Engineer

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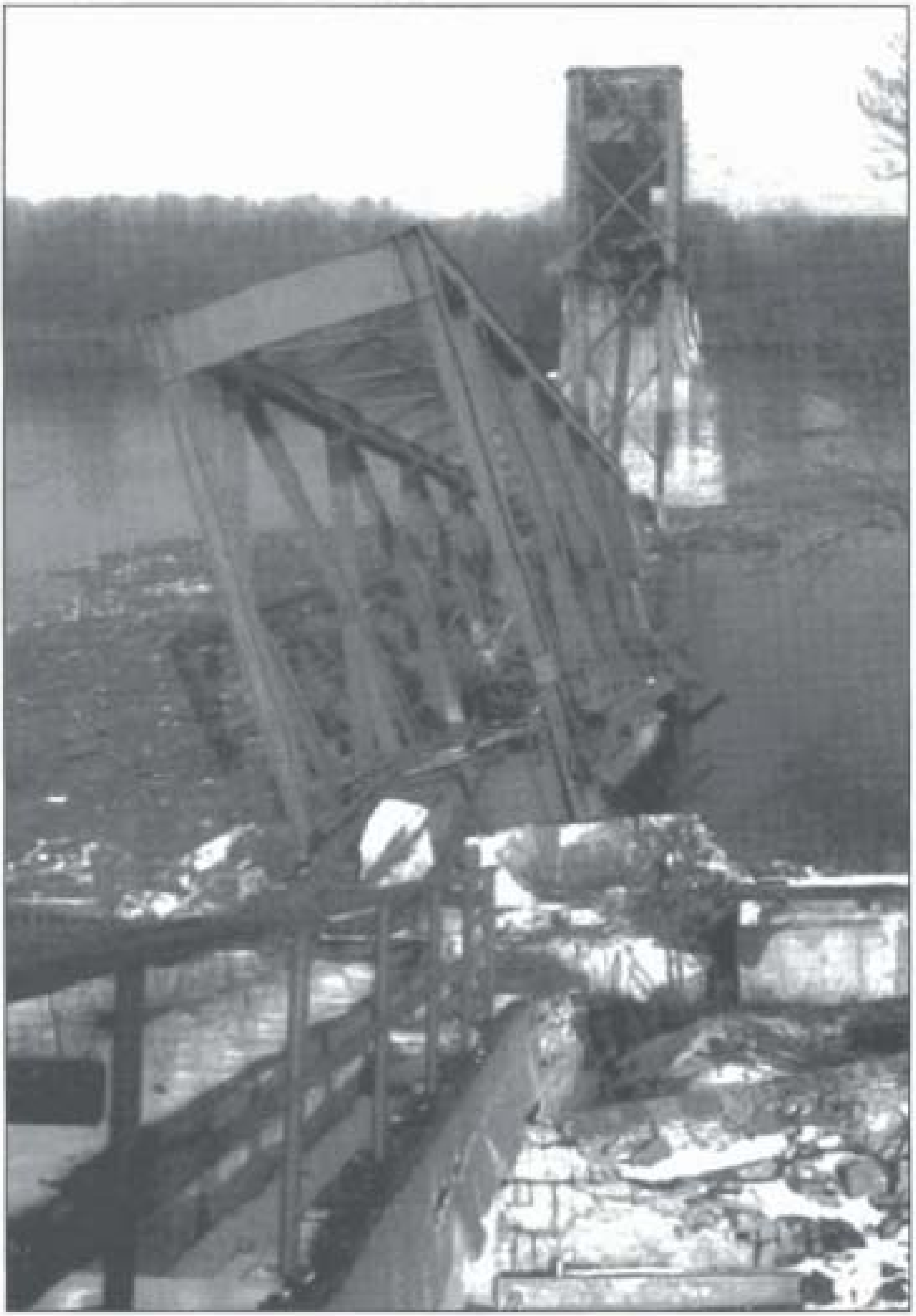

RAIL REPAIR IN BOSNIA

Headquarters, Department of the Army
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CLEAR THE WAY

By Major General Robert B. Flowers
Commandant, U.S. Army Engineer School

ENFORCE was a great success this year, with the Engineer Tattoo being one of the most memorable highlights in an event-filled week. I want to thank everyone for their long hours and hard work and for paying attention to the small details to ensure everything went smoothly. I am proud that Fort Leonard Wood was able again to shine and demonstrate that it is one of the Army's premier installations. (See article, page 13.) A job well done by all.

During his speech at ENFORCE, LTG Ballard announced the new regimental vision encompassing the entire corps and stressed the importance of everyone participating in the process to develop a truly comprehensive vision. I echo our chief's comments and expect everyone to get involved: read the vision, think about it, and provide feedback. The future of our Corps and its mission in service to the nation lie in the balance. So, take the time and become part of the future. The easiest way to do this is from the USAEC home page at www.wood.army.mil. Use the hotlink and go directly to the regimental vision to read and comment about the work to date. The candidate vision statement is:

The Engineer Regiment:

- **The World's premier engineering organization**

Our vision must encompass all members of the regiment (active and reserve, officer and enlisted, DA civilian and contractor, associations and retirees).

- **Full-spectrum engineer force**

We must be capable of meeting future engineering tasks across all conditions of peacetime and wartime.

- **Vital member of Army and Joint Teams**

The regiment is successful only if those we support recognize that we are integral to their mission success.

- **Values-based, respected, responsive, reliable**

In all we do, we must embody Army values and the Essayons spirit.

- **Meeting tomorrow's challenges—relevant to our National Military Strategy**

Throughout our history Army engineers have responded to the changing needs of the nation. We must continue this proud heritage by ensuring our regiment is fully engaged in proactively changing for the future.

Next, I invite you all to a conference this fall that will be just as rewarding as ENFORCE. A mine warfare symposium sponsored by the Association of the United States Army (AUSA) will be held at Southwest Missouri State University [SMSU] in Springfield and at Fort Leonard Wood. The purpose of the conference is twofold: to showcase how the United States is leading the international effort to demine the world; and then, after an introduction to our current mine doctrine, to conduct a live-fire demonstration of two self-destructing [SD] mine systems. Final dates and details will follow.

The first day, at SMSU, will include a series of lectures and displays. Presentations will cover the spectrum of the entire landmine debate, from official policy and training of deminers to treating and rehabilitating mine victims. The capstone for the day will be a mediated panel discussion representing all views on the use and utility of mines today and in the future. Topics to be debated will include the defense of our ally, the Republic of Korea; the responsible use and need of tactical SD mine systems; and feasible courses of action to eliminate the suffering caused by mines already in the ground. In preparation, I recommend reading an excellent article from the May 1998 issue of *Proceedings* titled "Landmines, Lies and Other Phenomena," by MG [R] J. D. Lynch, U.S. Marine Corps.

The next day, at Fort Leonard Wood, will center on the live fire of two SD mine systems, the Volcano and the Modular Pack Mine System (MOPMS). Following an introduction to their current tactical uses, both will be deployed. After the mine systems self-destruct, refreshments will be served downrange to clearly demonstrate the weapons' reliability. This is a unique training opportunity to see firsthand weapon systems used exclusively in tactical situations in high-intensity conflicts. We have already received inquiries from combat leaders who wish to see this demonstration, and I hope to also see many from the Engineer Regiment.

I have been your commandant for the last year and every day just gets better. From our dedicated civilian work force to the high quality of new soldiers entering the Army here, I am very impressed and pleased. Whether active, reserve, national guard, civilian, or retired, we have the best personnel here at Fort Leonard Wood.

Engineer

July 1998 Headquarters, Department of the Army ***Volume 28 PB 5-98-3***

***Front Cover:** Destroyed railroad bridge at Brcko, Bosnia (see article on page 2.)*

***Back Cover**: A historical example of the Army value "Duty."*

FEATURES

DEPARTMENTS

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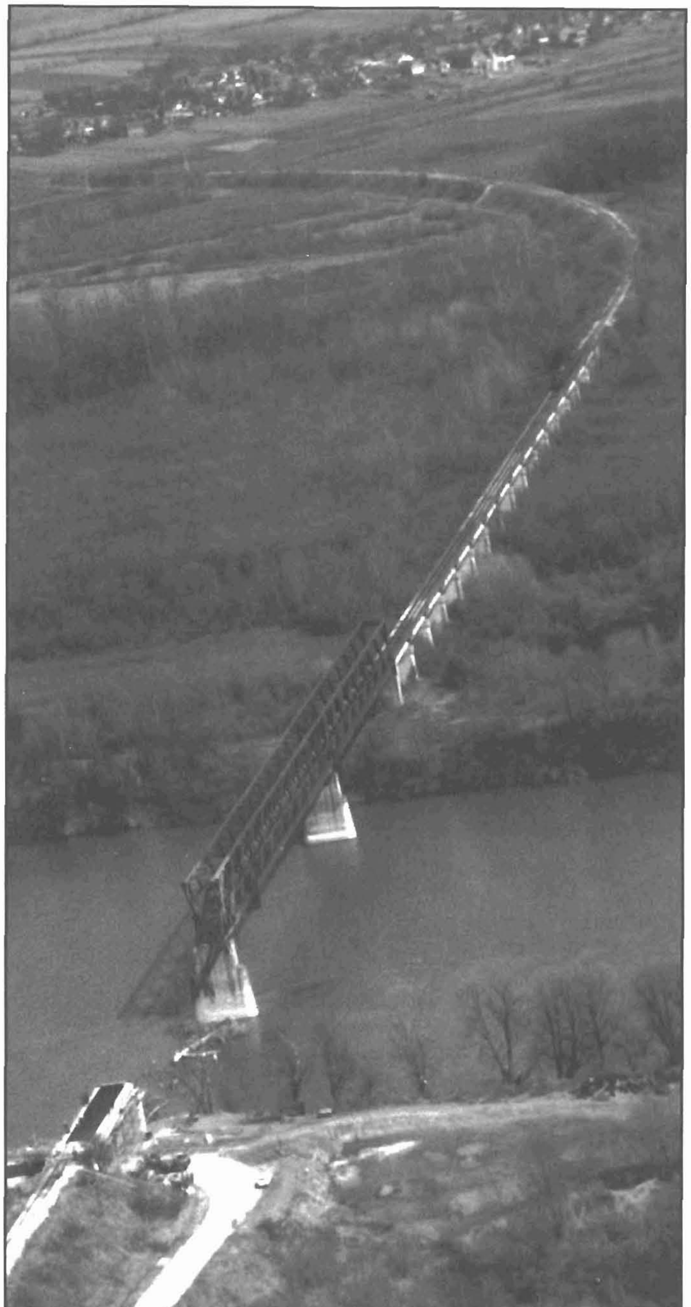
NATO Rail Operations in the Balkans

By Lieutenant Colonel Christopher J. Toomey



The railroad bridge at Brcko was reconstructed by USAID in 1997.

"We will take measures to repair and improve the road and rail infrastructure of the area in order to facilitate movements from east to west and north to south."

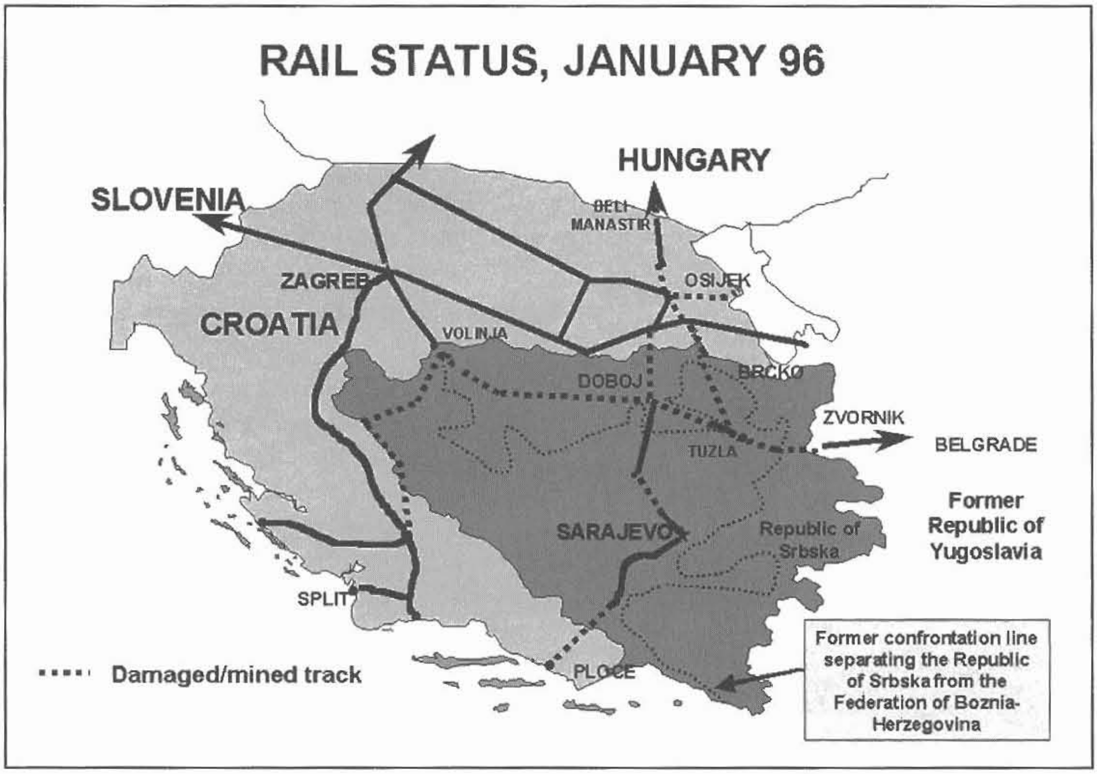
Carl Bildt
U.N. High Representative
14 February 1997

When the NATO Implementation Force (IFOR) deployed to Bosnia in 1996 to enforce the military provisions of the Dayton Accords and ensure peace and stability, it found a rail system in total disarray. The devastating civil war from 1990 to 1994 resulted in serious damage to the rail systems in both Bosnia and Croatia: lines were torn apart, blown up, or mined. Embankments were used as field fortifications and became inundated with bunkers. Wooden sleepers (pieces of timber used to keep steel rails in place) were burned for fuel or used in construction, as were tons of ballast. Bridges were destroyed and approaches mined. Telecommunications systems, rail stations, and rolling stock—the trains—became casualties of the conflict. More than 75 percent of the locomotives in the region were destroyed, and the traffic loss was immense. In 1996, passenger rail traffic was estimated at 10 percent of the 1989 level, and freight traffic was at 15 percent of the prewar level.

This article examines the efforts by both IFOR and Stabilization Force (SFOR) engineers, working in conjunction with the international community, to rejuvenate the Balkan rail system. The primary office responsible for theater-level engineer planning, the Combined Joint Engineer (CJENGR), is headquartered in Sarajevo.

To influence the rebuilding of the rail system, CJENGR accepted four major tasks:

- Serve as technical advisor to the command and civilian organizations.
- Develop policies and implement programs to translate the commander's intent into concrete action.
- Unify the various IFOR/SFOR agencies that touched rail operations, including the civil affairs and information campaigns.



- Synchronize SFOR actions with various civilian initiatives to ensure maximum use of resources.

1996 Initiatives

From the outset of its involvement in Bosnia, NATO's military planners and engineers were concerned with reestablishing an effective rail system. In a country with a very limited road network, a functioning rail line is an asset to any military force concerned with supplying and reinforcing its forces.

Initially, only IFOR had the resources, the manpower, and an organization available to make immediate and noticeable rail improvements. They focused on developing the rail network to link and support NATO's Multinational Divisions. Since the cost to repair severely damaged rail bridges along the Sava River was estimated at several million dollars, IFOR decided to avoid the north-south line and concentrate on opening the east-west line from Volinja through Doboj and on to Zvornik (see map). In all, NATO repaired or funded the rejuvenation of 460 kilometers of track at a cost of $5.6 million. The project consumed more than 1,000 tons of rail and included extensive demining and the repair of three major bridges.

The project was an outstanding example of multinational military cooperation, with German, Italian, Hungarian, Romanian, and U.S. engineer units working together along various sections of the line. The bulk of the work was executed by the Italian Railway Engineer Regiment, which also maintained overall technical supervision.

Several international organizations, working in coordination with NATO, initiated repair efforts during 1996. Three groups in particular—the International Management Group (IMG), the World Bank, and the U.S. Agency for International Development (USAID)—became key players in focusing money and resources on rail reconstruction in the region.

1997 SFOR Initiatives

Realizing the enormous economic potential that a fully rejuvenated rail system means to Bosnia, SFOR became involved in developing the system above and beyond direct support to NATO forces. Reestablishing an effective rail link between Bosnia and Europe will help promote regional stability, a major component of SFOR's mission.

Obstacles

Despite IFOR's efforts, there was still significant damage to the rail system at the beginning of 1997. The IMG repaired electrical and communication lines between Sarajevo and Ploce in 1996, but electrification and signaling remained major shortfalls.

Political problems complicate the situation. Three rail companies operate in the region, each aligned with a particular ethnic faction: Croatian Rail, Rail Company of the Republic of Srbska, and Rail of the Federation of Bosnia-Herzegovina (ZBH). With no central governing body, there is constant discourse on priorities and resourcing. Each company is fiercely territorial and consistently considers its portion of the line in isolation rather than as part of a network.

It is seemingly impossible to prevent political agendas from influencing activity along the rail lines. SFOR's freedom of movement along the lines is assured by the Dayton Accords, but in early 1997 physical damage and political impasse prevented restoration of regular traffic.

Developing Priorities

In establishing SFOR's priorities, CJENGR worked closely with SFOR civil affairs experts, the Civil Military Commission (CIMIC), to form the Theater Rail Working Group. This group periodically brought together SFOR and external agencies—IMG, USAID, and the World Bank—with a rail interest in Bosnia. The working group established the following priorities for 1997, with the overall aim of creating a link between Bosnia and the rest of Europe:

- Complete repairs to the east-west line.
- Improve signaling at Doboj Junction.
- Facilitate repairs between Tuzla and Brcko.
- Facilitate linking Brcko through Croatia into Hungary.

SFOR's priorities were synchronized with the IMG's plan to concentrate on upgrading the line between Ploce and Doboj while USAID constructed the rail/highway bridge over the Sava River at Brcko.

East-West Line. Funds from the 1996 project were used to resume repair on the east-west line in April 1997. The upgrade involved repairs between Banja Luka and Doboj and cost almost $5 million. Work contracted through the Rail Company of the Republic of Srpska included repair or replacement of ballast, sleepers, rails, switches, and rudimentary signaling at various sections along the line. Many small bridges were upgraded, and some areas were demined to permit reconstruction. NATO furnished much of the material and pushed initiatives to make local military personnel participate in demining. As in 1996, the Italian Railway Engineer Regiment maintained overall technical supervision of the repairs. Work on this line was completed in October 1997.

Doboj Junction. A major rail junction in Bosnia, Doboj Junction lies within the zone of separation between the Republic of Srbska and the Federation. The junction is important both technically and politically, because it is an area in which the two factions in Bosnia must come together to resolve differences.

Several months of discussion resulted in a decision by NATO to invest almost $500,000 to increase the junction's throughput capacity to 60 trains a day. This ensures that SFOR trains can travel uninterrupted for the foreseeable future. Improvements to Doboj Junction have definite civil benefits because the station links the important industrial areas of Tuzla and Zenica with the rest of Bosnia. Contractors completed the following work by November 1997:

- Improved the road network and buildings in and around the junction.
- Completed communication links between dispatchers in the station and along the line, switch operators, and operators in the locomotive depot and marshalling yards.
- Repaired automatic telephone networks.

Tuzla-Brcko-Hungary Line. Traditionally, the mineral-rich Tuzla Valley was a key economic area with a strong industrial base. Before the war and the destruction of connecting rail lines, goods and minerals were shipped by rail to the Sava River port of Brcko or to ports along the Danube. As 1996 ended, industrial output in the region was estimated at 15 percent of prewar levels, while unemployment was at 70 percent. SFOR and U.N. economic analysts projected that reopening full rail traffic would immediately bring nearly $20 million to the region and employ 1,200 people, with a potential for 56,000 jobs in the Brcko-Zenica industrial region.

Politically the area is troubled. Brcko, claimed by both Serbs and Muslims, is still a divided city patrolled by U.S. forces from Multinational Division (North). The potential for economic growth that a healthy rail line brings will help reduce political and ethnic tension.

In Croatia, the line enters another contentious area—Eastern Slovenia—which was governed by the U.N. Transitional Authority for Eastern Slovenia until late 1997. Conditions there were economically grim with un-employment at 60 percent. Completing the railroad enables access to the Danube River ports, connection to the European line in Hungary, and the potential for significant economic improvements.

Developing a Strategy

The SFOR effort was led by the CJENGR with heavy support from the CIMIC Task Force. These two organizations formed a "rail team" that attacked rail issues and worked as partners throughout the process. The team fully assessed the technical, political, and economic issues involved in re-vitalizing the rail system. Key components of the strategy follow:

Focus on the Permanent Railway. As with the 1996 effort, SFOR realized that it was initially important to make the track functional. Support for signaling and telecommunications will follow once the international community sees the tracks in use.

Work Closely With USAID-Bosnia. Since the earliest introduction of NATO forces, USAID resourced projects throughout the country. It rebuilt the rail and highway bridge

Photo courtesy of the 16th Engineer Battalion, 1st Armored Division.

The first train of U.S. equipment leaves the Bosnian military railhead at Lukavac on 21 April 1998.

across the Sava River at Brcko in anticipation that SFOR would rebuild the rail line between Tuzla and Brcko.

Use NATO Engineers When Available. Using SFOR or additional NATO forces to help construct all or part of the railway reduces the overall cost and makes projects more attractive to USAID and other civil organizations. The Italian Railway Engineer Regiment deployed to Bosnia in 1997. Other forces included the Romanian Engineer Battalion and Hungarian Engineer Contingent (a force larger than a battalion), which are directly under CJENGR's control as part of SFOR.

Open Negotiations in Croatia. Any work in Croatia requires the input of Croatian Rail and the Croatian Government, as well as civil organizations that act exclusively in Croatia.

Rebuilding Tuzla to Brcko

From the outset, USAID funded all material for repairing the line between Tuzla and Brcko but could not fund contract labor for the entire line. Deployment of the Italian Railway Engineer Regiment greatly reduced the overall repair costs. Italian engineers repaired more than 600 breaks in the line and replaced the main section between the Kalanac and Lipovac bridges. They were supported by the Hungarian Engineer Contingent, which executed numerous general engineering tasks, to include demining. Soldiers from the Army of the Republic of Srbska, who were trained under a U.S. Department of Defense-sponsored program, also performed demining.

USAID eventually contributed about $2 million, which provided material for the line; contract repair of bridges at Lipovac, Kalanac, and Spionica; repairs at a landslide at Tinja; and repair of the train station at Bukovac.

Rebuilding Brcko to Hungary

The map on page 3 shows that repairing the Tuzla to Brcko section was pointless without also repairing the line through Croatia into Hungary. However, the direct line to the north was heavily damaged in Croatia. A major technical obstacle was repair of the Basut River bridge and the 12 kilometers of track between the bridge and Vinkovci. Croatian Rail pledged to repair this section, including demining the line and the bridge, if USAID provided material assistance. USAID-Bosnia pledged the materials and committed $400,000 to repair the bridge. SFOR's office in Zagreb, in conjunction with USAID, provided project oversight and overall technical supervision. The project was completed in December 1997.

The line from Vinkovci to Osijek was entirely destroyed. Much of the 35-kilometer line was heavily mined and inaccessible. The estimate to restore the permanent railway is about $15 million, which makes it uneconomical to repair at this time. Instead, traffic was moved from Vinkovci to Vroplje and thence to Osijek, where the line was in good repair and required only additional switching and signaling to transfer the trains at Vroplje.

The last section, Osijek to Beli Manistar (along the Hungarian border), eventually required minimal SFOR input. Once Croatian Rail was convinced that the Brcko to Vinkovci section was a reality, they began to repair the Osijek-Beli Manistar line in a joint venture with Hungarian rail authorities. This effort included extensive contract and military demining.

Lessons Learned

Military engineers can gain much from CJENGR's experiences in developing the strategic rail plan.

Take a Team Approach. The success of SFOR's rail program is largely due to the positive interaction of the various elements of the command. Working as a team magnifies the expertise of individual components.

Look Beyond the Technical Issues. Most problems are complex and involve much more than surmounting technical obstacles. Engineers must become involved in addressing the often closely related political and economic issues. In many instances, CJENGR became involved in negotiations that required engineers to fully understand the economic and political issues at hand.

Work With Civil Agencies. An integral part of SFOR's efforts was to develop a positive relationship with interested civil agencies. This included understanding their objectives and concerns, as well as exhibiting the ability to compromise. Civil agencies do not necessarily have the same agenda as the military force and often have a different time line. Engineers must forge partnerships with civil agencies to tap into diverse resources and ensure a mesh between military and civilian planning.

Think Regionally. Infrastructure, particularly transportation networks, must be thought of regionally. Shifting political boundaries may not align with natural boundaries, which influences the development of road and rail networks. By developing a regional approach, military engineers can learn to appreciate the breadth of factors affecting issues.

Prognosis

Through the efforts of SFOR and partner civil agencies, the permanent railway is functioning along main sections of the line. NATO forces are using the rail system. In fact, much U.S. equipment moves over rebuilt sections of the rail line. Many countries that contribute forces to SFOR are expanding their use of rail in moving and supporting forces in the region. Rail is also used extensively in Croatia, with the Croatian government working to maximize the economic potential of a functioning rail system.

Civilian traffic within Bosnia is still minimal. Much of this is due to political complications. Perhaps the following 10 February 1998 statement from Radio Free Europe accurately sends the message:

Klein Urges Restoration of Bosnian Rail Traffic. Jacques Klein [deputy to the U.N. High Representative for Implementation of the Peace Agreement] said in Sarajevo on 7 February that the rail system presents "the worst case of all the public utilities [in Bosnia]. Almost no train is running..., [which] means waste on a large scale, because no train means no investment, no investment means no jobs."

Although some technical obstacles exist, most of the issues that prevent regular traffic are political and involve reluctance by the various entities within Bosnia and Croatia to grant full access to cross-border traffic. Many people recognize the importance of rail for economic regeneration, but internal restrictions to free movement across borders keeps political leaders from allowing the rail system to realize its enormous potential.

Ultimate responsibility for successful rejuvenation of the rail system rests with the Bosnian and Croatian governments. They must show the good faith and willingness to support progress that will entice international investment on a large scale. Restrictions on movement will be the deciding point on the future of rail traffic—and the regeneration of the economy—in Bosnia.

Lieutenant Colonel Toomey, U.S. Army Corps of Engineers, is currently commanding the 14th Engineer Battalion at Fort Lewis, Washington. He was previously SFOR's Chief, Engineer Plans. LTC Toomey is a graduate of the U.S. Military Academy.

Planning Engineer Support for a MOUT Attack

By Captain John C. DeJarnette

Today's soldiers must be prepared to fight on increasingly diverse terrain, including terrain containing manmade features found in urban areas. These elements are viewed as obstacles of maneuver. Military operations on urbanized terrain (MOUT) encompass all military actions planned and conducted on a terrain complex where manmade 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 seize 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 learned 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. Engineer 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. Answering the following questions will help engineer planners 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 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.
- ❐ **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/AH-64 helicopters, Michelin road maps, and tour books.

Support Products

The engineer staff planner helps when the following products are developed to support the military decision-making process (MDMP) after the initial warning order is received. 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 the enemy 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 on this estimate, so plan two levels down, based on the 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. 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 his 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 order of movement.

Time and materials will impact his 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 in adjusting the obstacle template. Locations and movement of mounted weapons may indicate usable lanes for our infiltration of vehicles.

Event Template

Determine what triggers the commitment of enemy counterattack forces. Determine 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

Construct positions to support the forward displacment 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 task force engineers allocate assets and determine when in-stride and deliberate breach techniques are required. Specify where to use the MICLIC, hand-emplaced explosives, armored combat earthmover (ACE), armored vehicle-launched bridge (AVLB), and tank-mounted countermine equipment.

Decision Support Template/Decision Support Matrix

Help the S3 identify and plan branches and sequels to the plan. It is essential to know where engineers will culminate and how rapidly 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 11).

Troop-Leading Procedures Time Line

Ensure that adequate time is available to prepare the rehearsal site and that rehearsals are directed and supervised by key leaders.

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 into the objective area. The named areas of interest (NAIs) assigned to engineers should have priority intelligence requirements (PIR) that determine the best reduction sites into 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 and HF 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. Address all the breach tenets and explain the movement-control plan during each phase of the ground maneuver.

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, reduction sites, and initiation of SOSR (suppress, obscure, secure, reduce).

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 Operation,* 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 discuss details of linkup and handover. 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 in 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 commiting 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 associated decision points and conditions.

Precombat Inspections. Inspect MICLIC and tank-mounted CME. 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 traffic control post (TCP). One technique is for this post to be initially manned by representatives 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. Key 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

Plan in detail the employment of artillery-delivered antipersonnel mines/remote antiarmor mines (ADAM/RAAM) 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.

Protective Employment of Scatterable Mines

Ballast load the Modular Pack Mine System (MOPMS) on vehicles moving into objective area blocking positions.

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 is 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 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 time line 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 precombat inspections conducted by platoon leaders, company commanders, and first sergeants.

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 initial reconnaissance 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 stocks.

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:

- 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 precombat checks, precombat inspections, 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.

Captain DeJarnette is an engineer observer/controller at the Joint Readiness Training Center, Fort Polk, Louisiana. He previously served with the 37th Engineer Battalion, Fort Bragg, North Carolina, and as commander, B Company, 11th Engineer Battalion, Fort Stewart, Georgia.

Several readers had questions regarding the article "The MARTEN: A Quantum Leap for Engineers" in the February 1998 issue (page 18). Some questioned the name MARTEN. The following information will clarify any misconceptions we may have unintentionally raised.

Using the TRADOC Concept Evaluation Program, the Engineer School obtained from Melroe Company a Model 763 skid steer in 1997 for evaluation. Their company logo reflects the face of a bobcat and their skid steers are called "Bobcats," a copyrighted name we could not use. The MARTEN is the author's name and is not official.

The article might also lead one to believe that the Army spent millions developing a system that is readily available as a commercial off-the-shelf (COTS) purchase. That is not so. The Engineer School leased the skid steer and all its attachments at a very favorable rate and has since returned it to the manufacturer.

The purpose of our evaluation was to quantify the increased performance afforded by a skid steer. The data and evaluation results are necessary for school personnel to create requirements documents, a process that eventually will result in fielding the skid steer to engineer and other units.

If readers focus on the name MARTEN versus Bobcat and not on how well the MARTEN performs, they completely miss the point. It's what the system brings to the engineer on the battlefield that is important. A system capable of increasing an engineer squad's productivity by 25 percent can be called anything you want, just have it available! If you've ever constructed a concertina fence by driving the pickets with a sledge hammer, I'll bet you'd rather have something (a MARTEN?) with a hydraulic picket-pounding attachment.

I encourage units that have utilized skid steers to submit after-action reports or comments to the Director of Combat Developments using the comment form on the Engineer School home page at http:\\www.wood.army.mil.

Alan Schlie
Force Development Analyst

ENFORCE
BREAKOUT SESSION SUMMARIES

By Lieutenant Colonel Susan Myers and the ENFORCE Team

ENFORCE Conference breakout sessions are evolving into a regimental think-tank, and the information they provide is valuable to staff and action officers working issues that impact our engineer force. Other sources of communication, such as the Engineer Center home page, video teleconferences, council of colonels, and e-mail newsletters, offer opportunities to link engineer leaders with the latest developments. Summaries of breakout sessions held during the April 1998 engineer conference follow. Some have been updated to reflect actions taken since the conference.

Echelons Above Division

By Peter Malley

This session had two purposes: First, to inform participants about proposed engineer force structure requirements to support Force XXI, new evolutions of the battlefield, and future redesigns of the echelons above division (EAD) organizations. Second, to seek input to assist in determining the "right" designs for EAD organizations based on wartime missions and future concepts—i.e., Force XXI and Army After Next.

We began by explaining how engineer structure is developed from approved doctrine, concepts, and comments from field personnel. We described how the workload allocation rule for the Engineer Battalion, Combat Heavy, was developed using 23 wartime tasks and the number of personnel assigned to the unit. This discussion raised the following questions:

- **Why aren't equipment hours factored into the workload allocation rule?** We asked the Concepts Analysis Agency to answer this question. The data used to determine engineer requirements is based on information provided by the Engineer Strategic Studies Center and identified wartime tasks. Neither of these sources itemizes equipment hours. Engineer School leaders will review this issue to determine if equipment hours can be factored into the workload allocation rule.
- **Who will develop the EAD operational and organizational (O&O) plan for Corps XXI?** TRADOC is developing the Corps XXI O&O plan. It will be accomplished through a series of workshops attended by proponent school personnel. A "tiger team" has been developed to provide engineer input on specific issues. The tiger team includes doctrinal and concept developers and is chaired by a colonel.
- **Will the engineer organization include one engineer group with planning capabilities or will a modular section be available to augment the senior engineer organization in theater?** This question will be answered during the Corps XXI redesign process, which will be completed by October 1998.

We briefed the evolution of the future battlefield layout and potential roles for engineers. MG Flowers provided his guidance and perceptions in response to questions. This topic will remain a hot issue and will be reviewed as it develops.

We discussed proposed redesigns of EAD organizations. Two major organizations, the Engineer Combat Battalion, Corps Mechanized, and the Engineer Battalion, Combat Heavy, were described in detail. Others, such as the Engineer Command, the Combat Support Equipment Company, and the Engineer Combat Battalion, Corps Wheel, were summarized. Participants were most concerned about the following units:

- **Engineer Combat Battalion, Corps Mechanized.** Today this unit is a mirror image of the heavy division battalion. Participants concurred that the organization requires changing and that it should be revised based on breaching, survivability, countermobility, and general engineering capabilities no longer available within the heavy division battalion. We agreed to review the possibility of adding a Delta Company in the design and discussed adding more 62 MOS operators and reducing the number of combat engineers. We agreed to consider replacing ACEs with D7 dozers—that decision will depend on the availability of ACEs. Questions were raised about requirements for the CEV (future) and the Panther. Consensus was that a "bunker buster" or some type of weapon could be used in lieu of the CEV (future), and that the Panther could be placed in war stockage and withdrawn when necessary. The group suggested that we replace the M548s (Volcano vehicle) with a newer version and provide a dedicated support vehicle for MICLICs. We agreed to add a property book officer to this organization because the unit has considerable property that requires this officer's expertise.
- **Engineer Battalion, Combat Heavy.** After reviewing the mission statement, most participants agreed there is no requirement for bituminous paving, quarrying, or crushing operations. Engineer School personnel will review this requirement during the redesign process. We reviewed the 23 wartime tasks and recommended that three more be added: force provider, chemical decontamination support, and lines of communication bridging requirements. It was suggested we also add range construction and road construction and upgrading to the list.

The Concepts Analysis Agency agreed that these tasks can be added if the commanders in chief (CINC) have these requirements. The tasks will be added based on CINC input.

- **Engineer Command.** The Engineer School requested that representatives from the two engineer commands review their tables of organization and equipment (TOE) to determine whether this unit can be redesigned using modular sections versus the standard TOE staff positions. They agreed to this request.
- **Engineer Brigade, Theater Army.** Requirements for the brigade headquarters are not clearly defined in engineer doctrine. Colonel Quinn, 411th Engineer Brigade, provided a paper that identifies the brigade tasks. His data will be used to define the unit's mission and roles in future force structure requirements.
- **Engineer Combat Battalion, Corps Wheel.** Several commanders wanted to discuss this organization, but we could not because no proposed redesign has been developed. The commanders agreed to review their Unit Reference Sheets and submit suggestions for the redesign.
- **Engineer Combat Support Equipment Company.** Two options were raised: The Engineer School either develop a workload allocation rule or embed this company in the Corps Mechanized and Wheel Battalions. Consensus is that this unit must remain in the structure because its capabilities are critical to adequately support divisions.
- **Engineer Battalion Headquarters Team.** Participants requested that the Engineer School develop a team to command and control the separate corps companies and teams. Engineer School staff are reviewing this proposal.
- **Engineer Terrain Analysis Platoon.** We briefed a proposed redesign, which has increased the number of Active Component spaces to support terrain analysis requirements. Participants suggested we place some of the platoon sections in the Reserve Component structure. The Terrain Visualization Division is reviewing this proposal.

Comments and suggestions regarding this session are welcome and may be sent to the following e-mail address: malleyp@wood.army.mil.

Digital Breach Operations

By Lieutenant Colonel Harry Greene

This session began with presentations on the Wolverine and the Grizzly, which will form the backbone of the future heavy divisions' breach capability. When fielded in FY00 and FY04, respectively, both the Wolverine and the Grizzly will have situational awareness capabilities similar to those of the supported heavy maneuver force. We also discussed engineer command and control and the engineer portion of Force XXI Battle Command Brigade and Below (FBCB2). After these briefings, we posed the following questions to stimulate discussion:

- Given the information dominance provided by a digital force, do leaders still need to conduct a dismounted reconnaissance to determine the best breach site?
- Can we reduce the number of breach rehearsals or change the type of rehearsals conducted?
- Is it smart to use an M1 tank to follow reduction assets through a lane and provide security?

While we did not come to resolution on these questions, we will use the information and opinions gathered to shape future doctrine development for digital breaching operations. Several themes recurred during our discussion:

- Digitization and the resulting information dominance are most useful before and after a close fight. During a close fight, we expect communications to be conducted by methods similar to those used today. Attendees agreed that FM radios provide the most responsive form of communication at critical points in a battle.
- Marking lanes digitally is most valuable when vehicles approach the breach lane. Manually marked lanes are still required at the entrance and as vehicles move along the breach lane.
- Humans will remain a critical element on the digitized, situationally aware battlefield. Human eyes are needed for reconnaissance, and leadership is critical at the breach.
- Digitization and situational awareness were discussed at length. Participants agreed that digitization will increase the availability of information and the speed at which information is disseminated. We did not agree on how that information will impact the decision-making process.
- The presentation on engineer use of FBCB2 provoked lively discussion on reporting and command and control links. Engineer School leaders are working to clarify the types of reports required and the proper flow of reported information.

This breakout session served as a means to continue ongoing dialog concerning how digitization and situational awareness will impact engineer operations. Discussion will continue in *Engineer* magazine and at future ENFORCE conferences. The point of contact is guilford@wood.army.mil.

Force XXI Topography

By Lieutenant Colonel Earl Hooper

We began with a review of Task Force XXI and Division Advanced Warfighting Experimental designs and insights for future topographic missions. Most of the discussion focused on Topographic Force Structure 2010. The Terrain Visualization Center is developing future topographic structure options, and two major options were presented. Lieutenant Colonel Hooper described a single theater battalion with robust corps companies. Lieutenant Colonel Luce (commander of the 29th Engineer Battalion) presented a two-battalion design with heavy theater companies and a unified brigade headquarters. Both designs focus on a set of key factors, which will drive future topographic missions and which, in turn, will drive our doctrine. Descriptions of the key factors follow.

- **A common terrain operating environment (CTOE).** This does not mean that we all have the same view of terrain. We know that requirements for terrain visualization, analysis, simulation, and modeling differ across each battlefield operating system and across each echelon. The CTOE is the commonality of the underlying terrain data that drives each system to accomplish its terrain visualization and evaluation missions.

- **Rapid data production and data dissemination.** Data production from the National Imagery and Mapping Agency (NIMA) is critical. That agency's future plans call for it to provide foundation data "on the shelf." The foundation data will not meet all terrain data requirements for our future digitized organizations. Rather, that data must be reinforced with more detailed data sets produced "just in time" to support military operations. The "just in time" data production forms the basis of mission-specific data sets (MSDS). For the Army topographic community, this opens two new missions. The first is to get rapidly produced data to digital systems throughout the battlefield. The second is to fill data voids in the MSDS with data produced by Army topographic elements. The NIMA phrase used to represent this sift in data production philosophy is "just in time, not just in case" data production.

- **Expanded availability of terrain analysis support.** Future digital command and control systems offer extensive communications connectivity. This allows the analysis and dissemination of terrain data. Previous terrain analysis efforts normally reached only G2/G3 elements due to limited personnel and the low volume of hard-copy products. Digital distribution allows each command and control node down to the maneuver battalion level access to many of the analysis products previously limited to operations and planning elements at division level or above.

- **Embedded terrain evaluation in command and control systems.** Each system can perform many basic evaluation tasks and develop visualization products formerly provided by terrain analysis teams. These tasks include lines of sight, masked area plots, intervisibility plots, oblique views, perspective views, and slope analyses. Embedded tools allow individual users to obtain many visualization products without direct support from a topographic element. This capability is key to the overall terrain visualization mission in Force XXI. Topographic missions continue to shift toward data creation, management, and dissemination. The new missions provide the terrain data that empower the evaluation capability embedded in future command and control systems.

Attendees at this session provided an excellent cross section of the engineer community. The collected expertise included all topographic battalion commanders, the commandant of the Defense Mapping School, and the commander of the Topographic Engineering Center. The session closed with comments from MG Flowers and BG Arnold. They encouraged the team not to focus on fixing the existing structure but to design a structure that will meet future requirements.

The Terrain Visualization Center is working with the Concepts Division of the Directorate of Combat Developments and the Engineer Personnel Proponency Office to expand the two echelons-above-division options noted above. The assistant commandant provided an initial review and guidance in June. We are preparing a detailed concept design that will be staffed throughout TRADOC this fall. The point of contact is hoopere@wood.army.mil.

Long-Range Experimention Plan

By Vern Lowrey

The Maneuver Support Battle Lab (MSBL) hosted a breakout session to discuss engineer-related experimentation proposals as far forward as FY01. We briefed the battle lab experimentation process described in TRADOC Pam 71-9, *Requirements Determination.* We also discussed an ongoing effort by TRADOC to expand Army experimentation efforts over five axes:

- **Army XXI axis** to determine final requirements for the First Digital Division (FDD) by FY00.

- **Corps/Echelons Above Division axis** to experiment with structures needed to support the FDD and follow-on digital divisions that support fielding the First Digital Corps (FDC) by FY06. A corps Advanced Warfighting Experiment (AWE) will be conducted in FY03.

- **Joint Contingency Force axis** to experiment with contingency and expeditionary forces will culminate in an AWE planned for FY02.

- **Battle Force Group/Strike Force axis** to experiment with concepts tied to a highly lethal and deployable force.

- **Army After Next axis** to continue intellectual thought and discussion on Army force requirements beyond the year 2025.

We then discussed proposed engineer-related experiments based on the new Army patterns of operations (project the force, protect the force, gain information dominance, shape the battlespace, conduct decisive operations, and sustain and transition the force). Resourced MSBL experiments will tie into each Army axis as appropriate.

Feedback from ENFORCE participants was extremely helpful in validating engineer-related experiment proposals.

Tighter linkage of MSBL experiment efforts was discussed with the Director of the U.S. Army Corps of Engineer laboratories. A proposal was made to tie materiel-related experiment efforts with existing operational requirement documents to determine if the requirements are still valid or need modification.

The MSBL Long-range Experimentation Plan (LREP) has been staffed with the U.S. Army Chemical, Engineer, and Military Police Schools. It is posted on the MSBL Internet home page. Comments or suggestions for future engineer-related experimentation ideas are welcome. The point of contact for the LREP, Major Steve Jeselink, may be reached at (573) 563-4082 or Defense System Network (DSN) 676-4082.

The Bradley-Equipped Engineer Company

By Lieutenant Colonel Dick Hornack and Major Doug Victor

During this session, we solicited input concerning the Engineer Regiment's transition to the Bradley engineer fighting vehicle (BEFV). The Engineer School will use data from the session to develop and finalize an operational and organizational (O&O) concept to incorporate into the BEFV concept evaluation plan. The O&O concept will address the optimum organization for the engineer company, training issues, and doctrinal impacts of a Bradley-equipped engineer force. The Maneuver Support Battle Lab will continue to work this action.

Subject areas used to facilitate discussion were engineer company and platoon organizations, training and doctrinal implications, and follow-on testing that will fully develop the Bradley engineer company concept.

Engineer Company Organization. Engineer combat repair teams and combat service support should mirror requirements of the maneuver community. First sergeants should be in M113s along with the repair teams. Company commanders/operations sergeants must have a HMMWV, so we need to relook HMMWV distribution within engineer companies. Units may not be able to deploy with 100 percent of their assigned systems due to soldiers who are sick, on profile, etc.

Engineer Platoon Organization. Reduction platoons should have redundant capabilities to reduce obstacles and proof and mark lanes. They need the armored combat earthmover (ACE)—a mobility asset—organic to the platoon to complement other reduction assets. The ACE can reduce antitank ditches and berms (constructed obstacles) and provide proofing capability through complex obstacles. Maintaining the ACE in reduction platoons will minimize task organization changes for offensive operations within engineer companies.

Training Implications. We presented three proposals for engineer gunnery:

- Fire tables I-VIII.
- Fire tables I-VIII; don't fire tables III and IV.
- Fire tables I-VIII (Modified); don't fire tables III and IV.

The group thought that engineer gunnery tables should parallel the maneuver tables I-XII, with tables XI and XII being the squad and platoon qualifications, respectively. Engineer qualification tables should be merged into the current Bradley tables I-XII to create an engineer gunnery program with an end state of completely qualified squads and platoons. The Engineer School will continue to work engineer gunnery issues, including resources.

Doctrine Implications. Engineer commanders expressed concern that four Grizzlies may be insufficient to support a maneuver task force during breaching operations, since we need to make as many breach lanes as possible for the assaulting task force. Engineer companies must retain as much of their current breaching capability as possible, because the Army will buy only a limited number of Grizzlies.

Follow-On Testing. To help Engineer School personnel analyze the Bradley engineer company, the 4th Infantry Division's engineer brigade transitioned one engineer company to BEFVs in April 1998, using the same configuration as the infantry Bradley company. An Engineer School team will evaluate this concept, including load plans, maintenance, training, and doctrine. The 4th Infantry Division will test the concept throughout the summer and will deploy to the National Training Center in August with two engineer companies—one Bradley company and one M113A2 company.

The Engineer School will continue to evaluate engineer gunnery tables, engineer qualification tables, ammunition implications, the feasibility of adding a bunker-busting munition to the tube-launched, optically tracked, wire-guided (TOW) missile, and the need to change to the Bradley stowage capacity to accommodate engineer equipment. A proposed FY99 concept evaluation plan will address enhancements to the Bradley, which include rollers, plows, Volcano, MICLIC, and possible hydraulic/pneumatic tools. The point of contact is steinigp@wood.army.mil.

Total Army Training System Courses

By Lieutenant Colonel Susan R. Myers

We provided information about the Total Army Training System (TATS) courses and solicited feedback as to how material should be fielded throughout the engineer regiment.

The Total Army School System (TASS) is the realization of former Chief of Staff of the Army General Gordon Sullivan's vision for the Active and Reserve Components to train to the same standard. His vision is being realized now that seven functionally aligned training battalions offer reclassification courses to the engineer Reserve Components. TATS courses are the means to standardize training technical tasks, and the Systems Approach to Training (SAT) is the process used to develop programs of instruction.

Systems Approach to Training

The Training and Doctrine Command updated the SAT process in 1995 to re-establish a long-term approach to planning future training requirements for TATS courses.

SAT has five interrelated phases: analysis, design, development, implementation, and evaluation.

Analysis. This phase identifies and describes collective and individual tasks and determines what needs to be trained. Analysis for TATS courses is accomplished by bringing together representatives from all components to determine training needs. Achieving consensus on training needs and critical tasks is a difficult process. The Engineer School received Active Duty Special Work funds to help ensure that feedback from field commanders and Reserve Component instructors is integrated into the analysis phase.

Design. This phase ensures the systematic development of training programs and materials to enhance the learning process and make it more effective. Virtual and diagnostic learning strategies being incorporated into TATS courses will require access to and fielding of technological learning systems. Linking these systems is critical to the success of future training capabilities, and the medium to accomplish the link is component distance learning plans.

Development. This process turns the design into training products, programs, and materials required to implement training. The program of instruction, lesson plans, student handouts, soldier's manuals, and interactive courseware are products of the development process. Combat engineer courses were validated this year (1998) at Fort Leonard Wood, Missouri; the Army National Guard Regional Training Institute at Camp Grafton, North Dakota; and the Army Reserve engineer TASS battalion at Camp Dawson, West Virginia. This validation process ensures that training issues from all components are incorporated. Construction and equipment operator courses will be completed this fall. All courseware will be available for distribution from the Army Training Support Command in October 1999.

Implementation. During this phase, courses are conducted using training materials and exercises based on unit training needs. The implementation process is expanding to accommodate training battalion evaluation criteria mandated by the TRADOC accreditation program.

Evaluation. Units are evaluated annually, and TASS battalions are accredited every three years (as a minimum). The accreditation system evaluates instructor and student performance, instructor credentials, testing programs, course materials, and training resources. Some of the Engineer Regiment's greatest challenges are to plan and resource training to meet military occupational specialty qualification quotas and, more importantly, to ensure that soldiers are prepared to perform critical technical tasks to standard before graduating from the course.

The Future

Engineers must continually assess both individual and collective skills and knowledge to anticipate future training requirements. Acquiring resources for training is often the weak link because of changes in doctrine and lead times needed to procure materials. Distance learning is touted as the solution to reducing the time required for training. However, our technical skills and knowledge are perishable without continuous reinforcement and practice. The Director of Training seeks feedback and lessons learned concerning training needs, distance learning, and training effectiveness from unit commanders, training commanders, and other training experts. Leaders must learn more about the TATS courses. They are the tools to train the entire Force XXI Engineer Regiment and the bridge to bringing the Active and Reserve Components together for readiness. The point of contact is stephens@wood.army.mil.

Training Modernization

By Connie Welch and Al Waltman

This session presented the Engineer School's initiative to modernize engineer training. Participants were shown prioritized lists of modernization initiatives developed by the school's Training Modernization Integrated Concept Team and were asked to comment on the list's completeness and priorities.

Updated priority lists follow.

Maneuver Engineering

1. Training aids, devices, simulators, and simulations (TADSS) to support staff training in the technical engineer areas of breaching, force protection, obstacle planning, and river-crossing operations.
2. Computer-based training and simulations to train general tactical operations center (TOC) procedures.
3. TADSS to support mine detection (virtual-reality-based).
4. An improved mine-effects simulator for the combat training centers.
5. An armored combat earthmover (ACE) simulator.
6. A Volcano simulator.
7. More training events integrated with other TRADOC schools and between courses at the Engineer School.
8. A large, regional, fast-water, river-crossing training area for the Army.
9. A bridge boat operator and raft commander simulator.
10. Multimedia training to support bridge design and Bailey bridge/medium girder bridge simulators/simulations.
11. An improved mine-clearing line charge (MICLIC) and MICLIC trainer.
12. A remedial math class or computer-based training.

Force Support Engineering

1. TADSS to support heavy construction engineer equipment, such as dozers, graders, scrapers, loaders, and SEEs.
2. TADSS similar to a simulation network to support construction engineering activities.
3. A base camp demonstration site at Fort Leonard Wood for resident training, similar to the model motor pool or the military operations in urban terrain (MOUT) facility.
4. A handheld electronic expert system, which will contain the equivalent of FM 5-34, *Engineer Field Data*, and perform calculations.
5. A simulation to support engineer and route reconnaissance.
6. Move reclassificaton training to the Total Army School System battalions.

Terrain Visualization

1. Embedded training for the Digital Topographic Support System.
2. Digital terrain training support package (CBT) for producing map products.
3. Maneuver Control System and Joint Mapping Tools Kit training in leadership courses in the Engineer School.
4. Computer-based training that demonstrates battlefield obscuration and its effects on engineer operations.
5. A camouflage training site at Fort Leonard Wood.
6. Re-evaluate the initiative to move the Defense Mapping School to Fort Leonard Wood.

Systematic/Process Topics

1. Revitalize the individual training program process to identify resource requirements, and develop and program a training strategy.
2. Nonsystem TADSS acquisition system fails and requires redesign too often.
3. Review course length limits versus increasing skill complexity due to new technologies.
4. Standardize DoD equipment: Multiple brands of equipment across the total force cause problems.
5. Human factors are not included in training and equipment designs.

Participants made the following recommendations.

- ❐ Add Volcano and ACE training devices to the maneuver engineering list.
- ❐ Separate survivability issues from force protection issues on the force support list.

The second portion of this session was devoted to the Engineer Force Battle Command and Staff Trainer modernization initiative. Suggestions included:

- ❐ Consider consolidating the analog and digitized CD-ROM. Digitized training could be an annex or add-on to the analog CD-ROM.
- ❐ Add a company support platoon leader trainer.
- ❐ Add a company-level supply position trainer.

Engineer School personnel are reviewing these recommendations and will incorporate them into final prioritized lists. The lists will be presented to the school commandant for approval by mid-August 1998. The point of contact for training modernization at the Engineer School is waltmana@wood.army.mil.

Engineer Officer Advanced Course

By Major Darren Naumann

The purpose of this session was to brief results of the EOAC customer survey and Task Site Selection Board and discuss the Total Army Training System-Courseware (TATS-C) and EOAC-Reserve Component Distance Learning Implementation Plan. We also solicited input for improvements to the EOAC.

EOAC Survey. The group agreed that the EOAC customer survey is valid but were concerned that the top 10 tasks reflect priorities facing a peacetime Army. They thought that survey results should not drive the train for EOAC course instruction but should be viewed as one of many inputs to the course design. We discussed the complexity level of tasks instructed in the EOAC—whether they are the most difficult or most often encountered—and agreed that the course should focus on foundation skills on which the officer can build.

Consensus was that the survey be conducted annually, that it is beneficial for commanders to provide input to EOAC design, and that we should administer a similar survey to maneuver commanders. The following improvements were recommended:

- ❐ Change the cover letter to emphasize the importance of commanders' input to the course.
- ❐ Change the wording of questions to reflect the survey purpose; for example, "What important skills and knowledge should be taught in the EOAC?"
- ❐ Provide commanders the ability to quantify the detail level of skills and knowledge taught; for example, differentiate between "integrated," "awareness," "refresher," and "programmed" training.
- ❐ Administer future surveys to EOAC graduates as well as battalion/brigade/group commanders. To reduce costs, commanders will be responsible for distributing surveys to EOAC graduates in their command.
- ❐ Distribute future surveys to U.S. Marine Corps engineer unit commanders.

Task Site Selection Board. The group thought that the critical task list and recommendations from the board were not indicative of the engineer branch as a whole but reflected the types of units represented on the board.

Total Army Training System-Courseware. The group recommended that lesson plans for tasks encountered least often be converted and published first under the TATS-C program.

Distance Learning Implementation Plan. Participants agreed that it may be difficult to synchronize quarterly video teletraining and mobile training team sessions with Reserve Component units. They recommended that the sessions be archived so students can access them.

Recommendations. Teach EOAC students to be managers, not technicians, and focus instruction on management-level issues and systems that company commanders should know. Increase students' exposure to issues relevant to today's fight, such as support operations and stability operations, rather than focusing entirely on fighting "World War III." The point of contact is naumannd@wood.army.mil.

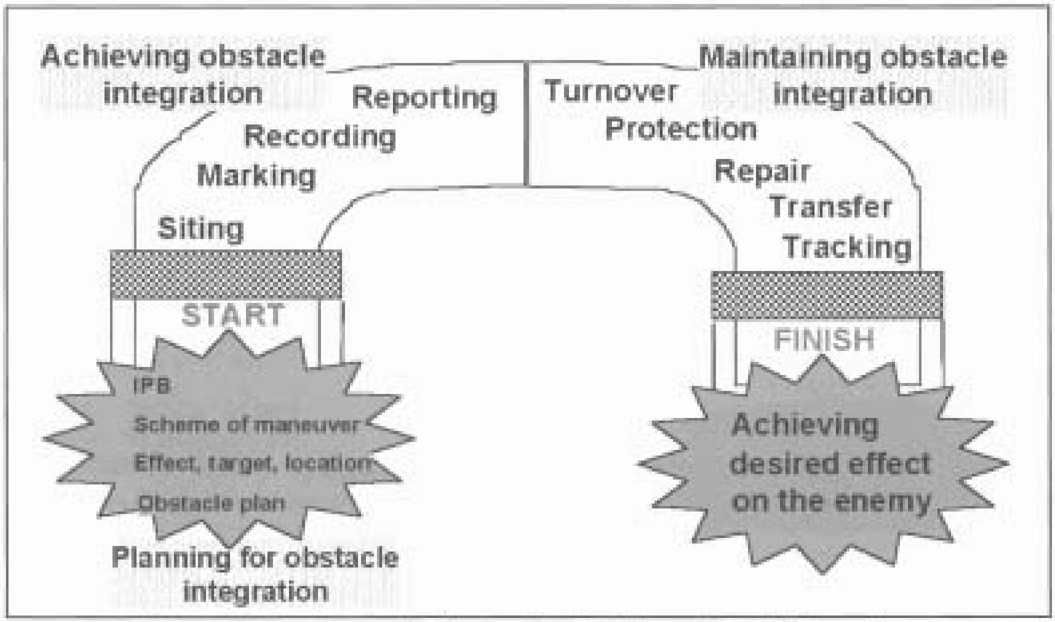


Figure 1. Planning, achieving, and maintaining obstacle integration

Scatterable Mine Systems and Integration

By Major David Holbrook, Major Michael Rose, Major Darold McCloud, and Mr. Charles Jackson

We discussed and solicited feedback on negative combat training center trends, current doctrine, and future systems related to scatterable mines. Attendees reviewed several trends related to scatterable mine employment and integration across DTLOMS, with doctrine, organization, and materiel trends being most notable. Engineer School personnel will work these issues based on information obtained during the session.

Doctrine

We agreed to develop a graphic training aid (GTA) that outlines system checks for the Volcano and MICLIC. Consensus was to limit the Volcano section to the ground Volcano, since aircraft crew chiefs conduct additional (nonengineer-related) checks on the air Volcano that are inappropriate for an engineer GTA. The group suggested that system checks for the MOPMS be included on a future GTA.

We discussed scatterable mine integration concepts in current doctrine. FM 90-7, *Combined Arms Obstacle Integration*, now being reviewed by the field, will contain information on planning, achieving, and maintaining obstacle integration (Figure 1). We concluded this section by discussing available scatterable mine assets and points in the military decision-making process that will assist leaders in planning scatterable mine integration.

Terminology was discussed in detail, particularly the term "dynamic obstacle," which emerged during the National Training Center's Advanced Warfighting Experiment (AWE) in March 1997 and was used in the Division AWE at Fort Hood last fall. Although the term has never been defined, it continues to show up in correspondence and in lessons-learned documents circulating through the Engineer School.

The term "dynamic" is frequently used in Force XXI operations, and engineers must embrace it. The Army is rapidly changing, and doctrine must keep pace. The "dynamic battlespace" we fight in today is leading the way for future systems that reach out and kill the enemy at greater distances. The Raptor is a system that fits this mold.

"Dynamic" in itself has a single meaning, but when added as a descriptor at the beginning of existing doctrinal terms, it requires definition in the doctrinal lexicon. According to Webster, "dynamic" is defined as (1) forceful; energetic (2) of or pertaining to force or energy related to motion. We proposed that to be "dynamic" an obstacle must—

- Communicate with command and control systems and other engagement systems.
- Be remotely controlled (on/off/on).
- Report battlespace intelligence (type, number, direction, and rate of movement).
- Be delivered remotely.
- Engage vehicles.

While these descriptors apply to the *future* Raptor system (see materiel section), they do not apply to current scatterable mine systems.

Participants thought we do not need another term to describe our obstacles, but they provided some interesting insights and acknowledged that many leaders use the term "dynamic obstacle." The term will be defined in future doctrine, based on the above criteria and the following synopsis of the attendees' comments:

- *Obstacle*—If it is not an obstacle, it is not linked to engineer proponency.
- *Dynamic*—Has on/off/on capability at least once.
- *Active*—Sensors are not active; they only receive. Mines are passive, while radar and sonar are active. To be "dynamic" a system must be active.
- *Mobile*—Replace the term "mobile" with "interactive" when describing the Raptor.

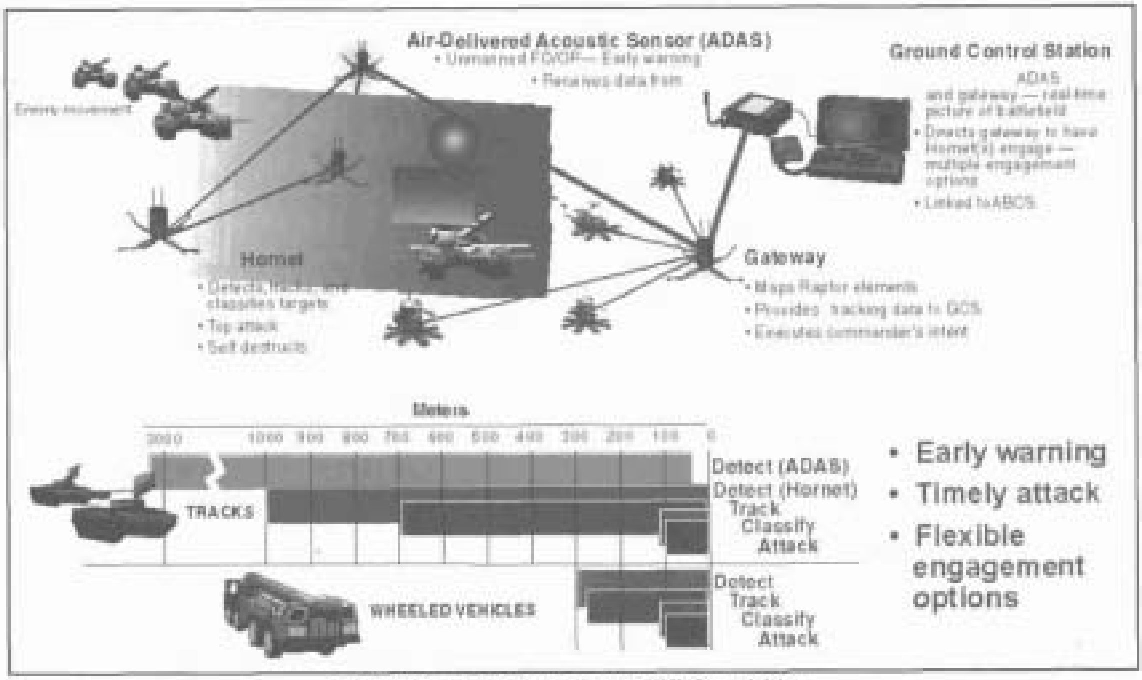


Figure 2. Raptor - A Force XXI Capability

- *Desired Effect*—Allows free mobility for the BLUE; is an obstacle to the RED; and is no danger to the GREEN (noncombatants).

Organization

Attendees agreed that the M548 Volcano carrier should have a communications platform for mounting a radio to enhance command and control of this critical asset.

Materiel

Suggestions concerning a standard minefield-marking system included:

- Establish the standard at theater corps level at the beginning of each operation.
- Use a material for the marking system that is readily available to all units.
- Include minefield-marking material in the STRAC manual.
- Ensure that the minefield-marking material can be used by both heavy and light forces.
- Adopt the Pearson Pathfinder marking system used by the British army.

Volcano Minefield-Marking System (VMMS). We discussed this possible future system, which would eliminate some negative trends users experience with the current Volcano at combat training centers. The VMMS will automatically mark the Volcano minefield as it deploys. Participants approved this concept and suggested improvements to be incorporated under the Volcano improvement plan. The VMMS should have a communications platform and built-in Global Positioning System (GPS) and be capable of being carried by soldiers (man-packed). This last feature will enable soldiers to rapidly mark any unmarked areas created by terrain or the system itself.

Self-Destruct Times. We agreed that different self-destruct times should be developed for our scatterable mine systems. The current times of 4 hours, 48 hours, and 15 days (for the Volcano) are not conducive to future mission execution. Suggestions included:

- Base changes to self-destruct times on enemy echelonment; for example, the duration should cover the time when the first echelon enters the main battle area through culmination of the second echelon.
- Change the times to 12 hours, 48 hours, and 15 days.
- Change the times to 4 hours, 18 hours, and 48 hours.
- Align all systems that have the RCU-controlled MOPMS with a command-detonation option.
- Increase the availability of scatterable mine Class V supplies (ammunition).

Raptor. Previously called the intelligent minefield (IMF), the Raptor is both a weapon and an information-collection system, which makes it hard to categorize. The system consists of air-delivered acoustics sensors, Hornet munitions, a gateway, and a ground-control station (Figure 2). Several suggested improvements to the Raptor concern safety and utility. The group thought the Hornet should have a disarm-and-reuse capability after it is fully armed. Currently the Hornet can be redeployed before final arming, but it either self-destructs at a preset time or is remotely command detonated when fully armed.

Conclusion

The ENFORCE Conference breakout sessions keep leaders of the Engineer Regiment informed of ongoing issues. Feedback gathered during the sessions will be extremely helpful in developing future doctrine and engineer systems. Your continued interest and support are appreciated.

Standardized Training Using Engineer Qualification Tables

By Sergeant First Class Russell Marth

The Army's new standardized qualification tables for engineers will enable every unit to have the same level of training and readiness. For many years, the Engineer Branch has operated without a common single training standard for weapons, demolitions, and mines. The Armor and Infantry Branches have used qualification tables for over 25 years, which gave them a significant advantage for justifying ammunition, terrain, and range use.

Engineer Qualification Tables	
Table/ Appendix	Title
I	Individual/Crew Weapons Qualification
II	Leader Demolitions and Mine Qualification
III	Individual Demolitions and Mine Proficiency
IV	Individual Demolitions and Mine Qualification
V	Preliminary React to Contact
VI	Preliminary Training Course
VII	Intermediate Proficiency Course
VIII	Intermediate Qualification Course
IX	Advanced React to Contact
X	Advanced Training Course
XI	Advanced Proficiency Course
XII	Advanced Qualification Course
A	Metric Conversion Chart
B	Engineer Ammunition
C	Engineer Qualification Table Work Sheets

The need for engineer qualification tables (EQTs) was established in the 1995 Senior Engineer Leader Training Conference. An ever-decreasing training budget and the increasing scope of employment and versatility of the force compounds this need. Breakout sessions held during the 1996 and 1997 Engineer Force (ENFORCE) Conferences established the framework for the EQTs.

Unit representatives from the ENFORCE sessions agreed that the U.S. Army Engineer School should create one set of tables to encompass all combat engineers, regardless of TO&E or component—*One Regiment, One Fight, One Set of Tables*. School personnel organized unit suggestions into twelve tables that mirror the Infantry and Armor gunnery tables. This design allows the three Army branches to speak the same language at training and resource meetings. The EQTs were then fielded to the entire engineer force for review, posted to the engineer home page, and reviewed at a 1997 ENFORCE breakout session. After those recommendations were incorporated, the revised version was staffed for review by engineer brigade commanders from selected engineer units. Final recommendations were incorporated in the EQTs and briefed to a council of colonels on 27 October 1997.

The new standardized EQTs permit sequential training and qualification of engineer units, progressing from individual to squad to platoon qualifications. Leaders are also qualified to ensure they are proficient at the tasks they will evaluate. The qualification process defines training readiness during mobilization, post mobilization, deployment, and sustainment at any location.

Squad and platoon tables contain foundation drills and tasks that combat engineer units must be able to accomplish to support maneuver forces during combined arms or joint operations. The unit commander can tailor the EQTs for the unit mission and the mission-essential task list (METL) by adding additional tasks and drills.

A combat scenario included in the EQTs is a vehicle for task execution. Embedded tasks are intended to be trained in this scenario or in a scenario created by the unit, as long as the tasks are directly linked to combined arms training strategies. While the scenario is not the only means of execution, it ties all tasks to the mission and allows effective use of training resources.

Authorization provided in DA Pamphlet 350-38, *Standards in Weapons Training* (Standards in Training Commission [STRAC]), is the basis of resource allocation for executing the tables. However, the EQTs are not constrained by those authorizations. Since the unit can tailor the EQTs to their METL and mission, ammunition use may vary. Appendix B is a feedback form designed to capture data and provide the Engineer School the amount of Classes IV and V materials used during the EQTs. The school will use data on these forms to justify future STRAC adjustments. Appendix C provides a method of recording the qualification status of individuals and units.

The final version of TC 5-150, *Engineer Qualification Tables*, is dated 16 June 1998. It is on the Engineer Center home page.

Sergeant First Class Marth is a senior combat analyst and writer in the Directorate of Training and Doctrine, U.S. Army Engineer School. He is an MOS 12B40 soldier with 17 years of service.

Commissioned Officer Development and Career Management:

Engineer Chapter of DA Pam 600-3 Revised

By Major David Hartley and Captain Aaron Walter

Officer Personnel Management System (OPMS) XXI is a new officer professional development and management system designed to build an officer corps that will fulfill future needs of the Army and the nation. The revised Department of the Army Pamphlet 600-3 (DA Pam 600-3) addresses officer professional development and career management under OPMS XXI. Army officers will use it as a road map when making career decisions based on OPMS XXI. DA Pam 600-3 is scheduled for publication in October 1998, so that officers will have it before the new Career Field Designation (CFD) boards convene in FY99.

The Engineer Personnel Proponency Office (EPPO) submitted a revised Engineer chapter to update DA Pam 600-3 in February 1998. This chapter includes current features of the Engineer Branch, required officer characteristics, engineer officer development information, and an updated section on engineer Reserve Component (RC) officers. The Engineer chapter provided for the updated DA Pam 600-3 is available on the Fort Leonard Wood web site (www.wood.army.mil/EPPO/eppo_hp.htm).

Some of the most significant changes to the Engineer chapter pertain to engineer officer development. This section describes branch qualification, education, leader development and command preparation, and assignments for each grade. Figure 1, the Engineer Life Cycle Development Model (Active), highlights the redefined branch qualification requirements for each grade. Other changes include goals of

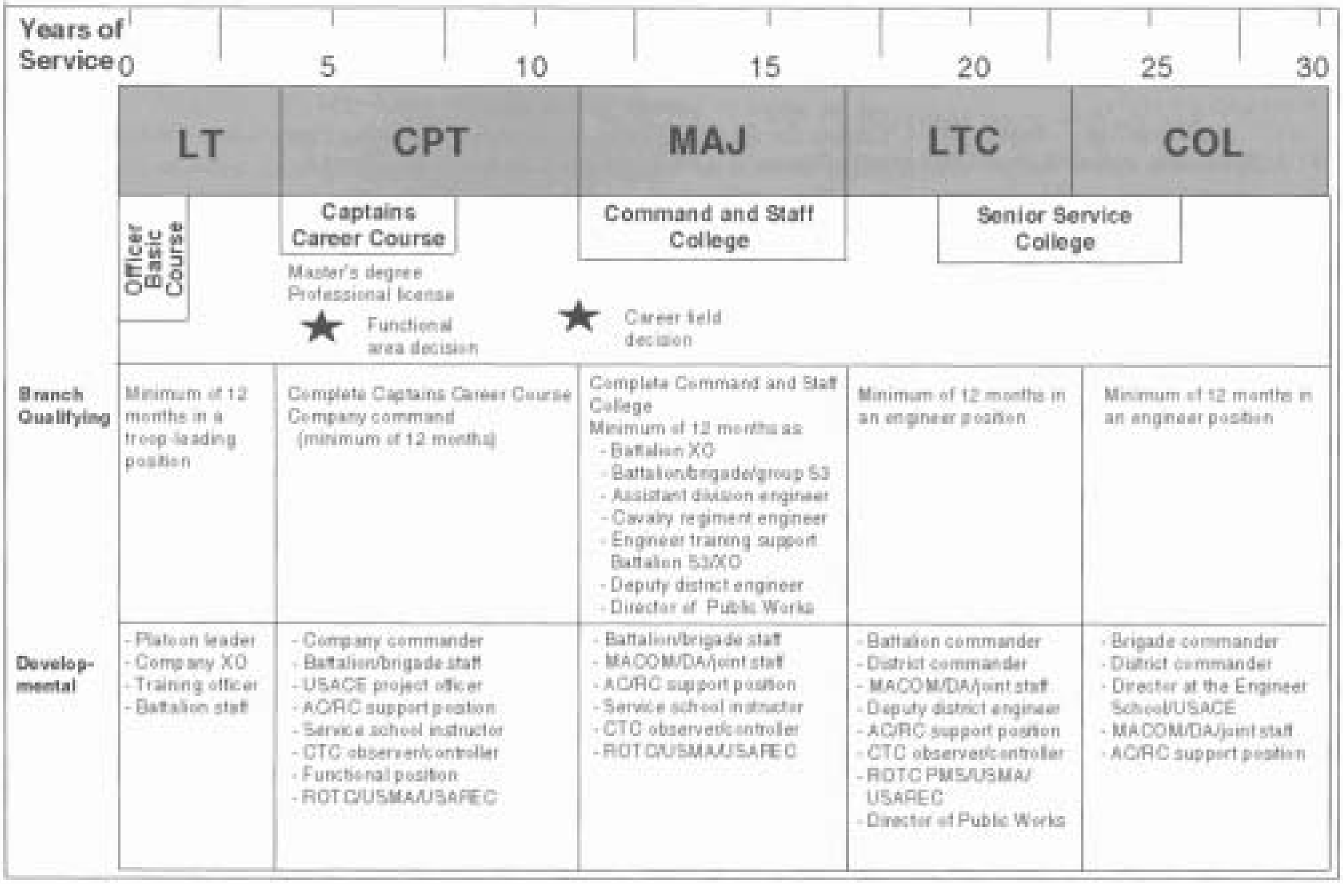


Figure 1. Engineer Life Cycle Development Model (Active), from Figure 16-1 in DA Pam 600-3.

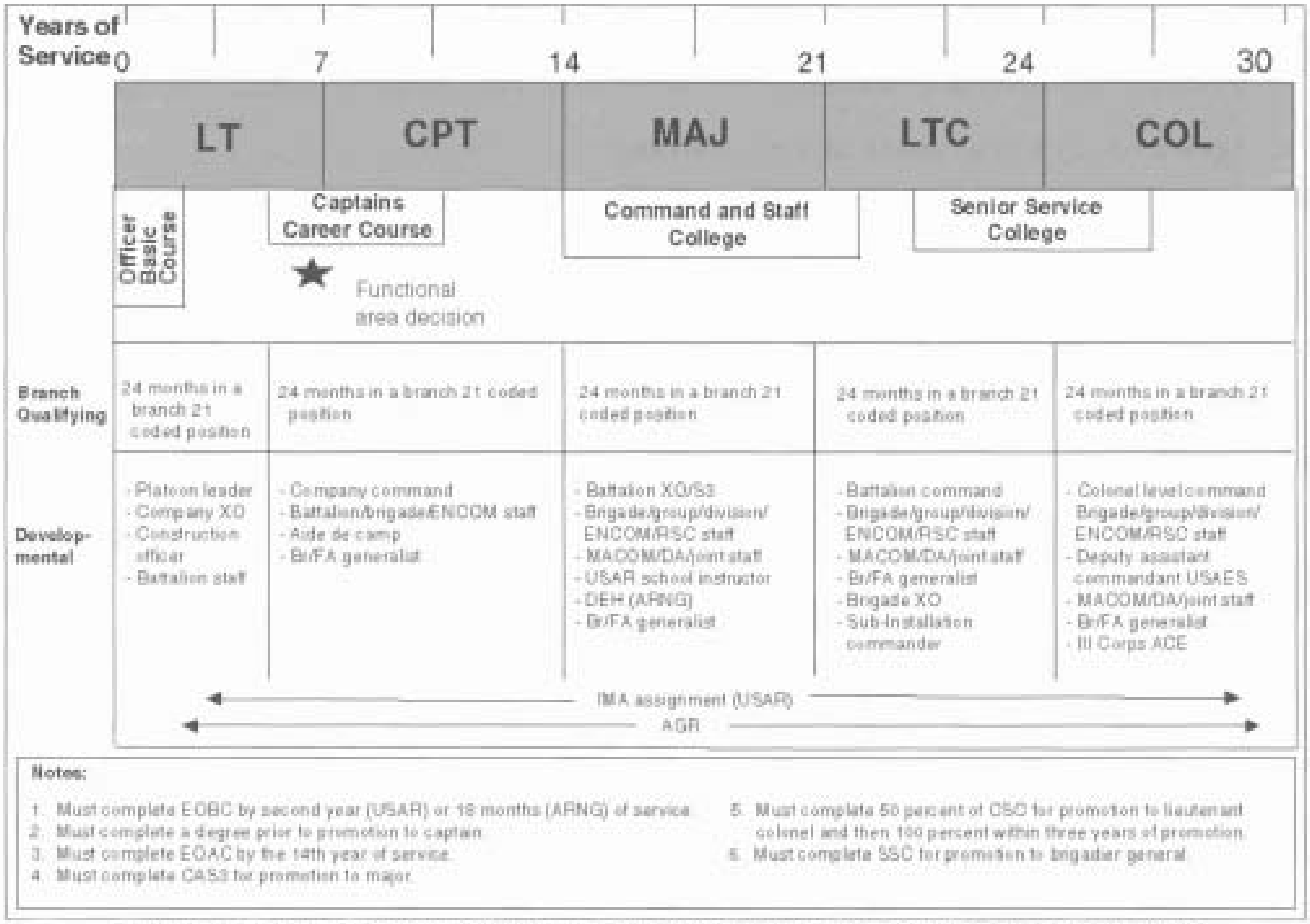


Figure 2. Engineer Life Cycle Development Model (Reserve), from Figure 16-2 in DA Pam 600-3.

15 to 18 months in command for captains and 18 to 24 months in one of the listed positions for majors. These goals are desirable for leader development and unit cohesion, as defined in the leader development and command preparation sections for these two grades.

Several changes in the updated DA Pam pertain to RC engineer officers. These changes are shown in Figure 2, the Engineer Life Cycle Developmental Model (Reserve) (from the Engineer chapter), and are briefly described below:

- Officers must complete the Engineer Officer Basic Course (EOBC) by the second (not third) year of service.
- Officers must complete a bachelor's degree before promotion to captain.

The Engineer Officer Advanced Course (EOAC) and the Combined Arms Services Staff School (CAS3) have been integrated. The new course is called *Captains Career Course*. AC and some RC engineer officers attend an 18-week EOAC, which is immediately followed by six weeks of CAS3. Most RC engineer officers, however, will continue to attend EOAC and CAS3 in its current format until EOAC-RC is reconfigured and other details are worked out.

For more information on OPMS XXI, visit the OPMS XXI web site (www.army.mil/opms) or the AR-PERSCOM web site at (www.army.mil/usar/ar-perscom/ppo.htm).

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Captain Walter (AGR) is the Engineer Branch Personnel Proponent Integration Officer at the Army Reserve Personnel Command (AR-PERSCOM) in St. Louis, Missouri. He can be reached at (314) 538-2737 or DSN 892-2737. His e-mail address is AARON.WALTER@arpstl-emh2.army.mil

Who Are Engineer Warrant Officers?

By CW4 Clinton Parker, CW4 Fred Tressler, and CW4 Gilbert Rios

Perhaps the least understood soldiers in the U.S. Army are warrant officers, who are appointed by warrant of the Secretary of the Army. They are highly specialized experts and trainers who—by gaining progressive levels of expertise and leadership—operate, maintain, administer, and manage equipment, support activities, and technical systems throughout the Army's diverse branches. More than 25,000 active and reserve soldiers are warrant officers, who serve in specialties ranging from helicopter pilot through veterinary services technician to legal administrator.

Engineer Warrant Officers

The Corps of Engineers is the proponent for two warrant officer military occupational specialties (MOSs)—Utility Operation and Maintenance Technician (210A) and Terrain Analysis Technician (215D). Until October 1994, the Corps of Engineers was also proponent for the Engineer Equipment Repair Technician MOS (919A), but now engineers have only training responsibility for this MOS, and the Ordnance Corps has all other responsibilities. Table 1 shows the enlisted feeder MOSs for accession into these warrant officer MOSs.

About 80 percent of engineer warrant officers are in the Reserve Components, which consists of the Army National Guard (ARNG) and the U.S. Army Reserve (USAR). Their missions span the military and civil engineering spectrum.

Duties

Most positions in the three warrant officer MOSs are coded for particular grades. Specific duties for each grade are shown in Table 2, page 25.

MOS 210A

Utility Operation and Maintenance Technicians organize and manage personnel and organizations that provide engineer support on the battlefield and in rear areas. They plan, organize, and supervise the maintenance and repair of utilities equipment to support commanders engaged in real property maintenance activities, such as rehabilitating or remodeling and upgrading existing facilities. They maintain fixed or mobile electrical power plants (Prime Power Teams), install or set up deployable medical hospitals, and install and maintain high-voltage electrical power lines.

MOS 215D

Engineer Terrain Analysis Technicians provide geographic information in digital and hard-copy forms, so that maneuver commanders and staff elements can visualize the terrain and formulate possible courses of action early in the decision-making process.

MOS 919A

Engineer Equipment Repair Technicians manage, supervise, and coordinate general support maintenance activities for engineer equipment and direct maintenance and supply management operations. In staff positions, they assist and advise commanders in areas pertaining to maintenance and maintenance operations. They also serve as training implementers and developers, combat developers (equipment), and maintenance officers.

Opportunities

A career as a warrant officer offers rewarding opportunities for leadership and growth. It also demands great dedication and the highest moral character.

Warrant officer candidates must have above-average skills, demonstrated ability, and supervisory experience in a particular feeder MOS. Their highly specialized skills are warrant officers' most vital contribution. Civilian education and experience may substitute for some military training and experience.

In addition to MOS qualifications, warrant officers execute numerous managerial functions. They are expected to keep abreast of changes in equipment, organization, and procedures in their specialty.

Male or female NCOs, E5 or higher, may have what it takes to become a warrant officer. The Army's goal is to appoint NCOs with eight or fewer years of service in either the Active or Reserve Components as warrant officers. Applicants with concurrent orders to active duty should not exceed 12 years of active Federal service.

Table 1

Warrant Officer Accession Sources	
Warrant Officer MOS	**Enlisted Feeder MOS**
210A	51B Carpentry and Masonry Specialist
	51H Construction Engineering Supervisor
	51K Plumber
	51R Interior Electrician
	52C Utilities Equipment Repairer
	52D Power Generation Equipment Repairer
	52E Prime Power Production Specialist
	52G Transmission and Distribution Specialist (Reserve)
215D	81T Topographic Engineering Specialist
919A	52C Utilities Equipment Repairer
	52D Power Generation Equipment Repairer
	62B Construction Equipment Repairer

Table 2

Warrant Officer Duties	
MOS	Grade
210A	**WO1/CW2** ■ Assigned to combat support and evacuation hospitals. ■ Supervise organizational maintenance of wheeled vehicles, mobile medical support equipment, and utility power plants. ■ Repair, modify, and rehabilitate utility systems and subsystems, facilites, structures, power plants, station hospitals, and mobile hospitals. **CW3/CW4** ■ Command separate detachments that produce prime power. ■ Plan and supervise expedient vertical construction and rapid rehabilitation of structures, facilities, and utilities. ■ Repair interior and exterior of facilities (carpentry, masonry, plumbing, electrical work, and painting). ■ Plan, design, and contruct base camps. **CW5** ■ Serve as supervisor or advisory manager or in a staff position.
215D	**WO1/CW2** ■ Work at division level, usually as Terrain Analysis Detachment commanders. ■ Support the G2 on intelligence preparation of the battlefield. **CW3/CW4** ■ Serve on theater topographic battalion staffs, echelons above corps, and at major regional commands to help formulate topographic and terrain analysis requirements. ■ Serve as project officers at the Engineer School's Department of Training and Doctrine or Directorate of Combat Developments, where they develop engineer doctrine and identify mapping, charting, and geodesy requirements to support a mobile army in a digital environment. **CW5** ■ Work at the Topographic Engineering Center to help identify and coordinate research and development initiatives to meet the technical and automation needs of tomorrow.
919A	**WO1/CW2** ■ Assigned to engineer, ordnance, and transportation (terminal service) companies and battalions. ■ Supervise engineer and nonengineer equipment maintenance. ■ Oversee repair of equipment for power generation; earth moving, shaping, compacting, lifting, and loading; quarrying; rock crushing; road surfacing; refrigeration and air conditioning; and engineering electronic equipment. **CW3/CW4** ■ Assigned to engineer battalions and ordnance companies (heavy and light divisions). ■ Supervise organizational and direct support maintenance and staff responsibilities. ■ Supervise general support maintenance activites for engineer equipment. ■ Oversee repair of power generation, earth moving, refrigeration, air conditioning, and other engineer and nonengineer equipment. **CW5** ■ Serve in staff positions at brigade level or higher, assisting and advising commanders in areas pertaining to maintenance and maintenance operations. ■ Provide maintenance expertise in ordnance, engineer, airborne, and light and heavy divisional and nondivisional units.

Additional requirements are a high school diploma, a general technical score of 110 or higher, and an enlisted feeder MOS.

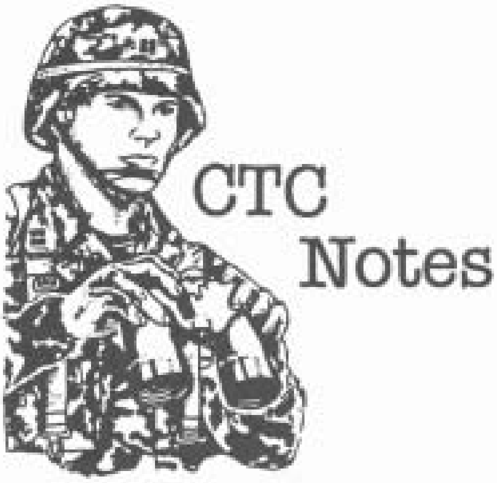
Warrant officer candidates must complete the Warrant Officer Candidate Course at Fort Rucker, Alabama, before attending the Warrant Officer Basic Course at Fort Leonard Wood, Missouri.

Army Regulation 611-112, *Manual of Warrant Officer Military Occupational Specialties*, Chapter 5, and Department of the Army Circular 601-94-1, *Warrant Officer Procurement Program*, provide detailed information on application procedures; or call CW4 Tressler at (573) 563-4088. To learn more about warrant officer history, visit the Warrant Officer web site at *http://leav-www.Army.mil/wocc.*

CW4 Parker is a training analyst at the U.S. Army Engineer School. A graduate of the Warrant Officer Staff and Advanced Courses, he holds a master's degree in management from Webster University.

CW4 Rios is a terrain analyst technician, U.S. Army Engineer School. A graduate of the Warrant Officer Staff and Advanced Courses, he holds a bachelor's degree from Austin Peay State University.

CW4 Tressler is the warrant officer coordinator in the Engineer Personnel Proponency Office, U.S. Army Engineer School. A graduate of the Warrant Officer Staff and Advanced Courses, he holds a bachelor's degree from Columbia College.



Joint Readiness Training Center (JRTC)

Survivability and Force Protection Operations in the Light Brigade Combat Team

By Captain John DeJarnette

Force protection operations are essential for a unit to be successful on the lethal, modern battlefield. Critical equipment and supplies must be protected from observation and attack. As stated in FM 5-103, *Survivability*, "Setting survivability priorities is a maneuver commander's decision based on the engineer's advice."

Units rotating through the JRTC typically struggle with planning and executing survivability and force protection operations. Most engineer planners do not clearly plan or effectively communicate their recommendations for survivability missions. Maneuver commanders generally do not place priority on the execution of survivability operations, and most soldiers and leaders do not know the standards for constructing individual and collective survivability positions. Guidance to help soldiers successfully plan and execute fortification and survivability operations follows.

Survivability Planning

Issue

Engineer company commanders and brigade engineers must prepare explicit plans for survivability operations and include this information in the brigade operations order. Omission of a clear, executable survivability plan is partly due to the lack of a clear doctrinal procedure for planning survivability operations at the brigade level. FM 5-7-30, *Brigade Engineer and Engineer Company Combat Operations*, thoroughly discusses the force protection planning process but does not provide sample survivability planning and execution products. Most engineer company leaders do not understand how to extrapolate the generic force protection planning process for tactical survivability operations. As a result, standard fortification priorities, work estimates, and sample planning and execution products are not included in their engineer and maneuver tactical standing operating procedures (TACSOPs).

Technique

Complete the following steps:

1. Identify all assets within the brigade. List the company-level organizations and major company assets in a matrix format. Explicitly state the command and control nodes, special signal equipment, major weapon systems, and high-value combat service support (CSS) assets that companies will control when they are task organized for operations. Include specialty units such as advanced trauma lifesaving teams, battalion mortars, combat trains, and forward aviation refuel/rearm points.

2. Prioritize the assets. Clearly state the priority of weapon systems within a given unit and the general priority of units.

3. Group the companies spatially as they will be arrayed on the battlefield. Recommended groupings are the brigade support area, forward logistics elements, forward aviation assembly areas, artillery batteries, tactical operations centers, the maneuver battalion, and signal nodes.

4. Prepare work estimates for the protective systems required to counter the anticipated threat. Consider preparing estimates to address three general threat levels. For example, Level I generally addresses subversives and criminals capable of small arms direct fire and mortar attack; Level II focuses on the addition of terrorists capable of stationary and moving vehicle bombs; and Level III addresses direct attack by a company-sized or larger element with cannon artillery indirect fire capability.

The resultant planning matrices are a useful reference for unit TACSOPs and initial force protection planning. The threat evaluation and the commander's priorities are then incorporated into the survivability execution time line prepared by the engineer company. Survivability priorities for each weapon system and unit must be included in the maneuver brigade and battalion base operation orders to avoid conflicts when the force protection plan is executed.

Survivability Missions

Issue

Maneuver commanders must establish clear command and control of engineer digging assets and aggressively monitor execution of the fortification plan. Maneuver and CSS battalions typically appoint a maneuver leader as "CINC Dozer" only during deliberate defensive operations. During offensive, stability, and support actions, the engineer equipment platoon leader often must decide how to execute the brigade fortification plan. When command and control is inadequate for the brigade force protection effort, several problems may emerge:

- The engineer unit and the customer unit fail to coordinate their work efforts before the blades arrive at the supported unit. This situation occurs when survivability sections in unit TACSOPs are poorly written and when units do not associate habitually during routine field training.
- Engineer equipment supervisors are not integrated into the advance parties of the supported unit. As a result, the supported unit receives no technical advice on how to site and mark survivability and protective positions. Inadequate coordination early in an operation results in wasted time and effort for both the customer and the engineer and inefficient use of engineer equipment. Drainage is a critical task that generally is not addressed and often is omitted when engineers are not part of the supported unit quartering party. The cumulative result of poor engineer integration is unnecessary disruption of the supported unit's operations in order to construct appropriate fortifications.
- When construction standards are not well documented, the engineer equipment supervisor usually receives conflicting guidance from the supported unit's first sergeant, the unit commander, and supported unit equipment crews. Poor coordination almost always results in wasted blade time and considerable frustration for both the engineer and supported unit leaders.

Technique

- Each customer unit should appoint a senior leader as "CINC Dozer." Establish graphic control measures such as logistics release points, checkpoints, or coordination points where engineer equipment teams will link with supported units.
- Coordinate early and train habitually with supported units to establish shared expectations.
- Document unit fortification requirements in the TACSOPs. Engineer equipment supervisors routinely should be part of the advance party of the supported unit to ensure that survivability positions are marked before the engineer and supported unit equipment arrives. This practice allows the supporting engineer unit to prepare fortifications before the main body of the customer unit arrives. It also allows the supported unit's chain of command to verify the overall layout of the unit's position.

Issue

Security of blade teams during movement is a continuing problem. Most maneuver brigades require the supported unit to provide security when this equipment is moved to battle positions or assembly areas. While this technique seems logical during a briefing, it is extremely difficult to execute. Because CSS units and infantry rifle companies lack vehicles with mounted weapons to escort the blade teams, engineer equipment frequently moves around the battlefield without escort or security. As a result, engineer equipment is frequently lost, damaged, or destroyed, and the brigade's fortification effort is significantly delayed.

Technique

The maneuver commander should dedicate a security element to escort engineer equipment to work sites. The security element should come from either the Delta Company of an infantry battalion or a Military Police section. Ensure that both the customer unit's "CINC Dozer" and the security escort unit know where and when to link up. Clearly state radio frequencies and call signs for link-up operations in the fragmentary order or operations order that directs survivability operations. Consider using existing CSS or maneuver graphic-control measures such as logistics-release points, traffic-control points, or coordination points as link-up locations for engineer equipment.

Construction Standards

Issue

Both engineer equipment operators and supported unit leaders must clearly understand fortification and digging standards. Because most maneuver leaders are not well versed in survivability construction standards, protective positions generally are substandard. Overhead cover and bunkers rarely are constructed to standard. Some are unsafe because soldiers don't know the construction standards and leaders don't check construction quality.

Technique

Document survivability position standards in brigade, battalion, and company TACSOPs. Require that both supporting engineer unit leaders and supported unit leaders inspect the construction standards of survivability positions. Quality-control inspections are particularly important for equipment not covered in FM 5-103, such as air-defense and fire-finder radar, signal intelligence equipment, and mobile subscriber equipment vans.

Battle Tracking

Issue

Maneuver commanders and their staffs must aggressively monitor the execution of force protection plans. When the survivability effort is not closely tracked, critical assets may be unprotected for long periods and survivability operations may react only to enemy events. When maneuver commanders are unaware of delays in survivability construction, they cannot adjust work and equipment priorities to support their main effort.

Technique

Include survivability levels and work priorities in the unit TACSOPs. Task force and brigade engineers should brief the execution status of the survivability construction effort daily at the commander's update.

Summary

Fortification and force protection operations at the Joint Readiness Training Center historically have not been well planned or well executed. Units can reverse this trend by applying the force protection planning process and by incorporating standard survivability planning and execution products in their unit SOPs.

Captain DeJarnette is the Engineer Company Observer/Controller at the Joint Readiness Training Center, Fort Polk, Louisiana.

Battle Command Training Program (BCTP)

Obstacle-Control Measures as a Synchronization Tool

By Lieutenant Colonel Ron Light

In the August 1997 issue of *Engineer* (page 42), LTC Dave Snodgrass discusses obstacle-control measures and effect intents. This excellent article is worth review, particularly for those serving at corps or division levels. In the article, LTC Snodgrass notes that all unit staff officers are familiar with obstacle-control measures, but few of them effectively use the obstacle zones and effect intents.

Recent BCTP Warfighter exercises indicate this inefficiency remains. Engineer staff officers fail to synchronize the mobility and survivability battlefield operating system (BOS) with the maneuver plan, especially during defensive operations. Engineers usually could achieve greater synchronization through the judicious use of obstacle-control measures and effect intents. The following information continues the discussion of how to improve synchronization of the engineer effort with the maneuver plan. I focus on division-level operations, although the lessons are essentially the same for engineer staff officers at corps, division, or brigade levels.

FM 5-71-100, *Division Engineer Combat Operations*, lists three obstacle-control principles that can help engineer staffs achieve synchronization. Obstacle zone planning is guided by these principles:

- Support the division commander's intent and scheme of maneuver.
- Balance maximum flexibility versus a focused obstacle effort.
- Facilitate future operations.

Let's examine these principles to assess how engineers can increase synchronization.

Support the Commander's Intent and Scheme of Maneuver

Engineers must understand the commander's intent and scheme of maneuver, specifically *where the commander wants to kill the enemy and how he wants to shape the battlefield.* Commanders and staffs often complete the military decision-making process (MDMP), but neither the base order nor the engineer annex address a cohesive, division-wide effort to shape the battlefield. Engineer staff officers must press the commander for these details.

Obstacle-zone and effect-intent graphics provide a doctrinal method to convey a common picture showing how the commander wants to shape the battlefield. Most commanders understand the obstacle effects of disrupt, fix, turn, and block. Use of obstacle-zone and effect-intent graphics allows the commander to determine if his plan will shape the battlefield in accordance with his vision and if the engineer effort is synchronized with the scheme of maneuver. These graphics help answer the following kinds of questions: Did we plan to turn the enemy into this high-speed avenue of approach? Do we really want to turn the enemy into this supporting-effort brigade? Do we have enough time and materiel to block the enemy across the entire division zone, and how will he react to that? Is my counterattack route free of friendly obstacles?

Doctrine does not require that the division commander use obstacle-zone and effect-intent graphics. The commander can specify how he wants to shape the battlefield and where he wants to kill the enemy in the intent narrative or in the scheme of maneuver. This rarely occurs, and when units attempt a narrative, it is often long and confusing. A simple graphic showing obstacle zones and effect intents can convey more than several paragraphs of text. Whichever method is used, the *entire division*—all staff officers and all subordinate units—must clearly understand how the commander wants to shape the battlefield. This is where synchronization starts.

Balance Flexibility Versus Focused Obstacle Effort

Experience gained at Warfighter exercises suggests that the engineer effort is not synchronized with the scheme of maneuver due to too much flexibility rather than too much control. In a desire to provide brigades with maximum flexibility, the commander and his staff often underprescribe obstacle-control measures and effect intents. The division engineer and his staff do not *focus* the division obstacle effort. The overall intents for division obstacle zones are left to subordinate brigades.

The lack of engineer focus also affects other staff areas. The staff engineer and the division G4 often allocate resources (such as Volcano systems and Class IV/V obstacle materials) to brigades in a way that does not support the scheme of maneuver. In an effort to be strong everywhere the unit ends up being strong nowhere, and mass is not achieved. To achieve a balance between obstacle control and subordinate unit flexibility is an art. Doctrine admonishes us to "get ahead of the enemy's decision cycle." Greater control—through the use of obstacle effect and intent graphics—makes sense on a dynamic battlefield where the staff must consider an end state that supports future operations.

Facilitate Future Operations

Effective use of obstacle-control measures facilitates future operations. Ineffective obstacle-control measures often result in disaster and chaos. Without a clear understanding of how the scheme of maneuver and obstacle plan "nest" within their higher headquarters' missions, subordinate unit leaders plan and conduct their fights independently. Brigades construct obstacles without regard to division-level counterattack routes or main supply routes. Self-destruct times for scatterable mines are not synchronized with the division plan. The division does not achieve the principles of war of mass, economy of force, offensive, and unity of command, because each succeeding echelon's concept of the operation is not nested in the other.

Obstacle-control measures should support future operations while *maintaining a degree of flexibility for the commander.* This is true for both offensive and defensive operations, which is a fact most engineer staff planners overlook. Just as engineers should plan a breach operation from the objective back to the line of departure, obstacle-control measures should support the operation from the end state of at least each phase of an operation back to the beginning of that phase.

When engineers fail to apply the three obstacle-control principles, the results are predictable: Without a clear understanding of how they are to shape the battlefield, subordinate units fight their sectors with little regard to the overall division fight. Other staff officers do not effectively weight their BOS to achieve mass. When the enemy's main effort becomes clear to the division, the commander is unable to defeat the attacker because the maneuver units cannot mass and counterattack routes are impassable. The enemy then defeats the maneuver brigades one at a time.

By using obstacle-control measures effectively, we can improve our ability to synchronize engineer operations with the scheme of maneuver. The obstacle-control principles listed in FM 5-71-100 provide division engineers and their staffs with a test of countermobility plans: Does my plan support the commander's intent and scheme of maneuver? Is it evident to subordinate units where and how the commander wants to shape the battlefield and kill the enemy? Does the plan provide for future operations? Evaluate your plan against these principles and METT-T, and determine if the engineer plan is synchronized with the scheme of maneuver. This evaluation allows you to gain a proper balance between obstacle-control measures and subordinate unit flexibility, and it will show the degree to which you must utilize obstacle-control measures.

Lieutenant Colonel Light is an observer/controller for the Battle Command Training Program at Fort Leavenworth, Kansas. He previously served as the S3 and XO of the 168th Engineer Battalion, 3rd Brigade, 2d Infantry Division, Fort Lewis, Washington.

National Training Center (NTC)

Increasing ABE Proficiency

By Captain Shawn McGinley

Recent rotations at the NTC have shown that the majority of assistant brigade engineers (ABEs), while working hard and accomplishing some great things, have been unable to fully develop themselves or their sections in providing continuous mobility and survivability support. Part of the problem is the lack of a mission training plan (MTP) that addresses tasks an ABE must accomplish. The only reference is the 1989 version of the Headquarters and Headquarters Company, Engineer Battalion, Heavy Division MTP.

Observations from past rotations have shown that to be proficient in their duties, ABEs must accomplish the following tasks for each mission:

- The engineer battlefield assessment (EBA)
- Terrain analysis
- Situational obstacle planning
- Engineer-related input to the brigade combat team (BCT) order

Observations and recommended solutions follow.

Engineer Battlefield Assessment

Observation

- ❐ Most ABEs are proficient in the elements that make up the EBA but seldom complete them due to poor time management skills. Many units train using computer simulations and are unprepared for the battlefield friction the NTC imposes on them.

Recommendations

- ❐ ABE sections and engineer battalion plans sections must incorporate time constraints, battlefield friction, and stresses of continuous operations in their home station training.
- ❐ Units should prepare detailed standing operating procedures (SOPs) that include the distribution of labor within the ABE and engineer battalion plans sections.
- ❐ Units should cross train all members of the ABE and engineer battalion plans sections to increase their flexibility.

Terrain Analysis

Observations

- ❐ The brigade staff does not appreciate how significantly terrain will impact BCT operations.
- ❐ Many ABEs brief terrain only in general terms (mountain high, valley low) and fail to discuss OCOKA (observation and fire, cover and concealment, obstacles, key terrain, and avenues of approach).
- ❐ Mission-specific terrain products are produced too late to assist the BCT and task-force-level planning.

Recommendations

- ❐ The BCT staff must allow sufficient time during the military decision-making process (MDMP) for the ABE to brief the impacts of terrain in detail.
- ❐ The ABE section must anticipate mission-specific requirements and produce terrain products early in the planning process.
- ❐ Everyone in the ABE section must be proficient in using TerraBase II software.

Situational Obstacle Planning

Observations

- ❐ The brigade staff plans situational obstacles only where the BCT expects to make decisive contact with the enemy.
- ❐ ABE and BCT staffs do not synchronize the observer and trigger plan for employing situational obstacles.
- ❐ The ABE section assigns engineer companies "mission impossible" situational obstacle tasks.

Recommendations

- ❐ Situational obstacles must be planned throughout the depth and width of the BCT zone. The enemy may not do what we want him to do!
- ❐ The observer must see the trigger (TerraBase II software helps with this). If he cannot, the observer must move, another observer must be put into position, or the BCT should forget about that planned situational obstacle.
- ❐ All planned, brigade-level situational obstacles should be war-gamed during the MDMP. The BCT staff must address the feasibility of employing situational obstacles based on the enemy situation and the employment system.

Engineer-Related Input to the BCT Order

Observations

- BCT base orders lack engineer-specific details to assist the BCT with executing missions.
- Brigade S3s do not allow ABEs to include critical engineer-related tasks—specifically subunit and coordinating instructions—in the base order.
- Many BCT subunits receive the brigade order but fail to read the engineer annex. Thus, the subunits do not accomplish critical engineer-related BCT tasks listed in the engineer annex.
- BCT orders rarely include survivability and countermobility time lines.

Recommendations

- Engineer battalion leaders must ensure that home station training for BCT staffs focuses on including critical engineer-related tasks in the BCT base order.
- The BCT order must include survivability and countermobility time lines to facilitate task-force-level planning.

Information in this article will help assistant brigade engineers as they plan home station training strategies. It does not describe all of the many tasks ABE sections must accomplish. While the ABE position may be deleted in future engineer battalion tables of organization and equipment, the mobility and survivability tasks discussed above will not go away. Therefore, engineer battalions must plan to do more with less. The above recommendations will help ensure that engineers provide quality mobility and survivability support and remain an integral part of the brigade combined arms team.

Captain McGinley is attending the College of Naval Command and Staff. He served as an observer/controller at the National Training Center, Fort Irwin, California, from 1996 to 1998.

MANEUVER SUPPORT BATTLE LAB NEWS

Soldiers from B Company, 5th Engineers, recently wear tested a new, lightweight chemical protective textile material at Fort Carson. B Company soldiers conducted mobility, countermobility, and survivability operations in support of 1/3 ACR.

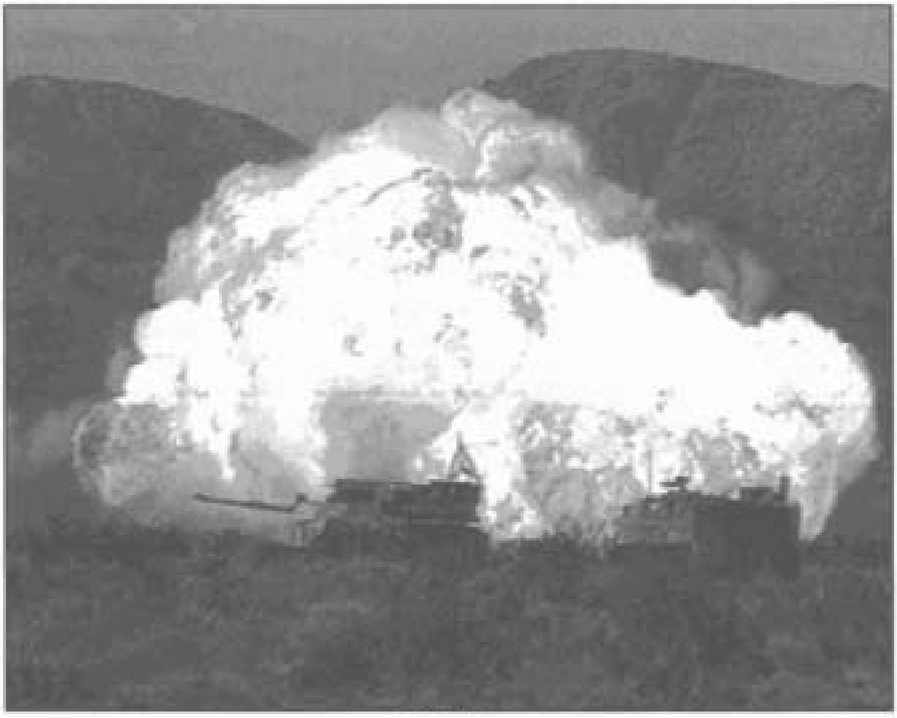
SP4 Reyes conducts preventive maintenance checks and services during the chemical protective combat uniform wear test.

Two soldiers from 2d Platoon, B Company, emplace a picket during the test.

Sidewinder Team Situation Report

By Lieutenant Colonel Richard Graves

Units rotating through the National Training Center (NTC) may have noticed several changes in the way brigade combat teams (BCTs) and their engineer battalions execute training missions. While none of the changes are revolutionary, collectively they substantially improve the quality and realism of training. Some changes contradict current rules of engagement, and many are innovations developed by units at home station and "tried out" during their NTC rotation. We provide the following information to units during their Leader Training Program and present it here to assist leaders as they develop their home-station training.



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Training Scenario

The Opposing Force is still the toughest enemy in the world, bar none. We have not changed the traditional mix of five force-on-force fights and two live-fire missions, with their usual assortment of attacks, movements to contact, and defense in sectors. The observer/controller (OC) and the platoon and company after-action review process are still the heart and soul of the NTC. The Sidewinder Team continues to provide as many instrumented battalion after-action reviews as possible, with focused reviews based on unit requests or OC recommendations.

What has changed for some BCTs is the addition of one to three days of division-directed rehearsals (DDRs) at the beginning of a rotation. DDRs are OC-directed situational training exercises (lane training), with the first day being platoon-level events and the second and third days company team and task force combined-arms events, respectively. First-day DDRs conducted by the Sidewinder Team include tasks from the engineer qualification tables. If your BCT plans to execute DDRs in either format, we suggest you coordinate early with the Sidewinder Team to establish a lane composition that meets your training objectives.

Another change to recent rotations is the inclusion of one or more flex missions in the scenario. These missions are BCT flexibility "gut checks." With from zero to 12 hours notice before execution, the BCT's higher headquarters—the 52d Mechanized Infantry Division—passes a fragmentary order to expand or contract boundaries, change objective locations, or even change the entire mission.

In addition to the normal planning requirements, we suggest that units assemble checklists of planning, preparing, and executing considerations for all likely missions before the rotation.

Training Realism

As a secondary role, OCs provide realistic battlefield effects. We have made several changes to better replicate expected battlefield effects and help units meet their training objectives. For example, we reintroduced the mine effects simulator (MES) for both the Blue and Opposing Forces. When the magnetic field of the MES is disturbed, it sends a pulse that kills all MILES II-equipped personnel and vehicles within its 10-meter killing radius. Employment requires an extra step—shunting two contacts on the

MES—but the payback is a more robust minefield obstacle.

The NTC has long been behind the times with respect to demolition effects simulators (DES). The rules of engagement allow DES on an exceptional basis. However, the NTC Standards in Training Commission (STRAC) Table 10-3 allocation for live-fire Class V materials does not provide enough detonation cord for breaching operations, much less DES construction. The Fort Irwin Training Support Center (TSC) does not stock the necessary cardboard tubes, clay, chalk, etc., so training units are not inclined to use DES.

Engineer battalions have successfully overcome these obstacles and learned that constructing and employing DES substantially improves force-on-force realism. The units used Class V materials allocated for live fire, but with a little planning, they can transfer sufficient Class V materials from their home-station to the NTC for this purpose. For a long-term fix, the Sidewinder Team is working with the TSC to procure the construction materials. The team is also working to change the STRAC allocation to provide more Class V materials for breaching and DES and to include modernized demolition initiators (MDIs). Until the STRAC allocation is changed, units can either transfer MDI from the home station to the NTC or conduct conventional initiating systems training at home station to prepare for their rotation.

Another success story involves improvements in scatterable mine employment. The NTC no longer categorically denies unit requests for additional situational obstacle capabilities and longer-duration self-destruct times. Each request is considered on its own merit and unit training objectives. The 52d Mechanized Division engineer reviews the mission, enemy, terrain, troops, and time available (METT-T) conditions before reallocating scarce Class V resources within the division, asking X Corps for additional resources, or granting longer self-destruct times.

Training Innovations

Most battalions bring to the NTC a unique organization, piece of equipment, or tactics, techniques, and procedures (TTP) developed at home station and expect to see how the concept fights. In the past year we have tested several variations of the consolidated blade and Volcano platoon concepts. Centralizing command and control, maintenance, and mission execution need not reduce flexibility or support to maneuver commanders, but this can't be determined solely by reading a manual. The best techniques usually are developed while units execute engineer missions.

Engineer reconnaissance is another task we have tried to improve this year. Engineer-specific intelligence often is poorly collected and disseminated or may not exist. One solution is to attach individuals or teams of sappers to a BCT or to task force scouts. Another option is for independent engineer reconnaissance teams to work for the engineer battalion S2. Most reconnaissance methods achieve some measure of success, and all of them provide training for the commander, staff, and sappers that is attainable only at the NTC.

Some units attach explosive ordnance disposal (EOD) teams or EOD companies to engineer battalions. This is a nondoctrinal solution to the EOD command and control problem (little doctrine exists). Historical precedence for this practice was set in Bosnia by the 1st Armored Division Engineer Brigade. In previous years at the NTC, EOD teams were attached to the forward support battalion in the brigade support area (BSA), with most of their "business" in the BSA. With that configuration, the EOD combat multiplier was seen and felt only on a small portion of the battlefield, and the rest of the BCT received little unexploded ordnance (UXO) procedures training.

With the engineer battalion focused on mobility, and with engineer command and control nodes spread across the entire battlespace from the BSA to the breach site, engineers are the best candidates for integrating EOD teams. Attaching the teams to the engineer battalion achieves a number of important training objectives:

- The BCT develops procedures to identify, report, and track UXO.
- The engineer battalion exercises command and control of attached units.
- The EOD company and team perform missions safely in a tactical environment.

Creating a UXO-rich training environment that more closely replicates wartime hazards and effects on mobility further enhances UXO training.

Conclusion

These innovations, and many we have not heard of yet, have a place at the NTC. Units are not penalized for attacking age-old problems, but solutions may be difficult in this era of ever-dwindling resources. FORSCOM/TRADOC Regulation 350-50-1, *Training at the National Training Center*, is fairly definitive about what units can do. However, requests for exceptions can be sent to the NTC by letter 180 days before the rotation. The Sidewinder Team will help as much as possible with obtaining exceptions and may even be able to provide some TTP ideas. Contact the team by e-mail or though the Sidewinder home page at http://www.irwin.army.mil/sidewinder. The site provides slides used for Leadership Training Program classes on obstacle integration and deliberate breach planning and other items.

Lieutenant Colonel Graves is the Deputy Senior Engineer Battalion Trainer at the National Training Center, Fort Irwin, California. He previously served as chief of the Doctrine Development Division, U.S. Army Engineer School.

Safety Compliance Training

By Major Scotty DeClue and Captain Glenn Gamlin

Ask anyone, in any organization, if he or she believes safety is important, and all will agree that it's one of the most important topics in the workplace. One might ask, "If everyone believes safety is so important, why should we perform safety compliance assessments?" The answer is that not everyone fully understands the safety rules or follows the published rules. *"Safety Rules"* are derived from 29 CFR (Code of Federal Regulations). These legal guides provide specifications for safe operations for people using chemicals or electrical and lifting equipment or who are involved with industrial activities.

The 416th Engineers conduct total facilities assessments (TFAs) at U.S. Army Reserve (USAR) facilities across the continental United States and overseas. The TFA includes an Environmental Compliance Assessment, a Facility Safety Assessment, an Energy Assessment, and a Facility Condition Assessment. The following information describes how to design, develop, and implement a Facility Safety Assessment training program for USAR soldiers.

Members of the USAR environmental staff and the 416th Engineers have taught an Environmental Compliance Assessment System (ECAS) training course for several years. As a result of this training, the USAR staff consistently produce high-quality environmental assessment reports, which help us achieve or maintain compliance with numerous environmental laws. Funding for a comparable safety compliance course was not available in 1997, so we developed the Facility Safety Assessment training course to help soldiers identify safety deficiencies.

Common OSHA* Violations

Circuit breakers must be properly labeled.

Electrical outlets within 6 feet of wet areas must have ground fault circuit interupters, as shown at left.

Live electrical equipment operating at 50 volts or more must be enlosed in a metal container.

* Occupational Safety and Health Administration

The Program

To prepare the program, we followed the five-step Systematic Approach to Training (SAT) process: Analyze, design, develop, implement, and evaluate.

Analyze. First, we conducted a needs analysis to determine if the training is required and can correct a deficiency. The 416th Engineers designated Safety Assessments as the number 2 priority after Environmental Compliance Assessments. Job and task analyses are part of this step. Conducting a Facility Safety Assessment is within the scope of the Facility Engineer Team, but its safety checklist (provided by the USAR Command [USARC] Safety Office) is only a list of potential impacts at USAR facilities. The checklist does not describe how to evaluate safety items to determine compliance versus noncompliance, nor does it provide a means to take corrective action on items identified as deficiencies. This information is needed to identify and correct safety deficiencies within USAR facilities.

Design. During this step, we wrote the *Facility Safety Assessment Guide*. We reviewed FY96 safety checklists to identify common deficiencies and verify requirements in 29 CFR. Then, using the ECAS format as a guide, we developed a "safety finding sheet." This sheet states the requirement, specific legal references, and information the assessor must check. Deficiencies are listed individually. The format is a significant improvement over the safety checklist because it describes the deficiencies in detail. We used information on the safety findings sheet to develop learning objectives and establish criteria for the performance-based evaluation.

Develop. During visits to several USAR facilities, we took photographs depicting safety deficiencies and prepared slides and overhead transparencies to support class discussions (see photos, page 34). We wrote a lesson plan to identify and correlate deficiencies and to present the training in a logical sequence.

Implement. We scheduled a classroom, coordinated use of a USAR facility for the field training exercise, prepared an agenda, and advertised the course, which has five phases: lecture, practical exercise, field training exercise, report preparation, and findings briefing. Then we conducted a practice session to validate that objectives were met and the level of instruction was appropriate.

Evaluate. The course has been evaluated several times to date, but this step is ongoing. Students evaluate the course at the end of every session to determine strong and weak points and if they feel it prepares them to conduct Facility Safety Assessments. They complete a second survey six months later to determine their retention of course content and if they have experienced difficulty conducting Facility Safety Assessments. The USARC Regional Support Commands, the USARC Safety Office, and USAR facility managers will evaluate the 416th Engineers' Facility Safety Assessments at the end of FY98. By identifying common deficiencies and corrective actions, the 416th intends to publish lessons learned to assist facility managers when they conduct self-assessments to improve their safety posture.

Benefits

We conservatively estimate that our initiative to design, develop, and implement the safety training program saved the 416th Engineers more than $150,000 in FY97. This figure is based on an estimate of current professional consulting rates and the hours we spent developing the course. By having Army Reserve soldiers conduct this training (versus professional consultants), we project annual savings in excess of $100,000. The USARC spent about $30,000 for a 2-day training course in 1996. We plan to conduct four 2-day Facility Safety Assessment training courses in FY99 on drill weekends instead of using annual training days.

The true measure of our success is not whether the 416th Engineers can produce excellent Facility Safety Assessment reports but if, through our efforts, USARC facilities are a *safer* place for soldiers and civilians to work. We believe that base camps in forward areas can use our facility safety assessment format to evaluate their safety compliance programs. The program we developed will reduce the number of noncombat injuries and assist the overall mission accomplishment of any operation.

Major Scotty C. DeClue, a registered environmental manger and certified environmental trainer, serves as the Technical Training Program Administrator for the Department of Energy's Savannah River Site in Aiken, South Carolina.

Captain J. Glenn Gamlin, a certified safety professional and hazardous materials manager, works as the Safety/Environmental Manager for Cummins Diesel Recon Company in Memphis, Tennessee.

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Improving Digitized Engineer Communications

By Captain Daniel R. Smith

The Army has pushed its advanced guard into the 21st century. The past decade has seen extensive experimentation at all levels, with the concept of a computerized (or digitized) Army of the future. Units involved in these experiments are known as Task Force XXI.

Recently, I served as supply officer (S4) and senior battle captain in the engineer battalion Administration and Logistics Center (ALOC) during the Task Force XXI Advanced Warfighting Experiment. For the 299th Engineer Battalion and the rest of 1st Brigade Combat Team, 4th Infantry Division, the AWE was much more than a two-month exercise in the desert. It was an 18-month learning experience. The daily lessons learned, problems solved, and challenges met provided Army soldiers, numerous defense contractors, and our senior leaders with valuable feedback to use in charting our course into the future. Ironically, communications—the very thing Force XXI was supposed to improve and the lifeblood of any tactical operations center (TOC)—became our biggest challenge. This article discusses four communications problems experienced by the 299th Engineer Battalion S1/S4 section and recommends some possible solutions.

Officers of the 299th Engineer Battalion (Task Force XXI)

Communications Problems

The experiment was conducted through a train-up and brigade-level training rotation in March 1997 at the National Training Center, Fort Irwin, California. Preceding the train-up were various computer instruction classes, computer equipment installations (known as *appliqué*), and new equipment training to familiarize leaders and soldiers with initiatives we were expected to use and test in simulated combat operations.

Numerous problems plagued our communications. Most grew out of the contractors' misunderstanding of engineer logistical operations and communications requirements and how they differ from maneuver logistical operations and communications requirements. Like other members of the brigade, we in the engineer battalion ALOC faced a myriad of technical, training, and architectural problems with the tactical internet and other experimental initiatives.

Problem: *Digital message traffic between the ALOC and specific engineer vehicles, which was essential to combat service support (CSS) execution, was virtually nonexistent.*

There was no digital message traffic between engineer company first sergeants or TOCs and the engineer battalion ALOC. The command sergeant major, the three company first sergeants, and each company TOC continually sent appliqué messages to the ALOC from their respective vehicles (known as platforms), but the messages never arrived. Digitized message acknowledgment logs inside the appliqué showed neither a machine acknowledgment of nor an operator response to the messages.

Possible operator training and/or communications and maintenance problems were exhaustively investigated and corrected when necessary, but we determined that they weren't the main problem. Continued investigation showed that the digital messages had to move through other platforms called *servers* or *nodes* to get from one vehicle's appliqué to another's. If a message had to "hop" through more than four nodes, it disappeared.

Lacking understanding of engineer operations, the contractor had arranged the vehicles in the tactical internet so if engineers tried to send a message to the battalion ALOC from one of the vehicles, the message almost always had to pass through more than four nodes. In addition, whenever a server became overloaded with digital traffic, messages reaching that server were ignored and disappeared. While a few messages were received, digital message communications

A soldier shows the appliqué inside his vehicle.

from each of the platforms remained inconsistent and unreliable.

Recommendation: *Continue to investigate the software for problems and revise the architecture so that the engineer command sergeant major, company first sergeants, and TOCs have a direct route for messages to the ALOC.*

With few exceptions, engineer units must maintain effective communications with maneuver command and logistics nodes as well as with their parent battalion's command and logistics nodes. It is essential that digital systems allow the company to communicate as effectively with the engineer battalion ALOC as it does with the task force.

Problem: *The modified table of equipment (MTOE) and appliqué architecture allocate an insufficient number of radios to the ALOC to monitor all essential nets.*

The MTOE allocates the engineer battalion ALOC only two radios. The appliqué architecture forces the ALOC to use those radios to monitor only the engineer battalion administration and logistics (A&L) net and the forward support battalion (FSB) A&L net. This architecture is not tactically sound for several reasons. First, the FSB conducts command and control (C2) and all other business on the FSB command net, not on the FSB A&L net. Therefore, the engineer battalion ALOC is out of the loop and does not receive essential information. Examples of missed information are enemy contact reports in the brigade support area (BSA), jump or movement C2, changes in the mandatory operational protective posture (MOPP) level, air defense artillery status, and all net calls. As a member/tenant of the BSA, the engineer battalion ALOC must monitor the FSB command net, not the FSB A&L net.

Second, current architecture does not allow the ALOC to monitor the engineer battalion command net. The ALOC is a battalion command post and an alternate TOC for the battalion TOC. Thus, the ALOC needs the capability to monitor, track, and C2 engineer combat operations. The A&L net is not effective for this purpose because the architecture dictates that the only platforms on that net are the ALOC, the company first sergeants, the command sergeant major, the support platoon, and the headquarters company commander. The architecture does not allow the Maneuver Support Company a single radio on the A&L net. If the ALOC could monitor the battalion command net, it would have voice communications with the battalion and company TOCs and commanders, which would facilitate battle and CSS tracking. A third radio is needed so the ALOC can monitor the engineer battalion command net.

Third, current architecture doesn't allow the ALOC to monitor the brigade A&L net. The engineer battalion is the only battalion in the brigade not on the brigade A&L net. As a result, the engineer ALOC is out of the loop for essential CSS information and coordination necessary for brigade mission success. The nature of engineer operations requires detailed coordination and cross talk among the engineer ALOC and the brigade and task force ALOCs. For example, Class IV resupply operations and task organization changes require detailed coordination to effectively distribute assets and materials. Allocation of a fourth radio would allow the ALOC to monitor the brigade A&L net.

Recommendation: *Allocate the engineer battalion ALOC two additional radios and change the architecture to allow the ALOC to monitor the proper nets.*

Typically, Force XXI maneuver battalion field trains command posts (FTCP) and headquarters company combat trains command posts (CTCP) are colocated and have a seven-net capability. They monitor task force command, A&L, brigade A&L, FSB command, and three other nets. The engineer battalion ALOC is required to perform both roles and, as a minimum, requires four-net capability to monitor engineer battalion command, engineer A&L, brigade A&L, and the FSB command nets.

Problem: *The appliqué architecture does not allow the Maneuver Support Company to monitor the A&L net for voice traffic.*

The Maneuver Support Company lacks even one platform with voice communications with the ALOC; the architecture dictates total dependence on digital message communication with that company. Digital message traffic, even if dependable, is not sufficient for battle or CSS tracking and does not support the ALOC's role as alternate battalion TOC.

Recommendation: *Change the architecture to allow voice communications between the Maneuver Support Company and the ALOC.*

Problem: *The battalion and company TOCs are not allocated a radio to monitor the battalion A&L net.*

According to current architecture, the engineer battalion and company TOCs do not have engineer A&L net capability, and the current MTOE does not allocate a radio to monitor the A&L net. As a result, the ALOC's only link to the engineer battalion and companies is through one of six platforms: the command sergeant major, the four company first sergeants, or the headquarters company commander. In addition, each vehicle is a light-skinned, low-survivability vehicle that is easily killed, further degrading the ALOC's ability to communicate. This problem is intensified because the engineer company TOCs are the primary battle and CSS trackers for the company (not the company first sergeant as in a maneuver company). With no A&L capability in the TOCs, the engineer battalion and company TOCs cannot talk to the engineer ALOC unless one platform or the other deviates from the architecture by changing nets. This is not practical because changing nets for any length of time disrupts the flow of digital traffic and either pulls a major C2 node off command nets or clutters them with A&L traffic.

Recommendation: *Change the MTOE to allocate engineer battalion and company TOCs an additional radio and change the architecture to allow the TOCs to monitor the A&L net.*

Summary

The technological advancements tested by Force XXI are exciting and point to a new era of combat operations. As combat engineers, we must be able to communicate and coordinate CSS issues to support faster moving, more flexible maneuver forces. Solving the shortcomings that hinder engineer ALOC communications will help ensure our digitized Army of the future.

Captain Smith served in the 17th Engineer Battalion as platoon leader, A&O platoon leader, and a company XO. After the 17th reflagged to the 299th, CPT Smith served as battalion S4 throughout the Task Force XXI Advanced Warfighting Experiment. He is a graduate of the United States Military Academy and holds a master's degree in engineering management from the University of Missouri-Rolla.

Note From the Directorate of Combat Developments

By Mike Bonomolo

In essence, Captain Smith is correct. The initial version (1.0) of the Force XXI Battle Command Brigade and Below (FBCB2) software had the six-node limit, which included the initiator and the destination. This problem has been solved through the application of role-based functionality. Now, if a first sergeant sends a logistics message, the FBCB2 software configures the network so that the message will not "hop" through more than four nodes. The FBCB2 system no longer sends the message up and across to reach a destination, therefore eliminating lag and reducing handling errors.

The shortage of radios within the battalion ALOC is a much more difficult problem to solve. The ALOC is authorized a fax, an Enhanced Position Locating Reporting System User Unit (EPUU-V1), a mobile subscriber receiver/transmitter (MSRT), a lightweight computer unit (LCU), a Unit-Level Logistics System (ULLS)-S4, and a VRC-89D radio. The maneuver battalion configuration can monitor up to seven FM nets between the FTCP and the battalion task force CTCP. Because the engineer battalion is not authorized a battalion task force CTCP, it is required to perform both roles from the engineer battalion FTCP. At the next command, control, communications, and computers (C4) configuration board in early FY99, we will recommend adding a single-channel, ground-to-air radio system (SINCGARS) with dual-net capability. Although operational requirements show that divisions need approximately 700 SINCGARS, there are only enough available to fill 535 of these requirements.

A joint tactical radio is being developed that passes voice and digital traffic simultaneously. This radio, which is scheduled for distribution in the FY03 time frame, should align the requirement of radio nets monitored with the capability on hand. In the interim, voice-based logistics messages must move to a digital format. The LCU can move digital message traffic within the battalion. The success of this option weighs heavily upon fielding the updated Maneuver Control System.

Limited Call to Active Duty for Captains

By Major David Hartley

The Army is conducting a call to active duty for captains in basic branches. **The original recall message was amended on 8 July 1998 to delete the requirement for officers to be branch qualified.** Applicants for active duty are restricted to captains who are in the United States Army Reserve (USAR), Army National Guard (ARNG), or former active duty officers. Neither USAR Active Guard and Reserve (AGR) nor ARNG AGR officers are eligible. Applications from lieutenants or field grade officers will not be accepted.

This call to active duty expires 30 September 1998.

To be eligible, applicants must meet the following parameters:

- Have a captain's date of rank of 941002 or later.
- Have not been passed over for promotion while on active duty.
- Be advised that those who received Voluntary Separation Incentive Pay (VSIP) or Special Separation Benefit (SSB) pay when they left active duty may have to repay that amount.
- Have a bachelor's degree or higher.
- Be medically qualified.
- Meet the height and weight standards outlined in AR 600-9.
- Be able to attain 20 years of active federal commissioned service (AFCS) by age 55.
- Be able to complete 10 years of AFCS before completing 20 years of active federal service.

PERSCOM has approval authority for this specific call to active duty. The authority for accession is 10 USC 12301 (D) and AR 135-210. Information on application procedures and forms is available from Ms. Smith at commercial (800) 325-4898 or Defense System Network 892-3398.

Major Hartley serves as officer coordinator for the Engineer Personnel Proponency Office at the U.S. Army Engineer School.

NCO Advancement

By Sergeant Major Jay Florance

A question we hear from soldiers is, "What can I do to get ahead?" For NCOs, there are several opportunities to excel and get in the best position for advancement.

A sergeant (P) or staff sergeant needs at least two years of squad leader time. This is more of a challenge in some military occupational specialities than others, but avoiding this duty puts you behind your peers. Once you gain this experience, look for a job in a table of distribution and allowances (TDA) environment that broadens your NCO skills. Jobs such as drill sergeant, recruiter, and instructor will help develop a career path. Most NCOs will be considered for one of these duties, so be proactive in letting your branch know your desires so we can schedule the best time possible. To be eligible, you must have a general technical (GT) score of 100 or higher and have no derogatory information in your personnel file. To a limited extent, duty at the Joint Readiness Training Center (JRTC) at Fort Polk, Louisiana; the National Training Center (NTC) at Fort Irwin, California; or with a reserve unit are possibilities. All of these jobs, when performed successfully, will help you achieve your career goals.

The most important job as a sergeant first class is time as a platoon sergeant. Following this experience, several jobs can help achieve the next plateau. Any job accomplished successfully at the grade level beyond your present grade indicates to the board that you are capable of handling responsibilities required of that grade. Sergeants first class who have the rare opportunity to serve as first sergeants, and who serve with distinction, are in the top percentile for advancement. Being an operations sergeant helps broaden your scope of military functions. There are TDA opportunities, especially if you have not yet served in one of these positions. Most jobs for sergeants first class are with reserve units, at the JRTC or the NTC, or as an instructor.

Remember that your peers are seeking these same skills. Since each NCO who gets a second TDA assignment keeps someone else from getting his first one, few will get a second TDA job. If your GT score is below 100, get with your education center and raise your score above 100. Most TDA jobs are tough, but success in them shows promotion boards you can adapt to that environment.

Your record has a lot to do with the duty you get and when you get it. Strong and consistent NCOERs determine the jobs you qualify for, so remember that every job is important! Concentrate on getting the troop time first and a TDA job second. If you have already worked one TDA job as a staff sergeant, get back into a modified table of organization and equipment (MTOE) unit before performing another TDA assignment. Too much TDA time can be a distracter! Some NCOs get into a TDA environment and never go back to troop-leading positions. This is a disadvantage since it appears they are "hiding" from the field unit environment. The Engineer Branch is available to provide career counseling.

Sergeant Major Florance serves as the Engineer Branch sergeant major at PERSCOM. His e-mail address is florancj@hoffman.army.mil.

Engineer Support to Engagement Area Development

By Major Kenneth J. Crawford

Most engineers are challenged when they prepare for combined arms defensive operations—it's never the same twice in a row. What we do to effectively integrate engineer expertise into engagement area planning depends on the military decision-making process (MDMP). We must thoroughly understand the impact engineers can have in tactical operations. This article describes how staff engineers can best support the planning phase of engagement area development during the MDMP.

Development Steps

Successful integration of engineer capabilities into the MDMP requires that we read, understand, and apply our knowledge of the supported unit's doctrine and tactical standing operating procedures (TACSOPs). Engineers who support division or brigade defensive operations that assign or direct engagement areas must understand how to effectively integrate their capabilities into engagement area development.

Doctrine provides a sound planning reference that must be applied to the current situation and surrounding terrain. Figure 1 shows a variation of the seven steps of engagement area development found in FM 71-1, *Tank and Mechanized Company Team*, and FM 7-20, *The Infantry Battalion*. The most significant difference is the switching of steps 4 and 5—positioning forces (direct-fire assets) before planning and integrating obstacles. This switch is logical because the maneuver commander is the "client" we support. In addition to pointing to a map and stating where he wants to kill the enemy (step 3), the maneuver commander must conduct mission analysis and understand the enemy's intent (steps 1 and 2) and know what he can see to kill throughout the depth of the battlefield.

1. Identify all likely enemy avenues of approach.

2. Determine likely enemy schemes of maneuver.

3. Determine where to kill the enemy.

4. Position direct fire weapon systems.

5. Plan and integrate obstacles with direct fires.

6. Plan and integrate indirect fires with direct fire and obstacles.

7. Conduct rehearsals.

Figure 1. Engagement area development steps.

Developing a defensive course of action (COA) takes each battlefield operating system into account and synthesizes a combined arms team designed to achieve a given mission against an attacking enemy. The focus of the defense is to destroy or defeat the enemy at predetermined sites where terrain favors the defending friendly forces—the engagement areas. Determining what will be critical events, or decision points (DPs), during defensive operations requires detailed planning, analysis, war gaming, and synchronization. DPs trigger multiple actions during combat operations and must be synchronized by thorough staff planning and coordination. When executing defensive operations, commanders fight from a position that allows them to visualize the battlespace (the three-dimensional fight). Engineers are the best-suited personnel in the combined arms staff to facilitate terrain visualization and positioning of forces during the MDMP.

To support the maneuver commander's intent and the combined arms staff, engineers must apply our capabilities and knowledge to each step of engagement area development. Just as the engineer estimate provides a format to align planning efforts with the MDMP, the following process provides an effective tool for defensive planning.

1. Identify all likely enemy avenues of approach

Staff engineers work closely with the S2 to analyze the terrain as soon as the mission is received. This is the first step in the engineer battlefield assessment. The OCOKA (observation and fire, cover and concealment, obstacles, key terrain, and avenues of approach) analysis must include the impacts of weather and the advantages and disadvantages that terrain offers. Engineers identify maneuver elements (friendly and enemy) favored by the combination of terrain and weather and explain why. Terrain visualization enables engineers to identify potential sites that offer an advantage over the range of the enemy's maneuver and weapon systems. Use of TerraBase II software and the Division Terrain Teams can help identify areas where terrain facilitates enemy approaches into our engagement areas behind intervisibility lines or through restricted terrain. Products engineers can easily produce to help in this process are lines of sight, obliques, weapon range fans (to identify dead space), and perspective images. As these products are developed, engineers should analyze them to determine the time and distance that enemy forces maneuver through and to estimate how long we can engage him with fires. These products can be used throughout the MDMP as tools for COA development (positioning of forces), war gaming, and rehearsals.

Engineers should consider the following factors when analyzing the avenues of approach through assigned sectors:

- Compartmentalization of the terrain and possible engagement windows for direct-fire and wire-guided missile systems (time of flight vs. tracking vs. enemy's ability to accurately return fire).
- Locations where the combination of terrain and man-made obstacles can achieve the desired effect.
- Availability and use of the Division Terrain Team. Early identification and prioritization of products created using TerraBase II promotes efficient use of resources by eliminating "nice to have" products. Since the situation and the commander dictate what is important for each mission, an SOP for product requirements is not needed but can be used.

2. Determine likely enemy schemes of maneuver

Engineers focus directly on the enemy's mobility/survivability capabilities and limitations during the second step of the engineer battlefield assessment. Working with the S2, they develop an estimate of enemy mobility/survivability assets and the order of battle, using TRADOC Pamphlet 350-16, *Heavy OPFOR Tactical Handbook;* FM 100-60, *AR and Mechanized-Based OPFOR Organization Guide;* and FM 100-63, *Infantry-Based OPFOR Organization Guide*. This step is critical because obstacle groups in engagement areas are designed to defeat the enemy's ability to sequentially breach or bypass obstacles in depth. Determining how the enemy will employ breach assets along an avenue of approach is a "best guess" based on staff engineers' knowledge and experience. The success of massed direct and indirect fires hinges on our ability to accurately site and emplace obstacles and target specific enemy mobility assets. Additionally, this step helps us to identify, recommend, and prioritize high-value targets.

3. Determine where to kill the enemy

By accurately estimating the force size, formations, speed, and the most likely and most dangerous COA along specific avenues of approach, engineers can predict where the enemy will transition his formations. Although distances for these transitions vary depending on the tactical situation, the following sequence and distances are doctrinally correct for an enemy attack:

- Mechanized infantry brigades transition to individual mechanized infantry battalion columns at 12-15 kilometers.
- Mechanized infantry battalions transition to company columns at 4-6 kilometers.
- Companies transition to platoon columns at 2-3 kilometers.
- Platoons transition to attack formations at 600-1,000 meters from the main defense.

If the situation permits, we can use ground or air observers, ADAM/RAAM, or attack aviation (provided we have air parity and a synchronized suppression of enemy air defenses [SEAD] plan) to disrupt the enemy's command, control, and maneuver as he transitions from battalions/companies in column to battalions/companies on line. Companies begin to transition to platoons in column where we plan to engage with tank- and wire-guided missile systems. If the combined arms staff can identify where the terrain masks enemy maneuver, it can position systems (covert operations lazing teams [COLT], scouts, fire support teams, observer teams, etc.) to engage enemy vehicles on the high-value target list. Otherwise, these vehicles may be in dead space to direct-fire systems that occupy DPs.

4. Position direct-fire weapon systems

Terrain surrounding potential engagement areas is the most significant factor in positioning direct-fire weapon systems. Although the range capabilities of our weapon systems are

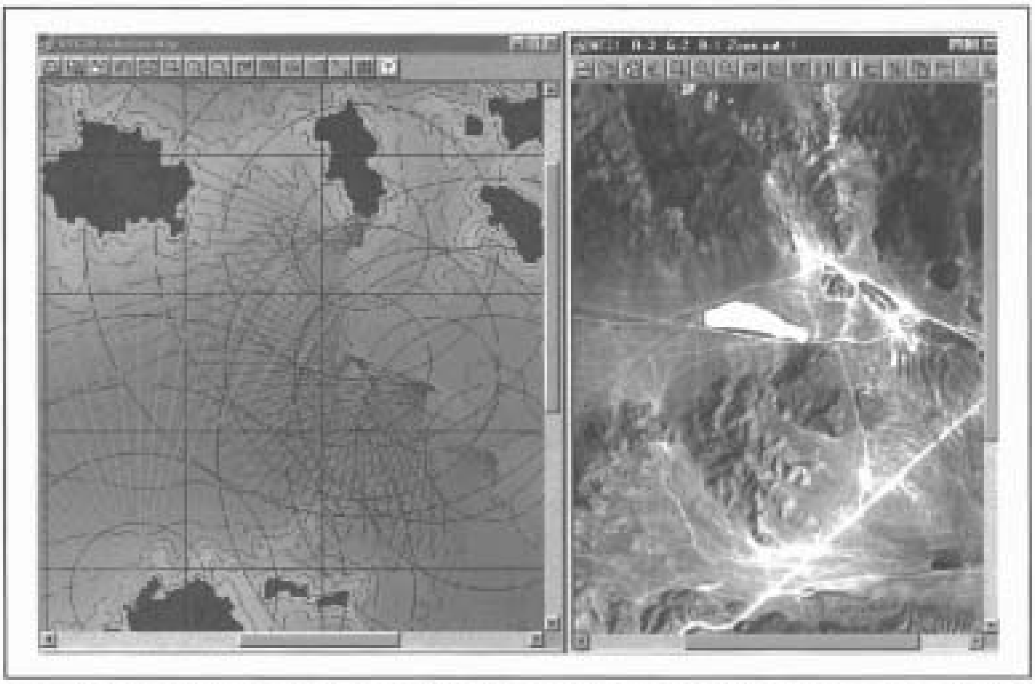

Figure 2. Direct-fire systems can be tentatively sited using a combination of terrain analysis and imagery. Above left depicts the center of mass for company team battle positions overlooking Drinkwater Lake at the NTC. To the right is a satellite image of the area.

considerable, the enemy has the advantage with wire-guided systems (the AT-5/8 = 4 kilometers and the AT-10/11 = 5 kilometers). Engineers must analyze the terrain to determine how to minimize the range of enemy systems. Use a reverse slope defense, intervisibility lines, defile, or integrate obstacles with restricted terrain to prevent him from maneuvering large formations.

The decision aids (tools) created in steps 1-3 are used to identify the best locations for the engagement area. For example, a weapon range fan shows that we can observe and engage a vehicle in an avenue of approach for 2.5 kilometers. The next step is to calculate how long it will take the enemy to move that distance at a given rate of march (2.5 kilometers/20 kilometers per hour = .13 hours or 7 minutes 30 seconds). At this range, the tracking time for our wire-guided missile systems (12 seconds at 211 meters per second) and 120-millimeter main gun (2 seconds at 1,517 meters per second) is an important factor. The maneuver S3 knows the distance where the probability of hit (P_h) and probability of kill (P_k) are highest. For planning purposes, determine these probabilities for each type of maneuver unit (mechanized and armor) based on the unit's Table XII gunnery and apply them as a constant.

Vegetation is another consideration. Neither the Digital Topographic Support System (DTSS) nor the TerraBase II program accurately shows how vegetation affects observation at any given position. We must analyze maps and conduct reconnaissance to confirm data the DTSS or TerraBase II provides.

Engineers may create additional products that support COA development and use them when completing the analysis and decision steps of the MDMP. The only limitations on product development are time, initiative, and experience. The needs of the supported element will dictate which products are most useful.

After the commander selects a COA, the staff provides the terrain products to subordinate units for their use during reconnaissance and when occupying positions or sectors. The terrain selected for the fight drives the frontages of each subordinate element. For example, when fighting in an open desert, the frontage of a defending platoon can be extended significantly further than when it is defending in rolling and forested terrain. Prepare for the possibility that terrain and vegetation may degrade the range of enemy and friendly weapon systems to meters rather than kilometers.

After tentatively identifying positions for weapon systems throughout the sector (Figure 2), the staff engineer can develop a survivability execution matrix for blade assets. After the COA decision brief, the commander's survivability guidance may include:

- General intent for engineer effort.
- Priority of support by unit, engagement area, and/or phase.
- Focus of digging assets, including the survivability level and priority for each system.
- Level of force protection for key command, control, and communications nodes.

If the COA calls for alternate, supplementary, or successive battle positions, use the data developed in the third step of the engineer battlefield assessment and identify what support engineers can provide. If the COA requires additional blade assets, identify the duration, benefits gained, and the potential impact or alternatives if the assets are not available. The TACSOPs must state that occupying maneuver units, not engineers, are responsible for positioning systems. Once maneuver elements identify these positions, they must mark and prioritize the positions to maximize the efficiency of blade assets (Figure 3). However, as the terrain experts, engineers must coordinate with the supported unit before the blades arrive and recommend ways to improve blade effectiveness based on site conditions (rocky, water table, egress routes, etc).

5. Plan and integrate obstacles with direct fires

FM 90-7, *Combined Arms Obstacle Integration*, describes how engineers can be most efficient and effective during obstacle emplacement. This step comes after the direct-fire weapon systems are positioned. To effectively site, mark, emplace, and turn obstacles in sector, engineers must know what can or cannot be seen from the battle positions (Figure 4). When analyzing the combined effects of obstacles and direct fires, we must know the P_h, based on the percentage of vehicles entering the observed obstacle group and detonating a mine.

The enemy decides whether to breach or bypass an obstacle group. If he elects to breach, use the P_h for the obstacle effect (see Figure 5, page 44), combined with the P_h/P_k of our direct-fire weapon systems to determine the number of vehicles the enemy is likely to lose. For example, the direct-fire engagement trigger will be the lead motorized rifle battalion (MRB) encountering a fix effect obstacle group. The P_h for an MRB in battle formation is 50 percent (worst case). This equates to four vehicles through the depth of the obstacle group (nine tanks lead in an MRB attack formation). The enemy must react to the obstacle encounter, which triggers the overwatching elements' direct-fire engagement. A tank company team firing against a lead enemy battalion (approximately 42 combat vehicles) at a range of 2.5 kilometers may have a P_k of 90 percent. This would yield 29 enemy vehicles remaining at the end of the first volley (42 enemy vehicles -[14 friendly vehicles engaging X 90 percent P_k = 12.6] = 29.4 or 29 enemy vehicles remaining).

Figure 3. Maneuver company team commanders must site and mark positions before survivability assets arrive. Blade teams must understand the standard for the types of positions they are to prepare.

Few units have perfect fire control or distribution and kills for every round fired against a moving target. In this scenario, the combined effect of obstacles and direct fires is 25 enemy vehicles attempting to maintain command and control, maneuver, breach, and return fire. Specific fire-control plans destroy the enemy's primary breach assets. This may cause the enemy to fix friendly forces and wait for second echelon forces before continuing to move, attempting to bypass, withdrawing, or mechanically breaching through the obstacle group.

To clarify his intent and help develop the engagement area, the maneuver commander provides the following information to focus engineer countermobility efforts:

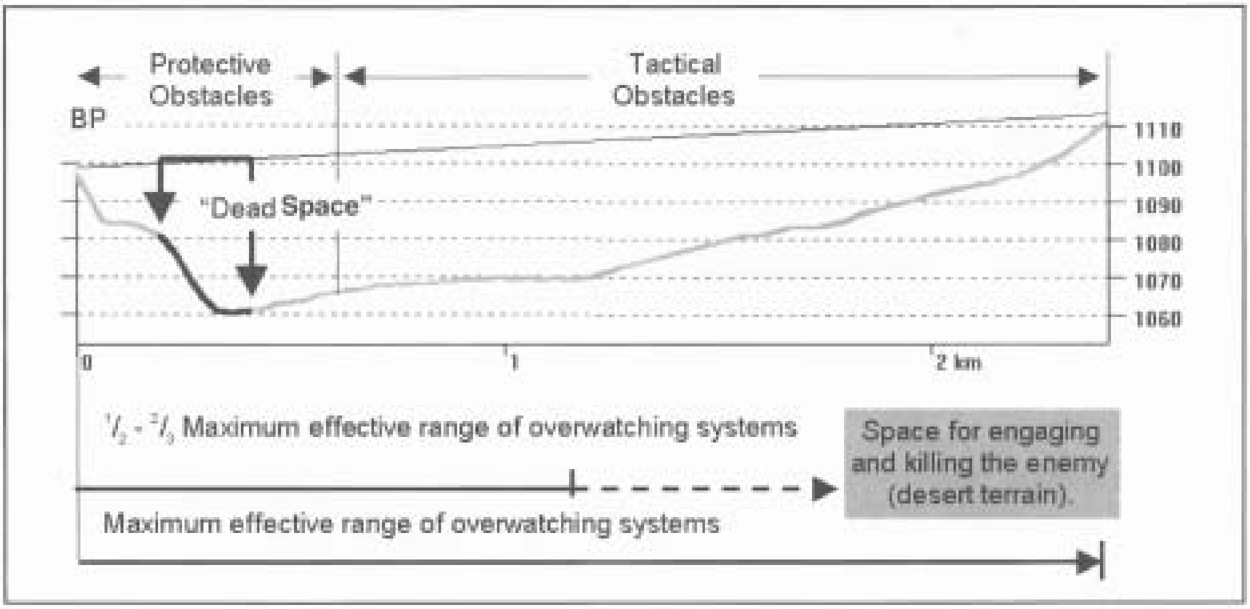

Figure 4. Example of a TerraBase II line-of-site view at Drinkwater Lake. It accurately depicts range, dead space, and elevation data from a given point on the ground.

Standard planning factors identify the resources (Class V mines) required to emplace obstacles along an avenue of approach as follows:

Obstacle Effect	Resource Factor (RF)	Probability of Hit (P_h) (percent)	Linear Density
Disrupt	0.5 X AA	40 - 50	0.4 - 0.5
Fix	1.0 X AA	50 - 60	0.5 - 0.6
Turn	1.2 X AA	75 - 85	0.9 - 1.1
Block	2.4 X AA	>85	>1.1

AA = Avenue of approach.

Linear density (LD): number of mines ÷ front length(m) = mines per meter of front.

Area density (AD): number of mines ÷ front X depth = mines per m^2.

To convert AD to LD: AD X depth(m) = LD.

Figure 5. Minefield probability planning based on effect

- Priority of obstacle effort by engagement area or phase.
- Intent for obstacle effects—disrupt, fix, turn, or block. (These are the results the maneuver commander wants to achieve through combined use of direct fires, obstacles, and indirect fires along specific avenues of approach.)
- Mobility requirements and obstacle restrictions (counterattack axis, main supply routes, withdrawal routes, reserve obstacles, etc.).
- Intent of employing scatterable mines or situational obstacles (by system—where, when, duration, and authority).
- Maneuver forces' support to obstacle effort (guard force requirements for reserve obstacles, marking, mine dump and Classes IV and V support, etc.).

Note: *Using engineers to mark obstacles, in addition to emplacing them, reduces the total amount of obstacle effort in sector.*

- Obstacle protection (counterreconnaissance, reseed plan, deception, enemy breach asset destruction).
- Obstacle command and control (execution authority, marking, lane closure, reporting, tracking, restrictions, and control measures—zones, belts, and groups).
- Obstacle deception.

Situational obstacles require a significant amount of staff synchronization. Step 2 identifies how the enemy is likely to attack and employ breaching assets according to the order of battle. The trigger for situational obstacles is one of three things: enemy action, friendly action, or a combination of both. By employing a scatterable mine system triggered by enemy action (for example, a company-sized or larger force approaching or passing through a DP), the distance from the targeted area of interest (TAI) to the DP can be calculated using the following equation:

$\underline{M^3 + E + A < T > C}$, where:

M^3 = the cumulation of the following applicable times. The cumulation must be less than the time it takes the enemy to reach the TAI.

- *Movement of communications* (time required for the observer to call the controlling HQ, plus the time for the HQ to receive approval from the authorizing commander, plus the time for the HQ to direct the emplacing element/unit to execute).

- *Move to TAI* (the time required to move/fire to/into the TAI [ground/air systems or time of flight for indirect munitions]).

- *Move from TAI* (the time required for the element/unit to move from the end point to a reload or secure hide position).

E = time required to dispense or fire the mission.

A = time required to arm/activate the munitions.

T = time required for the targeted enemy element to move from the first observed location in a named area of interest (NAI) to the TAI (or obstacle location). Contact there is initiated by either a mine strike or direct fires from an overwatching element.

C = time required to position a friendly maneuver element in an overwatching battle position. Friendly forces must establish a defensive posture in a battle position (or other advantageous position) before the enemy has the opportunity to engage. (Plan a minimum of a 4-kilometer range for enemy antitank weapon standoff and understand the risk when applying lesser distances.)

Maneuver commanders at company team, battalion, and brigade levels must ensure that obstacles, direct-fire weapon systems, and indirect fires are integrated. Ground reconnaissance cannot be replaced with "eyeballing" a map or using decision aids developed for the COAs. Ground reconnaissance helps site obstacles and must occur as early as possible. To expedite obstacle emplacement after the COA is approved, staff engineers provide subordinate engineer units with information to help them begin parallel planning and direct coordination between engineers and supported maneuver units. When the MDMP is complete, execution matrices, time lines, Classes IV and V resourcing and allocation, and a survivability plan are developed and included in both the Engineer Annex and the subordinate engineer operations order.

6. Plan and integrate indirect fires with direct fire and obstacles

As staff engineers identify obstacle groups, fire support coordinators develop a fire plan to support the intended effects of engagement areas. They target fires on the enemy side of obstacles where the enemy is most likely to be (dead space), the point at which assets begin to canalize through a breach point, or at targets determined by the maneuver commanders and subordinate fire support teams. The point where obstacle groups tie, or anchor, into existing obstacles is critical. The anchor point is where the combined effects of the obstacles and fires force the enemy to commit to a breach or seek a bypass.

This is not the time to consider using ADAM/RAAM, because integrating ADAM/RAAM must be done early to be effective. The maximum planning range of scatterable munitions is 17.5 kilometers for M109 fires and 17.7 kilometers for M198 fires. If the point along an avenue of approach where the second echelon mechanized infantry brigade transitions from battalions in column to battalions on line can be targeted, or if the advanced guard main body can be separated from the second echelon battalions, we can identify the associated NAIs, DPs, and TAIs to support this mission. The key concern is whether it will take more than 15 minutes for a battery to fire the mission. When developing the COA, identify how many artillery batteries are available to support the mission and determine whether to use low- or high-angle fires. Since the maximum rate of fire is four rounds per minute per tube, the angle of fires directly impacts the length of time and number of rounds it will take to fire the mission. Generally, high-angle fire requires four times more rounds than low-angle fire for RAAM. Therefore, more time or tubes may be required to complete the mission.

The staff must weigh the advantages and disadvantages of the time it may take the fire support elements to complete the mission (for example, copperhead, interdiction, SEAD, or suppression) and make recommendations to the maneuver commander. He must decide whether to use artillery tubes to fire ADAM/RAAM missions based on the size and type of enemy element (target), the P_h for the avenue of approach (location), and the overwatching elements' ability to observe/engage the enemy as he negotiates the obstacle (effect).

7. Conduct rehearsals

Units conduct combined arms rehearsals to ensure that all elements are properly synchronized. Review CALL Newsletter No. 98-5, *Rehearsals,* and incorporate its concepts into TACSOPs. Specific engineer-related topics addressed in combined arms defense rehearsals follow:

- Priorities of engineer effort (obstacle group sequence of emplacement, who is marking, link up and execution of blade effort, Q36 radar and air defense artillery coverage).
- FASCAM triggers and execution ($M^3 + E + A < T > C$).
- Classes IV and V supply point and mine-dump operations. (These may be discussed during combat service support rehearsals but must be understood for the combined arms rehearsals.)
- Obstacle turnover, responsibility, and security.
- Lane closures.
- Counterattack mobility support.

At any given time during mission execution, engineers should be able to tell the maneuver commander where the engineer effort stands—the "glide path." Engineers must thoroughly understand and translate the impact that incomplete obstacle groups have on enemy maneuver so the commander can adjust his orders to achieve the same effects.

Summary

Engineer staff officers are key players in engagement area development. They produce quality and useful decision aids, integrate engineer capabilities into engagement area plans, understand the capabilities of supported units, and provide sound tactical recommendations to commanders based on a complete analysis of the mission, enemy, terrain, troops, and time available (METT-T). Engineers are especially important in terrain visualization. They know where to apply available tools to best support the commander's battlespace visualization during engagement area development.

Major Crawford is Chief of Combat Engineer Tactics at the U.S. Army Engineer School. Previous experience includes EOAC Small Group Instructor, Senior Company and Platoon Observer/Controller at JRTC, and two company commands at Fort Bragg and in Somalia. He holds a master's degree from the University of Missouri-Rolla and will attend FY 98-99 Command and General Staff Officer Course at Fort Leavenworth.

The Command Post SOP: A Blueprint for Success

By Captain Eric R. Price and Captain Jay A. Hedstrom

Six months have passed since you left the Advanced Course and were assigned as an assistant S3 in a divisional combat engineer battalion. In that time you have helped develop the battalion's training plan, which culminates with the battalion's first National Training Center rotation in two years. Today, as you update the battalion commander, many thoughts race through your mind. The battalion changes command in just two weeks; three key staff captains recently took command, leaving lieutenants to pick up the pieces; the battalion operations NCO just arrived last month; and enlisted personnel turbulence within the Headquarters Company is high. Your chest tightens as you realize for the first time that only two staff exercises remain before the rotation. The battalion commander reminds you that since the new S3 just arrived, you are the senior, most experienced man on the battalion's battle staff. Heading back to the office, you war-game ways to pull the staff together in the short time left to prepare.

In today's Army of rapidly changing missions and high personnel turbulence, integration and quick training of new personnel are prerequisites for success. Engineer battalions work hard to develop, refine, and execute simple battle drills at squad and crew levels. Limited training resources have resulted in focused platoon battle tasks and company mission essential task lists. However, many units spend little time organizing command post operations, or when they do, they fail to commit the results to paper. At best, this causes them to reinvent the wheel—rather than building and refining an existing product—every time a new commander, executive officer, or S3 assumes his duties. Worst case, units must re-establish procedures every time their command post deploys. In either case, the command post staff spends too much time managing internal operations rather than focusing on timely and effective command and control of combat operations. Units arriving at the National Training Center often are ill-prepared to execute the key staff battle task of operating the battalion tactical operations center (TOC). Battalions with a well-established Command Post Standing Operating Procedure (CPSOP) for their main, rear, tactical, and administrative command posts are better able to cope with the rapidly changing conditions of the battlefield and tend to conduct more successful combat operations.

This article describes a method the combat engineer battalion's battle staff can use to develop and implement a basic CPSOP. The method is applicable to all battalion command posts. It focuses on establishing the CPSOP around six basic TOC functions; identifying the key supporting tasks and related tactics, techniques, and procedures (TTPs) for each of these functions; and organizing and implementing those TTPs.

CPSOP Development

There are several ways to arrive at a workable CPSOP. Each member of the battle staff should first turn to doctrinal manuals, because it is important not only to understand his own duties and responsibilities but also those of other personnel. Many manuals include an overview of TOC operations, but few provide detailed guidance on establishing and implementing a workable SOP. Our CPSOP development begins with the six basic TOC functions identified in the Center for Army Lessons Learned (CALL) newsletter, *Tactical Operations Center* (May 1995).

- ❒ Receive information.
- ❒ Distribute information.
- ❒ Analyze information.
- ❒ Make recommendations.
- ❒ Integrate resources.
- ❒ Synchronize resources.

This CALL newsletter clearly explains how to assess current command post operations and develop a training plan for improvement. The six TOC functions are not listed in any Army field manual, but they fit the axiom "form follows function." In other words, decide up front what functions the TOC must perform to be successful. Then identify the methodology to best accomplish each function with available resources.

Despite calling them six "TOC" functions, they apply to the main, tactical, and rear command posts. Throughout this article, references to the TOC pertain to all combat engineer battalion command posts. To ensure that all essential tasks and supporting TTPs are addressed and fully integrated in the final product, all staff sections and other command post personnel must be involved in the development process. Begin by gathering personnel from each battalion command post to discuss these functions. Work together to determine essential tasks that support each function. Because each function depends on the others, some tasks don't fit well under any particular one. List those tasks separately, as they will be addressed further when CPSOP organization begins.

Tasks in the CALL Newsletter provide an excellent starting point for developing a list of tasks that support each TOC function. Identify additional tasks based on the unit's specific experience and mission. Detailed descriptions of the functions and supporting tasks identified in CALL's *Tactical Operations Center* follow:

Receive Information. Receive information through standardized reports and orders from subordinate, higher, and adjacent units. Supporting tasks include:

- ❐ Receive messages, reports, and orders.
- ❐ Monitor the tactical situation and track the battle.
- ❐ Monitor the location and activities of friendly units.
- ❐ Update TOC charts and heads-up displays.
- ❐ Update maps and overlays.
- ❐ Maintain a TOC journal.

Distribute Information. Control information distribution within the TOC; report information to subordinate, higher, and adjacent units.

- ❐ Submit reports.
- ❐ Control message traffic flow.
- ❐ Conduct retransmission operations.
- ❐ Conduct relay operations.
- ❐ Publish and distribute orders.
- ❐ Conduct shift change, command, and information briefings.

Analyze Information. Consolidate reports and conduct battle staff analysis as part of the Tactical Decision-Making Process (TDMP).

- ❐ Consolidate reports.
- ❐ Conduct predictive analysis using collected data.
- ❐ Develop a time line.
- ❐ Conduct the TDMP and orders drill.

Make Recommendations. Submit recommendations to the commander based on the analysis of information collected.

Integrate Resources. Coordinate integration of the unit's activities with those of subordinate, higher, and adjacent units.

- ❐ Conduct assistant brigade engineer and tactical operations.
- ❐ Produce annexes for the higher headquarters order.
- ❐ Receive and integrate engineer and combined arms attachments.

Synchronize Resources. Synchronize the unit's activities with those of subordinate, higher, and adjacent units.

- ❐ Conduct liaison operations.
- ❐ Coordinate with other units.

The following tasks relate to the overall operation of the command post and support all six basic TOC functions:

- ❐ Identify the task or purpose of each command post.
- ❐ Set up and dismantle the command post.
- ❐ Establish mission-dependent command post configurations.
- ❐ Establish guard, sleep, and shift manning plans.
- ❐ Monitor radios.
- ❐ Provide life support for TOC personnel.

After identifying essential supporting tasks, outline the TTPs used to execute each task based on doctrine and the unit's way of doing business. If the unit has no established method for executing an identified supporting task, brainstorm a method and commit it to paper. Since this is a working document, it's okay to try new things. However, the TTPs you develop should not conflict with other established SOPs for your unit or with those of your supported maneuver unit. Once TTPs for each supporting task have been identified, organize the tasks into a logical sequence to develop the layout of the CPSOP.

CPSOP Organization

The six basic TOC functions provide a means of identifying supporting tasks, but because the functions are interrelated, it is difficult to use them to organize supporting tasks in a final SOP. Instead, look at the tasks using the five "Ws"—*who, what, when, where, why*—and *how*. Sections of the CPSOP can then be designed around answering one or two of these questions. Organize each section by addressing the TTPs that support each task as it relates to all of the unit's command posts. Use subparagraphs or subsections as necessary to provide detailed information regarding TTPs that pertain only to one command post. The figure on page 48 shows a sample format.

Another method of organizing the CPSOP is to first list the main, tactical, and rear command posts and then discuss the manning, layout, and operation of each. However, this approach can lead to redundancy and a sense of compartmentalization. Addressing tasks in the CPSOP by the five "Ws" focuses on the fundamentals of command post operations before differences between each type are described. This method eases the transition of personnel from one command post to another within the unit, as often happens when units "surge" personnel to the main command post just before a battle.

CPSOP Implementation

The last stage in the process is to train and implement the CPSOP, thus turning written products into true TTPs for the entire battalion battle staff. While many approaches will achieve the desired results, CALL's *Tactical*

Sample CPSOP Format

Table of Contents

I. Command Post Overview ***(Why)*** - a brief description of the how and why of each command post.

- Mission of each command post within the unit (tactical, main, rear, combat trains, etc.).
- Task or purpose of each command post.
- Battlefield laydown and locations of command posts.

II. Duties and Responsibilities ***(Who, What)*** - a definition of the specific role each person plays in command post operations in terms of mission requirements.

- Manning and shift makeup and schedule.
- Life support for command post personnel.
- Roles and responsibilities of all command post personnel (battalion commander, executive officer, command sergeant major, primary staff and staff NCOs, support staff and staff NCOs, assistant brigade engineer, battle captains and battle NCOs, liaison officers, radio-telephone operators, drivers, etc.)

III. Command Post Layout ***(Where)*** - a detailed description of the command post's physical properties.

- Physical layout of command post vehicles, extensions, briefing tents, sleep tents, and antennas.
- Locations of maps, heads-up displays, equipment, equipment storage, supply storage, and personnel.
- Alternate command post configurations.
- Integration with supported unit command post.
- Security plan.
- Communications or other links with adjacent command posts.
- Required items such as maps, overlays, charts, orders books, manuals, and supplies.

IV. Command Post Operations ***(When, How)*** - a clear description of routine actions during the planning, preparation, and execution phases of combat operations. Lay out this section using the six basic TOC functions as an outline. It should address:

- Information management.
- TOC chart and heads-up displays.
- Battle-tracking procedures.
- Maintaining the command post journal.
- Briefing formats.
- Standard unit time lines.
- TDMP procedures.
- Reporting procedures.
- Shift-change procedures.
- Displacement procedures.
- Integration procedures.
- Retransmit and relay operations.

V. Standardized Charts/Heads-Up Displays ***(How)*** - examples of each tracking or information chart to be posted in the command post. These should be standardized across all command posts within the unit.

Operations Center newsletter suggests the following:

Conduct CPSOP Classes. Conduct classroom training for all command post personnel on tasks such as the TOC journal, battle tracking, reporting and TDMP procedures, displacement, and setup/teardown. Classes will familiarize personnel with procedures outlined in the new CPSOP.

Make the CPSOP Part of Garrison Operations. Take tasks from the CPSOP that mirror tasks currently performed in garrison and make them part of the daily routine. For example, train battle-tracking skills by maintaining a status board of the battalion's companies in the S3 shop using the command post heads-up displays. In addition, have radio-telephone operators answer phones, maintain a staff journal, and pass on messages using the same forms as those used in the command post. Train subordinate units to submit reports in garrison using the report formats in the tactical SOP.

Set Up the Command Post Every Month. Exercise load plans, storage plans, and multiple command post configurations. Coordinate for all the battalion command posts to set up and conduct communications exercises and TOC exercises simultaneously and regularly.

Integrate Command Post Operations Into Routine Unit Training. Don't set up command posts only during field training exercises or command post exercises. Use routine training events such as firing ranges and land navigation courses as training opportunities for the command post. Set up battalion command posts to support company training events so that both company and battalion command post personnel receive training.

Revise and Improve the CPSOP. Use the above training methods to validate the CPSOP. Reassess the TTPs and update them as necessary. The CPSOP must be a "living" document to meet the changing needs of an organization.

Conclusion

Observations at the National Training Center indicate a direct correlation between the ability of units to conduct synchronized and efficient command post operations and their level of success in executing combat missions. Unit tracking charts may not make the breach go in, but accurate information gives the commander and staff opportunities to take advantage of situations as they develop. A battalion battle staff can identify command post functions and essential tasks that support each function, commit those tasks to paper, and train them like a battle drill. Then they can use training opportunities like those provided at the National Training Center to train personnel in the art—rather than the mechanics—of command and control.

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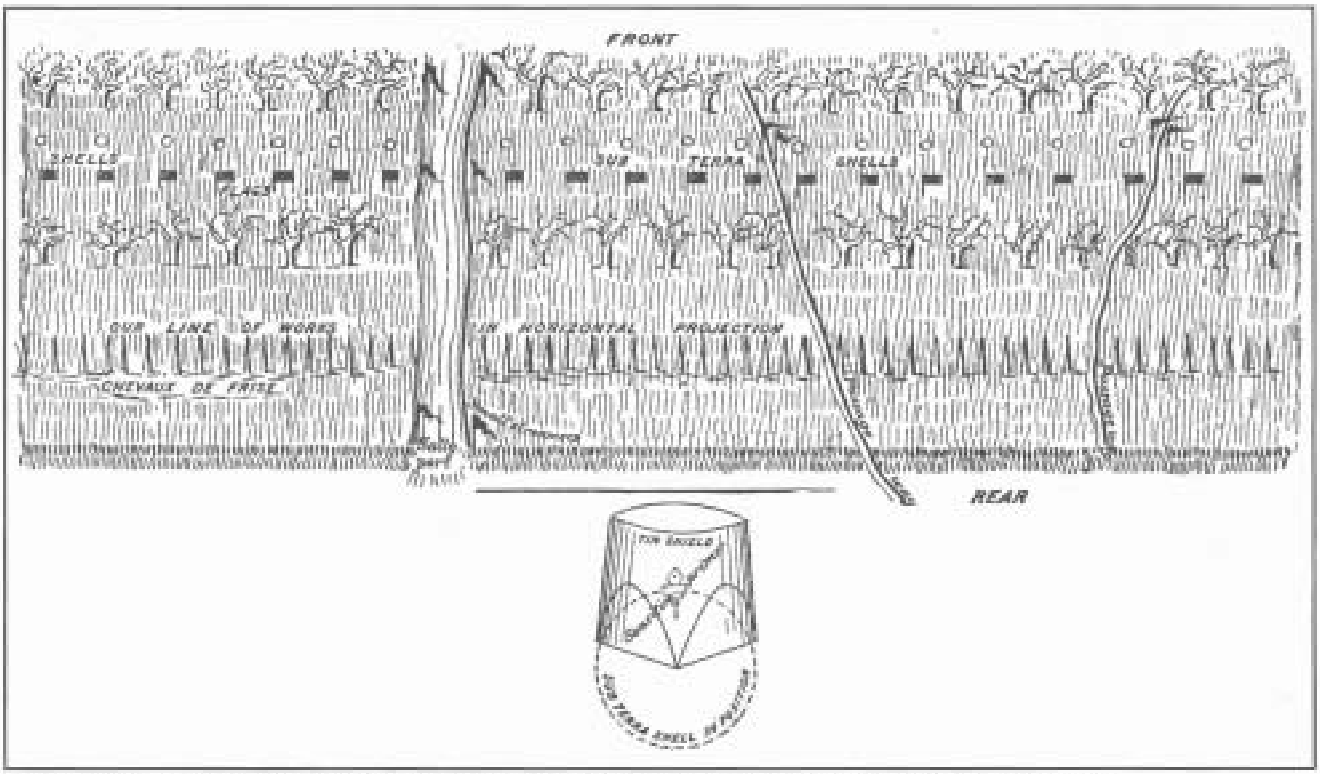

Earliest known sketch of a Civil War minefield (Official Record of the Rebellion, Vol 42, Pt. III, published 1893, GPO, Washington, D.C.)

The Origins of Military Mines: Part I

By Major William C. Schneck

Innovations in mine warfare have come from a variety of sources throughout history, and it is often engineers on the ground who gain the critical insights required for the next leap forward. Mine and countermine technologies and techniques have evolved over the past 3,000 years and continue to evolve in the typical measure/countermeasure/counter-countermeasure cycle seen for other weapons. Part I of this article traces that evolution from the first underground mines through the antipersonnel mines and boobytraps used during World War II.

Early Mining

Commercial underground mining first began in the Bronze Age when surface deposits of minerals and gems were exhausted, forcing miners to follow ore veins deeper into the earth by digging vertical shafts and horizontal drifts. The earliest identified underground mines, dating from 7000 B.C., were copper mines in Anatolia, now part of Turkey. Egyptians began to mine copper and turquoise in Sinai around 3400 B.C. The following Iron Age began among the Hittites, who mined iron ore between 1900 and 1400 B.C. They used this revolutionary material to make superior weapons that greatly facilitated the conquest of their neighbors.

Early in the Bronze Age, walled cities began to appear in the Middle East to protect against raiders and other attackers. Jericho, on the west bank of the Jordan River, just north of the Dead Sea, is the oldest known walled city (dating from approximately 8000 B.C.). The walls at Jericho were about 7 meters high and 4 meters thick and were surrounded by a moat 9 meters wide and 3 meters deep.[1] Later, protective walls developed into huge affairs. Under Nebuchadrezzar II (around 600 B.C.) the walls at Babylon increased to a thickness of about 26 meters.[2]

Early military mining techniques were developed in response to these walled cities and probably were devised by impressed civilian miners at the behest of conquerors. Before military mining, attackers' options were limited to blockading a city (starving them out), scaling the walls, breaching the walls with a battering ram (which began in Egypt about 2000 B.C.), or by stratagem (such as the Trojan Horse). Although the stone-throwing engine of war was first developed by the Phoenicians, the *catapult* was one of the first effective missile engines. It was developed for battering down town walls during the reign of Phillip II of Macedonia, the father of Alexander the Great.[3] In the third century B.C., the great military engineer Archimedes built a missile engine that could hurl a 173-pound stone about 200 meters. Engineers took their name from these "ingenious" devices.[4] Mechanical stone-throwing engines remained in action as late as the Siege of Rhodes in 1480[5] and Cortez' conquest of Mexico (around 1520). In fact, improvised grenade-throwing catapults were used in close combat situations during both world wars.

Early Military Mines

The Assyrian Army organized the first known "corps of engineers" during the time of Ashurnasirpal II (about 850 B.C.). These elite specialists operated siege and bridge trains and provided mobility support for chariots. They were the first soldiers equipped with advanced iron pioneer tools and are credited with the first known use of offensive mine warfare. This occurred about 880 B.C. when engineer soldiers drove tunnels (mines) under or through walls and fortifications[6] to gain access to fortified areas or to create a breach large enough for a full-scale attack. These engineers excavated a chamber under the wall and braced the ceiling with timber supports. The supports were then burned, causing the chamber and the structure above it to collapse. Attacking soldiers then assaulted through the breach.

Among the many successful mines throughout history are those used by Alexander the Great and his engineer Diades at the sieges of Halicarnassus (334 B.C.) and Gaza (332 B.C.)[7] and Julius Caesar and his engineer Mamurra during the siege of Marseilles in 49 B.C.[8] Although effective mining and other combat engineering skills were critical to the military successes of both of these great captains, the skills frequently are neglected by historians.

Early Obstacles

An early example of a reinforcing obstacle intended for use on a battlefield, as opposed to during a siege, occurred around 330 B.C. during the time of Alexander the Great. The Greeks were aware of a new invention called *caltrops*, which could be scattered in front of their battle lines to disrupt the terrifying attacks of the massive Persian war elephants.[9] Caltrops are devices with four metal points arranged so that when three are on the ground, the fourth projects upward as a hazard to animal hooves or tires. Caltrops were used as recently as the Korean Conflict, when the U.S. Air Force dropped them on Chinese convoys to puncture tires. The U.S. also dropped them on the Ho Chi Minh trail during the Vietnam War.

During the siege of Alesia in 52 B.C., Julius Caesar's engineers directed the emplacement of a complex obstacle 100 meters deep. It was a combination of towers, palisades, ditches, abatis, and caltrops to slow the attacking Gauls, so that Roman missile engines could more effectively engage them. These obstacles gave Caesar time to successfully deploy reserve forces to threatened areas along his 13-mile perimeter.[10] Another early obstacle is the *abatis*, emplaced by English longbow men to protect against mounted French knights at the Battles of Crecy (1346) and Agincourt (1415).[11]

Black Powder

Although the origin of black powder is uncertain, it probably was developed by Chinese alchemists seeking an "elixir of immortality" during the T'ang Dynasty around 850 A.D. It was used against the invading Mongols of Ghenghis Khan in 1209.[12] Black powder apparently remained an oddity, for although it terrified those unfamiliar with it, the Chinese did not successfully integrate it into an effective weapon. It apparently impressed the Mongols, who carried black powder with them during their reign of conquest and introduced it to Europeans at the disastrous Battles of Liegnitz and Sajo River in April 1241.[13] The advent of black powder in Europe marked the beginning of modern artillery, when it was fired from mechanical missile engines used by military engineers of Medieval Europe. In fact, the term *gunner* may be a variant of "gynour," a form of engineer.[14] *Serpentine* powder, the earliest form of black powder, was a dust that burned slowly and gave low bore pressure. A method of "corning" powder into larger grains to increase performance was developed about 1450.[15]

Explosive Mines

The ability to manufacture and detonate black powder occurred in Europe in the 14th century and resulted in the next major improvements in military mining.

Tunnel Mines

The surprise and effectiveness of tunnel mines was significantly increased by exploding large charges of black powder at the end of galleries driven under fortifications. The first recorded use of such a mine in Europe was in 1403, during a war between Pisa and Florence, when the Florentines exploded a charge in a forgotten passage in the walls surrounding Pisa.[16] One of the individuals involved with these early explosive mines was a military engineer named Leonardo Da Vinci, who was working for Ludovico, the Duke of Sforza, around 1500.[17] However, for a long time black powder was a scarce and expensive commodity,[18] so the less spectacular method of burning out the timber supports beneath the walls continued for some time.[19] The slow evolution of the cannon eventually forced the high castle walls of the Middle Ages to be replaced by low-walled bastioned fortresses, finally making this method of mining completely obsolete.

In his work on siege warfare (published in 1740), Sebastien Le Prestre de Vauban (French Marshal, 1630-1707) codified principles of military mining that remained valid well into the 19th century.[20] Vauban, in what could be considered the first scientifically based demolitions manual, described a method of charge calculation and placement based on characteristics of the target fortress and the desired effect. He defined these mines by the depth and size of the charge:

- For depths less than 3 meters, it was called a *fougasse* (or *contact mine).*
- For depths greater than 3 meters, it was called a *mine.*
- When used as a "countermine" against an enemy mine, it was called a *camouflet.*
- When intended to destroy an entire fortification (using 2,500 kilograms of powder or more), it was called *pressure balls (globes de compression).*

According to Vauban's tables, explosive charges for mining could range up to 12,200 kilograms. The purpose of mines was not only to cause destruction but also—with the rocks and soil ejected—to form an earthen ramp that assault troops could use to gain immediate access to the breach. Because the demolition often came as a surprise to defending forces, it frequently caused panic and confusion among them.

Tunnel mines were very time consuming to employ. Typically about 18 miners and 36 unskilled workmen were employed in three 8-hour shifts to construct an assault mine. Military mining during a siege could last 30 days or more, and specialists were required for the job. During the Middle Ages, coal miners were hired. Formal mining units were not formed until standing armies were raised by the absolute monarchs of the 17th century—1673 in France, 1683 in Austria, 1742 in Prussia, and 1772 in Britain (the Company of Soldier Artificers). Their work demanded courage and special caution—lack of oxygen and possible flooding were hazards.

Against the bastioned fortresses of Vauban's time, mining normally began as soon as sappers (military specialists in attack and defense of fortifications) completed the last parallel in front of the glacis of a fortress or fortified town. Then besieging miners dug galleries about 1.25 meters high and 1 meter wide and lined them with wood. Once they reached the site selected for the explosion, they dug the blast hole perpendicular to the previous direction of the gallery. Then they filled the mine chamber with the amount of black powder determined by the siege engineer.

To ignite the mine, they fed an ignition "sausage" out of the mine chamber. This sausage was a tube made of linen and filled with granulated black powder that led back to the point of ignition (minenherd). The ignition sausage, a predecessor of the modern time fuze, was normally laid in a 6-centimeter-wide wooden duct and covered with a board to protect it from moisture or other damage. The gallery was finally tamped with sod or earth, over a length of 6 to 10 meters. At the appointed time, the miner ignited the powder in the ignition sausage with an ignition sponge and then retreated quickly before the sponge burned to the powder.

Immediately after the explosion, the besiegers could assault the fortress or extend their sap trenches into the crater and reinforce them with gabions. If necessary, additional mines were used to destroy the palisades of the covered passage and the supporting walls of the counterscarp or scarp, thus facilitating entry into the fortress.

While working in tunnels, miners looked for the defenders' listening tunnels and countermines. Attackers tried to deceive the defenders' listening posts by constructing phony "noise" galleries, where they intentionally made a lot of noise.[21]

Military engineers incorporated the latest technologies from civilian mining as they became available, including more efficient explosives: nitrocellulose in 1845 (Christian Schoenbein, Germany), dynamite in 1866 (Alfred Nobel, Sweden), picric acid in 1871, and TNT in 1902 (C. Hausermann, Germany).[22] Other improvements included electric (galvanic) ignition (1850s)[23] and forced-air ventilation systems. During World War I, both sides employed new mechanical tunnel-boring machines developed for commercial coal mining, as well as traditional techniques.[24]

Tunnel mining has continued sporadically into the modern era and was used by Napoleon at Acre (1799), the Crimean War (Sevastopol),[25] General Grant's men in the American Civil War (Vicksburg[26] and Petersburg[27]), the Russo-Japanese War (Port Arthur[28]), World War I (Western Front[29] and the Isonzo Front[30]), World War II (Russian Front[31]), and the French-Indochina War (Dien Bien Phu[32]). Most recently, the Peruvians used tunnel mines to liberate hostages held in the Japanese ambassador's residence in Lima. The North Koreans may use them in the future—some of their tunnels have been discovered under the demilitarized zone (DMZ) and more are suspected.

Fougasse[33]

Frederick the Great, King of Prussia, stated that "Fougasses formed into a T-like mine, in order to blow up the same place three times, can be added to the entrenchments. Their use is admirable; nothing fortifies a position so strongly nor does more to ward off attackers."[34] These fougasses were simple black powder devices first developed for defending permanent fortifications. They were intended to detonate in the face of an enemy assault. A black powder charge was placed in a chamber excavated in the face of a fortification (firing horizontally) or in front of it (firing vertically). The chamber was then packed with a quantity of fragments, normally rocks or scrap iron and called a *stone fougasse,* or filled with explosive artillery shells and called a *shell fougasse.* If properly emplaced, a horizontally fired fougasse functioned as a crude claymore mine, while the shell fougasse could function like a bounding antipersonnel (AP) mine or a simple fragmenting mine. Fougasses were command-detonated by manually igniting a powder train from a protected position at the appropriate time. Fougasses had several defects: they were vulnerable to the elements—even moderate dampness rendered them inoperative—and were difficult to detonate at the optimum time. However, in the right circumstances, *fougasses* caused heavy casualties, as occurred during the sieges of Ciudad Rodrigo, Badajoz, and Santander in the Duke of Wellington's Peninsular Campaign of the Napoleonic Wars.

Fougasses were employed by one of George Washington's engineers, Francois de Fleury (of de Fleury Medal fame), in October 1777 against the Hessians at Fort Mercer, New Jersey, on the east bank of the Delaware River.[35] During the War of 1812, an American ammunition chest accidentally exploded during a British attack on Fort Erie, Canada. This caused the attack to collapse, and the fear of additional fougasses prevented further British attacks.[36] (The only engineer unit in the American Army during this war—the Company of Sappers, Miners and Bombardiers—fought in this battle). During the Mexican-American War of 1845, the Mexicans attempted to employ fougasses on the approaches to Chapultepec.[37] Stone fougasses are still employed occasionally by irregular forces, such as the Viet Cong, Central American guerillas,[38] and Bosnians,[39] who lack access to modern land mines.

Self-Contained Mines

Military engineers in China employed the first self-contained explosive AP mines against Kublai Khan's Mongol invaders in 1277. Manufactured in many shapes and sizes, these mines could be command-detonated or activated with either a pressure device (probably based on a match) or a pull-firing device (a forerunner of the flintlock mechanism).[40] However, they were seldom used and were largely forgotten by the time Western explorers arrived in the Orient.

Introduction of the European flintlock in 1547 led to the first target-activated AP mine in the West. This *fladdermine,* developed by Samuel Zimmermann of Augsburg in 1573, consisted of one or more pounds of black powder buried at a shallow depth in the glacis of a fortress. It was actuated by stepping on it or by tripping a wire along the ground that released a flintlock igniter to fire the main charge. Like the fougasse, these devices were highly vulnerable to dampness and required frequent maintenance. They were used mainly around fixed fortifications.[41] Fladdermines were used against Frederick the Great during the Siege of Schweidnitz in 1758 and by the Germans during the Franco-Prussian War in 1870-1871.[42]

Although the Chinese first introduced explosive shells (as opposed to solid shot) in about 1221, they were unreliable and were used mainly with mortars. Re-introduction of explosive shells in the West in the 1700s, combined with the invention of the percussion cap by Reverend Alexander Forsythe of Scotland in 1814,[43] made possible the next important step in the development of reliable mines by greatly improving their resistance to moisture. Confederate soldiers under General Gabriel Raines improvised the first of this type of AP mine from artillery shells at Redoubt No. 4 near Yorktown, Virginia, during the campaign of 1862.[44] After several casualties, these were cleared by two companies from the 50th New York Volunteer Engineer Regiment.[45] By the end of the Civil War, the Confederates had emplaced thousands of *land torpedoes* around Richmond, Charleston, Mobile, Savannah, and Wilmington, which produced hundreds of casualties (see table on page 53). Robert E. Lee, John Mosby, and J.E.B. Stuart all advocated the use of AP mines.

Land torpedoes were also used against Sherman in Mississippi, by General Raines on roads into Augusta, and by General Wheeler on the roads into Savannah and Pocotaglio. A *coal torpedo* (a type of boobytrap with an irregular sheet-iron case filled with black powder and painted black) was used to destroy General Butler's headquarters steamer *Greyhound,* and coal torpedoes were implicated in the sinkings of the *Chenango* and the *Sultana.* Union troops of I Company, 3rd U.S. Colored Troops, also used torpedoes near Savannah. Five of the torpedoes designed by General Raines were found near Mobile, Alabama, in 1960.

The British employed mines during the Boer War in 1901 to protect railroads and deny fording sites to the enemy.[46] In the Siege of Port Arthur during the Russo-Japanese War of 1904, the Japanese tried to breach Russian mines with volunteer suicide squads that were to force a passage by sacrificing their own bodies. Upon approaching the minefield, the volunteers found that heavy rains had exposed many of the mines.[47]

Between the Civil War and World War I, powerful military explosives were introduced that significantly increased the mines' lethality. Black powder shells of the Civil War period burst into only two to five fragments, while those of the Franco-Prussian War burst into 20 to 30 fragments. By World War I, a 3-inch high-explosive shell produced about 1,000 high-velocity fragments.[48]

The German *tretmine* (step-on mine), the next high-explosive mine to appear, went into limited production before World War I. Lieutenant Ernst Junger of the 73rd Hanoverian Fusilier Regiment described German improvised mines this way: "These hotheads are forever puzzling out the possible ways of ...making the ground in front of the trench murderous with explosive machines. Perhaps they cut a narrow passage through the wire in front of their posts in order to entice an enemy patrol, by this bait of an easy way through, straight up to their rifles."[49]

The United States also had a fairly advanced concept of landmine warfare, as stated in *Engineer Field Manual, Parts I-VII,* in 1918.[50] However, all the World War I combatants relied heavily on artillery and machine guns and seldom used AP mines. It was not until the Second World War that AP mines reached full maturity, and they have been an important facet of almost every conflict since.

Fragmenting AP Mines

Even though modern, self-contained fragmenting AP mines have been employed in the West in relatively small numbers since the American Civil War, they did not appear in significant numbers until World War II. At that time, three types of fragmenting AP mines emerged: *bounding mines,* the predecessors of the M16 "Bouncing Betty"; *directional*

Civil War Landmine (Torpedo) Employment

Location	Type/Number	Effect/Result	Date
Columbus, KY	Improvised electrically command-detonated 4-pound shell filled with grapeshot and two bushels of powder in a cast-iron container	None; visually detected and cleared by a company from the 27th Illinois Infantry	March 1862
Redoubt No.4, Williamsburg, VA	A few shells with pressure or trip-wire fuzes	Marked with small red flags; caused about 36 casualties including some killed in action	4 May 1862
Road out of Williamsburg, VA	Four 10-inch shells with trip-wire fuzes near felled trees	Union cavalry took "some" casualties; caused a three-day delay	5 May 1862
Fredericksburg, VA	Railroad mines with percussion fuzes	None; "contrabands" identified their location and cleared the mines by hand. Proofed by a flat car pushed slowly ahead of the locomotive.	May 1862
Nashville and Chattanooga Railroad near Tullahoma, TN	Railroad mines laid by CPT McDaniel	Two "heavily laden" trains were destroyed	27 June 1863
Battery Wagner, SC	Many, including 56 10-inch shells, about 20 24-powder, more than 30 10-gallon wooden kegs, and three 15-inch naval shells	At least seven were exploded, killing two and wounding 11	Summer 1863
Fort Esperanza, TX	24 improvised 40-pound torpedoes, electrically command-detonated	Discovered after the fort was captured	Fall 1863
James Island, SC	Land torpedoes and flame mines reported	Union troops avoided the area	1864
City Point, VA	One 12-pound clockwork torpedo brought aboard an ammunition barge	At least 58 killed, 126 wounded, $4 million in damages	9 August 1864
West Point Railroad south of Atlanta, GA	Sherman's troops emplaced pressure fuzed mines during railroad destruction	Unknown	28 August 1864
Fort McAllister, GA	7- or 8-inch shells 3 feet apart	12 killed and about 80 wounded	13 December 1864
Fort Fisher, NC	24 electrically command-detonated Singer torpedoes, 200 feet in front of the trenches around the fort, 80 feet apart	Firing wires cut by artillery fire	22 January 1865
Sister's Ferry, GA	James Tomb laid 40 to 50 torpedoes using 6- and 10-powder shells	Two exploded and killed "several" of Sherman's men	29 January 1865
Richmond, VA	At least 1,298 mines	Delayed Union General Weitzel's XVIII Corps' advance by several hours	April 1865
Spanish Fort, AL	205 Raines mines	"Several" killed	9 April 1865
TOTAL	**Thousands of mines laid**	**Hundreds of casualties**	

mines, the predecessors to the M18 Claymore; and *simple fragmenting mines*, like the Soviet POMZ-2 stake mine.

Bounding AP Mines. An 1859 U.S. military engineering manual by General Halleck includes the design for an improvised command-detonated bounding AP mine called a *shell fougasse*.[51] However, modern manufactured examples of this type did not make their combat debut until early in World War II, when French patrols on the Siegfried Line began to take unexplained casualties. These casualties were attributed to a device the French dubbed "the silent soldier," the famous German "S" mine introduced during the 1930s.[52] These mines were commonly called *"Bouncing Bettys."*

Directional AP Mines. These mines descended from an early directional type of stone fougasse used in Europe. Under the guidance of physicists Franz Rudolf Tomanek and Hubertn Schardin, the Germans developed a directional AP mine, called a *trench mine*, late in World War II. The French fielded a directional AP mine in 1947, but it was the Americans who refined it in response to the human-wave attacks of Chinese Communist forces during the Korean Conflict in the early 1950s. The new mine was developed and placed in production in 1953, too late to see combat in Korea. Called the M18 Claymore after a famous type of Scottish broadsword, it first saw combat in Vietnam in 1961.[53]

Simple Fragmenting AP Mines. Stake-mounted, fragmenting AP mines were introduced in the Russo-Finnish War of 1939, when badly outnumbered Finns improvised them from grenades. When the Finns fought the Russians to a standstill along the Mannerheim Line in November 1939, this setback forced the Russians to conduct the first mounted breach of a mined, complex obstacle. In preparation for a deliberate breach, the Russians improvised roller tanks and flamethrower tanks and conducted extensive rehearsals.[54] The *stake mine* that emerged from World War II is still used today without significant changes to its design.[55] The best-known example is the Soviet-made POMZ-2 mine.

Blast AP Mines

Blast AP mines descended from the vertical fougasse and large underground mines that were dug under fortified positions and then detonated. It is unclear which mine is the first modern "toe-popper" blast AP mine, but the Soviet-made PMK-40[56] and the British-made "Ointment Box"[57] mine are good candidates.

Chemical Mines

The British-developed Livens Projector was first employed in 1917 and is arguably the first chemical mine.[58] The Germans also developed and employed what the Allies dubbed the "Yperite Mine" in 1918. It used a delayed action demolition charge containing mustard agent ("Yperite") to deny bunkers that were being abandoned during a withdrawal.[59] The first modern chemical mine, the Spruh-buchse 37 (Bounding Gas Mine 37), was developed and produced by Germany during World War II and normally had a mustard-agent fill. It was never used in combat.[60] Except for the introduction of nerve-agent fills, the design of chemical mines has not changed significantly since the Second World War.

Flame Mines

"Liquid Fire" and "Greek Fire" have existed since classical times. However, the first reported flame mine was improvised by Confederate soldiers near Charleston in 1864, possibly from shells containing Greek Fire, which the Union fired into the city and that failed to function.[61] During World War II, the Russians used a trip-wire-activated static flamethrower at the Battle of Kursk.[62] These devices were quickly copied by the Germans and used in the Atlantic Wall.[63] The British also employed improvised flame mines during the First Battle of El Alamein in 1942.[64] The United States developed the first modern flame mine, the XM-55, for use in Vietnam. It was a pressure- or trip-wire-activated bounding mine.[65] There are no indications that it was ever used in combat. Improvised flame mines, sometimes called *flame fougasse*, are still occasionally used in combat.

Boobytraps

The first explosive boobytraps were employed by the Chinese against the Mongols in 1277.[66] They first appeared in the West during the Seminole War of 1840.[67] During the Civil War, Confederate soldiers employed a variety of these devices—including pull-firing devices, timer-rundown fuzes, and coal or wood "torpedoes" that detonated when burned in a boiler. Boobytraps reached full maturity during World War II, when reliable German mechanical anti-handling devices were introduced, and have been used in almost every conflict since.

Conclusion

During the 20th century, the antipersonnel mine evolved into a highly effective weapon and combat multiplier. It proved to have great utility for protecting outnumbered American soldiers against dismounted attacks, as shown in Anzio and Korea. The innovations that made this mine possible came from a variety of sources, including the ingenuity of combat engineers.

Part II of this article begins with antivehicle mines, first used around 120 B.C., and continues through countermines, sea mines, and antiaircraft mines being used or developed today.

Major Schneck, a professional engineer, is the Assistant Division Engineer, 29th Light Infantry Division (Virginia Army National Guard), and a senior project engineer in the Countermine Division, Night Vision and Electronic Sensors Directorate, Fort Belvoir, Virginia. A veteran of both the Gulf War and Somalia, he has published numerous papers on mine warfare. Major Schneck is a graduate of the Command and General Staff College and holds a master's degree in mechanical engineering from Catholic University.

Endnotes

[1]*Ancient Inventions*, by Peter James and Nick Thorpe, Ballantine Books, New York, page 200.

[2]*A History of Fortification, From 3000 BC to AD 1700*, by Sidney Toy, Heineman, London, 1966, page 2.

[3]*The Generalship of Alexander the Great*, by J.F.C. Fuller, Rutgers University Press, New Brunswick, N. J., 1960, page 45.

[4]*Origins, A Short Etymological Dictionary of Modern English*, by Eric Partridge, the Macmillan Company, New York, 1966, page 251.

[5]OP CIT, *A History of Fortification, From 3000 BC to AD 1700*, page 256.

[6]*The Art of Warfare in Biblical Lands, Volume 1*, by Yigael Yadin, McGraw-Hill Book Company, New York, page 317. Note however, that the earliest mention of engineer soldiers is attributed to the Hittites as early as 1600 BC. Also, the early Hittite capital Boghazkoy had predug tunnels to allow for defensive sorties against any prospective besiegers. See The Hittites, by O. R. Gurney, Penguin Books.

[7]OP CIT, *The Generalship of Alexander the Great*, pages 200-218.

[8]*War Commentaries of Caesar*, by Julius Caesar, translated by Rex Warner, The New American Library, 1960, pages 259-266.

[9]*Warfare in Antiquity, The History of the Art of War, Volume 1*, By Hans Delbruck, translates by Walter Renfroe, University of Nebraska Press, Lincoln, Nebraska, 1990 edition, page 212. See also "Weaponry," by Robert W. Reid, Military History Magazine, August 1998, page 20.

[10]OP CIT, *War Commentaries of Caesar*, page 173.

[11]*The Face of Battle*, by John Keegan, Penguin Books, 1976, pages 90-91.

[12]*The Genius of China*, by Robert Temple, Simon and Schuster, New York, 1986, page 224.

[13]"Mongol Invasion of Europe," by Erik Hildinger, *Military History Magazine*, June 1997, page 44.

[14]OP CIT, Origins, *A Short Etymological Dictionary of Modern English*, page 271.

[15]*The Complete Illustrated Encyclopedia of the World's Firearms*, by Ian V. Hogg, A & W Publishers, New York, page 8.

[16]*Mine/Countermine Operations at the Company Level*, FM 20-32, Department of Doctrine and Training Development, US Army Engineer School, Fort Belvoir, Virginia, 30 September 1976, page 133.

[17]*Engineers of the Renaissance*, by Bertrand Gille, The MIT Press, Cambridge, Massachusetts, page 124-125.

[18]*A History of Artillery*, by Ian V. Hogg, Hamlyn, New York, pages 23-24. The entire English inventory was only 84 pounds of powder in 1370.

[19]As portrayed during the siege of Harfleur (1415) in Shakespeare's play "Henry V."

[20]*A Manual of Siegecraft and Fortification*, Sebatien de Vauban, translated by George Rothrock, The University of Michigan Press, 1968.

[21]"Siege," by Gert Bode, *International Military and Defense Encyclopedia, Volume 5*, Brassey's Inc., Washington, D.C., 1993, page 2421.

[22] *Military Explosives*, TM 9-1300-214, Department of the Army, September 1984, pages 2-4 to 2-8.

[23]Although Count Volta invented his "voltic pile" battery in 1800, its potential utility was only slowly recognized.

[24]*War Underground, The Tunnellers of the Great War*, by Alexander Barrie, Tom Donovan, London, England, pages 196-206.

[25]*An Elementary Course of Military Engineering, Part I, Comprising Field Fortification, Military Mining, and Siege Operations*, By D. H. Mahan, Wiley & Son, New York, New York, 1867, pages 172-177.

[26]"Engineer Operations During the Vicksburg Campaign," by Robert Puckett, AD-A255-141, Ft Leavenworth, KS, 1992, pages 124-132.

[27]*The Siege of Petersburg*, by Joseph P. Cullen, Eastern Acorn Press, 1970, pages 17-23. The mine exploded by Federal troops under the Confederate earthwork at Elliot's Salient at Petersburg, Virginia, on 30 July 1864 was 510 feet long, charged with 8,000 pounds of powder and produced a crater 9 meters (30ft) deep, 18 meters (60ft) wide, and 52 meters (170ft) long. The subsequent Federal assault, however, was unable to exploit the temporary advantage gained by the explosion and the surprise. A work force reaching over 400 men at times completed the mine in slightly over a month.

[28]*The History of Fortification*, by Ian Hogg, St. Martin's Press, New York, pages 185-189.

[29]OP CIT, *War Underground, The Tunnellers of the Great War*, pages 243-261. On 7 June 1917 British engineers fired nineteen mines with 430 tons of Ammonal at a depth of 40 meters at Wytschaete Salient south of Ypres, destroying three German battalions.

[30]On 13 March 1918, Austrian engineers blew up part of Mount Pasubio, which was occupied by the Italians, using 50,000 kilograms (55tons) of explosives killing 485 men.

[31]*Small Unit Actions During the German Campaign in Russia*, CMH Pub 104-22, Center of Military History, Washington, D.C., Facsimile edition 1988, pages 165-168). The "Blitzkrieg" oriented German Army of WWII maintained special "Minier Pioniere" units throughout the war (Pioniere, Entwicklung einer Deutschen Waffengattung, by Dietrich Petter, Wehr und Wissen Verlagsgesellschaft MBH, Darmstadt, Germany, 1963, page 245). The British and Canadians are retained this type of unit during WWII.

[32]*Hell in a Very Small Place*, by Bernard Fall, J.B. Lippincott Company, 1966, pages 184-388.

[33]Not to be confused with the improvised flame mine that US Army engineers occasionally employ and call a "fougasse."

[34]*Frederick the Great, On the Art of War*, by Frederick II, edited and translated by Jay Luvaas, copyright 1966, The Free Press, New York, page 288.

[35]*Engineers of Independence, A Documentary History of the Army Engineers in the American Revolution, 1775-1783*, by Paul K. Walker, Historical Division, Office of the Chief of Engineers, Washington, D.C., page 158-159.

[36]*Campaigns of the War of 1812-15 Against Great Britain, Sketched and Critised, with Brief Biographies of the American Engineers*, by MG George Cullum, James Miller, New York, 1879, pages 237-250.

[37]*The War with Mexico*, by Donald Chidsey, Crown Publishers, New York, pages 161-163.

[38]*Ayudas de Instruccion Contra Minas, Trampas Y Artefactos Explosivos*, Guatemalan Corps of Engineers, undated, page 60.

[39]*Engineer Contingency Handbook* (former Yugoslavia), US Army Engineer School, Ft Leonard Wood, Missouri, July 1993, page 1-32.

[40]OP CIT, *The Genius of China*, page 235-237.

[41]"Mine Warfare, Land," by Ulrich Kreuzfeld, *International Military and Defence Encyclopedia, Volume 4*, Brassey's Inc., Washington, D. C., 1993, pages 1756-1757.

[42] OP CIT, *Pioniere, Entwicklung einer Deutschen Waffengattung*, pages 36 and 118.

[43]*The Illustrated Encyclopedia of 19th Century Firearms*, by Major F. Myatt, Cresent Books, New York, page 18.

[44]*Lee's Lieutenant's, Volume 1*, Douglas Southall Freeman, 1942, pages 268-269. See also Southern Historical Society Papers, Volume III, January to June 1877, Broadfoot Publishing Company, 1990 edition, pages 38-39. The shells used were ordinary 8- or 10-inch mortar or columbiad shells.

[45]*Bridge Building in Wartime, Colonel Wesley Brainerd's Memoir of the 50th New York Volunteer Engineers*, edited by Ed Malles, University of Tennessee Press, Knoxville, Tennessee, 1997, page 65.

[46]"The Royal Engineers Journal," December 1, 1903, page 267.

[47]*The Short Victorious War, The Russo-Japanese Conflict, 1904-5*, by David Walder, Harper & Row, New York, page 102.

[48]*The Evolution of Weapons and Warfare*, by T. N. Dupuy, Bobbs-Merrill Company, Indianapolis, 1980, page 213.

[49]*The Storm of Steel, From the Diary of a German Storm-troop Officer on the Western Front*, by Ernst Junger, Howard Fertig, New York, 1993 edition, page 43.

[50]*Engineer Field Manual, Parts I-VII*, Professional Papers of the Corps of Engineers, US Army, No.29, Fifth Edition (corrected to December 31, 1917), Government Printing Office, Washington, 1918, page 422.

[51]*Elements of Military Art and Science; or, Course of Instruction in Strategy, Fortification, Tactics of Battle &c.* by H. Wager Halleck, D. Appleton & Company, New York, New York, 1859, page 363. Note however, that this type probably predates this work and in fact, it may be shell fougasses that were emplaced by the Mexicans at Chapultepec, but the available descriptions are not clear.

[52]*Engineers in Battle*, by Paul W. Thompson, Military Service Publishing Company, Harrisburg, Pennsylvania, 1942, pages 64-71, translation of an article in Vierteljahreshefte fur Pioniere, 3rd Quarter, 1940.

[53]*Claymore Mines, Their History and Development*, by Larry Grupp, Paladin Press, Boulder, Colorado, 1993.

[54]*The Winter War, The Russo-Finnish Conflict, 1939-40*, by Eloise Engle and Lauri Paananen, Charles Scribner's Sons, New York.

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

[56]*Soviet Mine Warfare Equipment*, TM 5-223A, Department of the Army, Washington, D.C., August 1951, page 129.

[57]*British, French and Italian Mine Warfare Equipment*, TM 5-223D, Department of the Army, Washington, D.C., May 1952, page 61.

[58]*Chemical Warfare in World War I: The American Experience, 1917-1918*, by Charles Heller, Leavenworth Papers No. 10, Combat Studies Institute, Ft Leavenworth, Kansas, September 1984, page 20-21.

[59]"Report on an Yperite Mine," Report No. Z-741, by A. Kling, Municipal Chemical Laboratory, Paris, France, 3 December 1918, DTIC # AD499536.

[60]*German Mine Warfare Equipment*, TM 5-223C, Department of the Army, Washington, D.C., March 1952, page 146.

[61]*Infernal Machines, The Story of Confederate Submarine and Mine Warfare*, by Milton F. Perry, Louisiana State University Press, 1965, page 166.

[62]*The History of the Panzerkorps Grossdeutschland, Volume 2*, by Helmuth Spaeter, J. J. Fedorowicz Publishing, Winnipeg, Canada, 1995 edition, page 121.

[63]OP CIT, *Eastern Europe, World War II, Landmine and Countermine Warfare*, pages 387-399. For an example of their use in the Atlantic Wall, see "Defenses of the Normandy Peninsula," by Sherwood Smith, The Military Engineer, Vol. XXXVII, No. 2, page 50.

[64]Report from the 3rd Reconnaissance Battalion, 21st Panzer Division, dated 26 July 1942, Captured German Records, National Archives, T-313, Roll 411, Frame 8723884.

[65]*Vietnam, 1964-1969, Landmine and Countermine Warfare*, Engineer Agency for Resources Inventories, Washington, D.C., June 1972, page 47.

[66]OP CIT, *Ancient Inventions*, page 207.

[67]*Southern Historical Society Papers, Volume X, January to December 1882*, Broadfoot Publishing Company, 1990, pages 257-260.

ENGINEER UPDATE

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

Maneuver Support Center (MANSCEN)

MANSCEN Events. The initiative to stand up the MANSCEN at Fort Leonard Wood is on track. The following events indicate progress to date:

- MG Flowers was appointed the provisional MANSCEN Commander by General Hartzog, TRADOC Commander, effective 30 April 1998.
- Garrison Command is preparing the Reception Plan, which will be completed by 1 October 1998.
- Final plans for integrating Fort McClellan elements into Fort Leonard Wood facilities are under way. Many organizations will move within the schoolhouse and telephone numbers will change. New telephone numbers will be listed on the Fort Leonard Wood LAN system.
- Construction of new facilities is on schedule. Anticipated occupancy dates are being finalized, which will affect the procurement of furniture and the installation of communications and data lines.
- The Chemical Defense Training Facility will begin surety training and testing in January 1999.
- MANSCEN training begins in June 1999.

Additional information is available on the MANSCEN home page at:
www.wood.army.mil/manscen/index.htm
POC is LTC Susan Myers, -6134.

Department of Training and Doctrine (DOTD)

Field Manual Update. Engineer School personnel recently digitized several field manuals that are not currently available in the Army Doctrinal and Training Digital Library. These manuals are posted to the Engineer School's Publications Page at http://www.wood.army.mil/PUBS/newpubs.htm.

The Engineer School is reviewing the first draft of the next iteration of doctrine to support Force XXI operations. This doctrine will be published as changes to existing manuals.

The following manuals are scheduled for publication and release to the field within the next 180 days.

- FM 5-116, *Engineer Operations: Echelons Above Corps*
- FM 5-34, *Engineer Field Data*
- FM 5-436, *Paving and Surfacing Operations*
- FM 5-415, *Fire Fighting Operations*
- FM 5-434, *Earth Moving Equipment*
- FM 90-13-1, *Combined Arms Breaching Operations*
- FM 90-7, *Combined Arms Obstacle Integration*

POC is Sandra Gibson, -4100.

Directorate of Combat Developments (DCD)

M34 Blasting Machine. A Safety of Use Message (SOUM ACALA 98-05) from the Tank and Automotive Command (TACOM) deadlines the M34 Blasting Machines manufactured by Minowitz Manufacturing. The M34 is a component of Demolition Kit (LIN F91490) and EOD Field Maintenance Set (LIN T57126) and is used with the MICLIC (LIN 67342). If you have a Minowitz M34 Blasting Machine or a blasting machine that cannot be identified as manufactured by a company other than Minowitz, it must be removed from service until it is tested. A blasting cap connected to the machine can be detonated by voltage produced when the bail lock is released and the handle of the blasting machine is extended to the "ready" position. Minowitz M34 Blasting Machines are identified by a lot number beginning with "MMW" that is etched or stamped on the bottom. To obtain a detailed test procedure from TACOM, call the Logistics Management Office at Rock Island Arsenal at (309) 782-1709 or DSN 793-1709. POC is Alan Schlie, -6191.

Nuclear Densimeter. The contract award for a new nuclear densimeter is scheduled for July 1998, with the date of issue programmed for the 4th quarter of FY99. An article describing the equipment and the responsibilities of the using unit commander will appear in the fall issue of *Engineer*. POC is SSG Troy Miller, -6185.

Lead the Way

By Command Sergeant Major Robert M. Dils
U.S. Army Engineer School

ENFORCE Conference

Another ENFORCE Conference has come and gone. By all accounts, this was a great one. All of us at the Engineer Center appreciate your efforts and the support you provided. Now it's time to look ahead.

Change

Our Army is an institution that constantly changes. Reasons include changes in our National Policy, the impacts of changing resources (people, funding, etc.), and technological advances. All of us are impacted, but some feel the effects of change more than others. As noncommissioned officers, it is our responsibility to remain positive about changing conditions and to give leaders our ideas and opinions concerning proposed changes. You can address your ideas and opinions to Army leaders through the chain of command and to the Engineer Center, which is your "voice" on issues related to changes in engineer doctrine, force structure, equipment modernization, and training. We value your input and, frankly, we can't do without it. Input to the chain of command and the Engineer Center is a positive way you can affect change.

At the same time, we must shelter our subordinates from negative, nonproductive discussions about change. As noncommissioned officers, we must remain focused on training, maintenance, quality of life issues, and mentoring. We must help our soldiers focus on what is truly important. If we do this, the impacts of change will be reduced and less noticeable to our soldiers. We must help them adjust to required changes and ensure they remain focused on what is truly important: training, maintenance, and career development.

Command Sergeants Major Fall Engineer Training Conference

As you may have heard, a Command Sergeants Major Training Conference will be held in Vicksburg, Mississippi, on 20-22 October. If you have not received an invitation and would like to attend, please send an e-mail message to: dilsr@wood.army.mil. Invitation packets will be mailed by 15 August 1998. A very informative program is planned and we look forward to seeing you.

In preparation for this training conference, we ask that you complete one of the three surveys posted on the Fort Leonard Wood home page (www.wood.army.mil). Separate surveys are posted for NCOs in career management fields (CMFs) 12, 51, and 81. We ask that you complete the survey no later than 1 September.

Engineers Lead the Way!

We extend a big "Hoo-ah!" to the following individuals for their outstanding achievements:

- Specialist Jason D. Etling, 642nd Engineer Company, 41st Engineer Battalion, 10th Mountain Division, Fort Drum, New York, is the Division Soldier of the Quarter for the 2nd quarter, FY98.
- Sergeant John W. Swartz, D Company, 10th Engineer Battalion, 3rd Infantry Division, Fort Stewart, Georgia, is the Division NCO of the Quarter for the 2nd quarter, FY98.
- SSG Bradley J. Houston, 12B, Fort Leonard Wood's Drill Sergeant of the Year, was recently selected to be the United States Army Active Component Drill Sergeant of the Year.
- SSG Thomas J. Ross, 12B, 98th Training Division Drill Sergeant of the Year, was recently selected to be the runner-up for the United States Army Reserve Component Drill Sergeant of the Year.
- SPC Mack H. Welch, 12B, C Company, 16th Engineer Battalion, Engineer Brigade, 1st Armored Division, was selected to be the United States Army Europe (USAREUR) Soldier of the Year for 1998.
- Did you know that the 4th Engineer Battalion, Fort Carson, Colorado, has 12 members of the Sergeant Morales and the Sergeant Audie Murphy Clubs? That significant record will be hard to beat!

Congratulations to you all!

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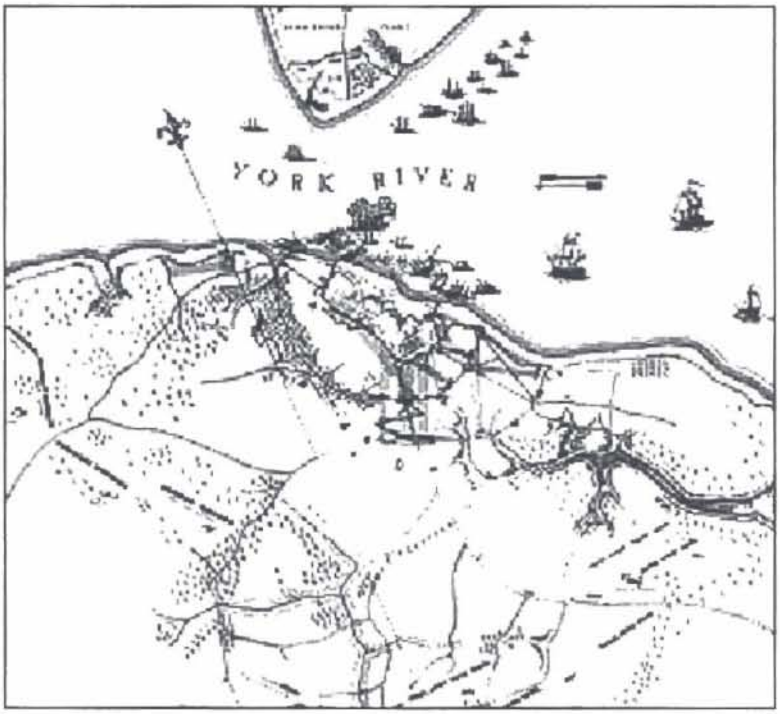
ARMY VALUES

DUTY

"Do your duty in all things. You cannot do more.
You should never wish to do less."
Robert E. Lee



Map of the Yorktown Battle
Showing Engineer Siege Works (October 1788)

"This corps of Miners was reckoned an honorable one ... I was a sergeant and I think I did use my best abilities to perform the duties of the office according to my best knowledge and judgement. Indeed, I can say at this late hour of my life, that my conscience never did, and I trust never will, accuse me of any failure in my duty to my country ... I always fulfilled my engagements to her ..."

Sergeant Joseph Plumb Martin, Company of Sappers and Miners

History Office, U.S. Army Engineer School

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