Engineer

Headquarters, Department of the Army

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS

August 1993



Bridge Building in Somalia

PB 5-93-3 Approved for public release; distribution is unlimited.



CLEAR THE WAY

By Major General Daniel W. Christman
Commandant, U.S. Army Engineer School

Greetings once again from the Ozarks! Just finished another outstanding SELTC (Senior Engineer Leaders Training Conference) and I must say—never have I been more impressed with the professionalism, agility, and versatility of the Corps of Engineers! It is now crystal clear to all of our Army's senior leadership that engineers are an integral part of the combat combined arms team as well as vital contributors in the combat support and combat service support arenas. Our exceptional performances in recent operations other than war, including disaster relief, nation assistance, counterdrug operations, peacemaking, and peacekeeping operations, graphically demonstrate our capabilities and versatility. As always, we are committed in extremely diverse circumstances and geographic areas—but the results are outstanding for each and every mission. Super job—keep it up!

Now, some information about what is happening at your Engineer Center. Yes, we too are reorganizing. By the time you read this, the current Directorate of Training and Doctrine and Department of Instruction will be combined into a new Directorate of Training (DOT). The meshing of these two major assets will greatly enhance our ability to provide excellent training for students at the Engineer School. The consolidation will improve our ability to write doctrine because we will have a clearer and simpler chain of command that combines responsibilities for these important functions. Additionally, the reorganization will allow greater flexibility in responding to future training load changes and improve our ability to absorb minor structural changes. We will improve the linkage between trainers and training developers, and improve the expertise and utilization of instructor personnel. Last but not least, the structure of the Engineer Center brigade is being economized: the newly reorganized brigade will consist of an Officer Student Battalion, an Advanced Individual Training Battalion, a Staff and Faculty Battalion, and a Support Battalion.

These changes will unquestionably enhance our ability to produce a better product—better trained soldiers—in the near future. However, like our great friends the Marines, we are looking for a few good men and women to help implement these changes and help shape our Engineer Center and Corps for the 21st century. Unique opportunities abound for those of you who wish to be on the cutting edge of shaping our future here at Fort Leonard Wood. Your school has provided personnel and resources to virtually every major engineer deployment, including Desert Shield\Storm, the restoration of Kuwait, hurricane clean-up operations, Somalia, Bosnia, drug\counterdrug operations with Joint Task Force 6, and nation assistance with Joint Task Force Bravo. We will continue to provide these kinds of support to both our Army and our sister services. Nowhere else will you be exposed to such a vast array of unique engineer operations or have the opportunity to help shape the future of our branch and the Army. Contact your branch manager if you are interested in an assignment here at the Engineer Center. Would love to have you as a member of our team. Hoo-ah!

Had a unique opportunity to speak with the French Engineer Corps recently, as part of the Vauban-Putnam lecture series. French engineers, too, are concerned about the new world order and what impacts it will have as they restructure and downsize their force. Much like us, the French are trying to balance the realities of available resources with the needs of their country to maintain a robust and capable armed force. Although it was comforting to realize that we are not alone in struggling with this issue, the most refreshing part of that exchange was reflecting on the close relationship between our two branches. As most of you know, our Corps of Engineers has been closely aligned with French engineers since the American Revolution. We owe much to them for our initial structure and professional development. Our motto, ESSAYONS, is a tribute to the French engineers who helped shape our corps' character more than two centuries ago. For this, and for our continued cooperative alliance, we must remember the French engineers' contributions to our Engineer Regiment.

All the best from the heart of the Ozarks! Keep up the great work!

Engineer

August 1993 Headquarters, Department of the Army Volume 23 PB 5-93-3

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

COMMANDER/COMMANDANT
Major General Daniel W. Christman

MANAGING EDITOR
Catherine Eubanks

CONTRIBUTING EDITOR
Cindy Paterson

GRAPHIC DESIGNER
Jennifer C. Bolyard

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:



MILTON H. HAMILTON
Administrative Assistant to the Secretary of the Army

04483

Cover photo: *Engineers from the 41st Engineer Battalion (Light) construct a Bailey bridge over the Juba River in Somalia.*

FEATURES

2 **36th Engineer Group in Somalia: Operation Restore Hope**
by Officers of the 36th Engineer Group

10 **Bridging the Juba**
by Captain Joey Wyte

12 **Engineer Support to Peacekeeping**
by Major Boyd D. Houck

18 **Interview with Major General Daniel Christman**
by Catherine Eubanks

24 **Notes from the Commanding General**
by Major General Daniel Christman

26 **Advances in Mine Warfare: Antipersonnel Mines**
by William C. Schneck, Malcolm H. Visser, and Stuart Leigh

34 **K-Span Structures: A Versatile Alternative for the Theater of Operations**
by Captain Andrew Goetz

36 **Pre-engineered Buildings: Quality Assurance Tricks of the Trade**
by D.G. McIntosh

39 **FY 94 SDTs Affect NCO Careers**
by Jim Evans

40 **Mapping Your Career the Engineer Way**
by Master Sergeant Jose Bonilla, Master Sergeant Kathryn Kindle, and Sergeant First Class Benjamin Twigg

46 **Germany's Military Role in a New World Order**
by Lieutenant Colonel Reinhold Hocke and Second Lieutenant N. Dan Nelson

50 **Terrain Intelligence and Battlefield Success: A Historical Perspective**
by Major William J. Bayles

DEPARTMENTS

Inside Front Cover: **Clear the Way**

25 **Personal Viewpoint**
35 **Engineer Problem**
42 **Lessons Learned**
45 **Engineer Solution**
55 **Engineer Update**
57 **Bridge the Gap**

ENGINEER (ISSN 0046-19890) is prepared quarterly by the U.S. Army Engineer School, ATTN: ATSE-T-PD-EB, Fort Leonard Wood, MO 65473-6650. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to ENGINEER, the Professional Bulletin for Army Engineers, ATTN: ATSE-T-PD-EB, Fort Leonard Wood, MO 65473-6650.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7535, DSN 676-7535.

DISCLAIMER: ENGINEER presents professional information designed to keep Army engineers informed of current and emerging developments within their areas of expertise for the purpose of enhancing their professional development. Views expressed are those of the author and not those of the Department of Defense or its elements. The contents do not necessarily reflect official U.S. Army positions, and do not change or supersede information in other U.S. Army publications. Use of news items constitutes neither affirmation of their accuracy nor product endorsement. ENGINEER reserves the right to edit material.

CONTENT is not copyrighted. Material may be reprinted if credit is given to ENGINEER and the author.

OFFICIAL DISTRIBUTION is targeted to all engineer and engineer-related units.

PERSONAL SUBSCRIPTIONS are available by contacting the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7950. Address changes for personal subscriptions should also be sent to the Superintendent of Documents.



36th Engineer Group in Somalia:

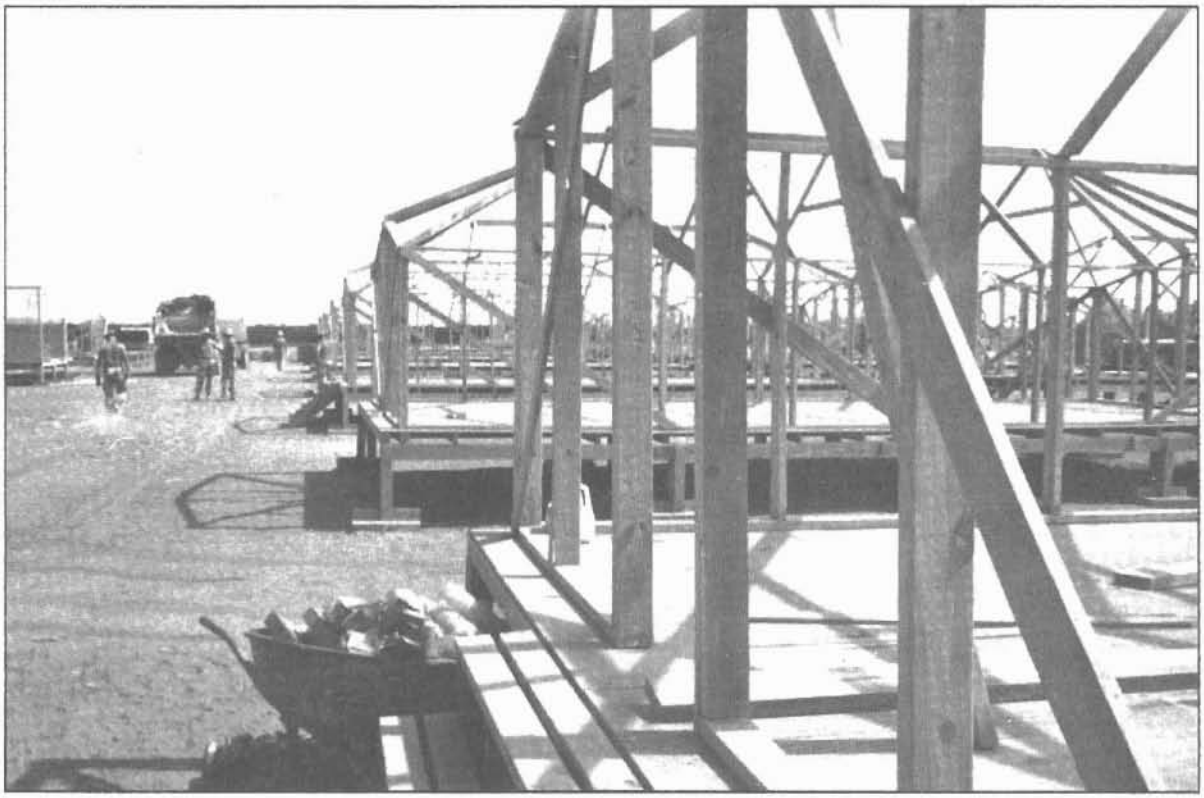
Operation Restore Hope



By Officers of the 36th Engineer Group

Since the fall of the Marxist government in February 1991, Somalia has been torn by civil war. The territory of the former nation was divided among several warlords, who locally filled the void left when the national government ceased to exist. Civil strife, coupled with drought and crop failures, led to severe food shortages and displaced large segments of the population. Beginning in August 1992, the United States participated in UN-sponsored humanitarian relief efforts, primarily flying food shipments to remote areas. From the beginning, banditry and organized resistance from rival clans hampered these efforts. In November 1992, the Bush administration decided that the situation demanded a new approach—a U.S.-led peacemaking mission to pacify the country.

Peacemaking is a relatively new concept in American foreign policy that goes beyond the traditional UN peacekeeping role. In peacekeeping operations, diplomats establish an agreed peace; then the UN provides relatively light forces to monitor the arrangement. Peacemaking, by contrast, involves imposing



Elevated strongback tents in a Bardera base camp.

order on the warring parties as a prelude to diplomatic efforts in achieving a long-term political solution.

From a military standpoint, peacemaking is similar to warfighting. Operation Restore Hope had all the characteristics of a major invasion, with the added challenge of simultaneously supporting humanitarian relief operations. The combat force was built around the 1st Marine Division and the Army's 10th Mountain Division (Light Infantry). Air Force and logistical support packages were tailored to deploy and sustain the joint task force (JTF).

Assembly of a theater engineer element to support the operation was crucial to the support package. Engineer missions included constructing and maintaining more than 2,000 kilometers (km) of main supply routes (MSRs), establishing life-support facilities (base camps) for U.S. and coalition forces, opening and maintaining airfields, and providing other special engineer support such as well drilling, port construction, mapping, and power generation. The two major components of this package were the Naval Construction Regiment (NCR 30), under the Marine Forces (MARFOR), and the 36th Engineer Group, with the Army Forces (ARFOR). This article addresses the ARFOR engineer support in theater.

Task Organization

Because significant engineer forces at nondivisional echelons were required to support the ARFOR, Forces Command selected the 36th Engineer Group as the engineer command and control headquarters. The troop list included the 43rd Engineer Battalion and the 63rd and 642nd Combat Support Equipment (CSE) companies. Those troops joined the 10th Mountain Division's 41st Engineer Battalion (LT) in providing the necessary engineer support for the ARFOR in theater.

The theater was divided into nine humanitarian relief sectors (HRSs) for the command and control of peacemaking coalition forces. For engineer support, Somalia was split into two work sectors. The northern sector was given to the Marine and Navy engineers, under the command of NCR 30. The southern half was designated as the Army engineer sector, under the command of the 36th Group. Supported maneuver forces in the southern sector included a brigade from the French Marines, an Australian Regiment, a U.S. Marine and a Belgian parachute battalion, and a brigade from the 10th Mountain Division.

Threat

The threat to engineer forces varied by geographic area

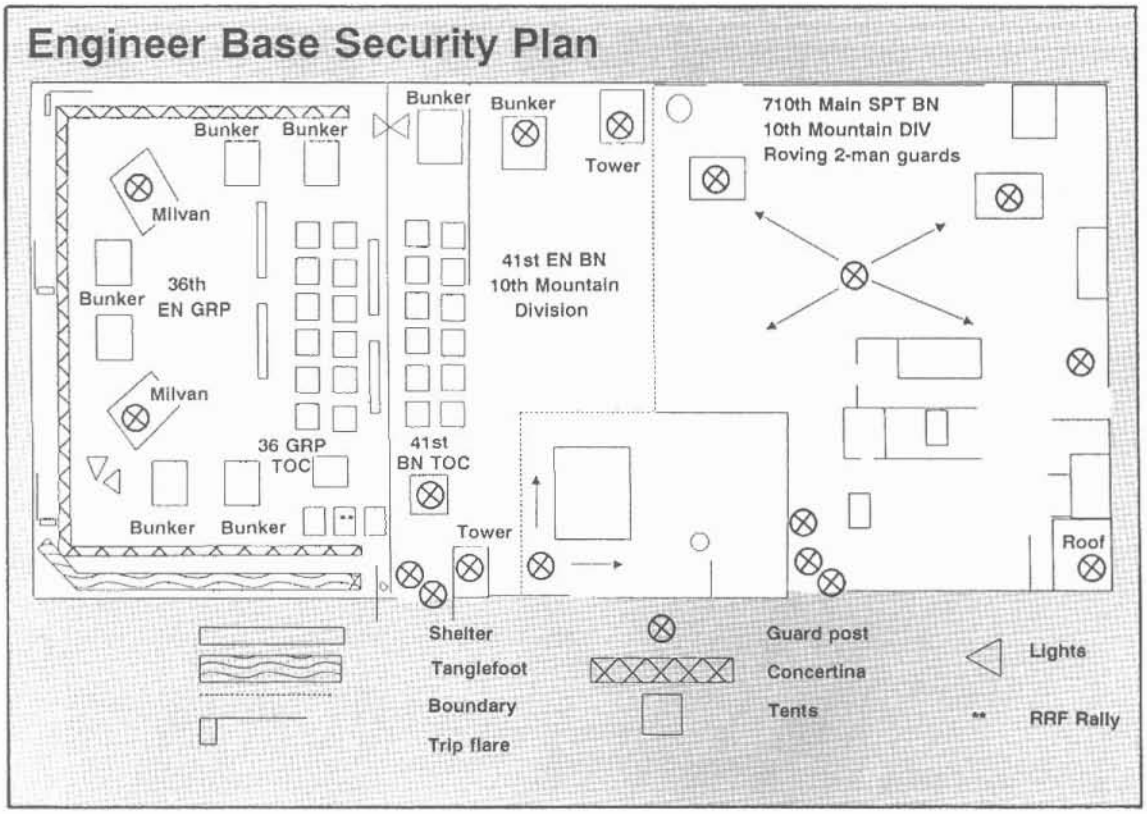


Figure 1

and included random violence, organized sniping, ambushes, criminal activity, and localized civil unrest. Criminal activity, the primary threat, included petty theft and rock throwing. Engineer Class IV items were a prime target for thieves.

Base defense and job-site security were major concerns. The base cluster in Mogadishu, as portrayed in Figure 1, included the 36th Engineer Group headquarters; HHC, 41st Engineers; and the 10th Mountain's 710th Main Support Battalion. The 36th used floodlights, trip flares, triple-standard concertina fences, and guard towers extensively. The base cluster security force ranged from 10 personnel during the day to 20 at night. Off-duty security personnel comprised the base cluster's quick reaction force (QRF). Shelters (bunkers) were built for personnel not on security or part of the QRF. The HRS commanders provided job-site security and the QRF to defeat levels two and three threats. Level two response was usually military police, while response to a level three threat was a tactical combat force. Depending on the HRS, that force included light infantry, armor, or attack helicopters.

Mission

The mission for theater engineers was to construct roads, airfields, and base camps to meet the end state conditions for transition to a follow-on UN command. The 36th Group staff developed a plan to complete the assigned missions in the ARFOR engineer sector by February 28, 1993. (See article, p. 8.)

Execution

In developing the road network for MSRs, towns were identified where food distribution was critical to keep thousands of Somalis from starving. The MSR upgrade mission included more than 1,000 kilometers (km) of roads linking critical towns, construction of 150 km of new roads through virgin terrain, maintenance of two airfields, and mine clearing operations.

Vertical construction focused on providing better living conditions for coalition security forces. Engineer forces conducted site surveys throughout the sector, while supported commanders of the coalition forces determined their base camp requirements. The vertical effort included construction of 300 latrines and showers, 110 tent floors, 55 wooden tent frames, 13 Southeast Asia (SEA) huts, and 75,000 square feet of roofing on existing buildings.

The ARFOR engineers also completed 35 civic action projects for many towns and nongovernmental organizations (NGOs),

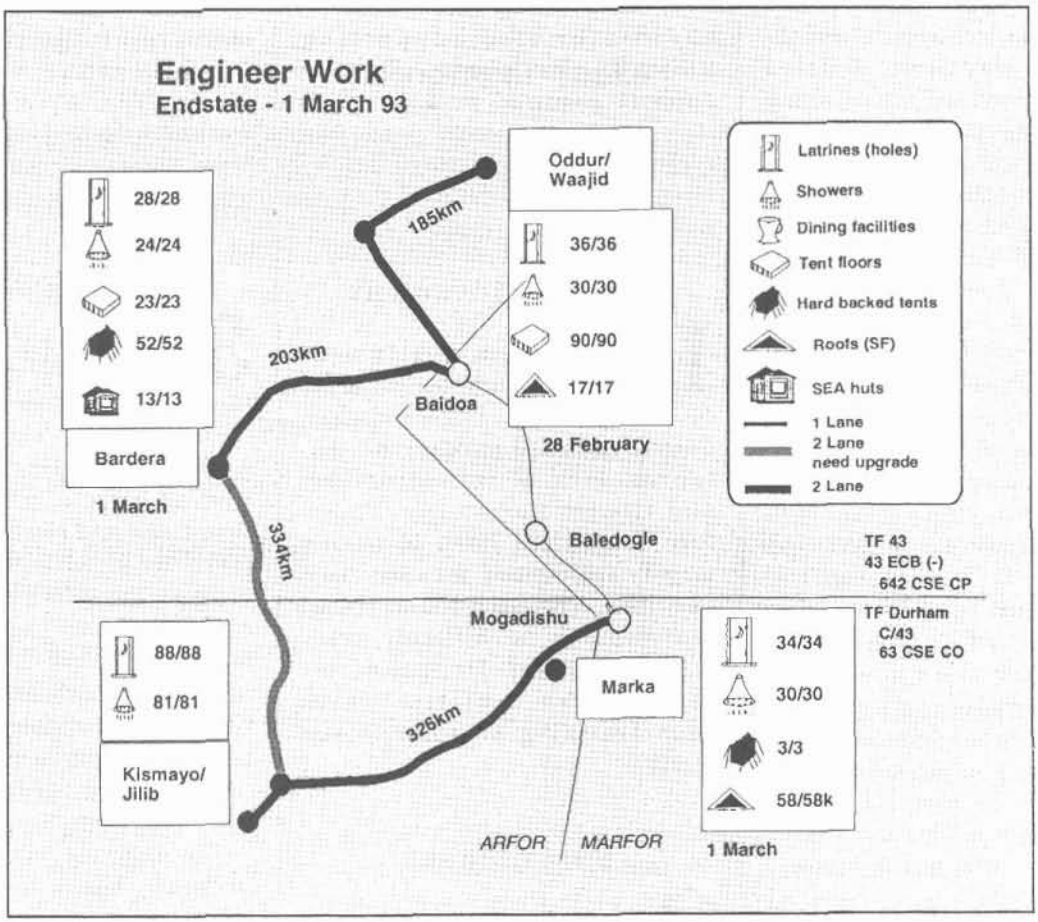


Figure 2

including school construction and renovations, well upgrades, land clearing, and building renovations. Civic action projects were important to support initiatives by local leaders and humanitarian-relief NGOs. Financial and legal constraints limited the construction support U.S. engineer forces could provide. The key criteria for evaluating civic action projects were that they must—

- Support relief organization initiatives.
- Benefit the community as a whole.
- Promote self-help in the area.
- Require little or no materiel investment.
- Not interfere with mission accomplishment.

To facilitate mission accomplishment, the 36th Group split the ARFOR engineer sector in half and task-organized for two battalion-sized task forces. In the north, TF 43 consisted of Headquarters and Support Company, A and B Companies of the 43rd, and the 642nd. In the south, TF Durham, commanded by the group executive officer, included elements from HHC, 36th Group; C Company, 43rd; and the 63rd. The two task forces developed individual plans for accomplishing their engineer missions. Progress was tracked graphically and portrayed work accomplished and remaining (Figure 2). This provided the ARFOR commanding general and his staff with a single document to track the engineers' progress.

Service Support

Somalia was an immature theater where austerity was the rule. The 36th took a conservative approach for planning purposes, with the goal of sustaining itself for at least 15 days in all classes of supply except Class III (bulk). Bulk POL was so scarce that they were allowed to ship full tank and pump units, but this provided only two days of supply (DOS). Based on guidance from the JTF engineer, the 36th deployed with 30 DOS of Class III, Class VI, select Class IX items, and enough materials to build two AFCS 1,000-man base camps. Each company had one 400-gallon water trailer with processed water for personal hygiene from the reverse osmosis

water purification unit. Throughout the deployment, bottled water was procured for drinking and cooking requirements.

To visualize the needed extras, the S-4 section thought through a typical day in Somalia. This approach helped anticipate necessities such as "Australian" showers, laundry pails, clothespins, and sundries packs. In addition, the Fort Benning central issue facility provided a special CTA-50 issue, (including desert camouflage uniforms, mosquito nets and poles, 2-quart canteens, goggles, and sunglasses), plus plenty of Deet and Permethrin for insect control. These supplies, plus sets, kits, and outfits, filled 270 containers. Each container was marked with equilateral triangles on all sides to facilitate rapid identification and follow-on movement from port facilities. Accurate inventories were critical because containers were ultimately transported on three ships. With no reception facilities in country, passenger airflow was keyed to the ships' docking dates. This ensured that soldiers flying in to theater would not exceed the capacity of the life-support supplies and equipment on the ground. Once in theater, the advanced echelon (ADVON) S-4 section immediately began to prepare for the three logistical phases of the operation: reception, onward movement, and sustainment.

Reception

The morning after the ADVON's arrival, they began to ready the engineer base in Mogadishu for arrival of the main body. Battalion and company staging areas were laid out to link the soldiers with their equipment, establish accountability, and perform maintenance. While these linkups were taking place and soldiers were acclimating to their new environment the S-4 briefed supporting units on the mission and the support required to accomplish it. These meetings laid the groundwork for onward movement and sustainment.

Onward Movement

Forward area deployment was necessary before units could begin work. Logistical challenges included geographic distances, lack of infrastructure, and theater immaturity. Therefore, logistical base locations largely influenced forward base locations. The 36th found transportation to be difficult, with stiff competition for limited assets and frequent tire losses from traveling on unimproved roads.

Sustainment

Sustaining the force during mission execution would not have been possible without the superb support of the 593rd Area Support Group (ASG). Multiclass resupply logistical packages met the sustainment needs for seven companies spread over 1,100 km of road, with rations, one to three DOS of potable water, and one to two DOS of bulk fuel carrying capacities. Units within 50 miles of a logistical base provided their own vehicles to shuttle supplies. Outside that radius, the 593rd hauled three DOS, leaving required tankers and bladders with the companies.

To assist the 593rd in its initial planning, the S-4 developed a graphic portrayal of consumption rates. The number of soldiers at each location drove the ration and potable water consumption quantities (10 gallons per soldier per day). The ASG was notified daily of specific support requirements through a simplified logistical status report that permitted units to submit reports via tactical satellite (TACSAT). The system worked well, and all engineer missions were completed on schedule with no supply delays.

Maintenance

36th Group equipment maintainers knew the challenges that lay ahead because they had recently tested their equipment while participating in Hurricane Andrew relief efforts. Long logistical lines and the harsh environment required a beefed-up prescribed load listing (PLL) and authorized stockage list. Before deployment, the 36th purchased major assemblies, numerous tires, and commercial construction equipment repair parts and loaded them into containers bound for Somalia.

The engineer mission was well underway before the ASG became fully operational; therefore, repair parts had to last. The 36th sent two soldiers to Mombasa, Kenya, to purchase repair parts from a local Caterpillar dealer. The plan called for parts to be identified, purchased, and shipped to the requesting unit within 72 hours after equipment was determined not mission capable. Unfortunately, the 36th's demands were too large for the dealer's supplies, and the 72-hour criteria was seldom met. Still, procurement from Kenya saved valuable time when compared with the time required to ship parts from the U.S.

The long distances over which the 36th operated, coupled with the high operational tempo and the late arrival of several unit PLL containers, caused additional maintenance challenges. The 43rd established a direct-support (DS) engineer maintenance base in Baidoa, where they worked with an Australian contingent to replace major assemblies. Along with their organic DS, the 43rd had a

Engineer Tasks

Residual Engineer Force METL	Priority of Responsiblity		
	Somali Labor	Coalition Forces	Engineer Force
Force Protection	2	1	3
Countermine Operations	- - -	1	2
Maintain Airfields to C-130 Standards	3	2	1
Maintain All-Weather MSRs	1	- - -	2
Other Major MSR Maintenance (Dry Season)	- - -	- - -	1
Maintain Base Camps Beyond Self Help	- - -	- - -	1

five-man team from the 598th Maintenance Company. This team provided valuable DS automotive service to engineer units in theater. The 63rd and their DS engineer maintenance team, along with a DS automotive maintenance support team from the ASG's 602nd Maintenance Company, were deployed to Jilib to support TF Durham.

Communications

Operation Restore Hope was complicated by extensive distances and austere communications packages. The 36th's organic FM vehicle communications needs were met by installing a new single-channel, ground-to-air radio subsystem (SINCGARS) just before deployment. The SINCGARS radios operated well in the hot, arid, dusty environment. After nearly two months, the only SINCGARS radio to experience operational failure was found to have been installed incorrectly.

While SINCGARS provided basic FM communications for short distances, additional systems were required to connect widely dispersed construction teams. This support came from a combination of single-channel TACSAT radios, older high- frequency radios (AN\GRC-106), SINCGARS FM retransmission stations, and telephone communications provided by mobile subscriber equipment. All units in sector had redundant communications capability. By using a network of old and new technologies, the 36th retained command and control of the engineer force throughout the operation.

Health and Safety

No serious injuries or deaths occurred within the 36th during the two-month operation. Units obtained excellent intelligence information before deployment regarding safety and health risks soldiers would face in this hazardous environment.

Preventive medicine classes were incorporated into readiness processing. Soldiers received instruction on health hazards and preventive measures necessary to minimize them. Chain-teaching classes were given on rules of engagement and medical evacuation procedures, and all soldiers received situation training. Standards on safety, proper wear of the uniform, and preventive medicine were printed and distributed to soldiers in a pocket-sized format. Unit success was attributed to minimizing risks through intelligence and assessment, providing training, and enforcing standards.

Residual Engineer Force

Engineer staffs at the JTF, ARFOR, and 36th Group worked together to develop the residual engineer force's (REF's) mission statement to maintain minimum acceptable MSRs, airfields, and base camps until United Nations Operation Somalia, Phase II was established. Analysis of work requirements

identified six major tasks (see table, page 7), which were matrixed against who had primary, secondary, and tertiary responsibility for each. Primary responsibility for half the tasks lay with local labor or coalition forces, not with the REF.

Based on this analysis, engineer force requirements included one vertical platoon to accomplish force protection and base camp repair tasks, and two horizontal platoons to complete countermine operations, airfield maintenance, and all-weather and dry-season MSR maintenance. This force could be best provided by a CSE Company augmented with a combat heavy vertical platoon. The 63rd and a platoon from B Company, 43rd, remained in theater as the residual engineer force. The 63rd was attached to the JTF Support Command to maintain the infrastructure necessary for continued logistical support to the coalition forces in theater.

Conclusion

Operation Restore Hope, a historic undertaking for the U.S. armed forces, may be typical of the military's mission in the post cold-war era. The deployment was a unique opportunity for the soldiers of the 36th Engineer Group, joint, and combined forces to make a difference in a country desperate for assistance. By constructing roads, base camps, and airfields in Somalia, engineer units continued a legacy of providing assistance to nations throughout the world.

Coauthors include COL Phillip R. Anderson, LTC Dwight S. Durham, MAJ Chris Buswell, MAJ Earnest Brown, MAJ Mario Carrillo, MAJ Mark Feierstein, MAJ Michael Meeks, and MAJ Albert Bleakley.

Determining the Engineer End State

By Colonel Robert Flowers

"It is hard to get there if you don't know where you are going."

A Wise Man

One of the most difficult tasks facing a tactical commander deployed in a contingency operation is to envision the end state his force must achieve in order to accomplish the mission. In combat operations such as Operation Desert Storm, the destruction of the enemy's force or controlling specified terrain may be key indicators of success and victory. In operations with less clear objectives, such as Operation Restore Hope in Somalia, gaining a clear vision of the objective end state is significantly more difficult. This article describes the process the Joint Task Force (JTF) used to define the engineer end state for coalition forces and to assist the commander in developing his operational end state.

The austerity of the theater's infrastructure drove the operations tempo for JTF Somalia. The country lacked nearly everything. There was no civil government. Basic utilities such as water and electricity were nonexistent. Seaports, roads, and airfields were severely limited in capability and were in serious disrepair. Buildings of all kinds were rubbled, bullet-ridden, vandalized, and in most cases had no roofs. Such problems meant the engineer mission would be extensive. Further, the mission would be oriented to providing mobility and sustainment engineering operations in support of the JTF's employment in country, self-sustainment, and humanitarian relief efforts.

For engineers, an end state had to be defined in terms of the amount of work to be done and the construction standards to be met. To gain a vision of the engineer end state, the JTF engineer staff coordinated fully with other JTF staff sections and developed several options for theater engineer operations. The J2 staff and the engineers jointly analyzed intelligence on the condition of the infrastructure and the security situation. They obtained the commander's intent and the concept of the operation from the J3, both verbally and through the basic operations order. The J4 provided planned main supply routes. Available resources such as engineer soldiers, construction materials, and civilian contract construction support were also carefully considered.

End State Options
(Construction Standards)

Option	Facilities	Date	Mission Supply Routes
1	Tents with wooden floors Field latrines	1 Feb	Emergency repairs only Passable - one way
2	Strongback admin tents Showers Austere kitchens	15 Feb	Two-way traffic
3	All strongback tents Mess facilities Maintenance area	7 Mar	Subbase stabilization Some drainage
4	SEA hut admin areas Laundry facilities Water wells Maintenance hardstands Food storage (tents)	1 Apr	Grading, shaping Drainage
5	All SEA huts K-Span food storage	15 May	All-weather, Class 30 at 35 mph

Various assumptions were made to fill the void where facts were not available. The first assumption was that all seaport engineer construction or repair operations would be executed by a civilian contractor. The second was that, at a minimum, a C130-capable airfield would be required at the hub of each of eight humanitarian support sectors. They would provide initial support and, later, contingency support to coalition force sustainment and humanitarian relief operations. The third assumption was that some slippage of engineer units arriving in theater would occur due to competing priorities for the limited airports and seaports. The fourth assumption (but definitely not of least importance) was that sufficient construction materials would be available to accomplish the mission.

Based on thorough staff coordination and determination of the facts and assumptions, the JTF engineer staff developed details for each option. These details focused on the amount of work to be done, the construction standards to be met, the engineer units required to do the work, and the time it would take to execute each option. Before briefing the JTF commander for a decision, the engineer staff briefed the commander of each subordinate component (U.S. Army, Air Force, Marine, and coalition partners) to gain feedback and concurrence. This coordination was instrumental in gaining a decision from the JTF commander because the components were now organic to and had a vested interest in developing the plan.

Having the components' feedback and concurrence, the JTF commander was briefed on the five options (see chart). He selected option 2 with minor modifications and published a fragmentary order directing its implementation. The components, already directly involved in the plan and now having an end state to reach, set to executing the plan. Minor variations occurred because the arrival dates of some engineer units and construction materials slipped, but the mission was accomplished successfully.

Commanders of contingency forces will often need help creating a vision of their end state. Engineer commanders and staff officers have the obligation, not to mention the interest, to ensure that senior commanders understand the engineer implications associated with the mission. Engineers must be proactive in showcasing potential engineer end states to help their commanders focus on the operational end state.

Colonel Flowers is the Director of Training at the Engineer School. He served as the Joint Task Force Engineer in Somalia from 5 Dec 1992 to 28 Feb 1993. Previously he served as commander of the 20th Engineer Brigade (Combat Airborne Corps), and led that brigade as an expanded force of 10 battalions during Operations Desert Shield/Storm. Colonel Flowers has a master's degree in civil engineering from the University of Virginia and is a graduate of the National War College. He is a registered Professional Engineer in Virginia.

Bridging the Juba

By Captain Joey Wyte

Before deploying to Somalia, sappers from Alpha Company, 41st Engineer Battalion, characterized mobility operations as bangalore breaches, pop and drops, and hasty mine sweeps. Early intelligence reports indicated that large quantities of mines had been randomly placed throughout Somalia over the past two years. Based on this information, battle drill rehearsals centered around mine sweeping and clearing operations. In Somalia, however, the sappers found that while mobility was their primary mission, physical engineer reconnaissance changed their way of thinking.

Bravo Company, 41st Engineer Battalion, had deployed with the 10th Mountain Division's 2nd Brigade in late December 1992. Their reconnaissance teams reported that a major washout at the Juba River north of Kismayo had closed the inland main supply route (MSR). Alpha Company's advance party arrived in Somalia on January 7, and the main body closed on Mogadishu two days later. On January 10, they received the mission to emplace a Bailey bridge to open the MSR. Reality had hit.

To accomplish the mission, the company relocated to the port city of Kismayo, 250 miles south. They received additional equipment from the 43rd Engineer Battalion and Bravo Company, 1st Platoon. Equipment now consisted of seven HUMMWV's, two 5-ton trucks, three stake and platform (S&P) rigs, two 20-ton lowboys, one D8 dozer,



A crane is used to emplace bridge panels.



The bridge opening provided a means to move northward, and thus supported troop efforts for humanitarian relief operations in the Juba Valley.

one 25-ton crane, a contact truck, and a wrecker. So much for being light!

The first task was to organize the company and attachments for the move. The washout prohibited ground movement, and air transportation was not viable for the heavy equipment. Therefore, the company decided to make maximum use of LCU-2000 craft from the Army's 710 Boat Company to conduct an intratheater sea movement. Personnel and selected pieces of equipment flew by C-130 aircraft on January 12 and 15. The remaining equipment was loaded on two LCUs and arrived at Kismayo on January 16.

Getting the Bailey bridge into Somalia was no easy task. Two bridge sets from England and two erection sets from Germany were identified for shipment. Because the situation was urgent, these parts were flown to Somalia on four C-5A and two C-141 aircraft. The battalion staff worked diligently at matching equipment with aircraft and coordinating with other staffs to make movement a reality. These actions finally came together on January 20 and 21, when the bridge parts arrived in Kismayo.

While waiting for the bridge to arrive, Alpha Company conducted leader's reconnaissance and rehearsals and finalized plans for bridge erection. The initial design called for a 160-foot, double-truss, triple-story bridge capable of Class 55 traffic. Modifications to this design made use of an intermediate pier and called for a triple-truss, triple-story bridge capable of Class 80 traffic. Other planning determined that 15 S&P loads over two days would be required to haul the bridge parts 45 kilometers from Kismayo's airfield to the bridge site.

Site preparation was another task. Upon arrival, the company discovered that local businessmen had established a market at the washout site, including ferry service across the gap. Construction was delayed while the company relocated the market downstream with the aid of psychological operations, civil affairs, and interpreters.

After all parts were in place, Alpha Company began construction on the largest Bailey bridge built by U.S Army engineers outside of CONUS since the Vietnam War. Survey teams from the 43rd Engineer Battalion assisted in site layout. Two senior bridge NCOs from the Engineer Center at Fort Leonard Wood were flown in to provide technical expertise. Synchronization of panel, transom, and pinning crews was textbook perfect. The 25-ton crane and D8 dozer proved invaluable. By the end of the first day of construction, 13 of the required 16-panel sections were erected.

The bridge was completed by close of business on January 24. Clamps, stringers, and bolts were welded to prevent removal. PSP matting was placed on the decking to increase the wear surface and prevent theft of the wooden chess.

Although the soldiers did not anticipate emplacing a Bailey bridge, it proved to be an exciting and rewarding mission. The bridge over the Juba was a critical part of restoring Somalia's infrastructure. It allowed for inland movement of relief supplies to an impoverished population. The mission redefined mobility operations for light engineers and brought new meaning to the battalion's motto, "Sappers Forward!"

Captain Joey Wyte is commander of A Company, 41st Engineer Battalion. Previous assignments include assistant operations officer for G-3, 10th Mountain Division, and platoon leader, company executive officer, and S-1 for the 9th Engineer Battalion. He is a graduate of the Engineer Officer Advance Course and earned a bachelor of science degree at Western Carolina University.

Engineer Support to Peacekeeping

By Major Boyd D. Houck

"If you think peacekeeping is expensive, try war."

Attributed to COL David J. Lofgren, former Chief of Logistics for the Multinational Force and Observers in Egypt

In recent years, peacekeeping operations have gained greater visibility and importance because they contribute to local and regional stability. As bipolarity faded, many local rivalries that had been contained by the influence of world superpowers burst into open conflict. The world community realizes the value of containing these conflicts so they can be resolved (or at least defused) peacefully. As a result, there is an increasing call for peacekeeping operations to stabilize hot spots in Europe, Africa, and Asia. This article addresses planning considerations for engineer support to peacekeeping operations and highlights basic issues engineers should address when preparing to deploy as part of a peacekeeping force. Experiences from the Multinational Force and Observers (MFO), a peacekeeping organization along Egypt's border with Israel, provide real-life examples throughout the article.

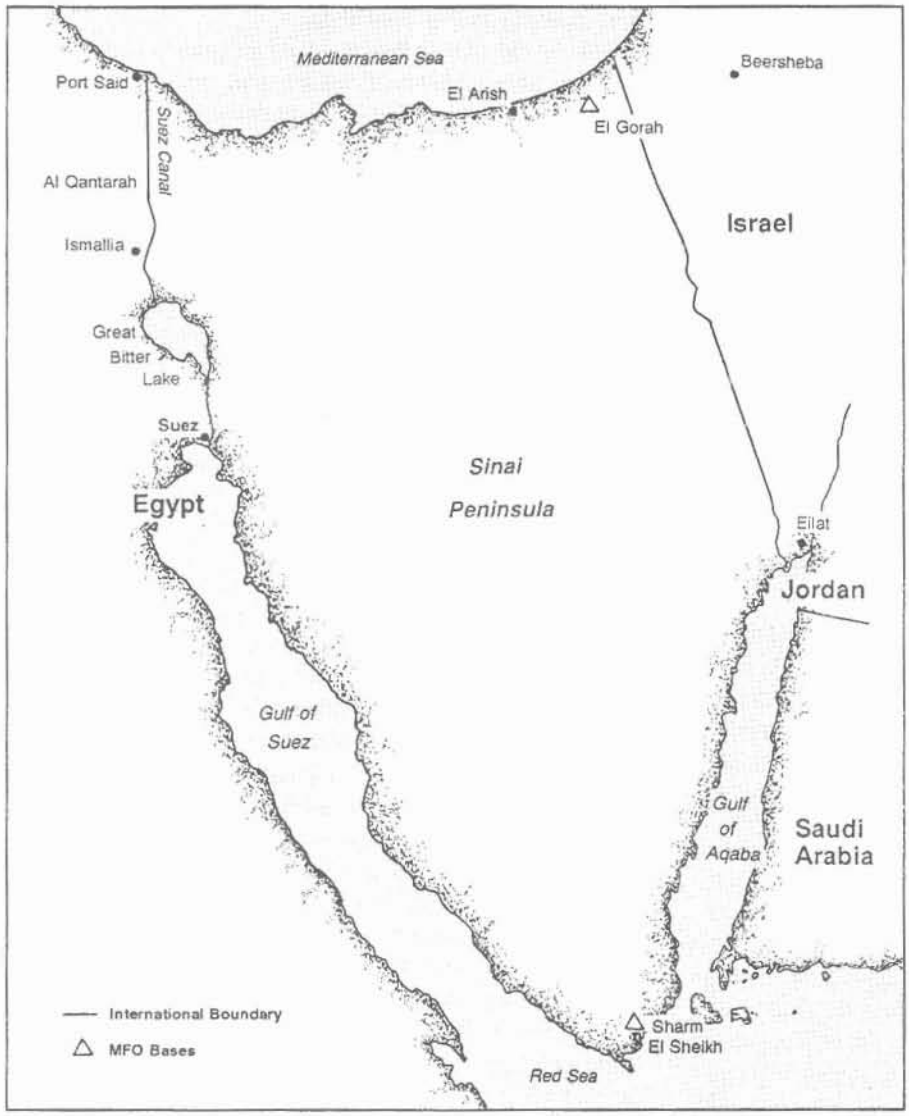


View of the main gate to the MFO's North Camp. Gate guards are soldiers from a Colombian infantry battalion.

Overview

Peacekeeping is a primarily military operation designed to achieve the political goal of maintaining peace between two or more parties to a conflict. Such operations help maintain the negotiated settlement of disputes. In general, all belligerents must want peace for such an operation to be successful. Peace, however, is not the same as the absence of conflict or disagreement—it is the remnants of hostility and the root causes of conflict that necessitate the presence of a peacekeeping force. The residual animosity between the conflicting parties has a major impact on the nature of the peacekeeping environment.

Engineer support to peacekeeping operations covers a wide range of activities, from constructing or maintaining facilities to marking or clearing minefields. Peacekeeping may include any of the basic engineer missions of mobility, countermobility, survivability, sustainment engineering, and topographic engineering. Individual engineers may hold staff positions within peacekeeping organizations or function as observers. Specific requirements for types and numbers of engineer units and for specialized engineer equipment depend on the nature, duration, and



size of the operation, as well as the operational environment. Army Field Manual 5-114, *Engineer Operations Short of War*, chapter 6, describes planning for peacekeeping operations. Throughout this article, I will address one situation where the U.S. Army is providing engineer support to an international peacekeeping operation.

The Multinational Force and Observers

The MFO is an international organization that helps keep the peace in the Middle East. An Egyptian-Israeli protocol (signed August 3, 1981) established the MFO to observe, report, and verify compliance with the Egyptian-Israeli peace treaty of March 26, 1979 (the Camp David Accords). The MFO consists of both a military force (the "Multinational Force") and a civilian observer unit, or COU (the "observers"). It is not affiliated with the United Nations (UN) but was set up after the UN was unable (due to the international political climate at the time) to establish a peacekeeping force in the area.

Two camps serve as the MFO's primary bases of operation in Egypt's Sinai Peninsula. One camp is located in the north near the town of El Arish, and the other is in the south near the resort town of Sharm El Sheikh. In addition, approximately 30 remote sites along the eastern edge of the peninsula support the MFO's mission. Eleven nations are currently represented in the MFO.

Engineering Support to the MFO

A U.S. Army engineer lieutenant colonel and two U.S. Army engineer majors currently serve 1-year tours with the MFO. The lieutenant colonel serves as force engineering officer and is the force commander's staff engineer. One major serves as the deputy force engineering officer, while the other is the facility engineer for the South Camp. An Australian engineer major oversees engineering support at the North Camp. The remote sites are the responsibility of an engineer major from New Zealand. Each of these officers has a noncommissioned officer to assist with daily operations. Military and civilian personnel from Canada, Fiji, and Egypt round out the engineering staff with design, administrative, and technical expertise.

Engineer support for the MFO is predominantly provided by Egyptian contractors and a U.S.-based support contractor, Holmes and Narver Services, Inc. In addition, the government of Uruguay has contributed an engineer detachment that furnishes heavy engineer equipment support and maintains roads that provide access to and between the remote sites. The major units that participate in the peacekeeping operation (infantry battalions from the U.S., Colombia, and Fiji) also have engineers assigned or attached. The variety of sources providing engineer support and the multinational nature of the supervisory structure create unique opportunities and challenges for engineers participating in the MFO's operation.

General Considerations

Political nature of peacekeeping. Anyone who participates in a peacekeeping operation must keep in mind its political nature and objectives. Peacekeeping is one of the most clearly political uses of military forces to achieve a political aim. The political nature of these operations may result in requirements, restrictions, and limitations (such as on the use of force) not normally experienced in other types of operations. To the soldier on the ground, these imposed conditions may not seem logical. For the statesmen involved in gaining acceptance of a peacekeeping force, they may be essential prerequisites for gaining the belligerents' acceptance of foreign troops on their soil. Thus, peacekeepers must be fully briefed on all aspects of the operation.

The governments of Egypt and Israel appoint a civilian as the director general (DG) of the MFO. The Force Engineering Office in the Sinai coordinates with the DG's staff in Rome on all engineering-related matters. As the offices interact to address issues, develop programs, and resolve problems, they consider the political implications of potential courses of action. After spending time in the MFO and gaining a better understanding of its purpose, one begins to appreciate the importance of reviewing the political impacts of decisions. A peacekeeping organization is clearly an extension of political will—peacekeepers deploy to an area to fulfill a political mandate. While we in the U.S. military understand the concept of civilian control of the military, we usually do not deal with it on a daily basis. When one works in an organization such as the MFO, where civilian leadership is not that far removed in the chain of command from those who actually keep the peace, the linkage to political leadership becomes very clear.

Multinational aspects. Most future peacekeeping operations in which the U.S. will participate will be multinational. This has two principal effects. First, sharing the costs lessens the burden on any one nation. Second, multinational participation adds legitimacy to peacekeeping operations and makes them less open to charges of being the imposition of one nation's will. Unique requirements may arise in multinational operations when soldiers of each participating nation interact with other soldiers whose cultures may seem totally alien. Open-mindedness is essential to maintaining harmony within a multinational force. Individuals at all levels must keep personal preconceptions from interfering with force functions. Because language differences may be a barrier to smooth operations, peacekeepers should learn some key phrases in the languages of other nations participating in the operation.

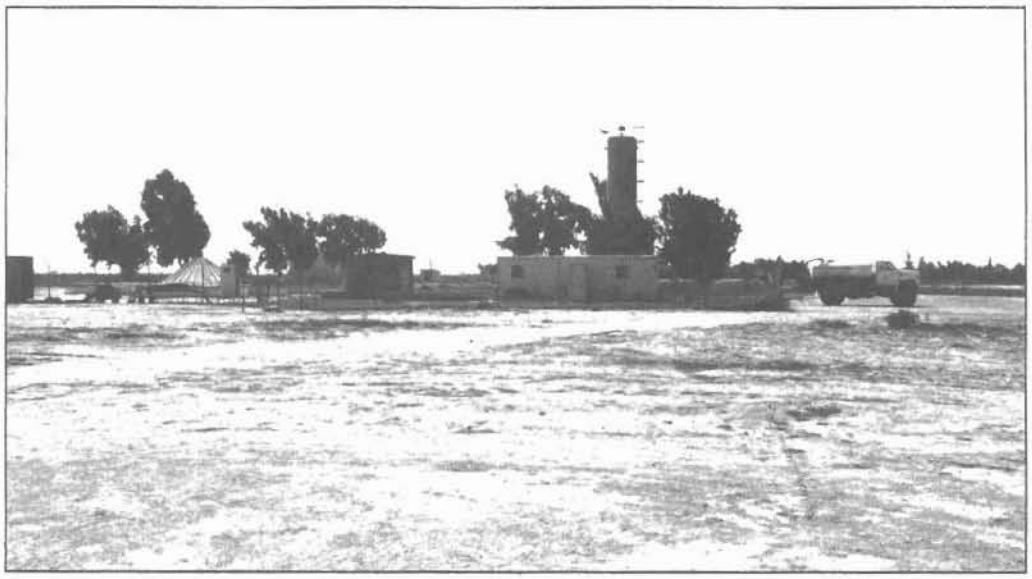
We in the U.S. often think of language barriers as existing only between English- and non-English-speaking peoples. However, communicating with others who speak English (those who feel they speak real English!) can also be a challenge. While many terms are the same on both sides of the Atlantic and the Pacific, some words have additional meanings that differ from those with which we are familiar. Many basic engineering terms (such as beam, slab, and joist) seem to be universal but some are unique to Commonwealth countries (the United Kingdom, Australia, New Zealand, etc.). For example, "metal" may mean gravel, "plant" refers to equipment, and "gullies" are drains. It takes a while to learn basic Commonwealth engineering terms, but it is an interesting process.

Interaction with the local populace. In addition to maintaining peace in an area, peacekeepers are informal ambassadors of their countries. Members of a peacekeeping force normally wear a distinctive uniform, and the force becomes a very visible entity in a sensitive and potentially explosive situation. Peacekeepers should attempt to understand the culture and language of the people they are assisting.

The relationship between the local populace and a peacekeeping force must be kept in balance. Peacekeepers must remain impartial and not appear to take sides in a dispute because a perceived bias can destroy their effectiveness. On the other hand, peacekeepers cannot appear aloof or uncaring. They operate in a region at the invitation of the parties to a conflict and must look upon the local populace as their *partners* in maintaining peace. Maintaining this balance is essential for successful peacekeeping operations.

Temporary nature. A peacekeeping operation ideally is a short-term activity. Upon the final resolution of a conflict, a multinational force can be disbanded, withdrawn, and returned to the contributing countries. Few nations can afford to devote a significant portion of their military forces for protracted periods to providing peace and security for others. While some peacekeeping operations have lasted for extended periods, most are temporary endeavors. The temporary nature impacts on the types of facilities provided for a peacekeeping force and on the way in which the force is supported. Planners generally design the facilities and the support structure to be adequate but austere.

Financial constraints. Because military budgets are shrinking worldwide, peacekeepers often operate under financial constraints. While budgetary concerns should not interfere with accomplishing the mission, financial limitations may require conservation of resources and innovative approaches to support requirements.



Waste-water treatment plant for the 2000 soldiers on the MFO's North Camp. Engineer planners must include ecological considerations when preparing to conduct peacekeeping operations. Degrading a host nation's environment will not make us "good neighbors."

Engineering Considerations

Threat level. The threat level in a peacekeeping force's area of operations is one of the most important factors in deciding how engineers will support the force. The local threat level impacts on the—

- Types of missions engineers will perform.
- Degree of hardening engineers will provide for facilities.
- Dispersion of critical assets.
- Basic manner in which engineers will conduct operations.

The threat level also affects the types of equipment and weapons (if any) that engineers will carry, as well as whether they will require external assets for job-site security. Threat levels vary widely, and every engineer soldier must fully understand the potential threat that surrounds him. For example, the environment in which the MFO currently operates is relatively benign, while peacekeepers in southern Lebanon face a considerably more hostile threat. Even in a historically low-threat area, however, the level of hostility may increase if tensions rise between the conflicting parties. Peacekeepers must continuously update their threat analysis. If tensions increase, engineers may be called upon to upgrade the security of base facilities, Construction materials should be stocked for this because rapid procurement may not be possible after the threat level rises.

While there is currently no significant threat in the MFO's area of operations, terrorism can strike anywhere. Basic force protection measures at MFO facilities include perimeter wire, security lighting, and continuous observation of site perimeters. The MFO operates in areas with a substantial local population, and a commonsense approach to applying these measures is required to ensure that civilians are not endangered. Being a good neighbor supports peacekeeping goals.

Operation Duration. While it is not possible to predict exactly how long a peacekeeping operation will last, planners can estimate an approximate duration. This planning figure affects the number and type of facilities that engineers will construct (ratio of purely functional to recreational facilities), the type of construction they will employ (tents versus wood-framed buildings), and the amount of effort they will put into building support facilities (fuel points, warehouses, motor pools, and so forth). Generally, the longer the projected duration of an operation, the more extensive and permanent the facilities will be. Other considerations may also place limitations on facilities. For example, diplomacy may dictate that a peacekeeping force maintain an appearance of nonpermanence to gain acceptance of their presence. Financial constraints on an operation may also limit the degree of facility development. Engineers should plan for a peacekeeping mission based on its projected duration but be prepared to extend operations indefinitely.

A peacekeeping mission with no specified end requires a balance between providing adequate support and conserving resources. The MFO was originally envisioned to operate for 10 years, and most facilities were built to last that long. The 10-year mark has passed, and the MFO continues to operate with no foreseeable termination date - but it could come any time. The engineering staff is faced with the question of whether each decision, project, and program makes sense within this context. On one hand, they

must adequately maintain their facilities. On the other hand, they have an obligation to the countries that contribute funding to spend their money wisely.

Operation Maturity. The length of time that a peacekeeping operation has been under way impacts on the engineer support requirements. An incipient peacekeeping operation may have significantly different (and usually greater) engineer requirements than a well-established one. The correct mix of engineer equipment may differ for establishing a peacekeeping force than is required for facility maintenance. For example, it may be necessary to drill water wells, construct observation posts and base camps, and build heliports or airports while bedding down a force. Engineer units rotating to an established peacekeeping force should communicate with the unit they are replacing well in advance to determine the current status of facilities and what missions they should be prepared to execute.

Facility standards. The standard of the facilities that a peacekeeping force occupies affects the level of maintenance required for their upkeep. This, in turn, affects the structure of the engineer force that will support the operation. At one end of the spectrum, a force may occupy a "tent city" and use temporary facilities. These situations may require support from engineer construction units, as well as engineer detachments (prime power teams, well-drilling teams, fire-fighting teams, etc.). At the other extreme, a peacekeeping force may occupy relatively permanent facilities—albeit on a temporary basis. For example, the MFO's North Camp was built as an air base by the Israelis. A permanent installation may dictate deployment of engineer teams (and individual engineers) with expertise in areas normally found in directorates of engineering and housing (DEHs). The work force performing maintenance on peacekeeping force facilities in this situation may come from military units, contractors, the local populace, or a mix.

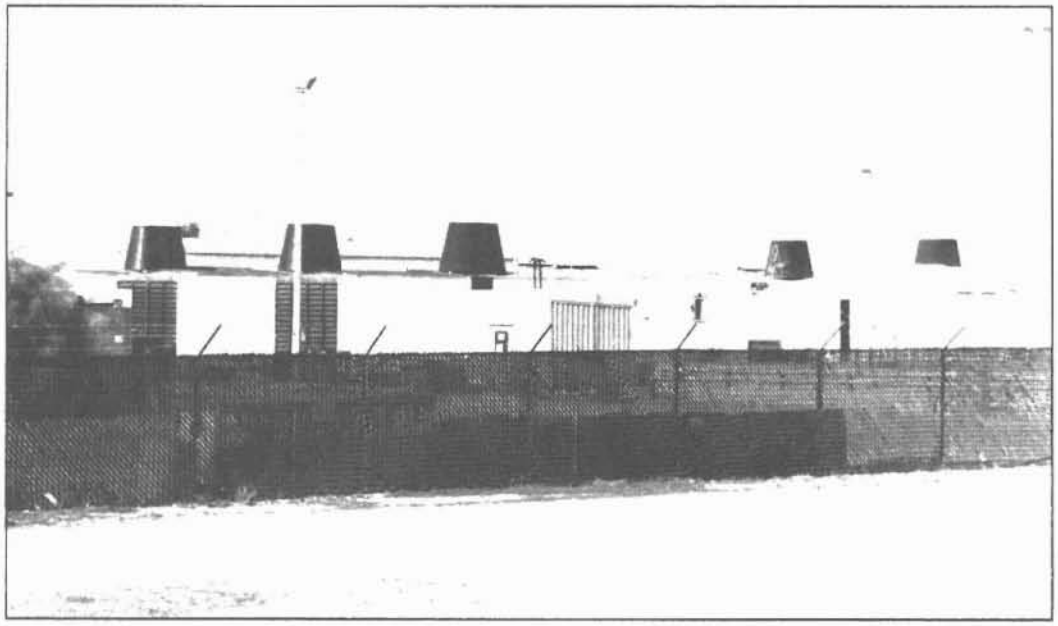
The MFO's billeting facilities range from prefabricated metal buildings (2-, 14-, and 19-man sizes) to three-story concrete barracks and three-bedroom duplexes. Offices, dining halls, and support activities occupy permanent and semipermanent structures. While these facilities are more comfortable than a tent city, they require more intensive (and expensive) maintenance. Supporting semipermanent sites in a remote area like the Sinai is much like running the public works department of a small city. The civilian support contractor provides dependable water supply, sewerage, and power. The multinational force and local contractors construct, maintain, and replace roads, buildings, and other facilities.

Age of facilities. The age of a peacekeeping force's facilities affects the amount of engineer effort needed to maintain them. Ongoing initial construction or the maintenance of very old facilities requires more engineering support than maintenance of a well-established operation that is only a few years old. As facilities age, factors such as type of construction, original design life, and the amount and quality of preventive maintenance impact on the effort required to keep them operational. Take, for example, a base camp designed to last 5 years (based on initial projections and diplomatic commitments). If the mission continues significantly longer, an increasing amount of resources must be devoted to maintaining the facilities, and this may conflict with financial constraints. In a stable peacekeeping environment, nations contributing personnel, equipment, or funding are likely to expect costs to remain relatively constant (or decrease) over time. Thus, engineers maintaining older facilities must become adept at low-cost repair and rehabilitation.

Local infrastructure. The degree of development and current condition of an area's infrastructure impacts significantly on engineer support to a peacekeeping operation. The current condition is as important as the degree of development—first-rate infrastructure may be rendered useless by the ravages of war. Power, water, roads, railroads, airfields, and ports are the most significant infrastructure components that influence engineer operations in a peacekeeping environment. These elements may be in good condition and adequate to support the peacekeeping force, or there may be no remaining (or previously existing) infrastructure. Because resources are often limited, augmentation from engineers in the peacekeeping force may be required.

The MFO receives most of the water for North Camp through a pipeline operated and maintained by the government of Egypt. The local infrastructure can support the camp's water supply needs. However, due to the remote location of the camp and its power requirements, the Egyptian power grid cannot meet the camp's electrical demands. Six 1.2 megawatt Electromotive Division (EMD) diesel generators supplied by the U.S. provide the necessary power.

Local support. Construction materials, facility repair parts, and labor (both skilled and unskilled) may be available locally to assist engineers as they support a peacekeeping force. The level of residual hostility in the region will affect the amount of commerce and interaction that occurs between the local populace and the engineers. Additionally, the location of the operation will influence the cost, quality, and availability of materials. Standards and quality will vary, but engineers must be prepared to adapt to and use local materials. This is especially true for bulky items such as cement, brick, block, timber, and plywood



MFO North Camp's power plant can produce 7.2 megawatts. These six Electromotive Division diesel generators are Vietnam-era units provided by the U.S. government. Switch gear and control apparatus allow plant operators to run from one to six units.

because transporting them from home countries may be cost prohibitive.

Working with Egyptian engineering contractors is an eye-opening part of an assignment with the MFO. We in the western world tend to take the availability of engineer equipment for granted. In the eastern Sinai Peninsula, manual labor often replaces equipment. Egyptian contractors make sizeable concrete placements using small mixers (about the size of the U.S. Army's 16S mixer) and laborers who transport the concrete with wheelbarrows. While their techniques differ from the mechanized methods common in the U.S., the Egyptians efficiently and effectively get the job done. Time and time again, they demonstrate innovative "low-tech" solutions to daily engineering challenges.

Prioritization of requirements. During many peacekeeping operations (as in other situations), requests submitted by supported units exceed the capabilities of the assets available to the engineer planner. Allocating critical assets (materials, man-hours, and equipment-hours) takes on new dimensions when the choices affect different units and different nationalities. Engineers must be sensitive to this fact and ensure they do not create the appearance of favoritism. Planners must review all requests for support, ensure they are clearly defined, and identify the resources required to fulfill them. They must then evaluate the requests based on their importance to the requesting units (keeping in mind that cultural considerations may increase the relative importance of a request) and to the overall peacekeeping mission. After the engineer planners have considered those factors, they can prioritize the requests relative to other outstanding requirements. When possible, engineers should explain to their supported units why requests have been denied. Developing open lines of communication and positive working relationships with supported units contributes to an improved atmosphere within a multinational force.

Conclusion

Because of their importance to world and regional stability, the U.S. will continue to contribute to and participate in peacekeeping efforts. The advantages that accrue from multinational peacekeeping operations make them more likely to occur than unilateral efforts on the part of the U.S. This article may assist engineers as they plan and execute support for multinational operations. These considerations, however, are only a starting point. Each operation is unique due to its location, the belligerents involved, and the nations contributing forces. Unique situations generate both customary and unusual requirements, both of which must be addressed with imagination and innovation. The most important advice for engineers planning these operations is to keep an open mind and take nothing for granted. While many challenges are involved in these operations, there are many opportunities for personal and professional development.

Major Houck is assigned to Fort Hood, Texas. He most recently served as the Deputy Force Engineering Officer for the Multinational Force and Observers in the Sinai, Egypt. Previous assignments include Regimental Engineer, 2nd Armored Cavalry Regiment and Commander, B Company, 94th Engineer Battalion. He is a graduate of the Command and General Staff College.

Interview with
Major General Daniel Christman



Q: *We've heard military leaders speak about many changes within the Department of Defense. In your opinion, where is the Engineer Branch heading?*

A: First, let me say that the future for the Engineer Branch is very bright. Like the rest of the Army, the branch is getting smaller. Further, our branch will rely on the Reserve Component (RC) to a degree unusual in other combat arms; even now, almost three-quarters of our force is in the reserves. However, more and more our country is witnessing and recognizing the importance of the Engineer Branch in all forms of endeavor, both on the battlefield in war and in operations other than war. The success of our branch in Somalia especially highlights that. We are a national asset, equally valuable in peace and in war.

The other reason why I say the future is bright is that our branch is now recognized as a vital, integrated member of the combined arms team. We saw that emphasized repeatedly by senior leaders from our maneuver corps and divisions who spoke during the SELTC (Senior Engineer Leaders' Training Conference) in April. Each of them highlighted the roles of engineers as vital contributors, side by side with infantry and armor, field artillery, and aviation. That contribution and the recognition of that contribution will continue without question because of the success we've enjoyed in recent combat operations and at our combat training centers.

Q: *What would you say are the most important initiatives currently affecting engineers in the field, within the Engineer School, and at the Department of Army (DA) level? Specifically, what will be the role of engineers in the combined arms arena?*

A: Let's break that question into three parts. In the field, two initiatives stand out. One is the continued employment of engineers in operations other than war, as highlighted by the Hurricanes Andrew and Iniki and Restore Hope Operations. The support that engineers provided in those operations gave our branch, indeed our entire country, a picture of engineer capabilities that is as old as the nation. Those experiences reflect our involvement in humanitarian relief and construction in the most positive manner possible.

The other initiative I would highlight in the combat arena is an important development with respect to equipment—and that concerns the M1 tank. Last December, several divisions recommended that we replace the combat engineer vehicle (CEV) with an M1 tank in the heavy divisions of our force to provide breaching capabilities and improved mobility. I fully supported that initiative, and the Vice Chief of Staff of the Army endorsed it in May. This initiative, in essence, will replace the CEV with an M1 tank equipped with a track-width mine plow or mine roller in virtually all Active Component (AC) combat engineer battalions. This is a very positive development because it underscores the point I made earlier: it solidifies the

Interview by Catherine Eubanks
Managing Editor, ENGINEER Professional Bulletin

engineers' role in the combined arms team as a vital and continuing contributor.

In the schoolhouse, one important development continues to be doctrine writing. We are participating fully in the DA initiative to draft a new field manual that describes support to U.S. civil authorities, called FM 100-19. It is scheduled for publication in July. We are using lessons learned from our experiences in Somalia and hurricane relief efforts to provide the right engineer perspective to that manual. It, in conjunction with FM 5-114, *Operations Short of War*, and other companion documents, will present good intellectual and operational "grist" for Army commanders tasked to perform similar missions in the years ahead.

At the DA level, the critical initiatives include support for ongoing equipment modernization efforts, principally in the minefield breaching arena; the topographic arena; and sustainment engineering equipment, principally tactical construction equipment.

Q: *You mentioned how important RC units are to the total force. What do you see as the evolving role and changing missions for RC engineer units?*

A: Earlier I mentioned that reserve units make up 75 percent of the engineer force. So, I must emphasize that RC soldiers are completely integrated into the Army's total force planning effort for engineers. Most RC engineer activities focus on what we call "echelons above division." We see that most visibly in our combat heavy battalions, the bulk of which are RC units. The real change for RC engineers, however, will be in *when* they are needed. Many missions now almost totally in the RC were, until a year or two ago, performed at the division level. Bridging is one example. Assault float-bridge companies and medium-girder bridge companies, now predominantly in the RC, may well be among the first units deployed in future contingencies. This means that selected RC engineer units, to include combat heavy battalions, must maintain their readiness levels as high as possible. These units must realize they may be among the first called in future overseas activities or to disaster relief or humanitarian missions in the U.S. That's what our Chief means when he says, "Everyone is deployable."

"Our challenge is to minimize the impacts of budget reductions on training and to divest activities that do not relate directly to the training mission."

Q: *Let's go back to engineer doctrine. How do you see our doctrine evolving in response to changing world events?*

A: Let me answer that by first describing where I think the Army is going. Our new Army capstone field manual, FM 100-5, *Operations*, is scheduled for publication in June. It contains valuable information regarding operations other than war, especially disaster assistance, humanitarian relief, and peacekeeping operations. That emphasis in the Army's capstone manual will eventually be reflected in the Army's branch manuals, such as FM 5-114. In effect, the evolution of branch doctrine will reflect the evolution of Army doctrine. Army doctrine will continue to focus, as it should, on war fighting. But it will give more attention, because the public demands it, to roles we perform throughout the operational continuum, such as humanitarian relief and disaster assistance.

Q: *The Army's budget and manpower resources have been reduced by about 25 percent and more reductions are projected. In your opinion, how will these reductions affect Army missions, training, and readiness?*

A: Our goal, of course, is to minimize the impacts of budget reductions on training and readiness. The Chief's primary goal is to assure that our Army remains trained and ready in the decade ahead—in spite of the budget reductions just described. The Army has taken the bulk of those reductions to this point in force structure and modernization, so that dollars could be plowed back into training.

There is clearly a limit to how far we can go in that direction without some impacts on training. I would be less than candid if I didn't say that we see some impacts already. For example, we've had to cancel field training exercises (FTXs) in certain MOS at the Engineer School. We have also reduced training support in areas such as motor transport. We're trying to reduce the training budget intelligently so we can continue to provide commanders in the field with trained and ready soldiers, who will contribute solidly to their collective training goals.

Again, our challenge is to minimize the impacts of budget reductions on training and to divest activities that do not relate directly to the training mission. We've done that already by reducing overhead in the installation support arena. But we must have the guts to raise a red flag if the cuts go too far. We must tell our senior leaders, "Time out— this is beyond the point where we can absorb further reductions." Something

must be done to protect the Army's basic interest—and that's our training mission.

Q: *Can you give a few examples of items cut from the Engineer School's budget?*

A: Sure. At Fort Leonard Wood we have significantly reduced the cost of doing business in club activities; we've almost totally eliminated support for the horse stables and rod and gun clubs, which formerly were funded with non-appropriated dollars. Instead, we've plowed that money back into installation support areas normally funded by taxpayer dollars—in particular, sports programs that would have been cut to the bone by the reductions in appropriated funds. We've also consolidated our dining facilities and reduced grass cutting and janitorial services. All of that was done to preserve our corps' mission—to train soldiers.

Q: *Can we still provide a high quality of life for soldiers in spite of those cuts?*

A: Yes. The Army recognizes that training and readiness involve more than simply rounds down range. Training and readiness include the quality of life for soldiers. That means barracks that are well maintained, clean, and equipped with modern furniture. It means housing areas equipped with modern conveniences and appliances, where families can live safely. The Army's budget priorities now reflect that total emphasis on soldiers' quality of life, and that's all to the good.

Q: *With the trend toward decreasing resources, what do you see changing in base operations functions, specifically with regard to Directorate of Engineering and Housing (DEH) responsibilities? For example, do you expect more combat heavy units to be used in base maintenance operations?*

A: Yes, combat heavy units and combat support equipment companies, which are similar in terms of their horizontal construction capabilities, will be used increasingly in base maintenance operations. It's a fact of life.

Increasingly, DEHs throughout the Army will be financially constrained. In fact, their O&M (operations and maintenance) accounts are already pared to the bone. Fewer dollars are available for day-to-day base maintenance, which is their "seed corn" for future infrastructure vitality. One way the DEHs can get by with decreased O&M budgets is by using the TO&E (tables of organization and equipment) engineer units just highlighted—the combat heavy and combat support equipment companies.

Our challenge, as a branch, is to ensure that when units perform those functions, they do it in a METL-related context. They must try to limit themselves to missions that have a direct bearing on what they will do in time of war. In most cases, that's fairly easy. Range road maintenance, hasty repair of buildings and grounds, and cantonment layout are examples where installation commanders have called upon engineer units to execute peacetime missions on their posts that are directly related to missions they would perform in time of war. We need to insist, though, that units be provided an opportunity to deploy. Most installation commanders I have talked to are sensitive to the need for regular deployment exercises. Obviously, "deployment" skills will deteriorate if training is devoted exclusively to installation management, and we must ensure that does not happen.

Q: *In light of the recent decision to allow women to fly combat aircraft, when do you expect the remaining combat engineer MOS to be opened to women? Do you expect this decision to affect training standards for engineer soldiers?*

A: First, let me applaud the decision by the Secretary of Defense to open more positions in the armed forces to women. It's a positive development. It's consistent with the initiatives we took a year ago to open more positions in the Engineer Branch to females. We opened all bridge companies and the ERI (engineer restructure initiative) brigade headquarters and headquarters detachments to female officers. The only exception is the brigade commander's position, which remains closed. How far the Army will go beyond the initiatives outlined by Secretary Aspen is a question that the Chief of Staff and senior leaders in the Army are wrestling with now. I expect to weigh in shortly with my view on the branch to General Franks, at TRADOC. His staff recently asked for our recommendations.

My bias on this issue is to be inclusive not exclusive, and to open additional opportunities for females in the branch wherever we can. We are now collecting input from the leadership of the branch and the school to provide a response to TRADOC. Regardless of what happens in TRADOC, however, I expect that the trend toward opening additional opportunities for women, as highlighted by Secretary Aspen's announcement, will continue throughout our armed forces. Again, that's a very positive development. And it will not affect training standards!

Q: *Some soldiers have expressed concern about the Army's education system, especially training for engineers. Can you provide some insight into where the education system is headed with regard to engineer NCOs and officers? Are there plans to expand NCO training to make it more parallel with officer training?*

A: I think the basic structure of the education system is sound and is unlikely to change in the near term. The NCO system that we have grown accustomed to over the past 10 years (PLDC, BNCOC, ANCOC, and the Sergeants Major Academy) works splendidly. The officer education system is being tweaked on the margins but is unlikely to be radically altered. What we have tried to do at the Engineer School, though, is to ensure consistency in the kind of training offered at the Libby NCO Academy and in officer courses in Lincoln Hall. Our NCO Academy was reaccredited last February by TRADOC. One area that we worked on as part of the reaccreditation effort was to ensure consistency across the board in areas such as mine/countermine operations and engineer battlefield assessments. Feedback from field personnel and students indicated that, in those areas especially, NCOs and officers were not being taught consistent doctrine or procedures. Now there is one standard, and we're operating from the same updated field manuals throughout the school.

What will further improve the situation is the movement this summer toward a consolidated Directorate of Training (DOT) in the Engineer School. That directorate will have responsibility for all training—officer, NCO, and enlisted. Consolidation will both standardize instruction to ensure the same doctrine is being taught, and enhance opportunities for shared training in situational training exercises and simulations.

Q: *Do you expect shared training to expand in the future?*

A: Shared training has increased significantly in the last few years, and we'll look at every opportunity to provide more. Whenever we bring student officers and NCOs together, feedback is extremely positive. That's true whether they are together for a social event or an FTX. The problem is simply one of scheduling. We are trying to provide students more opportunities to read, relax, and enjoy the Ozarks, especially on weekends and holidays. Can't do that if our goal at the same time is to maximize shared training across the board. So we're trying to strike a balance. I expect shared training to increase a little, but we've just about reached the limit without sacrificing some quality of life.



Q: *Is there any interest in increasing joint training between services? Can you explain the impacts of joint training between, for example, Army and Marine engineers?*

A: The Army is doing that already in our combat training centers (CTC). When I visited the JRTC (Joint Readiness Training Center) last year, a corps wheeled battalion from the South Dakota National Guard was training next to the 25th Division from Schofield Barracks, Hawaii. It worked extremely well. That's the model, it seems to me, for training in the future. We will use the CTCs to collectively train and integrate RC units more and more into our Army's "go to war" preparations.

A: In the Engineer School we have had a joint training agreement with the Marines for years. They send Marines to virtually every officer advanced course, and we train enlisted Marines in Brown Hall. We expect that training to continue—both services love it, and both Army and Marine engineers benefit from the experience. Colonel Flowers, Director of Training, is exploring a parallel initiative with the Navy, to see if we can capture a similar program with the Seabees. That exchange would provide Seabees in our school and vice versa.

The impacts of joint training on the Engineer Branch are significant. Several studies, including one recently commissioned by General Colen Powell, Chairman of the Joint Chiefs of Staff, examine roles and mission issues with respect to engineers on the battlefield, especially responsibility for the joint training of engineers in all services. Even as I speak, an examination is under way to determine the cost effectiveness of having Fort Leonard Wood, for example, assume responsibility for some element of engineer training for all services. That could mean that Air Force, Navy, Marine, and Army heavy equipment operators would be trained here, if the initiative is proven to be cost effective. We're working the numbers now and expect some preliminarily assessments in the very near future.

I don't see that initiative changing the role of the Engineer Branch as we know it. For example, the initiative would not eliminate the Corps of Engineers as a combat branch or eliminate the Air Force Red Horse and Prime

Beef units or the Navy Seabees. Each service would maintain its engineer capability. But we would look for ways to enhance joint training as a means of saving dollars.

Q: *A benefit of joint training is that engineers would find it easier to work together in joint operations. Is that where you see the real payoff?*

A: Yes, down stream that's exactly what's at stake for those who desire joint training. In addition to potential dollar savings, it's the realization that, if you train together early in your career, it will be far easier to work together later, when a contingency might demand it.

Q: *The Corps of Engineers has been appointed the Army's proponent for environmental awareness training. What do you see as the role for the Engineer Branch in this arena?*

A: The Engineer School has been asked by TRADOC to develop a training support package for environmental awareness. We have worked with TRADOC under an "umbrella contract" to flesh out the details for awareness training. The intention is that everyone in the Army, whether a junior private or a senior maneuver commander, must acquire an increasing awareness of the role that environmental sensitivity and protection must play in all they do.

I don't envision that the school's responsibility will entail the technical aspects for environmental cleanup and restoration. That responsibility belongs elsewhere. The Engineer School is limited to providing awareness training across the board, and that is where I intend to keep us focused.

Q: *Earlier you mentioned the Engineer School's reorganization. How will it affect the quality and kinds of training provided to engineer soldiers?*

A: I've already discussed the most important element of the reorganization, and that's the creation of a single Directorate of Training. But other school initiatives are also important. One is the creation, in effect, of a Director of Proponency, which pulls the Engineer Personnel Proponency Office under the Directorate of Combat Developments. So, that directorate now has equipment and personnel proponency in its domain.

We also eliminated the position of deputy assistant commandant. Now each principal directorate in the schoolhouse—Combat Developments, Training, and Evaluation and Standardization—will report to the assistant commandant with no intervening layer. This change is reflective of a TRADOC school model that most other schools have adopted.

Q: *We've heard that some MOSs may be consolidated for efficiency. What is the Engineer School doing in that area?*

A: Well, the biggest issue we wrestled with last year was the proposed consolidation of the 12-series MOS. That action would have consolidated the 12B, 12C, and 12F MOSs into a combat engineer MOS, notionally called "12B." We cancelled that effort because feedback from the field was strongly against it. Must also say that trying to overlay a training requirement for the 12Fs, who would have to man and fight the M1 breacher while also being skilled in bridging and basic combat engineering, didn't make sense. So we will not combine the 12-series MOS.

We're still looking at the 51-series MOS for possible consolidations. In fact, we've created a new, consolidated 51T MOS that brings together soils, draftsmen, and surveyors from the old 51G, 81B, and 82B areas. We're also consolidating the photo layout and printing MOSs, (83E and 83F). These initiatives are under way and make good sense. That's all the MOS consolidations I can see in the near term. We will continue to look for opportunities to save but will not go into any initiative blindly.

Q: *When you came to the Engineer School, you wanted to concentrate efforts on improving engineer equipment. What strides do you feel we've made in this area?*

A: We have some genuinely good news here! It is difficult to see short-term results in this area because of budgeting and because equipment modernization systems take so long to develop. However, we completed an extremely successful functional area assessment (FAA) last fall. School staff went to Washington to brief the Vice Chief of Staff for the Army, and we came out of the FAA in very good shape. For example, we initiated a funding line for a new, light bulldozer, called the "Deuce" (deployable universal combat earthmover), to equip our light and airborne divisions. Equally important was an agreement to "plus up" our tactical construction equipment line. The goal is to sustain roughly $25 million annually for equipment purchases in areas that badly need updating—for example, compaction

"Everyone in the Army, whether a junior private or a senior maneuver commander, must acquire an increasing awareness of the role that environmental sensitivity and protection must play in all they do."

equipment and cranes.

The vice chief also supported some critical topographic enhancements, especially the purchase of a TIIP (Topographic Imagery Integration Prototype). It will allow us to process commercial satellite imagery for use by military commanders at the corps level and below.

Last but not least, we received continued funding for the engineers' most important combat mission, minefield breaching. The M1 Breacher and the M1 Bridger both received strong, enthusiastic support. And I would add that providing M1s to the Active Component to replace the CEV, and recognition by TRADOC and DA of the need for engineers to be equipped with the M2 Bradley fighting vehicle as an engineer squad vehicle, are significant developments even beyond the positive outcomes of the FAA. Those items are very good news for the engineer force. Hopefully, my successor or his successor will see that equipment in the field before this decade is gone.

Q: *What are the major benefits of switching to the M1s and M2s?*

A: First and foremost, this change provides the engineer force with equipment that allows us to attain equivalent battlefield mobility. This is particularly true with the M1. Secondly, the M1 gives the engineer and the engineer element of the task force a breaching vehicle. The CEV is not a breacher but the M1 with a track-width mine plow is. So we will have, with engineer supervision, an armored platform whose primary mission is to assist in breaching complex obstacles, and that's a very important development.

The principal advantage of the M2, the Bradley fighting vehicle, is that it provides survivability for engineer squads on the battlefield comparable to the survivability afforded to infantry members of the maneuver force, with whom we work. Right now engineers use the M113. It is a fine piece of equipment but has significantly fewer survivability characteristics than does the M2.

Q: *What do you see as the Engineer School's greatest achievements during your tour here as commandant?*

A: I am proudest of the recognition we have received and continue to receive from senior maneuver commanders at division and corps levels for our role in the combined arms fight. The SELTC, in April, showed that. The briefings we received from General Wesley Clark and General Carmen Cavezza underscored how engineers have been recognized as true members of the combined arms team, working side by side with other elements of the maneuver force to achieve decisive victories. And that's the element that I believe is our proudest achievement, not just during my time as commandant but during the stewardship of many commandants before me.

Would say that one of the most moving achievements during the 24 months of my stewardship was the commitment we made to restore hope to the people of Somalia. The Engineer School sent a seven-soldier engineer team along with mobile training teams to Somalia last winter and early spring. Welcoming home those soldiers to a thunderous ovation from the installation and the community was a moment of great pride for the installation and the branch.

Q: *As you move forward in your Army career, what do you think will be some of the major challenges facing General Ballard, as your successor?*

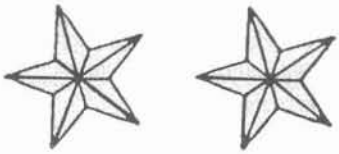
A: Joe Ballard will face the same basic challenge that Dan Schroeder and I faced here. Dan Schroeder brought the school from Fort Belvoir to Fort Leonard Wood. But he also had the first glimpse of what a steeply declining budget means to a large installation such as this. That's been my greatest intellectual challenge—to continue the downsizing effort here in a way which does not break faith with the Army's imperative "trained and ready." So one major challenge that Joe will face is the continued accommodation to the budget realities of this decade.

A second challenge is to continue equipment modernization for the branch. We've had some great successes in the past few years in highlighting the importance of equipment modernization for combat engineers. The road ahead will be rough because the research, development, and acquisition funding account will take, in my view, more and more hits. Joe will be forced to continually defend those programs that are vital to the branch's future. That will mean prioritizing what on our list is a keeper and what, as the budget continues to be shaved, we might be willing to let go. We must compromise on some things and protect the most important elements of the modernization piece. Big task.

Q: *In closing, do you have any words of advice for young soldiers coming into the engineer force?*

A. I would say, "Come on in and join us!" It's a great branch. The diversity of the Engineer Branch has been a hallmark of our corps since 1779 and will remain a characteristic of the branch for decades to come. You can see that by reviewing what we have done just in the last three years—Desert Storm, hurricane and disaster relief, and humanitarian assistance to Somalia. There are enormous opportunities out there for any young man or woman who wants to join the most exiting branch in the Army. Essayons!

Notes from the Commanding General



To: Members of the Engineer Regiment

Following Secretary Aspin's announcement regarding expanded opportunities for females, I provided the attached memo to General Franks, TRADOC, outlining the position for combat engineers. Believe this position is consistent with Secretary Aspin's goals and will expand opportunities for women in our branch in a manner fully consistent with the enormous strides we have made as members of the combined arms team. Hoo-ah!

Subject: Women in combat

1. Sir: [MGs] Den Malcor and John Herrling have been keeping me in the loop on status of DOD study group regarding women in combat. Understand you may be asked for TRADOC position on associated policy issues. Want to give you the view from my lane on combat engineers.

2. Testified last year to the Presidential Commission on the assignment of females. Told the commission my bias is to be inclusive, not exclusive; believe we should do away with the current DOD "risk rule" based on location on the battlefield and open all MOS in the Army. Entry into an MOS would be based on aptitude evaluations, plus an assessment of strength and endurance. (FYI: Don't believe this is a big deal; Canadian Army experience indicates very few females will volunteer—instincts are we'll move beyond any "start-up" problems very quickly.)

3. However, recognize Chief and SECDEF are not contemplating wholesale removal of gender-exclusion rules. Thus, under current rules, recommend we open our MOS 12C (bridge crewmember) to females. Female officers already serve in bridging units. Further, bridging units do not meet the conditions for female exclusion under a broad interpretation of current coding. More difficult are MOS 12B (combat engineer) and MOS 12F (engineer tracked vehicle crewman). My view in a nutshell: If MOS 11B (infantryman) is opened, then open MOS 12B; if MOS 19K (M1 armor crewman) is opened, then open MOS 12F. Otherwise, keep 12B and 12F closed for the time being. Not withstanding my views in para 2, above, don't want to lose close association engineers have developed with our infantry and armor branches.

4. Believe approach with 12Cs consistent with the broad thrust of SECDEF goal, reflected in [MG] John Herrling's last profs: "Continue to look at possibilities of opening more opportunities to women." Stand ready to elaborate on any points you wish. Would add one thought in closing: Believe Army should implement gender-neutral strength and endurance tests for all MOSs. This is clearly encouraged in AR 611-201, para 1-11, and would provide a more objective basis for selection policies under any expanded regime.

Thanks for hearing me out. My senior NCOs, including ECCSM Roy Burns, fully on board. ESSAYONS, Dan Christman.

Taking the Lead Without a Division Patch

Reality Check

I can still remember the commandant's question at the battalion precommand course: "How many of you are going off to command a nondivisional battalion at a division post?" My hand, along with the hands of about four others, went up. "Well, let me tell you about your OER. Best you can do will be a two block; don't be shocked at a three block. That's the way it will be." Our hands slowly went down as the divisional guys smiled at their first kills. He was partially right; most FORSCOM patched units do become odd man out at OER time. But it does not have to be that way. It depends on you.

A few weeks ago all of this came back when I was giving a leadership seminar to the officers of a "nondiv" battalion. It was during the question and answer period. Every other comment was the we-they type ending with a "we're nondivisional; we're out of it. There is nothing we can do except go straight to FORSCOM; maybe write General Christman a letter." You could do that and you would be within your rights. However, you will end up dead right.

In fact, let me give you four other sure-fired ways of going down in flames. The first one is to whine and run to FORSCOM—something the division staff really enjoys when it means they must respond to an end run.

- ***Use your mission essential task list (METL) as a reason why you can't participate.*** While you are at it, you might as well hang a sign on your back saying "kick me." All units have METLs and none of them list the hundreds of actions that need to get done to survive on a post. You are no different.
- ***Define your training needs as being only collective-level training performed off post.*** No one likes a prima donna; we all would like to train at the best locations with the best resources but we can't. Leadership comes forth in meeting challenges. Be a team player and think combined arms, small-unit tactics, and backyard training; or add an exclamation point to that sign on your back.
- ***Compete head-to-head with the divisional units.*** Of course it's their turf, rules, and resources. You will be remembered—perhaps as a war hero but definitely as an egotistical leader who sent his unit through a lot of trouble to come out on the losing end.
- ***Fight post taskings without providing realistic alternatives.*** No one wants to perform post duties and you should not be the doormat for all the "hey you" details. But don't be the open sore, either. Carry your load, plus, and when you can't do a tasking, work to solve it.

Is This Getting Close to Home?

Let's review the bidding to see if the combat boot fits. You, as the battalion commander, are senior rated by the division commander. Your battalion is part of a uniquely named support brigade that is made up of other nondivisional units, commonly referred to as "ash and trash." Your company commanders are senior rated by the brigade commander, an infantry or armor officer who longs for a "real" brigade. There are two dozen "hoo-ah" battalion commanders in the same senior rater chain but they all wear a division patch. Add to all of this the facts that post support is eating you up, your FORSCOM money does not filter down to you, taskings are killing you, and you get leftovers for ranges. Is this you?

I've run that gauntlet and am here to say that you can come out on top, nondivisional patch and all. It all boils down to a positive team attitude and some solid visionary strategy.

Strategy for Success

- ***Align your priorities with those of your senior rater.*** Ask for his support form and read it carefully. Keep it handy and periodically check your alignment with him, not the reverse. Bring your rater into your decision-making circle and allow him to participate. He will quickly sense that alignment and will support you. Keep your priorities in check until you have covered your boss' priorities.
- ***Don't compete head-on.*** Determine your unique strengths and use them to support the division. When you compete head-on you will be forced to

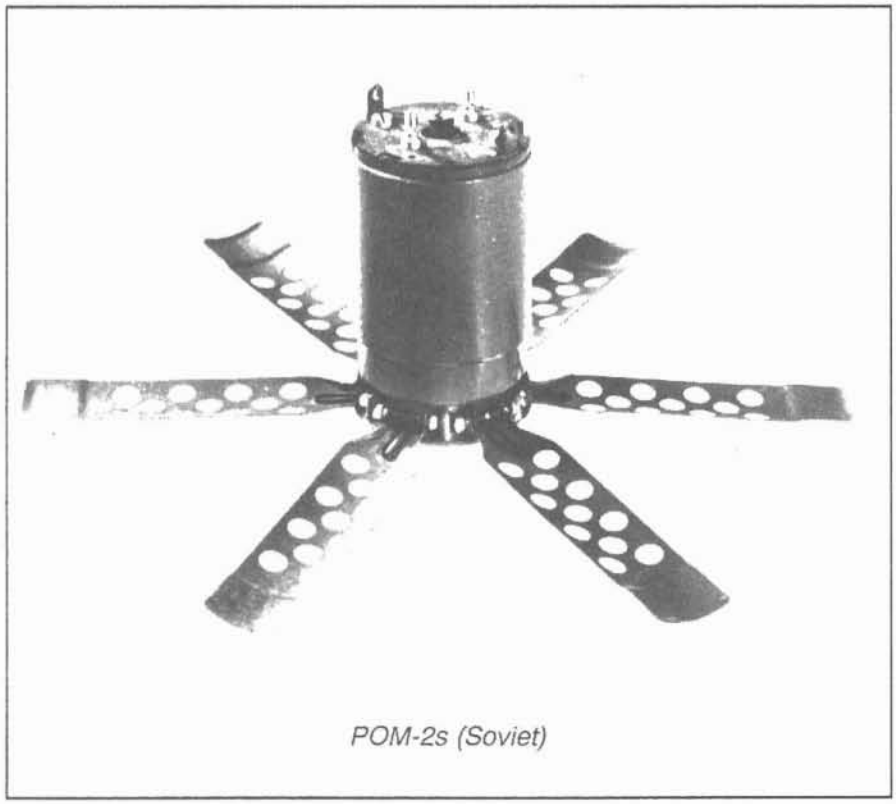
(Continued on page 38)

Advances in Mine Warfare:

Antipersonnel Mines

By William C. Schneck, Malcolm H. Visser, and Stuart Leigh

Dismounted combat engineers face an increasingly dangerous and complex mission as the effectiveness of antipersonnel (AP) mines continues to advance. Significant improvements in technology over the last 30 years have also made AP mines inexpensive and readily available. They now pose a major threat to combat engineers tasked with providing mobility support to dismounted units. As with other serious combat threats such as chemical weapons, the best way to counter these hazards is through realistic training and aggressive accumulation of knowledge. This article, the second in a series of three, addresses the AP mine threat and effective countermeasures.



POM-2s (Soviet)

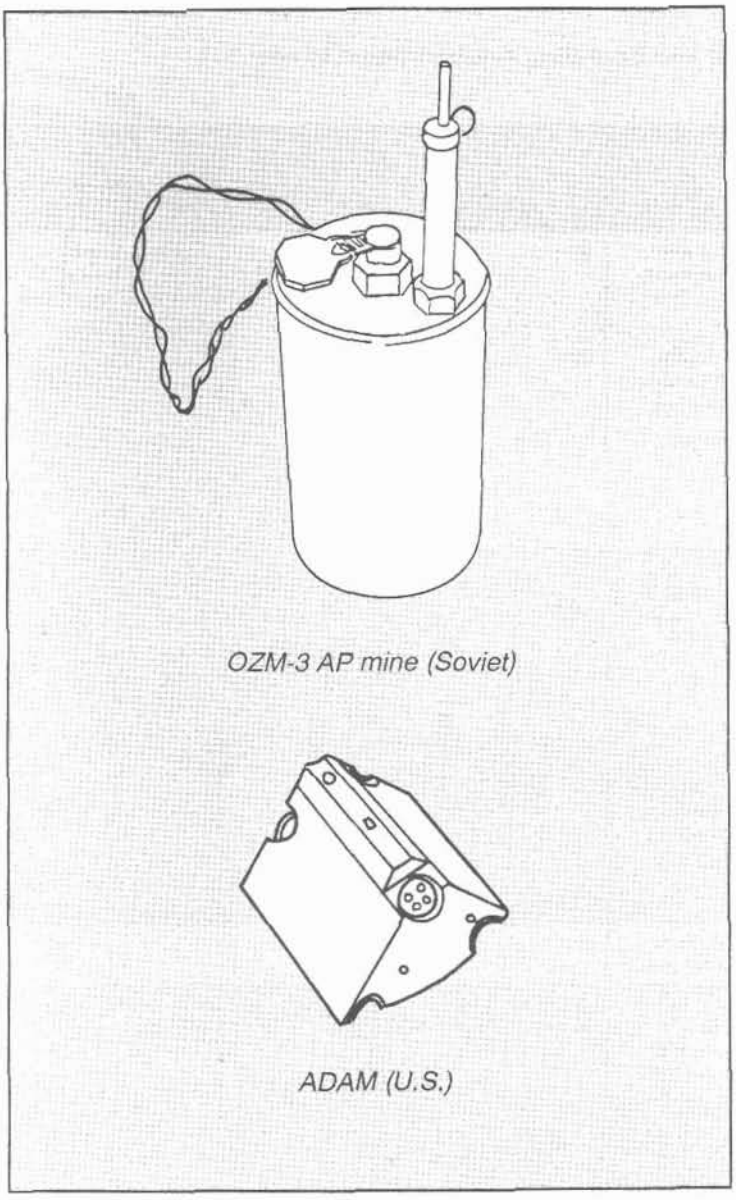
Figure 1. A scatterable fragmentation antipersonnel mine

Mine Threat

U.S. ground forces may encounter AP mines in any combat situation, regardless of climate, terrain, or enemy. In a mid- or high-intensity conflict, mines may be found in tactical and protective minefields. In a low-intensity conflict (LIC), AP mines may be almost anywhere. Typically, they are laid without pattern along roads and trails or as part of a belt of protective obstacles around an enemy base camp. In the LIC scenario, AP mines probably are the most serious threat to friendly units because of the numerous dismounted operations conducted[1] and because poorly equipped forces often rely on land mines as combat equalizers. AP mines have evolved into three general types: fragmentation, blast, and chemical.

Fragmentation AP Mines

The first land mines used in combat were fragmentation AP mines. Confederate soldiers improvised what they called "land torpedoes" from cannon balls and



OZM-3 AP mine (Soviet)

ADAM (U.S.)

Figure 2. Bounding antipersonnel mines

friction fuzes during the battle of Yorktown in the Peninsula Campaign of 1862.[2] From this crude origin, three varieties of fragmentation mines have evolved: bounding, like the U.S. M16 "Bouncing Betty"; directional, like the U.S. M18 Claymore; and simple fragmenting, like the Russian POMZ-2 stake mine or the scatterable POM-2s (Figure 1). In recent years, the addition of advanced fuzing has significantly increased the performance of each variety. All three types are inexpensive and readily available.

Dismounted soldiers must remember that many fragments remain dangerous well beyond the "lethal" range of these mines, even though the chance of being hit decreases as the distance from the point of detonation increases. The lethal range (or radius) of a fragmentation mine is the distance from the point of detonation to the point where there are still 0.5 fragment per square foot with 5.8 foot-pounds of energy.[3]

Bounding. The Germans introduced the first bounding AP mine, known as the "S" mine, in 1935.[4] All bounding mines developed since then use the same basic principle. When activated, a small propellant charge launches the mine to a height ranging from 1 to 2 meters, where it detonates. The lethal radius ranges from 15 to 30 meters, depending on the model (Table 1, page 28). One common bounding mine used throughout the world is the Russian OZM-3 (Figure 2). The U.S.-made ADAM is a more advanced bounding AP mine that can be scattered by 155mm howitzers to ranges up to 17 kilometers (Figure 2). It is particularly useful for disrupting operations in the enemy rear. A modified version can be hand emplaced as a pursuit-deterrent munition.[5]

When equipped with a simple trip-wire fuze, directional and bounding AP mines are devastatingly effective. Their performance can be enhanced further by incorporating more sophisticated fuzing. Three-pronged pressure fuzes such as the U.S. M605 and the Czechoslovakian RO-8, used mostly with bounding AP mines, have proven to be resistant to explosive breaching equipment such as the MIC-LIC and the bangalore torpedo.[6] Recently fielded fuzes employing such state-of-the-art technologies as seismic-influenced fuzing and breakwire circuits present a grave threat to dismounted troops.

The first seismic-influenced fuzes used extensively were the Russian VP series of mine control devices (Figure 3, page 29). They possess an advanced processor for target discrimination and are used with either the MON or OZM series of mines.[7] First widely employed by the Red Army in Afghanistan, these devices were particularly effective during campaigns in rugged, rocky mountain valleys.

Both the Russians and the French have fielded breakwire fuzes. These devices, which are based on the principle of collapsing circuits, can be

Table 1. Directional and Bounding Antipersonnel Mines

Origin	Type	Nomenclature	Fuze	Lethal Range (m = meters)	Lethal Arc	Number of Fragments	Remarks
U.S.	Directional	M-18	Trip wire, command	50m	60°	700	Copies made by Chile, S. Korea, Egypt, S. Africa, and Pakistan.
	Bounding	M-16A2	Trip wire, command, pressure	30m	360°	NA	Copies made by Greece, India, and S. Korea.
		ADAM	Trip wire	6 to 10m	360°	600	Scattered by U.S. 155mm howitzers; Self-destruct: short-4 hours, long-48 hours.
U.S.S.R.	Directional	MON-200	Trip wire, command, breakwire, seismic	200m	15°	910	
		MON-100		100m	15°	405	
		MON-90		90m	60°	NA	Large, Claymore type.
		MON-50		50m	60°	455	Similar to the Claymore.
	Bounding	OZM-3	Trip wire, command, breakwire, seismic, pressure	25m	360°	NA	
		OZM-4		25m	360°	NA	
		OZM-72		25-30m	360°	NA	
Czechoslovakia	Bounding	PP-Mi-Sr	Trip wire, command, pressure	20m	360°	NA	
		PP-Mi-Sr II	Trip wire, command, pressure	20m	360°	NA	
Yugoslavia	Directional	MRUD	Command	50m	60°	650	
	Bounding	PROM-1	Trip wire, pressure	22m	360°	NA	
Italy	Bounding	VALMARA 69	Trip wire, pressure	27m	360°	1200	Used by Iraq.
		BM-85	Trip wire, pressure	20m	360°	1000	
		P-40	Trip wire	22m	360°	NA	
China	Bounding	Type 69	Trip wire, pressure	13m	360°	240	
France	Directional	MAPED F1	Command, breakwire, pressure	40m	60°	NA	
	Bounding	M1951/1955	Trip wire, breakwire, tilt rod	45m	360°	NA	
Germany	Directional	SM-70	NA	NA	NA	NA	
	Bounding	DM-31	NA	NA	360°	NA	

NA = Data not available.

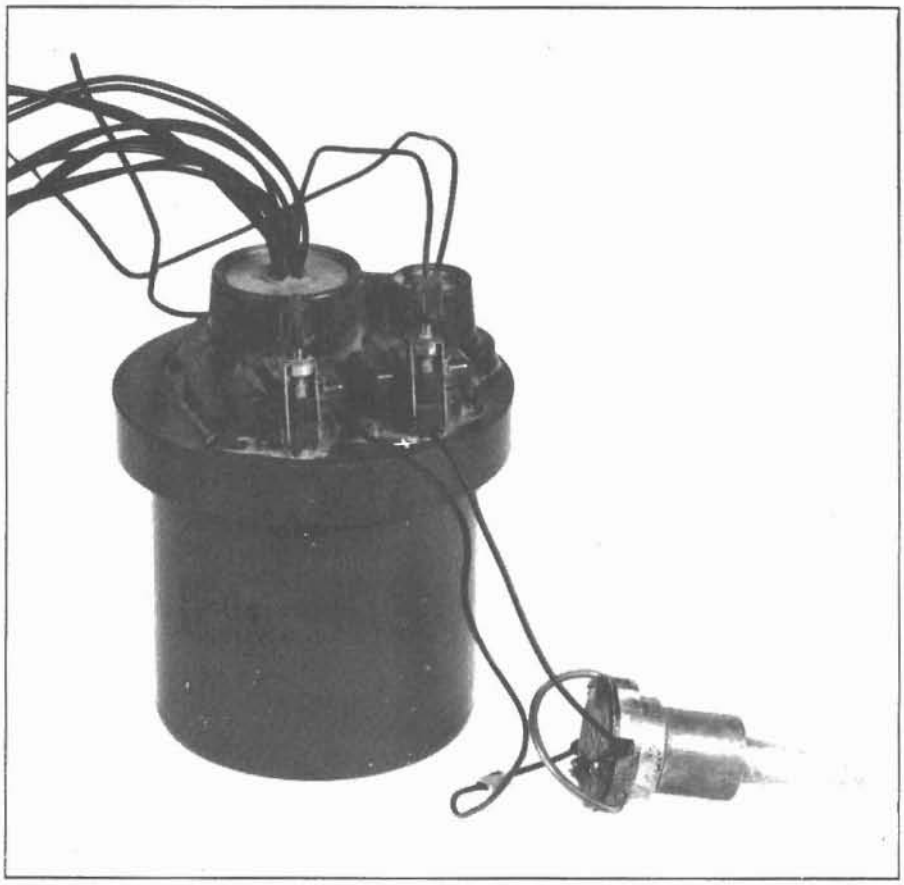


Figure 3. VP 04 AP minefield control device (Soviet)



Figure 4. Valmara 69 AP mine (Italian)

used with either bounding or directional AP mines. When the delicate "trip wire" is stepped on or cut, an electric circuit is broken and the mine is activated.[8] If the enemy is known to possess this type of device, soldiers must check both ends of any trip wire found before cutting it, regardless of whether it is slack or taut.

The Italian VS-APF1 is one of the most sophisticated add-on fuzes available today. It is an improved electronic fuze designed for use with the Valmara 69, a bounding mine employed in large numbers during the Persian Gulf War (Figure 4). The VS-APF1 has a 10-minute safe arming delay. After this delay, it dispenses three highly sensitive trip wires. It also has a field-programmable, self-neutralization device that allows the user to set neutralization times from 2 1/2 hours to 40 days. The mines can be recovered and reused after self-neutralization.[9]

Directional. The first U.S. directional AP mine, the M18 Claymore, was introduced during the Vietnam Conflict.[10] The Claymore has a lethal range of 50 meters and covers a 60-degree arc. Because of its wide attack angle and overall effectiveness, the Claymore has been copied extensively, and many countries around the world employ versions of it (Table 1).

Several nations have developed effective directional mines of their own. Two of the most noteworthy are the Russian-manufactured MON-100 (Figure 5, page 30) and MON-200. Both cover an arc of only 15 degrees but have effective lethal ranges of 100 and 200 meters, respectively. While some large Claymore-type mines have ranges approaching 100 meters, no other directional AP mine currently in use can match the long-range lethality of the Russian MON-200.[11]

Simple fragmenting. Simple fragmenting AP mines have been

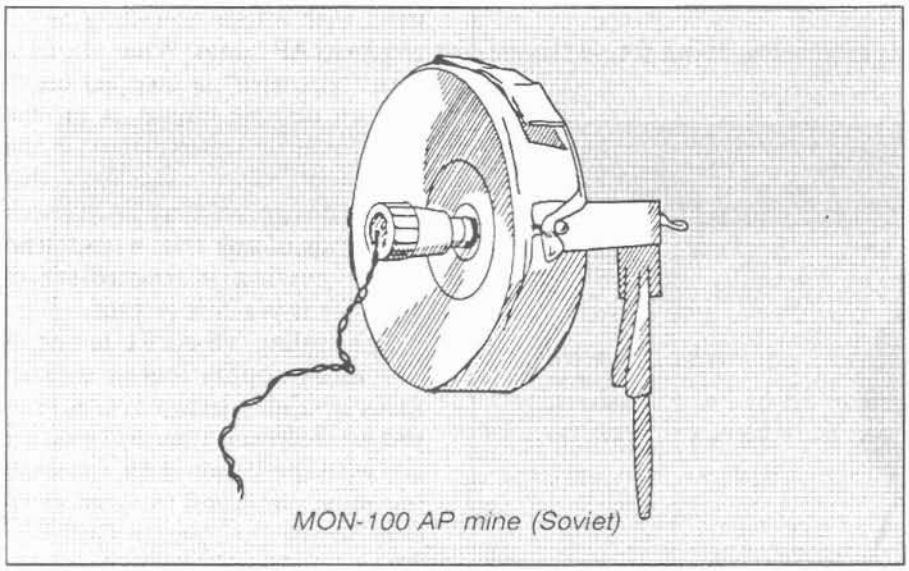


Figure 5. Directional antipersonnel mine

employed since World War II without significant design changes.[12] Some of the better known examples include the Russian-made POMZ-2M and the Czech PP-Mi-Sk stake mines. This class of AP mines includes several scatterable mines, which can be deployed from such platforms as towed vehicles, helicopters, and fixed-wing aircraft.

Blast AP Mines

Blast AP mines are produced by several countries (Table 2, page 31). They include the PFM-1 and PMN mines (Figure 6), which the Russians used so effectively in Afghanistan. Although these "toe poppers" are quite simple, several advances have been made over the years. Advances include the virtual elimination of metal, blast over-pressure protection, low operating thresholds, integral anti-handling devices, scatterability, and self-destruct and self-neutralization options.[13]

The Italians have made the most significant advances in blast AP mines, with their SB-33 (Figure 6) and VS-MKII. The Yugoslavian PMA-3 is notable because it contains no metal. The most unusual blast AP mine is the Yugoslavian UDAR, which is a command-detonated, bounding, fuel-air explosive (FAE) device.[14]

Chemical Mines

Chemical mines typically are identified by their unique colors and markings. No significant

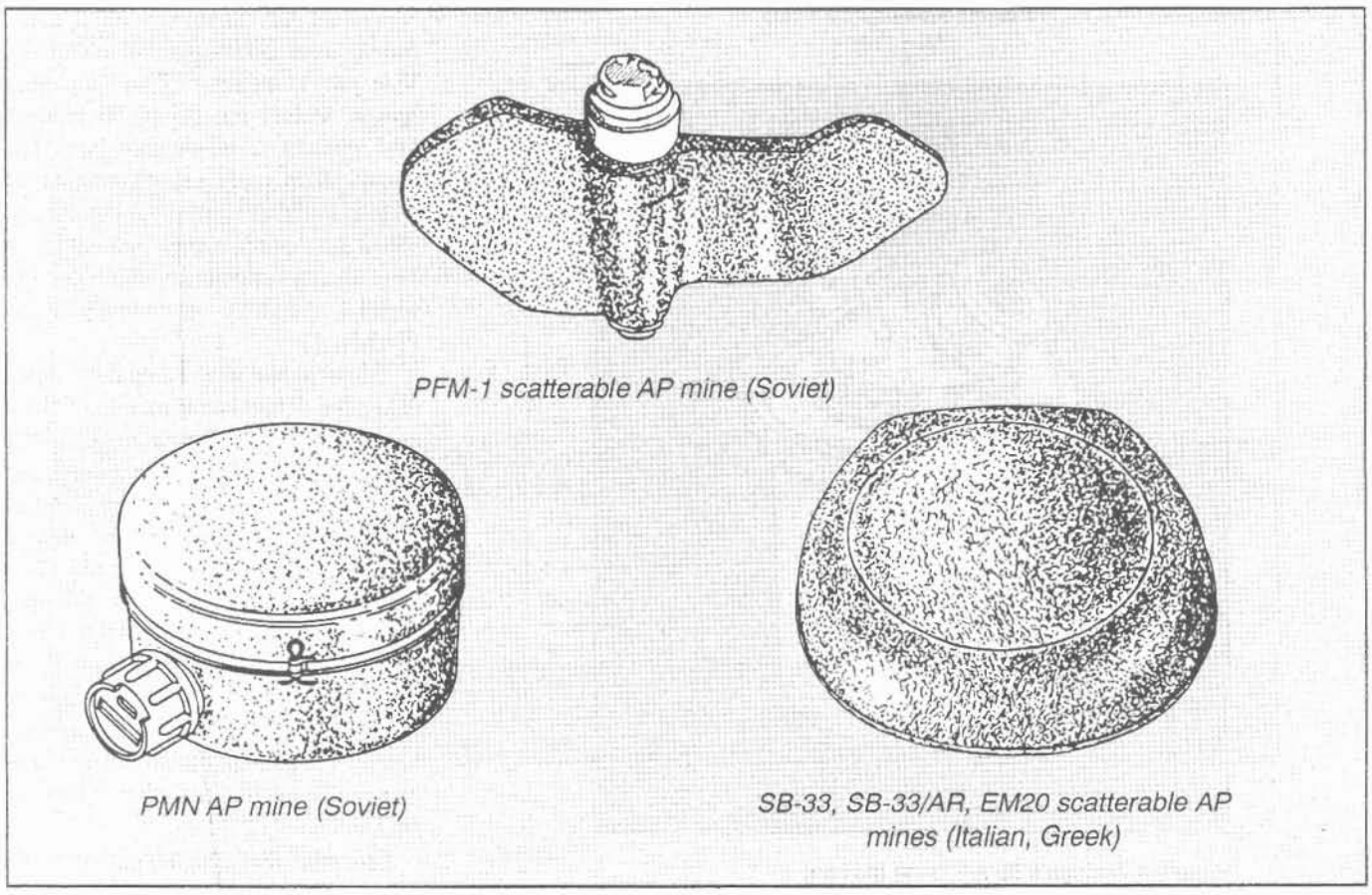


Figure 6. Blast antipersonnel mines

Table 2. Blast Antipersonnel Mines

Origin	Nonmenclature	Antihandling Device	Metal Content	Blast Protection	Emplacement	Remarks
U.S.	M-14	No	Low	No	Manual	
U.S.S.R	PMN-2	No	High	Yes	Manual	
	PMN	Optional	High	No	Manual	
	PFM-1	No, but very sensitive	Some	No	Fixed-wing aircraft, helicopter, mortar	
	PMD-6M	Optional	Some	No	Manual	
Czechoslovakia	PP-Mi-Ba	No	Low	No	Manual	
	PP-Mi-D	Optional	Some	No	Manual	
Yugoslavia	UDAR	No	High	No	Manual	Command-detonated bounding FAE mine.
	PMA-1	No	None	No	Manual	
	PMA-2	No	None	Yes	Manual	
	PMA-3	No	None	Yes	Manual	
Italy	SB-33	Optional	Low	Yes	Helicopter, manual	
	VS-50	Optional	Low	Yes	Helicopter, manual	
	VS-MKII	Optional	Low	Yes	Helicopter, vehicle dispensed, manual	
China	Type 72 A/B	Optional	Low	No	Manual	
U.K.	Ranger	No	Low	No	Vehicle dispensed	
France	M-59	No	Low	No	Manual	
	M1951	No	Low	No	Manual	
Germany	PPM-2	No	Low	No	Manual	East German origin.
	DM-11	No	Low	No	Manual	

improvements have occurred in their design in recent years. Only the U.S., the People's Republic of China, and the former Soviet Union are known to have produced them.[15] However, it is easy to convert a mine (usually antitank) from blast to chemical: the manufacturer need only remove the main explosive charge from the blast mine and replace it with the desired chemical agent. This retrofit can be readily accomplished in the field.

Booby Traps

Booby traps (improvised explosive devices) can use any of the fuzes and kill mechanisms discussed above, or they may be equipped with one-of-a-kind fuzes constructed from whatever is handy at the time.

The only limit to a booby-trap's design is the imagination of the fabricator. For example, one type uses photovoltaic cells—when light of sufficient intensity strikes a sensor, the device detonates. Such a mechanism could be left in a darkened room, to initiate the next time the door is opened. Another type uses antiprobe pads; it explodes when a mine probe is pushed against it. Fortunately, soldiers rarely encounter such fuzing.[16] The vast majority of booby traps are simple affairs that have mechanical or electromechanical fuzes.[17]

Whatever the design, booby traps are best defeated by a simple technique: Soldiers must avoid handling anything left in an area recently occupied by the enemy. In particular, they must not touch items traditionally collected as "war trophies," such as enemy weapons or uniform accoutrements. Additionally, pilferable items such as food, alcohol, foreign currency, and precious metals should remain undisturbed.[18] Even a single coin, cleverly

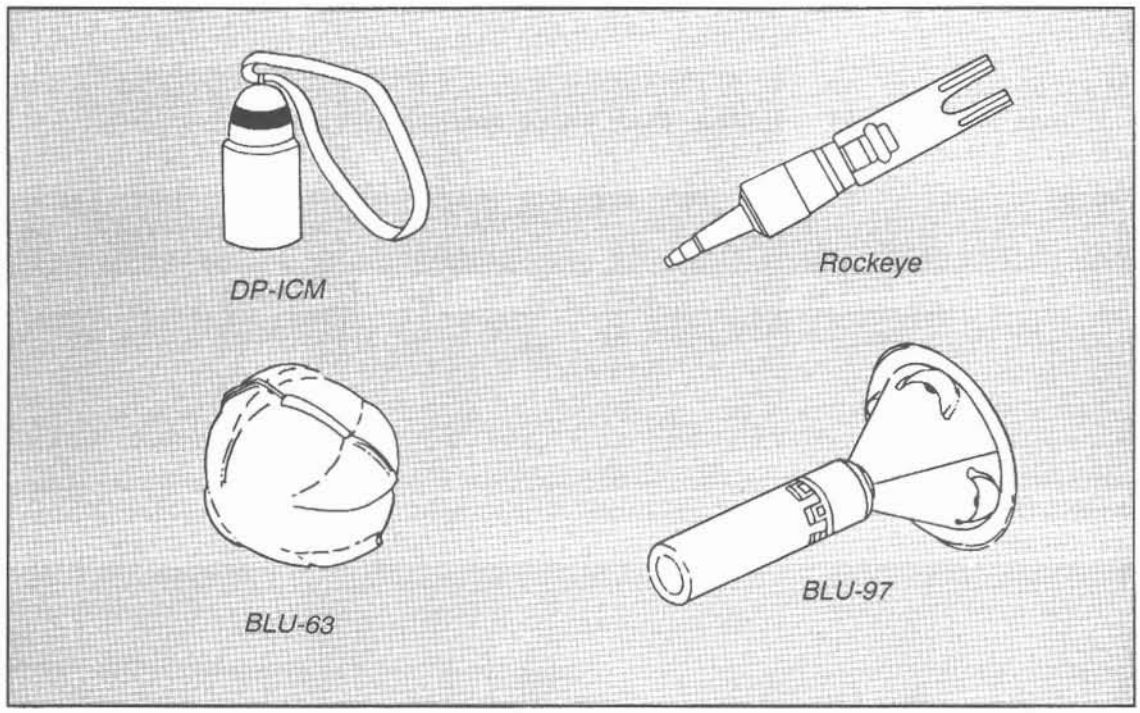


Figure 7. U.S. submunitions

connected to a hidden trip wire, can cause tragedy to personnel securing a former enemy stronghold. The lesson is clear—never handle anything found in a captured enemy position until the designated clearance team has thoroughly checked the area.

Unexploded Ordnance

Combat engineers must be prepared to counter another threat similar to a scatterable minefield. Before most ground assaults, U.S. forces subject enemy positions to intense aerial and artillery bombardment, using cluster bombs dropped from Air Force or Navy tactical aircraft and artillery-delivered, dual-purpose improved conventional munitions (DP-ICM). While U.S. submunitions (Figure 7) do not have a particularly high dud rate, so much ordnance may be thrown against enemy positions before an attack that significant quantities of unexploded bomblets may litter the objective. This problem is likely to be worse in jungles, swamps, or deep snow. Unfortunately, fire-support elements generally do not provide information to maneuver units or their supporting engineers about areas that contain these "dud minefields." This means that attacking ground units may encounter them with no advance warning.

Problems with unexploded submunitions arose both during and after Operation Desert Storm and resulted in a number of U.S. casualties. Unexploded ordnance remains a serious problem in Kuwait. Engineer units must learn from this experience and be cautious when operating in such areas. Soldiers must never pick up or handle dud submunitions, unless they are under the direct supervision of a qualified EOD technician.[19] These submunitions are often extremely sensitive: sometimes only a shake or nudge will activate the device. When practical, duds should be marked and left for clearance by EOD teams. If necessary, they may be neutralized by small-arms fire (from a safe distance) or by blowing them in place.

Countermeasures

Technical advances in AP mines impact significantly on tactical operations. In addition, U.S. countermine equipment has changed little since World War II. Under these circumstances, all combat engineers must employ some practical countermeasures. They must—

- Understand the nature and seriousness of the threat and respond accordingly. Otherwise, their ability to counter this threat will be severely limited.
- Know which breaching and detection techniques are effective against which types of mines and be prepared to improvise.[20]
- Conduct thorough advance reconnaissance of known or suspected enemy obstacle zones. Good reconnaissance can provide detailed technical information on enemy obstacles, including types of mines present and their approximate depth and density. Such information facilitates better breaching preparation.
- Remember some basic, commonsense rules (see box). Executed with good judgement, these rules can maximize performance and save lives.

Countermine DOs and DON'Ts

DO

1. Maintain proper intervals between personnel
2. Stay alert for signs of mines
3. Check wells and shaded areas before using them
4. Check doors and windows before entry
5. Maintain good battlefield police (G.I. junk makes great booby traps)
6. Control the night so the guerrilla cannot lay mines
7. Mark mines and report their location to the chain of command

DON'T

1. Use paths
2. Become predictable
3. Allow more than one man to recover a man wounded by a mine
4. Collect war trophies

Summary

Combat engineers must recognize that they are the key to solving the mine threat. If they know the capabilities of the mines used in potentially hostile countries and constantly reinforce that knowledge with realistic training, they will be able to support the mobility of U.S. maneuver forces on any battlefield.

Mr. Schneck is a civilian project engineer for the Countermine Systems Directorate, Belvoir Research, Development, and Engineering Center, Fort Belvoir. During Desert Shield/Storm, he trained 19 U.S. engineer battalions in mine warfare techniques and Iraqi mines. He holds a bachelor's degree from the Georgia Institute of Technology.

Mr. Visser is a civilian project engineer for the Countermine Systems Directorate, Belvoir Research, Development, and Engineering Center. He previously served as an instructor in the Department of Military Engineering at the U.S. Army Engineer School. Mr. Visser is a graduate of the U.S. Military Academy, West Point.

Mr. Leigh is a special projects officer in the Countermine Systems Directorate, Belvoir Research, Development, and Engineering Center. He is a retired Army officer. Previous assignments include deputy TRADOC systems manager for mine/countermine warfare. Mr. Leigh is a graduate of the U.S. Army Command and General Staff College and holds a bachelor's degree from Golden Gate University, San Francisco.

Endnotes

[1]TC 5-31, *Viet Cong Boobytraps, Mines, and Mine Warfare Techniques*, December 1969.

[2]Freeman, Douglas Southall, *Lee's Lieutenant's, A Study in Command, Volume 1*, Charles Scribner's Sons, 1934, pages 268-269.

[3]*Wound Ballistics*, Office of the Surgeon General, Department of the Army, 1962, page 837.

[4]TM 5-223C, *German Mine Warfare Equipment*, March 1952, pages 123-129.

[5]*Jane's Military Vehicles and Logistics, 1991-1992*. Jane's Defence Data, 1991, pages 143-206.

[6]*Mine Recognition and Warfare Handbook*, U.S. Army Engineer School, Fort Leonard Wood, MO, November 1990, pages 196 and 197.

[7]FM 20-32, *Mine/Countermine Operations*, September 1992, page D-17.

[8]*Jane's*, pages 143-206.

[9]*Jane's*, page 172.

[10]*Significant Landmines and Booby Traps Employed by U.S. and Allied Forces, 1940-1970, Landmine and Countermine Warfare*, Engineer Agency for Resources Inventories, June 1972: Washington, D.C., page 6.

[11]*Jane's*, pages 143-206.

[12]*Eastern Europe, World War II, Landmine and Countermine Warfare*, Engineer Agency for Resources Inventories, August 1973: Washington, D.C., page 155.

[13]*Jane's*, pages 143-206.

[14]*Jane's*, pages 191 and 201.

[15]*Jane's*, pages 191 and 201.

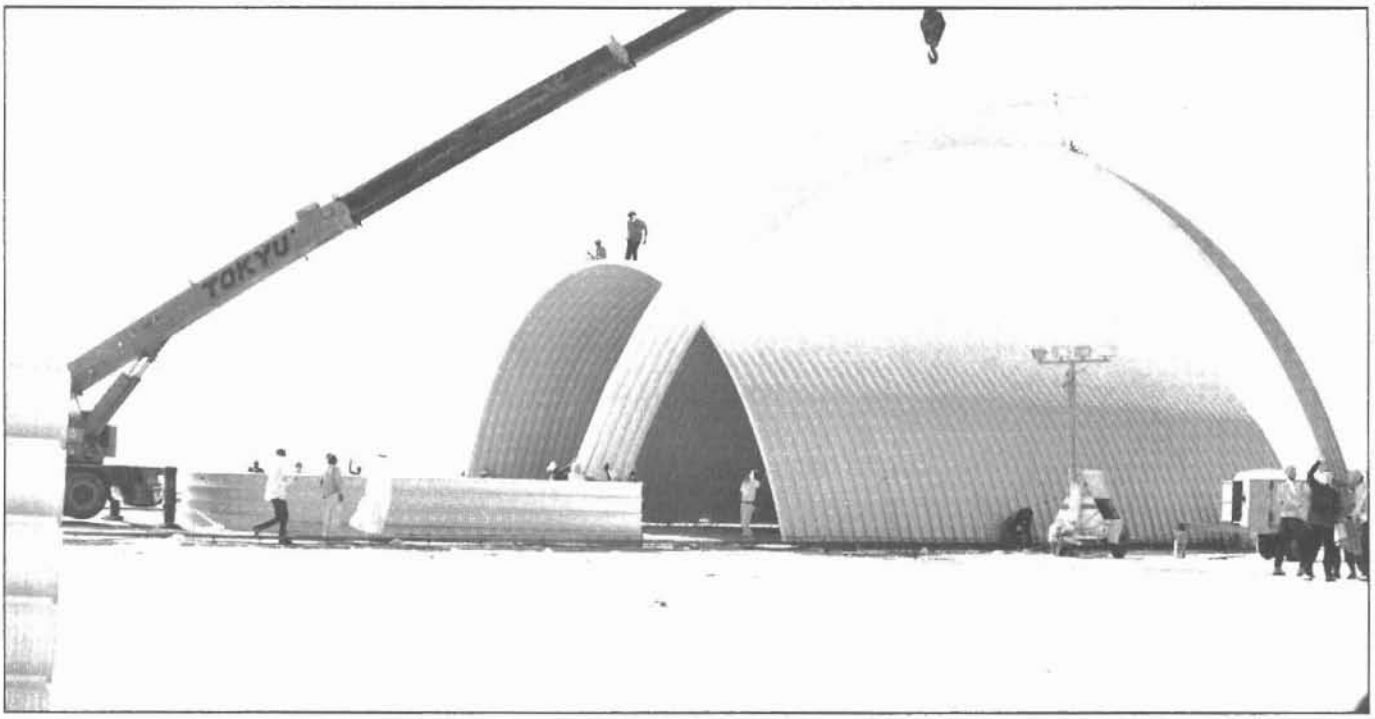
[16]DeForest, M. J., *Principles of Improvised Explosive Devices*, Paladin Press, 1984: Boulder, CO.

[17]FM 5-31, *Boobytraps*, September 1965.

[18]TC 5-31.

[19]Schneck, William C., "After Action Report, Operations Desert Shield and Desert Storm," Belvoir Research, Development, and Engineering Center, 12 November 1991, pp. 13 through 15.

[20]Schneck, William, "Desert Storm, Countermine Improvisations," *ENGINEER* Magazine, July 1992.



K-Spans are well suited to field construction. This K-Span is being constructed with civilian labor in Saudi Arabia.

K-Span Structures:

A Versatile Alternative for the Theater of Operations

By Captain Andrew Goetz

Self-supporting steel arch structures have had many military applications since Quonset huts were introduced in World War II. One modern iteration of this design is the "K-Span"-type building. K-Spans are versatile, easily erected, and relatively inexpensive, and they are rapidly becoming the structure of choice for many military requirements in CONUS and overseas.

K-Span construction requires a commercial, trailer-mounted, automatic building machine (ABM), coiled flat steel, and an electric seamer. Optional accessories meet a wide variety of needs. The ABMs most commonly used in military construction are the MIC-120 and MIC-240, both built by M.I.C. Industries, and the K-120 and K-240, built by K-Span, Incorporated. These ABMs are similar and parts are interchangeable. The 120s are used to build structures ranging from 30 feet wide by 12 feet high to 80 feet wide by 24 feet high. The 240s can produce "Super K-Span" structures up to 120 feet

wide by 40 feet high. K-Span structures can be assembled to any desired length.

In addition to the ABM, seamers, and coiled steel, K-Span construction requires a crane to lift arch panels into place, concrete form work (available as a kit), and a welder. The skin of the building and the end walls are formed from flat steel. There are no supporting members or trusses other than door and window frames.

The ABM forms flat, continuous steel stock into straight, channelized sections of the desired length. Straight panels are curved by the trailer to form the arch. An electric seaming machine joins adjacent panels to create a strong, weatherproof joint. Once in place, the arch is self-supporting and requires no additional support except a concrete cap along the base of the panels.

K-Span structures have attributes that make them ideal for use in a theater of operations. Available accessories include doors, windows, skylights, roof vents, utilities, and insulation. These accessories may be used when building aircraft hangars, motor pools, or billets. Concrete slab foundations are preferred, but any level surface can be used.

The ABM is transportable by C-130 aircraft and can be pulled by a wide assortment of military and commercial prime movers. Coiled steel is easily transported, or it can be purchased in most theaters of operation. Special-purpose accessories are usually purchased in CONUS but come well packed for overseas shipment.

K-Span construction procedures are fairly simple, and learning curves for the erection process are short. An experienced supervisor working with an untrained crew can erect a simple design in a few days. The same crew could then erect subsequent buildings even faster. Larger or more complex buildings require more construction time, and concrete slab floors must cure before use. Nevertheless, the time savings achieved is significant when compared to construction of more traditional pre-engineered buildings.

Easy to build, durable, and relatively inexpensive, K-Spans are filling a wide variety of military requirements from Fort Hood to Saudi Arabia. In a theater where engineers are in high demand, K-Span construction, supervised by experienced engineers but erected using unskilled labor, seems to fit the bill. For more information, call the Vertical Skills Division at the U.S. Army Engineer Center at DSN 676-5440 or (314) 563-5440.

Captain Goetz is chief of the Vertical Skills Division, Directorate of Training, at the Engineer School. He received an ROTC commision and a bachelor of science degree from the University of California. Previous assignments included battalion maintenance officer, company commander, and maintenance detachment commander of the 82nd Engineer Battalion and company executive officer and battalion adjutant of the 14th Combat Engineer Battalion.

Engineer Problem

You are the commander of an engineer company in a combat heavy battalion, working on a joint task force project in Honduras. Your mission is to upgrade an existing airfield for use by C-130 aircraft to support area, medium lift airfield standards.

The existing airfield, which is surfaced with aggregate, shows no significant wear from use by small aircraft. The battalion's soils specialist used a dual-mass cone pentrometer, which had been obtained from the Waterway's Experiment Station prior to deployment, to measure the strength of the runway. He determined that the airfield has a California Bearing Ratio (CBR) of 80 for the top 24 inches of soil. Other reconnaissance determined that the airfield is 2,000 feet long and 60 feet wide, and is located 2,300 feet above sea level. Surveyors informed you that the effective gradient is 2 percent. Your task is to determine the design length (takeoff ground run) of the airfield required for it to land C-130 aircraft.

Reference: Chapter 12, TM 5-330

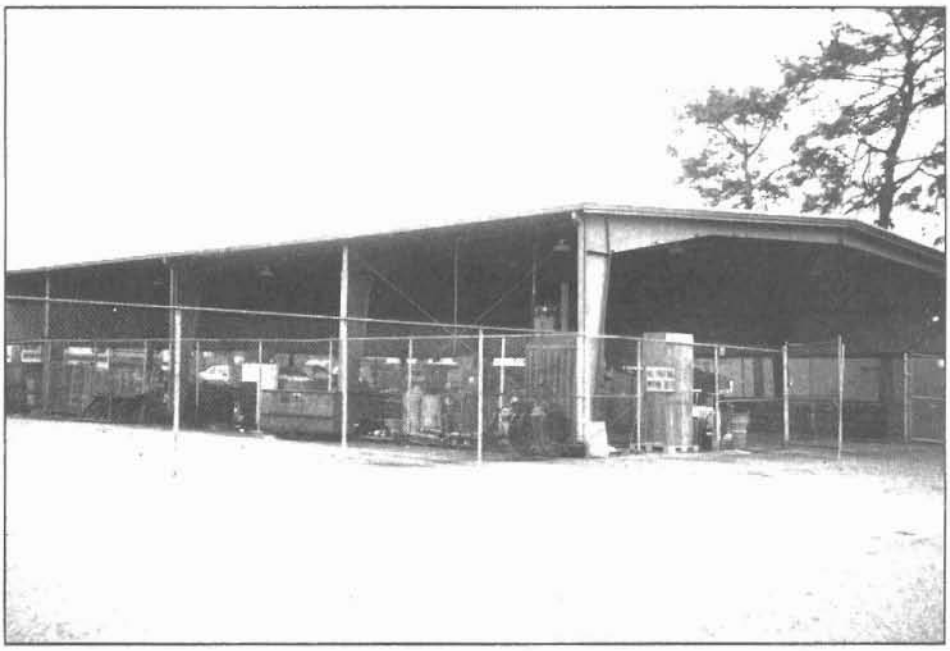
ENGINEER Solution is on page 45.

Pre-engineered Buildings:

Quality Assurance Tricks of the Trade

By D.G. McIntosh

Pre-engineered buildings (PEBs) are multipurpose structures developed to satisfy temporary needs at stateside or forward-area locations. These structures sometimes become long-term solutions—for example, some Quonset huts erected for temporary use before, during, and just after World War II are still in use today. Because "temporary" buildings may be used 50 years or more, engineers must achieve quality construction standards that facilitate their durability over time. This article describes some tricks of the trade that will assure durable construction of these versatile structures.



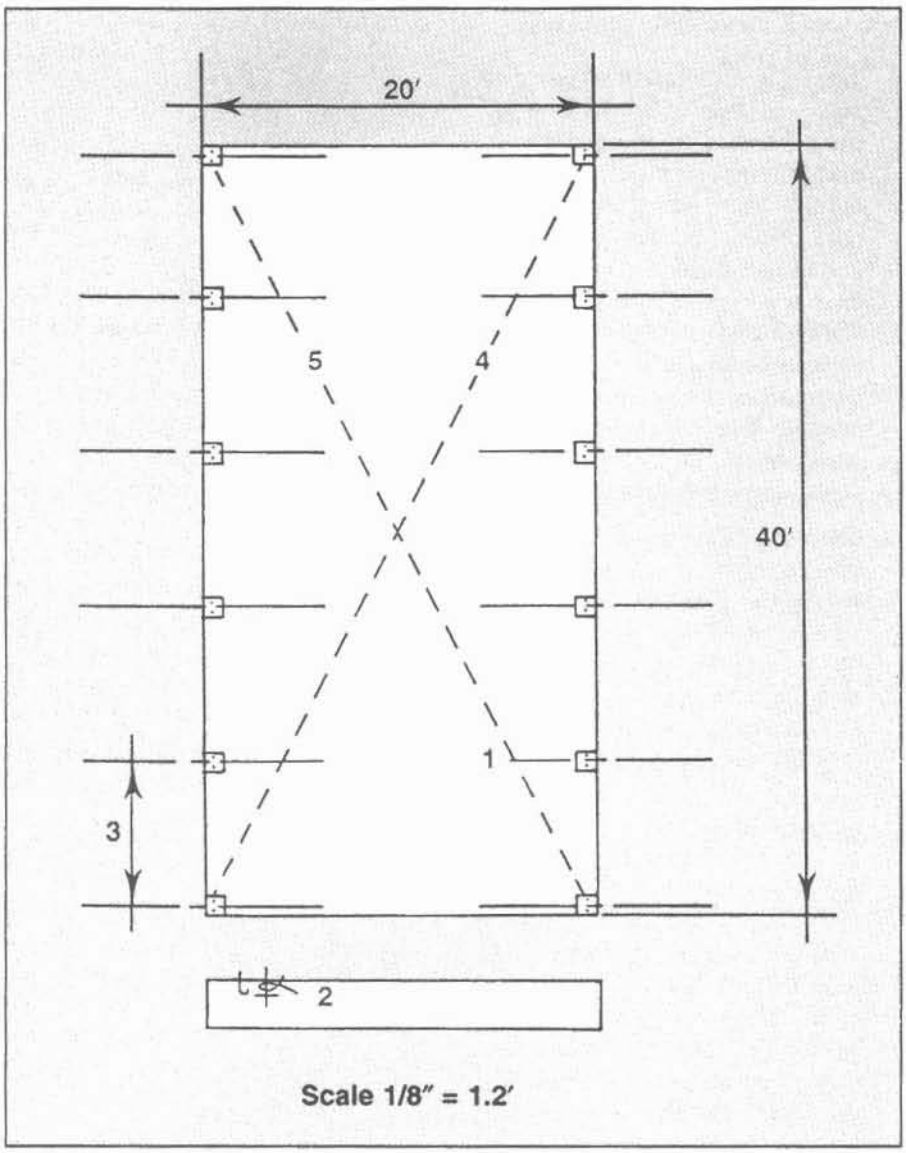
Pre-engineered buildings have many uses. This one is used to store heavy equipment and bulky supplies.

Case Study

Let's assume office space is needed. The unit has received permission to build a structure, selected a construction site, and obtained funding. A PEB purchased through the supply system is on site. It is a 20-foot by 40-foot general purpose building manufactured by any of several companies (such as Kaiser, Pascoe, Butler, or Monroe). Site clearing and underslab compaction preparation have begun, and construction will start soon. A supervisor and crew, regardless of their levels of expertise, can erect a PEB and get a high quality final product by following four quality assurance steps.

Step 1: ***Open each box containing PEB parts.*** PEBs come in many boxes—for example, box 1 of 19 may be bolts, and box 7 of 19 may be girts. Before construction begins, open each box, count the contents, and match them to the manufacturer-supplied inventory list. Visually check and account for each part of the PEB. This step ensures that all components required to erect a structurally sound building are on hand. It also provides time to replace any missing or defective parts.

At this point, the right soil compaction has been reached. Underground utilities are placed, tested, and stubbed up. Footers, piers, pier pads, or column pads are dug. Rebar is tied and emplaced, and forms are being put in place.



Option. Secure at least two reversible, variable-speed electric drills with screwdriver bits for use on the metal screw and rubber or neoprene washer combinations that attach the exterior "skin" to the metal frame of the PEB. Two drills will expedite the skinning out process—when only one is used, the windings often burn up from overuse. If these drills are not available, manual screwdrivers or drills without the variable-speed option may be used.

Step 2: ***Take accurate measurements.*** This step is critical to ensure proper anchor-bolt placement and a "square" structure. Take measurements after all the form work for the slab is finished and in place. The figure depicts measurements 1 through 5.

Measurement 1 is the proper distance between column anchor-bolts.

Measurement 2 is the distance across the width of the form.

Measurement 3 is the distance between anchor bolts on each side (length) of the form.

Measurements 4 and 5 are the distance between the opposite corners. These measurements must be exactly the same to guarantee that the PEB is square. This is important when skinning out a PEB because an out-of-square structure may result in misaligned roof panels or a shortage of material on one or more sides.

At this point, the slab for the PEB is poured. A 7-day cure time elapsed before the forms were stripped off. Some backfilling and grading were done around the slab. Columns are erect and secured with anchor bolts.

Step 3: ***Bolt rafters to the columns.*** This step has three parts.

- Ensure that all rafters face the same direction before bolting them to the columns. This will allow the roof fasteners to be equally spaced when the roof is attached.
- Ensure that all bolts face the same direction, have washers, and are torqued to the manufacturer's recommended foot-poundage. This ensures proper alignment and quality assurance and allows for inspection at a single glance.
- Emplace all girts and purlins before tightening the first one. Snug up girt and purlin bolts one bay at a time to minimize the chance of misaligning the structure. (Bays are the distance between any two columns on the same side.)

Erection of the PEB is now nearly complete. All columns, rafters, girts, purlins, braces, and kickplates are in place and properly and securely bolted together. Door and window openings are installed. The frame is solid and has been inspected and approved by the resident officer-in-charge of construction or the activity civil engineer.

Step 4: ***Skinning out the PEB.*** This three-part step will assure a watertight structure and a quality final product.

- Attach the first piece of "skin" or metal sheeting that forms the exterior of the PEB. Proper alignment of the first sheet is critical because it

dictates the alignment of those that follow. When the first sheet is properly aligned, secure it with an electric drill and sheetmetal screws. Each screw must have a rubber or neoprene washer to ensure the PEB is weather-tight.

- Form metal joints by overlapping each sheet on the previously placed sheet. Adjust the overlap to lengthen or shorten the joints, but use this technique only when necessary—for example, it may be needed around doors or windows.
- Caulk the edge of all sheeting to ensure watertight joints. Most PEB manufacturers require a sealant between the overlap joints, but the gum-backed sponge-rubber sealant provided by the manufacturer may have exceeded its shelf-life by the time the PEB is constructed. To form a proper seal, obtain several tubes of white, clear, or black caulk, preferably the nonhardening type.

Summary

Any erection crew can use these quality assurance steps as tricks of the trade to construct a PEB that will retain strength and durability throughout its serviceable life. Following these steps will extend the life and durability of any pre-engineered building and allow the user to successfully accomplish the mission.

Mr. McIntosh, a building code inspector in Pensacola, is a retired chief utilitiesman from the U.S. Navy. While serving in the Seabees, he deployed with several construction battalions, served as an instructor, and served as an operations chief for a construction battalion unit.

(Personal Viewpoint, continued)

focus on your weaknesses and you will lose. Use your engineer assets, unit equipment, and talents—it's called "leveraging"—and use them to support others. Having said that, you must excel in soldier basics and small-unit tactics. Compete to standards; be your own competition, using your uniqueness and the rater's priorities. Set the standards of excellence, compete against those standards, and win.

- ***Talk, live, and breathe operations orders and FRAGOs.*** Don't be a part-time soldier, saving operations orders only for the field. The mindset must be a battle-focused one, and you get that only by practicing it all of the time.Make sure there are six paragraphs with the additional one being "safety." Be toe-to-toe with all other units when it comes to soldier skills, a warrior spirit, and safety. As part of this battle focus, keep your units on the cutting edge by having part of your command, at almost any time, in the field. Be the first in line for Joint Readiness Training Center and National Training Center support, even if it's only to send one platoon. Take those rotations and combined arms training over long-term engineer deployments. Don't extend beyond the interests of the division.
- ***Get yourself, the unit leaders, and the soldiers involved with the community.*** Sponsor a school; offer to assist with the rear detachments of deployed units; support a boy scout troop, Army Emergency Relief, Association of the U.S. Army, the division association, or whatever else is out there requesting help. In essence, belly up to the community bar before you are asked to by the command. Spot the post challenges and become the solution. Make it happen. And as you do it, advertise the unit but never yourself. You're not the center, your soldiers are.
- ***FORSCOM is number 2; the division, even though you don't wear the patch, is number 1.*** The division staff knows who FORSCOM is and what units belong to it; you don't have to remind them nor should you try to play one against the other. In USR and other capabilities briefings, focus on what you can do for the division not what you can't do or what the division must do for you. No one likes a moaner so keep a positive attitude and face the distant guns.

Choose Your Strategy

The choice really is yours. You can groan and take everyone to task or you can use your strengths to make your soldiers invaluable to the division. The "Charles Atlas position" on the OER is not where you have to be. Know your boss and line up your priorities. You will find that you can do your own thing and enjoy it, to boot.

Wisdom is the combination of experience and vision. I have stated my two cents worth of experience and vision. Do you have the wisdom to properly apply it? Choose your block.

Colonel Harback is commander of the Louisville District, Army Corps of Engineers. Previous assignments include commander, 14th Combat Engineer Battalion; and XO, Bayonet Combat Support Brigade, 7th Infantry Division. He has masters degrees from Northern Illinois University and Long Island University and is a graduate of the Command and General Staff College and the Army War College.

FY 94 SDTs Affect NCO Careers

By Jim Evans

Scores from FY 94 self-development tests (SDTs) will be a key factor in determining promotions, assignments, school selections, and retention for Active Component noncommissioned officers (NCOs). (SDT scores will not affect Reserve Component NCOs until FY 95.) Whether you are a unit commander or an NCO, the following recommendations can help with the SDT preparation process.

Commanders

Although you are not required to provide unit training for SDT testing, you have a vested interest in ensuring that your talented people do well on these tests. This support requires only a minimum investment of unit resources:

- ☐ Ensure that each NCO has a personal copy of FMs 22-100, 22-101, 22-102, and 25-101. These are basic references for the training and leadership portions of SDTs.
- ☐ Ensure that the local learning center has all references listed in each NCO's STPs and SDT notices. Don't overlook low-strength MOSs.
- ☐ Delay testing until near the end of the three-month test window if some references for an MOS are not available in the learning center when the window opens.
- ☐ Encourage your NCOs to share references and strengths by forming study groups. Many soldiers have sizable personal reference collections; all have knowledge to share.
- ☐ Coordinate with other units so that NCOs can become familiar with equipment not available in their unit.
- ☐ Avoid scheduling NCOs for overnight duty the evening before testing. SDT scores are potentially as important to NCOs as college entrance exams were to you.

Note that four of these six recommendations pertain to references. To make their best scores, NCOs must study the appropriate references. The role of learning centers in providing references for all NCOs they support cannot be overemphasized. Support your soldiers if they encounter problems at the learning center.

NCOs

FY 94 SDT scores (unlike the scores from the past two years) will significantly affect future opportunities in the Army. To get the best score possible,—

- ☐ Ensure that the local learning center has or acquires all references listed in your STP.
- ☐ Notify the local TSO or your supervisor if you do not receive an SDT notice approximately two months before the test window opens.
- ☐ Take your notice to the local learning center as soon as you receive it, and request any required publications not on hand. Refer problems encountered at the learning center to your chain of command.
- ☐ Begin preparing for the SDT immediately after receiving the notice.
- ☐ Understand the reference portion of the SDT notice. The references used to prepare the questions for any given task are noted by letters in the right-hand column and listed at the end of the skill level portion of the notice. Study only those paragraphs or pages that relate to a particular task.
- ☐ Request time to become familiar with pertinent equipment in nearby units if they have some your unit lacks.
- ☐ Form a study group with NCOs in your MOS to prepare for the technical portion of the SDT, and study with NCOs of your rank to prepare for the leadership and training portions.
- ☐ Know how to use the calculator you will take to the test site if one is prescribed in the notice. To be safe, take an extra set of batteries.
- ☐ Get a good night's rest before the test.
- ☐ If you are nervous at the test site, try alternately tensing and relaxing your muscles. This simple exercise can help tremendously.

Remember, to prepare for this important test, seize the initiative early. Ensure that all references are available. Seek others who share your MOS and skill level, and study with them. The Army values initiative; the SDT requires and rewards it!

Mr. Evans is the product manager for SDTs at the Engineer School.

Mapping Your Career the Engineer Way

By Master Sergeant Jose Bonilla, Master Sergeant Kathryn Kindle, and Sergeant First Class Benjamin Twigg

Making a career as an enlisted soldier is not a quick or easy decision for anyone. Once you've made the decision, planning how to accomplish your goal is the next step. The following sample engineer career maps provide the guidance needed to stay competitive in three career management fields: Combat Engineers (CMF 12), General Engineers (CMF 51), and Topographic Engineers (CMF 81). Additional information is in AR 611-201 and DA Pam 600-25. Use your NCO support channel to get your career plan on track.

MSG Bonilla, MSG Kindle, and SFC Twigg are proponent coordinators with the Engineer Personnel Proponency Office, at Fort Leonard Wood.

CMF 12 Career Professional Development Program

Civilian schools	High school, GED diploma	College * (1 year / 2 years / 3 years) * A goal; understand that troop assignments often preclude off-duty education				
Other schools	Drill Sergeant School → | Recruiting School	1SG Course → |	Battle Staff Course → |			
NCOES	PLDC → |	ANCOC → |	BNCOC → |	USASMA → |		
Encouraged assignments	Reserve Component advisor / CMF 12 staff assignments →	Operations / Intelligence sergeant →	Instructor →	Recruiter, Retention Drill sergeant →	CSM	
Key leadership assignments	Crewmember Veh operator Cbt engineer	Team ldr Crew chief AVLB cdr	Sqd ldr Sec ldr CEV cdr	Plt/sec sgt Det sgt Team sgt	1SG	CSM
Rank	PVT, PFC SPC, CPL	SGT	SSG	SFC	1SG MSG	SGM CSM
Years of service	1 - 3	4 - 6	7 - 9	10 - 15	16-19	20-30

CMF 51 Career Professional Development Program

Civilian schools	High School, GED Diploma	College * 1 year / 2 years / 3 years * A goal; understand that troop assignments often preclude off-duty education				
Other schools	Drill Sergeant School → | Recruiting School			1SG Course → |		Battle Staff Course → |
NCOES	PLDC → |	BNCOC → |	ANCOC → |		USASMA → |	
Encouraged assignments				Reserve Component advisor CMF 51 Staff assignments → Construction sergeant Inspector / Foreman → Operations/Intelligence sergeant → Instructor → Recruiter, Retention Drill sergeant →		CSM
Key leadership assignments	Equip operator Const specialist Gen engineer	Team ldr Sr equip opr	Sqd ldr Const sup Sec ldr	Plt/Sec sgt	1SG	CSM
Rank	PVT, PFC SPC, CPL	SGT	SSG	SFC	1SG MSG	SGM CSM
Years of service	1 - 3	4 - 6	7 - 9	10 - 15	16-19	20-30

CMF 81 Career Professional Development Program

Civilian schools	High school GED diploma	College * 1 year / 2 years / 3 years * A goal; understand that troop assignments often preclude off-duty education				
Other schools	Drill Sergeant School → | Recruiting School			1SG Course → |		Battle Staff Course → |
NCOES	PLDC → |	BNCOC → |	ANCOC → |		USASMA → |	
Encouraged assignments				Reserve Component advisor CMF 81 staff assignments → Senior topographer → Intelligence sergeant Operations sergeant → Instructor → Recruiter, Retention Drill sergeant →		CSM
Key leadership assignments	Equip operator Inst repairer	Team ldr Sect sgt	Sqd ldr Sec ldr Proj NCO	Plt/Sec sgt Det NCOIC	1SG	CSM
Rank	PVT, PFC SPC, CPL	SGT	SSG	SFC	1SG MSG	SGM CSM
Years of service	1 - 3	4 - 6	7 - 9	10 - 15	16-19	20-30

Lessons Learned

The Role Of The Engineer Liaison Officer

This article describes the duties and functions of an engineer liaison officer (LO). U.S. Army engineer units performed critical roles in such joint and combined operations as Operations Desert Shield/Storm, Provide Comfort and Restore Hope, and Joint Task Forces Andrews and Iniki. One key to the success of those operations was the ability of engineer LOs to coordinate and complete multiple missions with diverse maneuver and engineer units. The LO's primary role is to teach and advise the gaining headquarters on his unit's assets and capabilities.

Some engineer LOs, however, do not understand their duties or lack adequate support to accomplish them. Because the world situation is unstable, the Army will continue to participate in combat operations and operations other than war, such as humanitarian assistance and disaster relief missions, which require effective engineer liaison support. The following information will help future engineer LOs perform their missions successfully. For more information write to Commandant, U.S. Army Engineer School, ATTN: ATSE-ESA-L, Fort Leonard Wood, MO. 65473-6630. Or call (314)-563-5302, DSN 676-5302.

Issue: Some engineer LOs provided inadequate liaison support during recent combat operations and operations other than war.

Discussion: During Desert Storm, U.S. Army engineer LOs assigned to the French and British armies lacked adequate support, including communications equipment and vehicles. As a result, their ability to perform duties and provide timely and effective coordination was severely degraded. How many times have you been in an engineer tactical operations center (TOC) and heard either the S3 or the commander state that the unit needed to send a liaison officer to brigade, division, or another unit? Usually in those situations, there is some debate about who to send to best meet the requirement.

Commanders face two issues when tasked with sending an engineer LO to another headquarters. First, they must resource the requirement from already scarce personnel resources. Thus, some commanders may choose to send a newly assigned or inexperienced officer who has limited tactical experience, no knowledge of the unit's standing operating procedures (SOPs), is unfamiliar with the staff, and does not know how the unit normally functions in deployment or during an exercise. Secondly, they must provide physical support requirements, such as vehicles, communications equipment, and additional enlisted personnel. Although these requirements may be scarce, the parent unit must provide them. Insufficient support can quickly lead to frustration or complacency on the LO's part and result in the unit's failure to receive crucial and timely information.

Recommendations:

Supporting (Parent) Engineer Commander's Decision Criteria

The LO represents his commander at the headquarters of another unit and coordinates and promotes cooperation between them. A commander should assign LO duties to someone dedicated full time to that position, not make it an additional duty. An engineer commander who sends a poorly qualified or poorly equipped LO hurts himself and his unit, and makes a poor impression on the headquarters to which the LO is assigned. When selecting an engineer LO, the commander must ensure that the candidate has the following qualifications:

- Rank and experience appropriate for the headquarters to which he is assigned. The LO should possess tactical engineer skills in areas such as battlefield assessments, breach and obstacle planning, etc.
- Ability to communicate effectively both orally and in writing. It is especially critical that the LO possess strong staff briefing skills.
- Detailed knowledge of the parent unit's SOP and operation plans and orders (OPLANs and OPORDERS).
- Knowledge of the coalition force's language, when working with an allied unit. If knowledge of a foreign language is required but not available, the parent unit ensures an interpreter is provided.
- Attributes such as a proper uniform and sharp personal appearance enhance effective liaison activities.

Parent Engineer Unit Responsibilities

After an LO is selected, the parent unit headquarters provides appropriate briefings and support:

- The G3/S3 or his duty officer thoroughly briefs the LO about the current situation in the unit and the commander's intent, including details of the concept of operations. This briefing includes unit locations, front line trace, engineer planning factors, combat readiness factors such as personnel strength and logistic considerations, and a map with overlays.
- The G3/S3 briefs the LO about the current status and missions of the assigned unit. After this briefing, each staff section informs the LO about their specific liaison and information requirements. For example, the S2 may require detailed terrain information. These briefings ensure that the LO clearly understands his mission and responsibilities.

Engineer Liaison Officer Responsibilities

To perform successfully, an engineer LO must complete the following tasks:

- The LO places all acquired information in a battle book, which he can carry easily and use to file information needed or obtained at the duty site. The LO uses the battle book when conducting briefings.
- The LO ensures that arrangements for communications and transportation meet mission requirements. He checks assigned radios, signal operating instructions (SOI), challenge and passwords, and ensures rations are provided. The LO obtains required specialized equipment, security clearances, and credentials for identification into the higher headquarters' TOC.
- If conducting liaison with coalition units, the LO ensures that language or interpreter requirements are met.
- After arriving at the assigned unit, the LO reports to the commander or his representative (G3/S3 or chief of staff) and is prepared to brief the parent unit's situation. He visits each staff section, provides information requested, and obtains information needed by the parent engineer unit.
- Because the LO provides a vital link to the parent unit, he continually advises the TOC duty officer, the secretary of the general staff, or chief of staff of his whereabouts.
- Throughout the tour, the LO keeps informed of the situation at the parent unit and makes that information available to the commander and staff of the assigned unit. He accomplishes this task without interfering with operations at the assigned unit. He keeps an accurate record of all communications in a staff journal. He reports on those matters within the scope of the mission and informs the assigned commander of information sent to the parent unit.
- A major LO function is to promote harmonious relations between the parent engineer unit and the assigned unit. As the parent unit's representative, the LO's actions significantly affect the higher headquarter's perception of his unit's engineer support.
- The LO immediately informs the parent unit any time he is unable to perform his responsibilities at the assigned unit.
- After completing his mission, the LO presents an out-brief to the commander or G3/S3.
- Upon return to the parent unit, the LO briefs the engineer commander or his representative regarding all information received during the visit. This includes detailed information concerning the higher headquarter's mission, unit locations, future operations, commander's intent, mission requirements and requests for information. The LO clearly and accurately briefs all staff sections regarding detailed information received during the visit, and transmits information required by higher headquarters to each staff area of responsibility.
- The LO keeps abreast of the current situation and stays prepared to respond to future liaison requirements.

Assigned Unit Responsibilities

After the engineer LO arrives at the duty site, the assigned unit provides the following briefs and support:

- The staff briefs the LO about their current operations. They provide the LO with rations, fuel, maintenance (if possible), communications equipment, and work and sleep areas.
- Like the LO, the assigned unit's staff fosters and promotes harmonious working relationships.

Liaison officers resolve issues and problems between headquarters. The responsibilities described in this article and on the next page will help engineer LOs perform their duties successfully and promote mutual understanding and unity of action between parent and assigned units.

Major Mark Camper is an Infantry officer assigned to the Directorate of Evaluation and Standardization. A graduate of CGSC, he has served with airborne and mechanized infantry units in command and staff positions.

Engineer Liaison Officer Checklist

Engineer Commander Responsibilities

For a liaison mission to be successful, the commander of the parent unit ensures that the LO—

- ☐ Has the rank and experience appropriate for the assigned headquarters.
- ☐ Is experienced and knowledgeable about tactical operations, engineer battlefield assessments, engineer planning factors, combined arms breaching/obstacle operations, and construction operations.
- ☐ Can communicate well both orally and in writing, and has superior briefing skills.
- ☐ Has a working knowledge of a common foreign language or access to an interpreter if working with a coalition unit.

Liaison Officer Responsibilities

After notification of the liaison assignment, the LO—

- ☐ Hands over his previous duties to a replacement or the person assuming his responsibilities.
- ☐ Is briefed by the commander or his representative on the unit's present situation and future operations.
- ☐ Develops a battle book, which contains as a minimum:
  - Parent unit's operations orders, plans, and overlays
  - Parent unit's tactical SOP
  - Commander's intent for the present operation
  - Planned operations
  - Engineer planning factors
  - Personnel and logistics combat readiness factors
- ☐ Obtains each staff section's requirements and/or required reports.
- ☐ Obtains proper security clearances and credentials from the G2/S2.
- ☐ Obtains signal operating instructions (SOI) and challenge and passwords from the communications officer.
- ☐ Obtains communications equipment.
- ☐ Checks out communications equipment and coordinates with communications officer for replacement equipment.
- ☐ Obtains vehicle support.
- ☐ Coordinates for maintenance and Class III fuel support.
- ☐ Conducts vehicle safety check.
- ☐ Obtains Class I rations support or coordinates for its issue.
- ☐ Obtains required specialized equipment.

Upon arrival at the assigned unit and throughout the tour of duty, the LO—

- ☐ Briefs the commander or his representative on the status of the parent unit, using the battle book.
- ☐ Meets and coordinates with primary staff members.
- ☐ Identifies work and sleep areas.
- ☐ Establishes and maintains communications with the parent unit.
- ☐ Coordinates for Class I, III, and maintenance support.
- ☐ Maintains a staff journal.
- ☐ Submits reports as required.
- ☐ Conducts briefings as required.
- ☐ Develops and maintains harmonious relationships with the assigned unit.

Before returning to the parent unit, the LO—

- ☐ Out-briefs the commander or his representative.
- ☐ Updates and completes all reports, the staff journal, and the battle book.
- ☐ Conducts a final briefing with all staff sections.

After returning to the parent unit, the LO—

- ☐ Briefs the commander or his representative on the tour of duty, including the supported unit's present and future operations, and presents updated reports and overlays to the parent headquarters.
- ☐ Submits the battle book to the G3/S3 duty officer.
- ☐ Visits and updates all staff sections.
- ☐ Turns in assigned vehicles, equipment, security items, etc.

Assigned Unit Responsibilities

The assigned unit provides the LO with—

- ☐ In-brief concerning unit operations and missions.
- ☐ Information required by the parent unit, including daily briefings, maps, reports, etc.
- ☐ Work and sleep areas.
- ☐ Common logistical support, including rations, water, fuel, ammunition, and maintenance support.
- ☐ Access to communications systems.

Engineer Solution

A determination of the runway length required for any aircraft includes the surface actually needed for landing rolls or takeoff runs, plus reasonable allowances for variations in pilot technique, psychological factors, wind, snow, other surface conditions, and unforeseen mechanical failures. The runway length is determined by applying a safety factor to the takeoff ground run (TGR) established for the geographic and climatic conditions at the installation. The process to compute the runway length follows:

Step 1. Determine takeoff ground run. Using Table 12-3, you determine that the TGR for C-130 aircraft in a support area is 2,800 feet at sea level for an average maximum temperature of 59°F.

Step 2. Determine pressure altitude correction. To determine the correct pressure altitude for Honduras, add the height of the elevation differential (dH value) for the site to the geographic altitude. Then increase the TGR by +10 percent for each 1,000 feet in altitude above 1,000 feet. Using Figure 12-5, you determine the dH value is 200 feet. Complete the following equation to calculate the correction:

$$(2{,}300 + 200 \text{ feet} - 1{,}000 \text{ feet}) \times \frac{10 \text{ percent}}{1{,}000 \text{ feet}} = 15 \text{ percent or}$$

$$1.15 \times 2{,}300 \text{ feet} = 3{,}220 \text{ feet}$$

Step 3. Determine temperature correction. For runways with a TGR less than 5,000 feet, increase the pressure correction length by +4 percent for each 1°F increase in temperature above 59°F. The average maximum temperature for Honduras (from Figure 12-6) is 90°F. (When in between isopleth values, use the higher value.) The calculation to determine the temperature correction is:

$$90^\circ - 59^\circ \times \frac{4 \text{ percent}}{10^\circ} = 12.4 \text{ percent or } 1.124 \times 3{,}220 \text{ feet} = 3{,}619 \text{ feet}$$

Step 4. Incorporate safety factor. Add a correction factor for safety. For support area airfields the factor is 1.25.

$$1.25 \times 3{,}619 \text{ feet} = 4{,}524 \text{ feet}$$

Step 5. Determine effective gradient correction. Increase the effective gradient by +8 percent for each 1 percent of effective gradient over 2 percent. Because the gradient at this airfield is 2 percent, no correction is necessary.

Step 6. Round up. Next, round up the TGR that is corrected for pressure altitude, temperature, and safety factor to the next higher 100 feet:

$$4{,}524 \text{ feet} = 4{,}600 \text{ feet}$$

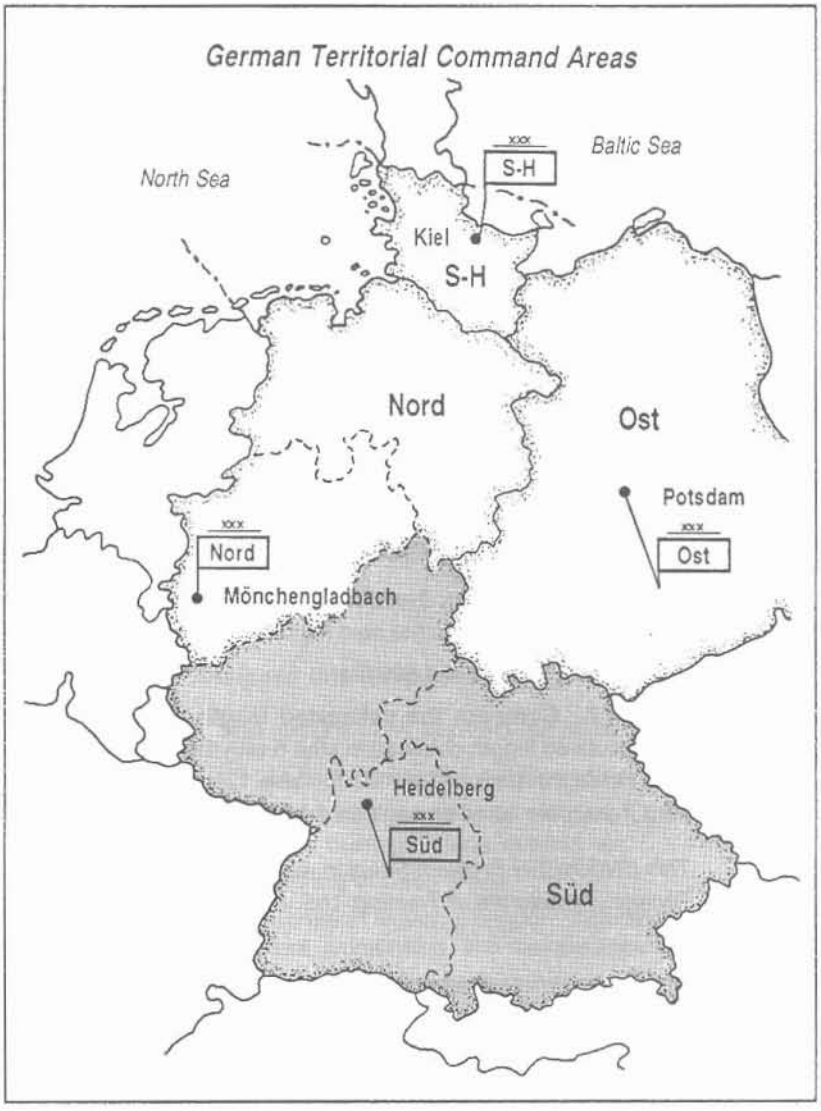
Step 7. Compare the calculated length with the minimum required. Finally, compare the calculated length obtained in step 6 with the minimum required, as shown in column 5 of Table 12-4 (foldout in back of TM 5-330). Table 12-4 shows a required length of 3,500 feet. Congratulations if you calculated and selected 4,600 feet as the appropriate length for the upgrade.

This ENGINEER Problem/Solution was submitted by Captain Mark S. Kuehl, Chief, Horizontal Skills Division, Directorate of Training, U.S. Army Engineer School.

Germany's Military Role in a New World Order

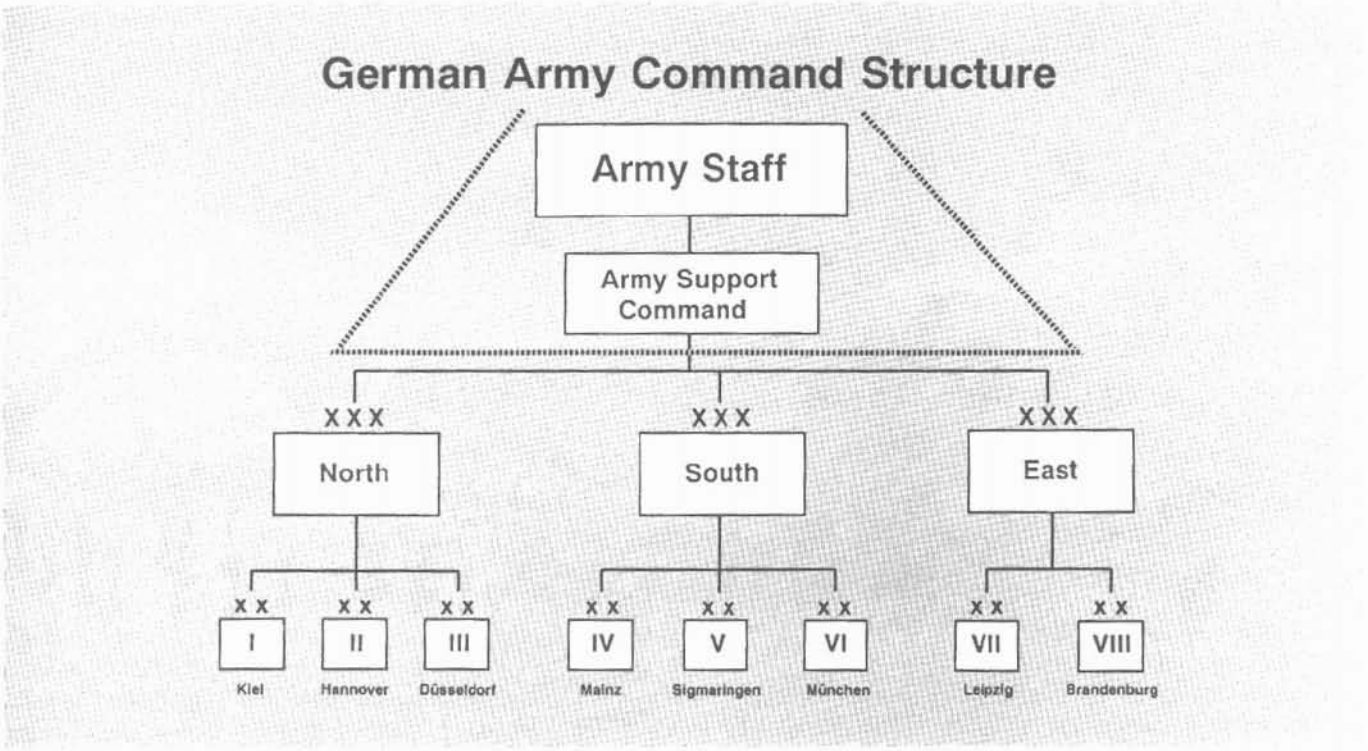
By Lieutenant Colonel Reinhold Hocke and Second Lieutenant N. Dan Nelson

The east and west republics of Germany, divided since 1949, reunited on October 3, 1990. Since that time, the German Army (Bundeswehr) has been redefining its military mission within a larger German border and an unstable eastern Europe. While remaining a loyal and committed member of the North Atlantic Treaty Organization (NATO), the political and economic agendas Germany faces today have led it to look beyond the static General Defensive Plan (GDP) mission. The GDP-oriented military training used during most of the Cold War is being revamped to include more flexible, mission-oriented postures that are better suited to the changing world environment. The shift away from a sole main defensive force will result in additional airmobile units, in-place crisis reaction forces, and basic military organizational elements.



Facing The Challenge

Since 1990, the Bundeswehr has been responsible for all ground forces in Germany,



including those that were part of the German Democratic Republic (GDR) People's Army before 1990. Germany has successfully integrated those troops into its defensive network and thus into the overall NATO alliance. Soviet-made equipment once used by the GDR is being destroyed, stockpiled, or sold to third parties on a restricted basis—for example, some bridging equipment is being sold to Finland. The current Bundeswehr can use only a limited amount of this equipment because most of it does not meet West German safety and environmental standards.

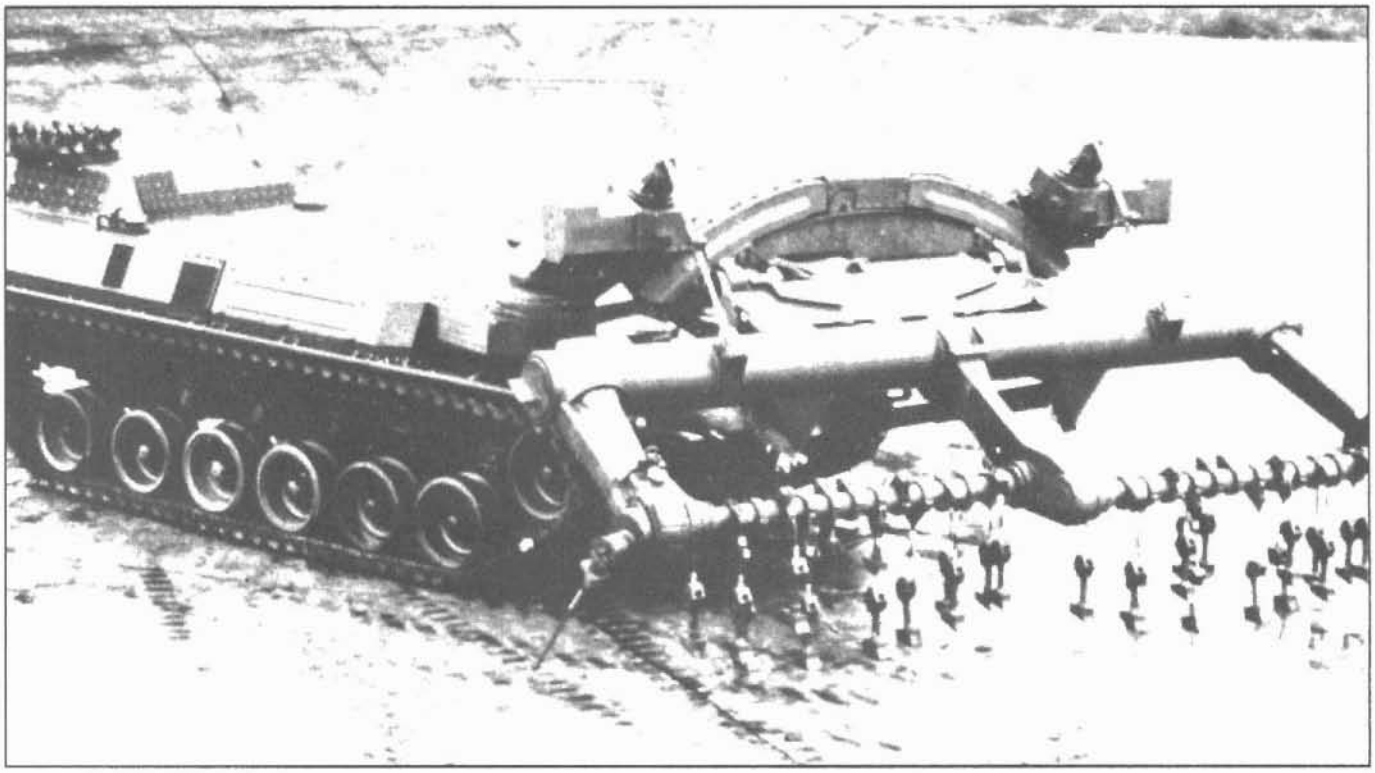
Germany is actively developing a Franco-German Corps. This multinational military structure may be a prelude to a unified multilateral European community force that would work under the auspices of the Western European Union (WEU). To facilitate this movement, Germany and France are working to resolve technical issues such as weapons, communications compatibility, and common rules of training and engagement. Once operational, the corps' mission would be to "preserve and restore the peace." This force may be willing to deal with intricate problems such as the current situation in the former Republic of Yugoslavia. While Germany has provided relief supplies and humanitarian aid to Yugoslavia, it has not been involved militarily in this conflict for historical reasons and because of Basic Law parameters.

> "Countermobility, mobility, and survivability will remain the principal missions of the engineers."

The German Basic Law, or Grundgesetz (Constitution) was drafted after World War II to ensure that Germany could not establish a strong offensive force. Article 87a of the Grundgesetz prohibits Germany from committing forces to such military actions as Operations Desert Shield and Desert Storm. Thus, Germany has not deployed forces outside the NATO area since 1950.

Criticism concerning Germany's lack of combat involvement in Operation Desert Storm led to a political movement in the Bundestag (parliament) to amend Article 87a. This amendment would broaden the range of permissible missions, allowing the Bundeswehr to participate in military actions. Until such an amendment is approved, however, Germany is limited to providing nonmilitary personnel for humanitarian assistance in crisis-torn areas (not combat zones).

The Bundeswehr's newly defined mission statement includes several modified or new missions that will help Germany deal with problems it could not address before reunification. The mission



The Keiler mine-clearing tank

statement directs Germany to—

- Protect German territorial integrity and citizens against outside threats.
- Fulfill commitments to the NATO alliance.
- Maintain strong, lasting military cooperation with allied nations and all European partners in order to facilitate political stability in Europe through military stability.
- Be prepared to assist in UN missions defined by Chapter VII of the UN charter.
- Be prepared to assist in disaster relief and environmental protection missions.

Restructuring

In spite of these developments, Germany is expected to decrease its active forces from the current 450,000 to 370,000 by 1995. This reduction will be accomplished through generous early retirement programs and decreased recruitment of personnel strength levels. No change is expected in the conscription laws that require all able-bodied males to serve in the military for a minimum of 12 months.

The restructured Bundeswehr will consist of three corps: North, South, and East. Of the 370,000 troops, 257,800 will be Army; 83,200 will be Air Force; and 29,000 will be Navy. The Pioniere (Corps of Engineers) will constitute roughly 7 percent, or 17,850 troops.

Engineer units will be concentrated at two levels. Independent engineer companies will support maneuver brigades; other engineer assets will combine to form engineer brigades that operate at the division or military district command levels. Each brigade will consist of one active and one reserve combat engineer battalion, one active and one reserve bridging battalion, and one active and one reserve NBC battalion.

Countermobility, mobility, and survivability will remain the principal missions of the engineers. Minefield emplacement, minefield breaching, and river and gap crossing operations will continue to be the most important tasks. General engineering, however, will be broadened to encompass survivability, disaster relief, environmental protection, and nature preservation missions. Airmobile operations will gain in importance and will include the continued development of air-transportable bridging equipment, folding trackway, engineer construction equipment, and modern mine-delivery systems.

Despite a smaller force and continued defense cuts, Bundeswehr engineers will be equipped with the modern tools needed to successfully complete missions. These tools include mineclearing, bridging, and mobility equipment.

Mine-clearing equipment. The Keiler is the most modern mine-clearing tank in the German inventory. Consisting of a two-man crew carrier vehicle and the



Dornier Foldable Bridge

clearing device, the Keiler can remove all currently known types of mines, including surface-laid and buried mines and those equipped with high-tech fuzes. It is very effective in breaching minefields. Using flails on a rotating drum, the Keiler can create a lane 4.7 meters wide and 0.25 meter deep. The revolving elements fling mines sideways out of the vehicle's path. The device is highly resistant to wear, and flails can be replaced when damaged.

Bridging equipment. State-of-the-art bridging equipment will be integral to the newly restructured engineer brigades. The M3 amphibious, fast-floating bridge system will be procured from Great Britain beginning in 1995. The M3 can construct a bridge up to 100 meters long, carry vehicles up to military load class (MLC) 70, and operate in currents up to 3.5 meters per second. The Dornier Foldable Bridge, a heavy assault bridge with a maximum span of 40 meters, can carry an MLC 70. Five men can construct the bridge in one hour.

Mobility equipment. The folding trackway (Faltstrassengeraet) and the Badger Engineer Tank II (Pionierpanzer II Dachs) will substantially improve mobility operations in the restructured engineer brigades. The Faltstrassengeraet rapidly provides trafficability on poor terrain, and the Pionierpanzer II Dachs is used to prepare river accesses and exits.

Looking Forward

While the U.S. government is reducing its force structure and closing several bases overseas, there is no plan yet to reduce U.S. forces below the 65,000 proposed for Europe. German politicians do not want a radical reduction in U.S. troop strength below that already planned in Germany. While base closures cause unemployment in affected German communities, the primary reason for a continued U.S. presence is the desire to preserve the NATO alliance.

The friendship that exists between the U.S. and Germany must continue. For more than 40 years, U.S. Army and Bundeswehr troops have trained side by side, fostering friendships and exchanges on individual and unit levels. Programs such as sporting events, school exchanges, and German-American clubs promote open communication and understanding.

The Bundeswehr is restructuring its current force to meet future challenges. The diverse events shaping European history today will define the future German force structure and ultimately affect the shape of the NATO force and the U.S. presence in Europe.

Lieutenant Colonel Hocke serves as German Foreign liaison officer to the U.S. Army Engineer School and Center, Fort Leonard Wood, Missouri. He previously served as commander of the German 61st Engineer Battalion, 6th Armored Infantry Division. Other assignments include staff officer engineer and senior combat engineer officer, Headquarters Allied Forces Central Europe, and executive officer for the 850th Pipeline Engineer Battalion in Zweibruecken. He is a graduate of the German General Staff Officers Course at the Federal Armed Forces Command and General Staff College, in Hamburg.

Second Lieutenant Nelson currently serves as a close combat platoon leader with the 2nd Infantry Division, Korea. He is a graduate of EOBC, airborne, and air assault schools. He holds a bachelor of science degree from the University of Florida and has recently returned from a year in Germany as a Federal Chancellor Scholar.



Terrain Intelligence and Battlefield Success:

A Historical Perspective

By Major William J. Bayles

Today, as in the past, terrain intelligence and obstacle data are critical to the success of any maneuver commander. Army professional journals frequently print graphic descriptions of National Training Center battles in which attackers are disrupted and subsequently destroyed in minefields that they failed to locate—until too late. During World War II, commanders learned many such lessons, at greater cost. This article describes successful and unsuccessful missions that illustrate the relationship of terrain intelligence to battlefield success.

The Second Battle of Schmidt

The Second Battle of Schmidt demonstrates a costly failure of terrain intelligence. On November 2, 1944, the 28th Infantry Division launched an attack toward Schmidt, Germany, to seize its road junction and gain maneuver space and additional supply routes for future operations. The attack drove the Allies closer to one of several large and operationally important dams on the Roer River.[1] The plan of attack called for elements of the 112th Infantry Regiment to secure the village of Schmidt, with supporting armored forces following to blunt the edge of any German armored counterattacks. Thus, the division's success depended on getting armored vehicles to Schmidt.

The V Corps commander assigned General Norman D. Cota's 28th Infantry Division to this important objective and allocated many assets to support the attack. A towed antitank battalion added fires to the tank battalion and tank destroyer battalion that were normally attached to the division. The bulk of V Corps' artillery and the entire 1171st Engineer Combat Group supported the division in this operation.

The "Keystone Division," named to reflect its Pennsylvania National Guard origins, needed all the help it could get. In addition to fighting a resolute enemy, it had to contend with very difficult weather and abominable terrain. The weather was wet and cold, though temperatures generally remained above freezing in early November. Constant rains soaked the ground, and roads quickly

became quagmires under almost any traffic. The clouds and low ceilings associated with the rain grounded the U.S. aircraft charged with isolating the Schmidt battlefield from German reserves.[2]

The terrain was perhaps more hostile than the weather because the steep-sided valley of the Kall River was between the 28th Division and the objective. This gorge was more than 1,000 meters wide and about 150 meters deep. The sides were thickly forested, and only one cart track offered potential for armored or supply vehicles to cross. Charles MacDonald, author of two official histories of this attack, assessed the situation: "General Cota could only hope that the cart track across the Kall, which had to serve as a main supply route, would prove negotiable: on aerial photographs, parts of the track did not show up."[3]

Although the trail and the bridge across the Kall River were vital to the operation's success, the 28th did little to ascertain their condition. The 28th relieved the 9th Division on October 26 and planned to attack on October 31. They later postponed this attack until November 2, which allowed time for intelligence collection. The 1171st Group tasked the 20th Engineer Battalion to provide three reconnaissance teams. The 3rd Battalion, 112th Infantry, had an experienced patrol led by the S-2, 1LT Greene; they were known as the "Greene Hornets."

Though assets for reconnaissance were available, little patrolling occurred because of the enemy's presence and the forbidding terrain.[4] After the attacking infantry passed through the gorge on November 3, sketchy and incorrect information about the condition of the trail and bridge was passed back to decision makers. As the 3rd Battalion dislodged German defenders from Schmidt, the Greene Hornets guarded the battalion's flank north of the gorge and never traversed the treacherous trail.



Kall Trail supply route between Vossnack and Kommersheidt on the Vossnack side of the gorge. Thrown tank tracks litter the trail.

Because conditions in the gorge were unknown to the leaders who could focus the engineer effort, the trail remained a bottleneck throughout the operation. The 20th Engineer Battalion's primary mission was to clear the trail, and Companies A and B were assigned this task. Although mobility efforts on the trail started after nightfall on November 3, only three engineer platoons worked on it during the night. These soldiers worked with hand tools until a bulldozer arrived in the middle of the night. The dozer broke down after working for about an hour. The 20th Engineers employed no other assets until after noon on November 4, when General Cota personally ordered the 1171st Group commander to send "a competent officer" to take charge of the trail-clearing operation.[5]

The engineer effort at the gorge was clearly too little and too late to relieve the bottleneck. Three small tracked vehicles, called weasels, carried supplies to Schmidt during the night on November 3, and three tanks traversed the gorge with great difficulty the morning of November 4.

This support was also too little and too late because the Germans counterattacked that morning. Their tank and infantry forces drove the Americans out of Schmidt, although the battle continued for several more days. Some additional vehicles traversed the difficult Kall Gorge,



The M29 cargo carrier (weasel) was the first vehicle to traverse the Kall Gorge and support the 28th Division's attack.

but the 20th Engineers never made it an acceptable supply and reinforcement route. Disabled tanks from the first abortive attempts to force the passage blocked the trail.

Had General Cota been provided accurate information concerning conditions in the Kall Gorge, he could have devised a plan to overcome the obstacle. The most crucial engineer asset at his disposal was a command structure to oversee mobility efforts on the trail and ensure that resources were prepared to work as soon as the area was secured. However, the absence of terrain intelligence hobbled General Cota's operation from the beginning. As a result, the Kall Gorge cost the Keystone Division success at Schmidt.

Operation Flashpoint

U.S. Army planning for Rhine River crossings in the spring of 1945 reflected costly experiences such as the Battle of Schmidt. In contrast to the 28th Infantry Division's operation, the 79th Infantry Division conducted extensive reconnaissance before Operation Flashpoint—the crossing of the Rhine.

"During the actual assault...divisional engineers crossed in the first wave and reconnoitered routes of advance and minefields."

Extensive terrain reconnaissance was a vital part of the preparation for Operation Flashpoint. During planning stages, the corps engineer merged the S-2 sections of the supporting 1148th and 1153rd Engineer Combat Groups. These staff sections coordinated an intelligence collection effort and performed their own reconnaissance to determine detailed information about the crossing area and the river. They determined soil trafficability and located potential bridging, rafting, and assault sites. All sites were further reconnoitered by infantry commanders accompanied by engineer leaders down to the platoon level. During the actual assault operation on March 24, divisional engineers crossed in the first wave and reconnoitered routes of advance and minefields. They found weak spots in the German obstacles on the far shore.

Operation Flashpoint was a walkover because there was little enemy resistance. However, extensive terrain intelligence enabled the 79th to accomplish

detailed planning and rehearsals vital to heavily opposed crossings.[6]

Other Campaigns

Combat engineers in the European and Mediterranean Theaters of World War II frequently conducted terrain reconnaissance and evaluation missions. In some cases, engineers augmented maneuver forces during reconnaissance operations. In the final analysis, even though "There was initially a marked reluctance to permit engineers to collect their own intelligence and put it in a form suitable for use by engineers,"[7] engineers did contribute to intelligence collection efforts throughout the European Campaign.

During World War II, the U.S. Army organized and equipped the combat engineer battalions much like today's wheeled corps combat battalions. The nondivisional combat battalion was identical to its counterpart in the infantry division. These units had organic reconnaissance sections,[8] as did the armored engineer battalions in armored divisions.[9]

The headquarters and headquarters company of the engineer combat group also had a reconnaissance section. Doctrine charged the group S2 to be a combined collection planner, intelligence agency, and liaison with division G2s.[10]

Just as the organizational structure provided for the reconnaissance mission, doctrine and training heavily favored engineer reconnaissance. Every mission outlined for combat engineers in FM 5-6, *Engineer Field Manual: Operations of Engineer Field Units,* placed reconnaissance as the first step. This manual devoted an entire chapter to reconnaissance, outlined sources of terrain information, and defined engineer reconnaissance as "searching for engineer information regarding topography, resources, and enemy installations and activities affecting engineer operations."[11] FM 5-5, *Engineer Field Manual: Engineer Troops,* indicated that engineer headquarters' S2s at all echelons were responsible for the collection plan, gathering and evaluating engineer information, and supervising reconnaissance training.[12] Outside the engineer community's doctrine, combat engineers were clearly expected to make a contribution, as indicated by FM 100-5, *Field Service Regulations: Operations:* "Small engineer groups should constitute a portion of ground reconnaissance units to obtain and report information concerning routes of communication and movement, demolitions, land mines, and obstructions."[13]

The Cost

History shows that combat engineers were organized, trained, and employed for reconnaissance during World War II. The efforts of the engineer S-2s were sometimes duplicated by their maneuver counterparts or information was not shared soon enough, but the system established by doctrine produced the necessary information most of the time. Nevertheless, the European Campaign provided an example of the tragic cost of inadequate terrain intelligence—the Battle of Schmidt.

Major Bayles serves as XO, 1st Armored Division Engineer Brigade, Bad Kreuznach, Germany. Previous positions include commander of the 84th Engineer Company. He is a graduate of the Command and General Staff College and of the the School of Advanced Military Studies and holds master's degrees from Rensselaer Polytechnic Institute. He is a registered professional engineer in New Hampshire.

Endnotes

[1]MacDonald, Charles B., and Mathews, Sidney T., *Three Battles: Arnaville, Altuzzo, and Schmidt,* Center for Military History, Washington, D.C., 1952, p. 251.

[2]MacDonald, Charles B., *The Siegfried Line Campaign,* Washington, D.C., Center for Military History, 1984, p. 345.

[3]Ibid.

[4]MacDonald. *Three Battles...* p. 255.

[5]Ibid. p. 313.

[6]*Rhine Crossing by the 79th Division,* 24 March 1945, Headquarters, 79th Infantry Division.

[7]Final Report of the Chief Engineer, European Theater of Operations. 1942-45., Headquarters, European Theater, p. 90.

[8]FM 5-5, *Engineer Field Manual: Engineer Troops,* Washington, D.C., War Department, 11 October 1943, p. 53-54.

[9]Forty, George, U.S. Army Handbook, 1939-1945, 1979: Charles Scribner's Sons, p. 64.

[10]FM 5-5, p. 4.

[11] FM 5-6, *Engineer Field Manual: Operations of Engineer Field Units,* Washington, D.C., War Department, 23 April 1943, p. 25.

[12]FM 5-5, p. 13.

[13]FM 100-5, *Field Service Regulations: Operations,* Washington, D.C., War Department, 15 June 1944, p. 52.

U.S. Army Engineer School

Directorate of Training

Organization/Title	Name	Symbol	Phone No. (314) 563-xxxx DSN 676-xxxx
Director	COL Flowers	ATSE-T	-6330
Technical Director	Mr. Holtz		-6295
Program Management Division	LTC Ilams	ATSE-T-PD	-7727
Senior Program Manager	Mr. Lubina		-7726
Operations	Mr. Lastrapes	-O	-7332
Program/Doctrine Management	Mr. Fitez	-PM	-7759
Product Integration	MAJ Aldridge	-PI	-7742
Collective Training	Mr. Toy	-CT	-7821
Publications	Mr. Woodbury	-P	-7536
Engineer Bulletin	Ms. Eubanks	-EB	-7535
New Systems Training	Mr. Marr	-NES	-7807
Reserve Training Office	Mr. Warrick	-RT	-7545
Training Support Division	MAJ Freeman	ATSE-T-TS	-7634
Staff & Faculty Branch	Mr. Grzyb		-7316
Academic Library	Mr. Novy	-AL	-7986
Special Facilities	Mr. Thomas	-F	-7656
Department of Tactics & Leadership	LTC Wetherell	ATSE-T-TL	-5683
Technical Director	Mr. Dunstedter		-5683
Tactics Division	MAJ Burns	-T	-5729
Marine Corps LO	LTC Drury	-A	-5461
Air Force LO	LTC Kunzli	-L	-5195
EOAC Division	MAJ McCall	-TD	-5742
Leadership & Environmental Branch	MAJ Neeley		-5657
Training Development	CPT Cromby		-5649
Department of Construction Engineering	LTC Boothe	ATSE-T-CTE	-7456
Technical Director	Ms. Welch		-7797
Vertical Skills Division	CPT Goetz	-VS	-5440
Maintenance Division	MAJ Page	-MT	-7784
Horizontal Skills Division	CPT Kuehl	-HS	-7787
Training Development	Mr. Tapp	-TD	-7505
Department of Combat Engineering	MAJ Jones	ATSE-T-CE	-5800
Technical Director	Mr. Jackson		-5501
Combat Engineering Division	MAJ Jones		-5803
Bridging Division	CPT Carey	-B	-5521
CEV Division	CPT Hauert	-V	-5810
Training Development	vacant	-T	-6214

ENGINEER UPDATE

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

Directorate of Training (DOT)

Directorate Consolidation. The Directorate of Training (DOT) was established on June 4, 1993 at the Engineer School. Combining teaching, writing, and doctrine development in a synergistic relationship, the DOT is responsible for all training development functions and engineer training, from AIT through the Pre-Command Course. Included in the new organization are the former Deputy Assistant Commandant office, Directorate of Training and Doctrine, Department of Instruction, and some functions previously managed by the 1st and 3rd Brigades. A partial directory and phone list appears on page 54. POC is Cynthia Mathews, -6343.

Field Manual (FM) 5-71-100 Distributed. FM 5-71-100, *Division Engineer Combat Operations,* was distributed in April. It describes the principles, engineer tactics, techniques and procedures used to guide the conduct of engineer operations that support the division. POC is Joe Sillyman, -7532.

Change 1 to FM 90-13-1 Published. Change 1, dated 7 May 1993, adds two appendices to FM 90-13-1: Appendix D, *Breaching Rehearsals,* and Appendix E, *Breach Lane Marking.* FM 90-13-1 is bound with staples; to update it, remove the old pages and insert the pages in Change 1. POC is Joe Sillyman, -7532.

Directorate of Combat Developments (DCD)

Mine Clearing Line Charge (MICLIC) Update. As of 16 July 1993, the MICLIC launcher and trainer are reportable as a system on unit status reports. A future edition of AR 700-138, *Army Logistics Readiness and Sustainability,* will reflect this change.

Three recent system improvements have increased the reliability of the Army's MICLIC: installation of an arming wire weave, correction of slack in the detonating cord between the fuse connector and the first block of C4, and correction in the orientation of the rocket motor receptacles with the arming wire weave.

NOTE: Prior to acceptance, units must check the NSN and ammunition code of rockets and line charges. The Army's assets of line charges are M58A4/5, NSN 1375-01-237-5933/1375-01-302-0527, ammunition code M913. The Army only has MK22 MOD4 rockets, NSN 1340-01-118-2838, ammunition code J143. The Marine Corps still has line charges without the system improvements (described above) and MOD3 rockets. Some Army units have been issued Marine Corps assets (line charges without modifications and MOD3 rockets); these should be returned to the appropriate supply activity. POC is CPT LeRoy Maurer, -7347.

Armored Vehicle Launched MICLIC (AVLM). The current AVLM is not an Army fielded system, and it should not be used in peace time. Tactical Army Command (TACOM) has agreed to design, build, and test a prototype mounting bracket for an AVLM system. The Engineer School's goal is to field a standardized, safe, and tested mounting bracket in the near future. POC is CPT LeRoy Maurer, -7347.

Directorate of Evaluation and Standardization (DOES)

Essential Library Publications for Disaster Relief. Because any engineer unit may find itself responding to a humanitarian assistance mission or deployed for disaster relief, all units must maintain and deploy with a select library of essential construction management and planning references. This applies to all combat, combat heavy, and corps combat battalions, and to all construction support and combat support equipment companies. We recommend (at a minimum) the following publications:

- TM 300-series AFCS Manuals (in the battalion S-3 or company headquarters)
- FM 5-233, *Construction Surveying*
- FM 5-333, *Construction Management*
- FM 5-420, *Plumbing/Pipefitting for Water Supply/Distribution Systems*
- FM 5-421, *Sewerage*
- FM 5-424, *Interior Wiring*
- FM 5-480 *Port Construction and Repair*
- FM 5-551, *Carpentry*
- FM 5-742, *Concrete*
- TC 5-340, *Air Base Damage Repair (Pavement Repair)*
- *National Electrical Code* (commercial)
- McMaster/Carr Industrial Supply Catalogue (commercial)
- W.W. Granger Industrial Supply Catalogue (commercial)
- *The Lineman's & Cableman's Handbook,* Kurtz and Shoemaker, 7th edition, McGraw-Hill Book Co., ISBN 0-07 035686-6 (commercial)

POC is Vern Lowrey, -5304.

Engineer Branch Safety Office (EBSO)

Truck/semitrailer Accidents. Two soldiers were killed recently in an accident involving an M920 truck tractor and an M870, 40-ton lowbed semitrailer. After the accident investigation, TACOM issued three Safety of Use Messages (SOUM). SOUM 93-03 and 93-08 provide procedures for recurring brake adjustments for the M870 and M870A1 40-ton lowbed semitrailers. SOUM 93-06 describes a modification work order (MWO) for an auxiliary air tank on the M915-series of vehicles. Engineer units must have these SOUMS and comply with their instructions. POC is Paul Rusinko, -5008.

News and Notes

1992-93 Military History Writing Contest. Students attending officer advanced courses and the Sergeants Major Academy during calendar years 1992 and 1993 are encouraged to enter the Military History Writing Contest. Sponsored by the U.S. Army Center of Military History, the contest is designed to improve communication skills and enhance knowledge of the profession of arms. Winners receive cash awards and DA certificates of achievement. Manuscripts must be unpublished, with a maximum length of 3,500 words, and must be postmarked by midnight 31 December 1993. For contest rules and more information, call Billy Arthur, at (202) 504-5368, DSN 285-5368.



BRIDGE THE GAP

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

Just completed 33 days of temporary duty at Fort Benjamin Harrison, as a voting member for the Master Sergeants' Board. I was assigned to a panel made up of one colonel (armor), one lieutenant colonel (engineer), and three command sergeants major. I now realize that many noncommissioned officers (NCOs) need to update their personnel qualification records (PQRs) if they wish to remain competitive for future training and promotions. Let me expand on what I learned.

Our panel was given 10 days to vote 2000 files of armor and engineer sergeants first class, in the primary and secondary zones, to the rank of master sergeant. We spent an average of 8 minutes on each file; less time was used for those records that clearly were in great shape.

Records. The short review time means that PQRs must be clear, concise, and above all, up-to-date. Commanders and command sergeants major must establish a system to ensure that all soldiers eligible for promotion review their files. Commands are notified 120 days before the board convenes, and they are given two suspenses for submitting PQR, and current DA photographs to the Enlisted Records Evaluation Command, at Fort Benjamin Harrison.

The first record I voted had critical flaws. The DA photo, taken in 1980, showed the rank of staff sergeant on the uniform. The soldier had not signed the DA Forms 2A or 2-1 (PQR), and the latest duty assignment did not match the assignment on the forms. The file contained a one-half inch thick packet that had been mailed to the board. It was unnecessary because most of the documents in it were posted on the individual's microfiche and/or the DA Form 2-1. Incredibly, it did not contain an updated photo. The mailing of this packet indicated that the individual's microfiche had not been reviewed at the duty station. Needless to say, that soldier was not highly competitive!

NCOERs. Overall, many of the principal duty titles I reviewed did not match the duty MOS, Parts III(A) and (B). For example, Part III(A) might show, combat construction foreman and Part III(B) incorrectly show 12B40 instead of 12Z50.

Senior raters' comments (Parts V, C and E) weigh heavily in the selection process. These comments must focus on an individual's potential and make concrete recommendations for promotion, schooling, and the likelihood of future success. Senior raters who do not perform this task adequately may hinder their soldiers' promotions.

Training and Education. I am pleased that all NCOs had completed the Advanced Noncommissioned Officer Course, and most serving in first sergeant positions had attended the first sergeants' course. Commanders must also ensure that soldiers serving in operations or intelligence staff positions have attended the battle staff course. Files I reviewed indicated some NCOs lacked this training.

Many records showed little correlation between training and subsequent duty assignments. Some NCOs are in positions without prerequisite training, and some who received training are not in positions to utilize it. This creates a perception of "ticket punching," which we must change. We also must emphasize the need for self-development (college) courses. Some good files I reviewed were marred by a lack of civilian education beyond a high school diploma or general education development (GED).

Utilization and Assignments. The most competitive individuals had a healthy mix of TOE and TDA assignments. CMF 12 soldiers exhibited an excellent pattern of rotating through key duty assignments—their files documented considerable time in challenging assignments.

Secondary Zone NCOs. Interestingly, I felt this group of NCOs were as qualified as and had a higher civilian education level than those in the primary zone. However, platoon sergeant time was critical; NCOs need 18 months or more to be competitive.

Bottom Line. The most competitive NCOs had a good mix of challenging leadership assignments, good performance in those assignments, and they exceeded standards for military and civilian education. To be a leader in tomorrow's Army, you must seek the tough jobs, do well, and actively pursue educational opportunities.

Army leaders are responsible for their soldiers' development; they are the future. Leaders and subordinates must use two documents published by the Engineer School: a "Career Professional Development Program" and "NCO Leader Self-development Career Maps" (updated career maps are on pages 40-41). These tools are in the system to promote growth and professionalism. Let's use them.

DEPARTMENT OF THE ARMY

ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN: ATSE-T-PD-EB
FORT LEONARD WOOD, MO 65473-6650

USPS 522-390
OFFICIAL BUSINESS

Automated Integrated Survey Instrument (AISI)

Features:

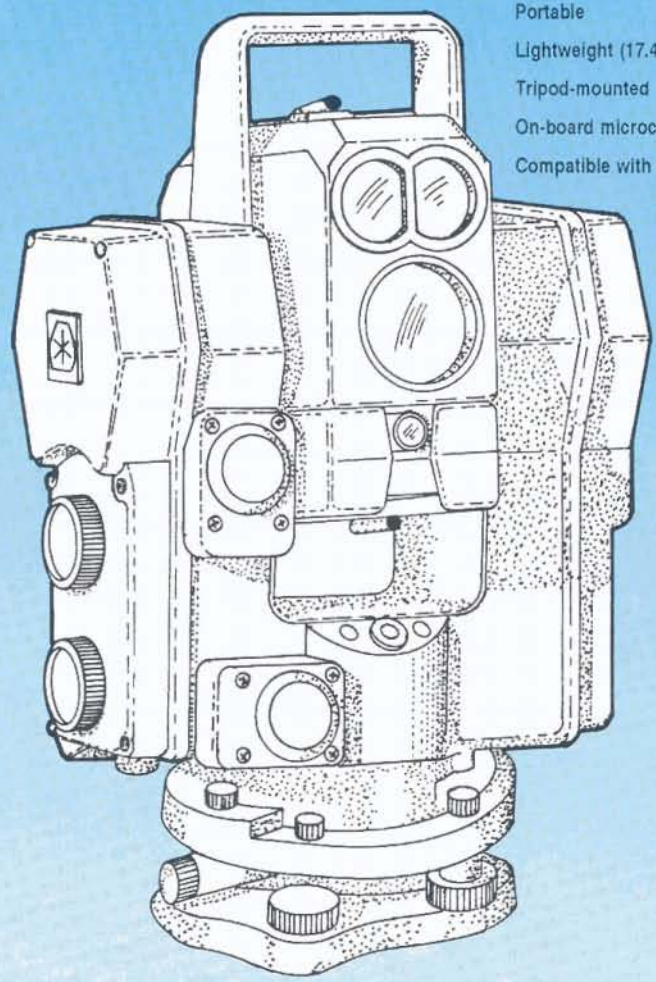
Portable

Lightweight (17.4 pounds)

Tripod-mounted

On-board microcomputer

Compatible with other microprocessors



The Army's construction and topographic surveyors will move into the future with the automated integrated survey instrument (AISI), a state-of-the-art infrared/optical-sensing survey instrument. An electronic total station, the AISI integrates functions accomplished by standard theodolites and electronic distance-measuring equipment into a single device. It provides commanders with timely survey support for weapons systems, communications, intelligence gathering, and command and control activities.

PIN: 071-184-000