conducting a field training exercise (FTX).

A case-study video and lesson plan will promote environmental ethics, unit environmental operations, and use of TC 5-400. The video's four segments highlight compliance programs and how to conduct before, during and after-action environmental checks during an FTX. The video is scheduled for distribution to TASC offices in April 1995. POC is CPT Richard Heitkamp, -4122.

ENGINEER Mail-List Update. Thanks are extended to those who have responded to the ENGINEER mail-list update letter we distributed in October. Responses are used to correct addresses and to adjust the number of magazines distributed. Units that have not yet responded are encouraged to return the entire letter, even if there are no changes to report. To request an update letter, call (314) 563-4104. POC is Catherine Eubanks,-4104.

Directorate of Evaluation and Standardization (DOES)

M9 ACE Post Fielding Training Effectiveness Analysis (PFTEA) Report. Copies of the PFTEA report were sent to all Army and Marine Corps units owning the M9 ACE in November. The report contains survey results and comments from ACE operators, mechanics, supervisors and unit commanders. Additional copies may be obtained by calling Ms. McAvenia, at (314) 563-4009. POC is Vern Lowrey, -4007.

Engineer Personnel Proponency Office (EPPO)

Warrant Officer Basic Course Extended. Starting with Class 05-95, 6 January 1995, the 919A Warrant Officer Basic Course at Fort Leonard Wood will be extended from 11 weeks to 17 weeks. The extended class will provide additional training in diagnostics, troubleshooting, battlefield damage assessment and repair, and case studies. POC is Mr. Mello, (314) 596-0837.

Reserve Components (RC)

Reserve Component Combined Arms and Services Staff School (R-CAS3). Reserve, National Guard, and Title 32 AGR officers in the Fort Leonard Wood area may now attend CAS3 in a centralized location. CAS3, now required for promotion to major, is available through the 5038th USARF School satellite unit. Class 94-03 began 5 November. Eligible officers completed the Phase I correspondence course before the schoolhouse phase. After eight weekend drills and two weeks at Fort Leavenworth, they will be CAS3 graduates and will have fulfilled their required professional education for promotion to major.

Other changes to academic requirements for enrollment in the Command and General Staff College include grade of major and completion of CAS3. This makes CAS3 the hingepin for future successful careers and an important professional milestone. POCs are LTC Jim Smith, -4085 and LTC Herb Hiatt, (314) 774-5645 or (314) 596-0302.

News and Notes

Department of Defense Fire Protection School. The new Department of Defense Fire Protection School, at Goodfellow Air Force Base, Texas, will officially open on 19 January 1995. The school currently trains military and civilian Air Force, Army and allied forces personnel. Marine Corps personnel are scheduled to participate beginning in October 1995. Course graduates receive DOD ceritfications ranging from entry-level fire fighter through the supervisory level of fire chief. In addition to classrooms and equipment storage facilities, the school has a state-of-the-art live fire training area, a training tower/residential burn building, and a fire truck maintenance facility. POC is SFC Robin Compton, (915) 654-4827 or DSN 477-4827.

BRIDGE THE GAP

By Command Sergeant Major Roy L. Burns, Jr.
U.S. Army Engineer School

Reflections

As I look back on my last two years as command sergeant major of the Engineer Center and reminisce about my initial excitement, enthusiasm, anxiety and anticipation for this position, two early goals come to mind: Improve two-way communication between the Engineer Center and field units, and ensure that the quality of training taught at Fort Leonard Wood is realistic, tough, and above all, safe.

To improve communication with field personnel, I have visited about 80 percent of our engineer units, both CONUS and OCONUS. After meeting with unit leaders and soldiers, I brought their concerns back to the Engineer Center for resolution. The Senior Engineer Leaders Training Conference (SELTC), held each April at Fort Leonard Wood, has helped improve communication. There, senior leaders from all units meet to discuss personnel, equipment, training, and doctrinal issues. Afterwards, Engineer Center personnel work diligently to fix problems bought to our attention at the conference. The improved communication is achieving benefits for the entire engineer community.

The quality of training at Fort Leonard Wood continues to be tough, realistic, and safe. To improve training effectiveness, the Engineer School's Directorate of Training (DOT) has recently reorganized. The DOT has three departments that are responsible for the development and execution of training. The Department of Tactics and Leadership is responsible for the Engineer Officer Basic and Advanced Courses and warfighting training. The Department of Combat Engineering is responsible for career management field (CMF) 12 training; and the Department of Construction Engineering is responsible for CMFs 51 and 62 training. They are working hard to ensure that high quality, tough, realistic and safe training is conducted in all programs of instruction.

Of the many other initiatives put forward during my tenure here, I will review three:

Unit Training and Equipment Improvements. Engineer School personnel are working to resolve the low operational readiness rates of the Combat Engineer Vehicle (CEV), the Armored Vehicle-Launched Bridge (AVLB), and the Armored Combat Earthmover (ACE) vehicle fleets. We are working closely with equipment managers at the Tank Automotive Command and training developers and trainers here to resolve problems through improved parts availability, equipment upgrades and better training strategies. I'm confident that our efforts will have a positive effect on equipment readiness.

New Equipment. The Engineer Center is working to procure several new engineer systems, including:

- The Grizzly (formerly called the Breacher). It is an M1 chassis-based breaching system that will replace the CEV fleet on a two-for-one basis. The first unit equipped is scheduled for fiscal year (FY) 99.
- The Wolverine (formerly the Heavy Assault Bridge (HAB). Another M1 chassis-based system, it will launch a 24-meter, military load class 90, Leguan-type bridge. The first unit equipped is scheduled for 2000.
- The Improved Common Bridge Transporter. This modified M977 HEMTT chassis will be used to transport the ribbon bridge. The system will be a one-for-one replacement of current bridge transporters. Fielding will begin in FY 96.

These are a few of many systems being procured to ensure that engineer soldiers have the best equipment possible to accomplish their missions.

Personnel Issues. The drawdown has affected engineers as it has everyone in the Department of Defense, but we are working diligently to lessen impacts on the engineer force. One initiative is to consolidate military occupational specialties (MOS) wherever possible. We have consolidated MOS 51G (materials quality specialist), 81B (construction draftsman) and 82B (construction surveyor) into MOS 51T (engineer technician). We are now working to roll MOS 12F into MOS 12B. The aim is to eliminate the low density 12F MOS and improve opportunities for advancement. We have also opened the enlisted and noncommissioned officer specialties of MOS 12C (engineer bridge crewman) and 12Z (combat engineer senior sergeant) to women. This was done to provide continued promotion and assignment availability to women, while meeting the needs of the engineer force.

I have learned much in the last two years, but one thing stands out. The Engineer Center is here to help engineer units resolve their equipment, training, doctrine and personnel issues, and to establish the regimental azimuth for the future. Let us hear from you!

The 65th Engineer Battalion, 25th Infantry Division; 299th Infantry, Hawaii National Guard; and the 1st Marine Brigade train together in West Wind, a brigade-size, joint services, amphibious landing exercise. This counterinsurgency anti-guerilla operation on the island of Molokai took place in April 1964.

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