ENGINEER

The Professional Bulletin of Army Engineers

January-March 2003

Headquarters, Department of the Army
PB 5-03-1 Approved for public release, distribution is unlimited.

U.S. Army Engineer School

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Engineer (ISSN 0046-19890) is prepared quarterly by the U.S. Army Maneuver Support Center, 320 MANSCEN Loop, Suite 210, Fort Leonard Wood, MO 65473-8929. Second Class postage is paid at Fort Leonard Wood, MO, and additional mailing offices.

POSTMASTER: Send address changes to U.S. Army Maneuver Support Center, ATTN: ATZT-DT-DS-B *(Engineer)*, 320 MANSCEN Loop, Suite 210, Fort Leonard Wood, MO 65473-8929.

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to *Engineer* at the preceding address. Telephone: (573) 563-4104, DSN 676-4104. *Engineer's* e-mail address is: *bridgess@wood.army.mil.* Our Internet home page is located at: *http://www.wood.army.mil/engrmag/emag_hp.htm.*

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January-March 2003 | Headquarters, Department of the Army | *Volume 32 PB 5-03-1*

Front Cover: *Engineers perform a variety of missions.*

Back Cover: *Soldiers from the 60th Engineer Battalion assist German civilians in the town of Sterkrade. 30 March 1945*

FEATURES

DEPARTMENTS

Clear The Way

By Major General R.L. Van Antwerp
Commandant, U.S. Army Engineer School

In the last issue, we started a discussion on this page on one aspect of how we intend to change the organization and operations of the Regiment as we transform the Army. From that, and from many other venues, we have received lots of great feedback on those thoughts from the field, and I really appreciate it. The strength of our Regiment has always been—and will always be—our people, and your thoughts reflect that strength.

The key concepts from the last issue are perhaps best described as ***force pooling*** and ***modularity***. In this issue, I want to open a discussion with you on the ideas of what ***information superiority*** can really do for us in the future. Let's look at it from today's perspective first.

In the past, the Army wrote combined-arms warfighting doctrine, knowing that we would not have real information superiority. The reason we, the mobility and countermobility BOS, fight the way we do is that, in many ways, we are reacting to the enemy's efforts. Through very sophisticated efforts, we seek to put mobility assets in the right formations so they can be at the right place and time on the battlefield with the right tools and techniques to overcome enemy countermobility efforts. But what that means is that the enemy has already conducted countermobility operations, and now we must reactively task-organize to perform mobility operations for our maneuver forces. Thus, mobility operations were, at best, described as predict/confirm, avoid if possible (bypass), and neutralize by breaching. Fundamentally, that's a reactive way of doing business. And many of us have experienced the tremendous frustration of having some part of that approach break down.

With the information superiority that underlies the Objective Engineer Force, we are trying to achieve a much more proactive approach. If we know what the enemy is capable of doing and how he typically does it, and we see indicators of what he is getting ready to do, then we can be proactive. With this information superiority, we have the ability to *predict* his efforts, search for and *detect* them, *prevent* them, *avoid* them altogether or *neutralize* them, and *protect* our soldiers in this effort. This simple description of predict, detect, prevent, avoid, neutralize, and protect is part of the broader concept of assured mobility, but it represents how we can use information superiority to operate. Using a tactical example, with advanced C4ISR technology, we are able to *predict* and *detect* enemy countermobility operations that will affect us. When we do detect enemy sappers moving out to place minefields in a maneuver corridor we must use, we *prevent* the operations by using systems to destroy those sappers. Let's say that for some reason we don't get them all, and some minefields are emplaced. Then, using ASTAMIDS, GSTAMIDS, HSTAMIDS, and C4ISR to precisely locate the minefields allows us to *avoid* them. If that avoidance cannot be achieved, we will use that information to *neutralize* the mines on our approach. We might maneuver forward an unmanned mine neutralization vehicle controlled remotely to destroy the mines in our path. And finally, in addition to neutralizing the danger of the obstacle, we will develop vehicles that can *protect* the lives of our soldiers by withstanding the effects of a mine blast. This is but one example of the difference on a tactical level.

Today, I think we are seeing some aspects of that ability to develop information, apply knowledge to it, and enable proactive operations. And I'm not just talking about information-processing systems. I think we are seeing it in such areas as increased initiative and flexibility in real-world missions, tremendously improved situational awareness/understanding, and so on. But that's just an echo of what we could be. Essentially, information superiority will allow us to see first and understand and then be able to act first and finish decisively (the proactive part). I believe it is easy to see that this is an important departure from the past, but one that is challenging on all levels—strategic, operational, and tactical. With that challenge, we need all engineer leaders to look toward the future.

We have to address this all the way from the physical act of seeing (sensors of every type, from human to stationary to robotic, from national to tactical) through the analysis and distribution (and we all know that's really tough business) to the ability for a commander to see all that and decide what to do (we call it battle command). That's a serious set of ideas, but the combat power in such an approach simply cannot be denied. We want to be part of that combat power, so think about it, talk about it, work on it, and tell us here at the school about it. After all, people are the absolute key to information as part of combat power.

Thanks, and I look forward to hearing from you.

Essayons!

Lead The Way

By Command Sergeant Major William D. McDaniel, Jr.
U.S. Army Engineer School

Let me begin by saying that I am extremely proud and excited to have the opportunity to serve the U.S. Army Engineer School and our distinguished Regiment as your new Regimental Command Sergeant Major (CSM). I look forward to the challenges that lie ahead and the professional interaction with MG Van Antwerp and BG Castro.

During my interview with MG Van Antwerp and BG Castro, I told them that I feel this position is larger than the soldier who serves in it and that the Regimental CSM is a reflection of all enlisted soldiers. He serves as a senior enlisted adviser to our Commandant and Assistant Commandant, while thoroughly involved with all aspects of the Regiment. I informed them that I am a soldier with lots of energy who wants to make a positive difference for all the members of our great Regiment. I told them that I don't know all the answers but what I do know is that I love being a soldier. And because of this passion, I will continue to embrace every challenging position with absolute commitment and selfless service.

I often say that throughout our careers we never know how it will end up but that we will always strive to make a positive impact in our ranks every day. Certain events in our lives shape us, our leaders challenge us, our mentors guide us, our spiritual beliefs ground us, and our families love and support us. All of these important elements make us who we are today, and I challenge all of you to maintain that balance in your lives.

I also challenge all of you to seek out a leader as a mentor, particularly one that you have served with and respect. I have had several mentors, and I have always looked to them for guidance and feedback throughout my years. Many are retired now, but they all played an important part in who I am as a leader.

As we all know, our branch is very diverse, and it also has the largest number of Reserve Component organizations. I recently attended the Sergeant Major of the Army (SMA) Nominative CSM Conference at Fort Bliss, Texas. The SMA continually stated that we are one Army, regardless of component. It is important to note that we do not just give this lip service. I represent all engineer soldiers—Active, Guard, and Reserve (past and present). I am a leader who gets involved to effect the necessary change within our Regiment in the best interest of all. In saying this, we all need to understand that we must speak with one voice. Once our Commandant has made a decision, then we need to get onboard as a team. This will allow us to tackle the complex issues that face us now and in the future from all fronts.

Since moving into this position on 5 November 2002, I have been engaged with leaders and soldiers while I traveled to the Corps of Engineers Headquarters, PERSCOM, Fort Bragg Special Forces Training Center, the 420th Engineer Brigade Leader Conference, and the Fort Bliss SMA Nominative CSM Conference. I visited Germany to participate in the activation and assumption of command ceremony of the 18th Engineer Brigade on 21 January. Then I traveled throughout Germany and Kosovo from 21-28 January to visit our soldiers and talk to their leaders. Here at Fort Leonard Wood, I participated in the Joint Countermine Conference and in a session with the Precommand Course for our inbound battalion commanders.

I will continually get out and visit the soldiers of engineer organizations around the world and report the key issues back to the Commandant and Assistant Commandant. We will work the hard issues that impact our leaders and soldiers daily and leverage the directorates within the Engineer School to identify solutions to resolve these issues. In saying all of this, we do not make this happen by ourselves; it takes a dedicated team of professionals within our School. They are the heroes behind the lines, engaged in solving the many issues that impact our soldiers.

It is important for us to say thank you to a couple of great leaders—CSM Dils and CSM Robinson—who both recently retired with 30-plus years of service. Speaking for all soldiers in the Regiment, we want to thank you for your faithful and honorable service to our nation, the U.S. Army, the Corps of Engineers, and the Engineer Regiment. You and your families have made many sacrifices, and you all have made such a tremendous impact on countless numbers of soldiers and families throughout your career. You are professional soldiers, role models, mentors, and superb leaders. We send our very best to you and your families during your transition into retirement.

We also need to welcome our new Corps of Engineers Command Sergeant Major, CSM Michael Balch. I look forward to working with him.

Today, as always, our Regiment is extremely busy with supporting our nation's war on terrorism, while at the same time transforming our Army and our Regiment. Our thoughts and prayers go out to all the soldiers on point around the globe and to all their families during their separation.

Remember to always think safety as we accomplish our required missions, regardless of where we find ourselves. Take care of your soldiers, yourselves, and your families. I look forward to our future together in the greatest Regiment in our Army!

Essayons!

Planning Engineer Support for an Urban Attack

By Captain John C. DeJarnette

This article was originally published in Engineer, July 1998, PB 5-98-3, U.S. Army Engineer Center and Fort Leonard Wood, Missouri. A revised version appeared in CALL Newsletter No. 99-16: Urban Combat Operations; Chapter 6: Mobility and Survivability. Since this article was written, FM 90-13-1 has been superseded by FM 3-34.2, Combined Arms Breaching Operations, and FM 90-10-1 has been superseded by FM 3-06.11, Combined Arms Operatons in Urban Terrain. Please read the article on page 10 to learn how doctrine has changed concerning urban operations.

Today's soldiers must be prepared to fight on on-creasingly diverse terrain, including terrain containing man-made features found in urban areas. These elements are viewed as obstacles to maneuver. Military operations on urbanized terrain (MOUT) encompass all military actions planned and conducted on a terrain complex where man-made construction impacts on the tactical options available to a commander.

This article provides considerations for engineer planners and leaders to employ when battalions and brigades attack built-up areas. It is intended to amplify current doctrine outlined in FM 90-10-1, *An Infantryman's Guide to Combat in Built-Up Areas (with Change 1)*. Lessons are drawn from observing attacks on the Shugart-Gordon MOUT training facility at the Joint Readiness Training Center.

Mission Analysis

Mission analysis sets the conditions for planning and ultimate success of MOUT operations. All planners must identify specified, implied, and essential tasks as well as constraints and limitations. Well-prepared engineer battlefield assessments (EBA) and terrain analysis products are essential to successful MOUT planning. Answering the following questions will help engineer planners, in conjunction with the principal battle staff, develop an effective MOUT offensive mission analysis:

- ☐ **Where is the key/decisive terrain?** Identify this terrain for the approach march and for seizing buildings. Conduct a line-of-sight analysis along the route and compare it to the enemy template.
- ☐ **Where are the best obstacle reduction sites and support-by-fire positions for securing a foothold?** Consider the terrain, the enemy force template, and massing fires. Determine the minimum engineer force required to seize a foothold, seize essential facilities, and provide mobility support to mounted forces, such as how to sequence engineer tasks and change the engineer task organization to accomplish essential tasks. Identify the key leaders required to facilitate command and control of critical events and task organization changes. Decide how to best integrate cannon-delivered smoke, hand-emplaced smoke, and smoke generators to conduct breaching operations.
- ☐ **How should subordinate units execute in-stride versus deliberate breaching operations based on the enemy template and results of reconnaissance and surveillance (R&S) efforts?** Decide where to use the mine-clearing line charge (MICLIC), tank-mounted countermine equipment, and manual breach techniques. Balance exposure of the breach force to enemy fires with the probability that a system may be killed before it can be employed.
- ☐ **How will reconnaissance forces link up, guide, or mark obstacles for bypass/breaching operations.**
- ☐ **What are the counterattack routes of the enemy force?** Consider the terrain and weather. Determine if enemy counterattack routes can be used to move friendly combat service support assets based on the enemy event template

and time phasing of the counterattack. Determine what situational obstacles (rapid mining, scatterable mining) the enemy counterattack force has available.

- **What is the safety zone and trigger for using scatterable mines?** Ensure that this information is disseminated at all rehearsals.
- **What is the composition of the buildings to be attacked?** Determine the effects weapons will have on these structures (this drives the selection of fuze/shell combinations and aircraft attack munitions).
- **What is the "layout" of the town both above and below ground?** Determine the protected areas, such as churches, hospitals, and museums. Sources for this information are imagery from the division, gun camera tapes from OH-58/H-64 helicopters, Michelin road maps, and tour books.

Support Products

The engineer staff planner uses the following products developed to support the military decision-making process (MDMP). All of these products must be developed in conjunction with the S2. These products are updated based on the results of reconnaissance and surveillance.

Engineer Battlefield Assessment

The EBA feeds many of the subsequent products. Clearly articulate the enemy engineer capability based on the most likely and most dangerous courses of action. Consider past experience with this enemy, his current strength, anticipated barrier material basic loads, expected resupply rates, and locally available materials he can use to prepare his defense. This information will support development of the situation template (SITEMP).

Identify friendly engineer capabilities for mobility, countermobility, and survivability operations. Explicitly state the number and types of breaches each engineer unit is capable of executing based on its personnel, equipment, and logistical status. Leader proficiency and audacity impact this estimate, so plan two levels down based on the particular unit. Use this information to develop the task organization later in the MDMP.

Estimate the impact of terrain and weather on both friendly and enemy capabilities. Line-of-sight, hydrology, cross-country movement, and line-of-communication overlays are helpful and can be provided by the division terrain detachment or quickly approximated from maps.

SITEMP

Know the enemy capability based on an estimated unit basic load of Classes IV and V materials and anticipated resupply. The time available to prepare the defense is essential. Reconnaissance assets should observe the delivery and emplacement of barrier materials. The S2 and the engineer template enemy obstacles and counterattack routes based on terrain and weather conditions. Determine what resources are available in the MOUT area (ammonium nitrate, acetylene, propane, lumber yards, jersey barriers, vehicles, and construction equipment) that can contribute to enemy defensive preparation.

Based on this analysis, the engineer and S2 jointly template the enemy engineer countermobility/survivability capability on the SITEMP. It should include minefields, tactical and protective wire obstacles, and vehicles and other barriers in roads. This overlay is used to plan the engineer task organization, because this and the friendly scheme of maneuver determine the number of sapper squads needed and where mobility assets are placed in the movement.

Time and materials will impact enemy defensive capability. The force array in the security zone and main defensive belt impacts the amount of defensive preparation. Indirect-fire systems can only service one priority target and must shift to cover other targets, which may help with refining the obstacle template. Locations and movement of mounted weapons may indicate usable lanes for friendly infiltration of vehicles.

Event Template

Determine what triggers the commitment of enemy counterattack forces. The engineer planner can assist the S2 in determining what situational obstacle capabilities he has, where and for what purpose the capabilities will be committed, and what the triggers are. Determine the structures likely to be set for destruction (such as petroleum and natural gas storage facilities).

Friendly Forces Survivability Time Line

The engineer and the S4 plan to construct positions to support the forward displacement of combat support and combat service support assets and limited command and control nodes. The survivability effort should be an essential part of the maneuver deception plan.

Breach Execution Matrix

This matrix helps the task force allocate engineer assets and determine when in-stride and deliberate breach techniques are required. Specify where to use MICLIC, hand-emplaced explosives, armored combat earthmover (ACE), armored vehicle-launched bridge (AVLB), and tank-mounted countermine equipment to reduce enemy obstacles. It is important to keep in mind that rubble can be a more significant obstacle than conventional mines and wire obstacles.

Decision Support Template/Decision Support Matrix

Help the S3 identify and plan viable branches and sequels to the plan. It is essential to know where engineers will culminate and how rapidly engineer platoons can be consolidated, reorganized, and put back into the fight.

Execution Checklist/Operations Schedule

Develop with the S3 the operations schedule (OPSKED), which is a combination of key events from the synchronization matrix and associated code words. This product supports the decision support template and helps the battle captain and maneuver commander track the battle and make decisions. Prepare a rough execution checklist after receiving the warning order and continue to refine it during mission analysis. Finalize the checklist during wargaming and provide "bootleg" copies to task force engineers and squad leaders (see page 7).

Troop-Leading Procedures Timeline

Ensure that adequate time is available for engineers to both prepare the task force rehearsal site and conduct their own internal rehearsals.

R&S Planning Considerations

Integrate engineer reconnaissance teams into the brigade R&S plan. Focus these teams on engineer targets such as landing zone denial, obstacles in the reduction area, enemy survivability on the objective, and obstacles on approach routes. The named areas of interest (NAI) assigned to engineers should have priority intelligence requirements (PIR) that determine the best reduction sites in the city and confirm or deny enemy fortification of key sites.

Precombat Inspections (PCIs)

After conducting precombat checks (PCCs), inspect materials used to mark obstacle bypass lanes. Conduct FM radio communications exercises using the OPSKED and reports specific to the current operation. Inspect all maps for operations security considerations. Sterile maps are not required, but information provided on overlays should not compromise the attack plan. Overlays should portray only NAIs. Targets, pickup and landing zones, and link-up locations should not be on overlays taken into the objective area. All soldiers must clearly understand the NAI priority and associated PIR, casualty evacuation (CASEVAC) plan, abort criteria, compromise plan, exfiltration and link-up plan, and communications windows.

Mobility Planning Considerations

Providing mobility support to a maneuver force in a MOUT environment normally will require engineers to support multiple combined-arms breaching operations. The reverse planning process discussed in FM 90-13-1, *Combined-Arms Breaching Operations*, applies to all terrain situations. The following considerations complement this process:

Conduct Approach March

Plan a primary route and an alternate route to support the movement of each maneuver battalion's combat forces. Clear these routes using standard tactics, techniques, and procedures (TTP). Control of movement routes is critical, particularly when ground evacuation is the primary method of removing casualties. Coordinate one-way, two-way, and alternating-direction traffic on routes with the brigade executive and operations officers. Identify decision criteria for switching to alternate routes. Maximize aerial reconnaissance of routes to identify possible obstacles, combat outposts, and ambushes.

Precombat Inspections. Conduct standard route-clearance PCCs and PCIs, which should be listed in the unit SOP. As a minimum, check initiation systems, demolition charges, reduction equipment, marking materials, and mine detectors.

Rehearsals. The engineer, with the S3, ensures that all of the breach tenets and control measures are understood by key leaders at the task force rehearsal.

Secure the Foothold

Create lanes through obstacles using one sapper squad per lane, with a minimum of one lane per simultaneously assaulting platoon. (This does not mean nine lanes per infantry battalion. Analyze carefully.) Use adequate marking materials, guides for assault and follow-on forces, and lane hand-over procedures. It takes at least 30 minutes to "cycle" this squad back into the fight.

A squad cannot support breaching operations continuously. A decision point or trigger must support any changes in task organization and missions for engineers. Establish decision points for changing approach routes and reduction sites and initiating the breaching fundamentals—suppress, obscure, secure, reduce (SOSR).

Precombat Inspections. Equip the unit with bolt cutters (two per engineer squad), grapnels (three per engineer squad), a lane-marking kit, hand-emplaced explosives (10 per squad per lane), mine detectors, and probes. Ensure that handheld smoke is available for each infantry soldier and that vehicles or utility helicopters carry smoke pots. Mass this smoke with the breach force at the objective rally point. Ballast load marking system upgrade materials on gun trucks. Use expedient reduction tools, such as Skidco litters, for wire reduction.

Rehearsals. No matter what rehearsal type or technique is used, perform basic SOSR rehearsals. (See FM 101-5, *Staff Organization and Operations*, Appendix 6, for more information on rehearsals.)

Suppress. Ensure that all personnel understand the location of support-by-fire positions and the pyrotechnic and radio signals to initiate obstacle reduction and indicate when the lanes are open (proofed and marked). The rehearsal site should have a full-scale lane-marking system visible to every soldier. All key leaders should understand the commitment criteria for the breach force.

Obscure. Rehearse triggers for artillery-delivered, hand-emplaced, and vehicle-generated smoke. Consider the position of the moon relative to the support-by-fire position, the percent of illumination, and the night-vision goggle window.

Secure. Hold a combined-arms rehearsal of the breach force using the full-dress technique. This rehearsal includes engineers and attached maneuver elements dedicated to suppressing direct fires and destroying local counterattacks.

Reduce. The combined-arms rehearsal should include handing over lanes from engineers to maneuver soldiers. The rehearsal should be "NCO to NCO" and details of

Engineer Staff Planning Checklist (Brigade and Below)

Plan

General

- ☐ Identify and resource all mobility/survivability essential tasks.
- ☐ Address all the breach tenets during planning and rehearsals.
- ☐ Request terrain products, MOUT layout diagrams, and data on building composition from higher headquarters.
- ☐ Study available terrain products to determine which subsurface routes to use and how to defend against enemy use of these systems.
- ☐ Study available maps and photos to determine the best routes to use when approaching the city and within the city. Determine where to establish casualty collection points, aid stations, and ammunition and water resupply points.
- ☐ Use scatterable mines to support engagement areas that block mounted counterattack routes. Disseminate this plan to critical maneuver and combat service support leaders.
- ☐ Establish essential engineer friendly forces' information requirements and no-later-than report times.
- ☐ Nominate engineer-specific PIR and associated NAIs to support the reconnaissance plan. Ensure that the latest time information of value (LTIOV) is clearly understood. Decide what actions to take if the PIR are not answered before LTIOV.
- ☐ Disseminate the enemy obstacle template to all engineer leaders.
- ☐ Task-organize engineers to support essential mobility/survivability reconnaissance missions.
- ☐ Determine how much and what types of obscuration smoke are available. Determine the wind direction and speed, which will impact the effects of smoke. Coordinate with the fire support officer for recommended uses of white phosphorus (both mortar and artillery-delivered) and handheld smoke. Coordinate with the smoke platoon leader for duration of smoke and level of obscuration.
- ☐ Designate and clear routes for mounted forces and reserve forces.
- ☐ Identify the "conditions" and a decision point for initiating deliberate breaching operations during each critical event of the operation.

Approach March

- ☐ Designate routes for ground convoys and allocate engineers to clear them.
- ☐ Determine the clearance method and acceptable risk.
- ☐ Ensure that all vehicles have lane- and bypass-marking materials on board.
- ☐ Designate ground CASEVAC routes.
- ☐ Determine the decision point for using alternate routes.
- ☐ Determine when to establish traffic control posts (TCPs)/guides at critical obstacles on the route.
- ☐ Establish NAIs along the ground route to confirm or deny the enemy obstacle template.

Secure the Foothold

- ☐ Designate the best reduction site and technique based on enemy force array, terrain, and trafficability.
- ☐ Nominate NAIs for breaching operations.
- ☐ Designate one lane for each simultaneously assaulting platoon and the engineers needed to reduce it.
- ☐ Explain the lane-marking system.
- ☐ Establish a traffic-control plan for dismounted and mounted traffic.
- ☐ Establish a vehicle route and a dismounted route from the foothold to the CASEVAC helicopter landing zone.
- ☐ Designate locations for blocking positions to keep counterattacks from interfering with breaching operations. Resource blocking positions with MOPMS, conventional mines, and expedient barrier capability (such as abatis). Depict the planned locations of scatterable mines (include the safety zone) on maneuver and combat service support graphics to reduce fratricide.

Seize Key Facilities

- ☐ Designate buildings to enter and a reduction site that will support maneuver to the point of penetration.
- ☐ Designate where the support force will enter buildings.
- ☐ Resource battalions and their engineers with sufficient explosives and hand-emplaced and artillery smoke.
- ☐ Explain the cleared-building and cleared-lane marking systems.

Prepare/Execute

- ☐ Construct appropriate rehearsal sites to support maneuver and combat service support operations.
- ☐ Provide enough detail in the troop-leading procedure timeline to encourage both engineer and combined-arms rehearsals.
- ☐ Issue sketch maps and terrain products to engineers.
- ☐ Construct a lane-marking system and bypass-marking system that all vehicle drivers must go through en route to the objective area.
- ☐ Provide enough detail in the maneuver and engineer execution checklists to effectively use the Decision Support Matrix.
- ☐ Specify times for engineer-specific PCIs conducted by platoon leaders, company commanders, and first sergeants.

“Providing mobility support to a maneuver force in a MOUT environment normally will require engineers to support multiple combined-arms breaching operations.”

linkup and handover should be discussed. Consider the need to back-haul casualties when planning the number of lanes.

Seize Key Facilities

Plan procedures for dynamic entries into buildings and vertical envelopment, which require prepared special demolition charges (see FM 90-10-1, Change 1), expedient assault ladders, and climbing grapnels. Rehearse the TTP for getting into windows on second and third floors. Have cutting tools available to prepare climbing poles at the objective rally point. Plan for subsurface entry. Consider the use of reducing wire in stairwells and hallways.

Precombat Inspections. Inspect special breaching charges (see FM 90-10-1, with Change 1). Ensure that charges are properly constructed and that they will “stick” when placed. Use double-sided foam tape when placing vertical breaching charges during warm, dry conditions. Use spikes, braces, or Ramset-type power-actuated fasteners during rain or when temperatures are below freezing. Ensure that sufficient handheld and hand-emplaced smoke is available. Maneuver soldiers can carry smoke pots and additional explosives. Where practical, use battering rams (picket pounders or equipment found in MOUT areas) to enter doors. Conserve explosives by bringing one or two 24-inch crowbars to lift manhole covers and pry open entryways to buildings and sewers. Provide night-vision goggles to soldiers who reduce obstacles, because infantry leaders use infrared “tactical pointers” extensively, and reduction element soldiers must be able to see these signals. Use all available infrared lights. Mount and zero all AN/PAQ-4s and AN/PVS-4s during the preparation phase of the mission. Engineers must bring handheld infrared light sources (such as Phantom lights or infrared filters on Maglites) and visible light sources (D-cell Maglites or SureFire TAC lights) to help move and reduce obstacles inside buildings and subsurface structures. Ambient light inside hallways and underground is virtually zero, so plan for additional light sources. Mark cleared buildings so the marking is visible from rotary-wing aircraft and armored vehicles and by dismounted soldiers.

Rehearsals. Focus on the location and control of support forces and signals for committing the breach force. Ensure that soldiers understand the minimum safe distance and the best reduction site based on the building structure. Clearly identify routes between buildings and the marking method for “safe routes.” Deconflict building clearance markings from collection points for casualties, displaced civilians, and enemy prisoners of war. Rehearse close quarters combat drills for interior building clearing. Basic SOSR rehearsals from “secure the foothold” apply to dynamic entry into buildings, but these rehearsals usually focus on the infantry platoon and an engineer squad.

Civilians on the Battlefield/Enemy Prisoners of War. Establish “protected areas” for civilians on the battlefield, and clearly mark routes for displaced civilians. Consider an expedient countermobility effort to restrict access to these civilians and enemy prisoners of war. Liaison officers from psychological operations, civil affairs, and the military police should address this topic in the brigade maneuver rehearsal. Although there are no specific engineer requirements, be prepared to provide technical assistance during planning and execution phases.

Subsurface Fight. This is a variation on the theme of clearing buildings. Salient points are entering the tunnel or sewer complex using hand tools or explosives, identifying and neutralizing mines and booby traps, and marking cleared areas. Navigation inside sewers and radio communications from inside the tunnel to aboveground soldiers is challenging. There is no ambient light inside tunnels, so plan and rehearse using infrared and visible light signals.

Move Within the City

Plan one vehicle lane per mounted platoon entering each section of the city. The lane through tactical and perimeter protective obstacles will become an “axis” for movement within the MOUT area. These lanes initially will support one-way traffic. Plan and rehearse traffic control as lanes become alternating traffic lanes to allow for CASEVAC. Improve at least one lane to two-way traffic and designate this as the primary CASEVAC route. Designate, clear, and mark a route from the casualty collection point to the CASEVAC primary and alternate helicopter landing zones. Use combat route-clearance techniques to clear the ground CASEVAC route. Reduce or bypass obstacles created by “junk vehicles,” CONEXs, rubble, etc. If bypassing is part of the plan, make it a branch to the plan and include decision points and conditions.

Precombat Inspections. Inspect MICLIC and tank-mounted countermine equipment. Ensure that designated dismounted sappers have at least 20 blocks of TNT or C4 and 500 feet of detonating cord to reduce a 100-meter-deep “lane” for vehicles.

Inspect mine detectors carried by engineers designated to execute this mission. Sandbag one vehicle to use for proofing vehicle lanes, and dismount all passengers when proofing the lane. Ballast load additional lane-marking material on vehicles. To assist the maneuver force in locating the correct lane to support their tactical plan, ensure that markings for multiple lanes are easily distinguished by day and at night. CASEVAC lanes must have a dedicated TCP. One technique is for this post to be initially manned by repre-sentatives from the medical platoon of the lead task force. Integrate a tank-mounted plow or properly prepared heavy vehicle (dozer, loader, or 5-ton truck with winch) into the plan to reduce rubble or junk vehicle obstacles.

Rehearsals. A combined-arms breaching rehearsal is required according to FM 90-13-1. This rehearsal will serve as the final check for mission-essential equipment and final adjustments to the plan based on PCIs. Synchronize the establishment of support-by-fire positions to isolate reduction sites and trigger conditions for initiating reduction operations (the conditions and who makes the decision). Determine who shifts obscuration and suppressive fires and when they are shifted. Leaders must rehearse handing over lanes to follow-on forces. Rehearse time-phasing the ground CASEVAC route clearance to helicopter landing zones and ambulance exchange points. Construct the unit's standard lane-marking system and route signs at the rehearsal site.

Countermobility Planning Considerations

Address these issues in the brigade-, battalion-, and company-level rehearsals. Plan to issue a scatterable mine warning (SCATMINWARN) to prevent fratricide.

Tactical Employment of Scatterable Mines

The S3, engineer and FSO should plan, in detail, the employment of artillery-delivered antipersonnel mines/remote antiarmor mines (ADAMs/RAAMs) and Multiple-Delivery Mine Systems (Volcanos). Specify the target to be attacked, a tentative location, its effect (disrupt, turn, fix, or block), the delivery system, the observer, and the trigger. To reduce fratricide risk, the scatterable mine execution plan must be clearly understood by leaders of mounted elements.

Protective Employment of Scatterable Mines

Ballast load the Modular Pack Mine System (MOPMS) on vehicles moving into objective area blocking positions. Consider sling-loading the MOPMS, conventional mines, and limited barrier materials to support transitioning to the defense and blocking enemy counterattacks.

Engagement Area Development

Specify the engagement area to interdict the enemy counterattack force. Ensure that battalion and brigade reserve forces have specified routes to move to the engagement area. Engineers may not be available to emplace obstacles, so specify the engagement area development tasks, including obstacle emplacement and fire integration, to maneuver units.

Survivability Planning Considerations

Perform this work concurrently with initia recon-naissance and "condition setting" by the brigade to support the brigade and division deception plans.

Field Artillery

Determine positioning areas and plan counterfire radars and ammunition.

Forward Area Refuel Point

Establish locations for stocking fuel and ammunition. Plan for multiple refueling sites to support the attack and lift aviation simultaneously.

Advance Trauma Lifesaving Sites

Locate forward treatment facilities and ingress/egress routes. The implied task is to establish helicopter landing zones for these sites.

Summary

While the process for planning engineer support to a MOUT attack follows existing decision-making steps, engineer planners must understand how this diverse terrain impacts engineer operations. Critical points include the following:

- Structures become key terrain.
- Belowground and multilayered aboveground dimensions are added.
- Terrain enhances the enemy's countermobility and survivability efforts and increases the friendly force's mobility requirements.
- Decentralized execution—while staying collectively synchronized—is required.
- MOUT-specific PCCs, PCIs, and rehearsals must be conducted.

By accounting for these impacts, engineer planners can make sound decisions to set the stage for effective engineer support to the maneuver force in this demanding environment.

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DOCTRINAL CHANGES IN URBAN OPERATIONS

By Lieutenant Colonel Anthony C. Funkhouser and Major Janet L. Kirkton

Captain DeJarnette's article, "Planning Engineer Support for an Urban Attack," published in 1998 (see page 4), is a great primer to realize the significant doctrinal changes that have occurred since then and to stimulate thought on future operations within urban terrain. Most significant is the change in the operational environment. This article was written based on the premise that we would fight a peer competitor in a conventional manner. Most would agree that this is no longer a valid and/or necessary assumption. Second, doctrine at that time supported breaching obstacles by launching mine-clearing line charges (MICLICs) down streets, without consideration for civilians and collateral damage. Although a technique, this would probably not be the technique of choice today, especially with the prevalence of blast-resistant mines.

Recent combat experiences in Chechnya, Israel, and Afghanistan reveal a trend that contemporary adversaries will no longer directly confront our Army. Instead, they have developed new ambush techniques that reduce our Army's technological advantages, especially within the urban environment. Additionally, the political environment has changed. In most cases, destroying cities to get to the threat is no longer accepted by the free world. Based on these developments, the joint community and Army have published new doctrine on the conduct of military operations on urbanized terrain (MOUT), specifically JP 3-06, *Doctrine for Joint Urban Operations*; FM 3-06 (DRAG), *Urban Operations;* and FM 3-06.11, *Combined Arms Operations in Urban Terrain*.

Emerging doctrine in FM 3-06 takes into consideration the contemporary operational environment. It also establishes a new framework for commanders to visualize, describe, and direct urban operations. This new doctrine focuses on understanding the terrain, society, and infrastructure. The doctrine looks to minimize collateral damage and preserve critical infrastructure. Engineers must understand the political end state of the operation, because it impacts how we conduct military operations. If the end state seeks only to remove certain focused individuals and reestablish the government and infrastructure, then destroying certain utilities and negatively affecting the population may not achieve the desired end state.

As a departure from the article, today's adversaries do not emplace conventional minefields, instead they use individual mines with small ambush teams. Mines are not just placed on the horizontal plane: they now have side and top attack capabilities that are command-detonated. This offensive capability significantly affects future engineer operations in urban terrain. In addition, adversaries have realized our vulnerabilities and expanded their use of booby traps and improvised explosive devices (IEDs) to counter our detection and neutralization efforts.

Captain DeJarnette's article is a great means to see the impact of emerging doctrine on the military decision-making process and in execution. With the unconventional use of mines, IEDs, booby traps, vertical obstructions, limited straight-line distances and restrictions on collateral damage, tactics, techniques, and procedures (TTP) that used to be commonplace will most likely not be effective within a large city. As a result, engineer commanders will be challenged to establish an accurate situation template and task-organize the appropriate countermine equipment. There is not one piece of engineer equipment that can detect and neutralize all types of threats, so extreme thought must be used to properly resource subordinate engineer units. If breaching is required, new TTP integrating sappers, explosive ordnance disposal detachments, mine-detection dogs, and heavy route-clearance assets—such as rollers or Panthers—will have to be developed.

In summary, Captain DeJarnette's article was a well-written article that fully explored the engineer challenges of the urban environment at that time. However, the world has changed, and new doctrine will affect how we approach solutions to the problems. We challenge you to reread Captain DeJarnette's article after you read the emerging doctrine and reflect on solutions for combat engineering in urban terrain.

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Major Kirkton is the deputy chief, Doctrine Development Division, U.S. Army Engineer School, Fort Leonard Wood, Missouri.

Light Engineer Lessons Learned in the Contemporary Operational Environment

By Captain Philip J. Dacunto and Captain (Bo) Arnold

While executing combat operations after a sudden deployment to Southwest Asia, light sappers of the 41st Engineer Battalion, 10th Mountain Division, Fort Drum, New York, gave new meaning to the motto *Essayons*. Operating first in Uzbekistan and then in Afghanistan, the light engineers performed numerous construction and area clearance missions for which they had never trained. Their combat successes can only be attributed to their versatility and ingenuity, especially when tools and training for certain uncommon tasks were lacking.

Deployment

Task Force 1-87 Infantry assumed the division ready force mission on the day before the 11 September 2001 terrorist attacks on New York City and Washington, D.C. Alpha Company, 41st Engineer Battalion, provided habitual support to the task force with a light engineer platoon. Consisting of three 8-man sapper squads and a 3-man platoon headquarters, the engineer platoon was trained in customary mobility, countermobility, and survivability support to a light infantry battalion task force.

On 20 September, the task force was assigned an emergency readiness deployment exercise (EDRE), designed presumably to further prepare it for responsibilities as the division ready force. The entire task force underwent routine checks to ensure that each soldier was ready for deployment with regard to medical, legal, and financial requirements. The sappers then requalified on individual weapons and loaded their prepacked personal, squad, and platoon equipment. This included palletization of equipment and bags and U.S. Air Force joint inspection of equipment and vehicles. The EDRE followed standard routines until the task force members received new chemical overgarments, body armor, and desert camouflage uniforms. It was now clear that this was more than just another training exercise.

Learning that their squad vehicles were an extremely low priority for air movement, the sappers refined packing lists and palletized almost all of their equipment, along with Class IV supplies for constructing protective wire and fighting positions at the destination, wherever that might be.

On 2 October, the first elements of Task Force 1-87 Infantry repositioned to Fort Drum's rapid-deployment facility to load

Engineer soldiers construct a roadblock.

aircraft for their final, classified destination. In the next few days, remaining elements of the task force continued this flow through the rapid-deployment facility until all had deployed.

Uzbekistan

On 5 October, the sapper platoon leader awoke on a dusty air base in Uzbekistan, with only 50 other Americans within thousands of miles. During the days that followed, his squads arrived with their supported infantry companies.

As anticipated, initial sapper missions included countermobility (wire and obstacles) on the perimeter and survivability within the base camp. However, the requested dig asset package of two small emplacement excavators (SEEs) and one D7 bulldozer had not been high enough on the airflow priority to make it into country. Relying exclusively on hand tools, sapper productivity was severely limited. After two weeks, a loader and a SEE arrived with a logistics task force, but the light engineers could only borrow the equipment for limited periods of time. Nonetheless, within 30 days, the small platoon emplaced more than 8,500 meters of defensive wire around the air base and eventually built more than 40 fighting positions and bunkers.

Task Force 1-87 Infantry relied on the sappers for construction as well. Although they were neither formally trained nor equipped for vertical construction missions, the sappers were initially the only engineers in the area and were assigned all types of engineer missions. While at the air base, the platoon built a tactical operations center inside a hardened aircraft shelter, numerous tent platforms, four guard shelters, and a detainee facility. In addition to carpentry skills, the platoon often used the welding skills of some of its soldiers.

Afghanistan

As the Afghanistan Northern Alliance's operational successes changed the strategic situation, the task force prepared for another deployment and new missions. Moving forward with their habitually associated infantry companies, sappers cleared land and developed bases at several bare-bones airfields in Afghanistan. With an estimate of more than eight million mines emplaced within Afghanistan's borders and minimal marking or recording of their locations, the risk to forces operating there was extreme. In addition, there was a significant risk of unexploded ordnance (UXO) left over from more than a decade of war.

Clearing areas for force bed down soon became a concern at the operating bases, as the new units that were arriving needed lodgment areas faster than engineers could clear them. Around Baghram Air Base, which became a major U.S. and coalition force forward operating base, all areas had a high risk of mines and UXO and had to be thoroughly cleared before use. Through coordination with local Northern Alliance commanders, sappers began by mapping out the locations of the minefield using laser range finders and Global Positioning System (GPS) coordinates. Then they prioritized clearance requirements and began clearing with their limited assets.


Engineers construct a guard checkpoint.

The sappers soon found that their organic AN/PSS-12 mine detectors were of minimal value because of the large amounts of metal scraps and other detritus left in the ground from earlier fighting. Fortunately, a coalition Army unit at Baghram was equipped with a medium-sized Aardvark flail, which could be used to clear and proof selected areas. While progress was slow and communications with the foreign soldiers sometimes difficult, the platoon was able to clear several areas for base camp construction and airfield improvements.

After the Aardvark departed, the sappers relied exclusively on miniflails, but this equipment cleared at a very slow rate. Also available for area clearance—from B Company, 92d Engineer Battalion—was one D7 dozer fitted with a mine-clearing armor-protection (MCAP) kit that provided protection for the operator. This MCAP dozer allowed safe clearance of larger areas.

Concurrently with land clearing, the light sappers performed construction missions as well. Initially, the only other engineer unit at Baghram was a platoon from the 92d Engineer Battalion,


The MCAP dozer with operators from B Company, 92d Engineer Battalion

Engineer soldiers weld a gate at Baghram.

but this superb vertical construction unit was a limited asset with a long list of tasks. Thus, the smaller jobs—especially those related to survivability and countermobility—fell to light sappers. In addition to emplacing thousands of meters of wire during a two-month period at Baghram, the sappers built or assisted with two detainee facilities and several guard checkpoints, installed doors and windows in a guard building, constructed improvised Hesco bastions for use at entry control points, welded gates and drop arms, and completed a wide variety of other tasks. They borrowed tools and employed more and more carpentry and welding skills.

In a couple of months, other engineer units arrived at Baghram to augment the base's construction and mine-clearing capabilities. Included were a U.S. Air Force Rapid Engineer-Deployable, Heavy-Operations Repair Squadron—Engineer (RED HORSE) team and coalition assets such as a general-purpose engineer platoon, runway repair experts, and a mine-clearing detachment.

Operation Anaconda

In late February 2002, light sappers again showed their mettle in direct combat operations. Headquarters, 10th Mountain Division, initially designated as Coalition Forces Land Component Command–Forward (CFLCC–FWD), had moved into Baghram, redesignated as Coalition Joint Task Force–Mountain (CJTF–MTN), and assumed control of all conventional and special operations forces in Afghanistan. Additionally, CJTF–MTN began planning for what would eventually become Operation Anaconda, to eliminate a pocket of Al-Qaeda and Taliban forces in an area of the Paktia Province.

Task Force 1-87 Infantry's mission was to establish positions to block Al-Qaeda and Taliban troops fleeing the area after a concurrent attack by Afghan military forces. On 2 March—and under 3d Brigade, 101st Airborne Division command—the task force conducted an air assault into several landing zones. Although initially rebuffed by intense enemy activity at one landing zone, the task force successfully inserted and conducted continuous operations over the next nine days along a ridgeline at elevations between 8,000 and 10,000 feet—possibly the highest elevations at which the U.S. Army has ever conducted combat operations. The task force routed out enemy forces that had not yet withdrawn and destroyed caches and caves.

The task force commander attached a squad of light sappers to each infantry company with the platoon leader and platoon sergeant integrated into the battalion command posts, thus providing maximum flexibility and capabilities for the maneuver commanders. This close attachment proved essential because the rugged, high terrain made it impossible for sappers to move quickly between separated maneuver units. During planning, sappers focused on mobility and countermobility tasks, preparing to breach lanes through minefields and create obstacles at the blocking positions. During Operation Anaconda, however, sappers focused mainly on cache destruction. They made maximum use of their demolition skills, destroying caches of rocket-propelled grenades, recoilless rifles, small arms, mines, and even several howitzers, with only the demolitions that they carried on their backs. This often called for innovation, as they used limited demolitions to destroy the maximum amount of enemy equipment. For example, the sappers disabled the captured howitzers using claymore mines to augment the remaining two blocks of C4 demolition at that location.

Some of the limitations during Operation Anaconda were the weight of the soldiers' loads and the limited availability of resupply. Although leaders revised packing lists carefully to minimize excess after the initial insertion, soldiers learned that they had to pare down even more. They could not move and fight at the extreme altitudes while carrying even a modest rucksack load. Officers and NCOs ensured that their soldiers used a minimum of the most effective clothing to combat the freezing temperatures. They left behind all cotton items—even their desert camouflage uniforms—for a uniform of polypropylene and Goretex. To help lighten the load, some units deployed without sleeping bags, which were delivered a day or two later. Load limitations were particularly challenging for sappers, who brought only the most essential tools for their mobility and countermobility tasks. Planned obstacles relied on the innovative use of limited demolitions, and some materials—such as those for lane marking—had to be kept to an absolute minimum. Sappers relied almost exclusively on C4, leaving heavy bangalore torpedoes, cratering charges, and shaped charges back at Baghram, ready to be pushed forward should they be needed.

Lessons Learned

The light engineer platoon learned several important lessons from its deployment to Southwest Asia, which fall into three categories: deployment readiness, sapper tools, and sapper training.

Deployment Readiness

Don't reinforce one platoon too heavily at the expense of others for any operation. This is important whether the deployment is to the Joint Readiness Training Center or if it is an operational deployment. In our case, the priority of company personnel and equipment supported another platoon's impending rotation to Kosovo. As a result, our platoon deployed with only 21 of the 27 soldiers it was authorized, and it had more pronounced supply shortages than it might otherwise have had. This made the short period following the EDRE that much more difficult as leaders throughout the company sought to cross-level yet again.

Light engineer squads should not become too reliant on their vehicles. Modern deployments are usually made by air, and there is seldom enough space for all the authorized equipment. In our case, space was allocated for only one high-mobility, multipurpose, wheeled vehicle (HMMWV), so load plans designed for squad vehicles were not useful, and most squad equipment was palletized. In addition, sappers had to use their rucksacks to carry demolitions, breach kits, and other critical tools. Thus, it is important to have load plans with and without squad vehicles.

A survivability package of two SEEs and a D7 dozer should be on call for the division ready force engineer platoon. This package, assembled after our alert, was not assigned a high enough priority to make it into the airflow. The equipment would have dramatically increased countermobility and survivability capabilities, especially with the wide variety of pneumatic tools on the SEE. The light sappers used mostly hand tools to dig survivability positions and emplace wire to protect the airhead.

Sapper Tools

A pneumatic picket pounder attachment should be included with the SEE for deployments. The platoon emplaced more than 8,500 meters of wire for survivability positions and

An engineer clears an area with a miniflail.

obstacles in Uzbekistan. The attachment could have been palletized with minimal impact to aircraft space and would have greatly improved productivity.

Light sappers need to deploy with organic carpentry tools. Since light sappers were the first engineers on the ground in Uzbekistan, and construction engineers did not arrive for another month, many tasks normally assigned to vertical construction engineers fell to the light sappers. While their skills were adequate for the rudimentary construction jobs assigned, they had no carpentry tools. At a minimum, a power saw, power drill, hand saw, hand drill, and hammers should be procured locally, if necessary, and deployed whenever base development tasks may be assigned. Perhaps these common carpentry tools should be added to the light engineer squad tool sets. Larger equipment that would be very useful includes a reciprocating saw, hammer drill, small arc welder, and gas-powered cutter with a carbide blade. In addition, a small generator for the power tools would prevent the sappers from having to borrow power from other sources. These should either be deployed with the leading sapper unit or palletized for call forward. Again, perhaps these should be added to the platoon or company headquarters modified table of organization and equipment.

Detection tools incorporating ground-penetrating radar, such as the Handheld Standoff Mine-Detection System (HSTAMIDS), would be extremely helpful in augmenting existing or improved metal detectors (for example, the AN/PSS-12 and F1A4 Minelab).

A team of mine-detection dogs with handlers should be available to any deployed light sapper battalion facing significant mine-clearing missions. Mine-detection dogs were invaluable at Baghram, especially for proofing areas for mines and UXO. Dogs frequently found UXO in areas that were surface-swept, flailed, and scraped by both an MCAP dozer and a grader!

The sapper platoon needs a medium-sized flail, about the size of a HMMWV, that is deployable by C-130. The miniflail was helpful in proofing small areas, but it had serious maintenance problems and lacked the necessary power. Scraps of metal and uneven terrain defeated it, and because of its small width, it was unsuited for clearing large areas. A mid-sized foreign flail, the Hydrema, was extremely effective and cleared large areas at Baghram, but its size and weight would be a limitation for strategic deployment. Clearly, these additional mine-clearing assets need not be organic to every light engineer company. However, they should exist somewhere in the force structure and be attached to deploying units whenever minefield/UXO clearance is likely to be a significant task.

Sapper Training

Sappers must be able to clear large areas for base camps and assembly areas. The light sappers' capabilities in this area are weak, primarily because platoon tasks and company mission-essential task lists usually do not address area clearance for operational purposes. Instead, training most often focuses on breaching and bypassing. In reality, today's operational environment includes not just carefully laid obstacles in specific locations but often huge areas littered with mines and UXO.

Sappers need to be trained to defeat or reduce mines in a variety of ways. When confronted with mines, sappers are well-trained to either destroy them in place or bypass them. However, traditional destruction of mines with demolitions endangers nearby personnel and equipment and spreads explosive residue around, reducing the subsequent effectiveness of mine-detection dogs in that area. Sappers must be well-versed in the use of available flails, but we believe that more importantly, they must be experts in identifying and defusing most types of foreign mines. At a minimum, they should understand the design and attributes common to sets of mines that can contribute to inferences about other types of mines not previously studied. Mine instruction should also include disarming and defusing them so they can be removed safely and negate the requirement for explosive disposal. A rudimentary knowledge in identification of UXO is essential as well. Explosive ordnance disposal (EOD) assets are extremely limited, and when sappers are clearing areas, they are just as likely to find UXO as mines. Once UXO is found, engineers should still rely on EOD personnel to clear it.

Since it would be an impossible training challenge to bring all sappers up to these standards, one way to achieve a limited capability would be to train some trainers—perhaps one NCO per sapper squad—in a "master countermine course." Once trained, these sergeants would be certified as master countermine trainers. They would return to their home station and teach other members of their squads to clear areas for operational use, in addition to breaching and marking bypasses.

Conclusion

While the brown hills and dust of Uzbekistan and Afghanistan are now a fading memory for our company, other light sappers may deploy to another bare operational base in a mine- and UXO-littered area in the future. Therefore, all light engineers should benefit from these lessons learned and try to improve engineer tools and training. Such improvements, coupled with the *Essayons* spirit, will ensure accomplishment of the challenging light sapper missions ahead.

Captain Dacunto was the company commander who trained, deployed, and supported the sapper platoon. He concurrently served for three months in Afghanistan as the assistant division engineer in Headquarters, 10th Mountain Division.

Captain Arnold served as platoon leader through-out the six-month deployment. He was awarded a Bronze Star for meritorious achievement for his actions during the deployment and during Operation Anaconda.

QA/QC Construction Supervision . . . or "Just Wing It"

By Major Jeffrey J. Johnson

Quality assurance (QA) and quality control (QC) are two of the most important elements of any engineer construction project. However, QA/QC have not been officially proclaimed a part of the engineering process, and there is a trend among the junior officers and noncommissioned officers (NCOs) throughout the services to not employ the conceptual practices of QC. Additionally, senior leaders in the battalions and squadrons are not mentoring and developing a solid QA program within their organizations that ensures the success of the project and the service members involved in the construction.

The unit is responsible for maintaining construction standards as outlined in the design specifications, plans, and other standard engineering documents. How is this guaranteed? Supervision. Why is it important? There are many obvious reasons: safety; savings in time and materials; superior product or outcome; service member satisfaction and reduced frustration; training in organization, management, and construction techniques; unit reputation; and mission accomplishment. In other words, QA/QC provide a little more predictability in an often-unpredictable profession. Figure 1 shows improper bracing and construction of forms.

Figure 1. These forms were poorly constructed and not inspected. Notice the blowing and waving effect.

Engineering Process

Thousands of military engineers are trained in the engineering process annually at our formal schools. This process involves six fundamental elements: project management, planning, design, construction, operations/maintenance, and disposal. All six elements exist in almost any engineering undertaking. So which element does QA/QC fall under? None, some, or all? Up until now, not once during that formal school experience in the military was the phrase "QA/QC" emphasized, nor did students receive a block of instruction on how to set up a QA/QC program and implement it on a construction project. It's possible that it was camouflaged in the title of "leadership" or cloaked somewhere in the project management block of construction. Yet, as a company grade officer and the officer in charge (OIC) of many projects, I often found myself figuring things out through "on-the-job training"—and many of the problems were related to QA/QC.

Units from all services execute various types of projects (from simple to very technical) and implement their own concept of a QC program. Some of the programs are very good, but some are almost nonexistent. The quality of the program depends partly on the leadership, but a lot also has to do with the lack of formal instruction on the QA/QC process. It is a refined skill and program that needs to be taught as well as learned.

QC Recommendations

The project OIC needs to be concerned with the QC of the project, which can be broken into a phased control method. The complete performance of the control phases is the unit's responsibility, not the customer's or any third party's (such as outside contractors, material procurement representatives, or inspectors). The role of the S3 shop is to ensure that the control phases are performed thoroughly, in a timely manner, and by knowledgeable, unit-designated QC staff. Enforcing an existing unit SOP is always a good method. If there is no SOP, the U.S. Army Corps of Engineers implements a QC concept consisting of four phases: [1]

Preparatory Phase

This phase begins with actions in advance of construction. A few examples are reviews of designs, details, specifications, test reports, and mix designs; a physical check of material on-site against approvals and customer requirements; safety checks of equipment; and other preparatory steps that depend on the particular operation. This phase is active from the start of planning to the initiation of construction.

Initial Phase

This is the time for the unit, customer, and any third party to ensure or reestablish standards of workmanship. If there are differences of opinion on the interpretation of construction requirements, the issue can be discussed and settled at the outset of work rather than after the work is in place. The initial inspection phase is a practical method of performing preventive inspection and reaching agreements (in writing) in advance. Proper coordination from the unit must be made before construction starts and during the initial phase. This is to ensure that construction techniques meet specifications and the intent of the designer and that tests are identified.

Follow-Up Phase

This phase includes inspections and testing to determine continuation of compliance and workmanship established during the preparatory and initial phases. Follow-up inspections may occur on a daily, routine, or predetermined basis as required to ensure strict construction compliance (see Figure 2). This happens throughout the project. For example, units can construct "mock-ups"—such as sample footings, walls (masonry or lumber), and trusses—to establish standards or have inspectors approve the mock-ups before constructing the proportionate load of the project. Figure 3, page 18, shows a county inspector conducting a slump test on a grout place for a concrete masonry unit wall.

Completion Phase

When a segment of work or a project is near completion, the unit should carefully examine this work and prepare a list (called a punch list) of anything that is not completed or that does not conform to design/customer requirements. Prefinal and final inspections should be conducted by the customer, unit, and third parties about a week before the project is completed and turned over to the customer. This will ensure that all items are identified on the list and that the customer is satisfied.

Everyone in the unit—from commanders down to the junior NCOs—can make a big difference in the QC system by implementing daily meetings and establishing a team-building/project-ownership concept into the mission. First, daily meetings help the unit prepare for future tasks, identify possible material or equipment problems, recognize QC tests or measurements, and organize for the next day's operations (possibly for a week, if feasible). For instance, a platoon

Figure 2. This QC NCO ensures that the CMU wall and block are properly located and measured/cut for placement.

Figure 3. County inspectors assist the unit QC representative in conducting a "slump" test for a grout fill on a CMU block wall. The slump was to be about 8 inches.

preparing for a large concrete placement on a project can conduct daily meetings, which can help monitor and define the materials required (on-hand/shortfall), the equipment needed (such as vibrators, screed, a power trough, floats, and a pump truck), the personnel responsibilities and duties in support of that task, mandatory testing (such as slum or cylinder), deliveries, start and stop times, and on and on. This can be done for each task or subtask, using the critical path method of evaluation.

Second, explain the process, methods, and techniques to the most junior service members so they will understand the duties involved in concrete placement. This will help them appreciate what they are doing and why. It will also develop a sense of accountability for the workmanship quality. It should parallel the same actions taken by an infantry unit preparing for a patrol: inspections, briefs, sand table exercises, rock drills, and rehearsals.

Lessons Learned

Many lessons are learned on each project, and no project is ever the same as the last one. But there are a few consistent slipups that can mean the difference between quality workmanship and poor workmanship on any project.

Units seem to wrestle against developing a QC notebook that contains all daily QC reports, tests, and measurements. This notebook helps the project OIC or senior NCO formally document many things. It can help track deficiencies in materials and trends in production (positive or negative); document corrective actions; identify positions of assigned personnel, equipment usage, and tests or measurements conducted; and help maintain those reports in a neat and orderly fashion.

For example, a unit was placing several hundred yards of concrete for the foundation of a simunitions facility in North Bronx, New York. A few days after the placement, the customer requested documentation of the slump tests conducted on each batch of concrete delivered. The unit could provide only two handwritten documents on the entire placement (more than 12 truckloads), because the test results were either never documented or were lost. The unit was very close to hammering out the entire placement and starting all over. This could have been prevented if a QC representative had been supervising the requirements and the paper trail of testing for that task.

Units fall short in identifying the control, inspection, and testing procedures—both on- and off-site—for each task and assigning these responsibilities to the QC staff. On one project, a unit was placing concrete and didn't have a slump test kit. The trucks were turned away, and the placement was delayed until they found a kit. QC supervision, which was missing during this installation, could have helped identify tests to be performed for each task and state who was responsible for the results and who should have prepared and signed reports.

Checking the designs, details, notes, specifications, and checks, and measurements and ensuring that they match materials on hand are commonly overlooked until they affect the progress of the project. A unit that was constructing a facility in San Diego cut the rebar, bent it, and started placing it in the footers in preparation for the first placement of concrete. A county inspector failed the footings because specifications called for grade 60 rebar in about 90 percent of the foundation, but the unit had used grade 40. Figure 4 shows how rebar is marked and graded.

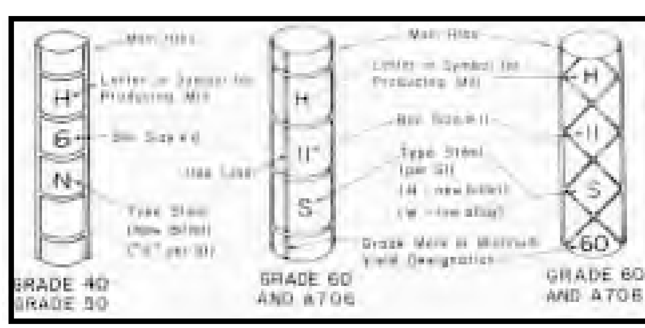


Figure 4. This is an example of the identification markings rolled onto the surface of reinforcing bars. The unit did not verify design specifications with the materials being used.

Constant QC oversight or supervision during the workday on tasks being performed is often sporadic. This causes a lot of problems with workmanship quality and construction techniques, which leads to many tasks being repeated. For example, one unit built, tore down, and rebuilt a concrete wall three times because it was not using proper masonry construction methods, and the wall consistently lost its bond and was out of plumb. Figure 5 shows a pilaster that was constructed incorrectly.

Figure 5. This pilaster is "out of plumb" by 1 1/4 inch on the seventh course, the second course CMU block is cut, and the mortar joints are sloppy.

QA Supervision

Now that a few control measures are in place, unit leaders must guarantee that QC actions are being followed through. As in troop-leading procedures, supervision is critical to the success of any mission. Therefore, QA becomes the final engineer troop-leading step on a construction project. This includes such things as inspections, intelligence updates (design changes or guidance), rehearsals (practicing essential tasks, revealing weaknesses, and improving understanding of the concept of operations at all levels), brief backs, rock/sand table drills, stick drills, site visits, meetings (daily/weekly/monthly after-action reviews), encouragement, motivation, mentorship, and participation. These are just a few effects that the leadership in a unit can bring to bear on a QC program and help set up young officers and NCOs for success. Figure 6 shows rebar with grease accidentally smeared on it. Adequate supervision could have prevented this problem.

Figure 6. The grease on this rebar will not allow the concrete to adhere around the reinforcement as it should. More care should be taken when lubricating forms.

Summary

It is possible that a QA/QC program could evolve by itself if solid "Leadership 101" was exercised; however, there are many negative lessons learned on a construction project that could be avoided if units would implement a formal program (the unit's SOP). Often, junior troops are fixing, replacing, working harder, taking longer, and exercising poor construction habits because the QA/QC program on the site for that project is broken. Thus, those experiences are carried over into the next project or back in garrison with sour attitudes about the leadership and the service. Behaviors then become a reflection of that attitude, and ultimately unit *esprit de corps*, motivation, and workmanship decline. As leaders, we owe it to our troops, our superiors, and our customers to not "just wing it" but to exercise excellence in organization and fineness in declaration.

Endnote

[1] U.S. Army Corps of Engineers, Engineer Pamphlet 415-1-261, *Quality Assurance Representatives Guide*, Volumes 1-5, 1992.

Major Johnson, United States Marine Corps, is the engineer planner at Joint Task Force 6, Fort Bliss, Texas. Previously, he was a platoon and company commander, 3d Marine Division, 3d Combat Engineer Battalion, and a wing engineer officer and department OIC, 2d Marine Aircraft Wing, Marine Wing Support Squadron 27. Major Johnson is a graduate of the Engineer Officer Basic and Advanced Courses and the Marine Corps Command and General Staff College and holds a bachelor's in architectural technology from the University of Memphis. He will attend the Air Command and General Staff College in 2003.

Out Front With the Divisional Cavalry

By Captain Elliott J. Bird

Alpha Company, 44th Engineer Battalion, Camp Howze, Korea, habitually supports 4th Squadron, 7th Cavalry Regiment (4-7 Cavalry), in Korea. The opportunity is rare in the Engineer Corps, because divisional cavalry units do not usually have habitual engineer support. As a consequence, their offensive and defensive doctrine are not well integrated. The support that engineers provide on a consistent basis offers great combined-arms training. In providing support to 4-7 Cavalry, Alpha Company works outside of the rest of the 44th for all its combat operations. This article addresses many of the keys of the trade that can help in understanding the cavalry's mission and mindset and how task force engineers can best support it.

Cavalry Operations

The divisional cavalry squadron is usually out in front of the division providing security and/or reconnaissance. In essence, the squadron is the eyes and ears of the division and provides vital information that allows the division commander to make critical decisions on the battlefield. Cavalry operations can be broken into four subcategories as listed in FM 17-95, *Cavalry Operations*. They are reconnaissance, security, offense, and defense. As an engineer supporting these operations, it is essential to understand what they mean and the fundamentals involved. Of these operations, reconnaissance and security will be discussed.

The combined-arms team battle-tracks situation reports from the troops.

Reconnaissance Operations

Divisional cavalry squadrons perform area, route, and zone reconnaissance. The squadron or troop especially needs to use engineers on route reconnaissance operations. Cavalry squadrons and troops are trained on this task, but not to the level of expertise of the engineer platoon leader or company commander. Coordinating efforts and fully understanding the roles that the engineers and the squadron play on this mission help give better reconnaissance results. The squadron's mission for reconnaissance, in relation to the fundamentals of reconnaissance as stated in FM 17-95, is as follows:

- Maintain tempo and focus.
- Orient on the reconnaissance objective.
- Report all information rapidly and accurately.
- Retain freedom of maneuver.
- Gain and maintain enemy contact.
- Develop the situation rapidly.

The squadron is tasked to clear routes for follow-on forces from the division. It must maintain a fast tempo to allow the rest of the division with more firepower to move up the designated routes or recommend different routes. The engineer leader in this situation must understand the objective and ensure that the squadron does not get slowed down by obstacles. Ensuring that each troop has the capability to breach obstacles allows the squadron or troop to maintain the proper tempo and focus.

The squadron and engineer support must also remember to orient on the reconnaissance objective—usually form-fixed points on the battlefield. The temptation is to lose sight of the objective of clearing routes and to focus on the enemy. Engineers must not let the squadron become bogged down in heavy enemy contact, which is not the purpose of the recon. They must ensure that mobility corridors are open to the squadron.

In reporting information rapidly and accurately, engineers become key personnel. If a route is not passable by heavy vehicles or tanks, engineers must ensure that the situation is properly reported. All too often, a troop or squadron commander will decide if a route is passable to follow-on forces without engineer input. An incorrect assumption can impede an entire operation. The engineer leaders must readily determine the trafficability of routes.

The troop and squadron need engineers to give them freedom to maneuver. The squadron, which is usually up front, may be the first to come in contact with the enemy, and it maintains contact and develops the situation. All of these elements are necessary for engineers to understand. The squadron engineer in the tactical operations center (TOC) must plan alternate routes for the squadron to allow the troop commander the maneuver freedom he needs to accomplish the mission. The terrain analysis that engineers bring to bear on the situation is unparalleled. As they plan the routes, they ensure that troop commanders and engineer attachments understand the routes and purposes for them.

Once the squadron gains enemy contact, the focus of the engineer effort shifts to route accessibility and possible mobility problems. The squadron will continually maintain contact through air troops, but ground troops will rely on engineer planning to find the most accessible route that allows them to maintain contact.

As the squadron gains contact, it develops the situation, and the engineer effort becomes secondary. Depending on the situation, the engineers may plan for the squadron to continue to push forward offensively or to hand off the battle to follow-on units.

When engineers and the cavalry squadron use all of these fundamentals, they become a greater fighting team, accomplishing the necessary missions together.

Security Operations

Security operations for a cavalry squadron are usually based on executing a screening mission, which it frequently performs out in front of a brigade or division front. A screen line is nothing more than a defense in-depth that allows the squadron to trade ground for time and allows the division to properly prepare its defenses or reconsolidate its forces for future operations. To have an effective screen line, the squadron needs a good engineer plan that includes situational obstacles. Screening operations also use some basic security fundamentals:

- Orient on the main body.
- Perform continuous reconnaissance.
- Provide early and accurate warning.
- Provide reaction time and maneuver space.
- Maintain enemy contact.

When a cavalry squadron prepares a screen line, the squadron engineer must be directly linked into the planning process. To orient itself on the main body, it often calls on the engineer to coordinate with engineer units behind the screen line to find the emplaced obstacles and ensure that lanes are available for passage of lines. This allows the squadron commander accurate information on what the defense behind him looks like and how to establish his forces.

Soldiers from Alpha Company, 44th Engineer Battalion, work in the TOC, updating reports and tracking engineer effort on the battlefield.

Out in front, the squadron becomes the eyes and ears of the division, and the air troops continue to send in reports of enemy movement, which helps the division commander make decisions on the course of the battle. This continuous reconnaissance provides the early and accurate warning needed. The squadron engineer must have knowledge of all such spot reports so he can plan for situational obstacles.

The obstacles that are planned and put in are usually scatterable mines or quick obstacles to slow an enemy and provide the necessary reaction time and maneuver space. By slowing the enemy and integrating an effective obstacle plan to support the squadron's screen line, engineers help the squadron maintain combat power and fulfill its overriding mission as the eyes and ears of the division commander.

As discussed previously, once enemy contact is made, the squadron will strive to maintain contact. At this time, engineer effort becomes secondary to the squadron's battle. The engineer in the TOC must look ahead to the next course of action and provide necessary mobility planning for the squadron to accomplish.

Conclusion

It is important to remember the history of the cavalry, its great lineage, and its current mission. The division cavalry squadron moves fast and furiously on the modern battlefield. Its missions are different than any other unit, because it is not a normal maneuver battalion. Although its capabilities and diversity make it successful, with proper coordination and planning, engineers can facilitate the squadron's overall success.

Captain Bird was the executive officer, Alpha Company, 44th Engineer Battalion, and later the adjutant for the 44th. He will attend the Engineer Captain's Career Course at Fort Leonard Wood, Missouri, beginning in March 2003.

Using the Royal Building System in Theater Construction

By Captain Samuel Pickands

This article describes the Royal Building System (RBS) as used in the New Horizons 2002 exercises in Nicaragua and El Salvador. The intent of the article is not to summarize the New Horizons 2002 projects or evaluate exercise results but to present to the military engineering community lessons learned from using the RBS. This system is one of several similar construction systems available today.

As part of the Deputy Joint Chiefs of Staff-directed New Horizons exercise organized by the U.S. Southern Command, active duty and reserve engineers from all four services train by building public infrastructure and utilities throughout Central and South America. The arrangement has been ideal for creating and maintaining expertise in theater construction methods in U.S. Army engineering units, while providing needed infrastructure projects to our American neighbors.

New Horizons 2002 did not focus engineer training on the concrete masonry building materials typically used in theater construction. Instead, U.S. Army South (USARSO) elected to use the Canadian-developed RBS for vertical construction. In the Caribbean, civilian RBS buildings have withstood tropical storms that leveled their conventional neighbors, bolstering the vendor's claims that the resulting buildings are among the most survivable structures, even though they can be built relatively quickly.

The RBS uses vinyl wall forms constructed of 4-, 6-, or 8-inch-wide modular sections to create a single continuous "mold" of a building. Vertical steel reinforcing bars are fixed into an underlying concrete slab and interweave through this mold, and they are tied together by horizontal steel bars. Finally, concrete is poured into the formwork from above in "lifts" or layers. Once the concrete sets, the result is a reinforced-concrete building with a colored vinyl covering.

The potential uses of these rapidly built reinforced-concrete buildings are obvious. Buildings that can be built quickly yet are well insulated, relatively soundproof, and resistant to blast damage, fires, and small-arms fire have many applications in semipermanent forward installations.

Designs for the project buildings were supplied to the task force by USARSO, and the vendor used the designs to project a bill of materials (BOM) for each site and supply the correct components. U.S. Army reservists from the 389th Engineer Battalion (Iowa), Marine reservists from the 6th Engineer Support Battalion, and active duty sailors from the 4th Naval Mobile Construction Battalion (Seabees) were all assigned RBS projects. None of the units had prior experience with the system, and both Marine and Army construction crews rotated out every two weeks, leaving only a handful of cadre for the duration of the exercise.

The New Horizons environment in Central America was ideal for testing the RBS. The tropical heat and limited infrastructure of the host nations mirrored the challenging conditions in forward-deployed operations. The reinforced-concrete buildings produced are also sure to be appreciated in the region where earthquakes and extreme weather are the norm.

In general, RBS wall forms were simple to use and suitable for military construction, even with untrained crews. Like any system, however, many lessons were learned from the first use of the RBS. If your unit has an opportunity to build with the RBS, you will profit by incorporating these lessons learned during your training, engineering, and logistics planning.

Assembly and Training

Building walls with the RBS is theoretically much faster than building with concrete masonry units (CMUs). Under ideal conditions (expert crews familiar with the RBS, good weather, horizontal work complete, all equipment and parts available, and long workdays) RBS structures can be built in 72 hours. These examples, however, are not useful for military planning, since they fail to account for the military realities of personnel rotation, confusion of site BOMs in shipment, remote worksites, BOM shortages, formwork adaptations to extreme climates, heat category work-rate limitations, time lost to force protection measures, local vendor delays, and utility connection delays.

When planning, leaders must also remember that the RBS is primarily a wall system. With trained leadership, wall construction may be faster with the RBS, but horizontal work and slab preparation are virtually identical to CMU construction. Roofing, utilities, doors and windows, and internal finishing are somewhat faster with the RBS, but at least initially, even these advantages will be offset by the unfamiliarity of the system. If your unit is not experienced at horizontal, utilities, roofing, and finishing work, your worksite progress will be slow, whether or not you use the RBS correctly.

In the final analysis, *RBS wall construction is not faster than CMU construction unless and until the worksite leadership has experience with the system*. Fortunately, the learning curve with the RBS is very steep, and a small number of trained cadre can shorten construction time even with untrained crews. For example, Task Force Oxelotlan needed 10 days to install the wall forms and pour the concrete at its first project, the San Marcos Lempas School in El Salvador. However, after the cadre had become familiar with the RBS, the task force was able to use two trained NCOs and an untrained multinational construction crew to install rebar forms and pour the walls in just 6 days for the Zamoran School. An even steeper learning curve can be seen in the overall project durations—the San Marcos Lempas School took 80 days to complete, whereas the Zamoran School took just 41 days.

Concrete Slab

The basis of all RBS structures is a concrete slab. Monolithic slabs were used in El Salvador; however, nothing about the RBS restricts the use of floating slabs instead. A unit that can build a slab for a CMU structure can also build one for the RBS.

First, unless the plans have already taken expansion into account, slabs must be slightly oversized to account for the predictable expansion of the wall forms in hot environments. If the slab is not oversized, the walls may overhang the edges of the slab by as much as an inch at points. Oversizing ensures that the walls are completely supported by the slabs and creates a professional appearance.

Soldiers brace the wall of the Zamoran School.

Slab and rebar for the Lempas project

The vertical rebar that will weave through the vinyl wall forms may be placed in the slab while the concrete is still wet. However, if the concrete is allowed to set (and concrete sets quickly in hot climates), engineers will need to drill holes for the rebar instead. To do this, units must be prepared with powerful (preferably pneumatic) drills and have three bits for each drill. Examples of suitable drills are the pneumatic drills in the small emplacement excavator (SEE) truck BII or the Marine Corps compressor-driven drill sets. To reduce wear on the drill bits (which are difficult to replace while deployed), the site crew must ensure that the metal reinforcing mesh is either set back from the edges of the slab or fixed so that that these vertical holes will not strike the mesh or reinforcing bar.

Form Distortion

The RBS forms were initially designed for use in Canada. They begin expanding once the ambient temperature exceeds 5°C or 41°F. The manufacturer has studied this expansion and can complete building drawings with this expansion taken into account if you provide the expected ambient temperature at the time of the pour. However, if you are using a standard military design drawing that does not account for form expansion in heat, use the formulas below to project how much larger your forms will be when assembled in a certain heat. Note that the following formulas are for 6-inch/150-millimeter panels. Different formulas are available for 4-inch/100-millimeter and 8-inch /200-millimeter panels.

Δ = overall change in length

L = planned length of wall being considered

T = ambient temperature at the expected pour time

If you are measuring length in meters and temperature in Celsius, use the following formula to determine the change in length in your wall given the temperature:

$$\Delta_{millimeters}=(((T_{celsius}-5)/15))(L_{meters}))$$

If you are measuring length in feet and temperature in Fahrenheit, use this formula to predict your change in inches:

$$\Delta_{inches}=(((T_{farenheit}-41)/27)(L_{feet}/40)(.48))$$

If you are faced with an existing slab that was not poured with this expansion in mind, there are two adaptations that can help minimize form expansion and fit the walls to the slab. If the projected wall overhang is large, examine the plans to see if there are any RBS panels you can remove from the form structure to meet the slab size. If the projected overhang is small, tap the panels tightly together with rubber mallets during assembly. RBS staff engineers have stated that the form expansion is otherwise irreversible, so if the modifications above are not enough, you may need to accept and manage wall overhang on the slab.

Form expansion is not the only challenge heat brings to RBS construction. In temperatures higher than 30°C or 87°F, RBS panels begin to soften. Softened form walls become more susceptible to hydraulic pressure from fluid concrete and tend to bow outward when filled. In El Salvador, the high heat and fluid concrete combined to create schoolhouse walls with noticeable inward and outward bends and even form blowouts.

To minimize the distortion and control possible blowouts, first cool the forms with a light spray of water. Not only will this stiffen the forms slightly by cooling them, but it will also help the concrete fill the forms completely and minimize air pockets. After spraying, fill the forms in thinner lifts, using five or six lifts instead of the typical three. This reduces the amount of fluid concrete in the forms at any one time and thus the hydraulic pressure exerted on the softened forms. Third, combine these thinner lifts with increased wall bracing. In the heat of El Salvador, however, the bracing had to be tripled and augmented by additional braces within the structure to produce smooth, straight walls with a pleasing appearance.

Soldiers work on the school at Zamoran.

A heat-damaged RBS panel

Storage

During shipment and storage, strict handling requirements must be followed to prevent damage to RBS panels. Panels that are at the bottom of large stacks, or have additional equipment piled on top of them, become irreversibly warped, particularly in the heat. In most cases in El Salvador, engineers could still fit warped components into the formwork once pieces had softened in the sun, but these pieces cost a good deal of labor time and effort to force into place. In the worst cases, however, some panels were completely unusable.

When temperatures regularly exceed 30°C (87°F), the following steps are recommended to protect RBS components:

- Store vinyl components in the shade or cover with loose tarps that provide shade but still permit airflow.
- Do not store vinyl components in unvented containers, as these can become hot enough to melt RBS parts.
- Store all components in flat, straight piles with continuous support underneath. If components are stored without even and flat support, they will become permanently warped.
- Do not store other equipment on top of RBS panels. In temperatures over 30°C (87°F), do not stack RBS panels more than 1 meter (40 inches) high.

Quality Control

With CMU construction, progress on the walls is gradual, and leaders have time to identify problems and correct them as they occur. Individual blocks that are out of line are easily identified and can be adjusted, or even knocked out and replaced. With the RBS, once the concrete is poured into the forms and sets, nearly all the previous steps of construction become irreversible. Consequently, quality control of every detail before filling the walls with concrete is necessary. A full workday dedicated to quality control—including rechecking the formwork level and plumb, bracing tightness, and rebar connections—produces the best results.

BOM Management

With CMU construction, if blocks are lost or broken in storage, one simply obtains more blocks, since CMU blocks are virtually identical from block to block, vendor to vendor, and even country to country. But with the RBS, if you break or lose a component you're stuck, since the nearest replacements may be in storehouses in Ontario. In the worst cases, components may have been custom-made for your project and may need to be remanufactured.

Even if all the RBS parts are intact, it is easy to misuse them. Most parts can be connected easily to other parts, and many look very similar to each other. Without supervision, engineers may use wall sections without conduit where plans call for conduit, or even insert sections with very slightly different widths in the wrong locations in the walls, creating opposite walls of unequal lengths.

In operational terms, what this means is that RBS components must be carefully inventoried, stored, and accounted for throughout construction. Outside of North America, loss, destruction, or accidental misuse of components is irreversible in a practical time frame. Rather than being an "extra duty" assigned to an unlucky junior NCO you don't trust to swing a hammer, managing RBS components is a valuable mission that is best performed by an experienced BOM manager.

Concrete Pumping System

RBS construction depends on crews being able to fill the form from above with concrete. In North America, this is usually done with a well-regulated concrete pump operated by crews on scaffolding. If all else fails,

Using a concrete bucket to fill the panels

The pump detail uses the large-volume hose to fill the panels.

engineers with ladders and pails of concrete could fill the forms, but this would take a very long time. For efficiency's sake, every effort should be made to find a concrete pump, either to deploy with your unit or to be on hand at your destination.

In general, lower-volume pumps are preferable to higher-volume pumps when filling RBS forms. Higher-volume pumps tend to create thick lifts, which create more hydraulic pressure and distort the forms under hot operating conditions. Higher-volume pumps also have larger-diameter hoses that become extremely heavy when filled with concrete. In North America, with a well-regulated pump, contractors generally start and finish a pour with one crew.

In El Salvador, the only available concrete pump in the region was a large-volume pump used for quickly pouring industrial slabs. The "pouring crew" was a grueling six-man detail that had to be rotated every 20 minutes as soldiers grew tired from steering the heavy, bucking concrete hose into the narrow RBS wall panels. This large-volume hose had a wider diameter than the RBS panels, which allowed concrete to spray over the surfaces of outer walls, requiring additional cleanup before the concrete hardened.

Spillage resulting from using an oversize pump

An alternative to a missing or an inappropriate concrete pump was used in Nicaragua. Here, a basin of concrete was suspended with a crane over an RBS wall. By managing a chute from this basin, engineers could gravity-feed concrete into the forms. This was much less work for the engineers and used labor and concrete more efficiently. However, it required lowering and refilling the basin often and was somewhat slower.

Maximum filling efficiency with the RBS can only be obtained with a concrete pump with a hose or nozzle diameter smaller than the width of the RBS panel you are using. Other options are available, but these will absorb more manpower, equipment, and time.

Summary

The RBS is simple to use and creates concrete or reinforced-concrete walls superior to CMU walls. RBS construction has the potential to be dramatically faster than standard CMU construction. But to attain this speed, task forces need to be familiar with the RBS, be trained in their other construction tasks, manage RBS BOM carefully, adapt construction techniques to hot weather, and ensure that suitable concrete-delivery systems are available. Otherwise, the RBS will create sturdier buildings than with CMU construction, but it will not necessarily do so faster or more efficiently.

Captain Pickands, who is now attending the Engineer Captain's Career Course at Fort Leonard Wood, Missouri, was chief of projects at Joint Task Force–Bravo, Soto Cano Air Base, Honduras, when this article was written. Previously, he was the deputy secretary of the general staff and deputy division G5, 1st Infantry Division, and engineer operations officer for Joint Task Force–Kelly. CPT Pickands holds a bachelor's in political science from Cornell University and a master's in international training and education methods from American University.

For more information concerning New Horizons projects and planning, contact the USARSO DCSEN engineer planner, presently Major Humberto Ramirez (ramirezh @usarso.army.mil).

For more information on the Royal Building System and its applications, visit the company's Web site at www.rbsdirect.com.

Hazards of the M9 Armored Combat Earthmover (ACE)

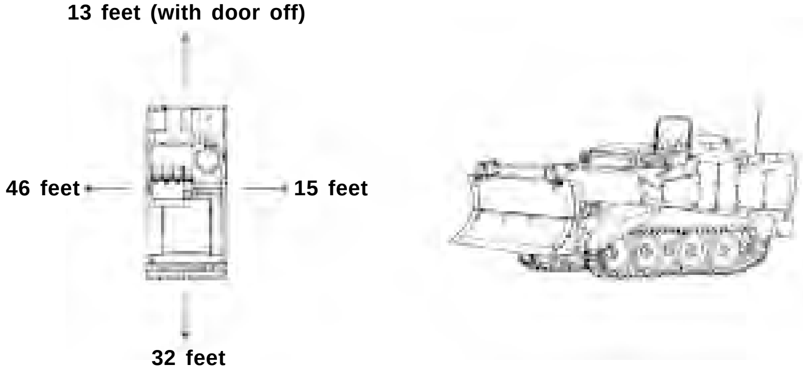
By Ms.Vicki Hall

Combat engineers are accustomed to finding themselves in precarious positions. However, many do not know that operating the ACE might be one of those instances. From the beginning of their training, operators are cautioned about the unique characteristics that make the ACE difficult to maneuver on most terrain and roadways. Additionally, recent cutbacks in equipment or personnel have decreased the amount of "throttle time." In actuality, students' behind-the-wheel experience may be no more than an hour or two, not nearly enough time to gain full operational knowledge.

When soldiers receive their first permanent duty assignment, the gaining commanders sometimes make the assumption that the soldiers know how to drive the ACE because they recently completed their formal school training. Nothing could be further from the truth. Soldiers are familiar with the vehicle's inner workings, how to properly perform preventive maintenance checks and services, how to spot a defective track, and how to troubleshoot some of the systems. However, training must continue at the first duty station and throughout the soldiers' tenure with their unit. Ongoing proficiency training and testing must also be a part of the soldiers' everyday routine.

A key element in training is ensuring that visibility or the lack thereof is explained to the new operators. When properly seated, they are at a disadvantage—they cannot clearly see obstacles directly adjacent to the vehicle. On level ground, with the operators seated, the "blind" spots range from 13 feet to the rear to 46 feet to the right (see figure). If the vehicle is on an incline, the distances of blind spots change dramatically. This factor is often not stressed during prebriefings, risk assessments, and after-action briefings. Soldiers must remain aware of their position in relation to everyone and everything else in the area in which the vehicle is operated.

M9 ACE Operator Visibility Chart



All distances shown are on level ground. Drivers cannot see objects or hazards within these distances.

Measurements are not to scale.

Operators must be thoroughly familiar with the capabilities of the vehicle. They must know, instinctively, where the vehicle is located in relation to the surroundings. This cannot be taught in school; it comes from hands-on experience. Commanders at all levels must ensure that operators are given ample opportunity to train before being placed in a dangerous situation with an unfamiliar vehicle. A dangerous situation can be nothing more than a roadway with a drop-off. For example, some drivers have driven the ACE off the road surface and down an incline because they could not see the edge of the roadway.

The ACE is designed to function as a bulldozer in combat conditions. However, the majority of the accidents have involved the vehicle being operated in either training or convoy scenarios. Engineer branch accident experience began in 1990 when two Army reservists (both E7s) were killed while riding on the outside of the operator's compartment. The driver lost control while driving at an excessive speed for the conditions, causing the vehicle to overturn, killing both persons outside the protection of the cab.

From this dramatic beginning, causes of accidents have stabilized and now range from operator error to track failure, which causes the vehicle to overturn. If operators are properly secured in the cab—properly seated and restrained with belts—they can survive a rollover. Rollover drills are a vital part of the training process and must be diligently conducted. The senior person on the vehicle is responsible for ensuring that all safety measures are enforced.

More complex missions and austere resources have become a way of life in the military. Loss prevention for both equipment and personnel is paramount to an effective fighting force. This means that accident prevention is everyone's business. We must all keep a watchful eye on daily routines, identifying potential problem areas before they become problems, and changing the way we do business. The blind spots on the ACE are just one example of hazards that are present. If you, as an operator or leader, make sure your soldiers know of this hazard and teach them how to operate within its contraints, you can prevent future accidents.

For additional information on this or any other safety subject, refer to the MANSCEN Safety Web site at *http://www.wood.army.mil/safety/*.

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The French Engineer School and U.S. Army Engineer Training Opportunities in France

By Major Andamo E. Ford

The *École Supérieure et d'Application du Génie***,** or French Engineer School, located in Angers, France, is the home of the French Engineer Corps and the training center for engineers in combat and technical skills. The school has two missions:

- Train future army officers and noncommissioned officers (NCOs) in the craft and culture of engineers, in three branches of the Engineer Corps: combat engineering, infrastructure, and civil defense. The school provides specialized training in civil defense on the techniques of lifesaving and clearing debris for missions during natural disasters.
- Perform doctrinal studies in the future employment of engineers and engineer equipment for operations worldwide.

To optimize personnel and equipment resources, the various engineer training establishments (equipment operators, electricians, mechanics, etc.) were consolidated in Angers. This reorganization was completed in 1995 with the fusion of the Technical Engineer School from Versailles and the Combat Engineer School in Angers.

The school trains about 3,000 students per year, with training covering more than 60 different courses. Students may attend courses ranging from a few days to two years for technical degree programs. A major characteristic of the school is its student diversity. Representing 25 different countries, students are officers; NCOs; soldiers; Ministry of Defense civil servants; and personnel from other branches, services, and government departments. The school is also responsible for intensive mine awareness training for more than 5,000 military and civilian personnel per year.

Organization

The school is organized into four levels:

Command Group. Consists of the general, the commanding officer, and the headquarters staff.

Administration and Resources Section. Covers all the functions required for operating the school.

Training Directorate. Including both the student courses and the facilities needed to train them, the directorate is divided into two areas:

- **Student Management Division**
  - √ *Division d'Application* (officer basic course)
  - √ *Division Sous Officiers* (NCO courses)
  - √ *Cours de Futurs Commandants d'Unite* (captain's career course)
  - √ *Diplôme Technique* (technical courses)
- **Training Departments**
  - √ *Departement Formation Operationelle* (tactics)
  - √ *Departement Formation Technique d'Arme* (engineer skills)
  - √ *Departement Enseignement Scientifique et Technique* (technical courses)

- √ *Departement d'Enseignement Physique et Sportif* (sports and fitness training)
- √ *Departement Formation de l'Exercice de l'Autorité* (leadership)

Support Group. Furnishes the troops needed to support practical training of students.

To carry out the missions, the school has several specialized installations, which include local training areas and camps, bridging schools on the Maine and Loire Rivers, diver training facilities, and other specialized facilities. The school also has ties to the civilian academic world, including universities and training institutions, which play an increasingly important role in technical training. About 40 civilian professors and instructors teach courses at the French Engineer School every year. This demonstrates a recognition of the quality of instruction.

Restructuring the French Army

The French Army has undergone profound changes, and as a result, there was a significant reduction in manpower. There are now just 85 total regiments, 11 of which are engineer. Eight engineer regiments are assigned and support each armored, infantry, and mechanized brigade. The other three are assigned to the French Engineer Brigade, located in Strasbourg along with a nuclear, biological, and chemical (NBC) group and a topographic group (not shown in the chart on page 30).

Over the period of army restructuring, the military manpower at the French Engineer School has diminished by 60 percent—from 1,500 to 630, which has impacted the support group—although there has been an increase in civilian personnel in administrative functions. The challenge is to train the same number of students, while maintaining the quality of instruction with less than half the original manpower.

Partnerships and contracting out are possible solutions to the manpower problem. To provide the practical training support, despite the disappearance of most of the support group, an arrangement has been established with the field army in which it provides the troops and equipment necessary to carry out field exercises. Contracting out allows some support and administrative functions to be provided by civilian companies, thereby saving military manpower. These contracts are expensive and cannot be expanded. Contracting out some of the training to civilian organizations or calling on external instructors, although they are already in place for technical training, is more difficult for specific military-type training.

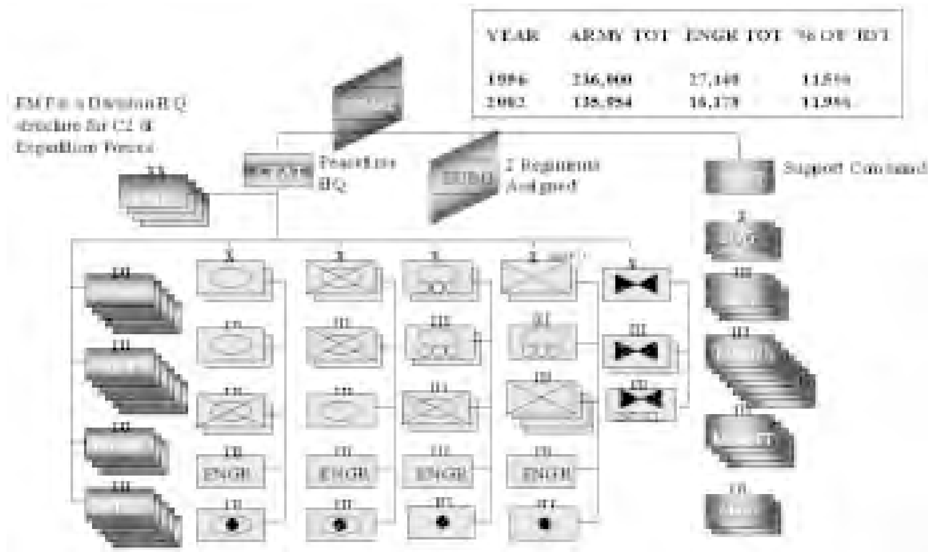
Liaison Officer Program

The Liaison Officer Program is supported by selected elements of allied defense establishments for the mutual exchange of information on combat development, doctrine, training, and educational information with appropriate personnel. Liaison officers act as TRADOC emissaries to facilitate the exchange of information and fulfill the host activity's requirements for information. Liaison officers represent the commandant of the U.S. Army Engineer School in France and effect and enhance coordination between the two countries on matters relating to doctrine, training, force structure, and equipment. They initiate, organize, and participate in joint studies, visits, and training activities designed to extend interoperability and improve understanding between the two armies. Liaison officers coordinate with the French research, development, and acquisition community. They operate independently under broad guidance from the

Students at the French Engineer School

French Army Structure for 2002

11 Engineer Regiments out of 85



Note 1: Of the two lieutenants in the brigades, one is airborne, the other is mountain.
Note 2: All units (regiments) below the brigade line should be multiplied by 2.

commandant of the U.S. Army Engineer School in the following areas:

Unit Visits. Work with the French army, the French Engineer School in particular, and engineer regiments around the country. Throughout the year, they visit engineer regiments to receive their latest mission/capabilities briefs.

Exchanges. Schedule various exchanges and training opportunities for U. S. Army Engineer and explosive ordnance disposal (EOD) units and individual soldiers either at the French Engineer School or with French engineer units.

Briefings and Presentations. Brief and teach classes in either English or French on the U.S. Army and engineers to the French equivalent of the Engineer Captain's Career Course (ECCC) and additional officer and NCO basic and technical-level courses.

Training and Testing. Help the U.S. Army Command and General Staff College liaison officer to the French army conduct English language testing of French captains. The intent is to test staff officers' proficiency in the use of U.S. operational terminology (operational English).

English language testing is an integral part of the training that French captains receive at their staff course, which all French officers must attend. The six-month course, which is equivalent to a combination of the ECCC and Combined Arms and Services Staff School (CAS3), consists of about 200 officers. U.S. and British officers conduct English language testing throughout the year. However, American English is critical to the success of a French officer's career, which means that the staff course has increased the involvement of Americans in all aspects of the course curriculum. Liaison officers also participate in training exercises throughout the year. They act as a higher-level commander, adjacent unit commander, or liaison officer receiving tactical operations order briefings.

Training Opportunities in France

U.S. Army engineers receive invaluable training from the French engineers each year. Recently, a U.S. Army engineer captain attended the CFCU, the French Engineer School's equivalent to the ECCC, and 16 officers and NCOs attended a one-week course conducted specifically for U.S. Army officers and NCOs that focused on demining operations in the Balkans. The French Engineer School continues to develop and train in the most up-to-date demining techniques in the world. It continues to emphasize the role of demining awareness and planning to all of their junior leaders. The school has the requirement for mine awareness training for the entire French army. The emphasis on demining training to junior officers and NCOs is typical of the importance placed in all branch schools as French army and engineer units are present on various operations worldwide.

These training opportunities are conducted through the International Military Training Office, 7th Army Training Command, Germany. Contact Mr. Art Brown at (011) 49-96-41-83-8449/8450 or e-mail *browna@hq.7atc.army.mil*.

Captain's Career Course

The 11-week CFCU is designed to prepare a captain for company command. The course flows in a progressive, mission-oriented manner. Blocks of instruction are not organized by subject area—such as construction, demining, or leadership—but by mission (for example, employing a unit in a peacekeeping operation). Subject areas are taught throughout the course as they apply to the mission type. The course is divided into two blocks:

Block I. The captain prepares the unit for employment.

- Exercise command. Includes communications/leadership/ command, training/ educating, and security.
- Know the environment. Includes the battlefield, enemy, other branches and their relationship to engineers, and engineer branch (missions, structures, principles, etc.).
- Optimize resources. Includes giving orders; organizing, conducting, and inspecting training; and managing personnel and materiel.
- Prepare unit for operations. Includes mobilization and deployment, planning (the military decision-making process), and force protection/NBC operations.

Block II. The captain employs his unit in an operational mission.

- Support combat operations.
- Support peace operations.
- Support civil authorities (disaster relief, civil defense, etc.).

The majority of instruction is devoted to tactical or combat engineering training. Sustainment engineering training is limited to deployment support missions such as base camp construction and route maintenance. The course consists of two sessions per year with about 30 captains per course. The average age of the French officers in CFCU is 30. About 70 percent have a college degree and an average of six to seven years experience in units, although some have as little as three years experience. The course is open to many foreign army officers.

Engineers who are interested in attending the French CFCU should meet the requirements below. Attendance at this course is in conjunction with a permanent change of station (PCS) to Europe.

- Be a first lieutenant (promotable) or a captain.
- Speak and comprehend French. (The course is taught entirely in French).
- Have completed the U.S. Army ECCC and CAS3—or be scheduled to attend these courses—and be eligible for a PCS move.
- Have not participated in the University of Missouri-Rolla master's program.
- Attend French engineer officer's advanced course (unaccompanied) TDY in conjunction with a PCS to Europe.
- Volunteer for the course.

Officers interested in attending the French CFCU should first contact their assignments branch manager at PERSCOM. Other important contacts include Ms. Victoria Anthony at the Engineer Personnel Proponency Office, U.S. Army Engineer School, (573) 563-6137, DSN 676-6137, e-mail *anthony @wood.army.mil*, or Major Andamo E. Ford, U.S. Army Engineer Liaison Officer (France), (011) 33-24-12-48-279, e-mail at *TRADOC.FR.ENLO@Wanadoo.fr* for additional information.

Demining/Mine Exercise (MINEX) Course

At least twice a year, the French Engineer School schedules a course for U.S. Army engineers and EOD units that is designed as a "train-the-trainer" course for leaders (NCOs and officers). Subjects covered during the course include—

- Learning about the French EOD branch.
- Demining according to international standards.
- Identifying and treating antipersonnel mines in the Balkans and Afghanistan.
- Identifying and treating antitank mines in the Balkans and Afghanistan.
- Demining in the Balkans and Afghanistan.
- Organizing and conducting a mine clearance worksite (classroom instruction).
- Identifying and treating rockets and missiles in the Balkans and Afghanistan.
- Identifying and treating grenades in the Balkans and Afghanistan.
- Identifying and treating booby traps in the Balkans and Afghanistan.
- Identifying and treating antipersonnel and antitank mines in a field environment.
- Using demining tools.
- Organizing and conducting a mine clearance worksite (in a field environment).
- Monitoring demining operations.
- Becoming familiar with the mine situation in Bosnia, Kosovo, and Afghanistan.

Transportation, lodging, and course fees are at no cost to the unit. Funding is handled by 7th Army Training Command, Germany. The point of contact is Mr. Art Brown, (011) 49-96-41-83-8449/8450, e-mail *browna@hq.7atc.army.mil*, or Major Andamo E. Ford, U.S. Army Engineer Liaison Officer (France), (011) 33-24-12-48-279, or e-mail *TRADOC.FR.ENLO @Wanadoo.fr* for additional information.

Major Ford has been a U.S. Army engineer liaison officer to France since June 2000. Previous assignments include commander, HSC, 84th Engineer Battalion (Combat) (Heavy), Schofield Barracks, Hawaii; battalion maintenance officer, 84th Engineer Battalion (Combat) (Heavy); and tactical support team commander and operations officer, D Company, 96th Civil Affairs Battalion (Airborne), Fort Bragg, North Carolina.

CTC Notes

National Training Center

Opposing Force's (OPFOR's) MTK-2

By Captain Thomas F. Nelson and Sergeant First Class Gary A. Smith

As the National Training Center (NTC) continues to implement the contemporary operational environment, the OPFOR will adjust its equipment inventory to better match threat capabilities. The MTK-2, the latest addition to the engineer inventory, provides the OPFOR with an explosive reduction capability that greatly enhances its flexibility across the battlespace. Though there are several sources that differ in their descriptions of the MTK-2, the NTC based its system on TRADOC's worldwide equipment guide and implemented an addition to NTC's rules of engagement (ROE).

MTK-2 in operation

Capabilities

Based on the 2S1 self-propelled howitzer chassis, the MTK-2 has a turret-like superstructure that contains three UR-77 rockets on launch ramps. The range of the rockets is about 200 to 400 meters. Each rocket is connected via a towing line to 170 meters of mine clearance hose that is stowed folded in the uncovered base of the turret on the vehicle roof. The hose, with pressure fuses, is command-detonated to clear a path up 140 meters long and 6 meters wide through minefields. The MTK-2 is capable of operating in a nuclear, biological, and chemical environment and has good cross-country capability.

Characteristics

The visual modification (VISMOD) of the MTK-2 is built up on an M113 chassis and includes the launching tubes and Smokey Sam rail. The organic OPFOR engineers, the 58th Engineer Company, configured three MTK-2 VISMODs. The MTK-2 will fight as a component of the movement support detachment for offensive missions. It will use the Multiple Integrated Laser-Engagement System (MILES) II.

NTC MTK-2 ROE

The MTK-2 is a similar vehicle to the U.S. Army armored vehicle-launched mine-clearing line charge (MICLIC) (AVLM); therefore, the OPFOR will simulate reduction with the MTK-2 using the same procedures as for the AVLM.

MTK-2 VISMOD (with launch tubes raised)

For each charge, 100 x 7 meters are allowed. The tank commander (or third crew member) will dismount from the vehicle and walk the vehicle through the minefield. An observer/controller will remove mines as the tank commander encounters them (only the mines directly in front of the vehicle to create a 7- by 100-meter lane).

The OPFOR will not transport an engineer squad in the MTK-2 VISMOD during offensive operations, nor will the vehicle be used in conjunction with the obstacle detachment.

The points of contact (POCs) for OPFOR engineer issues are CPT Tom Nelson (Red Devil 6), e-mail *NelsonTF @irwin.army.mil* and SFC Gary Smith (SW09), DSN 380-5151 or e-mail *Sidewinder09@irwin.army.mil.*

Leader's Training Program (LTP)

By Major Michael W. Rose and Captain Thomas B. Hairgrove, Jr.

The NTC offers a six-day LTP about 120 days before a scheduled rotation. Though the Wrangler Team is responsible for the brigade LTP, the Sidewinders provide additional resources to enhance the LTP experience.

LTP Attendees and Tools

To get the most from the LTP, the Sidewinders recommend that the following engineer battalion personnel attend:

- Battalion commander
- Battalion executive officer (XO)
- S3
- S2
- Assistant brigade engineer
- Assistant S3 (planner or battle captain)
- S1 or S4
- Company commanders
- Company XOs
- Specialty leaders (light engineer platoon, combat support equipment, explosive ordnance detachment)

The following tools are recommended:

- NTC maps
- Modified combined obstacle overlay of NTC
- Pluggers
- Laptop computers
- Printer
- Tactical standard operating procedure (SOP)
- Binoculars
- Digital camera
- TerraBase w/ MrSids Imagery
- NTC ROE
- Field Manuals 101-5, *Staff Organization and Operations*; 101-5-1, *Operational Terms and Graphics*; 3-90.3, *The Mounted Brigade Combat Team*; 5-71-3, *Brigade Engineer Combat Operations (Armored)*; 5-71-2, *Armored Task-Force Engineer Combat Operations*; 20-32, *Mine/Countermine Operations*; 90-7, *Combined Arms Obstacle Integration*; and 3-34.2, *Combined Arms Breaching Operations*.

Planners 101

The Sidewinder team conducts two classes during an LTP that are designed to enhance the performance of the engineer battalion planners. Both battalion and company-level planners benefit from the session. The first class is *NTC Terrain Analysis*; it focuses on how to provide the "so what" of terrain to the commander. The second class, *Engineer Planning at the Basic Combat Training and Task Force Level*, provides a planner's overview and tactics, techniques, and procedures (TTP) for planning in a time-constrained environment.

Brigade Combat Team Classes

The following classes are also available, by request, for either the engineer battalion and/or the brigade LTP participants: *Combined Arms Breaching Operations* and *Combined Arms Obstacle Integration.* Since trends at the NTC indicate that these two subjects pose significant challenges to brigade combat teams, we recommend that units work through their brigades to schedule these classes.

The POCs for the LTP are MAJ Michael Rose (SW03), e-mail *Sidewinder03@irwin.army.mil,* and CPT Tom Hairgrove (SW03B), DSN 380-5151, or e-mail *Sidewinder03B @irwin.army.mil.*

Reception, Staging, Onward Movement, and Integration (RSOI) MICLIC Range

By Captain James R. Koeppen and Major Michael W. Rose

To improve the battlefield performance of combat engineers, in particular MICLIC employment, the 52d Infantry Division now mandates in-theater training on the MICLIC by RSOI 4. Historically, units that have fired live rockets and high-explosive line charges during RSOI have maintained better MICLIC launcher operational-readiness rates and have had fewer misfires during the live-fire portions of their rotations. The Sidewinder team recognizes the tremendous potential this additional training offers and will ensure that every effort is made to include this event in each rotation.

Initial coordination for the RSOI MICLIC Range should occur during the LTP. During the LTP, the Sidewinder Team will provide the unit with a compact disk (CD) containing the MICLIC Range SOP that has a general overview of the event, rotational unit responsibilities, range layout with surface danger zones, sample memorandums required by Fort Irwin Range Control, Fort Irwin POCs, and a sample battalion operations order (OPORD). A MICLIC CD is also available from the Sidewinder team and includes TTP, photos, and other information to prepare units in their train up.

A MICLIC detonation

The following are keys to successful execution of the RSOI MICLIC range:

- This is a battalion effort; a single company cannot plan and resource this training.
- Issue a battalion OPORD for this training before deployment.
- Get the range officer in charge and range safety officer to range control on RSOI 1 or during the LTP.
- Coordinate with the Sidewinder team for MICLIC inspections on RSOI 2 or 3.
- Check your blasting machines with voltmeter (M34–220 volts, CD450-4J–220 volts, and a fresh 9-volt battery).
- Draw ammo no later than 1600 RSOI 3 and coordinate with the Sidewinder team to conduct joint inspection of ammo on RSOI 3.
- Plan to begin range operations no later than 0700 on RSOI 4; this will get you off the range by 1200.
- An M985 heavy expanded, mobility tactical truck (HEMTT) is required (M977 series does not have lift capacity for MICLIC tubs).

The POCs for the RSOI MICLIC range are MAJ Michael Rose (SW03), e-mail *Sidewinder03@irwin.army.mil* and CPT Jim Koeppen (SW11), DSN 380-7055, or e-mail *Sidewinder11 @irwin.army.mil*.

Joint Readiness Training Center

Troop-Leading Procedures (TLPs) for Task Force Engineers

By Captain Mark C. Quander

A trend that has become prevalent at the Joint Readiness Training Center (JRTC) among rotational engineer units is the lack of thorough TLPs. This has resulted in vague tasks and purposes for squad leaders and poor allocation of troops to engineer tasks. While most people understand the definition of TLPs and their functions, rarely are TLPs ever executed. Engineers have a method of linking the military decision-making process (MDMP) and TLPs through the engineer estimate (see Figure 1). Some of the critical issues observed at the JRTC follow.

Issuing Warning Orders (WARNORDs)

While missions are received and WARNORDs issued, it is common that the WARNORDs are incomplete. Key items missing from them include a clearly stated mission, specified subunit tasks with a purpose, critical precombat checks (PCCs) and precombat inspections (PCIs), and a tentative time schedule. Tentative plans are normally inadequate since proper mission analysis—which includes the engineer battlefield assessment (EBA), specified tasks, implied tasks, and facts and assumptions—are not delineated and known. Platoon- and squad-level operations orders (OPORDs) are normally only very detailed WARNORDs and lack the coordinating instructions necessary for integral and synchronized combined-arms fight. Doctrinally, leaders should issue three WARNORDs; at a minimum, they should address the—

- Higher headquarters restated mission (WARNORD #1).
- Terrain analysis and associated products (WARNORD #2).
- Engineer enemy composition, disposition, and strength (WARNORD #2).
- OPORD location and time (WARNORD #2).
- Updated timeline (WARNORD #2).

Relationship Between the Military Decision-Making Process, the Engineer Estimate, and Troop-Leading Procedures		
Military Decision-Making Process	**Engineer Estimate**	**Troop-Leading Procedures**
Receive the mission	**Receive the mission** - Issue the WARNORD to subunits	**Receive the mission**
Develop facts and assumptions	**Conduct IPB/EBA** - Enemy engineer capability - Friendly engineer capability - Impact of terrain and weather	**Issue a WARNORD** - State the mission - Specify essential tasks to subunits, critical PCCs - Issue timeline
Analyze the mission	**Analyze the engineer mission** - Specified tasks - Implied tasks - Constraints - Limitations	**Make a tentative plan** - Backward plan action from the objective(s) - Assign mission to subunits - 1/3 - 2/3 time management rule - Subunits conduct PCCs
Issue the commander's guidance	**Develop the SOEO** - Resource the essential tasks with generic units and specific classes of supply	**Initiate necessary movement**
Develop courses of action (COAs)	**War-game and refine the engineer plan** - Focus on key events in the operation - Backward plan from the objective(s) - Identify shortfalls in resources - Identify benefits and risk for each course of action (COA)	**Conduct reconnaissance** - Leader reconnaissance of critical objective areas - Subunits conducting individual and squad rehearsals
Analyze COAs	**Recommend a COA**	**Complete the plan** - Modify the tentative plan based on results of recon
Decide on a COA and issue orders	**Finalize the engineer plan and issue orders**	**Issue the operations order** - Key leaders attend - Brief on terrain model or sketch - Graphics and execution matrix to squad level **Inspect, supervise, and rehearse** - Leaders conduct PCIs - Rehearsals at squad, platoon, and combined-arms levels

Figure 1

- Subunit instructions (WARNORD #2).
- Types of rehearsals and locations (WARNORD #3).

Developing the Scheme of Engineer Operations (SOEO)

Another prevalent trend is the lack of information in the SOEO paragraph, which is directly linked to platoon leaders failing to issue a task and purpose to subordinate units. Task force engineers conduct limited EBAs that do not fully support the task force's mission analysis. These deficiencies in the initial planning phases lead to an inability to better impact and multiply the mobility/survivability effects of the task force maneuver plan. A clearly stated task and purpose with complementing SOEOs is generally absent from orders.

Task force engineers can help overcome this problem by conducting a thorough EBA and then, with the commander's guidance, fully participating in the COA development of properly allocating troops to engineer tasks. During the construct of the EBA, they should, in concert with the battalion S2, conduct an intelligence preparation of the battlefield (IPB). It is then that they will develop the enemy engineer situational template, continually updating the information. Some call this reverse Battlefield Operating Systems (BOSs). You identify to the battle staff what you think the enemy engineers will do, given resources and available time. At the conclusion of the mission analysis, the task force engineer should be able to clearly articulate the enemy engineer capabilities, friendly engineer capabilities, and the effects that terrain and weather will have on the operation to both friendly and enemy forces

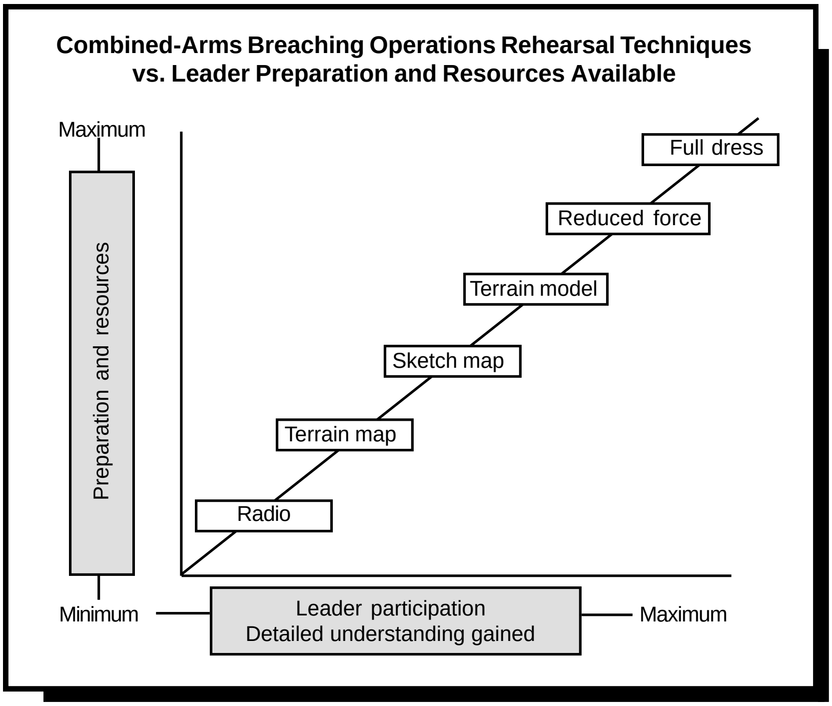


Figure 2

during the MDMP to the platoon sergeant so he can prepare the platoon as planning continues. The platoon sergeant must fully understand what type of rehearsals the platoon leader wants to conduct (confirmation brief, back brief, combined-arms rehearsal, support rehearsal, battle drill) and the various techniques so time is not wasted (see Figure 2). Failing to conduct rehearsals to standard also prevents a unit from identifying shortcomings in the plan.

and whom it favors. Friendly engineer capabilities should not just focus on what assets are available. They should also focus on what the engineers can do with those assets down to how many breaches they can conduct or how much minefield frontage they can emplace with time and resources available. Task force engineers should also look at the other BOSs and see how they can assist the engineer effort in shaping the battlefield for task force commanders.

Once the task force engineers have completed a detailed EBA and understand the commander's guidance, they can begin identifying the task and purpose of engineer subunits. They will have proper troops for engineer tasks and can communicate this to the squad leaders or other engineer units in a second WARNORD and eventually the SOEO.

Rehearsing

Platoons conduct very few rehearsals, and those that are conducted focus only on the basic engineer missions. Full-force combined-arms rehearsals are generally absent. The engineer-only rehearsals are mainly conducted as "talk-throughs" and never address an uncooperative enemy or a contingency plan. During the issuance of the WARNORD, or at least the OPORD, the task force engineers/platoon leaders should specify what actions to cover during the rehearsal and the type of rehearsal to conduct.

Task force engineers also fail to identify critical engineer tasks that serve as their "actions on the objective"; therefore, they do not make those tasks the priority for rehearsals. They should give specific guidance for what to rehearse

The lack of combined-arms rehearsals degrades the platoon's effectiveness in areas such as communication from squad to platoon, understanding individual responsibilities for the mission, and actions on contact. Platoon leaders must vehemently insist on combined-arms rehearsals, conduct detailed engineer-specific rehearsals, and apply analysis to decide the appropriate rehearsal type and technique. There are various tools and techniques for combined-arms rehearsals in FM 3-34.2, *Combined-Arms Breaching Operations*. The more detailed the rehearsal, the greater understanding the soldiers will gain.

Summary

Task force engineers must learn to balance task force engineer duties and responsibilities as well as those of platoon leaders. The task force engineer will fail to accomplish the engineer mission if he does not first conduct a thorough EBA and then pass that information on to his subordinates. For those that are inexperienced, a planning or preparation checklist outlining what to provide subordinates during each step of the TLPs in the form of a WARNORD, SOEO, and OPORD will lead to better time management and better preparation by those subordinate units.

Captain Quander is a light engineer platoon senior observer/controller. Previous assignments include commander, C/326 Engineer Battalion (Air Assault)—deploying to Afghanistan in support of Operation Enduring Freedom; platoon leader, A/307 Engineer Battalion (Airborne); and assistant brigade engineer, 1st Brigade, 82nd Airborne Division.

Enlisted PERSCOM Notes

By Lieutenant Colonel Jack Smith

On behalf of the staff here in Alexandria, Virginia, greetings from the Engineer Enlisted Branch, Total Army Personnel Command (PERSCOM).

Health of the Regiment

Overall, the Engineer Regiment is very healthy with a major exception of our flagship military occupational specialty (MOS), 12B (combat engineer). Today our Regiment is manned with 16 of 21 MOSs at or above 100 percent, with three more at 99 percent (see Table 1).

Our biggest challenge continues to be the 12B MOS. Manning levels in units throughout the Army have resulted in the addition of this MOS to the Army's top ten critical shortage MOS list. There are several reasons for this. The primary reason is the very low accessions for 12Bs in FY01 and early FY02 in order to decrease the MOS, which at one point reached 111 percent manning levels. This low influx of new combat engineers now has units in the field at or below 90 percent manning for skill level one soldiers. The fix to this problem is already in place. In October 2002, we raised the number of new soldiers that we will recruit into the combat engineer field. It is comforting to know we are taking action to bring manning strengths to appropriate levels; however, we also know that it will take almost a year to get the MOS healthy.

Several actions taken over the past fiscal year have dramatically improved our low density MOSs: 00B (diver), 52E (prime power production specialist), and airborne 62E/J (construction equipment operator). The largest issue for the diver community is the requirement to be diver-certified before being promoted to E5 and E6. The lack of progress in the certification process can slow promotion rates to a crawl. The good news is that the diver community can solve its NCO shortage problems by aggressively pursuing the certification process. The bad news is that we still have many promotion-eligible diver soldiers who are waiting to be certified.

Our prime power community will get healthy this spring with the graduation of the next advanced individual training class. We can fully expect this MOS to come off the Stop Loss Program at that time. Airborne construction equipment operators are always in short supply. These MOSs offer very attractive reclassification bonuses under the Bonus Extension and Retraining (BEAR) Program. Call this office if you are interested in reclassifying into these specialties.

Recruiting and retention have been well above historical averages across the Army and in the Engineer Regiment. Our FY03 recruiting program is at 103 percent, year to date, for the engineer career management fields, and we have recruited 71 percent of FY03s total engineer recruiting mission.

On the reenlistment side, all but one of our 21 specialties is well above the five-year historical trend. Current trends indicate this success rate will continue. Note, however, that in December 2002, a message was published that dramatically decreased the selective reenlistment program for the Army. More than 200 MOSs were removed from the bonus program, and the remaining few experienced decreases in the amount of money in the bonus program.

The long-term projections for the Regiment are very good. We can expect our shortage MOSs (12B10, 00B, and 52E) to improve dramatically in the next 12 months. Meanwhile, other

Engineer Enlisted Operational Strengths*

MOS	Authorized Strength	Strength (percent)
12B	8,161	96
12C	672	103
12Z	234	91
00B	129	102
51B	881	118
51H	433	106
51K	115	103
51M	247	94
51R	127	148
51T	257	127
51Z	116	100
52E	183	89
62E	1,326	103
62F	278	103
62H	102	101
62J	673	105
62N	466	102
81L	233	112
81T	469	100
81Z	19	95
82D	109	110
Total	15,240	98.5

*As of 6 December 2002

Table 1

specialties (51B, 51R, 51T, and 81L) will experience decreases in overall strength to bring them in line with authorized manning levels. The 51R, 51T, and 81L each have some soldiers enrolled in the Fast Track Program, where they are required to reclassify into another MOS due to overstrengths in those particular fields.

Assignment Process

The assignment process is simple:

- The Army defines where soldiers are authorized.
- PERSCOM identifies those authorizations that have no soldiers assigned to them.
- PERSCOM requisitions the branches for soldiers to fill those authorizations.
- An assignment manager goes into the personnel data base and identifies those soldiers who are eligible to fill the requisitions and nominates them to be slotted against those requisitions.
- The nomination process can end with the assignment manager's direct supervisor, depending on the complexity of the assignment, or the process may have to go all the way to the director of the Enlisted Personnel Management Directorate for approval to place a soldier on assignment instructions. In the case of specialty assignments like recruiting and drill sergeant, the files also have to go before administrative boards to ensure that only the best NCOs are slotted into those critical billets.

Now that I have been a part of PERSCOM for six months and have explained the assignment process, I am even more aware of some critical information that needs to be reviewed and updated periodically:

- Unit commanders, first sergeants, battalion S1s and S3s, and personnel managers at all levels must periodically review their modified tables of organization and equipment (MTOEs) or tables of distribution and allowances (TDAs) for completeness. These documents define the authorizations, and it is only these authorizations that can have soldiers requisitioned.
- Unit manning reports are the next important documents. The data in the reports is a direct reflection of what soldier inventory your unit has assigned against its authorizations.

Because I was a company commander for more than three years and a battalion S1, executive officer, and commander, I am familiar with the frustration that arises from trying to manage a unit manning roster. However, I cannot overemphasize that this data must be accurate so PERSCOM will have the opportunity to assign the right person to the right billet.

The most common mistakes in the database include improper grades for enlisted soldiers; soldiers spending an inordinate amount of time with a "gain" code, even after they have been working in a position for months; and soldiers not being placed on a loss roster. Improper grades for your soldiers have the impact of not getting the proper rank structure assigned to your organization. Remember that promotables are counted against the next higher grade for assignment purposes. The loss roster is perhaps the most important data at the unit level. If a soldier is not carried as a loss, the personnel system will never identify a soldier to replace that loss until after the soldier has left. In the case of retirements, this can result in a billet going empty for over 18 months since the unit will not have the soldier available during transition and/or on terminal leave.

In the last PERSCOM Notes, I provided a detailed discussion on how to get your assignment preferences to us. The preferred method is your Army Knowledge Online account. The next best way is to submit a DA Form 4187 *Personnel Action*. Also key is to contact your assignment manager at least every six months. Our Web site, listed at the end of this article, has all the phone numbers and addresses you need. It will have information that can help you make career decisions and set you up for future success in the Army. I highly encourage you to visit our Web page at least monthly. We are updating it every month with information pertinent to the engineer enlisted force. We also have a new site that lists critical billets throughout the Engineer Regiment that most soldiers do not even know exist. If you are an E6, E7, or E8 and are due for a new assignment in the next 8 to 18 months, visit this page on a monthly basis, and contact your assignment manager when you see a billet that piques your interest.

Promotions and Training

There is nothing more frustrating here at PERSCOM than reviewing readiness reports every month that complain about the shortage of NCOs across the Army. At the same time, we see monthly reports that lay out the thousands of soldiers who are eligible for promotion but have not yet been boarded. A look at the engineer star MOSs provides a clear example of how we could solve our own NCO shortages (see Table 2).

Fully understanding that not all board-eligible soldiers are worthy of consideration for promotion, I also know that most are worthy. The chain of command needs to aggressively pursue the promotion board program. There are thousands of reasons and excuses that make it hard to implement the promotion program, but it has to be done well for our great soldiers in the field. It is usually the combat units, the forward deployed units, and the units in the field that have the hardest times meeting the promotion board process because they are simply working so hard at their missions. But it is exactly these soldiers who deserve the promotions. I will never stop publishing the simple message to all the soldiers in the field. "If your unit

First Lieutenants to Korea: My Experience With the Program

By Captain Chad Suitonu

If you are a new lieutenant in the Army and are dissatisfied with your current assignment—if you're looking for a change and seeking career progression—then Korea could be for you. I went there from my first duty station in October 2000 on the First Lieutenants to Korea Program; was immediately sent to a company executive officer (XO) position in the 2d Engineer Battalion, 2d Infantry Division; and can honestly say that I was pleased with my decision and experience.

The Program

The First Lieutenants to Korea Program is an unofficial Army program that encourages experienced first lieutenants to serve a tour in Korea as company XOs or in staff positions. Because the short overseas tour is a year long, units are losing second lieutenants before they gain the rank and experience needed to fill company XO slots. This leaves most companies without XOs and forces them to assign their most senior second lieutenant to the position. These lieutenants often have limited experience and only serve in the position for a few months until their tours are up.

The target recruits for this program are first lieutenants with 18 to 24 months on station at the time they move to Korea and who will not be promoted to captain during their tour. Korea is considered a hardship tour, and you may wonder why someone would volunteer to participate in such a program. In this article, I share my perspective of the program's advantages.

Make a New Start

One reason for going to Korea is if you are dissatisfied with your current job. As a young second lieutenant, you may make a lot of mistakes. You may go about business incorrectly, gain an unfavorable reputation, or rub someone the wrong way—such as your platoon sergeant or your company commander. As you climb the steep learning curve a new officer faces, you should grow and mature and see the errors of your past ways. It is difficult to make a change to your leadership style and management practices while being part of the same organization and working with the same people. Going to a new place and working in a new organization, with new people, allow you to make a fresh start. You can more freely implement the lessons you learned from your previous assignment. The people who saw you struggle early in your career are not there; there are no looming notions about your shortcomings.

Obtain an XO Position

Another reason to go to Korea is if you want an XO position. If you have done your platoon leader time and want to progress to an XO spot, this program was especially designed for you. Most companies have three to four platoon leaders but only one XO. There could be a long wait at your current duty station for an XO position, and you might not get that opportunity at all but be moved to a staff position, such as assistant battalion S3, instead.

If you plan to take a company command, gaining experience as an XO will help set you up for success as a commander. As a platoon leader, you only see a slice of the company's overall operations. You do not gain the experience of tracking and running supply and maintenance issues at the company level. As an XO, you learn what needs to happen to allow the company to function successfully. You are drawn into the planning process and exposed to company- and battalion-level planning and coordination.

After your tour in Korea, you are automatically slotted for the Captain's Career Course at Fort Leonard Wood, Missouri, which puts you on a fast track. You can serve as little as 18 months at your current duty station, spend a year in Korea, and be at Fort Leonard Wood learning to be a company commander after being in the Army for only about three years.

Learn More and Faster

Korea has a high operating tempo. Things happen fast, and you are always busy and constantly reacting. It is demanding, and you will put in long hours. There is a real-world threat from North Korea, so along with addressing normal operations and training issues, you must deal with periodic alerts and maintain a high state of readiness to be prepared to "fight tonight." There are other complexities that come with working in Korea that enhance your learning experience. For example, there you are constrained by unique rules and procedures. Often you lack adequately trained manpower. It takes much longer to receive supplies ordered from the United States, and land to use for training is scarce. With all of the constraints you deal with and overcome, you become better at managing resources and finding innovative ways to accomplish the mission.

A side benefit of always being busy is that it helps time pass quickly. Everyone I have talked to agrees that although the year in Korea is somewhat difficult, it seems to fly by.

Broaden Your Experience

Going to Korea will broaden your professional and life experiences. This cross-fertilization helps you develop into a more sophisticated and well-rounded officer. Exposure to a new working environment gives you something your peers at their original duty stations will not gain.

Unique to an assignment in Korea is the opportunity to work with Korean Augmentation to U.S. Army soldiers—commonly known as KATUSAs. These Korean nationals live, work, and train with U.S. Army units to supplement manning needs. The assignment provides young officers the opportunity to manage and lead foreign soldiers, gain up-close exposure to a new culture, and address the cultural differences and language barriers.

How to Apply

If you are interested in the First Lieutenants to Korea Program, discuss it with your chain of command. They might be able to develop a solution that satisfies your desires and their needs without your having to make a permanent move. If you and your chain of command decide that going to Korea would be the best solution, call or e-mail your Engineer Branch representative for further details about the program. In my case, I simply submitted a DA Form 4187, *Personnel Action*, signed by my battalion commander, and I had orders a few weeks later.

A Korean assignment is not for everyone, but if you are interested in some of the benefits outlined in this article, it may be what you are looking for. I learned a lot from my participation in the First Lieutenants to Korea Program, and the opportunity for new experiences and professional growth was invaluable.

Captain Suitonu is the G3 (XO), I-Corps, Fort Lewis, Washington. He was previously the XO of C Company, 2d Engineer Battalion, 2d Infantry Division, Republic of Korea. CPT Suitonu is a graduate of the Engineer Captain's Career Course and holds a master's in public policy from the University of Missouri-St. Louis.

(PERSCOM Notes, continued from page 38)

Engineer STAR MOSs			
MOS	Rank	Number Needed	Number Eligible
00B	SSG	22	26
51K	SGT	7	31
51M	SGT	13	51
51M	SSG	19	26

Table 2

has you working or assigned to a billet that requires the next higher grade, go to your first sergeant and/or command sergeant major and request to be put before the next board if you are eligible." If the chain of command wants to work you at the next higher paygrade, then get promoted and paid for the level of responsibility that they are demanding of you.

Conditional promotions have been on the street for some time, but they require attendance in the requisite Noncommissioned Officer Education System (NCOES) course (Primary Leader Development Course, Basic and Advanced Noncommissioned Officer's Courses) within one year of the conditional promotion. Failure to meet this requirement can result in a demotion. There are exceptions to policy for operational and hardship reasons; however, it is imperative that the soldiers attend the NCOES courses as soon as possible. Do not hesitate to contact this office if you have questions about NCOES attendance or conditional promotions.

For information on pending selection boards, visit the PERSCOM Web site (*www.perscomonline.army.mil*) for the latest news. It's up to you to review your Official Military Personnel File. You can obtain a copy by following the procedures posted at the PERSCOM Web site.

Contacting Us

The sole function of Engineer Branch is to support soldiers and commanders in the field. I encourage you to contact your assignment manager, professional development NCO, branch sergeant major, or me with any questions you have about assignments or professional development. The PERSCOM Web site has information on how to reach us. Remember, the only thing in the assignment process that does not have to be a variable is your preference. Take the time to let us know your preference.

Assignment Opportunities in the Far East District, U.S. Army Corps of Engineers

By Major Richard T. Byrd, Jr., and Sergeant First Class Carl L. Lindsay II

Military assignments in Korea are many and varied. Among them are opportunities for active duty Army engineers to serve in the U.S. Army Corps of Engineers (USACE) Far East District (FED). Both noncommissioned and commissioned officers can serve here. This article describes two possible assignments—that of project engineer and construction inspector.

Project Engineer

Most officers assigned to the FED come through the Advanced Civil Schooling Program. This is usually an 18-month program in a specified engineering discipline or in construction management. (See the engineer Web site for more information: *https://www.perscomonline.army.mil/OPeng/advanced_civil_schooling.htm*).

Another way to be eligible is to already have your master's, perhaps through the University of Missouri-Rolla program at the U.S. Army Maneuver Support Center, Fort Leonard Wood, Missouri, or through the Degree Completion Program. You must also have completed a successful company command. If assigned to the FED, you will have the option of serving in a two-year command-sponsored tour or a one-year non-command-sponsored tour. If you select a one-year tour, then you will return to the states to complete your three-year commitment to the Corps. Currently there are seven engineer officer positions authorized at the FED, two of which are the commander and deputy commander.

As a captain or major you will probably be assigned as a project engineer, working in one of six resident or project offices. Project engineers serve in a position similar to an area construction manager in a civilian construction company. You will supervise civilian quality assurance representatives whose responsibility is projects ranging in cost from thousands to multimillion dollar contracts. Your job as a project engineer will include several types of contracts, to include military construction and host-nation-funded projects. The FED supports the United States Forces Korea (USFK), and therefore, our customers cover every service component and other agencies such as the Army and Air Force Exchange Service and Department of Defense Dependents' Schools.

Some of your responsibilities as a project engineer will include—

- Verifying and processing contractor payment applications.
- Visiting project sites to monitor safety, quality, and progress.
- Corresponding with contractors and customers.
- Interpreting contract drawings and specifications.
- Attending periodic progress meetings with contractors.
- Managing quality assurance representatives.
- Being involved in military exercises.

As a project engineer, you will also be appointed as a contracting officer's representative. This gives you the authority to administer contracts and direct contractors as they execute projects.

This job is an excellent opportunity to use your engineering skills/education that you may not have exercised in most troop units. You will manage projects of varying scope—from dining facilities and fire stations to barracks upgrades and airfield runway pavements. In managing these projects, you will interface with contractors, customers, facility users, Directorate of Public Works personnel, base civil engineer personnel from the Air Force, and a variety of other people involved in the construction process. This also includes a large USACE team. The FED maintains a staff of technical experts—to include designers and mechanical, civil, electrical, architectural, structural, environmental, and geotechnical engineers. You can also "reach back" to USACE labs, Centers of Expertise, or any other USACE district for assistance if you need to. So, although you may not have much experience in construction, you are surrounded by other people who do. It's just like being a platoon leader again; if you're smart, you keep quiet and listen to your NCOs. The same principle applies here; you listen and learn from those around you with the experience, and you'll be up and running in no time. The learning curve is initially steep, but you will catch on quickly and be on your way to being a successful project engineer.

Another responsibility you will have is working with the service components in Korea during contingencies. As the only USACE maneuver district, we have the added task of assisting with the development and maintenance of the contingency construction list—a list of construction projects to be executed in the event of a contingency. The major work for this list occurs during two exercises held each year: Ulchi Focus Lens and Reception, Staging, Onward Movement, and Integration. The FED provides liaison officers or teams to each service component, USFK, and the Republic of Korea army during these exercises. The entire FED team—as well as reach-back capabilities to the Centers of Expertise in the states—is utilized during these exercises.

Other duties during contingencies for military members include leading facility damage assessment teams, performing staff officer duties, or deploying as a member of a deployable forward engineer support team-advance (FEST-A) as part of the USACE field force engineering doctrine.

Construction Inspector

Noncommissioned officers assigned to the FED as construction inspectors are usually staff sergeants who have completed their squad leader time and are close to promotion to sergeant first class with military occupational specialty (MOS) 51H, construction engineer. Construction inspectors work for a project engineer and are delegated authority and responsibility to monitor and administer the contractual provisions for assigned projects.

About 10 percent of your time will be spent on—

- Reviewing plans and specifications during the design and/or bidding phase, paying special attention to existing field conditions.
- Preparing comments for possible changes to plans and specifications.

About 80 percent of your time will be spent on—

- Monitoring on-site contractor supervision and inspection of construction activities.
- Ensuring that construction quality is achieved by enforcing the quality control provisions of the contract. This includes ensuring that the contractor's field staff makes periodic inspections and tests.
- Reviewing and evaluating construction progress, quality assurance findings, and recommended field and office engineering changes for consistency with contractual provisions, specifications, and cost estimates.
- Discussing problems and recommendations with the project engineer and providing input for solutions or courses of action based on knowledge and experience with the contract and from observations made at project sites.
- Reviewing the contractor's construction schedules, safety program, and quality control plan and initiating field changes.

A project engineer inspects a standing seam metal roof.

A construction inspector checks roofing materials.

- Informing the project engineer of progress and other significant contract administrations.
- Ensuring that contractor as-built drawings are kept up to date.
- Participating in joint occupancy and final transfer inspections.
- Furnishing field information for construction progress and feeder information for other reports.

About 10 percent of your time will be spent on—

- Enforcing the project safety program.
- Supervising the contractor's efforts in the implementation of Engineer Manual 385-1-1, *Safety and Health Requirements*.

There are also exercises that the FED participates in that transition the soldier from the duties of construction inspector to those of a liaison officer for one of the service components. In this, you help the component complete the contingency construction list by offering the design and construction services the FED has as well as the ability to "reach back" for a vast amount of technical information. In addition, there are the daily soldier duties of physical fitness training, weapons qualification, etc.

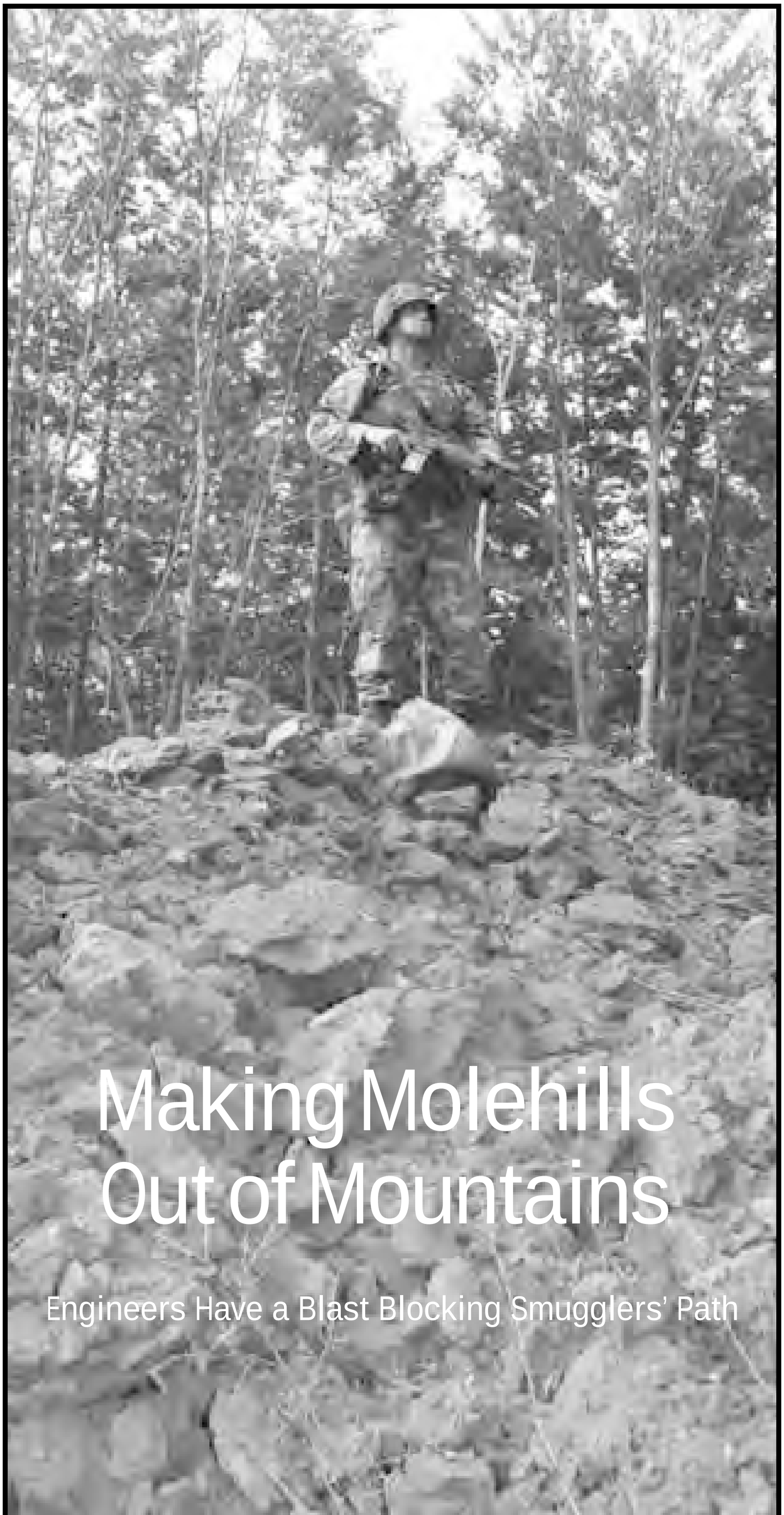
This assignment is definitely a career-enhancing assignment. The number of construction projects, methods, and techniques that NCOs will be exposed to during an assignment with the FED is unequalled in the average Army construction engineer's NCO career.

Conclusion

If you come to Korea with the right attitude and are willing to learn, you'll have a great tour. Things have changed since some of you were here. The commander has really worked hard to improve the quality of life all around the peninsula. Not only does this equate to more work for USACE but also to a better way of life for all of us here. This job is definitely unique and, no, you are not stuck behind a desk all day. Getting out and seeing the construction projects allows you to experience new things every day. It is a very rewarding assignment, knowing that you play a major role in improving the quality of life for all service members in Korea.

Major Byrd received a master's in construction management from the University of Oklahoma through the Army's Advanced Civil Schooling Program before serving two years with the Far East District of the U.S. Army Corps of Engineers as a project engineer in the Central Resident Office at Osan Air Base, Korea. He is currently a staff officer for the 8th Army Engineers, Korea. MAJ Byrd's next assignment will be the Command and General Staff College at Fort Leavenworth, Kansas.

Sergeant First Class Lindsay was a construction inspector with the Far East District of the U.S. Army Corps of Engineers when this article was written. He is currently the platoon sergeant of 1st Platoon, Alpha Company, 46th Engineer Battalion, Fort Polk, Louisiana. SFC Lindsay holds an associate in general studies and is working on a bachelor's in business and management.



Making Molehills Out of Mountains

Engineers Have a Blast Blocking Smugglers' Path

By Specialist Patrick Rodriguez

At Camp Monteith, Kosovo, the day ended not with a bang or whimper but with a tremendous thud that echoed through the valley. That morning, Task Force 9th Engineer Battalion had departed from the camp to blow up a suspected smuggling route crossing into the Former Yugoslavian Republic of Macedonia from Kosovo. The day began 16 hours before the last explosion, with the high-mobility, multipurpose wheeled vehicles (HMMWVs) crisscrossing up and into the mountains. The route soon became more of a footpath than a vehicle trail. Still, there was evidence that the trail had been used: scarred trees, discarded water bottles, and tire tracks.

First, the task force had to pick a site, which would depend on existing obstacles and terrain in the area. It would be best to link this access to a very steep slope on either side of the road. The site the task force chose was a trail in the German sector of Multinational Brigade (East) with steep slopes on both sides near the top of a densely wooded slope. There was some economic smuggling along the administrative boundary line that separates Kosovo from other provinces in the Federal Republic of Yugoslavia—tax avoidance stuff—but here, the problem was support to armed elements. The task force wanted to stop the smuggling of weapons and the support of ethnic armed groups on either side of the border.

The plan was to set off two explosions—the first from shaped charges and the second from cratering charges. Shaped charges, made of composition B explosives, will go through reinforced concrete and cut through steel. Inside the charge is a cone, and when it detonates, it detonates from the top and consumes itself. By the time it comes out the bottom, it's just a ball of plasma. It pushes everything out of the way. Shaped charges are set a couple of feet off the ground for optimum penetration. These charges would create six boreholes, which would be used for the larger, more robust cratering charges (made of composition H6).

But before destroying the smuggling route, the task force had a few tasks to complete that consumed most of the day:

- Phase 1 consisted of clearing the brush. The team hacked unmercifully for hours at the trees and bushes on both sides of the trail to provide a view of the explosions from both the shaped and cratering charges.
- Phases 2 and 3 consisted of preparing the explosives and setting them off.

The task force ensured that the U.S. and German soldiers who had been providing security for the platoon had evacuated the area after the shaped charges were placed the required distance above the sloped trail. From several hundred feet away, in the protective cocoon of an armored HMMWV, the demolition team set off the first explosion. It ripped through the valley and was felt more than half a mile away.

Soldiers duel-prime a 40-pound cratering charge with the use of composition B explosives.

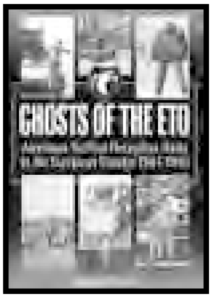
Moments later, the task force returned to the site of the explosion. The ground was covered with green leaves from the trees overhead, and the site smelled like fresh-cut grass. Five of the six charges had cleared holes straight into the ground. One of the charges hit a large rock on the way down and stopped a few feet short of the desired depth. After examining all six boreholes, the task force dug the holes so they were wide and deep enough for the cratering charges. Then, the cratering charges were put in place and detonated. The explosion rocked the mountainside and flung the trail skyward, including trees, gravel, dirt, and large rocks. Debris rained down on the HMMWV with loud bangs. This time, when the team returned to the site, it smelled like tilled earth.

A soldier primes a 40-pound shaped charge with a blasting cap crimped to detonating cord.

The "tank ditch" was such a success that the Task Force 9th Engineer Battalion worried that if smugglers came at night, they would be injured if they fell into the ditch. So the final touches to the 18-wheeler-size gouge across the trail were strands of concertina wire that led off the trail and down the steep slopes on both sides of the barrier.

Specialist Rodriguez is a journalist/photojournalist with the 302d Mobile Public Affairs Detachment, Camp Monteith, Kosovo.

Book Review



Ghosts of the ETO, American Tactical Deception Units in the European Theatre of Operations, 1944-1945, by Jonathon Gawne. Published by CASEMAT (Havertown, Pennsylvania) 2002, 342 pages, more than 100 photos. The ISBN is 0-9711709-5-9 for a hardback ($34.95).

For more than 50 years, a veil of secrecy lay over the role of tactical deception employed by the U.S. Army in the European Theatre of Operations (ETO) in World War II. This veil was lifted during 1996, when information was declassified regarding these deception operations and the Army organization that—for the first time in the history of warfare—was created to execute tactical deception operations as its full-time mission.

In an important new book, *Ghosts of the ETO*, author Jonathon Gawne chronicles the formation and activities of the U.S. Army's 23d Special Troops and credits its wartime deception operations with saving American lives and contributing to the Allied victory. In revealing the 23d's World War II activities, Gawne analyzes the role and importance of tactical deception and—in light of the Army's "deactivation" of a formalized deception capability following World War II—points to the need for the Army to revive tactical deception as a necessary tool for waging war.

Gawne identifies the two features that made the 23d a unique organization: One, it was the first organization in the history of warfare that was organized and dedicated to conducting tactical deception on a continuing basis. In the past, the great commanders—including Napoleon, Caesar, Hannibal and Lee—conducted deception operations on an *ad hoc* basis. They employed all or a portion of their troops in a deception operation, and when this operation was completed, the troops returned to their normal fighting roles. For the 23d, tactical deception was its sole mission. The organization was, in effect, a military traveling road show. It would perform its deception act in one location, and when the operation was completed, it would move on to another location and perform a similar or different act. At times, its units performed simultaneously in different locations.

Two, the organization raised tactical deception to a highly sophisticated, full-spectrum level. It was able to reproduce the "sights and sounds" of the various units and headquarters of a field army.

Gawne has written a fascinating, thoroughly researched, well-documented, and very readable account of this unique organization, covering the "what, where, when, how, and why." He describes its genesis and its activation as well as its "growing pains." He also describes, analyzes, and evaluates each of the 21 major deception operations, culminating with the 1945 crossing of the Rhine River. For each operation, he gives the "big picture" as well as a "nuts-and-bolts" account of what happened. Each deception plan has a battle sketch to facilitate easy understanding of the concept of operation. And an understanding of the tools of deception is enhanced by the inclusion of many photographs.

This new concept of tactical deception originated in the ETO as a result of a study initiated by General Devers, then the commanding general, which analyzed Field Marshal Montgomery's use of deception at the battle of El Alemein. General Devers submitted a request to the War Department for a unit to be authorized, organized, and dedicated to tactical deception, with the capability of simulating two infantry divisions and one armor division for the crossing of the Rhine River. This request was approved, giving birth to the 23d Special Troops.

The 23d consisted of a headquarters, a headquarters company, and four line units—two of which were engineer units:

- An engineer camouflage battalion to provide inflatable dummy tanks, trucks, artillery pieces, and other types of vehicles and equipment as well as to operate flash devices replicating the flash of artillery firing.
- An engineer combat company to provide perimeter security against enemy forces as well as local security against enemy agents and the local populace; conduct mine clearing; execute construction and demolition tasks, including digging tank and artillery positions; and simulate tank tracks by using bulldozers.
- A signal company to transmit false radio messages.
- A sonic company equipped with half-tracks and loudspeakers to reproduce sounds such as tanks on the move, assault boats in action, and bridging operations.

The 23d was activated at Camp Forrest, Tennessee, on 20 January 1944, with an eventual strength of 82 officers and 1,023 enlisted men. In the beginning, there was no guidance, no doctrine, no manuals, and no SOPs. Throughout most of the life of the organization, it was a matter of learning by trial and error—a large part of which occurred on the battlefield.

The organization's first mission was a small operation called Troutfly. A lieutenant and 13 radiomen landed in Normandy on D+3. The original plan was aborted, and the detachment became the 82d Airborne Division's main means of radio communications. The division had lost almost 95 percent of its radio equipment on D-Day.

The 23d participated in 21 major deception operations and several smaller ones that extended from Normandy to Brittany and Brest, through the rest of northern France, Holland, Belgium, Luxembourg, and Germany to the Rhine River and involved most of the divisions, corps, and armies.

By the time of the Rhine crossing, the 23d Special Troops was a seasoned organization, having learned its lessons well. And senior headquarters had gained an appreciation for deception and how to properly utilize the capabilities of the unit.

Some important lessons learned along the way include the following:

- There was a lack of knowledge of deception and appreciation for its value on the part of many commanders. Some showed little interest in employing deception, others used deception only half-heartedly, while others misused it.
- Close and continuous coordination of the deception operation with other aspects of the tactical plan was vital to success. In an attack at Brest, the maneuver plan was changed at the eleventh hour to have the main attack pass through the area where a deception buildup of forces had been portrayed. With the Germans in waiting, unnecessary casualties were sustained and tanks destroyed.
- The use of "special effects" was not considered during training in the United States. However, once the organization initiated operations, special effects became an important means of

completing the deception picture. Special effects involved the identifying features of the simulated units, such as shoulder patches, bumper markings, and command post signs. While the 23d units wore and displayed these identifying features, the simulated units were required to black out and remove their own identifying features. Special effects assumed progressively greater importance as the German aerial observation capabilities decreased, and the enemy placed increased reliance on ground observation for intelligence information.

- Tight local security was needed to prevent enemy agents and the local populace from observing certain aspects of a deception operation, especially the dummy equipment.
- It was not only necessary to deceive the enemy and the local populace but also to deceive *our own* troops to maintain secrecy of the deception operations. Enter another phase of playacting; scripts outlining the simulated unit's organization, recent activities, and current officers were given to the soldiers. Ad libbing was often required to satisfy incredulous officers and enlisted men as well as to carry on conversations with the local populace.
- Probably the most important lesson learned was the necessity for strict discipline and attention to detail during the planning and execution phases of a deception operation. Failure to do so could easily compromise an operation. Enemy intelligence was continuously on the lookout for operational irregularities and mistakes.

The crossing of the Rhine—known as Operation Viersen—was a classic deception operation, executed the way deception should be executed. The staff member of the 23d who masterminded the deception operation portion of the tactical plan was stationed in the Ninth Army G3 section to work closely with all elements of the Army staff and to monitor the execution of the deception operation. Consequently, the operation carried the full authority of General Simpson, the Army commander, resulting in the development and execution of detailed plans at all subordinate levels. In this operation, the 23d simulated—with all of its sights and sounds—the 30th and 79th Divisions. These simulated divisions were deployed in the center of the army sector with the mission of feigning the main attack on 1 April. To fill out the deception picture, as happened in some of its previous deception operations, the 23d was augmented with real units—in this case there were infantry, engineer, antiaircraft artillery, field artillery, and tank units. When the two real divisions attacked to the north, crossing the Rhine in the vicinity of Wesel on 26 March, they suffered only 31 casualties. This extremely low casualty figure was considered a remarkable achievement in view of the fact that the Rhine was a major barrier defended by a determined enemy and constituted the last barrier to entry into the heartland of Germany. In a letter of commendation to the 23d, General Simpson recognized its considerable contribution.

While the 23d participated in a few deception operations that were aborted, some that were of uncertain success, and others that were quite successful, the overall performance of the organization in these operations was judged as excellent. A measure of the real contribution of the 23d to the winning of the war was not in the number of Germans killed but rather in the many thousands of American lives that were spared.

In summary, *Ghosts of the ETO* is an excellent, balanced history of the 23d Special Troops. Gawne tells the story like it was—warts and all. I say this because I was there as commander of the 406th Engineer Combat Company.

Besides telling the story of the 23d, the book is important for another reason. To date, no book written about the war in the ETO has included the participation and impact of the 23d's effort on the outcome of the tactical plans of divisions, corps, or armies. This is understandable since the activities of the 23d were only recently declassified. In the future, such books should include a discussion of the organization's participation and an evaluation of its contribution to the outcome of the tactical plans in order to provide a complete story of what occurred. For the same reason, sections of many books already written about the battles in the ETO should be rewritten. This book is an excellent starting point for researching this new dimension in many of the ETO battles. In addition, many of the Army's field manuals need to be rewritten to incorporate the deception doctrine and techniques developed by the 23d, but they should be updated for the 21st century.

Gawne also addresses, in a limited way, the future of deception. He suggests that—building on the 23d's World War II experiences—new equipment, doctrine, etc., need to be developed that incorporate the latest technology. I venture to add the following comments:

With this "Everything-You-Ever-Wanted-to-Know-About-Tactical-Deception" book now on the market, it is fair to assume that at least all of the major foreign armies, intelligence agencies, and military schools will buy the book to learn about the sophisticated use of deception as developed by the Army in the ETO during World War II. With this background, foreign armies may do at least three things:

- Direct their intelligence agencies to ensure that they have the capability of gathering information on the full spectrum of the sights and sounds of the U.S. Army.
- Develop their own tactical deception units to operate on a continuing basis.
- Emphasize the teaching of deception in their service schools so that officers and noncommissioned officers at all levels are knowledgeable in the art.

What must the U.S. Army do? It must build on the solid foundation of the battlefield knowledge the 23d Special Troops gained in World War II and move forward by taking advantage of the latest technology and military thinking. To do this, the Army should establish a full-time organization to continuously study tactical deception with the goal of developing doctrine, materiel, etc., appropriate for future warfare. This organization should be charged with—

- Developing criteria, requirements, and funding for research and development of new, advanced tactical deception equipment.
- Developing doctrine, procedures, techniques, tables of organization and equipment, SOPs, etc., appropriate for the employment of a self-contained tactical deception unit.
- Ensuring that our intelligence agencies are devoting sufficient resources toward determining the enemy's means of intelligence gathering so that ways can be developed to neutralize, counter, or turn these means to our advantage.
- Ensuring that tactical deception is emphasized in its various aspects in the curricula of all of our service schools. Gawne's book should be a part of the course material.

The end product of these activities is a self-contained organization that is dedicated to tactical deception operations on a continuing basis and is operational at the outbreak of hostilities.

The U.S. Army Training and Doctrine Command should incorporate tactical deception in future organizations and training, to include all service schools.

Based on the above discussion, there is reason to believe that *Ghosts of the ETO* may be one of the most important books to come out of World War II. It should be read by all officers from the highest to lowest rank and by all noncommissioned officers.

Reviewed by Major General George A. Rebh (Retired). In addition to commanding the 406th Engineer Combat Company, ETO, he served in various units, U.S. Army Corps of Engineer Districts, and Chief of Engineers positions during his 32-year military career. He is a graduate of the U.S. Military Academy and was a Rhodes scholar.

Live Fire . . . Heavy

By Captain Alexander J. Buehler

Thunderbase, this is Metal 36. Adjust fire, over . . . BMP in the open . . . Dustoff 6, this is Metal 36 . . . I have three casualties, two ambulatory and one KIA. Similar radio transmissions echoed over the Wolverine network for ten intense days during the 94th Engineer Battalion (Combat) (Heavy) live-fire exercise—called Protective Wolverine—at Grafenwoehr training area in Germany.

The concept of such an exercise was foreign to the construction engineers of the 94th, which is assigned to the 130th Engineer Brigade. Even the most seasoned Wolverine soldiers, having spent more than five years in the organization, could not recall an event that was remotely similar. The genesis occurred more than ten months before, when the operations officer pitched a concept at the annual training strategy seminar. His suspicion, which included a perceived shortcoming in basic combat skills and a lack of confidence in weapons employment, was confirmed by the reaction of the officers and senior noncommissioned officers in the audience. The support for the live-fire concept was overwhelming, and Exercise Protective Wolverine steadily progressed from a concept sketch to a deliberate plan.

The Intent

The battalion commander's intent for the exercise was clear: prepare the leaders and soldiers of the battalion to respond to enemy contact, employ organic and nonorganic weapons systems, and survive and carry on with the construction mission. The overarching objective was to preserve and prolong the battalion's ability to construct in potentially hostile situations.

An additional aim was to define a model for leaders in the battalion to plan, resource, and execute large-scale training exercises according to the deliberate eight-step training process (see article " Cobra Gold '99 Tests the Eight-Step Training Model," *Engineer*, April 2000). The commander also quantified success for this exercise. Leaders would become more comfortable with making command decisions in a highly stressful environment. Furthermore, they would cultivate an appreciation for the fog of battle and understand its impact on deliberate planning. Most importantly, however, individuals would walk away from the exercise as better soldiers—more confident in basic tactics, more adept at integrating and synchronizing weapons systems, and more competent as construction engineers and warfighters. Finally, the commander specified one standard for implementation: safe execution with deliberate risk management.

The Plan

The S3 launched the military decision-making process, while the executive officer (XO) set the wheels in motion to stand up a responsive support network for the exercise. The plan was exhaustive with many considerations. The S3 synchronized a complex and expansive execution matrix, published all pertinent orders, specified evaluation criteria in painstaking detail, resourced and scripted the scenarios, mastered the muddled bureaucracy of range control, coordinated for all external resources, and developed a thorough plan to ensure preparedness for the exercise.

Such planning seems somewhat routine in the absence of external constraints; however, it was the indelible presence of these constraints, which were abundant and ever changing, that brought challenge to the planning and pliability to the execution. Limitations included no heavy fire on German holidays or after 0200 hours and narrow windows of opportunity for air medical evacuation (MEDEVAC) and C-130 overflights. Adaptation would be paramount.

In addition to planning the training, the S3 devised a notional operations order with a uniquely realistic enemy situation. All elements of the exercise were crafted to fit neatly into the big picture. The scenario was a coalition army fighting westward, leaving bypassed units and special-purpose forces in the battalion sector. Generally operating in 12-man teams, the forces would seek to impede construction operations, harass Wolverine soldiers, and disrupt logistical supply centers.

Concurrent with the diligent preparations of the S3, the XO harnessed the staff energy to cement a support cell. The burden of support was deliberately withheld from the unit level. All commanders would focus purely on combat training and safe execution. The "beans and bullets" would be left up to the battalion. This included a feeding plan with two separate mess operations along with Class I logistics trains, which allowed feeding downrange to reduce time in transit.

Additionally, the XO—along with the S4—planned the largest ammunition receipt, storage, and distribution plan in battalion history. Notwithstanding a major Class I and Class V push, the XO considered all details—no matter how trivial—and integrated them into the overall support network. The companies would not need to consider sustainment of their soldiers.

The platoon synchronized direct and indirect fire to suppress the enemy and then removed casualties via air MEDEVAC.

The Method

Exercise Protective Wolverine was not only a live-fire exercise, but it was also a platoon-level external evaluation. First, companies deployed from home station, conducted a convoy, and occupied a tactical assembly area, all of which were critically observed by observer-controller-evaluators (OCEs). Next, platoons cycled through a casualty evaluation, treatment, and evacuation (CETE) lane, training with battalion medics and air MEDEVAC personnel to perfect these skills before game day.

After successful validation of the CETE training, platoons proceeded through a fire-maneuver (F-M) lane, which focused on movement under direct fire, weapons discipline, and the initiation and control of fire. After a two-day hiatus for internal training, the platoon began the first of two capstone exercises, the convoy ambush lane. Conducting a tactical convoy en route to a construction site, the platoon was confronted with an enemy ambush. A complex blocking obstacle (a wire/mine configuration), a BMP in the open, and enemy soldiers to the front combined to intensify the complexity of the scenario and place an uncomfortable level of stress on the platoon leadership.

Platoons integrated and massed fire, called for 120-millimeter-mortar indirect fire, and ultimately removed casualties via air MEDEVAC. The "crawl-walk-run" training strategy was necessary to facilitate safe execution on the lane. After a crawl led by the OCEs, the platoon validated a daytime blank iteration—or walk phase—before the run phase, which added live ammunition to the training.

The platoon carries on with the construction mission.

Subsequently, platoons validated a nighttime blank iteration before the night run phase. The minimum number of iterations for this lane was five, assuming that platoons validated both blank iterations on the first try.

After the convoy ambush lane, the platoon progressed to the culminating event—the jobsite security lane. During this lane, the platoon conducted a tactical convoy to the jobsite, occupied the area, established jobsite security, initiated construction operations, and—upon enemy contact—suppressed and reduced the threat. Similar to the convoy ambush lane, the platoon synchronized direct and indirect fire to suppress the enemy and then removed casualties via air MEDEVAC. Likewise, OCEs implemented an identical crawl-walk-run methodology. Unlike the convoy ambush lane, the platoon installed, tested, and fired claymore mines as part of the validation. Finally, after successful completion of four lanes—CETE, F-M, convoy ambush, and jobsite security—companies regrouped, consolidated, and redeployed to their home station.

Exercise Protective Wolverine provided training for platoons, but the aforementioned summary does little to capture the training that occurred behind the scenes. Companies conducted extensive training before the exercise, and all officers attended a call-for-fire class at the Combined Arms Training Center at their home station in Vilseck, Germany. Additionally, all OCEs underwent an incremental train-up session and became validated on their lanes before their first iteration.

OCE teams were composed of six personnel from various backgrounds to maximize the collective experience and overall effectiveness of the team, and they adhered to a day-on, day-off schedule to maintain focus. As any veteran officer in charge (OIC) can attest, running a range on the Grafenwoehr training area is no simple undertaking. Throughout the 15-day Protective Wolverine exercise, the 94th Engineer Battalion occupied Range 117, managed an ammunition holding area on-site, survived numerous "courtesy" inspections from range control, and turned over the range and facilities without a hitch. Two officers worked alternating 24-hour shifts, manning the Range 117 tower. Several FM radios, two main frequencies, two Motorola frequencies, and two fixed lines combined to create a unique command and control challenge, but the tower OICs met the challenge head-on. Range control expressed ongoing approval for the exercise at large.

The numbers speak volumes regarding the intensity and complexity of the exercise. Ammunition expenditures included ninety thousand 5.56-millimeter rounds; ninety 81-millimeter illumination rounds; one hundred forty-four 120-millimeter high-explosive rounds; thirty M18A1 claymore mines; and an abundance of simulators, smoke grenades, and pyrotechnics. Black Hawk pilots logged more than fifty MEDEVAC flights in support of the operation. The live fire was . . . heavy.

The Aftermath

As platoons and companies redeployed, Range 117 was cleared and turned over. One resounding afterthought remained: the exercise was excellent, and the commander's intent was met. A value-added aspect of the exercise, which exceeded the commander's intent, involved the intangible team building that underlined the training. As leaders and soldiers prepare for upcoming construction missions in Africa, Poland, and Germany, they go forth with more confidence and proficiency, knowing full well that—in the event of hostile aggression—they are better prepared to survive the threat and carry on with their construction missions. And as for the organization, the 94th Engineer Battalion proved that combat heavy engineers can safely and effectively conduct a live-fire exercise and . . . the fire tends to be heavy.

Captain Buehler was the S4 of the 94th Engineer Battalion (Combat) (Heavy), 10th Engineer Brigade, Vilseck, Germany, when this article was written. He has since left the Army and is attending the Wharton School of Business at the University of Pennsylvania. His previous assignments include civil engineer for the 94th Engineer Battalion, where he deployed to Kosovo and Albania, and platoon leader, Task Force Able Sentry, Skopje, Macedonia. He is a graduate of the U.S. Military Academy, the Engineer Officer Basic Course, and airborne and air assault schools.

Washington—Engineer and Engineer Advocate

By Major John Richard Boulé II

George Washington was a great early American engineer. Hundreds of books have been written about his accomplishments as a Virginia planter, a military commander, a noble statesmen, and a symbol for the new American nation. Although Washington's surveying achievements are fairly well publicized, almost nothing has been written about Washington the engineer and engineer advocate. In this article, I will show that the father of our country was an accomplished engineer who served as a strong proponent for establishing American engineering institutions.

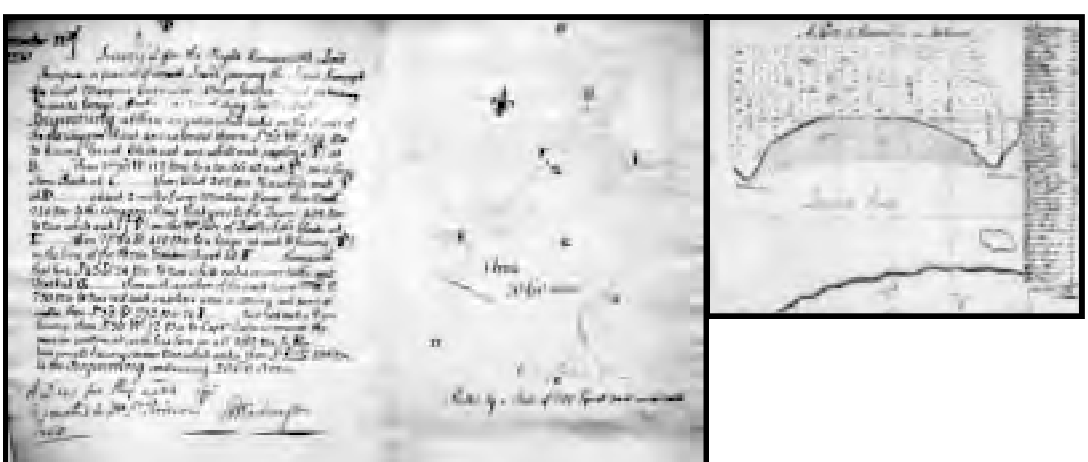
George Washington did not have a formal education. However, from the time he was a young man, he engaged in engineering activities. As he continued to mature, the same skills that made him a good surveyor, builder, and innovator were applied to other pursuits. These talents and experiences formed the solid foundation upon which Washington built his more notable achievements, much the way that Lee and MacArthur applied their engineering backgrounds to become two of the greatest American practitioners of operational art. As you will see, it is time to add Washington to the long list of great American engineers.

Defining Engineers

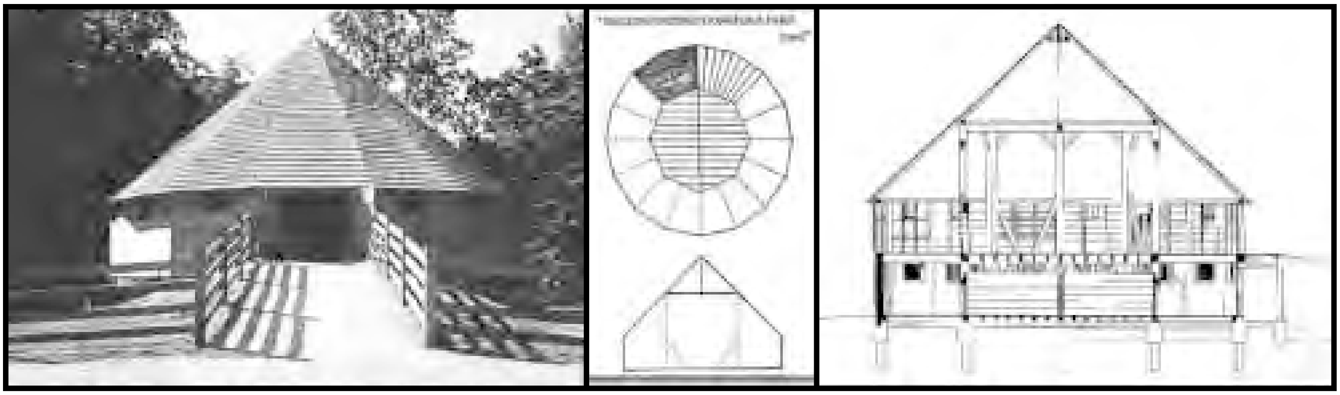
Engineers have been labeled as professionals who apply math and science to create something of value[1]—a rather mundane definition. Theodore Von Karman, an aerospace engineer, put it differently. "Scientists discover the world that exists; *engineers create the world that never was.*"[2] This definition fits Washington. In many ways, he was indispensable in creating a world that had not existed in his time. He did this on a grand scale in his efforts as commander of the Continental Army and first President of the United States. He also did it on a smaller scale in Virginia as a surveyor, planter, businessman, and gentleman. Washington created through natural talent, devotion, resoluteness, and hard work.

Engineers throughout history have used this formula for success. Rudyard Kipling recognized these traits when he wrote *Sons of Martha*, his ode to engineers. His ode defends Martha's comment to Jesus about her sister Mary (Luke 10:42). In Kipling's poem, now adopted as the poem for engineers, he writes:

"The Sons of Mary seldom bother, for they have inherited the good part; But the Sons of Martha favour their Mother of the careful soul and the troubled heart…They say to the mountains, 'Be ye removed.' They say to the floods, 'Be dry.' Under their rods are the rocks reproved—they are not afraid of that which is high. Then do the hilltops shake to the summit–then is the bed of the deep laid bare, That the Sons of Mary may overcome it, pleasantly sleeping and unaware."[3]



A survey, commissioned by Lord Fairfax, and a map of Alexandria, Virginia, were done by George Washington.



Washington's grain-threshing structure was rebuilt at Mount Vernon. He created these plans while President of the United States.

Washington was definitely a Son of Martha. He fearlessly persevered through many daunting challenges until he prevailed. Virginians, and later all Americans, benefited from his efforts.

Engineering in Washington's Time

Washington lived most of his life before the advent of the Industrial Revolution. Engineering, as we classify it today, did not exist in his day. Although colleges like Harvard and Columbia (then called King's College) operated in the colonies, America did not have a school where formal engineering skills were taught. In Europe, engineering instruction often focused on fortifications and siege craft. Even the Great Wall of China, finished in 1640, was barely 100 years old when Washington was born!

It is safe to say that American engineering was in its infancy during Washington's time. The first engineered structure in America, the Castillo de San Marcos, was designed and constructed in Florida in 1695, only 37 years before Washington's birth.[4] Some of the most famous engineering projects completed during Washington's time were the first municipal pumped waterworks in Bethlehem, Pennsylvania, in 1755, and the survey of the Mason-Dixon line, officially designating the Pennsylvania-Virginia boundary, in 1767. Engineers were not even legally recognized as experts in America until 1782, one year before the Revolutionary War concluded.[5] Therefore, we cannot expect Washington to be involved in *major* engineering projects; they simply did not exist. Likewise, we cannot consider him an engineer unless he demonstrated some engineering credentials.

Washington, Engineering Qualifications

As a young man, Washington learned to survey. He had a natural talent for mathematics. At the age of 16, he apprenticed with several accomplished surveyors on a month-long trip to the Blue Ridge Mountains to survey Lord Fairfax's lands.[6] He mastered the trade quickly, earning an appointment as county surveyor of Culpeper County, Virginia, at the age of 17.

Washington later used his knowledge of topography and mapmaking to produce drawings of the Ohio River Valley in 1753, while on a dangerous mission to deliver a message to the French demanding their withdrawal from the region. These sketches represented the state of geographical knowledge of the area at the outbreak of the French and Indian War that occurred shortly after his trip.[7]

Even though he was heavily burdened as a Virginia planter, businessman, and legislator; commander of the Continental Army for eight years; and President of the United States for eight years, he is credited with conducting an extensive number of surveys. During his lifetime, Washington surveyed more than 200 tracts of land consisting of 60,000-plus acres. He is credited with drawing more than 100 maps,[8] including a map of the city of Alexandria. He was involved with L'Enfant in planning the technical layout for the future capital city that would bear his name.

Washington, Innovator and Builder

In the true spirit of engineering, George Washington demonstrated his ability to create things to solve problems. Many of his innovations were designed to expand his business and to make farming more efficient and his residence more comfortable and stately. He engineered farm tools and wheat-processing facilities and designed and expanded his country estate. He was also involved in a land reclamation and canal project in the Dismal Swamp of southeastern Virginia and northeastern North Carolina.

Plow Invention

Washington's engineering achievements were numerous and varied in scale. By 1770, he had designed a new plow,[9] which was actually a combination plow and seeder. Seeds were placed in a perforated cylinder, and as the plow was moved, the cylinder rotated releasing the seeds. After experiencing some clogging, Washington redesigned the cylinder incorporating funnel-shaped holes that made it less likely for the seeds to jam.[10] He had demonstrated the tried and true engineer technique of trial and error to solve a practical problem.

Mount Vernon was largely designed and built by Washington without the assistance of an architect.

Mount Vernon Expansion

Washington greatly expanded the simple Mount Vernon farmhouse he inherited. Beginning in 1758, he turned the 1 1/2-story structure with several rooms into a 2 1/2-story, twenty-room mansion without the aid of an architect.[11] He also designed and built all twelve outbuildings placed around the central structure. Attempting to turn his property into an estate worthy of a country gentleman, Washington added a stunning two-story piazza overlooking the Potomac River and an elegant cupola on the top of his estate house.[12] With Mount Vernon, Washington demonstrated a flare for architecture.

Agricultural Facility

One of Washington's most innovative creations was his two-floor, sixteen-sided (or circular) barn. After experiencing mixed results from growing tobacco, he converted many of his fields to wheat. To separate the grain from the stalk, treading animals were commonly used. Washington wanted to create a facility that would keep the working animals out of the weather and protect his grain from theft.

In 1792, construction of his 52-foot-diameter barn began. (Remember, Washington was President at the time!) He had drawn diagrams of the structure and had done many computations to determine the bill of materials. His design specified a brick first floor and a wooden second floor. Washington's own calculations called for 30,280 bricks.[13] In the center of the barn was an octagonal room designed to store the separated grain. Horses would walk up an earthen ramp to the second floor and then tread on the harvested wheat while walking in a circle. Washington designed a space of 1 to 1 1/2 inches between floorboards to allow the separated grain to fall to the first floor. The grain was then placed in the octagonal room until it could be transported to his gristmill. The circular barn can be thought of as Washington's own threshing machine. This creation represented true originality in agricultural production.

Land Reclamation and Canal Construction

Washington spent his years between the French and Indian and Revolutionary Wars improving his estate and expanding his land holdings. In 1763, he visited the Great Dismal Swamp on the eastern border of Virginia and North Carolina, separating the Chesapeake Bay and Albemarle Sound.[14] Here he saw opportunities. Once again demonstrating his engineering vision, he suggested draining the swamp and digging a north-south waterway to connect the Chespeake and Albemarle.[15] Joining with other southern colonial businessmen, he formed two syndicates hoping to drain the swamp, harvest the trees, and use the land for farming. Washington directed the surveying and construction of a 5-mile-long ditch. By adding another trench, Washington's ditch provided a means to move logs and drain the swamp. The investors soon realized, however, that the task of draining the Great Dismal Swamp to reclaim the land was too difficult.

However, the idea of connecting the Chesapeake and the Albemarle by an inland waterway had other merit to Washington. In 1793, he and Virginia Governor Patrick Henry helped form the Dismal Swamp Canal Company to build a canal for flat-bottomed boats. The Great Dismal Swamp Canal—the oldest continually operating man-made canal in the United States—was completed by hand in 1805, six years after Washington's death.[16] In 1987, this canal was designated as a national civil engineering landmark. Today the canal is operated by the U.S. Army Corps of Engineers and provides a means for boaters to traverse between the two states, avoiding ocean exposure.

Other Contributions

The canal, estate, barn, and plow represented manifestations of Washington's engineering ability. His construction ability was initially displayed in building Fort Necessity, a stockade that he fought behind in 1754 during a losing battle with the French. In 1785, Washington became president of the Potomac Navigation Company. The company's goal was to connect a more navigable Potomac River with the Ohio River system using a portage road. Another engineer completed the road, later named the National Road.[17]

When combined with his cartographic portfolio, and considering the context of his time, there can be little doubt that Washington should be classified as an accomplished engineer. Yet, his greatest contribution to American engineering was his advocacy of developing native engineering institutions.

Washington, Master Advocate for Future Master Builders

The 19th century was a glorious time for engineering development in the United States. Engineers were often referred to as *master builders*, and chief engineers had absolute authority over all the operational, technical, logistical, financial, and administrative functions of major projects. Military engineers led many of America's largest engineering projects. These American engineers could trace their origins to 18th century George Washington.

As early as 1755, when Washington served as aide to General Braddock—English commander during the early part of the French and Indian War—he experienced the need for military engineers or pioneers firsthand. As Braddock's forces advanced from Virginia to attack Fort Duquesne (located at what is now Pittsburgh), they built a road to move the supply wagons and cannons. In front of the combined British and Virginian forces, pioneers cut a road west over the Allegheny Mountains.[18] Watching these early combat engineers, Washington must have filed away the lesson of the importance of infrastructure and the need to have the forces available to create it for military purposes.

Creating an American Corps of Engineers

Washington's later studies reinforced the importance of military engineers and sappers fulfilling important military functions, such as building field fortifications and conducting siege craft. This attitude was evident considering that after being named commander of the Continental Army on 15 June 1775, it took him *only a day* to appoint a Chief of Engineers. Colonel Richard Gridley of Massachusetts was named to that position, as he was one of the few colonials with experience in constructing fortifications.[19] Gridley's appointment was soon validated as his defensive plan provided protection for the militia in the staunch colonial effort at the Battle of Bunker Hill.

In early 1776, at Dorchester Heights, Gridley's successor, Rufus Putnam—in consultation with Washington—devised an ingenious method to erect aboveground fortifications, because of frozen earth conditions. These fortifications allowed the Continental Army to quickly emplace cannons, giving them command over the city of Boston. This positional advantage forced the British to abandon the city.

As Washington realized that the nature of the Revolutionary War would generally be defensive, he pleaded with Congress for more engineers.[20] Congress responded by recruiting foreign engineers like Frenchman Louis Duportail, who worked with Washington to establish a permanent and separate branch of sappers and miners, and Thaddeus Kosciuszko, who helped erect the formidable defenses at West Point. Washington later moved his headquarters there, as Continental soldiers continued to strengthen the Hudson River strongpoint. In 1778, Congress authorized three companies of engineers. The fledgling American Corps of Engineers enjoyed its finest hour at Yorktown in 1781 when Washington and his engineers conducted a successful siege that culminated by engineers clearing the way for the decisive assault that led to the British surrender.[21]

Advocating an American Engineering Institution

Washington's wartime experience convinced him that the new nation needed its own engineering educational institution. The long war had exposed America's dependence on European nations to provide military technical experts. On 1 May 1783, Washington wrote to Alexander Hamilton recommending the establishment of "academies, one or more for the instruction of the art military; particularly those branches of it which respect engineering and artillery, which are highly essential, and the knowledge of which is most difficult to obtain."[22]

A statue of George Washington at West Point, the first engineering school in the United States

Congress disestablished the Continental Army after the war because of strong political views against a standing military. Washington, however, continued to advocate the need for an institution dedicated to engineering instruction in the United States. In an address to Congress in 1796, making his case, he stated,

"Whatever argument may be drawn from the particular examples, superficially viewed, a thorough examination of the subject will evince that the Art of War is at once comprehensive and complicated; that it demands much previous study; and that the possession of it, in its most improved and perfect state, is always of great moment to the security of a nation. This, therefore, ought to be a serious care of every government: and for this purpose, an Academy, where a regular course of instruction is given, is an obvious expedient, which different nations have successfully employed."[23]

Washington did not live to see his academy established. He died in December 1799. In 1802, Thomas Jefferson signed legislation authorizing the establishment of a United States Military Academy. To overcome resistance to creating a purely military school, the federal law that established West Point called for an institution that produced trained officers who also possessed badly needed engineering skills for the nation.[24] West Point was the only engineering school of higher learning in the United States for fifty years. During that time, its graduates were largely responsible for the nation's initial railway lines, bridges, harbors, and roads.[25] If he had lived to see his vision materialize, George Washington would certainly have been content.

Conclusion

Washington's strong institutional support strengthens his impressive personal engineering achievements. This "Son of Martha" proved himself as an impressive practitioner and leader. Lacking formal instruction, Washington was a quick study who learned by doing. He was not afraid to apply his technical talents to solving practical farming, construction, infrastructure, or military engineering problems. Washington recognized the need for engineers in the United States Army and throughout American society. His early engineer advocacy, combined with his impressive personal portfolio, makes him one of America's great early engineers.

Author's Note: I would like to thank Professor William Calhoun of the Naval War College for his assistance in discovering the real George Washington. Attending his class on George Washington motivated me to write this article.

Endnotes

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[24]Jeffrey Simpson, *Officers and Gentlemen,* Tarrytown, Sleepy Hollow Press, 1982, p. 6.

[25]"U.S. Military Academy History," *United States Military Academy, http://www.usma.edu/PublicAffairs/history/,* 13 April 2001.

Major Boulé is a member of the Army Staff. Previous assignments include executive officer of the 2d Engineer Battalion in Korea and assistant professor in the Department of Civil and Mechanical Engineering at West Point. He has had numerous other combat engineer assignments in the 1st Armored Division, 10th Mountain Division, and 20th Engineer Brigade.

ENGINEER UPDATE

Commercial numbers are (573) 563-xxxx and Defense System Network (DSN) numbers are 676-xxxx unless otherwise noted.

Directorate of Training (DOT)

Officer Education System (OES) Transformation. The Army is moving forward with its plans for transformation of the OES. The proposed transformation is based on findings and recommendations from the Army Training and Leader Development Panel officer study published in May 2001. The transformed education system will include the following:

- *Basic Officer Leader Course (BOLC).* This course will ensure a tough, standardized, small-unit leadership experience that flows progressively from precommissioning (BOLC I) to the initial-entry field leadership experience (BOLC II), and then to branch technical/tactical training in BOLC III. BOLC III will be held in residence at the U.S. Army Engineer School, Fort Leonard Wood, Missouri. Plans are for the BOLC to be fully implemented in the 3d quarter, FY06.
- *Combined-Arms Staff Course (CASC)* and *Combined-Arms Battle Command Course (CABCC).* CASC is designed to train staff officer skills. The Engineer School has developed a modular concept for CASC that is built around six engineer staff/technical courses: assistant brigade engineer, assistant division/corps engineer, task force engineer, geospatial manager, construction engineer, and U.S. Army Corps of Engineers engineer. All six courses will include advanced distributive learning (ADL) and new high-impact resident training experiences. These courses will provide assignment-oriented training, just in time for the staff duty position. The construct of this design allows engineer officers to receive training before assuming a staff/technical position anywhere along their career path. The six courses have some foundational knowledge in common. This commonality allows for reduced training time as officers receive the foundational knowledge in the first course attended. Subsequent courses will not repeat this baseline, but will build on it to train the unique skills and knowledge for that course.

  Like CASC, the Engineer School has developed a modular construct to train battle command skills in CABCC. The curriculum in the proposed command course is divided into seven modules: take command, train, administer, maintain, deploy, fight, and lead. Each module will include both distance learning and experiential training activities. The course will culminate with a two-week combat training center (CTC) experience.

  Currently, the Army is considering two courses of action for CASC and CABCC. The first option separates the two training experiences into two distinct courses. CASC would require the student to complete two weeks of common-core ADL, one week of branch-specific ADL, and a two-week residential phase. CABCC would require two weeks of common-core ADL, two weeks of branch-specific ADL, a four-week residential phase, and a two-week CTC experience.

  The second course of action would combine the two experiences into one course. Under this option, the student would complete three weeks of common-core ADL, three weeks of branch-specific ADL, a six-week residential phase, and a two-week CTC experience. Both courses of action will be piloted in FY05. Plans are for the selected option to be fully implemented in FY06.
- *Intermediate Level Education (ILE).* ILE will provide all majors with the same common core of operational instruction and additional tailored education opportunities tied to the officer's specific career field/branch/functional area. Plans are for ILE to be fully implemented by 4th quarter, FY05.

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Contingency Operations (CONOPS) Training. In response to the Combined Arms Center's requirement that proponent schools provide additional training opportunities to students en route to "troop-listed" units, the Department of Instruction is teaching the following subjects to identified engineer noncommissioned officers (NCOs), lieutenants, and captains:

- Mine awareness training—Iraqi-theater specific
- Iraqi intelligence briefing
- Terrain analysis—developing and manipulating data and terrain products for the country
- Combined-Arms Lessons Learned from Desert Storm and other relevant operations

This training is being given to students with assignments to U.S. Army Europe; Fort Benning, Georgia; Fort Campbell, Kentucky; Fort Stewart, Georgia; Fort Riley, Kansas; Fort Carson, Colorado; and Fort Hood, Texas. Initial sessions were held on 25 January and 1 February. This training provides a tremendous opportunity for NCOs, lieutenants, and captains who will serve together in the not-too-distant future to interact with each other here at the Engineer School.

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Countermine/Counter Booby Trap Center (CMCBTC). The Center has developed seven countermine-related training packages: mine awareness training, mine awareness instructor training, engineer-specific countermine training, engineer-specific countermine instructor training, counter booby trap familiarization, Matilda robot training support plan (operator maintenance and employment), and Handheld Standoff Mine-Detection System (HSTAMIDS) training support plan. By the end of February 2003, the Center will have provided training to about 4,500 troops, CONUS and OCONUS. In addition, the Center has completed or initiated the following:

- Developed handbooks to counter the mine and explosive hazards facing our forces in Afghanistan (Explosive Hazards Reference Guide) and Iraq (Commander's Guide and Soldier's Handbook). Handbooks were coauthored by the National Ground Intel Center and Navy Explosive Ordnance Disposal Technical Center. They include common mine and unexploded ordnance (UXO) disposal hazards, plus their doctrinal usage; recognition features; immediate action drills; reporting; countermeasure equipment; and tactics, techniques, and procedures to deal with these threats. The Afghanistan book addressed known land mine hazards. The Iraq handbooks consist of a common soldier handbook and a more detailed commander's reference guide. Both Iraq books include land mines and UXO hazards and are available on the Web site discussed below.
- Is developing the Tactical Minefield Database (TMFDB) in concert with the Topographic Engineering Center and its materiel developer, Northrop-Grumman/TASC. The TMFDB can track and display point, linear, and area obstacles, minefields, and explosive hazards. Built as a subset of the Maneuver Control System (MCS)-Engineer, the application is being designed to interface with the command and control personal computer (C2PC) and MCS-Light, plus input and output minefield databases to multiple formats (for example, United Nations standard Information Management System for Mine Action [IMSMA]). This capability will be exportable and available to designated units via the Secure Internet Protocol Network (SIPRNET).
- Established classified Web sites on the SIPRNET (*http://www.faisa.army.smil.mil/remote/tradocmo/*) and on the Joint Worldwide Intelligence Communications System (JWICS) (*http://www.faisa.ic.gov/remote/tradoc/tradocmo/*). It also has an unclassified Web site (*http://www.wood.army.mil/cmcbtc/*).

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Mine-Detection Dog (MDD) Detachment. The MDD Detachment was approved by the Vice Chief of Staff of the Army and will be established at Fort Leonard Wood in FY04. DA approved $4.8M and will fund in increments, with the first increment expected to arrive by February 2003. An additional skill identifier has been designated (K9), and eight soldiers have been assigned to the MDD Detachment.

POC is Mr. Jim Pettit, 37887; DSN -7887, e-mail *pettitja@wood.army.mil*.

WANTED! Applicants for Terrain Analysis Technician Warrant Officer. Military occupational specialty 81T NCOs with five to twelve years of service may apply. The duty description is in DA Pamphlet 611-21, *Military Occupational Classification and Structure*. Soldiers may obtain information on how to become a warrant officer on the home page of the Warrant Officer Career Center, *http://leav-www.army.mil/wocc/* or U.S. Army Recruiting Command *http://www.usarec.army.mil/hq/warrant/*.

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Proponent Guidance "Promotion Book." The Engineer Personnel Proponency Office (EPPO) prepares proponent guidance for panel members to use to select soldiers for promotion to senior grades (E-7 through E-9). The guidance is posted on the EPPO Web site for NCOs to check where they stand. New guidance is posted on the day the annual board meets. Guidance for the upcoming calendar year 03 Master Sergeant Centralized Selection Board has been completed and is posted on the Web site.

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Center for Engineer Lessons Learned (CELL). The Web site repository of lessons learned is continually being updated. We have added a listing and short synopsis of Operation Enduring Freedom lessons learned. This list will continue to be updated as we receive material. You can obtain this material by viewing the CELL Web site (*http://www.wood.army.mil/CELL/index.htm*), selecting the items you want, and sending an e-mail request or calling the CELL POC below. Most current operations material is for official use only (FOUO) and cannot be placed on a public Web site but can be sent to a *.mil* e-mail address.

We thank units and individuals that have sent digital copies of their lessons learned and after-action reports (AARs) We request that all units forward engineer lessons learned and AARs from exercises and operations to the CELL POC. This material is used to revise/develop doctrine and training and is provided to units preparing to conduct similar missions. Others can benefit from your experiences.

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Field Manual Update. The Doctrine Development Division will release two publications for review in February 2003. The Regiment's capstone manual, FM 3-34, *Engineer Operations*, will be released as a coordinating draft. FM 3-34.221, *Engineer Operations - Stryker Brigade Combat Team*, will be released as a final draft. The development of quality doctrinal manuals requires the incorporation of lessons learned and insights based on the operational experience of the Regiment. As part of your busy schedules, please allocate some time to review these important manuals and provide us your feedback.

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Soldiers from the 60th Engineer Battalion, 35th Division Engineers of the 9th Army, assist German civilians in the town of Sterkrade in filling in a road crater made by one of our shells. 30 March 1945
(Photo courtesy of the U.S. Army Engineer School History Office.)

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