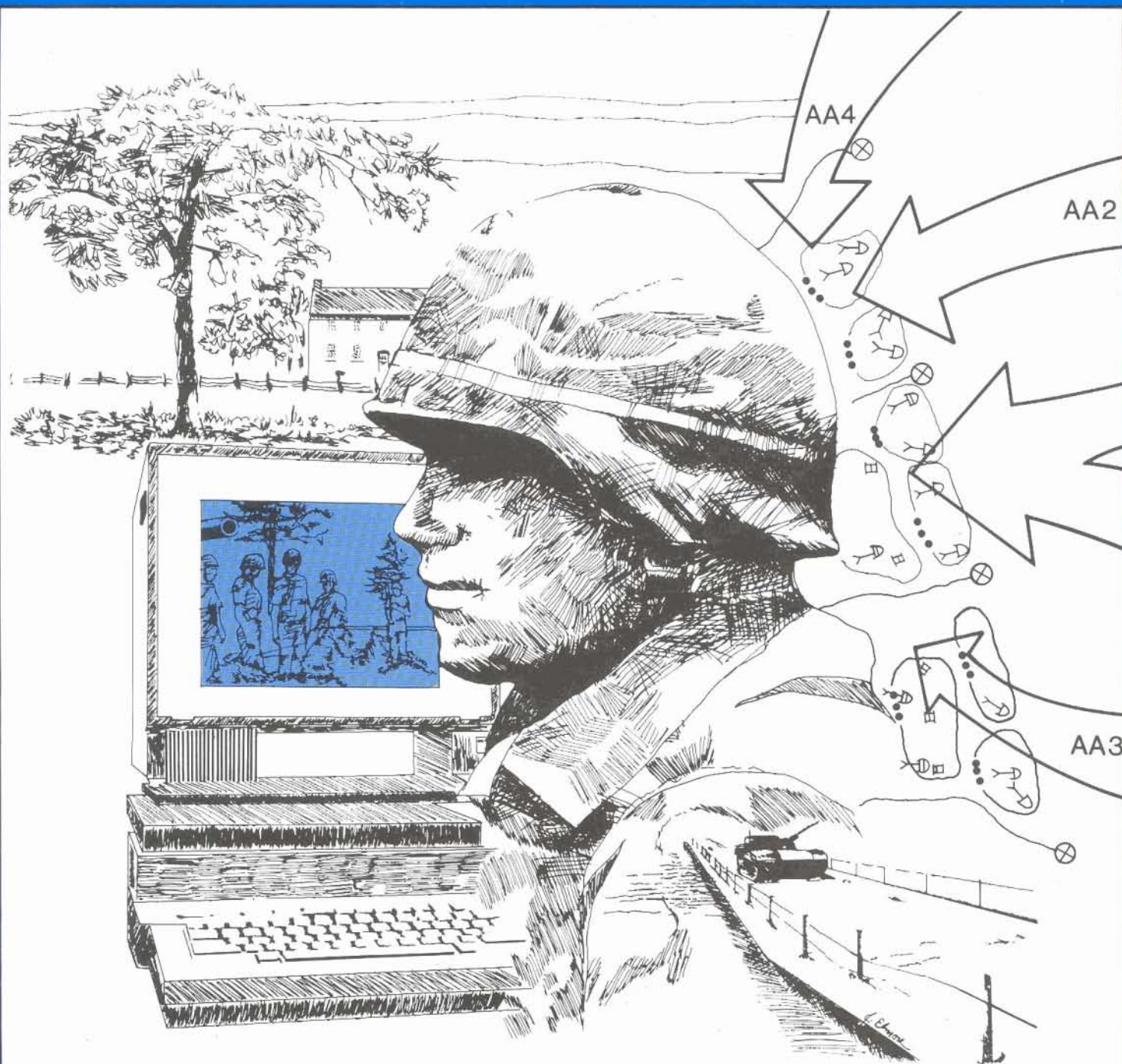


Engineer

THE MAGAZINE FOR ARMY ENGINEERS

SUMMER 1986



NEW HORIZONS AND LESSONS LEARNED

SCHOOL MOVE RIVER CROSSING LATIN AMERICA
TRAINING AUTOMATION AIRFIELD DAMAGE REPAIR

Military Engineering—Art or Science?

A Personal Viewpoint

by MAJ David J. Block and MAJ Gary W. Baumert

If every situation in combat is unique, so is the mind each engineer brings to battle. Doctrine provides the intellectual framework we use to think about military operations. However, having mastered the tenets, we are tempted to lockstep into schoolbook solutions—to become obsessed with the recipe rather than the result. As engineer officers, we can add flexibility and muscle to Army doctrine by applying personal judgment to the professional knowledge we bring to the battlefield.

In AirLand Battle, the fog of battle demands initiative. Time will rarely be on our side. We must free ourselves from thinking that we can lay perfect minefields . . . that we can solve problems by applying alluring formulas and tidy rules . . . that we will have sufficient resources on hand to do everything by the book. We must free ourselves to dream . . . to postulate "What if?" . . . to practice engineering as an art as well as a science.

For example, imagine your engineer company is supporting a forward infantry battalion defending against a Soviet motorized rifle regiment. Your warning order says that a major Soviet thrust is expected in four hours. The battalion is defending the brigade's critical left flank. Your sector is a 1,500-meter frontage with gently rolling hills. Two hard-surface roads divide the battalion into three distinct areas. There are no natural obstacles. This is not a location the battalion would choose to defend. But it is integral to the brigade and division defense strategy and must be held.

The battalion commander says he needs three minefields straddling the two roads that delay and channelize the enemy, but preserve the roads for counteroffensive. Brigade has allocated 900 M75 mines for use with your GEMSS dispenser to sup-

port the battalion. Additional mines cannot be resupplied before the attack. RAAMS and Volcano may become available following the attack.

This is the type of desperate situation where the military's greatest asset is our personal ability to apply imagination and ingenuity to doctrine and engineering practice.

Applying emplacement principles for GEMSS-delivered minefields (detailed in FM 20-32), you have resources for only two three-belt, .005 density minefields—not the three requested by the battalion commander. How do you accomplish the mission with the assets at hand?

The engineer reconnaissance team reports that all three areas must be mined for the defense to hold. Your options are shaped by enemy tactics, terrain, and time available. In this case you might consider—

- Varying the linear density across the front, keeping the same depth, and emplacing two belts instead of three.
- Laying two lower-density minefields and one standard minefield.
- Varying the linear density across the front by emplacing two belts instead of three, and varying the depth of the minefield.

Despite the shortage of mines, you see an opportunity to outwit the enemy by using the third option. You can cover the frontage with three two-belt minefields, but space the two belts so that the threat is forced to deploy and regroup. A sample solution in FM 20-32 recommends gaps of 50 to 100 meters between belts. You know the Soviets' minefield-breaching technique is basically to use rollers and plows to clear a lane 400 meters long, based on the premise that a U.S. minefield is generally 300 meters deep.

Since the threat expects to breach 400 meters and clear the minefield, a

second belt placed at least 400 meters behind the first could deceive him.

Theoretically, he will hit the first belt, breach 400 meters, think he has cleared the minefield, and resume the attack formation. He then encounters the second belt. His options are to bull through with direct tank losses to mines or resume clearing with prolonged exposure.

This option deviates from FM 20-32's guidelines on spacing belts, but preserves the intent of the minefield to delay, disrupt and channelize the enemy forces, making the threat more vulnerable to fire.

You brief the commander on the potential benefits and cost:

"Sir, I propose we lay three minefields with two standard-density belts instead of three. The two belts will provide uniform protection across the entire front. By preserving the density, the probability for an initial hit is the same as for a three-belt minefield. Fewer total mines means fewer tank losses to the minefield if the threat bulls through. However, we increase the delay factor and disrupt the momentum of the attack—regardless of whether he breaches or bulls—by spacing the belts so we create the effect of a second minefield."

Any example is necessarily general and oversimplified. But the point remains. Every engineer leader is challenged by the specific requirements of the mission and tactical situation to imaginatively apply, bend and mold the formulas and rules. In order to exploit opportunities to fix the enemy or turn disadvantage to advantage, we must be well-grounded in the concepts of AirLand Battle and masters of engineering science, techniques, tactics, and procedures. But as we

(continued on page 48)

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On the Cover

Simulation and automation are revolutionizing the Engineers' approach to training.

Art: Jeanne Elmore

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CLEAR THE WAY

by MG Richard S. Kem, Commandant, U.S. Army Engineer School

Engineers on the Battlefield

When training is sanitized, combat engineers suffer.

Too often, the way we train the combined arms team emphasizes the obvious. Training constraints—budget, environment, maneuver damage—eliminate terrain obstacles, friction and battlefield reality. The *dirty* battlefield is sanitized, and realism suffers.

Too often, the victim of that cleansing is the combat engineer. The importance of his battlefield role and contribution to the combined arms team is lost when *white tape* substitutes for obstacles... when units are pressed to continue maneuver—despite obstacles—to meet exercise timetables... when demolitions and digging are not allowed.

Map exercises and modeling that obviate the vertical dimensions of terrain or see the battlefield in 2.5-kilometer spatial increments also diminish the complexities of maneuver and hence the engineers' value to the team. While warfight models recognize the benefits of obstacles and survivability positions, they don't actively play the engineer effort. They generally assume the engineers can do the job—that the obstacles are in place and the maneuver forces are dug in. The magnitude of the engineer effort required to provide responsive support—C², manpower, time, materials—is overlooked.

Mobility, countermobility and survivability missions are easily downplayed when these factors have no assigned win-lose value. In this context, the misunderstandings of our maneuver commanders at company team, battalion task force and brigade are understandable. Unfortunately, such misunderstandings could prove critical—if not fatal—in future conflict.

For example, our AirLand Battle doctrine with its tenets of initiative, depth, agility and synchronization depends upon our ability to maneuver and sustain that maneuver as we take advantage of battlefield *windows of opportunity*. But windows of opportunity easily become *windows of vulnerability* if our maneuver commanders don't

fully appreciate battlefield reality, the effects of terrain, or the threat's ability to deny us maneuver.

The National Training Center—in that desert environment—provides the most realistic training battlefield yet... one that focuses Army interest on our combined arms ability to fight. With environmental constraints removed, the battlefield is not sanitized of factors that contribute to friction, delays and failures. Success depends on how well the commander synchronizes all elements of his force.

The realism is such that, in the words of the former FORSCOM Commander, GEN Robert Sennewald: "The Army has rediscovered the importance of the combat engineer to combined arms battlefield success."

Even as we understand the reality of NTC and the outstanding opportunity it provides for combined arms training, we must all understand its limitations:

- The desert environment does not approximate the terrain of Germany where forests, built-up areas, defiles, rivers, and streams hinder movement and change the ways engineers contribute to battle.
- The NTC in essence trains at armor and mechanized infantry task force level. Brigade headquarters are exercised in C² of two subordinate task forces, but it is the armor or mechanized task force that is fully challenged by the factors of METT-T, particularly enemy and terrain.
- Brigades continue to take augmented engineer rotation packages to NTC.

Because of these limitations, the challenge and complexity of providing comprehensive engineer support to larger maneuver units is not well understood. Since the engineers' ability to support larger forces—division and corps—is seldom practiced, there is considerable underestimation and misunderstanding of the limitations upon current engineer organizations in providing responsive support throughout all levels of the force.

The challenge to corps, division and brigade engineers is to work with their maneuver commanders to create field training exercises that



by CSM Matthew Lee Jr., U.S. Army Engineer School

Are You Ready for the First Battle?

If you are challenged to win the first battle tomorrow, do your soldiers believe you will see them through? Have you convinced your subordinates in the garrison and in the field that they should trust their lives to your leadership?

While engineer NCOs are making substantial contributions to readiness, we can do more . . . more to be technically and tactically proficient in our minds and professional in our hearts.

To be all you can be, the basics of soldiering must be a sixth sense—something that comes instinctively. When the APC breaks down, what will you do? You are on your own. Do you know without a doubt in your mind how you will accomplish the mission?

When that private says, "What do we do, Sergeant?" his life is riding on your answer.

Can you assemble and disassemble your weapon in your sleep? . . . Clean and repair it in a heartbeat? Are you ready to use a map and compass? Can you dig a foxhole correctly without hesitation? Are you fit, today, to endure a 15-mile forced march with the infantry? Forget that the Army PT minimum standard is 2 miles. Are you ready to survive? These are fundamentals that save lives.

As an engineer leader, you must be a master of all you survey—professionally proficient to teach

every aspect of your business. Teach it! That's the fundamental test. What you know well enough to teach, you *know*.

If you don't have the training, set pride aside and get it. Ask questions and refer to the manual until you've got the skills down cold—mobility, countermobility, survivability, equipment, weapons, demolitions, NBC, physical fitness.

Then spend time training your soldiers. In combat, your soldiers will do instinctively the things you demand they do right in training. See that they exceed the ARTEP and fitness standards. Those standards are minimum—the jumping off point where you begin.

The more you teach them, the more confidence they will have in themselves and in you . . . the better prepared they will be to entrust their survival to your hands.

Confidence is the key to winning. The Sapper Leader Course helps instill that warrior spirit in engineers. But not everyone gets to attend. Let's not wait for the Sapper Leader Course to be our crowning glory.

Go out and grab it . . . seize the initiative . . . create your own opportunities. Nothing short of excellence will win the first battle.

CSM Matthew Lee comes to the Engineer School from Hawaii where he was the command sergeant major for the 65th Combat Engineer Battalion, 25th Infantry Division (Light).

fully expose battle commanders and operational and logistics staffs to realistic battlefield situations.

We must also ensure that the maneuver commanders we train understand that friction, terrain, threat capabilities, and Murphy's Law—if disregarded in training or discounted in importance—will make a combined arms unit, which seemed well trained on the *clean* battlefield, ripe for exploitation in time of war.

The FTX and CPX remain the premier opportunity to experience the rigors, distance, pace and lethality of today's battlefield. Our challenge is to benefit and build on the lessons and experience gained. We must train to grow stronger—not as engineers—but as the *combined arms team*. Combined arms is the *key* to winning.



Engineer Personnel Proponency Office (EPPO)

SGA Restructure Deletes MOS 51C:

The Engineer Personnel Proponency Office has forwarded an MOS restructure plan to the Soldier Support Center, National Capital Region, to delete MOS 51C (structures specialist) from the Army's inventory.

This deletion is necessary because the onslaught of prefabricated materials eliminates the need for higher level technical expertise found in MOS 51C.

MOSs 51B (carpentry and masonry specialist) and 51K (plumber) will absorb the duties previously performed in 51C. MOS 51B will inherit the structural tasks—such as erecting prefabricated buildings—while 51K will assume the tasks of pipeline construction and metalworking. Current 51C authorized positions will be converted to MOS 51B or 51K depending on each specific mission. No authorized positions will be lost as a result of this deletion.

Personnel now holding MOS 51C will be reclassified before October 1986.

Reduced Spaces for ADM Specialists:

The Engineer Personnel Proponency Office is working with the U.S. Army Military Personnel Center to meet a force reduction in MOS 12E (ADM specialist).

A reclassification team from MILPERCEN and EPPO visited Europe and reclassified 234 of the 257 MOS 12E soldiers assigned to USAREUR. The remaining 23 soldiers were not reclassified because they had received assignment instructions for drill sergeant or recruiter, or were leaving the Army. Representatives from MILPERCEN and EPPO visited Fort Leonard Wood and Fort Hood to brief 12E soldiers on plans for their MOS.

EPPO is reviewing several proposals. A standards of grade authorization (SGA) restructure will ensure that soldiers in the specialty are competitive for promotion.

Because of the sensitive nature and unresolved problems of this issue, it is impossible to clearly project the future of engineer ADM missions or to establish milestones for the force structure.

Questions concerning MOS 12E may be addressed to: Commandant, U.S. Army Engineer School, ATTN: ATZA-EP, Fort Belvoir, VA 22060-5248. The point of contact is SFC Michael R. Mudge, (703) 664-2287, AV 354-2287.

Topographic Engineer Position Filled:

The Engineer Personnel Proponency Office recently filled the subject matter expert position for CMF 81 (topographic engineering). EPPO now has an expert for each engineer career management field. Questions, comments, or suggestions about CMF 81 can be addressed to: Commandant, U.S. Army Engineer School, ATTN: ATZA-EP, Fort Belvoir, VA 22060-5248. The point of contact is MSG Carlos Sellers, (703) 664-2287, AV 354-2287.

Department of Military Logistics (DML)

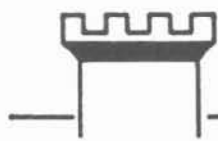
New FTX for AIT Soldiers:

The Department of Military Logistics has initiated a field training exercise for advanced individual training in MOSs 52D10 (power generation equipment repairer) and 52F10 (turbine engine driven generator repairer).

The department created a realistic FTX training site complete with administration buildings, direct fire lanes, and permanent tent pads. The FTX uses three training scenarios—a reconnaissance patrol, an aggressor attack, and a chemical attack.

Soldiers participate in the FTX during their seventh week of technical training at Fort Belvoir. MOS-specific skills learned in the classroom are integrated with basic combat survival skills throughout each FTX cycle. Each soldier is tested on 26 of the 30 common skill tasks from the SMART book. Soldiers also receive 22 hours of technical training on site.

The Department of Military Logistics continues to improve its FTX program and plans to include MOS 52C10 (utility equipment repairer) during FY 87.



Defense Mapping School (DMS)

MICROFIX V2.1 Training Package:

The Defense Mapping School will soon begin teaching MICROFIX V2.1, topographic configuration software. The Department of Topographic Sciences will use MICROFIX V2.1 to teach terrain analysts (81Q) and topographic engineers (21C) computer-assisted terrain analysis techniques.

Topographic engineers supporting the battlefield commander will use MICROFIX V2.1 to—

- Store, alter, and retrieve weather and terrain information.
- Enter current data into weather information files.
- Use DMA digital terrain elevation data (DTED) to produce line of sight plots, color-tinted elevation maps, weapons/sensor masking plots, slope maps, and three-dimensional oblique views of the terrain.
- Provide battlefield environmental effects on military operations for long- and short-term planning.

For more information, write: Director, Defense Mapping School, ATTN: TSD-AT, Fort Belvoir, VA 22060-5828. The point of contact is CPT McGregor, (703) 664-2978, AV 354-2978.

Directorate of Training and Doctrine (DOTD)

New Field Manuals:

New training and doctrine field manuals available this year include:

FM 5-335, *Drainage*—Planning, designing and constructing drainage facilities in the theater of operation.

FM 5-25, *Explosives and Demolitions*—Types and characteristics of explosives and demolition methods.

FM 20-32, *Mine/Countermining Warfare*—Planning, coordinating and executing mine/countermining operations.

FM 5-541, *Military Soils Engineering*—Evaluating soil conditions, predicting soil behavior and solving problems related to military operations.

FM 5-277, *Bailey Bridge*—Methods of assembly and maintenance, bridge components, loading and transporting, and special applications of the Bailey bridge.

These field manuals can be ordered from the U.S. Army Adjutant General Publications Center, 2800 Eastern Boulevard, Baltimore, MD 21220-2896.

Lineman's Handbook:

Do you have a 52G in your unit? These soldiers need *The Lineman's and Cableman's Handbook*, which has replaced TM 5-765. Units authorized the 52G MOS can still get one free copy.

Send the property book officer's name, Department of Defense activity access codes, and document number to: Commandant, U.S. Army Engineer School, ATTN: ATZA-TD-P-CR, Stop 291D, Fort Belvoir, VA 22060-5291.

After initial distribution, units must purchase copies from the publisher, McGraw Hill Book Company, New York.

Reserve Component Advisory Staff (RCS)

Reserve Officers Advanced Courses:

The new U.S. Armed Forces School—formerly the U.S. Army Reserve School—is going strong. However, some engineers confuse the *phases* of the Armed Forces School course with the *modules* of the Engineer School course.

- The Armed Forces course contains four two-week phases; two are available by correspondence.
- The Engineer School course contains seven two-week modules; none are available by correspondence.

You must decide which course you want to pursue and stay with it. You cannot mix the two courses. If you are enrolled in the old USAR seven-phase course, you must stay with it.

The new Armed Forces course has four phases:

Phase	Type of Course
I	Correspondence or USAFS at home station
II	Active duty on AT, ADT, FTTD (two weeks at Fort Belvoir)
III	Correspondence
IV	Active duty on AT, ADT, FTTD (two weeks at Fort Belvoir)

The Engineer School course has seven two-week modules which are all taught at Fort Belvoir.

Students must know which courses they have already taken when they report for class. Otherwise, delays result; and in some cases students are sent home because the block of instruction they need isn't being taught when they report.

For more information, call the Reserve Component advisory staff at (703) 664-4166, AV 354.

New USAR Advisor:

COL Joseph Cushieri is the new USAR advisor to the Engineer School. He comes to Fort Belvoir from the Army War College.

News & Notes

Engineers join the Army's regimental system

The Corps of Engineers officially joined the Army's regimental system at Fort Belvoir, June 23, 1986. Corps colors and crest were presented at the ceremony where the honorary colonel and honorary sergeant major of the Corps were introduced.

LTG Frederick J. Clarke, honorary colonel, and SGM Leon Van Autreve, honorary sergeant major, both retired, were chosen because of their distinguished service to the Corps of Engineers and the Army.

The first unit crests were presented to four outstanding engineers:

- SFC Dennis J. Ansay—winner of the 1986 Sturgis Award given to the Corps of Engineers top NCO—Company B, 237th Engineer Battalion.

- SFC Michael M. Balch—Drill Sergeant of the Year for Fort Leonard Wood—Company B, 2nd Battalion, 3rd Brigade.
- SSG Salvador Heridia—NCO of the Year for the Corps of Engineers—USA FESA.
- SSG Patrick Mahone—NCO of the Year for both Fort Belvoir and First Army—Company C, 11th Engineer Battalion.

All soldiers will receive the unit crest when they complete their primary engineer training.

The crest, designed by the U.S. Army Institute of Heraldry, reflects the traditions of the Corps of Engineers. Members of the Corps will wear the crest centered on the



pocket—above the name tag or any unit citations—on the Army green, blue or white uniform.

Log cribs protect post



Developed in Germany, these log cribs provide inconspicuous security against terrorists.

As worldwide terrorism increases, European military communities are caught in the dilemma of providing adequate security without restricting free movement. In Heilbronn, West Germany, the Directorate of Engineering and Housing uses residential log cribs as an innovative defense against terrorists.

Cheap, effective, and quickly produced—using 4x4s and 16d nails—these log cribs can be built in any shape. Once in position, they are filled with earth and double as planters for flowers and shrubs.

Though easy to build, these barriers are proven vehicle-stoppers and give excellent cover to soldiers on guard duty. They provide protection for potential targets like officers clubs, youth activities centers, family housing areas, and bachelor officers quarters.

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Soldiers from A Company, 307th Engineer Battalion (Airborne), practice the buddy rappel—a technique for rescuing wounded soldiers—while training at Camp Merrill, GA.

The 307th also acted as OPFOR for soldiers completing the mountain phase of ranger training.

Photo: Ruben Maestas

Fort Leonard Wood

— *room to move*



by LTC Richard L. Montgomery

Some say moving the U.S. Army Engineer School is like building a boat while being swept down a raging river. The analogy reflects the dynamics of relocating to Fort Leonard Wood by 1989.

The move realizes a long-standing dream to create a true engineer center where officers and NCOs from all engineer MOSs can train together—a campus specifically tailored to engineer requirements.

The dream is alive in the era of Gramm-Rudman-Hollings budget cuts because it makes long-term economic sense. In addition to cutting costs by consolidating training, the Corps of Engineers headquarters and other military agencies now leasing offices in Washington, D.C. will save money by moving to Fort Belvoir.

The move will generate anticipated savings of \$23 million in annual recurring costs. By this fall, Congress should decide whether to approve the first phase of a \$64 million military construction package which would allow work to begin in early FY 87.

When the Engineer School was established at Fort Belvoir in 1917, it accommodated both officers and enlisted engineers. But as demand for engineers grew, we outgrew Fort Belvoir. In 1941, most enlisted specialties transferred to Fort Leonard Wood.

Today, most engineer officers are assigned to Fort Belvoir twice in their careers—for engineer officer basic and advanced courses—while most NCOs serve repetitive tours at Fort Leonard Wood. Because few

engineer officers or NCOs are ever assigned to the other post, the possibilities for interaction are limited.

We want the synergy that comes from sharing a common campus—an advantage our armor, infantry and artillery counterparts already enjoy.

Four of our primary battlefield missions—mobility, counter-mobility, topography and survivability—focus on terrain. We need room to move. Fort Leonard Wood offers that. While engineers at Fort Belvoir have to journey 66 miles to Camp A.P. Hill for field training, Fort Leonard Wood offers 62,910 acres on post, including 19,000 acres of impact area.

When training is colocated, officers and NCOs will be able to train together on common field exercises.

For example, they might plan, layout and construct a base camp or put in a primitive (forward) airfield.

There are 300 live fire and demolitions ranges within minutes of the classroom.

A man-made lake has been created for bridge training, and there are opportunities for fast-water obstacle training on the Big Piney River.

Airfield damage can be simulated at an abandoned airfield.

There are 37 other training areas and bivouac sites, with room for expansion to accommodate modern engineer equipment systems like the M9 ACE.

To heighten realism, a mix of engineer TOE units will be stationed to Fort Leonard Wood so that skills and equipment reflect the entire spectrum of the engineer corps.

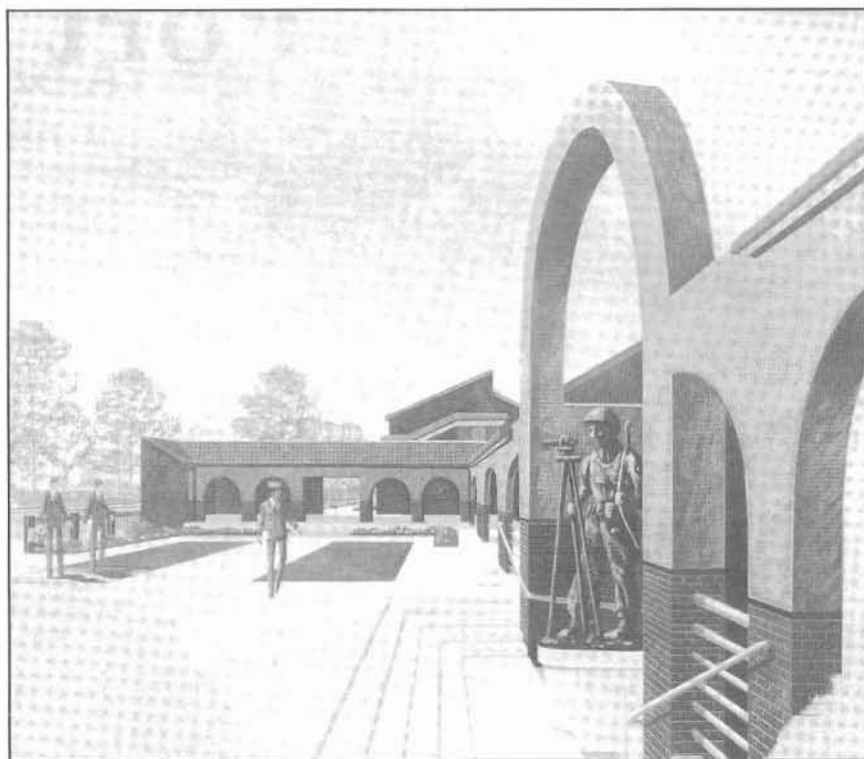
Plans for the move are being orchestrated by the Engineer Center Transition Office at Fort Leonard Wood in coordination with the Engineer School and TRADOC.

Five new facilities will be built: a headquarters, an academic facility, a training aids support center, a library, and 346 unaccompanied officers billets. To move by 1989, everything must be complete except the library and training aids support center which will open in the last half of the year.

The move should begin in early FY 89 when engineer proponency transfers to the commandant of the Engineer School at Fort Leonard Wood and the Military District of Washington takes control of Fort Belvoir.

Officer training will begin with classes in June 1989. Throughout the transition, a normal student load will be maintained—with adjusted FY 89 class dates creating a 60-day window to allow for the move.

A small contingent of the basic technical courses taught by the Defense Mapping School for MOSs 81C, 81Q, 82D, and 83F will remain at Fort Belvoir. Also, training of MOSs 52C, 52D, and 52F will come under the proponency of the Ordnance School October 1, 1987. Later, the Ordnance School will assume command and control of the 1st



At Fort Leonard Wood, officers and NCOs will be able to train together. This artist's concept shows the 346-billet unaccompanied officers quarters, one of five buildings planned. Others include a headquarters, an academic facility, a training aids support center, and a library.

Engineer Battalion, which becomes the 809th in September.

Training for lieutenants will markedly improve. They will train most often in the field—applying the combat engineering, construction and leadership techniques learned in class to tactical situations. They will be able to practice basic soldiering skills such as camouflage, dispersion and movement. Interactive computer-based training will increase opportunities for self-development. EOBC platoon trainers will be used as instructors for small group training.

NCO training groups will also be smaller—1 instructor for 12 students—and rely heavily on hands-on experience, field exercises and opportunities for leadership. ANCOC will focus on the platoon. Because 47% of all E7s serve in other positions, other primary responsibilities will also be highlighted.

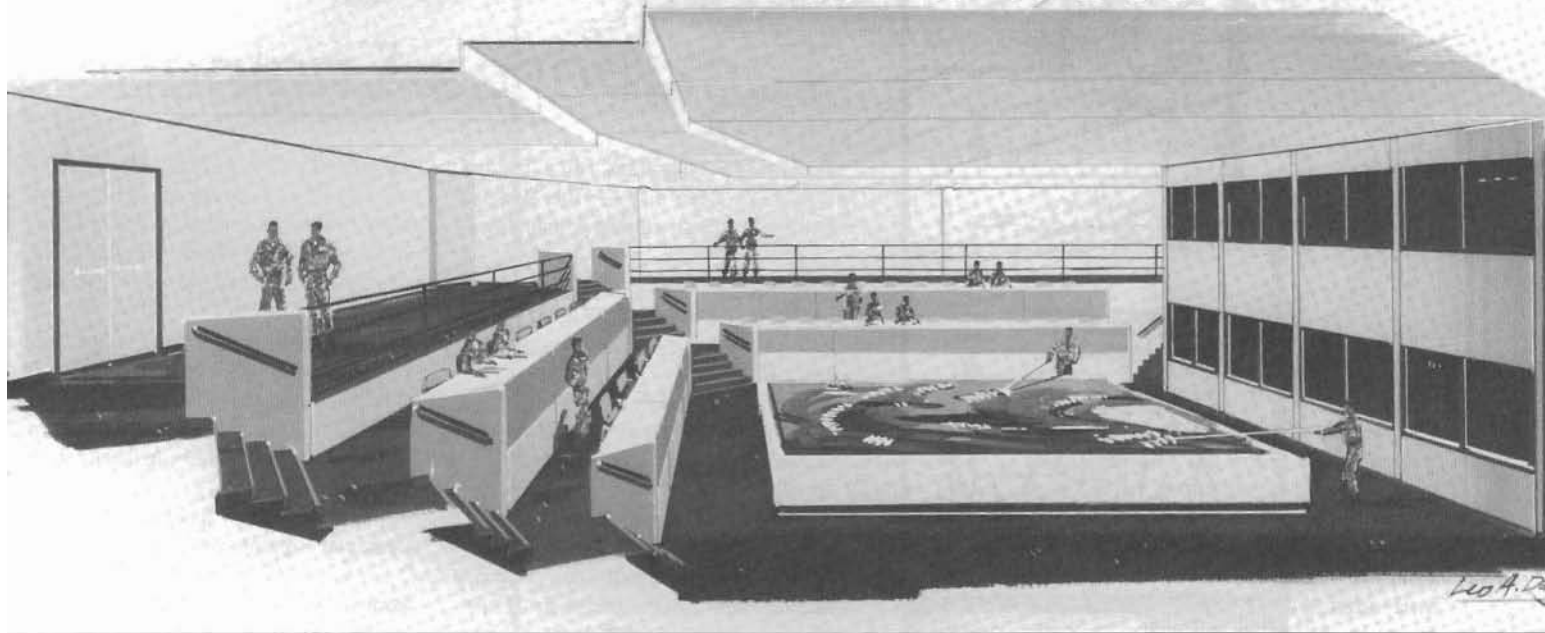
The NCO Academy will be part of

the U.S. Army Training Center and will continue to handle drill sergeants school, the primary leadership development course and BNCOC common core instruction.

The Engineer School move is a once-in-a-lifetime opportunity to design and build a facility that incorporates the latest developments in training technology and computer-based instruction. The result will be an Engineer Center tailored to train military engineers for combat.

LTC Richard L. Montgomery is the Engineer School transition coordinator at Fort Belvoir. A military intelligence officer, he last served as chief of threat analysis, HQLANDSOUTH, Verona, Italy, and has had two tours within TRADOC. He was commissioned from Infantry OCS and graduated from CGSC. He has a bachelor's degree from William Jewell College and a master of education degree from Boston University.

Engineer Tactical Training Center NEW DIMENSIONS at Fort Leonard Wood



by Mariellen Steece

An engineer tactical training center planned for the Engineer School will add new dimensions to training.

The two-story, multimedia, multi-purpose auditorium is being designed to harness new technologies for training military management and tactics. It will also accommodate conferences and seminars.

The auditorium will seat 70 students at desk consoles equipped with high-resolution video monitors and interactive computer capability. Soundproof glass booths along the back walls will serve as staff cells for TOCs during combat simulations.

Students will hone their skills using computers, video terrain displays and simulated field communications. Programs and briefings could be projected onto a large retractable central screen.

The terrain board in the middle of the room can be molded by a digital data base to resemble Korea, the

Middle East or other common scenarios. Eventually, holograms may be used to project military units over the terrain.

Several exercises could be run simultaneously from the training center's control booth. This means students working on a battalion maneuver exercise to defend in sector could generate data for a brigade task force exercise in the next booth.

Computer-assisted CPXs and video tutorials of tactical training exercises without troops (TEWTs) will help students gauge the success of their tactics and the consequences of their decisions. The training possibilities are limitless. Students could participate in:

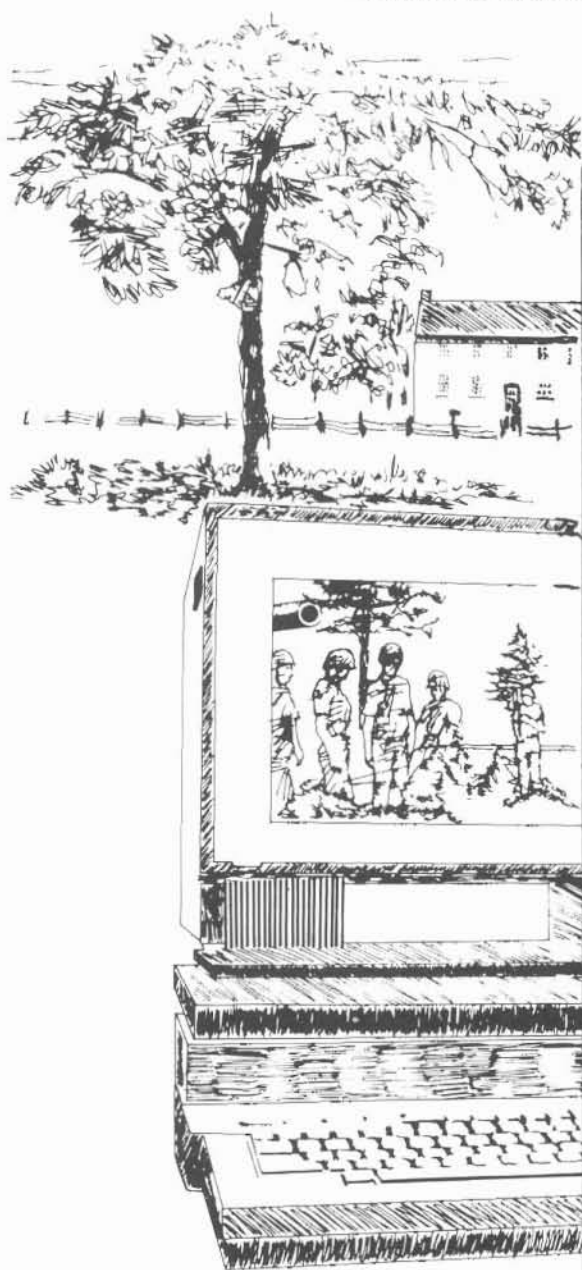
- Simulated terrain walks viewed on interactive video discs.
- Engineer command and control system exercises and engineer staff estimates.
- Modules on how to read contour maps for lines of sight, or on

weapons and equipment recognition.

At night, students will be able to continue practicing in their rooms at terminals that are linked to the tactical training center information bank.

Plans also call for the tactical training center to be linked to Fort Leavenworth's Combined Arms Training Activity's simulation center, allowing engineers to participate in joint exercises with other TRADOC schools. It will also connect with Army information networks like TACTICSNET for students' research on tactical concepts.

Mariellen Steece, chief of the Training Technology Office at the Engineer School's Directorate of Training and Doctrine, designed interactive video disc-based tactical training simulations and microcomputer-based training for the school for four years.



by George Larson



Interactive video discs are rapidly changing the way engineers train for battle.

By next year, engineer lieutenants will be able to call up a simulated battlefield on the Army's electronic information delivery system (EIDS) and practice task force engineer missions.

They will get practice in preparing engineer plans and work estimates currently available only to those engineers at EOBC and EOAC who participate in battlefield tactical exercise.

These students travel 35 miles from Fort Belvoir to Manassas to walk the terrain with Engineer School instructors. At the end of the day, they brief the task force commander—giving him their best recommendations for constructing obstacles, developing attack routes, ensuring survivability, and clearing fields of fire.

While a computer simulation can never fully duplicate field reconnais-

sance experience, interactive video disc training offers several attractive advantages for engineers:

- Experience that active and reserve engineers can get anywhere they have access to EIDS.
- Self-paced instruction that gives students a chance to revisit sites, rethink possibilities and review the exercise at a later date.
- Individualized learning that can't be dominated by a few students

Task Force Engineer

Training Package: Task Force Engineer interactive video disc — The Manassas battlefield tactical exercise without troops.

Scenario: The battalion task force is preparing to defend Dulles Airport against remnants of a motorized rifle regiment.

Frame 27, Situation 4: The Team Tank commander appears on the video display screen and addresses the student.

"Good afternoon, lieutenant. I've been expecting you. The S-3 wants you up to speed on Team Tank's responsibilities, so prepare to take notes. In addition to my mission to fire into the battalion engagement area (vicinity, Robinson house), I must be ready to counterattack southeast and then west across the ford in the 8299 grid square and envelope the enemy's right flank.

I need countermobility support in the armored kill zone and sur-

vivability for my TOW's tanks and APCs. I need mobility support for the counterattack. I want at least one engineer squad with me during that portion of the operation.

Now, let's walk the section and talk specifics. Since your platoon is in direct support of the task force, can you attach a squad to Team Tank for the counterattack mission?"

Computer Prompt: Yes or No?

Answer: No. You cannot attach or suballocate a unit that is in direct support of another.

Team Tank Commander: *"Now let's look at the ford in my sector. I want you to give me a one-way passage across that ford. In other words, I want to get across from my direction, but I don't want the enemy crossing from his. Can you do it?"*

Camera pans view of the fording site.

Computer Prompt: What recommendations do you have for this requirement?

- A. Put in a road crater and use the AVLB.
- B. Use FASCAM to cover it.
- C. Tie in a triangular tank ditch with mines and obstacles.

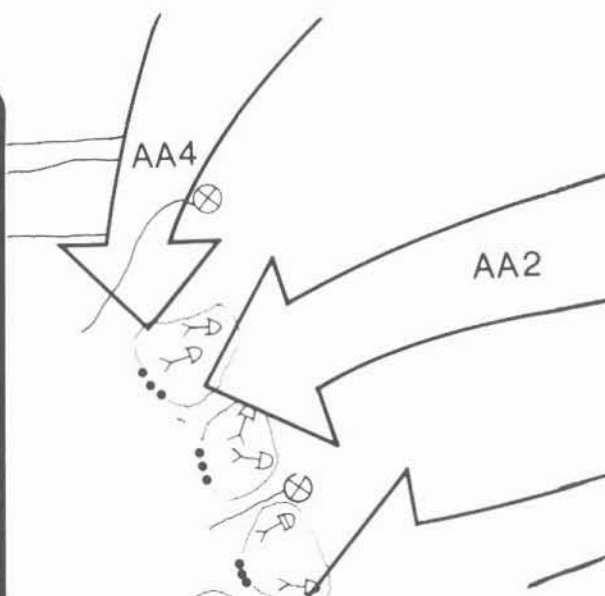
D. Put in a road crater or an antitank ditch and breach it when necessary with an engineer squad.

Student answer: D.

Computer prompt: How long do you think that would take? Come on, try again!

Student answer: C.

Computer prompt: OK, that just may work allowing the friendly force through, but being too steep for the enemy.



engineer support requirements.

Each possible weapon or defense position is recorded on film so students can call up a 180° to 360° pan of the terrain. Students can access a compass or terrain map sections for orientation. An engineer estimate worksheet is available at a keystroke to accumulate data and calculate the estimate.

The computer asks drill questions as terrain is reviewed to reinforce terrain analysis skills and evaluates the estimate as it is prepared to help students gauge their understanding of task force engineer concepts.

A map reading portion of the exercise allows students to try their hand at a preliminary obstacle plan and work estimate—calling up enlarged grids of the battlefield. The computer will prompt them with questions and check their terrain orientation. As the student reviews terrain features and chooses obstacle emplacements, the computer poses questions to help evaluate his decisions.

After the map reconnaissance, the terrain walk module gives the student a chance to practice land navigation skills. He reconsiders his plan in light of actual terrain conditions like trees that obscure site lines or mud in the stream bottom—limitations not readily apparent from a map.

When the student finishes the terrain walk, he takes a short self-test on the computer before he prepares a final engineer estimate, a briefing for the task force commander, a warning order for the platoon sergeant, and a time line allocating equipment and personnel for the engineer missions.

Task Force Engineer offers just a glimpse of the possibilities for multimedia, interactive video disc simulations in military training.

The Engineer School currently has proposals in the works for interactive simulations including:

- **Brigade Engineer** — a planning exercise for engineers in support of the brigade task force.
- **Gap Crossing** — an exercise to evaluate a division commander's concept of operation and to plan crossing support.
- **Bridge Construction** — an exercise on how to lay out a site and build a bridge, piece by piece.

The Army has just begun to tap the opportunities of this technology.

George Larson is a computer programmer for the Training Technology Office of the Directorate of Training and Doctrine at the Engineer School.

and that accommodates different levels of expertise in map reading, land navigation and engineer work.

During Task Force Engineer, tactical commanders and the battalion engineer will brief the students from the microcomputer screen while the students listen and take notes. They then accompany the engineer on a reconnaissance of the defense sectors—discussing the mission and

Computers Create Bridge Between Classroom and Field

by E. Joseph Griminger

 It began in the 1960s when the military first used computer driven flight simulators to train pilots and astronauts . . . simulators that imitated reality when actual experience was hazardous, expensive or time-consuming.

Today, the Engineer School relies increasingly on computers to make more efficient use of instructors and improve student performance in the engineer officer advanced course.

In the past decade, the word "simulation" has become nearly synonymous with "computer." But simulations are not limited to the electronic medium. The FTX is the granddaddy of Army simulations, but there are also classroom and written simulations.

Computer simulations create a bridge between classroom instruction and field experience—reinforcing basic strategies taught in class so time isn't wasted relearning basics during FTXs. The Army can concentrate its field exercises on honing higher level skills and judgments.

Interactive computers allow students to make decisions and observe the immediate consequences—both negative or positive. Free of inhibitors like danger, cost and time constraints, students ponder "What if?" and explore the ramifications. By examining the alternatives, they come away with a more comprehensive understanding of both problems and solutions.

For example, the school currently uses an NBC simulation to reinforce decision-making skills essential for reconnaissance in areas contaminated with nuclear and chemical agents.

The student's goal is to lead a

small patrol through the contaminated areas and return to base camp without casualties.

Students move the patrol around the grid using the keyboard. Options to the right of the grid allow the student to perform tasks such as:

- Change MOPP levels.
- Administer first aid.
- Send NBC reports.

Free of inhibitors like danger, cost and time constraints, students ponder "What if?" and explore the ramifications.

Students can also retrieve information concerning contamination levels. They can select these options any time the patrol isn't moving. Messages, feedback and a submenu are displayed in the area above the grid. The heat meter to the left of the grid indicates the risk of heat casualties caused by working in MOPP gear.

The patrol automatically halts when it encounters NBC contamination, giving students a chance to make decisions that avoid casualties and safeguard the mission.

They have complete freedom of choice. But just as in real life, there are no second chances. The entire patrol is lost if a student fails to mask immediately upon encountering nerve gas.

Several patrols may be wiped out before students master survival strategies. However, unlike the real world, a simple keystroke restores the patrol and the computer repeats the simulation.

Most students first try the NBC

simulation after classroom instruction—practicing and reinforcing procedures and tactics learned in class. The interactive nature of computer play stimulates questions that would otherwise go unasked when the class meets again.

Two other simulations are now part of the growing library of courseware at the Engineer School.

The obstacle planning simulation was developed by the U. S. Army Construction Engineering Research Laboratory. It allows students to develop an obstacle plan by placing obstacles on an intricate computer-generated map. Once in place, a simulated battle wages on the screen to test the effectiveness the plan.

An engineer staff estimate simulation is being developed by the Directorate of Military Engineering for use with the obstacle simulation. Students will use the simulation to master complex decision-making processes involved in developing the engineer staff estimate. They then check their effectiveness against the battle scenario for the obstacle simulation.

These simulations currently run only on the Engineer School's Cyber/PLATO mainframe system. However, an MS-DOS version of the NBC simulation is almost ready to run on IBM-compatible microcomputers. Simulations that run on microcomputers promise reduced costs and increased access for the engineer community.

E. Joseph Griminger is a computer-based instruction specialist at the Training Technology Division of the Directorate of Military Engineering at the Engineer School.

Laser Video Disc for 62N NCOs

by Margaret C. White

 Construction equipment supervisors will soon use interactive video discs to practice basic supervisory, management and technical skills.

The computer simulation—currently being tested at the Engineer School—is part of the 62N BNCOC course. Eventually, all 62N NCOs will be able call up the simulation at their unit once microcomputer and laser disc hardware for the electronic information delivery system (EIDS) is fielded.

This will be a boon to heavy equipment operators who are promoted to staff sergeant and given supervisory responsibility before they attend BNCOC.

The 62N Construction Equipment Supervisors training package has a video disc and student guide with job directives, maps and notes. Video sequences let students solve problems they are likely to encounter on the job.

For example, the platoon sergeant in the video gives the students a mission: build a 1/2-mile road leading to a heliport. The students then work with the computer making choices about supply support, medical support, maintenance support, status of personnel and equipment, time frame, security, and grid coordinates. The first sergeant on the video critiques the students' choices as they go.

The video then takes students on a simulated route reconnaissance—showing motion pictures of the road and terrain. Students also look at the job site to determine where they should place the equipment park and command post.

They use the computer to report back to the platoon sergeant who critiques their plans—showing video sequences of problems they have overlooked. Would a truck get stuck because the bridge clearance is too low? Could a bridge collapse because

it couldn't carry the weight of the equipment?

The students then have a chance to watch work in progress at the job site—identifying problems with equipment operation. For example, Is the dozer making the guide cut too deep?

Half the trick of being a good supervisor is the ability to anticipate. The 62N Construction Equipment Supervisors video disc program teaches students to foresee problems before real lives and heavy equipment are at stake. NCOs can learn from their mistakes, before mistakes become costly.

Margaret C. White is an education specialist for the Directorate of Training and Doctrine at the Engineer School and the project manager for the 62N video project.

C²MUG — Free Software for Computer Users

by CPT Leo J. Fontana

 If you want to reap the benefits of microcomputer-based automation, C²MUG—an Armywide information exchange—exists to help you.

C²MUG is the nickname of the Command and Control Microcomputer Users Group, sponsored by the Communications-Electronics Command (CECOM). The idea is to let soldiers share programs they create to help manage military missions or to pass on successful adaptations of commercially available software.

Programs of special interest to military engineers include:

- The automated construction management system.
- The engineer status program.

- The combat engineer mission management module.
- A deskmate utility with calendar and scheduling.

These programs run on an IBM personal computer (or compatible). Programs are available for the Apple II, IIe, and other types of computers.

You or your unit can join C²MUG at no obligation or cost. Services include:

- A monthly bulletin on automation news.
- A semiannual software catalog of free user-created, floppy disc-based programs in the public domain. (The only charge is for blank diskettes.)
- Assistance with automation problems.

- An annual command and control microcomputer seminar at Fort Leavenworth.

The Engineer School reviews many of the programs offered by C²MUG and has established a software library at the USAES computer lab (phone: (703) 664-3953, AV 354). Students may use the library to review programs and copy them onto their own floppy discs.

To request a membership, write: Chief, CECOM MCD, ATTN: AMSEL-FL-MCD (C²MUG), Fort Leavenworth, KS 66027-5600; or call: (913) 684-7550, FTS 753, AV 552.

CPT Leo J. Fontana is chief of the Technology Applications Branch of the Directorate of Military Engineering at the Engineer School.

We change our tools; then our tools change us.

Technology Aids Training

by Beverly Lloyd

 Electronic technology—microcomputers, artificial intelligence, interactive multimedia video discs, and satellite network communication links—are revolutionizing the Army's approach to training soldiers.

Imagine a fully integrated exercise that joins together students from the Army, Air Force, Navy, and Marines: Army and Marine student ground commanders call for artillery and Naval gunfire . . . Air Force students control air support . . . logisticians from all services conduct resupply planning and operations.

Today, it is a dream, but technology has placed the possibility of joint training simulations within reach.

The Army is committed to supporting research to tap the latest technology to nurture the tactics, terrain and leadership skills that are essential to success in battle.

The Army began fielding standard hardware for video-disc and com-

puter-based training to the TRADOC schools last fall.

The new electronic information delivery system—called EIDS—will eventually be available Armywide at every soldier's unit—active and reserve.

They will use EIDS to study at their unit—ordering the computer-based instructional materials they need to assist them. The new technology gives soldiers more control over their education and professional development because they won't have to wait to attend school to take advantage of training.

Studies are also underway to establish expert data banks of information that put a military expert a phone call away or an artificial intelligence on line to answer questions by providing data from its host computers.

Soldiers will also be able to communicate with instructors and other students when taking correspondence courses.

By the year 2,000, the Army should

see the day when a computer gives new recruits—active and reserve—diagnostic tests so they can test out of training if they already have the skills.

Much of their education will be self-paced, following a prescription of lessons tailored to their personal needs and career goals.

Computerized records of their skills, training and proficiencies would be continuously updated throughout their careers.

As electronic networks expedite communication between military schools and field units, changes to training and doctrine can be accomplished more quickly—making everyone more responsive to the challenges of our rapidly evolving Army.

Beverly Lloyd is an education specialist in the Training Technology Office of the Directorate of Training and Doctrine at the Engineer School. She is project manager and designer of the interactive video disc, Task Force Engineer.

Simulators for Military Engineers

A variety of simulators and automated devices will add realism to mine, countermine, counterobstacle and construction training in the decade ahead. Here's a sample:

The Placed Training Mine—an inert working replica of standard service mines—will let soldiers practice arming and disarming procedures and simulate mine warfare for combined arms exercises. A safe, audible response will warn when errors are made that would detonate a live mine.

The Modular Pack Mine System Simulator will give realistic hands-

on training on how to arm, operate and disarm MOPMS.

Devices to improve operator training on the GEMSS and Volcano are being considered, plus devices that simulate the effects of FASCAM in mine warfare.

The MICLIC Trainer M136 will teach how to use line charges to breach and neutralize minefields since the rocket-projected live demolition charge cannot be routinely fired in peacetime. The trainer will also help teach preventive maintenance skills.

The CEV Video Disc Gunnery Trainer and the **CEV 40mm Sub-**

caliber Device will help gunnery crews develop their skills. The CEV video disc will train crews in target acquisition and burst on target techniques. The CEV subcaliber device will provide inexpensive training rounds that meet safety requirements for most ranges.

A Heavy Equipment Simulator is being considered to provide operators a safe, cost-effective platform for construction equipment training.

An Operator Maintenance Trainer—a portable device that supports preventive maintenance checks and services—is being considered.

Latin America: *Where the action is*

"Engineer commanders take note: Latin America is to engineer units what the National Training Center is to maneuver, and more. The sum of the tasks challenge and frustrate even the most talented leaders. But by the end of the mission, we've seen, smelled and felt our way through the complexities of project coordination thousands of miles from home station. Rarely in peacetime do engineers have the opportunity to plan realistically in such detail."

*—MAJ James E. Brink, USSOUTHCOM,
Engineer Operations and Plans, 1985*

by Victoria McAllister

Those sentiments are shared by most engineers returning from Latin America whether they have been—

- Erecting bridges or repairing schools, clinics and community centers in isolated areas of Costa Rica.
- Cutting roads and drainage systems through the jungles of Panama's Azuero Peninsula to open markets previously accessible only on foot or horseback.
- Building roads, airstrips and an emergency power plant for the air base used by U.S. forces in the outer reaches of hot, dusty Honduras.

Since 1985, combat engineers from active and reserve components throughout the United States have been deploying to Latin America for training. Their heavy construction projects—called nation building—assist the people and democratic governments of developing countries.

In return, engineers gain experience in how to prepare for overseas deployment and build projects under tight deadlines in tropical environments. In most cases, they do with-

out what they forget to pack—be it a crane or jumper cables.

The Army also trains and tests evolving doctrine on the use of soldiers and engineers in low intensity conflicts.

The engineers have learned some hard lessons and gained invaluable experience.

Planning, Design and Bills of Materials

Prior planning is critical to produce a quality engineer project. While engineer commanders understand this, nonengineer decision makers often must be educated. Time, money and effort spent early pay big dividends—insuring a clear mission statement and solid design. All U.S. command levels must approve the mission statement and design so the scope of the project is within the constructing unit's capability.

Design must drive the bill of materials. Any attempt to develop the bill of materials without a design will lead to construction problems.

To provide adequate drainage, commanders must conduct thorough reconnaissance with host nation

representatives before, during and after the rainy season. Otherwise, culverts, outfalls, headwalls, and bridge supports may not stand up to seasonal rains. Commanders must seek out terrain and climate studies and use them.

Realistic Scheduling

Before deployment, engineer reconnaissance helps determine the scope of work and project duration. In one exercise the centerline for a road was not marked, and the team was unable to make a true and accurate assessment. They didn't take into account the massive side-hill cuts and blasting requirements or the number of ford sites to be improved.

Projects must be based on a thorough reconnaissance with host nation representatives. Planners must consider the time allotted, the experience of the soldiers, the equipment available, the terrain, and the weather.

Don't accept a project sight unseen or without the construction materials on hand. It is better to decline a mission than to promise and not deliver. Be conservative in your

"The problem is the training is so ideal . . . the conditions are so real . . . that subsequent training back in the States may seem anticlimactic and boring . . . Nothing is simulated. The engineers get a job and do it. When book solutions don't work, they rely on good old engineer ingenuity."

*—CPT Kenneth W. Moore, 123rd ARCOM,
Rio Indio, Panama, 1986*



The 135th Engineer Group, Missouri National Guard, installs culvert on the Azuero Peninsula in Panama. Here, two bulldozers cut into the harsh jungle terrain.



Tropical thunderstorms were one obstacle engineers overcame while constructing a bridge over Rio Indio in Panama.

estimates . . . If you manage to do more, everyone will be pleased. Allow time for inevitable delays for parts, fuel or the unforeseen. Tell the host nation right up front what is possible and what help you will need.

Coordination

A host nation liaison officer is essential when coordinating with military and local authorities to quickly review and approve design and construction changes. He should be attached to the task force immediately upon arrival to advise the commander on local customs, traditions and weather.

Coordinate with the host nation and logistical support element during prior planning to make sure projects won't be delayed because materials aren't delivered. Anticipate and plan around social and

political events in the host nation that could affect your construction schedule.

Establish a controlling headquarters early to coordinate all deployment during prior planning. At one site, logistical support elements arrived before the base camp was built or the access road was prepared.

Equipment

Sometimes vital equipment must be borrowed from other battalions. It must be in top condition before deployment because parts are difficult to come by in Latin America. In one case, two bulldozers—that would have been invaluable—arrived needing rock guards and new tracks.

Lending units must take extra care to repair equipment and verify that all issued parts are in place. To avoid unpleasant surprises, bor-



Fighting rain and the river, the 205th Engineer Battalion, Louisiana National Guard, constructs the Rio Negro bridge in Panama.

Photo: CPT Daniel B. Miles Jr.

rowing units should inspect all equipment thoroughly before they sign for it. Otherwise, the unit could be stuck with equipment that is unusable and in need of repairs before it is returned.

Make sure you take enough spare parts and equipment to remain operational. For example, if you need 10 dozers to do the job in a month, you may need to take 13 to keep 10 working at any one time.

Maintenance

We cannot dictate what resources a host nation allocates for maintenance. But the unit should get formal written agreement on the amount and type of maintenance the host nation will provide after construction is complete.

Victoria McAllister is the features editor of ENGINEER Magazine.



The 196th Aviation Company sling loads a backhoe for the 27th Engineer Battalion. The engineers worked on the Mocoron airstrip in Honduras during Cabanas '86.

Photo: James Mitchell

The Mine Effects Simulator

REALISM

by Dianna K. Green

A mine effects simulator will be tested this fall by the Armor and Engineer Board at Fort Knox, KY. Fielding of the simulator is slated for FY 90:

Engineer commanders and trainers have long been frustrated by the lack of realistic mine simulation in force on force, free play maneuvers.

A recent functional area analysis concluded that the Army's inability to simulate mine and countermine operations degrades combat readiness.

For example, the National Training Center uses a combination of fire markers, observers, painted wood blocks, plastic devices, air burst simulators, and smoke grenades to simulate the use of mines. None of these give attackers and defenders a realistic appreciation of mines and their effects.

The Engineer School is committed to developing a mine effects simulator that will strengthen maneuver arms and engineer training.

The Jet Propulsion Laboratory, California Institute of Technology, has designed a mine effects simulator. It is compatible with the multiple integrated laser engagement system—used to simulate combat strikes with other weapons. The mine effects simulator also smokes and flashes for use in non-MILES training. The new simulator is available in antipersonnel (Figure 1) and antitank (Figure 2) models.

During training, mine effects simulators will be emplaced like real mines. When a tank hits the pressure-activated tilt rod or trip wire, the simulator gives an acoustic

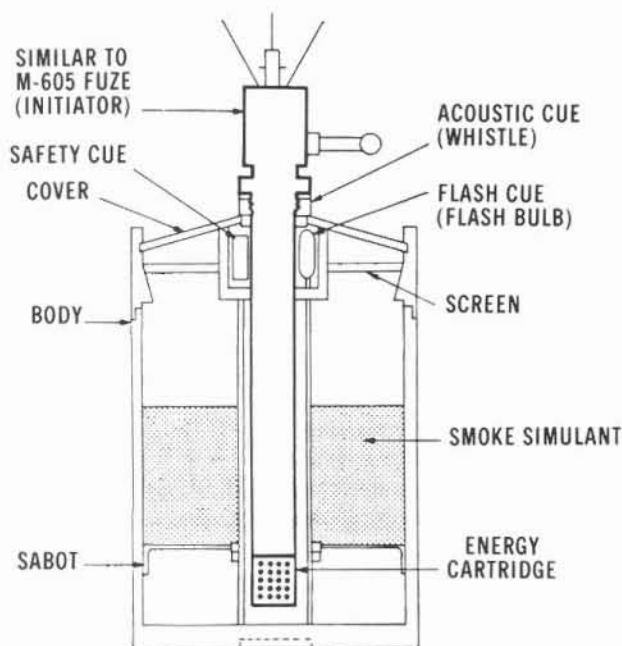


Figure 1.

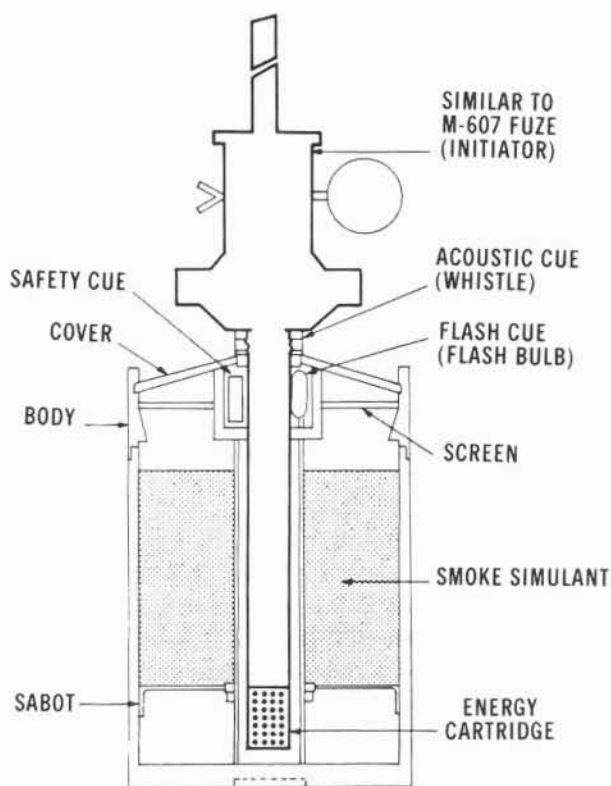


Figure 2.

signal that notifies the tank's MILES that it has been hit.

Different signals distinguish between antipersonnel and antitank mines.

The MILES compatibility of the mine effects simulator permits the scoring of real-time penalties in tactical situations, providing the soldier immediate feedback about the results of his actions. It also helps the unit commander evaluate his success in retaining control of his forces and the effectiveness of his tactics.

The mine effects simulator is designed for safety. It has a whistle which sounds before the simulator fires—allowing soldiers in the danger area to assume a protective posture.

Since Army safety regulations prohibit training systems from

approaching the fidelity of actual weapons, the simulator's cues only simulate the effects of mines rather than provide true weapon's fidelity. The smoke cue—a cloud formed from inert powder—is expelled from the device by the detonation of the black powder energy cartridge beneath a sabot.

The mine effects simulator is housed in a cylinder the dimensions of an M16AP mine. It is similar to the M16AP and the M15AT mines in physical appearance and weight and provides the same actuating options—pressure, trip-wire and tilt rod—as actual mines.

The simulator will consist of three components:

- A body resembling either the M15AT or M16AP mine.
- An initiator resembling either the M607 or M605 fuse.
- An energy cartridge containing black powder.

Units will draw the body and initiator from their training aids support center. The energy cartridge will be classified as ammunition and will be handled and distributed through the ammunition supply points. This will reduce the unit's ammunition expenses.

The mine effects simulator will provide the Army realism and responsiveness for effective mine warfare training.

Dianna K. Green is chief of the Training Support Branch, New Equipment Systems Office, Directorate of Training and Doctrine, at the Engineer School. She has a bachelor's degree in chemistry and a master's degree in environmental sciences.



A way to ensure first-round hits!

Range Finder for CEVs

by CPT Paul Harwig

When the tank commander gives the combat engineer vehicle crew a fire command, there is no margin for error—even in training. Wasted rounds cost \$400 a shot. Yet, estimating range is typically a problem because laser range finders are not standard equipment on the CEV.

The most accurate alternatives—taping or pacing off the distance—take time, forcing the tank commander to choose between accuracy and speed. Without an accurate range determination, the first round is usually a miss. The crew must use the burst on target (BOT) method of adjusting fire. It may take several shots to hit the target.

To save ammunition, the 42nd Engineer Company, Berlin Brigade, improvised a rapid range finding technique using a MIL formula for the Hewlett Packard (HP) 41C programmable calculator. The company tested the program during gunnery training at the Bergen-Hohne NATO Training Area, Germany, in March and October 1985. The CEV section chief, SSG Patrick Keener, successfully used the hand-held engineer calculator to compute the range. His crew made first-round hits every time they fired.

A short routine (Figure 1) simplifies the process of solving the MIL formula for range. The HP41C prompts the user, asking the target

size (in meters) and how many MILs the target fills in the sight reticle. It returns the range in meters or tells the tank commander the target is out of range. The tank commander relays the range to the gunner during the fire command. The gunner lays his sights on the target at that range.

For wartime planning, engineer companies normally calculate distances to targets from preplanned firing points and list the range in the tank commander's target folder. However, the preplanned firing point may prove unusable when the CEV gets to the site. The tank commander must choose a new firing point and determine the range. That's when the MIL formula program proves its worth.

For example, if he is firing at a bridge abutment, the tank commander selects a bridge dimension from the sketch in his target folder. He runs the MIL formula program on the engineer calculator, inputting the size and number of MILs in the main gun site reticle. The HP41C quickly determines the range.

A similar process works for targets of opportunity. For example, the CEV is told to destroy a bunker at an unknown range. The tank commander knows the bunker doors are generally 2 meters tall. His gunner sets the CEV sight on the door and reads that the height is 2.5 MILs. The tank commander runs the pro-

gram, inputting the size and MILs. The calculator tells him the range is 800 meters. He calls the range in his fire command to the gunner who lays the sight on the target at 800 meters and achieves a first-round hit.

The company ordered the HP41C as a nonexpendable item for \$163.83, and it arrived within a month. With main gun rounds costing more than

Figure 1.

MIL Formula

```

01♦LB "RANGE"
02 FIX 1
03 "SIZE?="
04 PROMPT
05 "MILS?="
06 PROMPT
07 /
08 1000
09 *
10 900
11 X<Y?
12 GTO 01
13 CLA
14 ARCL Y
15 " + METERS"
16 PROMPT
17♦LBL 01
18 "OUT OF RANGE"
19 PROMPT
20 END
  
```


\$400 a shot, the calculator paid for itself the first time the company fired a round. The computer is listed in the Army master data file (AMDF) as a calculating machine, NSN 7420-01127-0451. It falls under GSA contract GS-00F-69222. CTA 50-909 is cited in the justification.

The HP41C has a number of minicomputer capabilities designed specifically for combat engineers. The Construction Engineer Research Laboratory developed a

read-only-memory (ROM) module that plugs into the back of the HP41C. The ROM consists of six programs plus subroutines covering bridge classification, critical path method, road crater, demolition, mine, and wire calculations. (An article describing the ROM appeared in *ENGINEER*, Fall 1982.) The ROM chip is available through CERL, ATTN: CERL-FS, John Deponai, P.O. Box 4005, Champaign, IL 61820.

CPT Paul Harwig developed the MIL formula program for CEVs while serving as commander of the 42nd Engineer Company (SEP), Berlin Brigade. He also commanded D Company, 54th Engineer Battalion in Wildflecken, Germany. He is currently a student at the Combined Arms Services Staff School at Fort Leavenworth and will pursue a master's degree in geodetic science at Ohio State University. He is a graduate of USMA and EOAC.

Lessons Learned — Survivability

Editor's Note: This is the first in a series of combined arms training lessons learned featuring thoughts on tactical issues worthy of reflection and professional debate. It is not a comprehensive discussion, but a collection of impressions, opinions and insights on complex topics. Although these issues are reviewed and compiled by the Directorate of Evaluation and Standardization, the views expressed do not necessarily reflect the doctrine or policy of the Engineer School.

Issue. Survivability Positions versus Antitank Ditches.

Observations. Task forces increasingly use engineer earthmoving equipment more to construct vehicle fighting positions and less to dig antitank ditches. These positions are basically the same as shown in FM 5-103, except that to survive, a full-turret defilade with a hide position is essential—not just desirable.

Survivability positions are usually given priority over antitank ditches. This is because long antitank ditches cost the defender far more to construct and secure than they cost the attacker to breach. The priority is the task force commander's decision, based on METT-T.

If the commander's priority is survivability, consider using minefields as a less equipment-intensive alternative to antitank ditches. This frees equipment assets to dig survivability positions. Whatever the priority (survivability or countermobility), schedule the use of each piece of heavy equipment by priority and time allowed for each task. Then, adhere to it.

Issue. Survivability Positions that Work.

Observations. Correct positioning allows tanks and TOWs to both survive and kill. Surviving is key—a function of avoiding detection by the enemy and, if detected, moving securely to a different firing position. "What can be seen can be hit . . ." is trite but true.

- The "window" or "keyhole" position is one of the most successful survivability techniques. Simply stated, it limits exposure by deliberately restricting a tank's sector of fire. The tank is exposed only to the targets at which it is firing, then it shifts to other firing positions as targets are destroyed.
- Position to the flank of the enemy and behind frontal cover. It is far easier for an attacker to acquire and kill targets to his front than those to his flank or rear. For example, most kills at NTC are from the enemy's flank.
- Use a full hide position if at all possible. Stay there until the enemy is in the kill zone. A prone or dug-in observer forward gives a much smaller signature than a tank—even a tank in a good firing position.

- Berms need more than 30 to 40 feet of earth to be effective against modern APFSDS rounds . . . clearly impractical. They also make it easier for the attacker to spot the position.
- Hilltops are deathtraps. Use a backdrop and avoid anything that catches the eye. Likewise, a tank positioned in the vicinity of a large boulder or an otherwise prominent terrain feature will almost certainly be detected.
- Use covered routes into and out of firing positions. Experienced crews often put as much priority on covered routes as on the quality of firing positions.
- Valley-floor/open-field positions can be successful. Tank platoons at NTC have taken out battalions using this technique. However, the absence of a covered route of withdrawal is a clear disadvantage. The only way to achieve security is to kill all the enemy within range before moving.

If used, the position must be well constructed with at least one hull-down firing location for each tank and a covered route to full hide. These positions allow grazing fire analogous to effective machine gun emplacement. Very little of the tank is exposed in the firing location, yet there is normally a wide sector of fire. They can achieve surprise and make it difficult for an enemy element to point out the position to others or accurately adjust indirect fire. The task force often uses this technique with obstacles so that neither the obstacles nor the tanks can be seen until the enemy crests a hill.

- When constructing survivability positions, remember the enemy is almost invariably defeated at close range (less than 1,500 meters) in a web of fire from quality positions. Obstacle systems placed at maximum weapon/sight range prevent the enemy from rapidly assaulting the principal kill zones.

The POC for Lessons Learned is DOES. The Engineer School wants to hear your training experiences—good and bad—so the lessons learned can be shared with the rest of the force. Write: Commandant, USAES, ATTN: ATZA-ES, Stop 271, Fort Belvoir, VA 22060-5271, or call CPT Craig Travani at (703) 664-2172, (AV) 354.

MICROFIX V2.1 automates

by MAJ Todd S. Bacastow, CPT Eugene K. Ressler and MAJ Peter L. Guth

Terrain analysis entered the computer age this summer with the fielding of MICROFIX V2.1 software. All Army terrain teams will receive the new system this summer, and the Defense Mapping School will begin teaching MICROFIX operations in 1987.

MICROFIX V2.1 provides terrain analysts—

- Immediate computer-assisted terrain analysis capability—the first significant improvement in terrain analysis capability since World War II.
- Field experience to help develop more sophisticated systems that will eventually replace MICROFIX.
- Training on a relatively simple system for soldiers who will be primary users of the complex systems under development.

Currently, MICROFIX is the only standard Army system available to support the battlefield commander's topographic needs. It can be used to calculate line of sight profiles; assess placement locations for weapons, radars, or radios; or view three-dimensional representations of terrain.

MICROFIX consists of an Apple II microcomputer with enhancements and peripherals including—

- A hard disc that stores over 20 million characters (20 MB).
- Monochrome and color monitors.
- A dot matrix printer.
- A VCR player.
- A laser disc.

The VCR provides backup copies of the information on the hard disc and loads digital terrain data from prerecorded tapes. The laser disc serves as a map library with up to 50,000 map images on a single disc. The computer displays them on the color monitor and overlays military symbols. All components fit in sturdy olive drab cases that meet TEMPEST certification and field use specifications.

FORSCOM conceived MICROFIX in 1982 as a quick-reaction capability for the XVIII Airborne Corps. They

wanted to automate the functions of the intelligence analyst in the G-2 All-Source Production Section.

In 1984, the Belvoir Research, Development and Engineering Center proposed that MICROFIX be tested to define the unique automation needs of topographic units. Terrain units at theater, corps and division level worked with developers to improve MICROFIX and create more hardware and software. The result was the MICROFIX V2.1, which now contains a baseline configuration plus the topographic package.

The baseline software consists of three modules—

- Database application programs.
- Graphics control programs.
- System manager programs.

The database application programs allow the user to define databases and store them on the laser disc. The graphics control programs allow for a common interface with database applications to plot user-defined symbols on the videomaps and to print the overlays on the dot matrix printer. The system manager programs provide a series of user-friendly utilities to copy data and to backup the system on VCR tape.

V2.1 topographic software includes three packages—

- The tactical weather intelligence system (TWI) provided by the Atmospheric Laboratory at White Sands.
- The battlefield environmental effects system (BEES) developed by the Engineer Topographic Laboratories at Fort Belvoir.
- A digital terrain analysis program (TERRANAL) from the Computer Graphics Laboratory at the U.S. Military Academy, West Point.

The TWI package aims to assist the terrain analyst and staff weather officer, but clearly benefits all tactical planners. The five main functions aid in weighing the impacts of terrain and weather on NBC operations, MOPP, smoke operations, aviators' use of night



vision goggles, and the effectiveness of the electro-optical target acquisition device.

BEES provides six major functions—historical climatologies for several potential theaters of operations, helicopter density altitude calculations, sunrise and moonrise almanac determinations, cross-country mobility calculations, combat engineering obstacles planning from FM 5-34, and utility conversion routines.

The TERRANAL program provides digital topographic support. The program uses digital terrain elevation data (DTED) Level I produced by the Defense Mapping Agency. Characteristics of the data (resolution 60 to 120 meters; accuracy 30 meters) limit capability. Careful analysis of all results is essential.

Despite limitations, DTED Level I

Terrain Analysis



The MICROFIX system provides topographic analysis for soldiers in the field. The monitor displays terrain features and weather conditions while the printer supplies hard copy to help commanders plan their battlefield maneuvers.

covers most of the northern hemisphere and offers the only digital database that will be widely available for some time. Data sets used by the computer cover 30 minutes of latitude by 30 minutes of longitude, which correspond to four standard 1:50,000 maps or one eighth of a 1:250,000 JOG sheet.

The DTED data retains its geographic coordinate base (latitude and longitude) on the MICROFIX. The computer handles the transformations to and from the UTM coordinates given by the user. The configuration of the MICROFIX hard discs allows up to five data sets to be loaded and accessed simultaneously. The user loads additional data sets from VCR tape.

TERRANAL produces five types of output on the color monitor that can be reproduced on the system's dot matrix printer—

- Line of sight profiles,
- Weapons/sensor masking plots,
- Color-tinted elevation maps (air avenues of approach),
- Slope maps (ground avenues of approach),
- Oblique views.

Images generated using these functions can be stored on the hard disc and recalled to the screen for briefings or further analysis.

MICROFIX is a first generation system that cannot meet all user needs. But it continues to help identify key areas for future development while providing a usable interim

system. An ongoing partnership between users and developers will improve MICROFIX further and hasten the day when more advanced systems offer the combined arms commander more sophisticated terrain analysis capability.

The authors integrated the MICROFIX V2.1 system components and developed the digital terrain mapping module for the Computer Graphics Laboratory of the Department of Geography and Computer Science at the U.S. Military Academy.

MAJ Todd S. Bacastow, an assistant professor in the Department of Geography at USMA, is being reassigned in his alternate specialty as a topographic engineer with HQ USAREUR this fall. An infantry officer, he has served as a platoon leader, company commander and staff officer with the Berlin Brigade and the 5th Infantry Division at Fort Polk. He has an M.S. in geography from Penn State and graduated from USMA in 1974.

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MAJ Peter L. Guth is a visiting assistant professor at the University of Nevada, Las Vegas, and former assistant professor and research officer in the Department of Geography and Computer Science at USMA. He has served as a platoon leader, company commander and staff officer with the 44th Engineers in Korea and the 34th Engineers at Fort Riley. He has a Ph.D. in geology from MIT, graduated from USMA in 1975 and completed Command and General Staff College.

airfield damage repair

by LTC Gary L. Groat, MAJ John E. Gillette and Dr. Victor C. Barber

Our ability to repair runways quickly may be the single most important factor influencing the next conflict.

Airfield damage is a *war stopper*. The fate of entire military operations depends on our ability to make timely repairs.

Yet, recent training tests by the 416th Engineer Command revealed that much of the TOE equipment available to combat heavy engineer battalions is not ideally suited for runway repair.

This costs precious time and hurts quality, especially if units are unfamiliar with repair techniques.

Emergency repair is complicated by the fact the Army and Air Force share responsibility. Army equipment differs both within the Army family (active and reserve component) and from that available to the Air Force.

Ultimately, these differences may make it necessary to modify existing procedures, techniques and doctrine.

The regulations say the Army *assists* with emergency repairs when the damage exceeds the capability of the Air Force and makes all beyond emergency (semipermanent) repairs.

The fact is runway repair has now become a primary combat heavy battalion mission.

As air superiority grows more vital and runways become more vulnerable to new, more destructive bombs, the Army anticipates increased reliance upon the combat heavy to keep runways operational during the initial stages of any conflict.

Yet, OCONUS units—both Army and Air Force—have been slimmed down. Engineer assets are in short supply and high demand.

Since our ability to repair runways quickly may be the single most important factor influencing the next conflict, the challenge is three-fold:

- To practice crater repair techniques as an integral part of any unit training program so soldiers are skilled in the application of techniques and familiar with the capabilities of their equipment, avoiding pitfalls that waste time.
- To evaluate the appropriateness of the TOE for major mission tasks and seek better crater repair equipment.
- To take the initiative in encouraging the joint Army/Air Force training essential to effectively accomplish this mission in wartime. A memorandum of agreement (April 5, 1985) between the services provides for coordination and encourages coordinated development, fielding and employment of runway repair systems.

We must also remember that runway repair goes beyond filling craters. Units should change their overall mission statement to stress "restoration of the runway or facility"—not just "repair of a crater."

Field Tests

The 416th Engineer Command—which provides civil engineering planning support for U.S. Central Command—recognized the need to expand airfield damage repair training.

Evaluation of the engineering requirements for a variety of Southwest Asia scenarios made it apparent that airfield damage repair would be a key engineering mission during the early stages of any conflict. However, most engineer troops have only textbook knowledge of repair techniques.

During the summers of 1984 and 1985, the 961st Engineer Battalion tested platoon-sized units on four runway repair techniques.

Two were emergency:

- Crushed stone with foreign object damage (FOD) cover.
- Sand grid method.

Two were beyond emergency:

- Stone grout method.
- Concrete cap method.

With research of new crater repair techniques, materials and equipment underway at both Army and Air Force labs, a field training program was developed for the 961st and 389th Engineer Battalions in cooperation with the Waterways Experiment Station and the Engineer School. The objectives were to—

- Familiarize unit personnel with bomb damage repair procedures.
- Test the appropriateness of the organic TOE equipment found in a typical combat heavy engineer battalion.
- Suggest improvements.

To restore a minimum operating strip approximately 50 x 5,000 feet, combat heavy engineer units must anticipate repairing up to 20 large craters (>20 feet in diameter), 30 to 50 medium craters (<20 feet in diameter), plus thousands of spalls

throughout the work area. Repairs may have to be made in an NBC environment on a field littered with unexploded ordnance and antipersonnel bomblets.

For realism, the 389th Engineer Battalion paved an unsurfaced runway to specifications typical of Southwest Asia. Then, runway demolition teams from the 961st cratered the surface to simulate damage from a 750-pound bomb.

Four 20-foot-diameter craters plus the resultant 2 to 3 feet of debris provided a realistic training site. A 750-pound bomb crater displaces about 400 cubic yards of debris. Even when all the debris is backfilled into the crater, nearly 150 cubic yards of additional fill is required to repair a typical crater.

During the training, the 961st made seven tests using the different emergency and beyond emergency techniques. Repairs took considerably longer than anticipated.

NATO STANAG 2929 sets a goal that emergency repairs—those immediately required to allow air missions with minimum risk to aircraft—be conducted within 4 hours.

The Army and Air Force have incorporated this into doctrine, but it remains a goal that has proved difficult to meet.

It includes the time required to assess damage, remove unexploded ordnance, calculate the best place to make repairs, and haul equipment to the site.

During the Air Force exercise SALT DEMO, the average time was 1.5 hours for site reconnaissance and MOS selection; 5 for on-site repair work.

Beyond emergency work—semipermanent restoration to nearly original condition—is far more time consuming.

The actual time allotted is classified, but well within the capability of a unit like the 961st. The challenge, however, is to produce a quality product with the equipment in the current TOE. The 961st experienced critical shortfalls in standards of compaction and quality of the grout mixture.

Lessons learned focused on—

- Problems with TOE equipment.
- Non-TOE equipment that could expedite repairs.

- Construction tips that save time and improve quality.

TOE Equipment

The limitations of TOE equipment made it difficult to make quality repairs expeditiously. Compaction equipment was inadequate—either too small or too large for the job. This is the most critical problem facing the active and reserve units responsible for airfield damage repair.

The vibratory roller lacked mobility and maneuverability. It was difficult to get in and out of the crater and tended to crack undamaged runway edges.

It was too large for early compaction runs and could only be used for final passes within 8 inches of the surface.

A vibratory roller is critical when making semipermanent repairs where the entire crater must meet lift compaction requirements of 95% CE55 for the first 8- to 12-inch lift and 100% CE55 for the final 8- to 12-inch lift.

Gas-operated hand compactors, although easy to handle and maneuver into and out of the crater, did not compact backfilled debris to the required depth. They were extremely slow and exposed personnel to unexploded ordnance hazards.

The 250-CFM air compressor jack hammer used for cutting runway uplift was too slow, too small and too dangerous—exposing personnel to unexploded ordnance.

The JD410 backhoe was one of the most useful tools in the test—extremely good for backfilling and material handling. But the bucket reach was too short for a 20-foot crater. A longer reach would save time—about 25%—spent jockeying the JD410 into position.

Pavement drilling equipment was too slow for the quantity of bolt holes required. The electric pioneer trailer was the only tool available to drill the required 3/4-inch diameter holes.

The low bed trailer was indispensable for moving cement bags to the mix sites.

The 6,000-gallon water distributor tank unit was ideal for concrete and grout mixing sites.

Front-end loaders, dump trucks, and D7 and D8 dozers were important parts of the operation.

Non-TOE Equipment

Two items of non-TOE equipment were used with mixed results.

A gasoline operated pavement breaker, which is currently being purchased for USAF Red Horse (engineer) battalions, was on loan from Fort Belvoir.

This equipment performs the same functions as the 350-CFM air compressor.

The most useful attachment is a 1 1/2-inch concrete drill that drills eight holes, 1-inch deep, in less than a minute. The concrete cutter and soil spade tools were much more portable than those on the 350-CFM.

A heavy duty electric impact drill for drilling bolt holes in runways was provided by the Corps of Engineers Waterways Experiment Station. The multirotary hammer (Model TE22) is commercially available. It drills 3/4-inch-diameter holes, 8 inches deep, in 1 minute or less.

Construction Tips

A number of opportunities to improve construction methods were identified:

Crater Lip Removal—The D7 and backhoe are the fastest ways to remove uplifted concrete. The concrete breaker on the 350-CFM compressor was extremely slow.

Compaction and Backfill—The most time-consuming task is soil compaction.

By improving efficiency here, the entire construction schedule could be shortened.

Unless larger equipment becomes available (and the crater allows room to maneuver), the soil must be compacted in many small lifts with the hand compactor to assure correct compaction.

The nuclear density tester is indispensable to rapidly verify compaction. Considerable emphasis must be placed on the need to obtain proper compaction as well as the methods of achieving it.

Final Subbase Lift (Sand Grid)—The crater must be filled to within 16 to 22 inches of the surface before



Testing in a realistic environment reveals the combat heavy TOE is inadequate for rapid airfield damage repair. Here, engineers from the 961st combat heavy place cement. The TOE modifications being considered by the Directorate of Combat Developments would overcome current problems with quality, equipment, and time.

inserting two levels of sand grids. Anything shallower produces a lift in the finished surface. Extra sand can be used to level the surface if the debris/fill is deeper than 16 inches. Don't exceed 2 inches above or below any layer of plastic grid.

Open the grids at waist level so they are fully extended, then set them in place. While extended, fill a few grids by hand to anchor the material. Fill the remaining grids with the bucket loader or backhoe. Don't stake grids in the ground at one end and then attempt to extend them. It takes more time and equipment. A chain saw is very useful for cutting sand grid material to size before expansion.

Final Subbase Lift (Well-Graded Gravel)—The top layer of gravel (fiberglass matting technique) takes

much longer than sand grid. Unless it is perfectly level, dips and humps develop in the runway.

When using the vibratory roller to compact the top layers, be careful not to compound the damage by breaking off the edge of the adjacent runway. Don't make turns on the patch. To be even with the runway surface after compaction, the crater shouldn't be filled more than an inch or two above the grade.

Final Runway Surface (Slurry Cement Mix)—When concrete is mixed using the 16S mixer, a JD410 tractor and wheelbarrows are required. Cover the area around the mixer to channel the liquid into the crater and to aid in a speedy cleanup of adjacent runway areas.

Placing the calcium chloride over the grout in the crater makes it

difficult to get a good mixture. This material should be added in the final third of the cement batch. Approximately 2 hours remain to add stone and obtain a finished grade after adding the calcium chloride.

Use a very heavy plastic (10 mils or thicker) to cover the backfill so sharp stones don't puncture the seal. Sheets 12 to 15 feet wide should be considered the minimum. The seams between plastic sheets must be sealed with waterproof tape. Military issue 3-inch duct tape works well.

It helps to slide the slurry into the crater on a sheet of plywood. Dumping the mix into the hole is hard on the plastic seal and breaks down the mix. Don't use the vibrator. It gets stuck easily. A screed beam

placed from edge to edge of the crater helps keep a level surface.

Matting—The bolts on the matting broke loose and couldn't be removed or tightened. The Waterways Experiment Station is working to correct this problem.

The slow drilling problem was resolved by using larger (1½-inch) bolts. The larger holes provide greater tolerance, permitting the holes to be drilled before the mat was towed into place. A calcium chloride cement grout was used to anchor the bolts. Epoxy was not available for the test.

Loose nuts and other parts were easily lost or separated from the matting. These items should be identified early and stored until needed. Having extra bolts and bolt cutting equipment on site would expedite the repair construction schedule.

Conclusion

Runways are tactical, logistical and mobility lifelines—primary targets for the enemy's attempt to cripple his opponent. To counter this threat, engineers must be able to complete quality repairs in the shortest possible time.

The combat heavy battalion's airfield damage repair capability is an issue of ongoing interest at the Engineer School.

Army Field Circular 5-104-1, *Airfield Damage Repair*, October 1985, provides further guidance on approved techniques.

The Directorate of Combat Developments is considering TOE modifications—reviewing prototype tools like an interchangeable drum compactor and a pavement breaker attachment for the Small Equipment Excavator (SEE)—that hold promise for improved efficiency and capability.

Meanwhile, units must learn the Army's bomb-damage repair procedures and work with their Air Force counterparts to encourage efficient use of available resources.

LTC Gary L. Groat is a staff officer with HQ, 416th Engineer Command (USAR), Chicago, IL. He served in the Construction Directorate, Military Assistance Command Vietnam, and was a company commander

with the 24th Engineer Battalion in Germany.

He is vice president of DeLeuw, Cather and Company, a consulting engineer firm specializing in transportation engineering. He has a bachelor's degree in architecture from the University of Illinois, a master's degree in science from the University of Wisconsin, and is a graduate of CGSC.

MAJ John E. Gillette is XO and manager of the airfield damage repair work for the 961st Engineer Battalion (CBT)(HVY), Milwaukee,

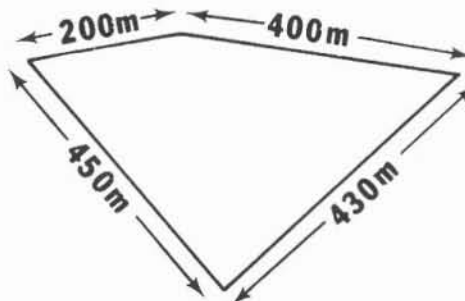
WI. He has managed water-system construction in the Philippines for the 1st Civil Affairs Battalion, Okinawa, and was the S-3 for the 36th Engineer Group (CBT) in Korea. He was also commander of the 517th Detachment (Terrain) in Germany.

Dr. Victor C. Barber is a research civil engineer at the U.S. Army Corps of Engineers Waterways Experiment Station. He specializes in military pavements and mine and countermine research and development.



Engineer Problem

Your platoon supports the 1/52nd Infantry Battalion located in the base camp shown below.



You are tasked to construct—

- Three 81mm mortar emplacements
- Two 4.2-inch mortar emplacements
- A protective wire fence around the camp limited to one of the following:
 - A. Two belts of 4- and 2-pace double apron wire
 - B. Triple standard concertina
 - C. A combination fence with one belt of each type

You have the following assets—

- 32 D-handle shovels
- 2,000 U-shaped long pickets
- 2,000 U-shaped short pickets
- 180 reels of barbed wire
- 700 rolls of concertina
- Unlimited corrugated metal

Your work is to be done at night, and your platoon is experienced in this work. Time is a critical factor.

Step 1. What type of fence will you construct and why?

Step 2. How many man-hours are required to complete all tasks?

REFERENCE: FM 5-34, *Engineer Field Data*

Problem/Solution submitted by CPT Craig Wonsidler and SFC Wayne A. Baker, EOBC Training Detachment, Department of Combined Arms.

AIRLIFT BRIDGE TRAINING LESSONS

by LTC Daniel Waldo

Training for engineer assault float bridge companies under wartime conditions is essential, but all too rare. ARTEP 5-64, Task 10-20, calls for helicopters as an integral part of ribbon bridge operations. V Corps in Germany successfully made combined arms airlift bridging a monthly FTX for ribbon bridge units.

Regular exercises allowed the 549th Engineer Battalion to identify typical problems and develop a systematic approach to bridging operations. The benefits for engineers and Chinook pilots were tremendous.

Initially, Chinook 47 aircraft availability was a problem. But as airlift bridging FTXs became a regular part of the monthly training schedule, the Chinook pilots' enthusiasm and interest grew.

In the first exercises only the bays were airlifted, but bridge boats were soon included. Bays and boats were offloaded from transporters in an open field where aircraft systematically picked them up and flew them to the river. But this proved unrealistic because it would leave all equipment exposed to hostile activity. Ideally, only one piece of equipment at a time should be exposed and for the shortest possible time.

The engineers decided in coordination with pilots and crew chiefs to lift the bays and boats directly off transporters. The transporters—carrying bays and boats rigged for

airlift—remained concealed until the last minute, pulling out into the pickup area as the helicopters arrived.

Before airlift, the bay latch pin was inserted into the travel latch and the lanyard rigged up in the bay. When the bay was set in the water, the crew approached the bay and pulled the lanyard, releasing the pin and unfolding the bay. Correct procedures had to be used or the crew lost time using boat hooks to release the travel latches.

The raft commander was responsible for organizing his loads in the sequence he wanted them lifted—boats first, interior bays, then end bays. This was easy for the pilots who automatically lifted whichever load pulled into the pickup area.

Peacetime safety requirements precluded allowing engineer divers to airdrop or rappel into the river to do their reconnaissance and recover the first boat. This lift was simulated, and a safety boat carrying the first crew was launched from the shore. After the first airlifted boat was recovered, the other crews were airlifted to the friendly near shore.

Boat crews recovered airlifted boats, which are first in the lift sequence. The remaining crew recovered the bays and began raft construction.

Repeated FTXs provided unexpected insights. Believe it or not, most pilots have no idea which direction is upstream or downstream. It proved important for

engineers to discuss with pilots where the rafts were to be set down. With raft construction ongoing at the crossing site center line, drops should be made slightly downstream of the center line. This avoids interference with rafts under construction if problems occur.

It helped the pilots when one boat was conspicuously marked so they could spot it quickly and always set the load upstream of the boat. Visual cues and signals proved particularly important when operating under radio silence or when communications equipment failed.

Pilots had a tendency to take off at an angle once they released their load. The propeller blast caused the bays to move and slowed down retrieval and construction operations. Pilots needed to be told to lift directly up, then maneuver away.

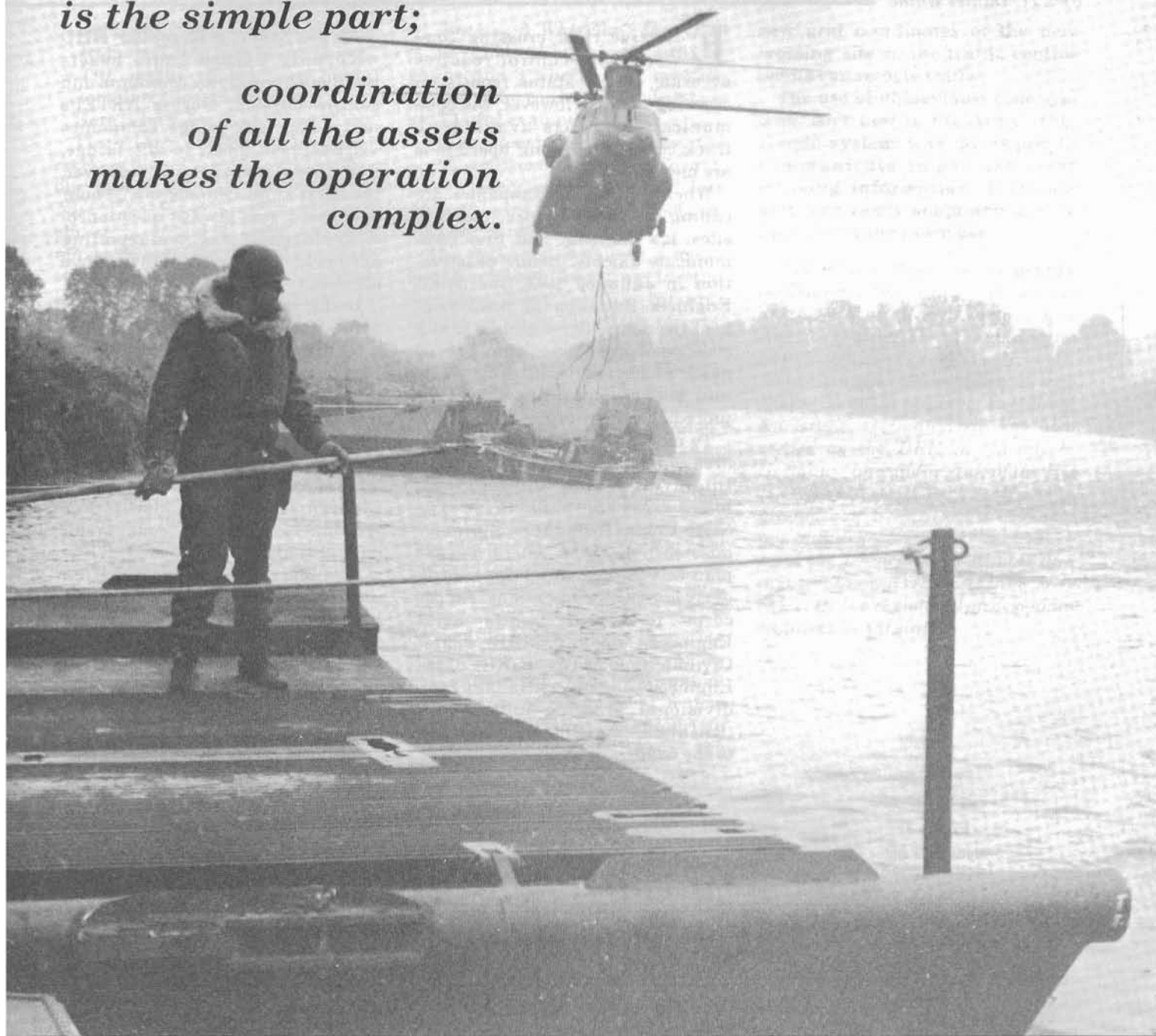
This left the bay sitting still and easy for the crew to approach and retrieve. On a river like the Rhine where the current moves at 6 to 8 feet per second, it is extremely important how and where the crew sets down.

Boat cabs were not airlifted or used because they restricted movement. In winter, water froze on the windshields blocking vision. Needless to say, boat crews found wet weather gear essential during retrieval operations.

Airlift bridging provides excellent combined arms training for engineers and aviators in V Corps. The techniques are as realistic as peacetime safety constraints allow. The

*Construction of the bridge
is the simple part;*

*coordination
of all the assets
makes the operation
complex.*



only deviation from wartime practice involves launching the safety boat with the first boat crew. The 549th Engineer Battalion deactivated in January 1986; however, airlift bridging remains an important monthly exercise for V Corps' ribbon bridge units and Chinook crews.

LTC Daniel Waldo is the deputy commander for military programs at the Corps of Engineers, Los Angeles District. He commanded the 549th Engineer Battalion in Schwetzingen, Germany, and was XO for the 565th Engineer Battalion in Karlsruhe, Germany. He has also served as the DEH in Garmisch,

Germany, and on the staff of the HQ USAREUR ODCSOPS. He is a graduate of USMA and CGSC. He has M.S. degrees in civil engineering from the University of Illinois and in international relations from Troy State. He is a registered professional engineer in Virginia.

RIVER CROSSING COMMAND AND CONTROL

by LTC Daniel Waldo

Effective river crossing command and control requires accurate, timely status reports on crossing traffic. However, the communications assets available to track complex crossing operations are meager.

When five bridge companies are calling the TOC from five crossing sites, it's essential that they communicate quickly. Before deactivation in January 1986, the 549th Engineer Battalion in Schwetzingen, Germany, developed an alpha code reporting system that proved quick and effective in three FTXs and became standing operating procedure for V Corps.

To move forward in the V Corps' area of operations, most of the 8th Infantry Division and follow on forces cross the Main River. The 549th Engineer Battalion's primary mission in the corps' general defense plan was the command and control of river crossing operations. All the corps' float bridge units—541st Engineer Company (MAB), 8591st Civilian Support Group (RB), 814th Engineer Company (RB)—and both divisional bridging units—E/12 (RB) and E/23 (RB)—were attached to the 549th.

At the 549th, a 35-soldier HHD with only limited radio assets handled this complex command and control mission. During ARTEPs and FTXs, the bridge companies verified their ability to raft, bridge, and cross maneuver units. However, the HHD's ability to sustain 24-hour operations was always questioned. A cumbersome, line item reporting system had to be revised to improve efficiency.

Using the 549th's procedure, an alpha code is applied to each crossing condition (Figure 1). The bridge units are given their basic mission—to have a raft or bridge operational at a particular crossing site at a specified time. The code becomes the basis for reporting. By adding codes, the system can be tailored for different needs. For wartime security, the code would change daily.

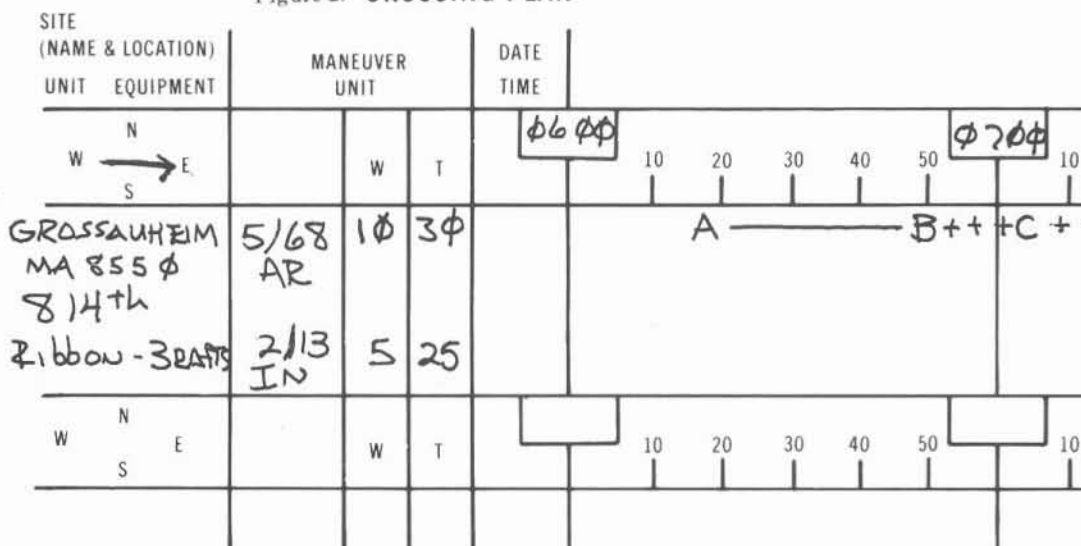
As alpha codes are reported, each unit's activities are tracked on a large board at the TOC. The crossing force commander and crossing area engineer can tell at a glance:

- What units have crossed, where, when, and with what.
- What units are currently crossing.
- What unit is in the engineer

Figure 1.
Alpha Code and
Tracking Symbols

- Alpha = Equipment departs bivouac site; bridge closure begins.
Bravo = Equipment on site and operational.
Charlie = Traffic at ERP (unit ID, number of wheels and tracks).
Delta = Begin crossing.
Echo = End crossing.
Foxtrot = Equipment returns to bivouac area; break bridge.
--- = Water march; moving to new site on the river.
+++ = Maintenance and resupply at the river; not crossing.
.... = Crossing traffic.
— = Other.

Figure 2. CROSSING PLAN



regulating point (ERP) or en route from the ERP to the crossing site.

- The status of bridging units, location and current activity.

Here is how the alpha code works.

The 814th Engineer Company receives the mission to have rafts operational at the Grossauheim site NLT 0700. Activity by the 814th is shown in Figure 2. When the unit moves from its bivouac site at 0620, the battalion TOC receives the simple message: "Alpha 0620." At 0650, the message "Bravo 0650" tells the TOC that all equipment is on site and operational.

These brief radio contacts quickly provide the exact status of the unit. When the 814th calls "Charlie" at 0705, it uses the unit identifier codes in the CEOI to inform the TOC that the 5/68 Armor is at the ERP with 30 tracks and 10 wheels.

Following normal river crossing procedures, the ERP will release raft loads in the priority requested by the maneuver commander. When the first raft load reaches the river and starts crossing, the unit reports, "Delta 0830."

While units are crossing traffic, they report status every hour on the hour. When the 814th reports, "0800;

20 Tangos, 3 Whiskies," the TOC understands that, as of 0800, 20 tracks and 3 wheels have crossed, even if radio contact is made late—at 0810 for example.

When crossing is complete, the 814th confirms that all traffic originally reported in the ERP has crossed, stating: "Echo 0830; 30 Tangos, 10 Whiskies."

The unit then goes into a maintenance mode awaiting further missions. When the 2/13 Infantry arrives at 0915, the 814th reports: "Charlie 0915." They give the CEOI identifier code for the 2/13 and the status: "25 Tangos, 5 Whiskies."

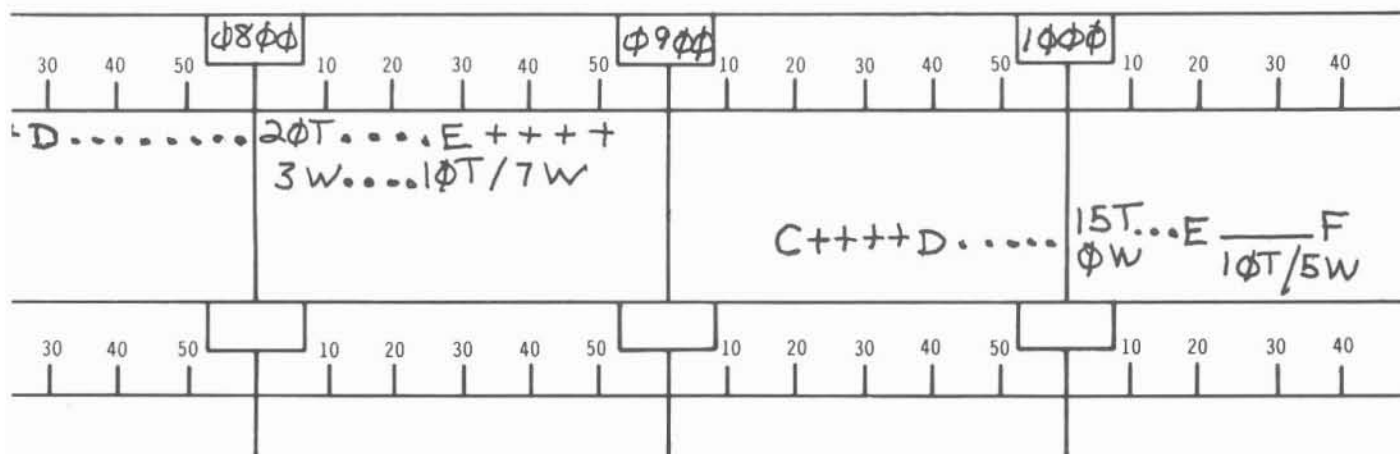
When the 2/13 finishes crossing, the 814th is told to return to the bivouac site. Back at bivouac, the unit reports "Foxtrot 1040."

If enemy activity had compelled the 814th to relocate to a new crossing site at 0930 before the 2/13 finished crossing, the unit would have called in "Echo 0930; relocating." At 1000, the unit would give its routine hourly report to update the TOC on the number of vehicles that crossed before the interruption. When crossing resumes at a new location, the 814th uses appropriate codes within the CEOI to give the

new grid coordinates of the new crossing site so the traffic control points can reroute traffic.

The use of abbreviated code systems isn't new to the Army. This simple system was developed to communicate important river crossing information. Engineer units can easily adapt and modify the code for their own use.

LTC Daniel Waldo is the deputy commander for military programs at the Corps of Engineers, Los Angeles District. He commanded the 549th Engineer Battalion in Schwetzingen, Germany, and was XO for the 565th Engineer Battalion, Karlsruhe, Germany. He has also served as the DEH in Garmisch, Germany, and on the staff of the HQ USAREUR ODCSOPS. He is a graduate of USMA and CGSC. He has M.S. degrees in civil engineering from the University of Illinois and in international relations from Troy State. He is a registered professional engineer in Virginia.



Combined Arms Water Obstacle Training Sites



BY LTC Floyd Elton Byrd

Tactical scenarios that require crossing the Arkansas River will soon enhance combined arms river crossing training. The Engineer School is developing scenarios and operation orders for brigade, task force, and company teams that can be adapted for mechanized infantry heavy or armor heavy units. They will be available to Active Army, National Guard and Army Reserve maneuver units.

Ongoing improvements to the combined arms water obstacle training site (CAWOTS) at Fort Chaffee, AR, are under way. Three crossing sites are complete and another is under development. The extensive road network is being upgraded. Equipment parks and assembly and launch sites are also planned.

The old family of bridging (Bailey, M4T6 and CL60) will be stored and maintained at the CAWOTS site so they are readily available. A Bailey

bridge and a timber trestle bridge kit are there now. The M4T6 and CL60 will be delivered when funds are available.

Fort Chaffee—a subpost of Fort Sill, OK—was identified as a combined arms water obstacle training site in 1985. A recent search of 50 other potential CAWOTS locations verified that Fort Chaffee is the best site available for combined arms training.

Good technical and tactical fast water obstacle training is offered on the military reservation and adjoining Corps of Engineers' property. Other advantages include: Fort Chaffee's central location, access to major road and rail networks, and an extensive range and training area.

The Arkansas River is located about 2.5 kilometers north of the Fort Chaffee military cantonment area. There are numerous crossing sites along a 5-kilometer stretch of river just below Lock and Dam 13.

Analysis of the flow data indicates the training site would be usable 88% of the time based on river access at a 116-meter surface elevation.

Even at flood stage the average current is 2.5 meters per second (MPS). During low water or drought, sufficient flow can be maintained to allow realistic, challenging bridging and rafting operations. The flow can be modified for short periods by the lockmaster at Lock and Dam 13. The lockmaster can also provide flow data and predictions.

The actual stream varies from 183 to 275 meters wide and 2.5 to 4.25 meters deep. Velocity varies from 1 to 2.5 MPS. The navigation channel is 75 meters wide and 3.75 meters deep.

The maneuver area on the south bank is 2.5 kilometers deep and 5 kilometers wide. The north bank maneuver area is 1 to 2.5 kilometers deep and 2.5 kilometers wide. The maneuver room north of the Arkansas River precludes brigade-



Engineers position a bridge section at one of Fort Chaffee's four training sites on the Arkansas River.



Working against swift current, Arkansas National Guardsmen complete this 800-foot bridge in 36 minutes.

size combined arms river crossings; however, smaller combined arms crossings can be conducted.

Access to both banks is through scrub timber, undergrowth and

alluvial sand. Bank conditions on both the north and south shores permit numerous access points. Both sides are well-drained, with the north bank somewhat higher.

Water Obstacle Training Sites

Installation	Width	Minimum Depth	Velocity Per Second	Maneuver 1st Shore	Space 2nd Shore
Ft Drum NY					
Black River	122m	10m	1-2.5m	10x15km	1x2km
Indian River	46m	1m	1.5m	10x15km	3x8km
Ft A. P. Hill VA					
Lonesome Gulch Lake	122m	3m	0	6x10km	3x2km
Camp Shelby MS					
Lake Janney	135m	2m	0	5x8km	3x7km
Ft Chaffee AR					
Arkansas River	183m	6m	2.5m	2.5x5km	1.5x2.5km
Engineer Lake	152m	3m	0	4x7km	2x2km
CP Ripley MN					
Mississippi River	135m	3m	1-2.5m	6x8km	Drive thru only
Miller Lake	183m	3m	0	3x5km	3x2km

Regional Water Obstacle Training Sites

Four regional water obstacle training sites have also been designated. They are: Fort Drum, NY; Fort A.P. Hill, VA; Camp Ripley, MN; and Camp Shelby, MI. They offer some combined arms potential, but primarily provide active and reserve component engineers:

- The non-TOE equipment necessary to practice wartime and ARTEP bridging tasks.
- Adequate water obstacle training sites at or near home stations.

The chart summarizes the physical characteristics for each of the sites. Units wishing to take advantage of CAWOTS or regional sites should contact the following site coordinators.

Commander
Fort A. P. Hill
ATTN: ATZM-FHI (Mr. Wells)
Building T143
Bowling Green, VA 22427-5000
AV 934-8204
AC (804) 633-8204

Commander
USAG Fort Chaffee
ATTN: ATZR-ZFE (CPT Muehlberg)
Fort Chaffee, AR 72905-5000
AV 962-2777
AC (501) 484-2777

The Adjutant General
Mississippi Army National Guard
ATTN: MSNG-POTO (COL Traxler)
PO Box 5027
Jackson, MS 39216-1027
AV 637-6311
AC (601) 949-6311

The Adjutant General
Minnesota Army National Guard
ATTN: MNAG-POTO (COL Forslund)
Veterans Service Building
St. Paul, MN 55155-2098
AV 825-4675
AC (612) 296-4675

Commander
10th Mountain Division
ATTN: AFZS-PTS-PO-O (Mr. Shaughnessy)
Fort Drum, NY 13602-5000
AV 341-6896
AC (315) 785-6896

LTC Floyd Elton Byrd is the training development coordinator at the Engineer School. He served previously as the TRADOC master trainer for the Leadership Assessment Program at First ROTC Region, Fort Bragg, NC, and as battalion commander of the 527th Engineer Battalion (CBT)(HVV).

THE TASK FORCE ENGINEER IN THE DEFENSE

by CPT Gregory R. Wine

The brigade's counterattack—delivered by an armor heavy task force with an attack helicopter troop and close air support—has destroyed the enemy's first-echelon motorized rifle division. Intelligence reports indicate that successful interdiction missions have delayed the second-echelon motorized rifle division for 36 hours.

You are a recent EOBC graduate assigned as a combat engineer platoon leader. Your platoon directly supports the armored task force whose mission is to defend in sector and destroy the lead motorized rifle regiment. As the task force engineer, how do you contribute to the success of the mission?

First, act the part of a task force staff officer. You must—

- Be ready to advise the task force commander and S-3 at all times. This requires constant radio contact with the task force command net.
- Speak the language of the task force. In other words, know the task force's tactical standing operating procedures (TACSOP). You can reduce radio transmission time.
- Maintain communications to keep higher engineer headquarters up-to-date and to pass along required reports.
- Use a net other than the task force command net to maintain contact with the rest of the platoon.
- Coordinate with other staff members and company team commanders.
- Assist the task force S-3 in writing the engineer annex to the task force operations order.

Communicate with the platoon sergeant. He, too, must fully understand the task force commander's intent and scheme of maneuver. The platoon sergeant is out in the dirt and the dark making things happen—supervising, coordinating, and reporting as obstacles are emplaced.

Anticipate. Things start moving when brigade sends the FRAGO to defend. A good engineer company commander will already be on top of the situation, planning to get the necessary engineer equipment forward.

Start by understanding the mission and assessing engineer capabilities for the task force commander's METT-T analysis. Get with the task force S-4 and request logistical support (Class IV and V). Don't wait for a hard copy OPORD; use your initiative to start work immediately.

Understand the scheme of maneuver. As soon as the task force commander completes his mis-

sion analysis, he begins planning his scheme of maneuver. You must participate in the entire planning process to advise the task force commander on an obstacle plan which supports his scheme of maneuver. First, you must understand how and where he plans to destroy the enemy.

Enemy avenues of approach. You and the task force S-2 should give the task force commander an analysis of the enemy avenues of approach. You must be an expert in analyzing terrain—able to identify mobility corridors and avenues of approach required by company-sized threat units.

The S-2 may be responsible for intelligence and reconnaissance missions—using a reconnaissance/surveillance plan to control the scouts and the ground surveillance radar. Ask him for the valuable information not available from a map reconnaissance. Then, determine possible locations for obstacles. Inform the commander of those which support his intent.

Tentative battle positions. The task force commander will select tentative battle positions keyed on weapon systems, planning ranges and engagement areas. Obstacles are extremely effective in engagement areas, so plan accordingly.

Mobility for company teams. You must ensure planned obstacles don't limit the mobility of the task force.

Lanes or gaps may be required to maintain mobility between battle positions.

Task organization. When task organizing your company teams—a key step in obstacle planning—you must know the locations of the weapon systems.

Develop an obstacle plan. To begin, you must know the—

- Locations of all battle positions including the type of weapon systems in each.
- Withdrawal routes to the battle positions.
- Required lanes or gaps within the task force engagement areas.
- Counterattack routes.
- Trigger and break points for each battle position.

Focus on major avenues of approach. Reinforce terrain with existing obstacles. Don't forget to include obstacles directed by higher headquarters. Analyze each battle position, keying on the weapon systems located there. Plan obstacles to enhance the effectiveness of weapon systems at trigger and break points.

Trigger points—identified by target reference points—indicate where initial enemy engagement will take place. Obstacles positioned at trigger points enhance the effectiveness of friendly fire.

Break points—also identified by target reference points—identify the closest distance the enemy can come before friendly forces move to new battle positions. Obstacles work extremely well at break points. They enhance friendly fires and gain time for friendly movement.

Use reinforcing obstacles among existing obstacles. Prepare and execute reserve targets in accordance with the commander's guidance. Make a plan—hopefully an SOP item—for the closure of these obstacles. Make full use of obstacles on reverse slopes. This adds surprise and greatly enhances weapon system effectiveness.

Obstacles with lanes or gaps must be closed once friendly forces pull back. They must be manned for security and executed on order or as directed.

The transfer of responsibility for target execution is a difficult mission. Pay particular attention if withdrawal and closure will occur in

darkness. Recognition signals, guides and rehearsals are essential. Train this task before the fight—regardless of whether you are using engineers, task force scouts, or obstacle guards to close the lane.

The plan should create a maze where obstacles channelize enemy vehicles into other obstacles and engagement areas throughout the entire depth of the task force sector. Obstacles must create targets for our gunners.

You must participate in the entire planning process to advise the task force commander on an obstacle plan which supports his scheme of maneuver.

Prepare the engineer annex.

You will assist the task force S-3 in preparing the engineer annex to the operations order. You will also provide an obstacle task list and an obstacle overlay. The obstacle task list should include—

- The obstacle's number, priority, type, and location.
- The unit preparing the obstacle.
- The element providing security.
- The unit guarding or executing each obstacle.

If Class IV and V are in short supply, you should designate both engineer and maneuver units for obstacle recovery.

Provide security. The maneuver commander must ensure security for prepared obstacles to prevent breaching by insurgents. You must ensure security for the engineers who are emplacing obstacles.

Provide direct fire. No obstacle should be emplaced without careful coordination between the emplacing unit and the unit covering the obstacle with direct fire. There should be pre-positioned artillery to the enemy side of all obstacles. Ensure the fire support officer plans linear artillery fire for obstacles such as minefields and wire obstacles.

If obstacles are repositioned during emplacement to improve direct fire coverage, ensure the location is corrected on the preplanned artillery list.

While emplacing obstacles, you must know the current status of the obstacle plan and keep the task force commander informed. Make sure the required minefield reports (DA Form 1355) are forwarded to the task force S-3.

Get a time sequence. The task force S-3 should give you a sequence for planning the engineer effort. He should give a NLT time to complete obstacles before a certain phase line and a final location for all engineer assets.

Assess your resources. When determining how many obstacles to emplace, consider available manpower, earthmoving equipment and logistics support.

Manpower. An engineer isn't needed to drive a picket or emplace an M21 landmine. Infantry, armor, clerks, cooks, mechanics, and others can augment the engineers. Once you determine the number of man-hours available, calculate how much can be done.

Earthmoving equipment. Blade hours dictate how many counter-mobility, survivability and mobility missions can be accomplished. Dedicate earthmoving equipment to digging survivability positions and providing mobility in and between positions.

Don't let dozers sit idle while maneuver commanders reconnoiter and decide on exact fighting positions for every vehicle. Use earthmoving equipment to begin counter-mobility missions until maneuver units are prepared to dig in.

You must schedule the use of each piece of earthmoving equipment and stick to it. In the engineer annex, show what time and how long each unit will have the earthmoving equipment. Dozers refuel often, so have fuel close by.

Logistics support. The task force commander will want an accurate estimate of obstacle material available for the defense. Get together with the S-4. You must consider both the amount of Class IV and V on hand and the amount available through logistics channels. A standardized obstacle package—part of the TACSOP—can assist in requesting barrier material.

Limited transportation assets are another problem. The task force is responsible to transport obstacle

material. The task force commander must use his transportation assets according to what is most important to his scheme of maneuver. You must closely monitor movement and delivery. Material lost or in the wrong place won't win the battle.

Have priorities. Higher headquarters will designate mission priorities—generally countermobility, survivability and mobility in the defense. However, the task force commander must establish his own priorities within each mission.

Countermobility. The task force commander will give a priority to each obstacle according to its importance in his scheme of maneuver. You use these priorities to determine when obstacles are emplaced.

Survivability. The task force commander

will assign a priority to each survivability mission by either company team sector, battle position or weapon system. The sequence is left up to the task force commander, but he must tell you what survivability missions are most critical to his scheme of maneuver.

Mobility. In the defense, mobility missions are limited to improving routes between fighting positions and maintaining the supply route. Use minimum effort unless your platoon has been significantly augmented by other engineer units or if mobility improvement is critical.

Plan FASCAM. Ensure the task force commander specifies where he wants FASCAM planned. FASCAM can be used to reinforce other obstacles on counterattack routes and

cover lateral avenues of approach. You must be familiar with the employment of all FASCAM.

The task force engineer can make or break the combat engineers' effectiveness as combat multipliers. With experience and the support of a tactically proficient platoon sergeant, you will provide the task force commander with a solid obstacle plan and pave the way for success on the defense.

CPT Gregory R. Wine commanded Company C, 17th Engineer Battalion, 2nd Armored Division, at Fort Hood, TX. He graduated from the U.S. Military Academy and the Armored Officers Advanced Course. He is now a professor of military science assigned to the cadet command at the University of Florida.



Letters to the Editor

E-FORCE—What Impact on DISCOM? Obstacle Belts—Germans Use Similar System

I found your spring '86 issue to be most interesting as did the German officers I am stationed with at the German Tactics Center. I would like to comment on two articles which appeared in that issue.

"E-FORCE" by MG Richard S. Kem, MAJ J. Richard Capka and MAJ Houn Y. Soo.

MG Kem's opening remarks "cleared the way" for this article. As the U.S. action officer at the German Tactics Center and deeply involved in preparing tactical map exercises for the Bundeswehr, I have gained new appreciation for the combat multiplier value of engineers.

E-FORCE is an excellent alternative to today's organization.

My concern, however, is that there was little discussion of the logistics and maintenance impact on the DISCOM.

E-FORCE would be part of a system, a division, and as such its impact on the entire system should be addressed. I would like to see a follow-on article that discusses what impact and changes such an engineer structure would have upon the DISCOM.

"Personal Viewpoints: Obstacles—Engineers and

Maneuver Forces Need Common Terms."

CPT Baehre makes a good point for properly and briefly communicating the commander's intent, something the Bundeswehr learned a long time ago and still does very well today.

He offers two terms when one is sufficient to describe a concept that certainly deserves a more adequate response than MAJ Marubbio provided. The task force/battalion commander needs flexibility to shape the battlefield based upon METT-T and within the context of the commander's intent.

MAJ Marubbio's second point deals with the "unconstricted engineer estimate" that is based upon the "physical plotting of anticipated individual obstacles."

If the Army is serious about mission-type orders and the intent of such orders, then higher headquarters have no need to be concerned with plotting individual anticipated obstacles.

Higher headquarters only need to know what the subordinate's resource requirements are, relying upon the judgment of subordinates to accurately request what they require to accomplish their assigned mission within the parameters placed upon them.

MAJ Marubbio's final point that maneuver commanders are

interested in individual obstacles is very valid for anything but a fast-paced, dynamic battlefield of tomorrow, or today.

The maneuver commander is interested in where he has mobility for his force and where the enemy is faced with reduced mobility, channelization and separation. The maneuver commander's engineer should be concerned with individual obstacles.

CPT Baehre's proposal appears to provide information to the commander much faster and more clearly. His proposal also follows more closely with the manner that our German counterparts follow. Their successful use of obstacles in WWII is well documented. I personally hope that CPT Baehre's proposal is given a better consideration.

*LTC Gary J. Bridges
CGSC Liaison Officer
German Tactics Center*

Author's Note: E-FORCE solves the maintenance dilemma that corps engineers working forward discover—the DISCOM is unresourced to provide support. E-FORCE adds 30 maintenance soldiers to the division, 16 moving from COSCOM (20 each FSB; 10 to MSB). Now repair parts and mechanics to support the engineer battalion will be provided in each FSB. Supply/transportation increases by 4. All have been coordinated with the Logistics Center.

Bring Obstacles Doctrine In Line With AirLand Battle

In reference to your "Point/Counterpoint" in the spring 1986 issue, CPT Baehre is clearly on the right track. A similar system was proposed by MAJ Fastabend and MAJ Graves in the February 1986 *Military Review*.

The key here is the difference between data and information. The division commander and his principal engineer advisor simply cannot absorb all of the data represented by the barrier overlay as used in most units.

He needs information such as "This goose egg (obstacle zone) is 75% complete and will be finished NLT 2400 hours." The task force commander, on the other hand, wants to know about individual road craters and point minefields.

It is the brigade engineer's job to aggregate the data into information for the division engineer's use. Should data on a particular obstacle be of interest, it can be retrieved; but

transmitting all data on all obstacles to the battalion TOC only serves to collapse the radio nets.

MAJ Marubbio's contention that the obstacle plan should grow from the bottom up is wrong and would prevent the effective use of AirLand Battle doctrine.

The division commander decides how he wants to fight the division and prescribes the scheme of maneuver. The last thing he needs is to have a battalion commander "shape the battlefield" and close off a major counterattack route.

The commanding general can prevent this by designating obstacle zones wherein his subordinates are free to use their initiative without further guidance, and outside of which they are forbidden to emplace obstacles without specific permission.

To the extent that maneuver commanders can be persuaded to develop a scheme of maneuver

rather than asking that the engineers create an "impenetrable barrier system," the use of obstacle zones and belts can streamline the engineer's job. If the maneuver commander plans the battle and the engineer plans the obstacles so that there is no need to maneuver through the belts, then the engineers can go at full speed executing the targets as they are ready rather than going through the target turn-over process.

From my perspective as a division engineer, I see nothing but advantages to bringing obstacle doctrine into line with AirLand Battle.

*LTC Jon S. Behrens
Commander
7th Engineer Battalion (C)
Fort Polk, LA*

E-FORCE—Don't Forget the Guard and Reserve

I read with great interest *E-FORCE* by MG Kem, MAJ Capka and MAJ Soo. It would appear that *E-FORCE* as described can now support the maneuver commander's combat engineer requirements.

The increase of the division's organic combat engineer battalions is not a new concept. It was discussed extensively in the late 1970s. There were too many nonbelievers at that time . . . too many senior engineer officers who felt WWII command and control doctrine would suffice and a can-do attitude would overcome the obvious weaknesses.

While it was not stated precisely, I assume the division engineer is a colonel and in essence a group/brigade commander. That seems implied by the statement, "The division engineer orchestrates the engineer effort throughout the

division area." I must also assume the *E-FORCE* concept has not yet been blessed by TRADOC or HQDA.

E-FORCE as envisioned in the article seems to address only the 10 heavy divisions in the Active Army. Let's not forget the Reserve Components. For example, there are 4 heavy divisions in the National Guard. In addition, there are 6 separate heavy brigades in the National Guard and Army Reserve whose requirements and mission must be considered as the force structure is developed and implemented. These are not roundout brigades.

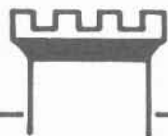
Equipping and training *E-FORCE* will be a challenge. At least 26 new division engineer battalions must be formed, and the 13 existing heavy division engineer battalions must be modified. With over 70% of the Army engineers serving in the Reserve

Components, *E-FORCE* is certain to affect the National Guard and Army Reserve. They must be involved in planning from the start.

E-FORCE is the way to go. If adopted, it will be a major step in closing the credibility gap with the maneuver commanders.

*COL (R) James B. Fleming
ARNG Advisor to the
Engineer School 1977-79*

Author's Note: *E-FORCE* was conceived as Total Force—applying to all 14 heavy divisions, 10 active and 4 ARNG, and to all separate heavy brigades, active and reserve. The concept was blessed by CG TRADOC to take to HQDA. Chief Army Reserve and Chief ARNG were briefed and concur in the concept.



Letters to the Editor

E-FORCE, Let's Do It!

The E-FORCE article in the spring 1986 *ENGINEER* magazine outlines a structure that is long overdue for those of us attempting to support the combined arms team on the AirLand battlefield.

My experience during REFORGER 1985 working on the 4th Infantry Division (Mechanized) staff and two rotations at the National Training Center as a company commander supporting the 1st Brigade, 4th Infantry Division (Mechanized), fully supports the points made in this article.

On exercises like REFORGER, the division combat engineer battalion is augmented with a corps combat battalion and an engineer group headquarters. This provides more engineers; however, this ad hoc organization hinders mission accomplishment.

Command and control, communications, maintenance, and logistics are dysfunctional from the start. Valuable time and efficiency of engineer effort are lost during the initial attempt to task organize this patched together support package.

The current Army "warfight" doctrine demands that we train as we shall go to war. Even on major exercises such as REFORGER, the two weeks of field training cannot overcome the inherent problems associated with the current engineer organization.

These problems become painfully obvious at the National Training Center. The battlefield demands that engineers must prepare the terrain in a realistic manner. In this environment, the task force

commander constantly demands more engineer assets.

To provide these assets, my company was augmented by a company(-) from a combat heavy battalion which performed the role of the corps combat company. The heavy engineer equipment and manpower were certainly a welcome addition to the engineer support package. However, the command and control, communications, maintenance, and logistics problems reduced the efficiency of this organization.

The command and control problems focus on the task force engineer. The engineer platoon leader is overwhelmed by his numerous responsibilities. To minimize the problems that even the best lieutenant cannot overcome, I assumed the role of the task force engineer during two rotations at NTC. This solved most of the problems for one task force. However, this created more problems for the second task force.

The decision of who should be the second task force engineer is then a toss-up between the normally associated engineer platoon leader—frequently inexperienced and trying to run his platoon—and the second company commander—who has a company staff and more experience, but is a stranger to the task force.

Further, the corps combat company is poorly equipped to survive while in support of the front line task force. Two engineer companies from different battalions supporting two task forces may "work" at NTC. Even with these

problems, however, it is not the appropriate AirLand battlefield solution.

The battlefield solution is the E-FORCE.

The experience of our companies at NTC demonstrates that only a combat engineer company can provide the mobility, countermobility and survivability required by a maneuver task force.

The company commander has the experience to properly advise the task force commander and the assets to fully perform his mobility, countermobility and survivability missions. Platoon leaders can learn to lead their platoons and start to experience the complexity of supporting the combined arms team on the battlefield.

That makes sense; let's do it!

Of course it is simple to draw the charts and outline the organization, but it is quite difficult to breach the barriers to implement the E-FORCE. These barriers must be breached because engineers in the field cannot overcome the problems without a change in structure.

The E-FORCE structure is what is needed; it will solve the problems. We have the responsibility to provide quality engineer support on the battlefield, but our current organization is not the answer.

The E-FORCE is the organization that will allow us to live up to our motto of "Essayons!"

*CPT Bruce A. Fink
Commander, Company A
4th Engineer Battalion
Fort Carson, CO*

Obstacle Zones and Belts Work; Current Doctrine Does Not

The system of obstacle zones and belts proposed by CPT Michael Baehre in the Spring '86 issue of *ENGINEER* is the same as one described by MAJ David Fastabend and me in "Maneuver, Synchronization, and Obstacle Operations" in the February '86 *Military Review*. The similarity is no doubt due to the common experience of CPT Baehre and my co-author in the 3d Infantry Division (M).

In his reply, MAJ Arthur Marubbio of the Engineer School

admits that such systems are often mentioned in the field. Indeed they are!

I have personally observed their use by the 8th Infantry Division (M), the 3d Armored Division, and the 130th Engineer Brigade, as well as the 3d Infantry Division. These units, and probably others, use zone and belt systems because they work, whereas the current doctrinal system does not.

MAJ Fastabend and I call our version an AirLand Battle obstacle concept because it supports the

latest Army maneuver doctrine. The objections posed by MAJ Marubbio can all be turned to arguments in its favor.

First, he states that division and brigade designation of obstacle zones restricts the flexibility of the battalion task force commander. That's the main purpose!

AirLand Battle doctrine focuses on the enemy rather than on the terrain. Defensive operations should attempt to seize the initiative and attack. Sector assignments are likely to change.

Very liberal designation of belts and zones could ease restrictions, but if the division commander intends to shift to the offensive, his planners must facilitate maneuver by restricting subordinate obstacle efforts to designated areas.

Current systems of reserved lanes, target turnover, and breaching friendly obstacles are too cumbersome and too slow.

Give the battalion task force commander freedom within assigned belts. But keep potential maneuver areas open—to be closed with dynamic obstacles if necessary.

The second objection is that the unconstrained engineer estimate must be based on detailed plotting of individual obstacles nominated by subordinate units. Please, no!

The war will not wait the three days it takes to perform this exhaustive reconnaissance, planning, and coordination effort.

Furthermore, why should one subordinate unit be rewarded with more engineer resources just because it plans more obstacles?

FM 100-5 emphasizes the importance of speed in defensive preparations. I interpret this to mean that a division will be lucky to have 24 hours to prepare.

Let me summarize the argument presented in our *Military Review* article: Division and brigade planners must allocate units and materiel based on the commander's scheme plus their knowledge of the threat and terrain so that orders, munitions and engineer units arrive in time to prepare the battlefield.

With reason, MAJ Marubbio asks, "How can the division and brigade planners request and allocate resources based on the general definition of zones and belts?"

In order to be timely, the allocation of units and supplies will have to be made on the basis of the engineer staff officer's estimates.

Currently, such estimates are very hard to make. The Engineer School could help by developing planning factors for determining troop, equipment, fuel, and munitions resources required to achieve different levels of obstacle effect in various types of terrain.

The standard obstacle concept should be refined and generalized to

predict supply consumption and work rates for committed engineer platoons, companies, and battalions.

This sort of "push" system is how munitions are provided to most of the Army's weapons systems.

The current method of trying to manage barrier munitions by "demand" from the squad level is an anomaly which frustrates engineers and logisticians alike.

My experience as a brigade and assistant division engineer does not support MAJ Marubbio's next assertion that maneuver commanders at all levels are interested in the status of individual obstacles.

As CPT Baehre points out, a system of belts and zones does not preclude tracking certain key individual obstacles. But what the maneuver commander wants most is to know the overall status of the preparation of the battlefield and the countermobility effect to be expected.

He can't make any sense of a long obstacle status list or a jumbled overlay, and the engineers can't provide such detailed information on a real time basis without an

Not Much Has Changed Since Kipling's Day

I was most intrigued, as a retired sapper, to see the article in the latest *ENGINEER* on the sapper, page 19.

I thought it might amuse you to see Kipling's definition as applied to Royal Engineers. I got my copy from the Library of Congress.

It strikes me that not much has changed since Kipling's day.

*COL (R) Brian S. Read
Fahey Engineering*

Editor's Note: Here are some excerpts from Kipling's poem, "SAPPER."

When the Waters were dried an' the Earth did appear,

("It's all one," says the Sapper),
The Lord He created the Engineer,
Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

When the Flood come along for an extra monsoon,
'T was Noah constructed the first pontoon
To the plans of Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

inefficient and dangerous overcommitment of command, control, and communications assets.

Detailed obstacle data—including minefield recording forms—need to be kept. But it is sufficient to compile hard copies and forward them every 12 hours or on the occasion of sector transfer.

In his "Clear the Way" column, MG Kem says that our equipment and force structure often lead others to view the engineers as cumbersome and deliberate.

We are also slowed by antiquated obstacle planning doctrine. Busy units take the time and effort to develop their own methods only when doctrinal solutions prove inadequate.

The AirLand Battle obstacle concept is more than a graphical technique; it is a complete planning system attempting to meet the needs of today's engineers and commanders.

I challenge the Engineer School to recognize that a problem exists and to help solve it.

*MAJ Ralph H. Graves
Department of Engineering
United States Military Academy*

For ever since then, if a war they would wage,
Behold us a-shinin' on history's page—

First page for Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

They sent us in front with a fuse an' a mine
To blow up the gates that are rushed by the Line
But bent by Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

They sent us behind with a pick an' a spade
To dig for the guns of a bullock-brigade
Which has asked for Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

Now the Line's but a man with a gun in his hand,
An' Cavalry's only what horses can stand,
When helped by Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!

Artillery moves by the leave o' the ground,
But we are the men that do something all round,
For we are Her Majesty's Royal Engineer,
With the rank and pay of a Sapper!



Brigadier General Roland H. Zedler, commandant of the German Engineer School and Army Technical School for Structural Engineering, made the following observations at a Dining In of the 7th Combined Arms Training Center First Sergeants Course, November 1985.

Since I have been assigned to the Engineer School in Munich, I have been happy to see the very close and friendly relations which exist between the American NCOs of the U.S. garrison in Munich and the NCOs of the German Engineer School. This is important since we would be highly dependent on one another in the event of war. The better we understand one another, the better we will be able to accomplish our mission.

Both of our armies have an old expression: "The NCO is the backbone of the Army." I am convinced this is true, but what does it really mean? The backbone gives the body bearing, strength and a self-confident appearance. The same is true of the NCO. He gives the Army bearing, strength and self-confidence. Without a backbone, the body is limp. Without NCOs, an army is unstable—lacking the necessary broad-based strength and technical know-how.

The position occupied by the first sergeant within the Army is special. In the German Army there is an old, affectionate nickname for him: *Mutter der Kompanie* which literally means *mother of the company*. He

is, in fact, like a mother to his troops. Without him, nothing functions. However, he often is not praised, promoted, heeded, or recognized commensurate with his importance.

Let me now offer some fundamental thoughts about the first sergeant in the 1980s:

- He cannot be desk-bound.
- He must be concerned about all soldiers entrusted to him... go to them... talk to them... and, particularly during exercises, he must live with them.
- He should be the mediator between the NCOs and the troops.
- He is the doorway to the company commander and commits a grave sin when he shuts off the company commander from his soldiers for bureaucratic reasons; exactly the opposite is expected of him.
- Moreover, he should be the guardian of his men, preventing them from doing anything stupid—a fatherly friend who points them in the right direction in life.

What does this mean? The first sergeant should ask his soldiers about their troubles and worries. He

should take care of the sick. He should take an interest in personal events such as marriages, deaths, accidents, or illness. The duty roster of the company should be impartial and fair. It should not be left to a clerk to decide who has weekend duty.

The first sergeant must personally look after his men when they have outdoor duty or are on exercises. Day and night, under any weather conditions, he must ensure a steady supply of food, hot or cold beverages, and other necessities, particularly to those on isolated posts.

His soldiers must feel that, although they are alone at an obstacle or outpost, the first sergeant is thinking of them and will take care of them. Like a real mother, he always knows where to find his unit or subelement. Whether his soldiers are away on temporary duty or hospitalized, the first sergeant keeps track of everyone. A mother always knows where her children are, leaving none to their own fate.

The first sergeant is expected to take care of those soldiers living in the barracks, even after duty hours, on weekends, and on holidays. He must be concerned about living conditions. Quarters inspections at every opportunity and irregular times are expected. During these visits, he should keep an eye on the quiet soldiers in particular; they are often the ones confronted with problems.

A good first sergeant is open-minded to soldiers' troubles, especially to those of young soldiers. This is more important now than in the past because many families no longer provide the necessary support to young people. In many cases, life in these families is disturbed. An alert first sergeant can resolve many problems before they create discipline problems. He also tries to speak the language of the younger generation.

Sometimes this builds bridges of understanding. Often the first sergeant can gain access to a soldier's thoughts by asking about his occupational background and friends. He must look into the faces of his men. There he will see the first

indications of trouble and worry. The suicide notes of many soldiers who took their own lives describe feelings of being left alone. Likewise, he may recognize the first signs of drug abuse in the expression on a soldier's face.

Usually the first sergeant is also the oldest NCO in the unit. He must be the leader of and set the example for the NCO corps—even in changing times. He must strive to keep the NCO corps together—despite the current trend to drift apart. It may be helpful to integrate the wives and fiancées into off duty events. He should school young NCOs in social manners so they feel secure in their military environment . . . and share the valuable tips and guidance he has gleaned in his career.

The first commandment for the first sergeant is *never tire*. Despite the rigorous routine and the endless stream of new faces, he must never lose heart and always be prepared to start over again. He must create a balance between administrative work and training his soldiers. A first sergeant who is devoured by paperwork is an NCO in the wrong position. Above all, a good first sergeant is dedicated to his occupation. It is not sufficient to consider his mission *just a job*.

Of course, the first sergeant must be physically fit. How could he otherwise meet the demands of his profession? How could he otherwise keep pace with his young soldiers? A first sergeant whose men regard him as *grandpa* will never have access to them.

Finally, a good first sergeant has a keen eye for detail . . . for cleanliness, order and punctuality. This applies particularly to the NCOs under his charge.

Clearly, the role of first sergeant is demanding. Only the best NCOs are called to fill it. All who are chosen for this professionally rewarding assignment should say, "I am proud to be a first sergeant."

Brigadier General Roland H. Zedler, now commandant of the Engineer School and Army Technical School for Structural Engineering (Pionierschule und

Fachschule des Heeres fuer Bautechnik) was deputy commander of the 6th Armored Infantry Division and commander of the Divisional Troops before his current assign-

ment. He is the author of numerous military publications dealing with command and control, including "Command and Control Systems of the Bundeswehr."



Hotline Q & A

Q. What are recent changes in engineer organizations?

A. The *engineer combat battalion (heavy)* has been reclassified to a Category II unit. This opens the entire battalion to women. The maintenance company and the headquarters company have been consolidated into a headquarters and support company.

The S-1 sections of the *corps mechanized* and *corps wheeled battalions* are being standardized with the S-1 sections of other engineer units. Two reconnaissance sections are being deleted, and the medical section is being reduced. The line companies remain unchanged.

Diving assets are being removed from all engineer TOEs and consolidated into diving detachments.

Topographic assets are being removed from the topographic battalion. Modular teams are being formed by functional area and will be resourced as each MACOM determines necessity.

Quarry assets are being formed into modular teams and are being removed from all engineer TOEs. Each MACOM will resource the requirements.

Q. How do we install an AN/GRC-160 radio on the M929 dump truck?

A. The recommended method is to order the general purpose kit MK1454 (NSN 5820-00-351-3003). See SB 11-131, *Vehicular Radio Sets and Authorized Installations*, for more information.

Q. Can Bangalores defeat all known single-impulse antipersonnel mines and will they defeat any known antitank mines?

A. Bangalores will not defeat the Soviet PFM-1 antipersonnel mines and are not recommended to breach minefields containing antitank mines.

Q. What is required to conduct a river reconnaissance?

A. The commander dictates what information he wants about the river. Typical requests include—

Hasty route reconnaissance — Subordinate unit will turn in a DA Form 1711-R and an overlay identifying water features. The commander may request other reconnaissance forms on specific water features, but time is a factor.

Deliberate route reconnaissance — Subordinate unit should have time to conduct a thorough reconnaissance of the area. The unit will turn in a reconnaissance report (DA Form 1251 or 1252) on each ford or ferry.

Engineer reconnaissance — Subordinate unit will conduct a reconnaissance for water points or possible water points. The unit can record several water points on DA Form 1711-B.

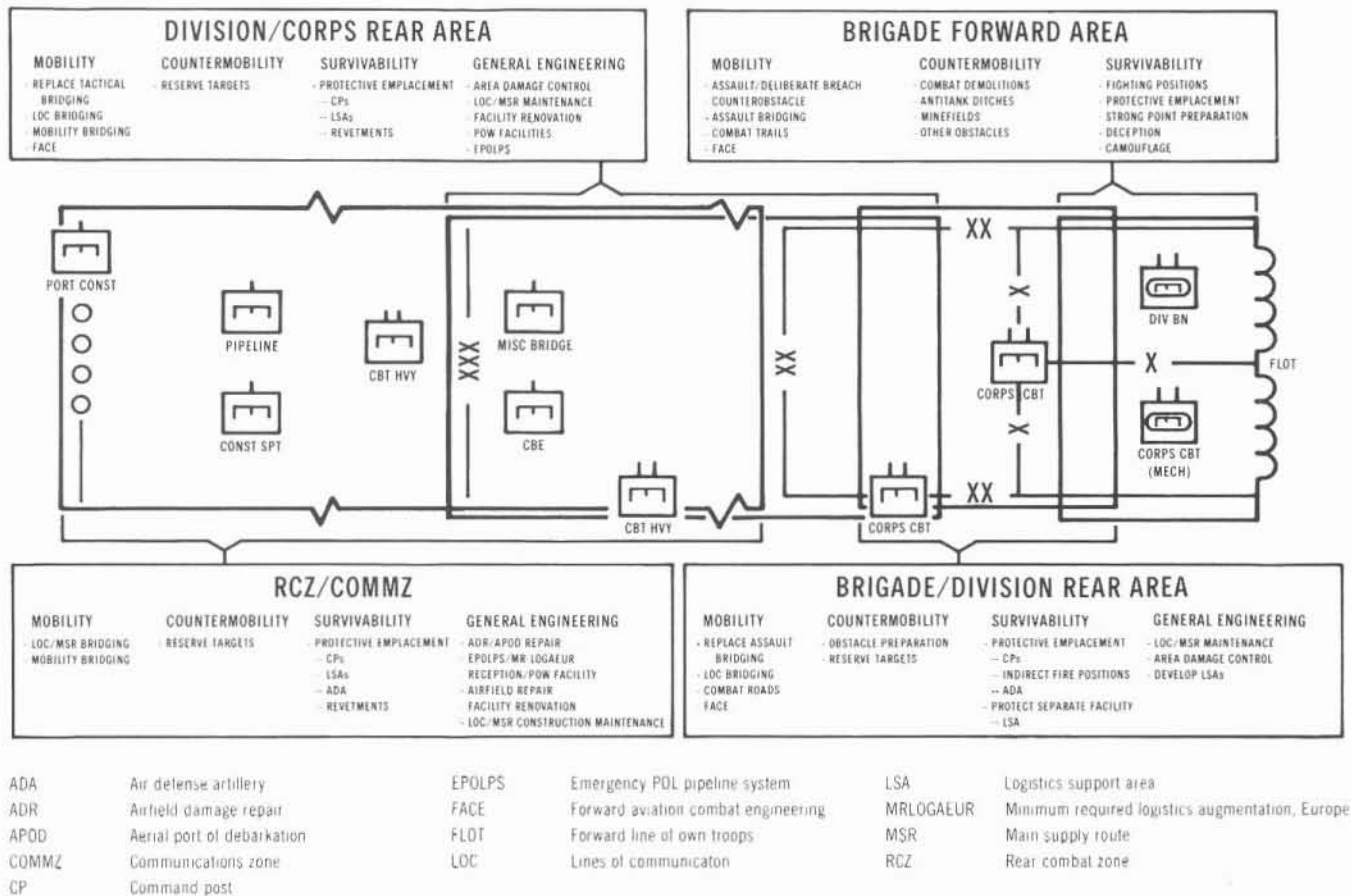
Q. How can I get the Combat Engineer Game?

A. The Combat Engineer Game (GTA 5-14-1) is available from training audiovisual support centers (TASCs) located at most installations.

Do you have problems, questions or comments relating to engineer doctrine, training, organization, or equipment? Call the Engineer Hotline. You'll receive a reply within 3 to 15 days.

The Hotline telephone number is (703) 664-3646; WATTS 800-336-3095, extension 3646; or AV 354-3646.

Engineer Battlefield Layout



by CPT Daniel Russell

Engineers perform a variety of support missions throughout the depth of the battlefield. These range from sapper-oriented combat engineering for forces facing the enemy to specialized general engineering like port construction for the theater.

The figure depicts a typical division slice of engineer units and their missions. The battlefield is divided into four regions:

- The brigade forward area.
- The brigade/division rear area.
- The division/corps rear area.
- The RCZ/COMMZ.

They overlap because in reality the boundaries for engineer missions

aren't clearly delineated. The overlap also emphasizes the need for coordinated engineer effort.

Most missions in the brigade forward area and the brigade/division rear area are mobility, countermobility and survivability tasks. Therefore, troops near the FLOT are primarily combat engineers. Mechanized combat engineers operate within the brigade forward area, and wheeled combat engineers work in the brigade/division rear area.

Moving rearward from the FLOT to the RCZ/COMMZ, the missions shift to general engineering and survivability. Construction engineer

units (combat heavy, equipment companies and bridge companies) operate in the division/corps rear area.

Specialized units such as pipeline and port construction companies are located in the RCZ/COMMZ.

CPT Daniel Russell is assigned to the Force Design Branch of the Directorate of Combat Developments at the Engineer School. He has served as a platoon leader and XO of the 814th Engineer Company (RB) in Hanau, Germany. He is an EOAC graduate and has a degree in mathematics from the University of Texas at Arlington.



by Bruce Barclay

Military engineers can earn journeyman status in technical trades while in the Army. Soldiers receive apprenticeship credit for military training in such diverse specialties as plant equipment operator, surveyor, rigger, firefighter, and electrician.

The Army Apprenticeship Program was created in 1973 in cooperation with the U.S. Department of Labor. Studies show that those who complete apprenticeship programs learn faster, earn more, and often become supervisors.

To qualify, you must learn your occupation through on-the-job training and technical instruction. Apprenticeship involves at least 2,000 hours experience with manual, mechanical or technical skills related to commercial industry. It cannot involve selling, management, clerical work, or one of the professional fields.

Enrollment

Your post's education center handles apprenticeships. A counselor will explain the options available for your MOS and provide the forms. You must be in the Active Army and hold the required MOS as a primary or secondary specialty.

On-the-Job Training

Once enrolled, you must keep a log of your work experience on DA Form 4567-R, *Apprentice Daily Work Experience Record*. You may earn up to 132 hours of credit a month. Your supervisor initials the entries and notes special pieces of equipment or unusual projects. At least quarterly, the local education center checks your records.

You may receive credit for experience or training while on active duty before you joined the program.

Army apprenticeship program

You may also transfer credit if you were enrolled in a federally or state-approved apprenticeship program before enlisting.

Technical Instruction

Each year, you must complete 144 hours of related military or civilian instruction—resident or nonresident. The Engineer School evaluates civilian courses.

Certification

An Army apprenticeship usually takes longer than one enlistment. Most programs call for 6,000 to 8,000 hours of hands-on experience and 432 to 576 hours of related instruction. Your documentation of work experience and related instruction is reviewed by the education center, the Engineer School, and TRADOC.

The U.S. Department of Labor's, Bureau of Apprenticeship Training issues a certificate of completion.

If you leave the Army before completing your apprenticeship, the education center provides a record of enrollment, DA Form 5004-R, that documents your work.

The U.S. Department of Labor considers Army apprenticeships equal to civilian programs and recommends that employers consider military apprentices as journeymen.

For more information, write: Commandant, U.S. Army Engineer School, ATTN: ATZA-TD-UI (Mr. Barclay), Fort Belvoir, VA 22060-5291, or call (703) 664-2498, AV 354.

Bruce Barclay is the Engineer School's action officer for the Army apprenticeship program.

Engineer School Apprenticeship Program

Program, Number and Skill Code	MOS	DA Pam
Plant Equipment Operator 99901-01	62G, 62H	621-76
Grading and Paving Equipment Operator 99901-02	62E, 62H, 62J	621-77
Heavy Duty Repairman (Construction Equipment) 99901-03	62B	621-78
Universal Equipment Operator (Construction Equipment) 99901-04	62F	621-79
Carpenter 99901-05	51B	621-84
Plumber/Pipelitter 99901-06	51K	621-85
Electrician 99901-07	51R	621-86
Firefighter 99901-08	51M	621-116
Refrigeration/Air-Conditioning Repairer-Servicer 99901-09	52C	621-115
Lithographer (Offset Press Operator) 99901-10	83F	621-112
Drafter (Architectural) 99901-11	81B	621-113
Industrial Electrician/Repairer 99901-12	52E (Electrical ASI)*	621-117
Power House Electrician Repairer 99901-13	52E (Mechanical ASI)*	621-118
Rigger 99901-14	12B, 12C, 51C, 51H	621-123
Surveyor (Engineering) 99901-15	82B, 82D	621-107
Lithographer Plate Maker 99901-16	83E	621-142
Stripper, Photolithographic 99901-17	83E	621-141
Photographer, Lithographic 99901-18	83E	621-143

*A 52E can enter either 99901-12 or 99901-13. The indicated ASIs show which branches of 52E perform the specific duties for each apprenticeship program.



Career Notes

Commissioned Officers Branch

Joint Assignment Proposed:

You should have at least one joint assignment if you want to qualify for general officer. Recent reemphasis by the Vice Chief of Staff, U.S. Army, and DoD Directive 1320-5 outline the requirement for a joint assignment. This requirement can be satisfied by serving in one of the following:

- Office of the Secretary of Defense.
- Office of the Joint Chiefs of Staff.
- Joint, combined, allied, or unified commands.
- Department of Defense agencies.
- Other government agencies.
- Military assistance advisory group or military group.
- Exchange tours with allied or sister services.

Engineer Advanced Civil School Board:

Branch-qualified officers interested in attending advanced civil schooling in FY 87 should apply for graduate school under provisions of AR 621-1. If you are interesting in teaching at the United States Military Academy, attending school fully funded, or entering the degree completion program, you must send your application to Engineer Branch before August 30, 1986.

CSC Schooling for LTC Promotion:

If you have not completed Command and Staff College (CSC) schooling before the LTC promotion board meets, you will not be selected.

A proposal to make CSC a requirement for promotional consideration could be in effect in 1988—primary zone for year group '73.

You are eligible for selection to resident CSC for four consecutive years—beginning the year you are selected for major. If you are not selected by the second year, start nonresident Army Command and General Staff College (CGSC)—the only nonresident qualifying school. This gives you enough time to complete the nonresident course, but does not affect your selection for the resident course.

About 50% of a year group will be selected for resident schooling and 70% for promotion.

CPT/CVI Board:

The December CPT/CVI board was a best qualified, not fully qualified board. Results were released in March.

- Individuals selected for captain who requested Voluntary Indefinite Status were selected for CVI.
- USAR officers must initiate the request between the 24th and 27th month of active federal commissioned service.
- There is no procedure to notify officers of their eligibility.
- Late requests will not be accepted.

NCO and Enlisted Soldiers Branch

NCO Notes:

All promotable E-5s who did not attend PLDC were removed from the standing promotion list July 1, 1986. Beginning March 1, 1987, you must have a high school diploma or its equivalent to appear before an E-5 promotion board.

Attention: 51H E-6s and E-7s. You must review and update the principal duty block on your DA Form 2-1, Section VII, Record of Assignment. Often, the principal duty title of *construction foreman* or *construction supervisor* is masking leadership positions (*squad leader* or *platoon sergeant*). Only a cross-reference with the appropriate EER details these assignments as leadership positions.

Recent promotion boards indicate successful leadership assignments are essential to recommendations for promotion. If your DA Form 2-1 states *construction supervisor* or *construction foreman*, you might not receive credit for serving in a leadership position. Your MILPO can add *platoon sergeant* or *squad leader* to your principal duty title.

MILPERCEN Hotline:

The Enlisted Engineer Career Branch now has a 24-hour Hotline—(703) 325-7150, AV 221-7150. When asked for the number of the person you are calling, dial 325-7710. Then follow further instructions. Leave your full name and social security number. Your career advisor will respond the following day during normal office hours (0700-1530).

Engineer Enlisted Personnel Office:

		CMF	(703) 325-xxxx AV 221-xxxx
Branch Chief	LTC Jack E. Weber		8329
Branch SGM	SGM James M. Welsh		8327
Senior Career Advisor	MSG William Kagee	12/81	7710
Senior Civilian Supervisor	SFC James Livers	12/51/81	7710
Career Advisor	SFC Richard Krohn	51	7710
Senior Career Advisor	SFC Lowell Abney	12	7711
Civilian Supervisor	Ms Toni Gibson	12	7710
Civilian Supervisor	Mr. Steve Patchan	51	7711
Professional Development NCO	SFC David Broadus	12/51/81	7710
Schools Assignment Manager	Ms Cleo Dugger		8326

(continued from inside front cover)

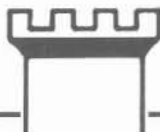
train, plan, research, investigate, reflect, and debate, we must remember some good counsel from *Infantry in Battle* that "elasticity of mind" is an "indispensable requisite when practicing the art of war."

As former TRADOC Commander GEN William R. Richardson said when he introduced the newly revised edition of FM 100-5, "Every officer must understand that the great value of our doctrine is not the final answers it provides but, rather, the impetus it generates toward creative and innovative solutions to the problems of combat."*

MAJ David J. Block and MAJ Gary W. Baumert were partners in a research project on the effects of minefield patterns on the probability of kills on armored vehicles during a master's degree program in operations research and systems analysis at Florida Institute of Technology.

MAJ Block is currently assigned as an ORSA analyst for casualty estimation at HQDA, ODCSPER. Previous assignments include experience in minefield emplacement as the company commander of the 84th Engineer Battalion in Vietnam. He was also a company commander with the 293rd Engineer Battalion in Germany. In addition to a master's degree at FIT, he holds a bachelor's degree in engineering from Alfred University and an MBA from Central Michigan University.

MAJ Gary W. Baumert is an ORSA analyst for integrated warfare at the U.S. Army Concepts Analysis Agency. He has served as XO of Company B, 11th Engineer Battalion (CBT) at Fort Belvoir, and commanded chemical units for the 9th Infantry Division and the 56th Field Artillery Brigade (Pershing) in Germany. He holds a bachelor's degree in zoology from the University of Colorado in addition to a master's degree from FIT.



Engineer Solution

Step 1. Type of fence

- Determine the perimeter $200 + 400 + 450 + 430 = 1,480$ meters
- Determine the effective length $1,480 \times 1.10 \times 2 \text{ belts} = 3,256$ meters
- Determine the number of 300-meter sections $3,256 / 300 = 10.8$ sections
- Determine the logistics for the three fence types (Use Table 4-3, page 109 in FM 5-34)

4- and 2-Pace Wire 10.8 sections (300m each)	Concertina 10.8 sections (300m each)
Long pickets $10.8 \times 100 = 1,080$	$10.8 \times 160 = 1,728$
Short pickets $10.8 \times 200 = 2,160$	$10.8 \times 4 = 43.2$ round up to 44
Reels of barbed wire $10.8 \times 15 = 162$	$10.8 \times 3 = 32.4$ round up to 33
Rolls of concertina	$10.8 \times 59 = 638$
Man-hours (MH)	
$10.8 \times 59 \text{ MH} \times 1.2$ (U-shaped picket value) $\times 1.5$ (night factor) $\times .67$ (experienced troops) = 768.5 MH	$10.8 \times 30 \text{ MH} \times 1.5$ (night factor) $\times .67$ (experienced troops) = 325.6 MH
Combination Fence	
1 belt of 4- and 2-pace wire	1 belt of concertina
Long pickets $100 \times 4.93 = 493$	$160 \times 4.93 = 789$
Short pickets $200 \times 4.93 = 986$	$4 \times 4.93 = 20$
Reels of barbed wire $15 \times 4.93 = 74$	$3 \times 4.93 = 15$
Rolls of concertina	$59 \times 4.93 = 291$
Man-hours	
$59 \times 4.93 \times 1.5$ (night factor) $\times .67$ (experienced troops) = 292 MH	$30 \times 4.93 \times 1.5$ (night factor) $\times .67$ (experienced troops) = 149 MH
TOTAL $292 + 149 = 441 \text{ MH}$	

- You have enough short pickets for either the concertina or the combination fence. Since time is critical, the concertina fence will require fewer man-hours for construction.

Step 2. Total man-hours

- Calculate the mortar emplacement man-hours.

81mm mortar emplacements	$3 \times 12 = 36$
4.2-inch mortar emplacements	$2 \times 29 = 58$
b. Add the man-hours for concertina.	<u>325.6</u>
TOTAL	419.6 MH

*GEN William R. Richardson, "FM 100-5: The AirLand Battle in 1986," *Military Review*, March 1986.

Engineers in Italy

The Port of Naples

by Dr. William C. Baldwin
Office of History, OCE

The first major western Allied landings on the European continent during World War II came in the summer of 1943. After the conquest of Sicily, the British Eighth Army crossed the straits to the tip of the Italian peninsula.

A few days later, on September 9, 1943, LTG Mark W. Clark's Fifth Army—composed of an American and a British corps—landed on the beaches around Salerno, just south of Naples. Although Italy surrendered on the eve of the Salerno landings, the Germans offered strong resistance. The Fifth Army did not reach the port of Naples—its first major objective—until October 1.

Naples was the second largest port in Italy, and Fifth Army planned to make it an important logistical base.

Before Naples' capture, the invasion force brought its supplies and equipment across the Salerno beaches. However, in late September a violent storm disrupted unloading for several days. By October 6, Fifth Army had only a three-day supply of gasoline. With British and American troops pushing north of Naples to the Volturno River, it was essential to open the port and establish a firm logistical base.

Allied bombings and German demolitions left the city and port in shambles. The Germans sank 32 large ships and hundreds of smaller vessels in the harbor. Many were next to the piers the Allies would need for unloading. German engineers wrecked all the cranes in the



Engineer ingenuity converted sunken ships into pier supports, opening the Naples port within 48 hours. Turning defeat into an asset, engineers thwarted German attempts to close the port.

Photo: Signal Corps

city, using demolitions to topple wharf cranes into berthing spaces.

In the port area, they destroyed large buildings and warehouses that had escaped Allied bombing—making sure the debris blocked streets, wharves and berths. To complete their denial operations, the Germans disrupted the railroads, water supply, sewers, and electrical facilities. The city of Naples and its port required extensive, rapid rehabilitation before they could support the Fifth Army.

On the morning of October 2, 1943, engineer operations began. Troops from the 1051st Engineer Port Construction and Repair Group began surveying the damage in the harbor while soldiers from the 540th Engineer Combat Regiment and the 111th Engineer Combat Battalion cleared rubble from the streets and quays.

The most pressing task was to provide berths so large cargo vessels—called Liberty ships—could unload at piers. Scuttled ships blocked most of the piers but removal would be too difficult and time-consuming. The engineers decided to improvise berths by incorporating the bodies of downed vessels into the piers.

Starting with the ships sunk on an even keel, engineers removed the superstructures and built timber and

steel ramps over the ships. Liberty ships could then tie up next to the sunken vessels and unload into trucks waiting on the ramps.

One scuttled ship lay on its side, but it had a flat bottom so the engineers built a ramp on the side of the sunken vessel, and Liberty ships tied up alongside to unload. In addition to opening berths, engineer units of BG Arthur W. Pence's Peninsular Base Section cleared roads; repaired rail lines; and rehabilitated the city's water, sewer and electrical systems.

On October 4, the first Liberty ship unloaded cargo in Naples. Three days later, 3½ Liberty ship berths were available. By the end of the month, engineers had opened 13½ berths for Liberty ships and 6 for smaller vessels. Engineer ingenuity—symbolized by the improvised piers in the harbor—helped provide Fifth Army with a port and the logistical base for the long and difficult campaign to push the Germans out of Italy.

Suggestions for further reading:
Engineer History, Mediterranean Theater, Fifth Army, 3 vols.

COL Joseph S. Grolinski, "Naples: Case History in Invasion," *The Military Engineer* 36 (April 1944): 109-14.



Latin America is "where the action is" for realistic training (story, p. 17). Here, the 205th Engineer Battalion, Louisiana National Guard, constructs one of many low-water crossings during Blazing Trails in Panama.

Photo: CPT Daniel B. Miles Jr.