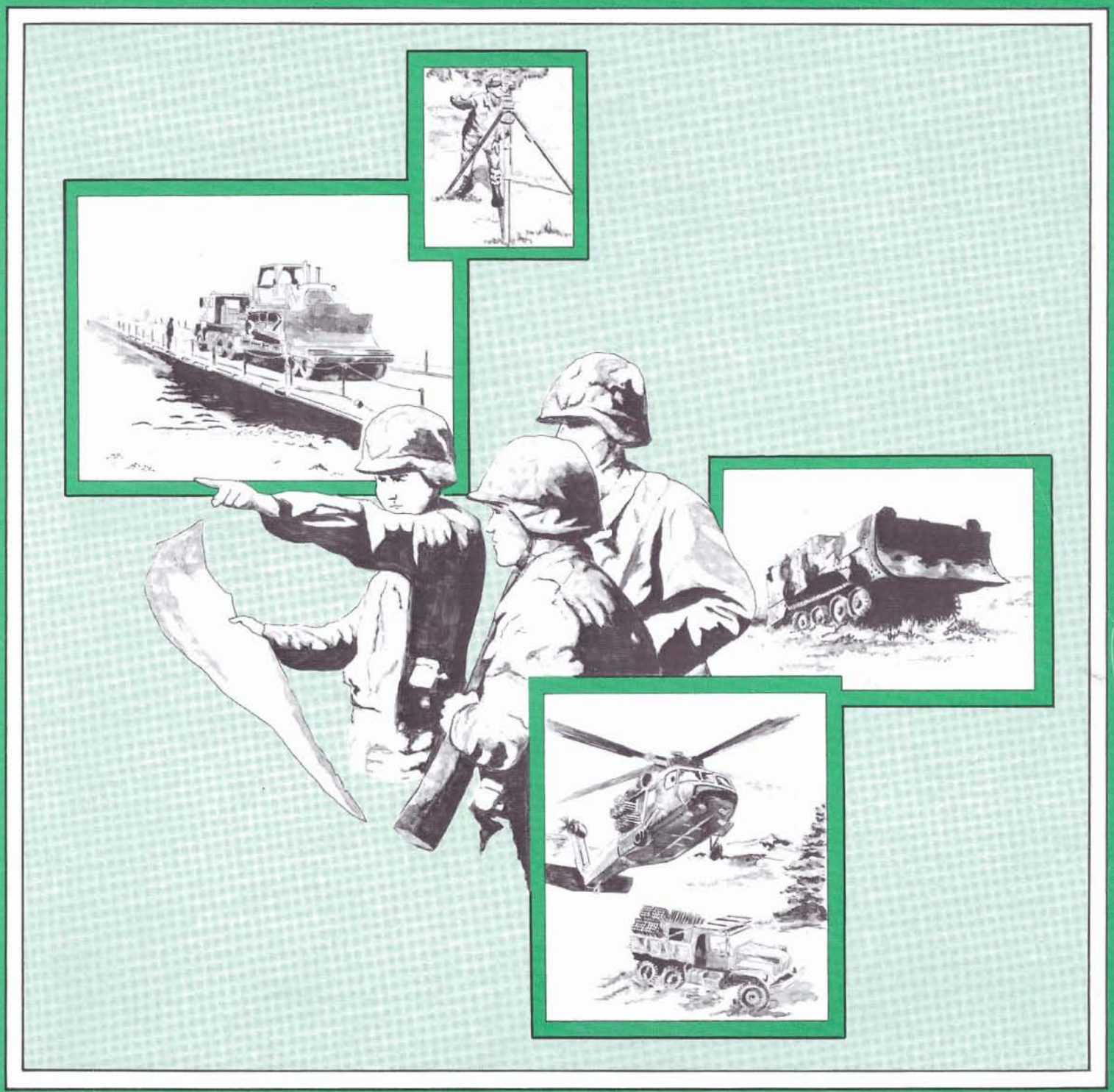
Engineer

THE MAGAZINE FOR ARMY ENGINEERS

FALL/WINTER 1986



COMBAT ENGINEER/TOPOGRAPHIC ENGINEER TEAM

ALSO: LIGHTENING THE LIGHT ENGINEER'S LOAD THE BLADE EFFORT TRIANGLE
THE PROFESSIONAL ENGINEER EXAM

A Personal Viewpoint

LIGHTENING THE LOAD OF THE LIGHT ENGINEER

by 1LT Thomas P. Smith

Of necessity, most of the light engineer soldier's load will be demolitions—cratering roads, knocking down walls and felling trees to create landing zones or to build expedient bridges.

But the Engineer School, the Waterways Experiment Station and the Army Materiel Command are realizing that the demolitions load is too heavy. Unless it's compact and versatile, it's incompatible with light engineers.

For example, a road crater currently takes up to eight 40-pound cratering charges—charges that eat space and can only be used for one purpose—making craters. Similarly, Bangalores are bulky and tailored to a specific task.

Last July, the 65th Combat Engineer Battalion, 25th Infantry Division (Light), helped the Army experiment with several explosives systems now under research and development for heavy forces, hoping they would hold promise for the light.

Under the supervision of WES, we tested—

- Self-forging fragment weapons system ballistic disks.
- XM-268 slurry.
- The rifleman's assault weapon.

We wanted to know not only whether ballistic disks will breach walls, but can they be hand-packed and fired from long distances? And can materials for the disks be found and fabricated on the battlefield?

We were interested not only in whether slurry creates better craters, but will it also breach walls? And can it be repackaged into flexible, backpackable loads?

The results raised some interesting possibilities, and the Engineer School has asked WES to follow up with further research.

Self-Forging Fragment Weapons System

Ballistic disks—copper or aluminum disks of varying shapes and thicknesses—were tested. This type of system is already widely used in antiarmor munitions.

The disks weigh only four pounds and don't take much space. They offer light engineers a possibility for breaching walls and obstacles (or hitting targets such as fuel storage tanks) from extended standoff distances.

The disks were placed inside short lengths of PVC pipe and packed on one side with C4—the engineer's most versatile explosive.

The disks worked well against concrete walls at a standoff distance of 20 feet—blowing a 12-inch hole in reinforced concrete that was big enough for a soldier. It did not cut the rebar, however—a deficiency that must be overcome by research and development.

The 65th also experimented with the ballistic disks as a way to make one-man fighting positions by firing the disks directly at the ground. The results were less than hoped, but research efforts could improve the explosive foxhole digger concept.

Overall, the tests demonstrated that the disks forge a slug that travels accurately over extended distances and offer a prospective low volume, lightweight breaching capability.

Slurry

If XM-268 slurry—a liquid explosive nearing the final stages of development—can be packaged for light soldiers, it offers an excellent alternative to standard military cratering charges.

The slurry consists of two nondetonatable chemical ingredients that become explosive when mixed.

It is under consideration as the liquid explosive for the Tactical Explosive Systems—to reduce embankments and create antitank ditches and road craters for the heavy force. Normally, it comes in 55-gallon drums to be mixed in large batches.

Possibly, smaller quantities could be packaged so soldiers could carry the ingredients in their rucksacks and mix them without special equipment.

During experiments, the 65th successfully devastated a triple-standard concertina obstacle by pouring the slurry, like paint, into 8-foot lengths of schedule 40 PVC pipe.

A rag was stuffed in one end, then chemicals were poured in. The explosive was primed, and another rag was used to plug the pipe. Soldiers spent only five minutes preparing three pipes—demonstrating the slurry is easy to use if a suitable container can be improvised.

The slurry also created a road crater larger than the conventional 40-pound cratering charge.

In another experiment, the 65th poured the slurry into an MRE bag and taped the bag to a telephone pole. One pound of the explosive cut a twelve-inch-diameter pole.

Rifleman's Assault Weapon

The RAW also offers interesting possibilities as a relatively lightweight, compact alternative to recoilless weapons like the 90mm rifle and the LAW.

This rifle-launched munition, which is in the early design stages, weighs less than 7 pounds. It fires lines of sight with little backblast.

The RAW blew a hole 12 inches in diameter in a 12-inch-thick, reinforced concrete wall. In an 18-inch-thick wall, 3 rounds produced destructive spalling; 5 breached it.

By comparison, it took 3 rounds to breach a 23-inch wall using the shoulder-launched multipurpose assault weapon—now used by the Marine Corps.

Potentially, the RAW offers light infantry soldiers high firepower without significantly increasing their load.

(continued on page 40)

Engineer

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On the Cover

Topographic engineers are a force multiplier for the combined arms team.

Art: Jeanne Elmore

FEATURES

DEPARTMENTS

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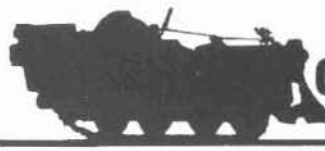

CLEAR THE WAY

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

View terrain through the eyes of topographic engineers

Terrain must drive a commander's concept of operation. But too often its effects and limitations are considered after the fact or not at all.

When this happens, we sell the METT-T analysis short and risk self-defeat...because two of those ***Ts*** are crucial to the way commanders prepare the battlefield:

- ***T*** for terrain because you don't just consider it, you can do something about it.
- ***T*** for time available because if you fritter away time trying to develop a concept, you can't shape the terrain to your advantage.

Thus, all combat engineers have a stake in the topographic mission. We must give commanders the answers they need to maneuver in the right place...without wasting resources. If we succeed, this may well be our greatest single contribution to future battles.

That's why all combat engineers must be the commanders' experts on the use of terrain and view terrain through the eyes of the topographic engineer. Our goal must be to get commanders to assess terrain implications ***before*** they prepare their commander's concept of operation.

We recently revised Army doctrine for topographic operations to clarify intelligence and engineer staff responsibilities at all levels of command. This issue of ENGINEER offers a preview of the new doctrine, FM 105-5, *Topographic Operations,* which will be published during FY 87.

The division engineer, in particular, has ***new*** responsibilities as the chief terrain advisor to the division commander. The brigade engineer must fulfill this role for the maneuver brigade commander.

Although the G-2 will continue to task the terrain team working in the All Source Intelligence Center at division, division engineers—who, lamentably, have often had little interaction with terrain teams—must learn to tap this resource. An NCO from the terrain team will support the division engineer by working in the assistant division engineer's office.

The division terrain team is also being expanded to meet the growing demand for terrain analysis.

Terrain analysis has come a long way since 1981 when the first division terrain teams were fielded and commanders and staffs at all levels routinely failed to consider terrain while developing their operational plans.

When tactics were taught, instructors would sweep their hands across the wall map, moving divisions here and there as if anything were possible. Problems were assumed away, *"Move the main attack along Avenue Strike,"* regardless of terrain realities...realities like narrow corridors, poor off-road mobility and difficult gap crossings that literally pinch the attacking brigade down to a single column of moving tanks.

That picture has changed dramatically. Terrain teams are now staffed with highly qualified enlisted soldiers and warrant officers who have access to tactical terrain analysis data bases and the All Source Intelligence Center.

The result: commanders are discovering the value of consulting their engineers. For example, at Fort Bragg the G-3 once announced the terrain team had saved the 18th Airborne Corps from certain disaster by determining that the terrain was ill suited for the airborne, airmobile and mechanized infantry operations envisioned in the commander's initial concept.

Similar lessons have been learned in other divisions and corps. Thus, the expectations and demands on engineers are growing. You must acquire terrain sense and be prepared to integrate your understanding of terrain into maneuver and firepower planning. You must be able to navigate with assurance...to apply tactical principles to infinite varieties of terrain quickly and intuitively...to recognize the effects of weather on terrain and battlefield operations.

All combat engineers must be closely allied with their topographic counterparts. Get to know each other personally—share one another's expertise. Get the special security clearances you need to learn the capabilities of terrain analysts working with the All Source Intelligence Center.

You must know how tailored products derived

BRIDGE THE GAP

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

There is something unique about a map. It's worthless unless it shows terrain of immediate interest. And then it's the most important piece of paper in the world.

Without a map to negotiate the terrain, you are quite simply and literally lost.

That was never clearer to me than while I was at a Chinese rough terrain school in Taiwan—***rough terrain*** meaning you must air drop into any terrain and do your job.

In the haste to deploy, the American members of the party jumped without a map. We landed in a rugged area—two men shattered their legs—and we hadn't a ghost of an idea where we were. We had radios, but without a map how could we tell the rescue party where to find us?

Some of us struggled our way to a road. But which road? Where did it go?

An operation that should have taken 4 hours took 15 while the injured soldiers, one caught in a tree, waited—all for want of a map. A simple piece of paper was the vital missing link.

A map is your eyes beyond your eyes—it lets you see miles in front of you, to your right, to your left, and behind.

Wrapped in mylar, it's the record where you make notes on your surroundings. It's where you identify your route and the conditions you found. What's been built? What's been demolished? How has mother nature altered the terrain? Are the road, bridge and soil classifications accurate?

At the end of each mission, you must share your map notes. They hold invaluable information for the soldiers who come next. But only if topographic engineers get the chance to incorporate your findings into their terrain data bases and pass the word.

If you think maps are worthless, you haven't learned their language. Maps are keepers of the faith for soldiers who know how to read them.

They tell you what's on the other side of the hill...where the enemy is likely to hide...how steep the slope is...whether there is a short cut...where the next drop zone will be...where to stash a food cache, look for water or plan a rest stop.

In Vietnam when my reconnaissance team went out, the first thing we asked for was a map. When I was chased, I'd throw everything away except my map, my compass and my weapons. If the pursuit continued, I'd shed the weapons; but I never gave up my map or the compass around my neck. They were the keys to coming out of the jungle.

It is imperative that every engineer soldier be able to use a map as well as he uses a dozer. If you are set down by a river and told to build a bridge, you might as well not start if you don't have a map. That map is as essential a piece of your equipment as the reinforcement bar that goes into the bridge.

After all, there is something that sets maps apart from the rest of a soldier's equipment. The infantryman can shoot his rifle, the aviator fly his plane, the engineer operate his dozer anywhere in the world. But a pack full of the maps of Europe and Korea won't help you in Grenada.

A map is worthless unless the terrain is of immediate interest. And then it's the most important piece of paper in the world.

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from terrain data bases can be used to guide tactical decisions and learn how you can help fill voids in those data bases during reconnaissance missions.

Finally, give high priority to ***your responsibility*** to understand terrain...to be the maneuver commander's expert on terrain, terrain effects on operations, movement through terrain, and terrain reinforcement through obstacle emplacement and construction of fighting positions.

Terrain analysis is the linchpin of the mobility, countermobility, survivability and general engineering missions...the heart of our contribution to AirLand Battle.

News & Notes

Assault River Crossing Operation

During a recent field exercise, Company A, 326th Engineer Battalion (Air Assault), built an expedient footbridge using aircraft cargo pallets. This bridge enabled infantry units to maintain contact with opposing mechanized forces without losing momentum.

The engineers used heavy drop pallets and 463L aircraft cargo pallets to build the bridge. Before the crossing started, engineers spanned the river with two steel cables. Anchored with deadmen, these cables provided extra stability for the bridge.

The rest of the construction was easy; they floated the pallets on the water and, using rings on the pallets, attached the pallets to each other with snap links. Finally, they snapped the bridge to the cables. The entire operation was performed quickly and quietly.

Lessons learned on the operation include—

- The 463L pallets are easier to use than the heavy drop pallets. Construction with 463Ls took half the time as with heavy drop pallets.
- Using the cable, 100 meters of bridge can be built in 1 hour.
- The cables are not necessary, but add stability when crossing troops.
- Since each pallet can hold the weight of a man and his equipment, this bridge could span any gap.
- Kedge anchors or shore guys could be used on bridges spanning rivers with strong currents.
- Because all preparation is below ground (deadmen) or below water (cables), equipment may be placed without detection by aerial reconnaissance.
- An entire infantry battalion task force, including slice elements, can cross in under 3 hours.

Engineer Mechanization

Engineers from the 54th Engineer Battalion convoy M577 armored personnel carriers from the railhead to the motor pool. The 54th and 82d Engineer Battalions received APCs as part of a plan to change V and VII Corps engineer units from wheeled to mechanized TOEs. Three more corps combat engineer battalions—the 317th, 9th, and 547th—were mechanized in FY 87. The 78th and 237th are to be mechanized by FY 88.

Units stationed at Fort Ord, CA, were the first to receive the M9 armored combat earthmover as TOE equipment in May 1986. The fielding came after 4 weeks of new equipment training, which included classes in operator/organizational maintenance and tactical employment. Many other units are scheduled to receive the ACE in the near future.

MINE WARFARE VIDEO AVAILABLE

A 17-minute video tape, TVT 6-135, entitled "Employment of FASCAM" (family of scatterable mines) was distributed to TASCs in mid-November 1986. The tape provides the maneuver commander and combat engineers with information on the use and capabilities of these rapidly deployable mines. If unavailable at your local TASC, the tapes may be obtained from—

US Army Audio/Visual Center
Joint Visual Information Activity
ATTN: ASNV-OJVT-ID (McIntire)
Tobyhanna Army Depot
Tobyhanna, PA 18466-5102

School News

Department of Military Engineering (DME)

BNCOC Changes:

Bridge crewmen who graduated from the 12C primary technical course before 1 June 1986 should attend 12B30 combat engineer BNCOC to receive credit for BNCOC attendance. This course provides BNCOC leadership training for skill level 2, but contains more advanced skill level 3 technical training.

Graduates of this course are proficient in skill level 3 tasks and have received the progressive and sequential training required for NCOs.

The 12C20 BNCOC combines the Sergeants Major Academy skill level 3 leadership training with skill level 2 technical training. Graduates of this course, which started at Fort Belvoir in June, receive credit for attending BNCOC.

A 12C30 BNCOC for bridge crewmen will start at Fort Leonard Wood, MO, in FY 89. At that time, 12C soldiers will no longer attend the 12B30 combat engineer BNCOC.

Directorate of Combat Developments (DCD)

Management Initiatives:

DCD is now applying two new management tools, the TRADOC Organization Management System (OMS) and the 1987 Engineer Functional Area Assessment (FAA).

The OMS will make it easier to spot breakdowns between force structure and the personnel and equipment aspects of TOEs.

The 1987 Engineer FAA, scheduled for presentation to the Vice Chief of Staff of the Army in January 1987, will analyze specific units to identify and correct problems with training, doctrine, force structure and personnel.

Using these techniques, DCD plans to survey selected engineer units to confirm what equipment field units have and correct the accuracy of TOE data. Engineers in the field can expect to hear from this property-book-level survey beginning in September 1987.

For more information, contact LTC Robert H. McDonald, ATZA-CDO-FI, Fort Belvoir, VA 22060-5281, telephone (703) 664-3826, AV 354.

School News

Hand-held Calculator:

The Directorate of Combat Developments has recommended that CTA 50-909, *Field and Garrison Furnishings and Equipment,* be changed to allow engineers to requisition the TI-30 SLR solar calculator. Offering more than 50 functions, this calculator should help solve the many mathematical problems associated with typical field engineering tasks.

For more information contact James E. Mason, ATZA-CDO, Fort Belvoir, VA 22060-5281, telephone (703) 664-3502, AV 354.

Defense Mapping School (DMS)

DMA Reviews Survey Support Requirements:

The Defense Mapping Agency is reviewing geodetic survey support requirements. New, user-operated precise positioning devices may eliminate the need for topographic surveyors in the 1990s. The basis for this review is *The Army Position and Navigation Master Plan*, April 1986, which is the Army plan for position and navigation systems.

If these systems meet all geodetic survey support requirements, they will eliminate the topographic surveyor (82D) MOS.

Address your comments to: Director, Defense Mapping School, ATTN: CW3 Besch, Fort Belvoir, VA 22060-5828.

MOS Revisions for 83E and 83F:

Several changes are in store for the topographic engineer career management field. The Deputy Chief of Staff approved two revisions in June 1986.

Photo and layout specialist (83E)—Revisions to this MOS include skill level progression to staff sergeant. A secret security clearance will be required for all skill level 3 personnel.

Photolithographer (83F)—The title photolithographer will change to *printing and bindery specialist.* A secret security clearance will be required for all skill level 3 and 4 personnel.

Both MOSs will have revised duty position titles and standards of grade authorization. Mandatory training will be added.

CMF 81 Streamlined:

An electronic maintenance study recommended the consolidation of MOSs for topographic instrument repair specialist (41B) and fire control instrument repair specialist (41C) to streamline maintenance-specific occupations.

The Engineer School agrees with the concept and expects a final report with approval soon.

Engineer Personnel Proponency Office (EPPO)

EPPO 24-hour Hotline:

The Engineer Personnel Proponency Office now has a 24-hour hotline to answer questions—about structure, acquisition, deployment, sustainment, professional development or separation—that cannot be handled at the installation or MACOM level.

EPPO hotline numbers are: toll free 1-800-336-3095, extension 3646, (703) 664-3646, AV 354.

Regimental System Update:

The goal of the Corps of Engineers in the new regimental system is to enhance combat effectiveness by forming all engineers into one unit characterized by strong bonds of loyalty and commitment. Army Reserve and National Guard engineers are now recognized as part of the Corps, emphasizing the strong kinship between Active and Reserve Components.

To further enhance the unity of the Corps, the Engineer School Brigade was redesignated the 4th Engineer Brigade, honoring the distinguished WWII unit of that name. In a November 7th ceremony, COL George T. LaBlonde turned over command of the brigade to COL Roger C. Strom, formerly Fort Belvoir's Director of Military Logistics.

At the same time, the 1st and 3d Battalions became the 809th and 554th Engineer Battalions, respectively, both also units with historic combat records.

At a ceremony held at Fort Leonard Wood on 28 September 1986, the following engineer units were redesignated: 1st Training Support Brigade became 136th Engineer Brigade; 2d Training Brigade—132d Engineer Brigade; 1st Battalion, 2d Brigade—35th Engineer Battalion; 2d Battalion, 2d Brigade—31st Engineer Battalion; 4th Battalion, 2d Brigade—589th Engineer Battalion; 4th Training Brigade—1st Engineer Brigade; 2d Battalion, 4th Brigade—87th Engineer Battalion; 3d Battalion, 4th Brigade—169th Engineer Battalion; and 4th Battalion, 4th Brigade—577th Engineer Battalion.

Distribution of the new Corps of Engineers crest has been delayed until FY 87 for active and reserve units. AAFES clothing sales stores began stocking these items in November. Ultimately, the crest will be issued to enlisted personnel, but officers and warrant officers must purchase their own. Wearing of the crest is governed by AR 670-1 and is optional for all personnel.

School News

Directorate of Evaluation and Standardization (DOES)

Lessons Learned Message:

The USAES *Quarterly Lessons Learned Message*—containing information from NTC, Team Spirit, Blazing Trails and REFORGER—has replaced the *Task Force Engineer/Combined Arms Package.*

For more information, contact: Commandant, USAES, ATTN: ATZA-ES, Fort Belvoir, VA 22060-5271. POC is CPT Craig Tavani, (703) 664-4172, AV 354.

DOES Staff Changes:

LTC John Carey is the new director of the Directorate of Evaluation and Standardization at the US Army Engineer School.

LTC Otis Williams is the new chief of the Evaluation and Standardization Division, DOES.

Reserve Component Advisory Staff (RCS)

Advice for EOAC Students:

If you are an Army Reserve officer planning to take the Engineer Officer Advanced Course at Fort Belvoir, remember that most Reservists are on TDY status (less than 140 days).

Plan to live off-post. Bring enough money to pay initial expenses. Fort Belvoir is a high-cost area and uses the "lodging plus" system.

More details about this system are in the *Advanced Course Welcome Packet.* Complete your plans at least six weeks early so C Company, 3d Battalion, can send your packet on time.

If you have received your orders but not your packet, call C Company toll free 1-800-336-3095, extension 2184, commercial (703) 664-2184, AV 354.

Directorate of Training and Doctrine (DOTD)

SQT Cancellations:

Changes in doctrine, publications or proponency cause skill qualifications tests to be cancelled. TRADOC has approved the US Army Engineer School's request to cancel the following SQTs for 1987:

52C1-3 Utility equipment repairer
52D1-3 Power generation equipment repairer
52F1-3 Turbine engine driven generator repairer
52X4 Special purpose equipment repairer
62N3 Construction equipment repairer

Soldiers holding these MOSs will take their next SQTs in 1988. Scores from previous tests will be used for personnel management purposes as appropriate.

Department of Military Logistics (DML)

Proponency Moves for 52C, 52D and 52F:

Proponency for MOSs utility equipment repairer (52C), turbine engine driven generator repairer (52F) and power generation equipment repairer (52D) is being transferred from the Engineer School to the Ordnance School. The commanding generals of both schools signed a memorandum of agreement in June 1986.

Proponency, training development, training and apprenticeship will transfer by October 1987. Command and control of troop units will move by October 1988. Training for MOSs 52C, 52D and 52F will continue at the Engineer School until facilities are available at the Ordnance School.

New DML Director:

COL Gerald M. Tippins is the new director of the Department of Military Logistics.

COL Jack E. Weber is the new commander of 809th Engineer Battalion.

The Combat Engineer/ Team

Do combat engineers occupy one turret of the engineer castle and topographic engineers the other? Do they enter the portal and go their separate ways without communicating? Unfortunately, too often the answer is, "Yes."

by COL David F. Maune

Combat engineers generally believe they alone are responsible for the engineer functions of mobility, countermobility, survivability and general engineering (FMs 5-101 through 5-104). Topographic engineers tend to take sole responsibility for the topographic function (FM 5-105).

In reality, the outcome of future battles depends upon our ability to work together as a team. New doctrine laid out in FM 5-105, *Topographic Operations*, which will be published in FY 87, demands that all engineers become terrain experts. Every combat engineer must be a topographic engineer, just as every topographic engineer must be a combat engineer.

FM 5-105 places topographic engineers squarely at the portal—not only of the engineer castle but of the supported command post—gathering terrain information from and disseminating terrain information to all.

The Army's keystone manual, FM 100-5, *Operations*, recognizes that ***"Weather and terrain have more impact on battle than any other physical factor, including weapons, equipment, or supplies.... Indeed, most battles have been won by the side that used terrain to protect itself and to reinforce fires to destroy the enemy."***

But terrain not only provides opportunities and imposes limitations; engineers can manipulate it—giving a decisive edge to the commander who uses it best.

FM 100-5 stresses that terrain analysis, engineer operations and intelligence preparation of the battlefield are all basic to the commander's operational use of terrain.

The command engineer, normally a combat engineer, is the terrain advisor at each level of command. He helps the commander see the battlefield and use the terrain—two fundamentals of war.

The strength of his expertise depends on how well his combat and topographic engineers understand one another's business and exchange terrain information.

For example, the combat engineer who understands topographic engineering can turn mobility and countermobility planning from artful guesswork into a science with the help of tailored products like the cross-country mobility analysis (story page 27).

At the same time, topographic engineers—who work primarily with space-based sensors, aerial photography and terrain data base libraries—need eyes and ears in the field. They depend upon combat engineers to establish the *ground truth* of their information so confident command decisions can be made.

They need reports on the latest status of minefields, obstacles, rivers, bridges, roads, railroads, ports, harbors, airfields, facilities and utilities. They need assistance to verify and update data bases on surface drainage, soils, vegetation and lines of communication.

All engineer missions require a constant exchange of terrain information between topographic and combat engineers (story page 13).

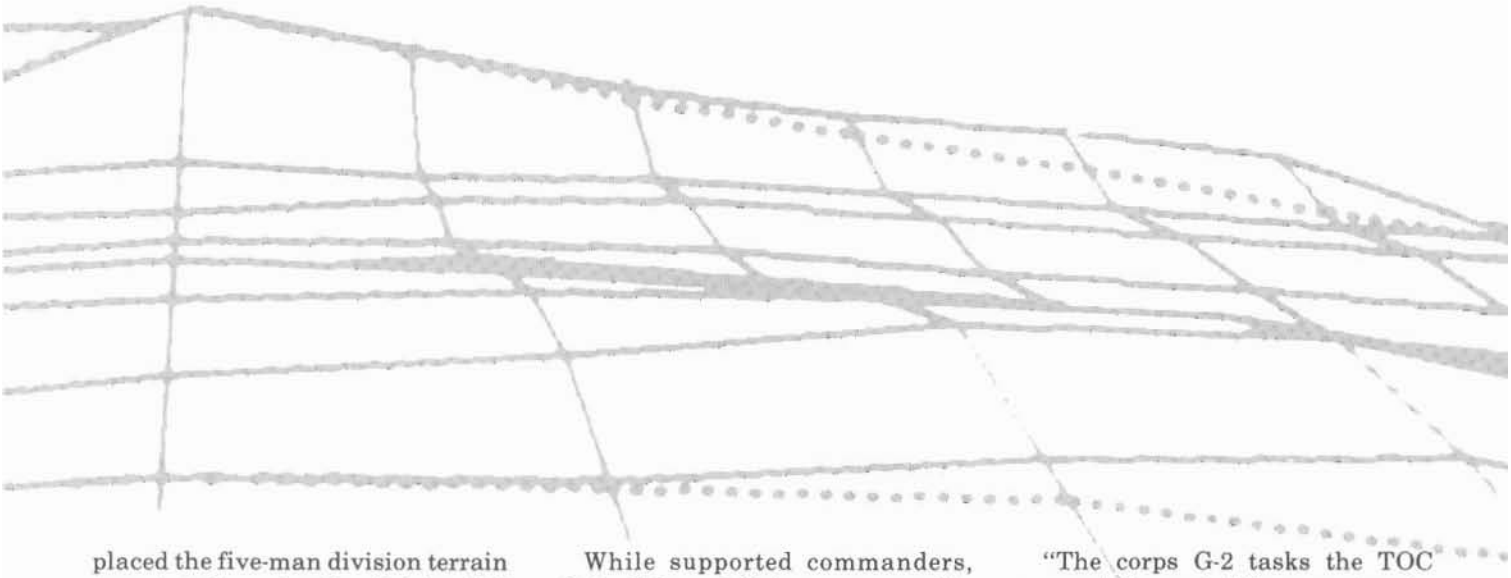
No system currently exists to support that exchange. But FM 5-105 opens the door for change.

New Doctrine

Before 1981, the Army did not routinely have terrain teams in direct support of maneuver divisions, and there were no terrain analysis technicians (warrant officers) as we know them today.

Until now, Army doctrine (FM 5-146, *Engineer Topographic Units*, and FM 21-32, *Topographic Support*)

Topographic Engineer



placed the five-man division terrain team totally under the division G-2 with the "special staff cognizance" of the division engineer.

Most division terrain teams worked in the All Source Intelligence Center of the TOC. While this worked for most of the Army, it had disadvantages for engineers:

- Division engineers and assistant division engineers had little, if anything, to do with division terrain teams. Combat and topographic engineers did not routinely share terrain information because they did not consider themselves to be mutually supporting.
- Division engineers were not necessarily the *terrain experts* they were expected to be. They were, therefore, less effective in recommending optimum ways to reinforce the terrain.
- Division engineers had no direct terrain analysis support to handle topographic responsibilities.
- The organizational structure made it difficult for overworked division terrain teams to request backup support from corps terrain teams or reconnaissance support from divisional engineer battalions.

While supported commanders, G-2s, G-3s and G-4s were generally pleased with their topographic support, the engineer house was not in order. To support AirLand Battle, we needed a more efficient, effective relationship between combat and topographic engineers.

FM 5-105 makes significant departures from the past by clarifying intelligence and engineer staff topographic responsibilities at all levels. The division engineer becomes the division commander's chief terrain advisor.

Intelligence Staff Responsibilities

"From the assistant chief of staff for intelligence at HQDA down through the division G-2, the intelligence officer has general staff responsibility for topography," according to FM 5-105.

"This means the intelligence officer is responsible for topographic policy, solicitation and validation of requirements, and establishment of priorities for topographic support within the command.

"This always includes high priority, continuing terrain analysis support of the intelligence preparation of the battlefield (IPB) process.

"The corps G-2 tasks the TOC support element of the corps terrain team and coordinates other topographic support requirements and priorities with the corps engineer.

"Battalion and brigade S-2s compile and submit topographic requirements and priorities for their commands to their division G-2.

"The G-2 consolidates these requirements with division staff requirements, establishes priorities, coordinates topographic support with the division engineer, and tasks the division terrain team."

Engineer Staff Responsibilities

FM 5-105 gives the engineer officer, from the assistant chief of engineers at HQDA, down through the division level, special staff responsibility for topography.

"This means the engineer officer is recognized as the terrain utilization expert responsible for topographic program execution, training, resourcing and coordinating technical topographic requirements with the staff and subordinate commands," FM 5-105 says.

"Battalion task force and brigade engineers are also terrain experts at their organizational levels.

"All engineers regularly assist in

terrain data collection (such as river, soil, route and bridge classification) to fill data voids and verify data in terrain analysis data bases.

"All engineers also exploit terrain data and analysis in order to focus reconnaissance efforts and otherwise assist in site selection, planning and estimating for performance of mobility, countermobility, survivability, and general engineering missions."

The Division Engineer

Most significantly, the division engineer has new responsibilities to:

- Advise the division commander on effective terrain use.
- Coordinate division topographic support requirements and priorities with the G-2 who tasks the division terrain team.
- Assist the G-2 in evaluating requirements, setting priorities and selecting alternatives.
- Coordinate terrain team deployment in support of the G-2.
- Coordinate support from the corps topographic company through the corps engineer.
- Task engineer units organic to the division to collect terrain data in the field.
- Prepare the topographic operations annex for division CONPLANS/OPLANS/OPORDS in coordination with the G-2, G-3, G-4 and chief of the division terrain team.

FM 5-105 focuses responsibility for topographic engineering in the office of the assistant division engineer where one NCO from the division terrain team will be physically located. The NCO will provide a liaison with the terrain team and assist the division engineer in carrying out his new responsibilities.

The remainder of the division terrain team is normally located with the G-2 staff.

This allows timely support to the division staff and gives the terrain team immediate access to the all source intelligence data that is critical to prepare current products.

It also helps the G-2 and engineer work closely together to satisfy division topographic responsibilities.

A new TOE, which will be implemented in October 1988, increases the staff of the division terrain team from five to eight to meet the growing demand for terrain analysis.

For the new doctrine to succeed, division and assistant division engineers must:

- Become familiar with the capabilities and limitations of topographic units.
- Give high priority to the management of topographic engineer resources and execution of topographic responsibilities.
- Obtain the special security clearances necessary to operate in the all source intelligence arena.

Corps and Above

The only doctrinal changes at corps and above involve the TOEs, which will also be implemented in October 1988.

For unity of command, the new corps TOE merges the corps terrain team as two or more terrain squads within the corps topographic company.

Modular TOEs are being used to tailor engineer topographic organizations at all echelons to the unique requirements of the supported theater.

Reach Out

When combat engineers join forces with topographic engineers to analyze and reinforce the terrain to maximum advantage, everybody wins.

The corps and division engineers are better advisors to their commanders.

The G-2s—responsible for weather, enemy and terrain intelligence—are better able to carry out their intelligence preparation of the battlefield mission.

The G-3s can develop concepts of operation and detailed plans of execution based on accurate terrain information and realistic analyses.

The G-4s can operate with superior knowledge of the capabilities and limitations of transportation networks.

The commander knows his entire staff is coordinating with the best possible terrain information.

Combat engineers, reach out and meet your teammates—the topographic engineers. Together, we can meet the challenges of AirLand Battle. Divided, we repeat past mistakes. Our choice is clear.

COL David F. Maune is the Director of the Defense Mapping School.

His combat engineer assignments included company command at Fort Leonard Wood, MO, and S-3 of a combat engineer group in Korea.

His topographic engineer assignments included company command and S-3 of a topographic engineer battalion in Germany; map and weather officer for HQ, US Army Vietnam; topographic plans officer, OACSI, HQDA; command of a topographic battalion in Hawaii; and inspector general of the Defense Mapping Agency.

COL Maune has a bachelor's degree in mechanical engineering from the University of Missouri at Rolla plus master's and doctorate degrees in geodetic science/photogrammetry from the Ohio State University. He is a graduate of the CGSC and the Naval War College.

Do you know?

During WWII, topographic support in Europe involved over 7,000 personnel who produced 30 tons or 600,000 maps per day—at a cost of $6 million per month.

Army topographic units produced 40,000 different maps covering 400,000 square miles.

The campaign in Northern Africa required 1,000 different map types—over 10 million actual map sheets. The Normandy Invasion required over 70 million map sheets.

Combat Engineer and Topographic Engineer Missions Intertwine

by MAJ Thomas E. Mathews

When the topographic engineer's terrain analysis skills are fused with the combat engineer's ability to shape the battlefield, we have immense influence over how the battle will be fought. Together, we give the combined arms team added muscle that neither of us has alone.

But few people realize how closely our responsibilities intertwine, and we neglect to share vital terrain information that could well make the difference between victory or defeat.

Combat engineers need to detect enemy minefields and obstacles in order to plan countermine or counterobstacle missions. Topographic engineers can predict likely locations—saving time and focusing the engineer effort. As minefields and obstacles are reported, the topographic engineers can plot the locations and characteristics on map overlays for dissemination.

When a minefield or obstacle is neutralized, engineers must report through the assistant division or corps engineer so the terrain team can annotate the master map overlays for dissemination to others.

To plan a gap or river crossing, combat engineers need details about the river or gap not available on topographic maps. Reconnaissance is warranted if terrain and time permit. The findings should be funneled to the division or corps terrain team.

When reconnaissance isn't possible, combat engineers should check with the terrain team to see whether information on the river or gap is available in the terrain data base (story page 27). Once the gap or river is crossed, combat engineers must share their findings with the terrain team so the master map overlays can be annotated.

Reconnaissance is also preferred when planning construction and repairs of roads, trails or airstrips. But if conditions don't permit, the terrain team may have useful data. Once the roads, trails or airstrips are constructed or repaired, information must again be reported through the assistant division or corps engineer to the terrain team so master overlays can be annotated.

COMBAT ENGINEERS	TOPOGRAPHIC ENGINEERS
Countermine or Counterobstacle	**Prepare/Exploit Standard Terrain Factor Overlays**
*Detect minefields and obstacles	*Surface configuration
*Plan/estimate	*Surface materials
Neutralize	*Surface drainage
Bypass	*Vegetation
Breach	*Obstacles
Clear	*Transportation
Mark minefields	
*Report	
Gap Crossing	**Prepare/Exploit Tailored Overlays**
*Reconnoiter	*Cross-country mobility
*Plan/estimate	For specified vehicles
Deploy bridging	Wet or dry weather
Prepare assault site	*Avenues of approach
Prepare far shore	*Landing zones
Construct/emplace bridging	*Drop zones
Cross	*Prediction of enemy minefields and obstacles
*Report	*Location of construction materials
Combat Roads, Trails and Forward Aviation Combat Engineering (FACE)	**Update Topographic Map Information**
*Reconnoiter	*Update map information on roads, bridges, airfields
*Plan/estimate	*Update other map features for currency, battle damage
Construct/repair	*Depict minefields and obstacles
Maintain	
*Report	

* Task where terrain information should be exchanged between combat and topographic engineers.

Do you know?

Maps and charts differ in that—

- ***A map is a graphic representation—usually on a plane surface and at an established scale—of the earth's natural and artificial features positioned relative to a coordinate reference system.***
- ***A chart is a special-purpose map, generally designed the terrain team will tailor its answers to your needs.***

Countermobility

Combat engineers normally perform map, ground or aerial reconnaissance to estimate the best locations for emplacing minefields, obstacles and demolitions to deny the enemy mobility.

Topographic engineers can provide cross-country mobility analyses and other tailored products that identify sites with potentially high payoffs (story page 27). They are ideal for obstacle planning, followed by ground reconnaissance to verify the merits of the site. Without them, combat engineers can waste valuable time and still end up guessing.

As countermobility missions are executed, engineers and maneuver units must report them through their division and corps engineers so terrain teams can annotate master map overlays and disseminate the information.

COMBAT ENGINEERS	TOPOGRAPHIC ENGINEERS
Mine Warfare, Obstacle Demolitions or ADMs *Reconnoiter *Select site *Plan/estimate Execute mission *Report	**Reproduce Map Overlays** Same as all of the mobility tasks except mobility models used for cross-country mobility analyses for countermobility tasks are based on characteristics of enemy mechanized and wheeled vehicles.

* Task where terrain information should be exchanged between combat and topographic engineers.

Survivability

Survivability involves camouflage and concealment, as well as construction of fighting, protective and decoy positions. Each requires a reconnaissance, if possible, before planning and estimating.

Terrain teams can tailor products that provide information on cover and concealment, observation and fields of fire, and other information to assist in survivability planning. They should also depict locations of fighting, protective and decoy positions, warehouses, hospitals, tunnels, utilities, food stocks, and POL.

To improve the data base, all new information must be funneled to the terrain team.

COMBAT ENGINEERS	TOPOGRAPHIC ENGINEERS
Fighting, Protective and Decoy Positions *Reconnoiter *Plan/estimate Deploy assets Construct *Report	**Prepare/Exploit Standard Terrain Factor Overlays** *Surface configuration *Surface materials *Vegetation
Camouflage and Concealment *Identify vulnerabilities *Plan/estimate Deploy assets Construct *Report	**Prepare/Exploit Tailored Overlays** *Cover and concealment maps for winter and summer *Concealment potential from horizontal/vertical observation *Observation/fields of fire maps, line of sight for weapons and radar
	Enhance Topographic Map Information *Urban area maps Facilities (warehouses, hospitals, tunnels) Utilities Food stocks POL
	Reproduce Map Overlays

* Task where terrain information should be exchanged between combat and topographic engineers.

Summary

If you feel that combat and topographic engineers have totally different functions, think again. Both have the mission to exploit or reinforce the terrain. Both advise their commanders on how to best use the battlefield terrain. Both require "terrain sense." Both need the best possible terrain information and rely on each other to get it.

The better we understand this concept, the better engineers we are, and the stronger the Army we support.

MAJ Thomas E. Mathews is the Mapping, Charting and Geodesy Doctrine Development Coordinator at the Defense Mapping School. His topographic engineer assignments include command of the Terrain Analysis Detachment supporting III Corps, and Chief of the Terrain Evaluation Division, Defense Mapping School.

His combat engineer assignments include command of panel bridge and mobile assault bridge companies, S-1 of combat heavy and assault bridge battalions, and assistant S-3 of a combat heavy battalion.

MAJ Mathews has bachelor's and master's degrees in physical geography from the University of Michigan. He is a graduate of the Command and General Staff College.

Do you know?

The Defense Mapping Agency (DMA) inventories over 21,000 different 1:50,000 scale topographic maps—a fraction of the line items in the total DMA inventory.

Even so, less than 50 percent of the world's land area has been mapped at a scale of 1:50,000 and only 80 percent at a scale of 1:250,000, according to a U.N. study.

Writer's Guidelines

Do you have any articles, photographs, or artwork to submit to ENGINEER? Here are some tips.

TOPIC: We focus on combat engineering; however, any articles of interest to engineers are welcome. Write in active voice and be as concise as possible. Please give your article a title, too.

LENGTH: Let your subject dictate length; generally, articles should be two to six pages, double spaced.

PHOTOGRAPHS AND ARTWORK: Besides photographs and artwork which supplement articles, photographers and artists should submit any work that may be of interest to engineers. Your photos should be 5 x 7 black and white, glossy. Please include a caption and photo credit. Drawings should be legible, but do not have to be camera ready.

DEPARTMENTS: We are always looking for items for our departments:

- **Letters to the Editor.**
- **Lessons Learned.**
- **News and Notes.**
- **Personal Viewpoint.**

ENGINEER PROBLEM: Please submit your challenging—but not too hard—Engineer Problems. Problems should be referenced to a manual, but must be original. They should be checked for accuracy and should strengthen combat engineer skills as well.

COVER LETTER: When submitting material to ENGINEER, enclose a cover letter with your name, address, and phone number. Also, please include biographical information such as military and civilian education and past and present assignments.

If you have any questions, please call us.

(703) 664-3082, AV 354.

Topographic Support Around the World

by Penelope Schmitt

Today's topographic mission is evolving downward and forward, moving toward flexibility and specialized services. Units provide field commanders with tailored terrain information; cartographic effort emphasizes command-unique products; decentralized product storage and distribution prevails; and surveyors support positioning and alignment missions.

To meet these new challenges, the topographic battalions are developing programs unique to their missions. Each battalion—the 30th at Fort Belvoir, VA, the 29th in Hawaii, and the 649th in West Germany and the 1203d (NG) in Alabama—reflects its theater environment and the special needs of the commands it serves.

These four battalions can provide every US field commander in the world with flexible, deployable, tailored topographic support on the AirLand battlefield. All you have to do is ask.

The 30th Engineer Battalion

The 30th Engineer Battalion, under the command of the 4th Engineer Brigade, receives peacetime missions from FORSCOM HQ and coordinates wartime planning with Third Army and CENTCOM. These linkages give the 30th an open line of communication throughout the Army.

While its counterparts often operate by deploying special teams to contingency areas, the 30th deploys much of its complement to the area of operations in order to provide full topographic support. Strong in arid area operations, the unit exercises throughout the western and southwestern United States and has taken its specialized skills to Honduras, Egypt and Jordan.

A Test Bed for New Systems—The Topographic Support System (TSS)

The 30th, collocated with the US Army Engineer School, is an ideal test bed for emerging doctrine and equipment. One of the battalion's prime achievements this year is its success in integrating, training and testing the TSS.

In October 1985, the battalion received the TSS, and its soldiers trained on the new equipment. During the post-training phase, the 30th conducted an emergency deployment readiness exercise, performing a full load out and a static load onto C5A aircraft, checking personnel for overseas deployability, and conducting a convoy. Other exercises followed, culminating in a battalion FTX to test the equipment in the field.

By January 1986, the 30th was ready to deploy a fully trained rapid response element for exercise Gallant Knight. On the way, the battalion proved the TSS's excellent roadability and learned the limitations of its air deployability—only two of the system's loaded semitrailer rigs could be airlifted on each C5A transport.

In just four months, the 30th successfully integrated and employed the TSS, deploying effectively and providing a major exercise with cartographic and reproduction support.

The 29th Engineer Battalion

The 29th Engineer Battalion, based in Hawaii, provides topographic support to the Pacific Command. Operating over a vast area, the 29th's flexible force can sustain simultaneous operations in widely separated areas.

The Rapid Mapping Support Team (RMST)

The 29th's rapid mapping support teams provide swift, deployable, topographic support to contingency and wartime operations. The specialized teams field 16 to 20 members with up to four pieces of mission-essential equipment. When deployed, the RMST can support a limited operation or serve with other units to support follow-on echelon forces.

The 29th trains two to four RMSTs each year. Selected soldiers are assigned to an RMST for intensive technical and tactical training. All team members cross-train in each other's MOSs to ensure full coverage of topographic and equipment maintenance skills.

The RMSTs deployed in 1985 and 1986 to the Team Spirit and Ulchi Focus Lens exercises in Korea and the Balik-Samahan exercise in the Philippines. In these and other situations, the RMST program gives tactical commanders forward topographic support and creates a unique training environment for topographic soldiers.

Tailored Topographic Products—The World You Need to See

The special maps produced by the 29th exemplify the made-to-order support commands can expect from all the topographic battalions. As always, DMA's standard products are the maps of first resort. But standard maps can't always do the job. Topographic support can modify

existing products or create new ones. They can—

- Change scale.
- Enhance or delete selected material.
- Combine map sheets to center the area of interest.
- Add information.
- Create or enhance a map with photography or intelligence data.
- Create a photobased map.

The 29th has recently worked with a variety of customers to design and produce these tailored products:

Lines Of Communications Designator (LOCD)—The customer needed a graphic index for existing computerized highway and railway data. The resulting map showed all base map features except water in subdued black and overprinted the LOCD information in a highlighted color.

Team Spirit Black Map—Army aviators needed to see map features and flight hazards under blue-green artificial light. The 29th developed and tested four prototypes during Team Spirit 86. These maps reversed the normal use of colors. They were less reflective in the cockpit, more readable under all lighting, and compatible with night vision goggles.

DMZ Flight Map—The customer asked to see authorized flight corridors along the DMZ in Korea. Accurate depiction of these corridors is critical, because aircraft outside them are treated as likely hostiles. Flight information was overprinted in highlighted colors on standard base maps.

Hokkaido Terrain Analysis Maps—The customer needed terrain analysis maps at 1:250,000 scale. Since no DMA standard terrain factor overlays existed for this area, the customer obtained host nation support. A montage of several map sheets formed each base map. To date, two sheets have been produced with overprints showing LOCs, cross-country movement for wheeled vehicles, and concealment. The last two overprints show winter/dry season and summer/wet season conditions.

The ability to visualize the terrain the way you need to see it is vital to the success of your military operation. This sampling of the support the 29th provides the Pacific Command typifies the topographic resources that are yours to exploit.

The 649th Engineer Battalion

The expert in topography for USAREUR is the 649th Engineer Battalion. Headquartered in Schwetzingen, the 649th has subordinate units stationed throughout West Germany. The battalion is mobile throughout Europe, sending elements to locations as diverse as Spain, Italy, Turkey and Holland. Like its counterparts, the 649th provides a wide variety of topographic support services, including standard, nonstandard and quick-response map products.

Intelligence Preparation of the Battlefield (IPB)—REFORGER 1986

One of the fastest-growing aspects of topographic support is terrain analysis. Knowledge of natural and manmade features, weather, and climate conditions can shape military operations. The 649th's seven terrain detachments provide direct IPB support to USAREUR corps and divisions. During the 1986 REFORGER Certain Sentinel exercise, the 526th Engineer Detachment proved the varied—and valuable—potential of terrain analysis. Maneuver restriction maps based on their intensive soil and weather condition analysis—

- Prevented vehicles from miring in soft or wet terrain.
- Protected valuable farmland and populated areas.

The analysis thus contributed immeasurably to a safe exercise. It also reduced the fiscal and political price of Certain Sentinel by avoiding damage to host nation lands and cutting the cost of reparations.

Planning topographic support for REFORGER starts a year before the exercise. For Certain Sentinel, advance production and quick-response support resulted in a distribution of 1.7 million map products—12 maps for every soldier participating in the exercise.

Nonstandard maps supplemented standard topographic, cross-country movement, and road and bridge maps. These were available for issue at all times at corps map supply points.

The diversified 649th keeps pace with the demands of tactical commanders, providing both standard and tailored support that mirrors changing developments on the modern battlefield.

The 1203d Engineer Battalion

Based in Dothan, Alabama, the 1203d Engineer Battalion, Alabama National Guard, provides topographic support both in the U.S. and overseas. Its HQ, cartographic, and survey companies, together with eight terrain analysis teams, offer high-quality topographic services.

The 1203d, like its active Army counterparts, offers both standard and specialized topographic support. For example, the battalion is the primary source of maps and charts for all Reserve, ROTC and National Guard units in the Southeastern United States. In overseas deployment for NATO's topographic exercise, DOMINATE, the battalion has operated map depots under wartime conditions.

The 1203d can also stand up to the active Army battalions in tailored support capability. It is now acquiring the new TSS, and will train on the system in January and February of 1987. Its eight terrain analysis teams supply 8th Division (NG) commanders with special-purpose map products, and team elements have participated in FTXs and CPXs in almost all 50 states. As a provider of timely, tailored map products and terrain analysis, the 1203d exemplifies the high standards of readiness and capability the National Guard maintains.

Penelope Schmitt is the Features Editor for ENGINEER magazine.

The key is teamwork— Germany to Vietnam

All topographic engineers are in the terrain information business. But terrain information is not generated in a vacuum. Data must come from those who know—combat engineers, infantrymen, aviators and others.

by COL David F. Maune

In the mid-1960s, I spent three years in key assignments with the engineer topographic battalion in Germany. We produced terrain studies specified by FM 30-10, *Military Geographic Intelligence (Terrain).*

These terrain studies included a series of 1:250,000 maps—each with separate map overprints depicting soils, rock types, drainage, vegetation and landforms.

We compiled data from each country before publishing the final study—a 24- x 30-inch confidential book, 1 inch thick. HQ USAREUR directed us to produce these terrain studies. But we never knew if they were needed or used.

Reassigned to Vietnam, I served as the map and weather officer in the G-2 office at HQ, US Army Vietnam. I visited both corps (called field forces in Vietnam), every division and brigade, and several battalions. At each TOC, I asked the G-2s, G-3s, S-2s and S-3s, "Are you satisfied or dissatisfied with your topographic support?"

The answers I received from the two corps were totally opposite.

In one corps, the consensus was that topographic engineers were worthless. In the other corps, the unanimous response was that topographic engineers were force multipliers essential to successful combat operations.

Each corps was supported by an identical organization—one topographic company and one terrain team. I wanted to know what we were doing right in one half of Vietnam and wrong in the other.

In the corps that had taken a dim view of its topographic support, the units were applying FM 30-10 doctrine...much as we had done in Germany. For security reasons, the units burned the 1:250,000 scale terrain studies upon receipt.

Confidential analyses of soils, geology, drainage, vegetation and landforms at any scale were of no use to the combined arms team. The topographic engineers had not talked with their customers to see what they really wanted or needed. The doctrine clearly didn't fit the war in Vietnam...and probably didn't serve the customer in Germany either.

In the corps that considered topographic engineers indispensable, terrain analysts regularly visited the combat units. They explained topographic unit capabilities and limitations and asked their customers what they needed. A team spirit emerged.

The combat units wanted their obsolete 1:50,000 scale maps updated regularly and wanted map overlays or overprints of intelligence and operations information. The combat units provided most of the data based on their reconnaissance, and the topographic engineers tailored products to meet their combat needs.

Here's how the system worked:

Whenever a reconnaissance patrol, task force, aviator or driver found map information to be obsolete, they reported the problem to the G-2s, G-3s, S-2s or S-3s so the map could be updated. This data was funneled to the terrain team, which maintained mylar overlays for every 1:50,000 scale topographic map within the corps' area of responsibility.

I watched terrain analysts brief a reconnaissance team on expedient measurement techniques and specific items to check when on patrol. I saw map overlays with approximate

traces of jungle trails not found on standard topographic maps. Annotations showed where bridges had been destroyed or added since the maps were last revised. Some of the annotations depicted enemy intelligence—locations of suspected enemy organizations and road locations with frequent enemy ambushes.

A day or two before a combat operation, the TOC staff visited the terrain team to personally review the overlays and add intelligence and operations information—helicopter landing zones, unit boundary symbols, artillery fire control plans.

The terrain analysts compiled this information so it could be overprinted on 1:50,000 scale topographic maps of the combat area. Then, cartographers drafted the information to make it suitable for reproduction. The map distribution platoon provided several hundred copies of the standard, 5-color topographic maps. The map reproduction platoon used a 6th color to overprint this new intelligence and operations information on the maps.

Just hours before a combat operation began, hundreds of unclassified, overprinted maps were furnished at the tactical scale. The information was so "hot off the press" there was no time for it to fall into enemy hands.

On 24-hour notice, the terrain team and corps topographic company furnished the combat units with indispensable topographic products. These topographic units effectively communicated with their customers and worked with them as a team.

Published doctrine didn't fit, so topographic engineers improvised with astounding results. Although the terrain team performed many tasks normally done by the cartographic platoon of a topographic company, they did what was necessary to contribute to the success of combat operations.

The key was teamwork. The payoff was a terrain data base that could be tapped at a moment's notice. The lesson is clear. If we exchange information habitually in peacetime, we will do it instinctively in war.

COL David F. Maune is Director, Defense Mapping School (DMS), Fort Belvoir, VA.

Defense Mapping Agency Customer Assistance Office

DMA has opened a new customer assistance office to handle inquiries from all users of DMA products and services. Located in the DMA Office of Distribution Services in Washington, DC, the customer assistance office—

- Helps to obtain DMA products and services.
- Provides status reports of current requisitions.
- Explains the availability and use of maps, charts and geodetic products.
- Handles emergency requests for standard DMA products.
- Coordinates DMAODS support to exercises.
- Forwards other questions and requests to appropriate experts.

The customer assistance office is open 0630-1900 Monday through Friday. After duty hours, telephone messages are recorded for action the next business day.

Call the customer assistance office—toll free (800) 826-0342, commercial (301) 227-2495, AV 287.

Defense Mapping Agency Crisis Management Team

DMA has a 24-hour crisis management team equipped with beepers to handle emergency requirements for standard mapping, charting and geodesy products:

- During duty hours, call the customer assistance office—toll free (800) 826-0342, secure 2334, commercial (301) 227-2495, AV 287.
- Outside normal duty hours, call the communications center—commercial (301) 227-2196, AV 287.

The crisis management team also handles requirements for nonstandard mapping, charting and geodesy products beyond the capability of supporting Army topographic units.

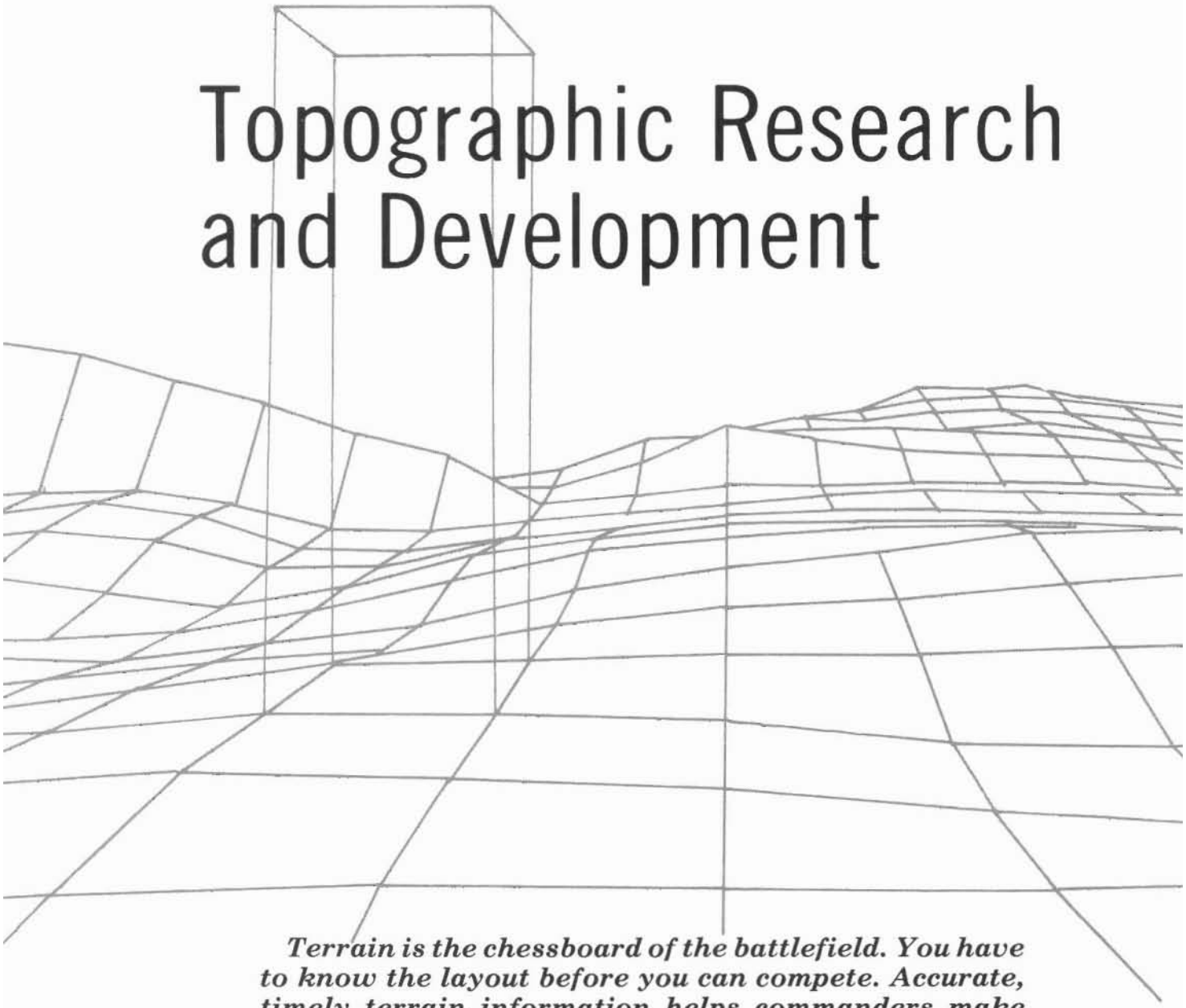
- During duty hours, call the crisis management team—commercial (202) 653-1401, secure 2305, AV 294.
- Outside normal duty hours, call the guard desk—commercial (202) 653-1375, AV 294.

Do you know?

Topographic support for the Army was first recognized on 25 July 1777 when GEN George Washington appointed Robert Erskine "geographer and surveyor of the roads, to take sketches of the country."

"The want of accurate maps has been a grave disadvantage to me. I have in vain endeavored to procure them and have been obliged to make shift with such sketches as I could trace out of my own observations and that of gentlemen around me. I think if gentlemen of known character and probity could be employed in making maps (from actual surveys), it would be of the greatest advantage."

Topographic Research and Development



Terrain is the chessboard of the battlefield. You have to know the layout before you can compete. Accurate, timely terrain information helps commanders make quick decisions—allowing them to fight outnumbered against superior firepower and win.

by COL Alan L. Laubscher and Sandra J. Cleva

A Technology is about to revolutionize battlefield topographic support. During the next decade, commanders will be getting terrain information at unprecedented speeds in new, more useful forms.

Digital topographic data—translating the earth's surface into numbers—already allows military missiles to hit targets with extreme accuracy and lets fighter pilots fine-tune their skills on aircraft simulators without leaving the runway.

New weapons systems—the Pershing II, cruise missile and FIREFINDER counterartillery and countermortar radars—depend on map information that is stored, processed and read by computers.

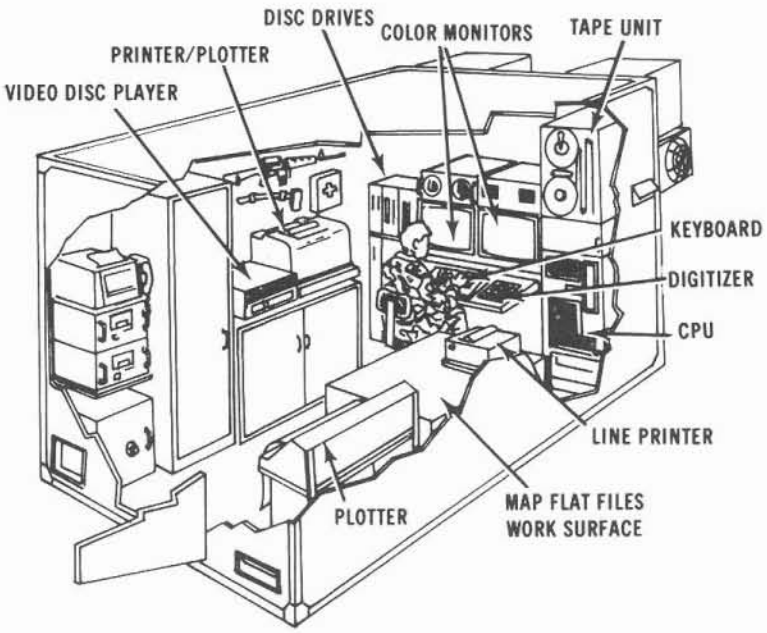
The Defense Mapping Agency began producing digital topographic data in the 1970s. Although the agency still produces millions of paper maps a year, digital data now accounts for more than half its output.

The agency currently produces two basic types of digital topographic data:

Digital terrain elevation data uses a matrix of uniformly spaced points to describe the shape of the earth's surface—its mountains, hills and valleys in x, y, z coordinates.

Digital feature analysis data describes the characteristics and geographic locations of manmade structures and natural landscape features using a series of x,y coordinates. DFAD depicts point features (towers, single buildings, silos), linear features (roads, rivers, power lines, runways, bridges) and areal features (fields, built-up areas, woods, lakes).

Scientists at the Engineer Topographic Laboratories are now working to bring the digital data revolution to soldiers in the field.



DIGITAL TOPOGRAPHIC SUPPORT SYSTEM (DTSS)

DTSS

The Digital Topographic Support System—scheduled for fielding in 1991—will automate much of the work now involved in terrain analysis. Instead of hardcopy overlays, slide rules and calculators, terrain analysts will use computerized digital topographic data bases.

DTSS will replace the direct support section of the topographic support system and will be mounted on a 5-ton truck. Plans call for one system per division, two per corps and two for echelons above corps.

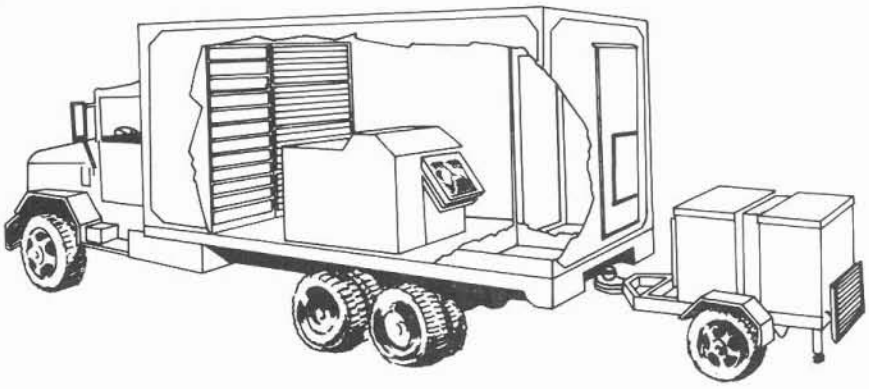
DTSS will give terrain teams access to more than 20 different terrain analysis programs which fall into two categories: ***intervisibility*** and ***mobility.***

Intervisibility analyses use elevation and vegetation data to define areas that can be seen electronically or optically.

Products include terrain profiles, masked area plots, perspective views, flight line masking graphics, minimum detection altitude computations and oblique projections.

They help commanders determine the best locations for systems by showing the effects of terrain on—

- Weapons performance.
- Communications facilities.
- Short-range radar.
- Other battlefield sensors.



QUICK RESPONSE MULITCOLOR PRINTER (QRMP)

For example, intervisibility analysis plots target acquisition—showing radar's range of coverage for targets approaching at different altitudes.

Mobility products help commanders in deciding where to maneuver men and equipment by—

- Computing the probability of aerial detection for troops and vehicles.
- Examining lines of communication.
- Predicting possible river crossing sites.
- Identifying optimal helicopter landing and drop zones, infiltration routes and air avenues of approach.

For example, the cross-country movement model shows a vehicle's off-road speed capabilities by comparing performance characteristics like climb and override to the slope, soil and vegetation found in the proposed area of operation.

QRMP

The Quick Response Multicolor Printer will soon give the Army fast, combat-oriented reproduction capability—making it easier to copy terrain graphics, maps and other products in the field.

What takes 27 soldiers and ten 30-foot vans full of equipment today will take one soldier and a 20-foot container on a 5-ton truck.

Fielding will begin in 1992. Plans call for two systems at corps and one system per terrain team at echelons above corps, corps and division.

The QRMP uses a dry printing process with a laser scanner. It will cut printing time for field-generated graphics from 8 hours to 5 minutes—turning out 75 multicolor or 225 monochrome copies per hour.

The first printers fielded will reproduce almost any type of hardcopy product—including standard maps, annotated maps, terrain analysis graphics, transparent overlays, photographs and captured enemy documents.

Later, a digital interface will let soldiers print hardcopy products directly from digital terrain data provided by the Defense Mapping Agency or DTSS.

Artificial Intelligence

Scientists are experimenting with artificial intelligence as a way to transfer some of the slow, laborious work involved in interpreting aerial photos from man to machine.

Artificial intelligence allows computers to manipulate symbolic data using informal decision-making rules. Like human specialists, the computers apply inferential reasoning, logic, deduction and a stored knowledge base to interpret information and solve problems.

Two demonstration projects now focus on using artificial intelligence to determine drainage networks and identify urban features like roads and buildings.

Researchers are also evaluating potential uses for terrain data from NASA space platforms and satellite-based sensors. Information from multispectral sensors from NASA's Landsat program is being merged with terrain elevation data from the Defense Mapping Agency to produce three-dimensional perspectives. Future studies will explore ways to generate tactical terrain graphics from multispectral imagery.

Computer Image Generation

Computer image generation—realistic pictures created by combining digital terrain data with information from maps, photographs and satellite imagery—is also on the horizon.

Computer-generated images are already being used for flight simulators and other training devices. The Engineer Topographic Laboratories are exploring possible applications for mission planning and battlefield management.

These images may prove an ideal command and control tool by eliminating much of the interpretation involved in map reading.

Commanders could then see the hills, trees, roads and waterways that make up the battlefield while planning their operation.

COL Alan L. Laubscher commands the Engineer Topographic Laboratories. He served previously as district engineer for the Corps of Engineers Galveston District. He commanded a combat engineer company in Korea and a combat engineer battalion in Germany.

He has a bachelor's degree in industrial engineering from Stanford University and a master's degree in geodetic science from Ohio State. He is a graduate of the CGSC and the Army War College.

Sandra J. Cleva, formerly a public affairs specialist at the Engineer Topographic Laboratories, now works for the Department of the Interior.

Do you know?

DMA produces point positioning data bases used by Army, Navy, Air Force and Marine Corps units equipped with the analytical photogrammetric positioning system to perform hasty point positioning surveys in friendly or enemy territory. System operators for all services are trained at the Defense Mapping School (DMS), Fort Belvoir, VA.

Although some courses are very modern—using satellites to establish accurate positions on the ground—DMS also teaches technology that is hundreds of years old—plane table surveying popular when George Washington was a topographic surveyor.

Terrain Analysis Data Bases-

by CW2 Kathleen Hawes

Topographic units, especially engineer terrain teams, are in the terrain information business. Every commander, staff officer, soldier and weapons system is a potential customer for our business.

Ask terrain analysts about the terrain or the impact of weather on the terrain, and we give you a professional answer—the best we can in the time available.

If we have a current terrain analysis data base covering the area in question, we can give good answers in minutes or hours. If we don't have the data base, we're all in a heap of trouble; it might take days, weeks or months to collect the raw terrain data needed.

The terrain analysis data base is our library of information from which analyses are prepared to answer specific questions. The data base consists of a series of terrain factor overlays described below.

Terrain Factor Overlays

Terrain factor overlays are normaliy produced by the Defense Mapping Agency (DMA) for use by terrain analysts, but may be produced by engineer terrain teams to DMA specifications.

DMA produces these overlays at two scales—the tactical terrain analysis data base at 1:50,000 scale and the planning terrain analysis data base at 1:250,000 scale.

There are six standard tactical terrain analysis overlays for each 1:50,000 scale topographic map. The data bases for overseas geography are usually classified *confidential* or higher because of their potential value to the enemy. Data bases of the United States are normally unclassified, but are available only for selected training areas.

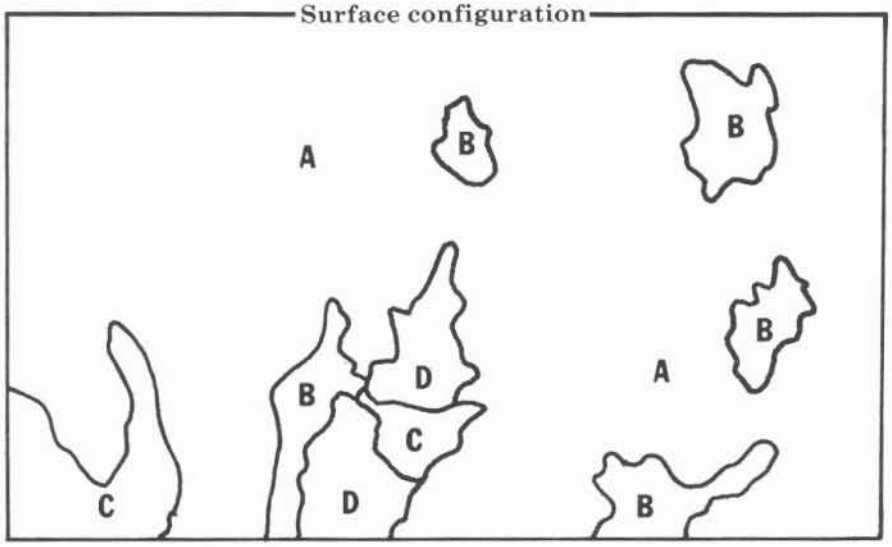
The ***surface configuration factor overlay*** portrays the maximum slope of the surface at each point on the ground, expressed as percent of slope. Areas are expressed as maximum slope into categories: 0-3 percent (A), 3-10 percent (B), 10-20 percent (C), 20-30 percent (D), 30-45 percent (E), over 45 percent (F) and open water (W).

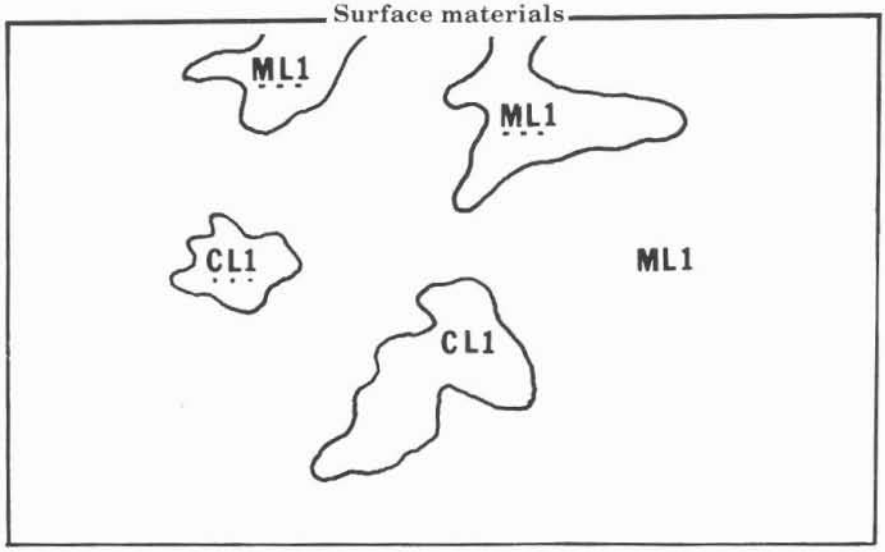
Data from this overlay is normally used only by terrain analysts, but combat engineers could determine locations for roads or airfields with slope limitations—for example, airfields with slopes under 3 percent.

The ***surface materials factor overlay*** portrays the soil on the surface using the categories of the unified soils classification system.

The CL in the example is an inorganic clay, and the ML is an inorganic silt. The third digit indicates surface roughness. Soil categories are further identified by moisture content. Dots underlining the category indicate a moist soil, and dashes indicate a wet soil.

This information is useful for combat engineers when planning construction or repairs of roads, trails and airstrips. This information is vital to terrain analysts performing cross-country trafficability analyses.



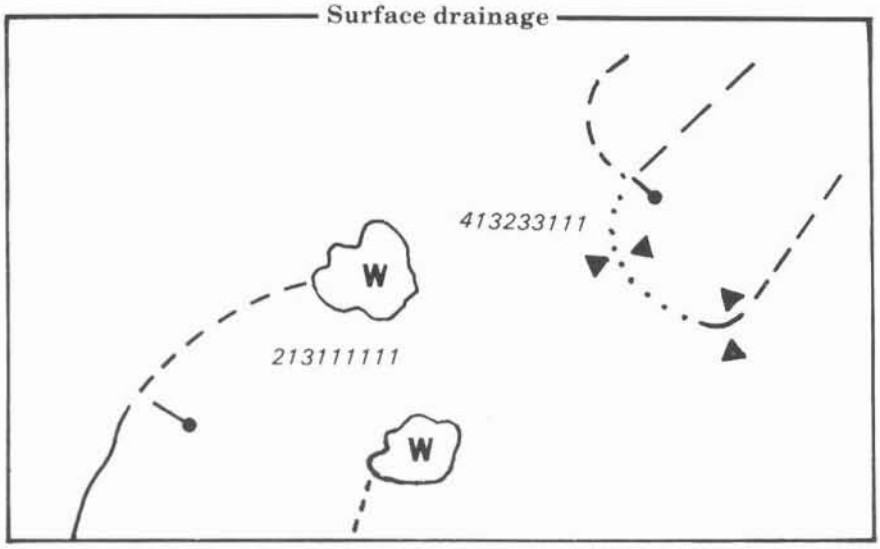


What's in them for YOU?

The ***surface drainage factor overlay*** portrays bodies of water on the earth's surface. Lakes, ponds and reservoirs are depicted as open bodies of water.

Rivers, streams, canals and ditches are defined using a nine-digit code to indicate the type of feature, gap width, bottom materials, height of right and left banks looking downstream, slope of right and left banks, average water velocity, and average water depth. The overlay's legend explains the symbols and nine-digit codes.

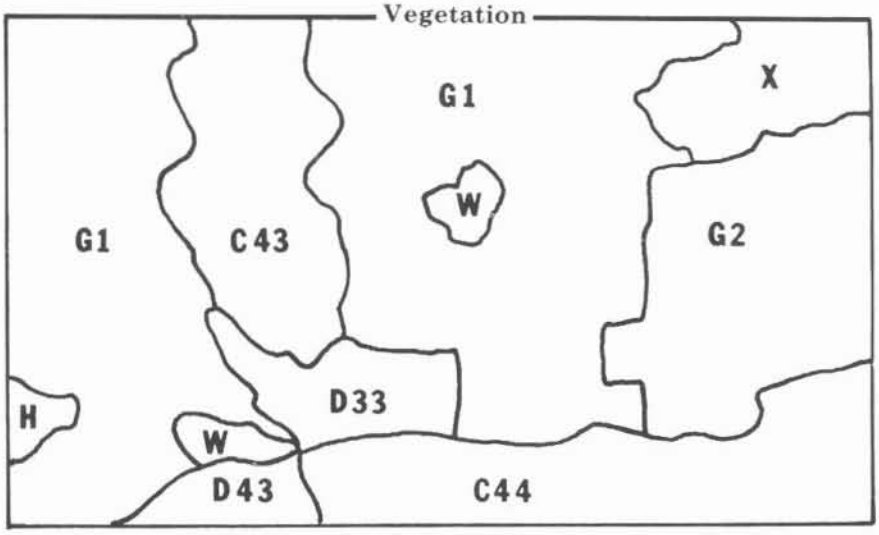
This information is extremely valuable to combat engineers planning river-crossing operations.



The ***vegetation factor overlay*** divides vegetation into categories of tactical significance. Coded letters and numbers indicate types, canopy closure and tree height.

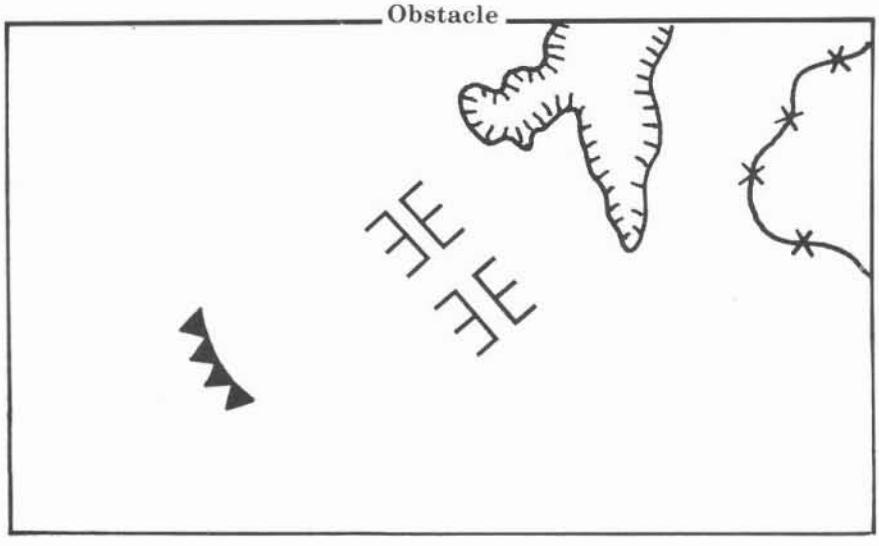
A vegetation factor table provides detailed information on average tree diameter and tree spacing plus the vegetation roughness factor on the forest floor used in trafficability analyses.

The vegetation factor overlay is also used by terrain analysts to calculate line-of-sight and provide cover and concealment information for survivability missions.



The ***obstacles factor overlay*** portrays linear terrain features that form natural obstacles not normally identifiable on a topographic map. All obstacles shown are over 1.5 meters high and longer than 250 meters. Obstacles include road and railroad cuts and fills, escarpments, embankments, depressions, fences and walls, and other microrelief features.

This information is a tremendous benefit to combat engineers making obstacle plans.



The ***transportation factor overlay*** portrays selected roads, bridges, tunnels, ferries, railroads and airfields over which troops and supplies could be moved during military operations.

Information shown on the overlay includes roadway widths; steep grades; length, width, and runway surfaces; and bridge information such as length, width, overhead clearance and bypass potential. A bridge identification number cross-references a bridge data table which gives added information, including construction material, span length and underbridge clearance.

This is important information for combat engineers, G-3s, G-4s and others requiring lines of communication data.

The planning terrain analysis data bases at the smaller scale are similar to the tactical terrain analysis data bases but also include special terrain overlays on water resources for arid areas. These are specifically designed to assist engineers in locating water supplies.

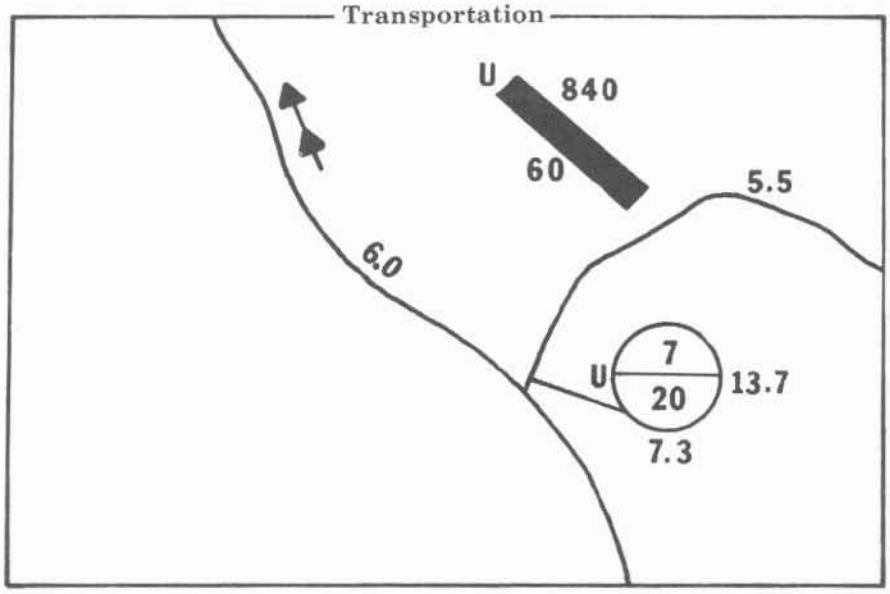
Combat Engineer Input

Combat engineers are uniquely qualified to fill voids in these data bases or to verify the accuracy of the data bases often derived through analyses of aerial photography. With the establishment of ground truth, engineer advice to commanders can be given with far greater confidence.

Combat engineers are well qualified to classify soils, roads, bridges or airfields and provide data for the nine-feature codes for rivers on the surface drainage factor overlays.

All engineers must recognize in peacetime the need for maintaining accurate and up-to-date terrain factor overlays. If and when the Airland Battle begins, we must be ready.

Having our terrain analysis data base complete and ready at all times is the only way engineers can be prepared for war. This is the key to the library which contains answers to the infinite variations of questions that commanders might ask about the terrain on which the battle is planned and fought.



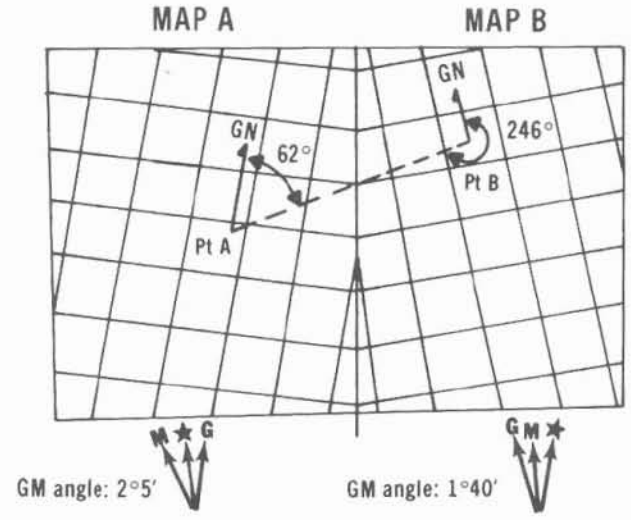
CW2 Kathleen Hawes is the Course Manager for the Basic Terrain Analysis Course at the Defense Mapping School. She has previously served as Chief of the 527th Engineer Detachment (Terrain) serving the 2d Infantry Division. (For three consecutive years, this terrain team was cited as the key to success in the annual Team Spirit exercises in Korea.)

Engineer Problem

Before a field exercise, you carefully tape together two adjacent maps that cover your area of operation. You observe that the grids of the two maps do not line up.

You are planning a night move from point A to point B. At point A, the measured grid azimuth is 62°. At point B, the measured grid azimuth is 246°.

What is the magnetic azimuth from point A to point B?



Engineer Problem/Solution submitted by MAJ Edward Wright, Advanced Technology Division, Defense Mapping School.

Terrain Analysis: Tailored to the Customer

Did you ever ask a terrain analyst to give you a terrain analysis of the area of operations? That's like asking for an ice cream cone without knowing they come in many flavors.

by CW2 Frederick N. Pessaro, Jr.

There are hundreds of different kinds of terrain analyses, each designed to answer specific questions from the supported commander or staff. Terrain analyses are normally tailored from information contained on appropriate terrain factor overlays (story page 24), augmented by the latest information available in the All Source Intelligence Center within the TOC.

The combined arms team as a whole needs analyses of the military aspects of terrain known as the OCOKA factors: observation and fields of fire, cover and concealment, obstacles, key terrain, and avenues of approach.

Infantry units are interested in all of these, but airborne units need special drop zone analyses, and airmobile units need landing zone analyses.

Aviation units require analyses of hazards to navigation, especially when flying nap-of-the-earth. They also need information on airfields and support facilities.

Armor units require analyses of cross-country movement. This requires synthesis of several terrain factor overlays (surface configuration, materials and drainage, vegetation, obstacles), mobility characteristics of specified tracked or wheeled vehicles, and current moisture conditions which affect soil trafficability. (Terrain teams in Europe have analyzed these same factors in peacetime to reduce maneuver damage during recent REFORGER exercises.)

Artillery units require choke point analyses to preplan artillery fires.

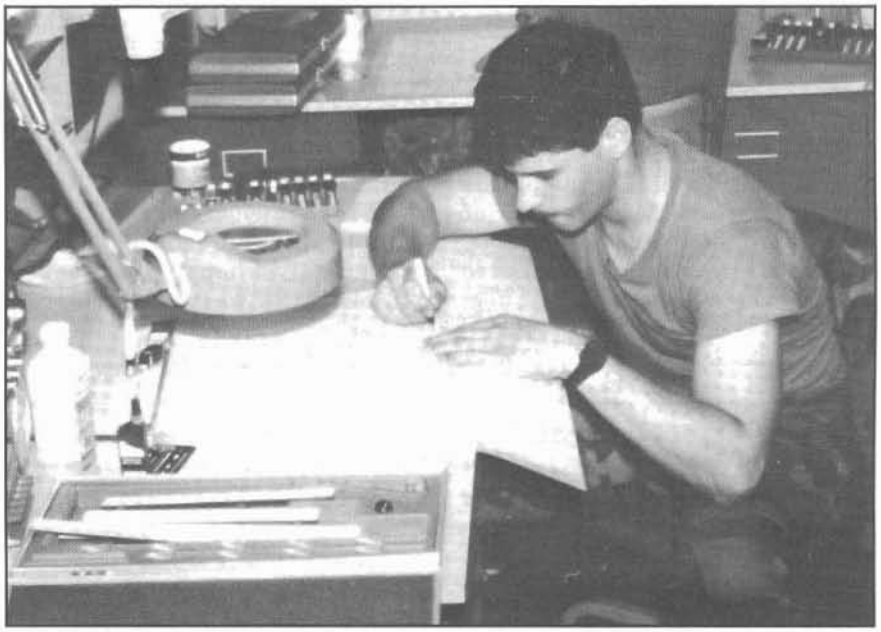
Engineers need analyses of rivers to plan river crossing operations or forecast floods. They need to locate water in arid regions. They need analyses of soils, geology or timber for construction. They need analyses of roads, bridges, pipelines, airfields, ports, landing beaches and other features affecting movement of supplies. They need many terrain analysis products to support mobility, countermobility, survivability and general engineering site selection, planning and estimating.

Intelligence personnel need a variety of terrain analysis products to support the intelligence preparation of the battlefield. This includes analyses of how the weather affects the terrain for both friendly and enemy forces.

Signal units require analyses of intervisibility for site selection of communication facilities.

Transportation units require analyses of all forms of lines of communications for logistics planning.

Marines may ask for assistance in analyzing the terrain for special



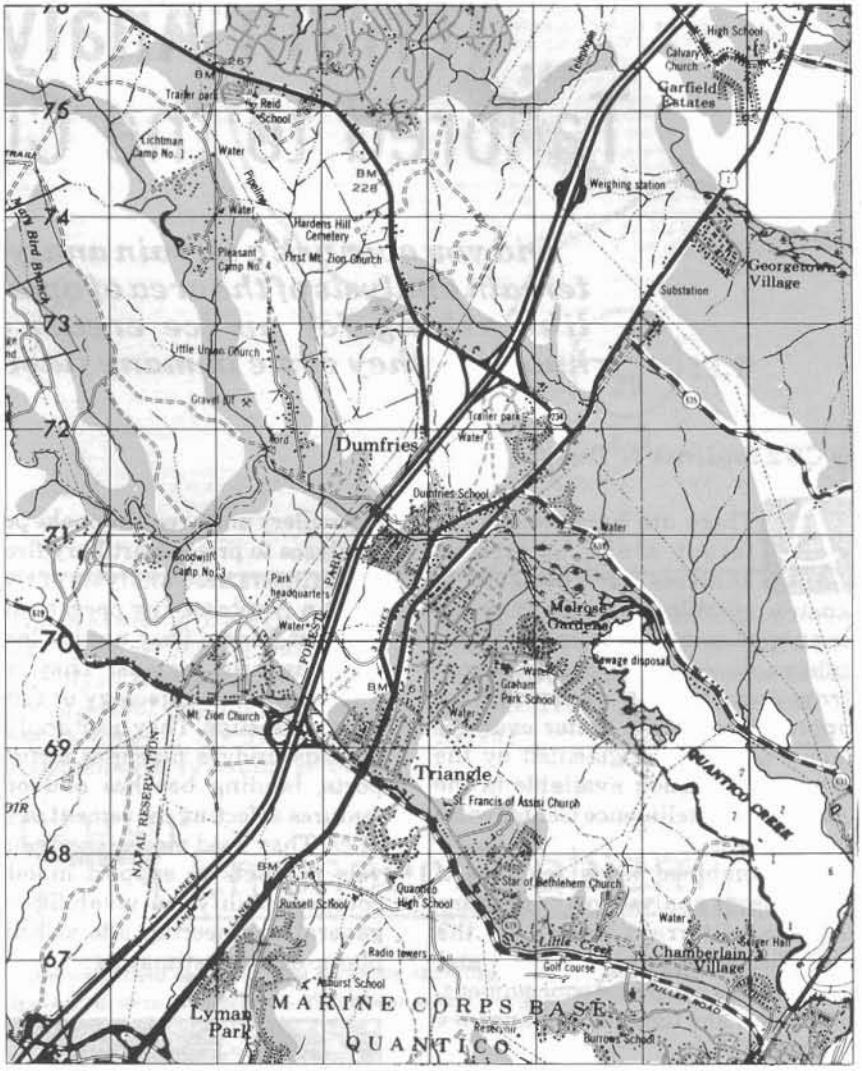
SP4 Rogers, 41D, 588th Engineer Detachment, updates a terrain overlay for Golden Saber XIII.

M-60 tank Cross Country Mobility (CCM) analysis near Quantico, VA. CCM overlays are used by terrain teams in analyzing potential mobility corridors and avenues of approach for specified tactical formations. Best locations for demolitions, minefields or other obstacles are quickly apparent even though such locations are not obvious from topographic map analyses or actual reconnaissance. Such products are frequently classified because of their potential value to the enemy. Time constraints cause such overlays to be normally produced in black and white rather than in color as shown here for demonstration purposes.

GO-AREA
>15 KPH

SLOW-GO AREA
1.5-15 KPH

NO-GO AREA
<1.5 KPH



amphibious operations.

Air Force units may ask for help in analyzing natural or man-made terrain features for selection of optimal ordnance to destroy targets.

Terrain teams have been asked to analyze the effects of smoke; fog; rain; fire; and conventional, chemical or nuclear weapons on the terrain.

In high-intensity warfare, the terrain is altered drastically. The terrain analyst must continuously track those battlefield terrain changes and analyze the effects on military operations.

So, the next time you need a terrain analysis, consider the above. If these options don't suit your taste, step right up so we can measure your needs and tailor our products to fit.

Do you know?

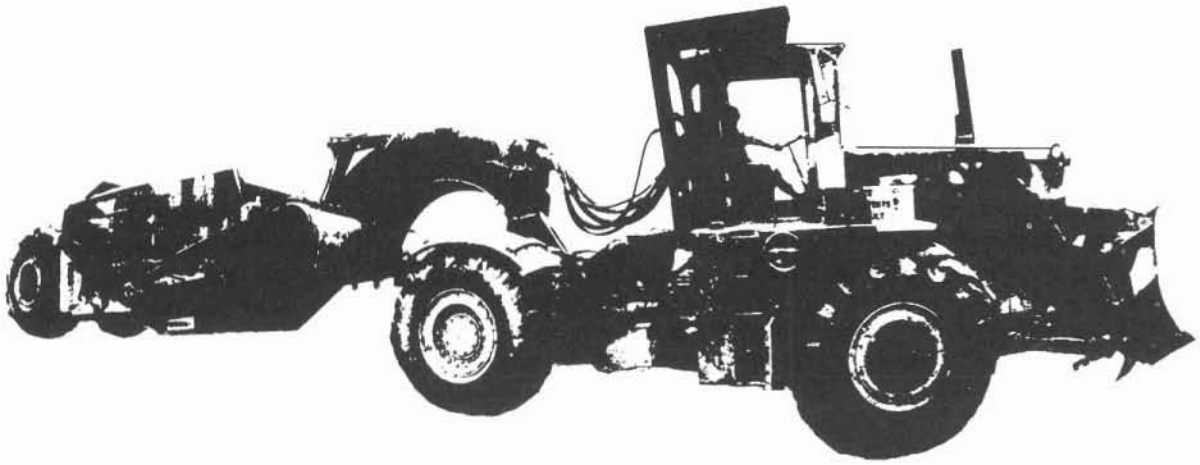
We did not have division terrain teams and terrain analysis warrant officers until 1981. The Defense Mapping Agency first received the mission to produce terrain analysis data bases a few years ago.
Since then, engineer terrain teams have had a dramatic influence in helping commanders see the battlefield and use the terrain to maximum advantage.
Finally, commanders are using various forms of terrain analyses to analyze the battlefield terrain before preparing the concept of operations.

CW2 Frederick N. Pessaro Jr. is Course Manager of the Advanced Terrain Analysis Course at the Defense Mapping School.

His previous assignments include: Chief, 524th Engineer Detachment (Terrain), 2d Armored Division, Fort Hood, TX; 1SG, 526th Engineer Detachment (Terrain) (VII Corps); and NCOIC, Theater Terrain Team of the 649th Engineer Battalion (Topo) (TA), Schwetzingen, FRG.

*Lessons Learned — **621B Scraper***

Lessons Learned features thoughts on tactical issues worthy of reflection and professional debate. Many questions have arisen concerning the capabilities and limitations of the 621B scraper, which is replacing the 290M tractor and 830MB scraper. The Engineer School is conducting a survey of 225 units to gather more data. Here are excerpts of comments from the 92d Engineer Battalion (CH), Fort Stewart, GA, based on 16 months of experience with eight scrapers. The views expressed do not necessarily reflect doctrine or policy of the Engineer School.



Issue. What is the 621B supposed to do?
Observations. Earthmoving contractors have used this Caterpillar scraper as their primary earthmover with great success. It is more maneuverable, faster and lighter than either the 830MB scraper or 290M tractor. Extra weight causes both maneuverability problems and soil bearing problems in many types of soil. The 621B lacks the power to pull itself in some soils—but not all. For example, it can often excavate the sandy soils of southern Georgia by the pan alone; however, this is not the most economical way to operate. When a scraper pulls itself, the heat exchanged through the tire causes premature failure. Replacement tires cost $2,600 to $3,000. Some contractors have gone bankrupt by mismanaging this aspect of maintenance.

Issue. The 621B gets stuck, and units spend exorbitant amounts of time recovering it.
Observation. The only reason for this is possibly inexperienced operators. When used with a push cat, this piece of equipment should never get stuck. If stuck, the 621B can be retrieved by any dozer organic to the unit. By comparison, we have seen 290Ms so stuck that, because of their weight, they had to be recovered by a tank retriever.

Issue. The 621B has no bull blade—a loss which has tremendous impact on production.
Observation. Effective use in scraper/push cat operations will help alleviate the problem. A 1:1 ratio of push cats to scrapers is wasteful and unnecessary. There are three primary methods of using a push cat: back-track loading, chain loading and shuttle loading. If these are used wisely, a 3:1 or 4:1 scraper to push cat ratio can be achieved.

Issue. Are there special maintenance or parts problems?
Observation. In 16 months, the only problem not due to normal wear and tear was in the tachometer sending unit, and it was rectified. Parts for Caterpillar equipment are available worldwide—a major advantage over the 830MB and 290M, which were used only by the Army. Since the 621B was fielded at the users' request, some units received it before parts were stocked in the Army inventory. This is not a problem with the equipment—just an example of getting the cart before the horse.

Issue. What about stability or possible blind spots?
Observation. Problems can only be attributed to inexperience. The Army should spend more time and effort training operators. The improved maneuverability of the 621B definitely outweighs any possible blind spots.

Issue. Durability.
Observations. The 621B has proven its durability and reliability, making it popular with earthwork contractors today. The Army has finally broken away from the concept that one piece of equipment can do everything. It has bought a tried and tested piece of name-brand equipment that performs scraping—its primary mission—well.

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 Tavani, (703) 664-4172, AV 354.

Hey engineer, *make your*

BY MAJ Ralph R. D'Elosua

The Blade Effort Triangle, or BET, offers maneuver commanders and supporting engineers a method of agreeing on the blade effort required to support the scheme of maneuver.

The Engineer School teaches the BET as a successful technique for integrating engineer plans with maneuver in combined arms operations, and it has been proposed for the Armor and Infantry schools.

The BET

Simply stated, the triangle (Figure 1) shows the extent to which engineers can support the blade effort priorities first established by the maneuver commander.

The Y-axis initially represents the amount of unconstrained countermobility effort (antitank ditch in meters) the commander wants.

The X-axis represents the unconstrained level of survivability (described in FM 5-103, page 2-6) he desires.

Since the engineer has a limited number of blades to support the operation, there is a direct relationship between the effort available for survivability and the blade effort allocated to countermobility. What's directed toward countermobility is not available for survivability.

Mutual Appreciation

A quick look at the BET while planning his operation shows the maneuver commander the tradeoffs he must make in establishing priorities. There are limits on what can be accomplished given the time and assets available. Once he has a reasonable best guess estimate of the engineer effort required to achieve a goal, he quickly realizes the engineers cannot achieve the impossible.

The BET gives the commander and engineer a framework for discussing priorities, shortfall problems and options. It also gives the engineer an appreciation for the difficult decisions facing the commander.

Simplicity

The beauty of the BET is its simplicity. It can be drawn quickly by virtually anyone. It can be vague (describing only concepts) or specific (showing exact numbers)—whatever is appropriate to the situation.

The BET is of greatest benefit early in the planning process when it can be drawn up to support the unconstrained engineer estimate.

This gives the engineer and his maneuver commander their first glimpse of how extensive the required engineer support will be.

Once the constraints on time and resources are known, the BET is redrawn to show the optimum mix of countermobility and survivability support to be accomplished by "defend time." This gives the engineer and maneuver commander a working agreement.

For example, a brigade with three battalion task forces (two mechanized infantry and one armored) is preparing to defend within 72 hours.

The brigade commander has directed effort to preparation of a counterattack route; overall priorities are to countermobility, survivability and other mobility tasks.

He wants Survivability Level VI with one initial and one subsequent battle position for each task force (see page 2-6 of FM 5-103).

The engineer has 20 blade equivalents within the brigade area for mobility, survivability and countermobility. The directed mobility effort requires 100 hours. (Note: a blade hour is a blade equivalent working for 1 hour.)

After accounting for the effects of travel, maintenance and refueling, he estimates he has 980 blade hours remaining. That's enough time to construct either 33 km of antitank ditch or 1,633 survivability positions

BET!

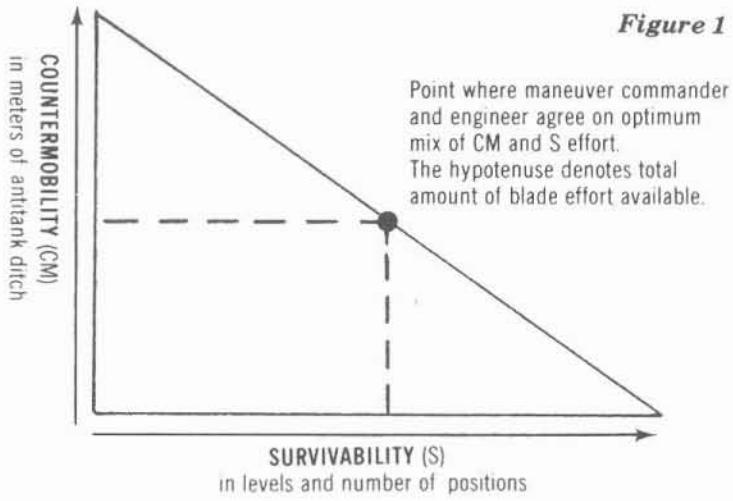


Figure 1

or some combination thereof.

Based on the unconstrained engineer estimate, he determines he needs 10 kilometers of antitank ditch to support the countermobility plan. Survivability Level VI for two battle positions per task force requires 1,110 blade hours—unattainable even if all blade assets were directed to the mission.

Given these realities, the question becomes how should the 980 blade hours available be allocated to best support the commander's intent? The BET (Figure 2) helps the engineer show the commander the tradeoffs at a glance.

The engineers can carry out the countermobility mission and provide Level IV or 1,133 survivability positions (Point A).

Or the commander can direct Level V for 1,550 battle positions and settle for less antitank ditch (Point B).

During the planning stages for defensive operations, the BET accomplishes several things:

- The maneuver commander and engineer agree early on how to accomplish established priorities realistically.
- The triangle provides a simple picture of how the engineer support is programmed.

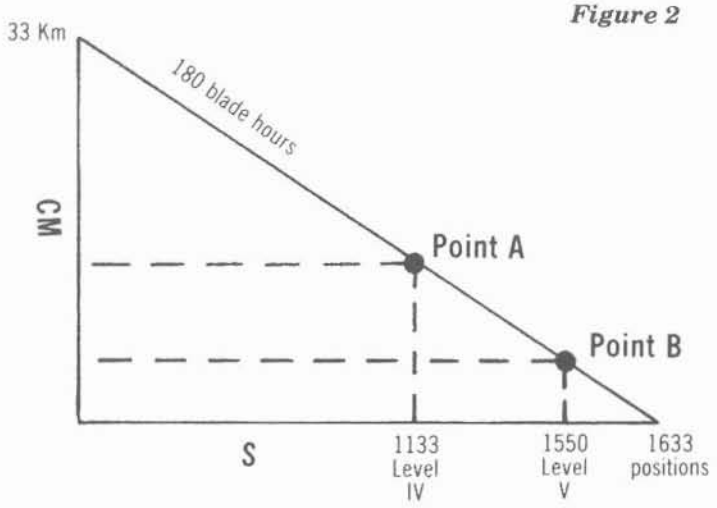


Figure 2

- The graph becomes a point of reference for reallocating resources as the situation dictates.
- Planners have a basis for considering alternate countermobility methods such as employing minefields, reinforcing targets or using manpower instead of blades.

Used properly, the BET is a tool for preparing engineer estimates in the defense that greatly enhance the integration of engineers into the maneuver plan.

Engineer, are your ready to make your BET?

MAJ Ralph R. D'Elosua is an infantry officer. He has commanded a BCT unit and an airborne rifle company and served as a battalion S-1 in the 82d Airborne Division. Recently, he was a tactics instructor in the Engineer School. He is a USMA graduate with a master's of science from University of Southern California. He is now attending the CGSC.

Gamelands offer realistic training sites for National Guard engineers

by LTC Charles M. Bechtel

National Guard units that need wide open spaces for training may not have to look farther than their state game lands.

The 876th Engineer Battalion, Pennsylvania National Guard, successfully works with its state game commission to devise annual training projects of mutual benefit to the state and the guard.

Engineers from the 876th Engineer Battalion, Pennsylvania National Guard, cut steel towers into sections before transporting them to a scrap dealer.

For the past two summers, the combat engineers have combined public service engineering projects with a realistic training scenario that included air insertions and OPFOR play. They demonstrated that soldiers can successfully train on state game lands without harming the environment.

Their initial mission—to demolish abandoned steel electrical towers—was part of a project to create landing zones for rotary and fixed wing aircraft. Pilots from the Eastern Army Aviation Training Site practice day and night landings in Bear Valley. The landing zones double as feeding plots for white tail deer.

But the battalion also constructed dirt roads and culverts, replaced unsafe bridges and performed other engineering maintenance for the state.

The chance to operate in 121,500 acres of rugged terrain provided realistic command and control challenges that are impossible to simulate when confined to a 10,000 acre post.

All levels of the command, including platoons and line company squads, had room to operate independently, but in an organized integrated manner as they would in combat.

Three FM radio retransmission stations on key terrain features permitted the commander to communicate over mountain ranges with almost all of the subordinate units.

Helicopters from the Pennsylvania National Guard were used extensively to give the 876th a chance to train with aviators. Helicopters resupplied units located 115 miles and a 3-hour drive from the command post. CH 54 flying cranes delivered 400-gallon water trailers to company sites.

Quartering parties were inserted by air.

UH-1s and LOH-6s helped provide reconnaissance, aerial survey, and command and control during battalion moves. They served as both OPFOR aircraft and friendly aerial covering force during simulated NBC attacks.

The 28th Infantry Division applied constant OPFOR pressure-striking by night and day, harrying soldiers working on construction projects and attempting to penetrate camp perimeters.

Nightly back briefs at the command post helped company commanders immediately analyze their tactical weaknesses and take corrective action.

Thorough coordination with state officials is critical for units who are interested in training on state lands.

The state game commission prepared the environmental impact statements and supporting documentation which set the parameters for the exercise. They provided fire fighting equipment and instructed the guard units on its use.

The state police played an important role—answering questions from people living near the game lands about gunfire and military traffic in the area.

The 876th proved that the National Guard can work closely with government agencies to develop field training exercises that benefit both the community and the soldier.

Other guard units should take stock of their ability to assist states with projects that don't otherwise fit the budget. The engineers' ability to remove unwanted structures, construct irrigation ditches and ponds, build and maintain access roads or conduct a wildlife census is a valuable asset.

When working with state officials remember to—

- Initiate planning and coordination early so environmental concerns are fully addressed.
- Inform the public and all potentially concerned parties on the purpose and extent of the operation. Emphasize the community benefit.
- Use the news media to explain the exercise and create a positive attitude before the exercise starts.
- Request additional equipment like transmission sets well in advance and check everything thoroughly before you need it at the site.
- Plan alternative transportation anytime aviation is the primary means for delivering critical supplies such as Class I items.
- Recognize local officials in the media with letters and awards. You may need their support again.

LTC Charles M. Bechtel commands the 876th Engineer Battalion. He is the state maintenance officer of the Pennsylvania Army National Guard at Fort Indiantown Gap. He is a graduate of the Command and General Staff College and holds an MBA from Penn State University.

Antique shop find...

...Timeless Values

by CPT Joseph J. Miano

I found a treasure in an antique shop in New Orleans last year. For $3.00, I purchased Ralph E. Brown's copy of **The Officers' Guide,** printed in 1939.

Ralph Brown was an officer in the Coastal Artillery Corps. He stamped his nameplate inside the cover as a first lieutenant in the 202d Coast Artillery and updated it faithfully as he progressed to the rank of major in the 5th HQ, Special Troops, 4th Army at Camp Swift, TX.

Within the well-thumbed pages of MAJ Brown's book, I found nine yellowed, handwritten pages of notes for a speech he apparently gave newly commissioned officers during World War II.

The Officer's Guide that served as the foundation for MAJ Brown's talk is one of those small lessons in history we so often forget—a reminder that the roots of today's policies and procedures are in our past.

Much has changed; yet much remains the same. Values are a timeless standard of shared beliefs—a cement that binds the aggregate members of the Army together. I was struck by how true MAJ Brown's message rings 40 years later...by how clearly the attitudes and traditions he sought to foster are engrained in our heritage.

I thought about trying to find out more about MAJ Brown...who he was...what he did...and I'm still curious. But in the end, I wanted to share his thoughts unencumbered as I found them. His words, stand alone. They need no biographic footnote to justify them.

Here are some excerpts of MAJ Brown's lecture notes some 40 years ago:

Stand on your own feet. Your seniors are interested in your past only insofar as it may indicate your future worth. The fact that you are well educated, that you spring from a famous family, or that you bear a fine reputation from prior work are all matters of small concern to your superiors. They are interested in how well you execute the tasks of today, so they can better estimate how well you may function tomorrow.

Most of us are men of ordinary capacity. Whenever an officer gets a secret suspicion that he is something more than an ordinary mortal, he is likely, unintentionally, to disclose his belief to others. The big fall is then not far distant. Ambition is normal and healthy, if wisely controlled. Officers, like other men in this "Land of the Free," are sometimes prone to take advantage of the freedom of speech. I refer to the habit of sneering, carping, grumbling and criticizing those who are above us.

The man who is anybody and who does anything is surely going to be criticized, vilified and misunderstood. This is part of the penalty for greatness; and every man understands it, and understands, too, that it is not proof of greatness. The final proof of greatness lies in being able to endure contumely without resentment.

Mind your own business. Do this, or if for any reason you should prefer not to, then take your choice of these: get out or get in line.

You must do one or the other—make your choice. If you work for a man, in heaven's name, work for him! If he pays the wages that supply your bread and butter, work for him...speak well of him...stand by him ...and stand by the institution he represents.

If put to the pinch, an ounce of loyalty is worth a pound of cleverness.

If you must vilify, condemn and disparage, resign your position; and when you are outside, damn to your heart's content.

But so long as you are part of an institution, do not condemn it. Not that you will injure the institution. But when you disparage it, you disparage yourself.

You cannot help the **Old Man** *as long as you are explaining in undertone and whisper, by gesture and suggestions, by thought and mental attitude, that he is a curmudgeon and his system dead wrong. You are not menacing him by stirring up discontent and warming envy into strife, but you are doing this...you are getting yourself upon a well-greased chute that will give you a quick ride down and out.*

Avoid thoughtless remarks. Once, in a large building on the East Coast, an officer was standing at a window gazing off over the city. An associate asked what interested him so profoundly.

"I was contemplating the damage we do ourselves by idle conversation. A year ago, I told a friend that sometime I would like to be stationed on the West Coast.

"Recently, my friend has been on duty where he has something to do with assignments. This morning I received a letter telling how happy he was to obtain my orders for the far west. I am to leave at once because of a casual remark made a year ago. I shall have to go to a distant station, far removed from the part of the country it is now in my great interest to remain."

All this is intended to emphasize the importance of avoiding those thoughtless remarks which may cause reaction counter to your intentions and, in the extreme case, may even create the impression of disloyalty.

You do mean to be loyal. Let no person have any doubt about it whatever. Disloyalty is a garment difficult to shed.

CPT Joseph J. Miano is a transportation officer assigned to the Department of Combined Arms, USAES. He served as the S-2 for the 78th Engineer Battalion and the S-3 for the 2d Movements Region, both in Germany. CPT Miano is a graduate of the Engineer Officer Advanced Course and the Transportation Officer Advanced Course. He has a degree in English from the University of Virginia.

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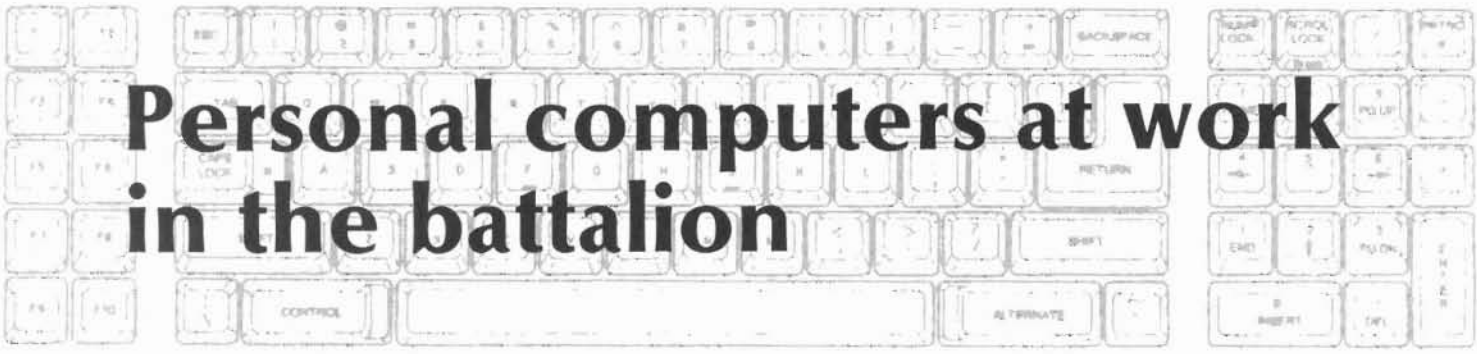

Personal computers at work in the battalion

by MAJ Robert R. McLaughlin

The 3d Battalion, Engineer School Brigade at Fort Belvoir, has successfully automated all aspects of its daily administration from training to duty rosters.

Thanks to a personal computer, the battalion commander and his first sergeant are no longer desk bound.

It handles many of the mundane operational burdens, freeing the staff to manage troops rather than administer records.

The battalion is responsible for command and control of more than 1,000 permanent personnel and 2,000 student officers and NCOs annually. It has two garrison companies of approximately 500 persons each and four student companies or detachments.

Before automation, managing a 500-man company with an authorized staff of two officers and two NCOs was a nightmare. The APRT cards alone required two file drawers.

The first step was to collect all the forms (from the suspense snowflake to the APRT card) and examine how they were used. Each had been maintained as a separate data base in its own unique file. If someone wanted a composite picture, he had to hand sort through piles of cards to collate the data.

The logical question was, "Why can't we use data base management software to do this on a microcomputer?"

Conceptually, a battalion system should encompass the functions of the S-1, S-2, S-3 and S-4. The company should feed the battalion data base and the battalion should feed brigade. Floppy discs can be used to transfer data from company to battalion.

Security is important. The automated data processing security experts on post must accredit the system.

The 3d Battalion's system works on an IBM PC using dBase III. The software includes a tutorial package that helps managers set up data bases and develop their own program applications. The battalion created electronic versions of the standard forms and developed programs so the computer will simultaneously update all appropriate forms.

If, for example, a soldier fails the APRT, the computer calculates his score and annotates his APRT form. It also compares his weight against the screening table weight (AR 600-9). If the soldier is overweight, it annotates his reenlistment card. The computer also reminds managers to schedule a medical evaluation and enroll the soldier in remedial PT and an overweight program if doctors verify the problem.

If the company commander wants to counsel the soldier, the reenlistment card, personal data card and quality point average can be called up at the touch of a button.

For the first time, the 3d Battalion commander has an instant handle on the status of all personnel in two large companies. He can get up-to-date reports on any functional area in minutes. The battalion uses the unit reports and has established a check and balance on the SIDPERS data base. The staff generates SIDPERS reports, compares them to company reports and resolves differences.

One of the biggest benefits is the ability to link the computer to a video projector. Charts and graphs on the computer can be projected on the big screen and edited during briefing rehearsals. Changes can be made on the spot if the boss has a better idea, if data changes or if mistakes were made. It now takes four hours to prepare the battalion's quarterly review and analysis instead of two weeks.

Automated duty rosters are another time saver. Each unit maintains 10 to 15 duty rosters. The clerk who used to spend two hours manually producing a duty roster for 60 people now spends five minutes. The computer completes the job in 45 minutes while the clerk performs other duties in the orderly room.

Computers are not a panacea for all that ails a battalion. Electronic forms aren't a complete substitute for the official hard copy forms and files. But they make it possible to keep accurate, up-to-date records and analyze data.

MAJ Robert R. McLaughlin now serves with the DCSOPS/G-3, US Army, Japan. He was previously the executive officer of the 3d Battalion, Engineer School Brigade, Fort Belvoir. He is a graduate of the USMA and the CGSC. He has a master's degree in engineering management.

Mobile soil labs:
Immediate quality control

by PFC Eric W. Cramer

Getting accurate, timely soils, asphalt and concrete testing is a major problem engineers face when working on road or airfield construction. Poor or insufficient quality control results in construction delays and limits the engineer's ability to make sound decisions in the field.

Part of the problem is that materials testing labs are usually located at the command post miles from the construction site. Quality control testing takes only a short time. But transporting samples to the lab and results to the field takes much longer...while expensive equipment and work crews are left waiting. This often encourages builders to cut corners by not taking the time to do proper testing.

The 802d Engineer Battalion solved this problem by building a mobile soils lab. The lab is equipped for everything from the simplest sieve analysis to asphalt Marshall testing and concrete strength tests. Working directly with the construction crews, the specialists provide on-the-spot quality control without expensive lost time.

SSG Kevin McCarn and SP5 Robert Warner helped develop one of the first such labs while serving in Korea with the 802d.

The mobile soils lab received a thorough workout during its first five days. Operations performed in the field included—

- Sieve analysis.
- Hydrometer analysis.
- Specific gravity test.
- Compaction test (CE55).
- Moisture content test.
- Density determination.
- California Bearing Ratio test (CBR).
- Field identification.

Having the lab at the construction site saved four days for each test, according to SSG McCarn. Quality control specialists performed tests while surveyors compiled all the survey information needed. No one had to leave the site until all important data for both soils and survey had been obtained.

A materials specialist with the 802d Engineer Battalion in Korea weighs a soil sample for sieve analysis. On the spot soils testing makes engineers faster and more efficient in the field.

Easy access to samples for testing was another advantage. "If we needed another sample to get clear results, all we had to do was step out the back door," SSG McCarn said.

A 2.5-ton shop van can easily be converted to a mobile soils lab with the following test kits:

- Soils, NSN 6635-00-641-3643.
- Asphalt, NSN 6635-00-641-3462.
- Concrete, NSN 6635-00-641-4361.

Four pieces of testing equipment must be bolted down—the concrete beam breaker, the concrete cylinder breaker, the Rotorex for asphalt analysis and the sieve shaker. You may have to attach angle irons to the sides of the concrete cylinder breaker to bolt it down. Remember, this equipment is heavy, so distribute its weight carefully.

The rest of the construction is straightforward carpentry. Plan shelving and cabinets in the shop van to best suit the needs of your unit and still permit access to the power bands in the sides of the van.

The mobile soils lab decreases delays and increases the engineers' ability to make sound decisions in the field. It is an idea whose time has come.

For more information on constructing a mobile soils lab for your unit, contact Jeffery Vernon, DME, Roads and Airfields Branch, US Army Engineer School, Fort Belvoir, VA 22060-5335. His telephone number is (703) 664-3075, AV 354.

PFC Eric W. Cramer is the associate editor of ENGINEER.

Maintenance Certification

by CPT Thomas P. Bostick

A surgeon cannot operate without being professionally certified. Plumbers, mechanics and masons must serve apprenticeships to do their jobs.

In the Army, however, it is not uncommon for junior officers and NCOs to have responsibility for equipment they have little chance to learn about. This makes maintenance a difficult area to manage. Many junior officers and first line supervisors lack sufficient knowledge to supervise correctly.

To combat this problem, our commander, LTC Daniel W. Christman, developed a maintenance certification program for new supervisors. This program helped our unit, B Company, 54th Engineer Battalion, win the 1983 Army Chief of Staff's award for maintenance excellence—given to the company with the best maintenance program in the Army.

Reservist light vehicle mechanics SGT Spencer Jones and SP4 Darryl Mortimer inspect a carburetor. Maintenance certification results in superior performance on maintenance inspections (Photo: CPT Gregory Taylor).

Our maintenance certification program ensures that new supervisors are competent in maintenance and aware of problems often overlooked by equipment operators. For instance, the program teaches new supervisors the answers to specific maintenance questions such as—

- If the brake system begins to leak, which fitting is most likely the problem based on past experiences?
- On a specific piece of equipment, which engine mounting bolts generally loosen first?
- Where on the vehicle frame should I look for cracks?

The certification program prepares the supervisor to quickly and accurately inspect the equipment.

The actual operation of this maintenance program is simple. Training starts at the platoon level. New personnel are trained by platoon leaders in the company equipment shed. The maintenance sergeant or platoon leader demonstrates the standard daily performance checks described in the operator's maintenance manual. Then the instructor explains problems typical to the equipment in the unit.

The new supervisor gets both a general overview of maintenance problems and a working knowledge of day-to-day maintenance problems with the unit's equipment.

The certification is complete when the new supervisor passes his written and hands-on examinations developed by the battalion maintenance officer. Officers are tested by the battalion maintenance officer; NCOs receive their training from the company commander. The maintenance certification program instills the self-confidence and ability that comes from demonstrated performance.

It also keeps maintenance supervisors abreast of ongoing problems. Best of all, new maintenance supervisors no longer have to learn their business by trial and error. The maintenance certification program not only helps on inspections but also acts as a confidence builder for maintenance supervisors and as a means for units' trainers to evaluate the quality of their training.

Maintenance certification provides leaders with the technical competence to supervise vehicle and equipment operators to keep our forces ready for battle.

CPT Thomas P. Bostick is an instructor in the Department of Mechanics, USMA. In 1983 he served as company commander of B Company, 54th Engineer Battalion, Wildflecken, Germany, a combat engineer company which won the Army Chief of Staff award for maintenance excellence.

CPT Bostick has master's degrees in both civil and mechanical engineering from Stanford University.

EOAC

Making the Army's best *better!*

By MAJ Randy R. Rapp

The Engineer School improved the Engineer Officers Advanced Course this summer. The changes derived from comments from EOAC graduates and suggestions from last year's Engineer Commanders Training Conference.

New ideas and constructive criticism from students, the field and the faculty have made EOAC the TRADOC model for all officer advanced courses.

Improvements make officers more responsible for their education and allocate time more efficiently. The course now places students in the team room, at the computer terminal, at home studying or at the library researching more than before. The improved course is still based on the seven pillars of EOAC.

Irreconcilable demands on student time have been eliminated, but the course schedule remains challenging. A typical day finds officers in class from 0700-1500 and at PT from 1500-1630. Homework still consumes most evenings and some weekends.

However, to make students' schedules less hectic—

- The course now sets aside 11 Wednesday afternoons for student appointments.
- Post support activities come to the School during a duty day to service students' needs.
- Many afternoons during the last four weeks students can attend to personal affairs.

Small groups—facilitated by team leaders—now last for 16 weeks. This adds small group instruction to the *Base Camps and Contingencies* and the *Operations Officer* modules. Students do scheduled physical training during this period and also retain their team rooms.

Communicative arts—with many improvements—remain a vital component of EOAC. Each of the first six modules includes one graded writing assignment. The course will

Comparison of student hours

	Class 1-85 (October 84)	Class 7-86 (June 86)
Lecture	329.5	259.5
Non-lecture*	406.5	523.5
Homework	165	179
Total	901	962

**Includes small group exercises, computer assisted instruction, guest speakers, case studies and programmed instruction.*

The seven pillars of EOAC

1. **Total fitness** — develops the student's mind, body and warrior spirit to increase his and his unit's potential.
2. **Small group** — focus on learning from experience and encourages the open exchange of ideas among students.
3. **Computer assisted instruction** — encourages the students to tailor their own instruction by completing automated lessons at their own pace.
4. **Integration** — reinforces learning by requiring students to incorporate concepts and skills from previous lessons into their current instruction.
5. **Team leader** — teaches total fitness and leadership, facilitates tactics and engineering training, evaluates student performance and potential, serves as a professional role model, and provides unity to the instruction of the course.
6. **Scenario** — hinges instruction on a framework of real world problems and conditions.
7. **Challenge/reward** — stimulates individual excellence in academic and leadership skills and promotes team excellence in collective and cohesive performance.

soon use a new TRADOC writing program. Instruction in briefing techniques is more structured than before.

Other improvements include—

Combined arms tactics/combat engineering. Eliminating the *One-Day War Game* allows time for new modules in *Engineer Support of Light Infantry and Special Operations* and *Heavy Battalion Task Force in the Attack* plus expansion of older lessons. Engineers learn to "talk tactics" with the perspectives of maneuver officers.

Technical engineering. A revised scenario makes students thoroughly address tactical considerations in their construction plans. As a result of lessons learned in Germany and Central America, more time is devoted to drainage and concrete construction. Nonstandard fixed bridging is completely revised and consolidated into three days of instruction. Training in POL pipelines is reduced.

Senior team advisor program. A senior engineer officer stationed at or near Fort Belvoir voluntarily associates with a team, critiquing their solutions to tactical and engineering exercises. The mature officer's involvement is limited only by his schedule and his desire to help teach young engineers.

Optional military studies program. Especially dedicated students voluntarily study military history, advanced tactics or professional values during free afternoons, with the guidance of a senior faculty member. Six seminars in each of these topics lend structure to off-duty efforts many students make to improve their professional competence.

Professional development day. Teams visit a military activity or battlefield of their choice. Conducted the last day the teams are together, this exercise gives the team leader a final shot at reinforcing course objectives.

Research paper presentation program. Instead of oral book reviews, students deliver formal classes about the results of research for their papers. The program exposes the teams to less familiar military subjects.

These improvements in the EOAC stem from the Engineer School's strong desire to provide the best captains' training possible. The infusion of new ideas from students, the field, and faculty makes the course the best it can be.

The improved EOAC better accomplishes its mission—to train battle winners.

MAJ Randy R. Rapp was the Senior Team Leader for the EOAC. He served in the 293d, 94th and 326th Engineer Battalions.

MAJ Rapp has a bachelor's degree from the USMA and a master's degree in civil engineering from the University of Missouri/Rolla. He is a licensed professional engineer in Virginia.

(continued from inside front cover)

Light engineers recognize better than anyone that highly specialized systems have no place in the light soldier's pack. We need versatile, light-weight, low-bulk explosives.

We may never be able to significantly reduce the weight light engineers carry. But we can certainly increase the efficiency and utility of our load.

Our mission and lack of organic resupply mean use what we can carry or find. I hope that the new technology, like slurry or the ballistic disks, will someday find its way into our rucksacks.

1LT Thomas P. Smith is currently the executive officer of C Company 65th Combat Engineer Battalion, 25th Infantry Division (Light). He served 18 months as a platoon leader, first of a combat engineer platoon, then for a light engineer platoon. He is a graduate of USMA and has completed EOBC, Airborne School, Jungle Warfare School, and the Sapper Leader Course.

Engineer Solution

The magnetic azimuth from point A to point B is 64°.

The fact that the grids do not line up is irrelevant. On either map sheet, the magnetic azimuth is determined using the magnetic declination diagram for that map sheet.

Map A

To convert from grid azimuth to magnetic azimuth, add the GM angle:

Magnetic azimuth = grid azimuth + GM angle
Magnetic azimuth = 62° + 2°5′ = 64°5′
Magnetic azimuth = 62° + 2°5′ ≈ 64°

Map B

To convert from grid azimuth to magnetic azimuth, subtract the GM angle:

Magnetic azimuth = grid azimuth - GM angle
Magnetic azimuth = 246° - 1°40′ = 244°20′
Magnetic azimuth = 246° - 1°40′ ≈ 244°

Magnetic azimuth (A to B) = 244° - 180° = 64°

The grids do not line up because the maps are compiled using different universal transverse mercator (UTM) grid zones. The grid in each zone is aligned with the central meridian (line of longitude) for each zone. As the meridians converge towards the pole, the two grids must also converge.

The direction of magnetic north is independent of grid zones and will be the same—or very nearly the same—for two adjacent map sheets.

Earn your professional engineer's license

by CPT Calvin Evans

The officer with a professional engineer's license has proven competency in engineering skills and enjoys greater credibility in dealing with civilian engineers. He can also be proud of a major accomplishment—doing all it takes to acquire the license is an achievement in itself, requiring a large investment of time to apply and study for the test.

I took the exam while I was attending the Engineer Officer Advanced Course at Fort Belvoir. After finishing the test, I thought I had passed, but I wasn't sure. So I wrote myself a few notes on things to do in case I had to take the test again.

I based this article on my notes, hoping that lessons I learned in preparing for the exam will help other officers to succeed in getting their PE licenses.

General Advice:

Don't attempt the exam unless you can put the time into preparing for it.

Acquire and read "Professional Engineer—A Guide to Registration." This pamphlet, published by the Engineer School, is a good explanation of the registration process and the exam's organization. It includes a fine bibliography of commercially available guides that can help you study.

Applying to take the exam is extremely time consuming and expensive. For example, it costs $245 to take the test and get a license in the state of New York. Most states require you to apply again and pay another fee if you fail the test the first time.

When to Take the Exam

During or shortly after advanced civil schooling—If you plan to attend advanced civil schooling, this is the ideal time to take the PE exam. You can usually arrange an academic program that satisfies degree requirements while preparing you for the PE exam by including classes in your weak areas. This will also accustom you to studying for tests and give you time to study specifically for the PE exam.

During EOAC—This is a good time to take the PE exam for several reasons. First, some of the topics covered in EOAC are directly applicable to the PE exam (for example: concrete, drainage, horizontal and vertical curve calculations, soil phase relationships). Second, although homework has increased, study time is available, and you will be accustomed to studying for tests. Third, many officers take the exam every year at Fort Belvoir, and your classmates can be valuable study aids. Any other point in your career where regular study hours can be set aside for preparation is also a good time to take the test.

Applying to Take the Exam

Shop around—Unless you want a license from a particular state, it may be advantageous to request application materials from several different states. The requirements are similar for most, but the experience requirements and fees vary enough to make it worth your time to shop around. Some states may not accept your military experience as meeting the requirements. Virginia accepts most military experience.

Start early—Apply well in advance of the exam to ensure that the registration board receives all your materials before the deadline. Starting application paperwork 6 months before the test is not too early. To allow for problems, 9 months to a year is not unreasonable. Each state requires that its own forms be used for references and verification. You have to allow enough time, for example, to send a particular reference form to a registered professional engineer now stationed in Europe, wait for him to fill it in and mail it back to you, and get it to the board.

Have your endorsements sent to you rather than straight to the board—I recommend having your references return their materials to you, then send the references to the board with your application. This way, you know your application is complete when you mail it. You won't need to call the registration board to ask if your references have arrived.

Ask for more references than are required—For one reason or another, one of the people you ask to write a reference may not get it to you on time. It is extremely frustrating and embarrassing to have to ask this person (usually a senior officer) if he has completed your reference or to try to hurry him up to meet your suspense date. It is better to ask for four or five references, then send the first three you receive with your application. This should enable you to avoid wasting time following up on references.

Ask for references before you leave your unit—If you plan ahead, you can get your references before you leave your unit and avoid mailing materials back and forth to Europe. This can save you a lot of time and expense.

Studying for the Exam

Get a study guide—This will tell you the areas covered and the kinds of problems you can expect. Professional Publications, Inc. publishes excellent review manuals for the PE exam in the four major areas (chemical, civil, electrical and mechanical engineering).

Take a review course—Taking a course designed to prepare you for the PE exam can be very helpful, but is not necessary. The advantages are that this will force you to spend

time studying and may help to expose areas on which you need to concentrate. Do not expect the prep course to teach you everything you need to know. These courses usually hit only major concepts and work a few sample problems in each area. Most of what you learn must come from self-study.

Start studying early—Don't wait for the day before the exam to try to learn a complete subject area.

Organize your study materials—While reviewing, it will be very helpful to tab or index your notes or books for quick reference during the exam. Good sample problems are particularly useful. The less time you spend searching through your references, the more time you will have to work the problems.

Get a good civil engineering handbook—A good handbook, such as Merritt's ***Standard Handbook for Civil Engineers***, is a helpful guide to the areas you have never studied before or for which you don't have a good reference. These are expensive, so you may want to try to borrow rather than buy one.

Study the basics in every major subject—Even if you have never studied, say, sanitary engineering, the basic concepts are fairly easy to understand. Sometimes the problems in less popular areas are significantly easier than those in the more popular areas.

Taking the Exam

Read all the problems before you start to work—The problems that you feel you can solve easily should be highlighted. Then quickly rate the problems from easiest to most difficult. The time you take to do this will be well spent.

Work the easiest problems first—You will feel more confident and relaxed after you have solved the first problem. All problems are equally weighted, so don't solve a large or difficult problem when an easier one is available.

Don't waste time copying the problem or redrawing figures—Only do this if a figure will help to show how you reached certain values.

Budget your time—If you are solving the easiest problems first, don't spend more than an hour on each one. It is better to get partial credit on all the problems rather than a "perfect" solution to only one or two.

Go for partial credit—If you are running out of time, write down the equations that show how you would solve the problem. This will be worth more points than number crunching. More weight is given to solution methods than to mathematical computations.

Conclusion

This advice may seem obvious, but it works. I hope the lessons I learned in obtaining my PE license can help those who are planning on taking the exam in the future. Good luck—and study hard!

CPT Calvin Evans is a registered professional engineer in Virginia. He served as a platoon leader, company executive officer, battalion S-4 and company commander in the 4th Engineer Battalion. A graduate of USMA, CPT Evans is doing post-graduate work in civil engineering at Stanford University.

Hotline Q & A

Q. What new 5-100 series field manuals are currently available?

A. New field manuals 5-104, *General Engineering*, and 5-105, *Topographic Operations*, should be fielded by January 1987.

Field manuals currently available are—

- 5-100, *Engineer Combat Operations.*
- 5-101, *Mobility.*
- 5-102, *Countermobility.*
- 5-103, *Survivability.*
- 5-106, *Employment of Atomic Demolition Munitions.*

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

Q. Are there refresher courses for field grade officers in engineer doctrine and equipment?

A. Refresher courses for field grade officers include—

- Mapping and Charting Geodesy for Topographic Assignments - 2 weeks.
- DEH Executive Management Course - 1 week.
- Combat Engineering Course, Phases II and III - 3 weeks.

A separate, 1-week refresher course to update field grade engineers being assigned as reserve component advisors or as engineer staff officers is scheduled for FY 88.

Q. How close can an M-16 rifle be to a magnetically fused mine before detonating it? How close can soldiers carrying helmets and weapons be to a mine before detonating it?

A. Magnetically fused mines are intended to respond to the metallic mass of a tank. It is unlikely that a soldier's steel pot or M-16 would detonate one of these mines. However, a good rule of thumb is to keep weapons and other metal objects at least 12 inches away.

Q. Can sand grids be used in place of sandbags for bunker construction in humid climates where sandbags deteriorate rapidly? How can I order sand grids?

A. No. Sandbags are meant to stabilize loose material without adding hazardous material to the potential area cf explosion. They are easily replaced when damaged and the entire system cannot be destroyed by one impact. Sand grids provide the stability required, but are not easily replaced. Lining sandbags with sealed plastic bags prevents deterioration in humid climates.

Sand grids may be ordered through the standard AFCS channels under the NSN: 5680-01-198-7955.

Commissioned Officers Branch

Captains Promotion Board:

If you are a Reserve commissioned officer—and want to remain on active duty after your obligation date—you must apply for conditional voluntary indefinite status between the 24th and 27th month of active federal commissioned service (AFCS).

The captains promotion board and conditional voluntary indefinite (CVI) board are held at the same time.

This year, 25 engineer officers failed to file their applications until June. As a result, their applications did not arrive at MILPERCEN in time to be reviewed by the board.

To avoid delays in career decisions and uncertain career status, you should submit your application at least 60 days before the board meets. The next CPT/CVI board is from 27 January 1987 to 10 February 1987.

Promotion Packet Photos:

Officers must have official photographs in their promotion packets. Officers should have a photograph taken as soon as possible after they are promoted to 1LT.

When the last board met, 30 percent of the officers did not have a photograph in their promotion packet. Engineer Branch sent letters to all officers with no photograph in their packets, but 15 percent still did not provide a photograph.

The photograph is essential to the promotion file. (See AR 640-30, *Photographs For Military Personnel Files).*

Preference Statement:

You must have a current preference statement in your file. This provides information on assignment preferences, duty and home addresses, and telephone numbers needed to contact you. Use the comments portion of DA Form 483 to explain your choices.

Engineer Officer Bulletin:

The *Engineer Officer Bulletin* gives up-to-date information on assignments and professional development issues. The bulletin is published twice each year by MILPERCEN, Engineer Branch. The latest bulletin, Number 3, June 1986, was distributed to troop units, Engineer Districts, ROTC units and schools. The next issue will be published this winter.

Officer Selection Board:

Selection boards for FY 87 involving Engineer officers—are listed below. Officers in the zone of consideration must submit current photographs, medical examinations and corrected Officer Record Briefs through their servicing MILPO in time to reach MILPERCEN for these boards.

Board	Dates
LTC Product Manager	20 Jan - 30 Jan
CPT Army CVI	27 Jan - 10 Feb
LTC Army	18 Feb - 27 Mar
MAJ Army	3 Mar - 18 Apr
RA Army	27 Apr - 1 May
Brigadier General	9 Jun - 2 Jul
Senior Services College	21 Jul - 21 Aug
CPT Army CVI	9 Sep - 25 Sep

Engineer Branch Visits:

The following Engineer Branch visits are scheduled for FY 87. Contact Engineer Branch if your unit wants to schedule a visit. Engineer Branch visits are funded by the visiting unit.

BC, USAREUR Engineer Conference	1-5 Mar 87
BC, Engineer Proponent meeting, Fort Leonard Wood, MO	20-23 May 87

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Aviation Engineers in the Southwest Pacific, WWII

by Dr. James Dunn
Office of History, OCE

The Army recognized the importance of aviation engineers shortly before the United States entered World War II. The first unit — the 21st Engineer Regiment (Aviation) was activated June 1940 at Fort Benning, GA.

Following the Japanese attack on Pearl Harbor, 7 December 1941, the engineer aviation battalions contributed greatly to America's success in the Pacific. Charged with the mission of building air bases in remote, undeveloped islands and tropical jungles, these battalions played prominent roles in the Pacific theater of operations.

The 804th from Hawaii and the 805th from Panama participated in ADM Chester Nimitz's Central Pacific offensive and built air bases for the B-29 heavy bomber units.

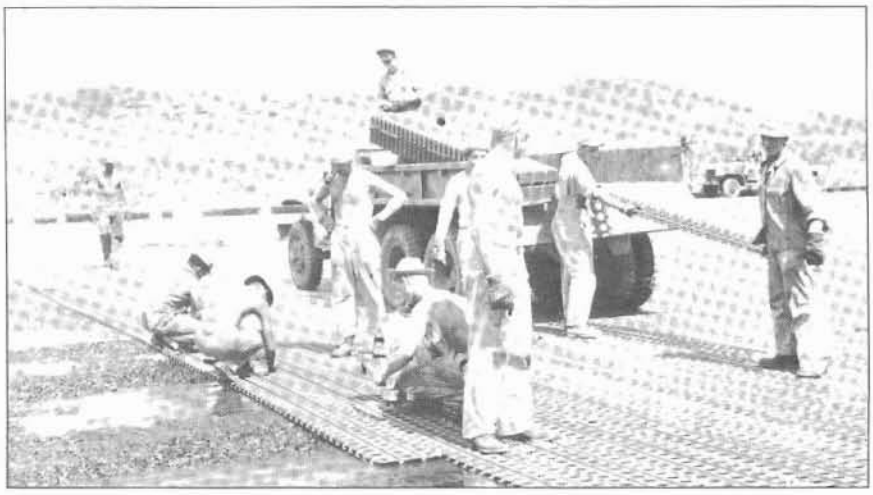
The 803d was captured in the Philippines when Bataan fell—but not before the battalion built 12 air bases on Luzon, moved and emplaced heavy guns for the defense of Bataan, built rice mills, and repaired roads and bridges. In the final days, the battalion fought as infantry in the front line.

The 802d remained in Alaska for the Aleutian campaign.

The 808th Engineer Aviation Battalion—activated in September 1941, March Field, CA—had little time to prepare for war. The commander, MAJ Elvin R. Heiberg, held the first formation on Saturday morning, 6 December 1941. Not knowing the Japanese would attack Pearl Harbor the next day, he told his men how fortunate they were to have such fine barracks and living conditions.

Alerted for tropical foreign service, the battalion sailed from San Francisco and arrived in Melbourne, Australia on 2 February 1942.

The battalion moved to the Northern Territory to build air bases around Darwin. Over 2,000 miles from the closest American depot, the 808th began operations with only three dump trucks and two tractors. The first mail was a month late, and February pay was delayed. However, local bread and beef were plentiful; and any spare time could be spent panning for gold.



Engineers construct an airfield in the South Pacific.

From February to July, the battalion built seven air bases in the Darwin area and developed a unique method of clearing the sites by stretching a cable between two tractors and moving back and forth across the field uprooting trees.

In keeping with GEN Douglas MacArthur's strategy of confronting the Japanese in the forward area rather than waiting to be attacked, the 808th moved from Australia to Port Moresby, Papua, New Guinea, in July 1942.

For the first time, the battalion encountered the difficulties of operating in an unfriendly, jungle environment: hordes of malaria-carrying mosquitoes, jungle rot, leeches, flying foxes, heavy rain and Japanese air raids. Yet, the 808th built an air base in one month and—between August 1942 and March 1943—completed four sites in the vicinity of Port Moresby.

These and other bases provided air support to stop the Japanese attack along the Kokoda Trail, aided MacArthur's attack on Buna, and destroyed an entire Japanese convoy in the Battle of the Bismarck Sea.

The 808th continued to operate in the Southwest Pacific area. At Finschhafen, New Guinea—in what the battalion considered its greatest accomplishment—the 808th hacked an air base out of the middle of the jungle in six weeks.

On Leyte, in the Philippines, the 808th started construction of the Dulag air base one day after the area was cleared of Japanese. The field was ready two days later for emergency use by Navy planes during the Battle of Leyte Gulf.

Forty-four months after leaving San Francisco, the 808th sailed into Yokohama Harbor as part of the American occupational forces in Japan.

The battalion—that had so little time to prepare for war—contributed greatly to America's success. Among the first US Army troops to reach Australia in early 1942, the 808th Aviation Engineer Battalion helped build the long Pacific trail that eventually led to victory.

Suggestions for further reading:

George E. White, Jr., "From Pearl Harbor to Tokyo," *The Military Engineer* 38 (January 1946): 1-8.

HQ Army Forces, Pacific, Office of the Chief Engineer, *Engineers of the Southwest Pacific 1941-1945*, Volume VI: *Airfields and Base Development.*

To our readers . . .

The editor and staff of ***Engineer*** appreciate the concern of our dedicated readers about the article "*Army Kills 41 Command, School Magazines*" published November 17, 1986, in ***Army Times***. Although the program under which ***Engineer*** was previously published has been discontinued, the function still exists. While there may be changes in funding and format, the function will not change, and we are assured that we will continue to publish. However, the publication may be called a professional bulletin instead of a magazine.

While some readers may have to purchase their copies in the future, be assured that all of our Engineer units and students will continue to receive free copies. We encourage your articles for ***Engineer***, and look forward to your continued interest in our publication.

Do not despair—***Engineer*** IS NOT DEAD!