Engineer

THE PROFESSIONAL BULLETIN FOR ARMY ENGINEERS
Headquarters, Department of the Army

January 1991



Civil Works and Military Construction

PB 5-91-1

Approved for public release; distribution is unlimited.

Teamwork: The Key to Success

The history of United States military operations is replete with examples and situations where Army and Marine Corps units have stood shoulder to shoulder on the same battlefield. From Mexico City in 1847 to the Argonne Forest in World War I; from Saipan and Okinawa in World War II through Korea and Vietnam; as recently as Grenada and Panama; and, of course, today in the desert of Saudi Arabia, soldiers and Marines have been part of the same force. All indications are that this trend toward joint operations will increase as we move into the 21st century.

While tomorrow's battle plans are being developed to address all phases of low-, mid- and high-intensity conflicts, there is no doubt that the support provided by combat engineers will always be a critical requirement. The Army's AirLand Battle doctrine and the Marine Corps' philosophy of maneuver warfare both call for engineers to increase the combat effectiveness of the total force.

Marine engineers are found in combat engineer battalions of Marine divisions, engineer support battalions of force service support groups, and Marine wing support squadrons of the aircraft wings. Combat engineer battalions provide direct combat engineer support to infantry regiments in the forward portion of the battle area. Engineer support battalions provide general engineering support to landing forces, and they reinforce combat engineer battalions when necessary. Engineers in Marine wing support squadrons provide ground engineer support to the Marine aircraft wings. All engineer forces are manned, equipped, and trained to deploy rapidly and provide support to the Marine air-ground task forces.

With today's projected force reductions and the continuing competition for limited resources, I believe the development and continued evolution of Army and Marine engineer forces should be closely coordinated in three specific areas.

Doctrine. Staffing of doctrine for mobility/countermobility, demolitions, survivability, bridging, vertical and horizontal construction, and all other aspects of combat engineering should be shared between our separate headquarters. I include in this joint review process the preparation and revision of Army field manuals (FM), Marine Fleet Marine Force Manuals (FMFM), and technical manuals (TM).

Solicitation of comments and inclusion of pertinent information from both services will lead to the production of more complete and sound documents than those currently available. After such closely coordinated publications are distributed, their use will be more widespread and content revisions should be required on a less frequent basis.

Equipment. Development and procurement of common engineer equipment should remain as one of our goals. The armored combat earthmover (ACE), small emplacement excavator (SEE), and mine clearing line charge (MICLIC) are but a few recent examples of items which can be employed successfully by all combat engineers. Who knows what the future may hold in this area.

Obviously the missions, roles, and concepts of employment dictate that not all equipment is suitable for use by both services. The Marine Corps' amphibious and expeditionary role calls for equipment that can be brought across beaches, that is helicopter transportable, and that can travel with the maneuver force at high speed. In many instances, today's Army has the same requirements. Thus, cooperative efforts in research, development, and procurement will lead to more efficient use of time and resources.

Training. The joint training of Army and Marine engineers at formal schools should continue whenever possible. Also, the preparation and validation of engineer battle drills should be a compilation of input from both services. Finally, major joint training exercises provide invaluable opportunities, and these should be scheduled as frequently as practicable.

Currently, more than 50 enlisted Marines attend schooling at Fort Leonard Wood each year. These Marines receive training in drafting, surveying, and material quality specialist courses. Additionally, 10 Marine captains attend the Army's Engineer Officer Advanced Course each year. Cross training of soldiers and Marines takes advantage of already existing facilities, curricula, and faculties. Cross training can also lead to more innovative and open-minded thinking and

(Continued on page 28)

By Lieutenant Colonel John E. Drury, USMC

Engineer

January 1991

Volume 21 PB 5-91-1

UNITED STATES ARMY ENGINEER CENTER AND FORT LEONARD WOOD

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Cover photo: The Army hopper dredge Essayons during Valdez oil recovery operations.

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

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

CORRESPONDENCE, letters to the editor, manuscripts, photographs, official unit requests to receive copies, and unit address changes should be sent to ENGINEER, at the preceding address. Telephone: (314) 563-7762, AV 676-7762.

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CLEAR THE WAY

By Major General Daniel R. Schroeder,
Commandant, U.S. Army Engineer School

Today, engineer soldiers face a multitude of challenges: deployments to Central and South America; humanitarian construction missions; readiness training at the National Training Center and the Joint Readiness Training Center; on-going civil works and environmental remediation; maintaining a forward presence in Europe, Central America, and Korea; and, of course, our current deployments in support of Desert Shield. You are doing all of these, and doing them well. Active Army, National Guard, Reserve and forces are meeting all of these challenges. Current successes, as with those of the past, are a testament to good training and leadership.

The most recent success involves our support of Desert Shield, and this is obviously our first priority at this time. To date, more than 6,000 engineer soldiers have deployed to Saudi Arabia. We have deployed the right combination of skilled soldiers and equipment in a timely manner to perform a specific mission: deter further Iraqi aggression. Picking up that many soldiers with their tons of equipment, placing them on the other side of the planet, and sustaining them is a remarkable feat in itself. That our soldiers have done this and are now in the execution phase of their mission shows how successful their leadership and training have been.

Fort Leonard Wood's 5th Engineer Battalion is among the many engineer units deployed for Desert Shield. While formally inspecting these proud soldiers at the farewell ceremony, I was struck by their professionalism and confidence. As with other deploying units across the nation, these soldiers were doing what they had trained to do, and without exception they were doing it well.

In speaking with many soldiers and their families, I was again impressed with the value of sound leadership and tough training. An important part of that leadership is taking care of families. Leaders at all levels must make the strong commitment to soldiers that their families will get the support they need. Every installation with alerted units will similarly support the family members of deployed soldiers.

While the current focus is on Southwest Asia, we cannot ignore the possibility of other regional conflicts. We must sustain our readiness to meet contingencies elsewhere in the world and prepare for additional deployments to Southwest Asia if they are needed. Europe, Central America, and Korea will continue to demand our attention.

Today's Army must and does provide our great nation with unique strategic capabilities that are versatile in nature and global in scope. As in operations Urgent Fury, Just Cause, and now Desert Shield, engineers must stand ready to be projected into any troubled part of the world. We must continue to hone our skills through deployments for training in Central America, to the National Training Center and the Joint Readiness Training Center, or to any location that provides a training opportunity.

Exercise-related construction and humanitarian civic assistance provide ideal training opportunities. In addition to developing engineer skills, they provide opportunities to work with other services and nations. At a time when joint and combined operations have become the norm, we must not underestimate the value of these experiences.

Army engineers must also maintain their readiness for civil works, military construction, disaster preparedness, and environmental remediation. The Exxon Valdez oil spill, Hurricane Hugo, last year's earthquake in California, and fires in our national forests are examples of recent disasters where Army engineers were called upon to provide relief. The routine stewardship of our national resources and infrastructure that is being done every day by our Engineer Districts provides a strategic and environmental foundation for our nation's future. Dredging harbors and maintaining the navigability of rivers are tasks that are vital to today's and tomorrow's economic strength. Works such as these are not simply an adjunct to our warfighting mission, they are an integral part of our engineer contributions to the nation's strength and security.

Army engineers must be ready to meet every contingency from high-intensity conflict to peaceful competition among nations. It is incumbent upon all of us to be ready mentally, physically, and spiritually. Training and leadership are common denominators in meeting this broad continuum of challenges. The two are inseparable; a good leader must also be a good trainer. Soldiers at all levels of responsibility incur the obligation to train and lead to the absolute best of their abilities. The nation and our follow soldiers expect that of us.



BRIDGE THE GAP

By Command Sergeant Major W. E. Woodall
U.S. Army Engineer School

Challenging and diverse duties are a fact of life for every non-commissioned officer (NCO). Because these duties are so numerous, some NCOs may feel there are stages during their careers when it is impossible for them to keep up with day-to-day missions and still have time to pursue self-development.

But this is not so. Self-development is key to any NCO's success. Being responsible for their self-development is one of the "three pillars" of becoming an effective leader, and it cannot be put on the back burner for long. NCOs must make time to improve themselves if they want to succeed in our modern, technical—and highly competitive—Army.

By the same token, our Army leadership is responsible for recognizing NCOs' self-development efforts, and they must provide the encouragement and support NCOs need to better themselves.

The new Self-Development Test (SDT) is one way in which NCOs will be able to better themselves in the future. Many questions and concerns have been raised about the SDT, which will soon replace the Skill Qualification Test (SQT). And, while much about the test is still in the proposal stage, I will give you as much information as we have now.

First, the facts. The objective of the SDT is to allow sergeants, staff sergeants, and sergeants first class to measure and guide their growth in the skills and proficiencies they need to develop as leaders. While most of the SDT will focus on job-related skills, it is not intended to be a military occupational specialty (MOS) test.

The SDT will be a formally administered, 2-hour test made up of 100 questions. Sixty of them will be MOS-related, and these will be taken from the Soldier's Manual. Twenty questions will deal with leadership. They will be developed by the Center for Leadership, based on FM 22-100, FM 22-101, and FM 22-102. The remaining 20 questions will relate to training; they will be developed by the Sergeants Major Academy from FM 25-101.

Separate tests will be developed for each skill level, sergeant through sergeant first class. Each test will be reviewed by a panel of sergeants major and validated by a group of soldiers from that career field before testing begins.

Soldier's Manuals will continue to be issued 6 months prior to the test date. The leadership and training manuals will be issued to soldiers when they attend the Primary Leadership Development Course or at their units, and these will be considered the soldier's personal property.

SDT notices will be provided to soldiers 60 days prior to their test date. However, preparation for the test will be the individual's (not the unit's) responsibility. There will be no unit-level "cram sessions," and no preparation will be allowed during duty hours.

For FY 91, all soldiers will continue to take the SQT. The SDT testing for Active Component (AC) soldiers will begin in FY 92. Reserve Component (RC) soldiers will take the SQT in FY 92 and begin SDT testing in FY 93. The AC soldiers will take the SDT every year, RC soldiers will take it every two years.

The final fact about the new test is that SDT results will be linked to the Enlisted Personnel Management System. Test scores will be used when a soldier is being considered for retention, school selection, promotion, reclassification, or separation.

Still in the proposal stage is just how the SDT will be implemented and scored, and more importantly, how scores will be used to determine a soldier's career options. For example, one proposal under consideration is that a soldier must score 70 percent or higher on the SDT in order to be promoted or selected for school.

The test window for the SDT is not yet decided. The Department of the Army has proposed there be one test window for the entire Army, and a final decision on this proposal is expected in January 1991.

Another self-development arena—Common Task Testing (CTT)—will change in FY 92.

A new strategy has been developed for CTT. Beginning in FY 92, CTT will include skill levels two through four for sergeants through sergeants first class. This change is intended to make the CTT a progressive and sequential tool. It is based on recommendations by the NCO Leader Development Task Force and input from the Major Army Commands, and has been endorsed by the Army Chief of Staff. The option of providing alternative written tests for those who cannot participate in hands-on CTT due to lack of equipment or other limitations will be eliminated. The hands-on CTT will be a requirement.

These changes to our NCO training program will emphasize an increased responsibility on the individual NCO for his or her own development. However, it should not launch us into unfamiliar territory. As non-commissioned officers and leaders, we have always been responsible for developing our training and leadership skills.

Let's not wait until the SDT is upon us. Start an individual program of self-development today. You will progress into a more competent and confident leader of soldiers—of tomorrow's Army.



Engineer Hopper Dredges & The Valdez Oil Recovery Operation



By Captain Charles Heaton, Jr.

On March 24, 1989, the tanker Exxon Valdez departed Valdez, Alaska, with a full load of crude oil for west coast refineries. Less than two hours after departure, the huge ship ran aground on Bligh Reef in eastern Prince William Sound. Approximately 11 million gallons of Alaskan crude gushed into the sound. The resulting oil slick spread west across Prince William Sound and out into the Gulf of Alaska. Patches of Valdez oil were eventually sighted in the Shelikof Strait, more than 300 miles from Bligh Reef.

On April 6, 1989, the Corps of Engineers, Alaska District, became an operational element of Joint Task Force Alaska, mobilized to help clean up the oil spill. Two Corps of Engineer hopper dredges, the Yaquina and the Essayons, were sent to assist in the effort. The Yaquina left her home port of Astoria, Oregon, on April 14, and arrived in Prince William Sound four days later. The Essayons left Astoria on April 17, and arrived in the spill area on April 21.

In this article, I will show how engineer ingenuity allowed standard hopper dredges to be used effectively in oil recovery operations—despite the vessels' apparent unsuitability for the job. I've included background information on the spill, general information on hopper dredges, and methods of enhancing the oil recovery capabilities of dredges.

The Background

Alaskan crude oil is pumped from the North Slope oil field, the United States' largest oil reserve. After tapping these vast reserves, a way had to be found to get the oil from the Arctic Circle to coastal refineries.

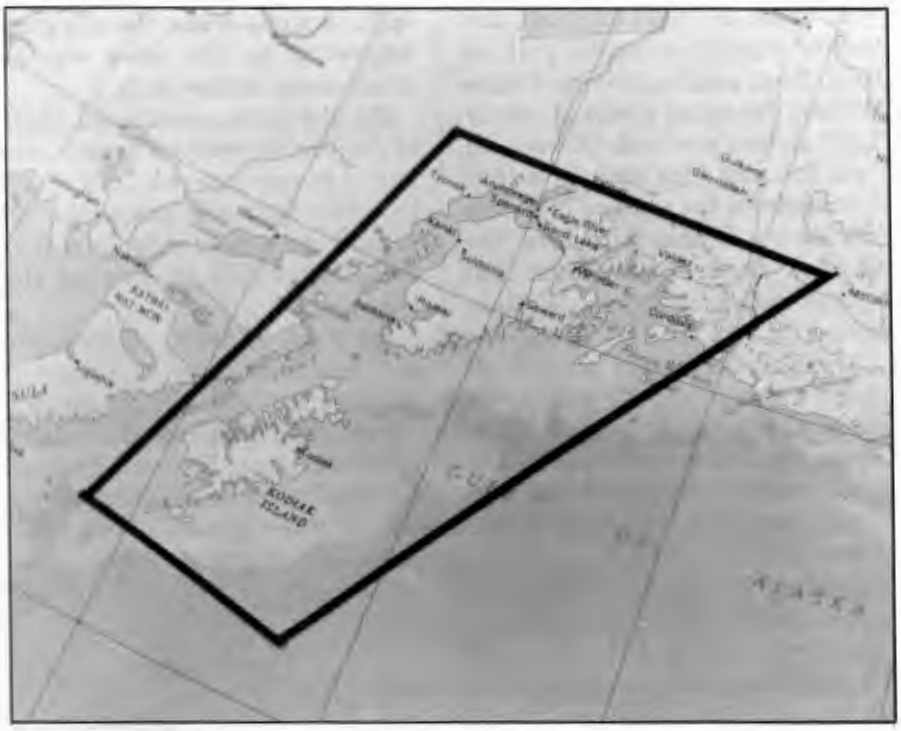
After much study, debate, and exhaustive environmental surveys, a pipeline was recommended. This pipeline linked the northern oil fields with Valdez, Alaska, and the year-round deep water port of Prince William Sound.

The $7.7 billion Trans-Alaska pipeline, owned jointly by eight major oil companies, is a 49-inch-diameter, 789-mile-long tube which carries about 1.5 million barrels a day. Within hours of reaching Valdez, Alaska, the oil is loaded into one of more than 60 ships that ferry their cargo to refineries or to other oil transportation points.

Since the pipeline opened in 1977, an estimated 6.8 billion barrels of oil have been transported without incident in more than 8,500 tanker voyages through Prince William Sound. But during the early hours of March 24, 1989, that commendable record came to an end.

The Exxon Valdez, which has since been renamed the Exxon Mediterranean, has a capacity of more than 1.4 million barrels of oil. The vessel was loaded with about 1.2 million barrels of oil when it left the Valdez dock at about 9 p.m. on March 23, bound for Long Beach, California.

The 987-foot ship was traveling at about 8 knots in the outbound channel when icebergs were detected on radar. The ship's captain requested and was granted permission to use the inbound lane in order to avoid the ice. However, the ship strayed nearly 3 miles beyond the eastern edge of the inbound lane.





Top: An estimated 700 miles of coastline were affected by the oil spill. By April 2, the oil had been blown southwest to Shelikof Strait and Kodiak Island—moving 300 miles in eight days.

Bottom: The hopper dredge Yaquina.

At 12:04 the next morning, the tanker ripped open its hull on Bligh Reef, pouring oil into Prince William Sound at a rate of nearly 1,000 gallons a second. Oil escaped from the ship with such force that it rose above the surface in three-foot waves. Within four days, the oil slick covered more than 100 square miles of Prince William Sound.

The Alaskan crude aboard oil tankers has a specific gravity of about 0.85, which means it's about 15 percent lighter than water. But when crude oil is spilled into salt water, many changes take place. About 24 hours after a spill, depending on weather conditions and wave action, the oil emulsifies with the sea water to form a very viscous material containing up to 70 percent water. The crew of the Army dredges found this material to have about the same viscosity as refrigerated chocolate syrup.

This material, called "chocolate mousse" by many of those who had to deal with it, had a serious impact on beaches and shorelines from Prince William Sound to Kodiak Island. It's been estimated that as many as 700 miles of coastline were affected by the oil spill. In some areas, the oily goop deposited by the tides was as much as six inches thick.

As the tides continued their cycle, the oil worked deeper into the coarse gravel and rock beaches. In some cases, the oil soaked through to a depth of four feet, effectively sterilizing the beaches.

By April 2, 1989, oil from the ship had been blown southwest to the mouth of Cook Inlet, causing extensive damage to the shorelines of Katmai National Park on Shelikof Strait across from Kodiak Island. When the oil reached this point, it had moved 300 miles in only eight days.

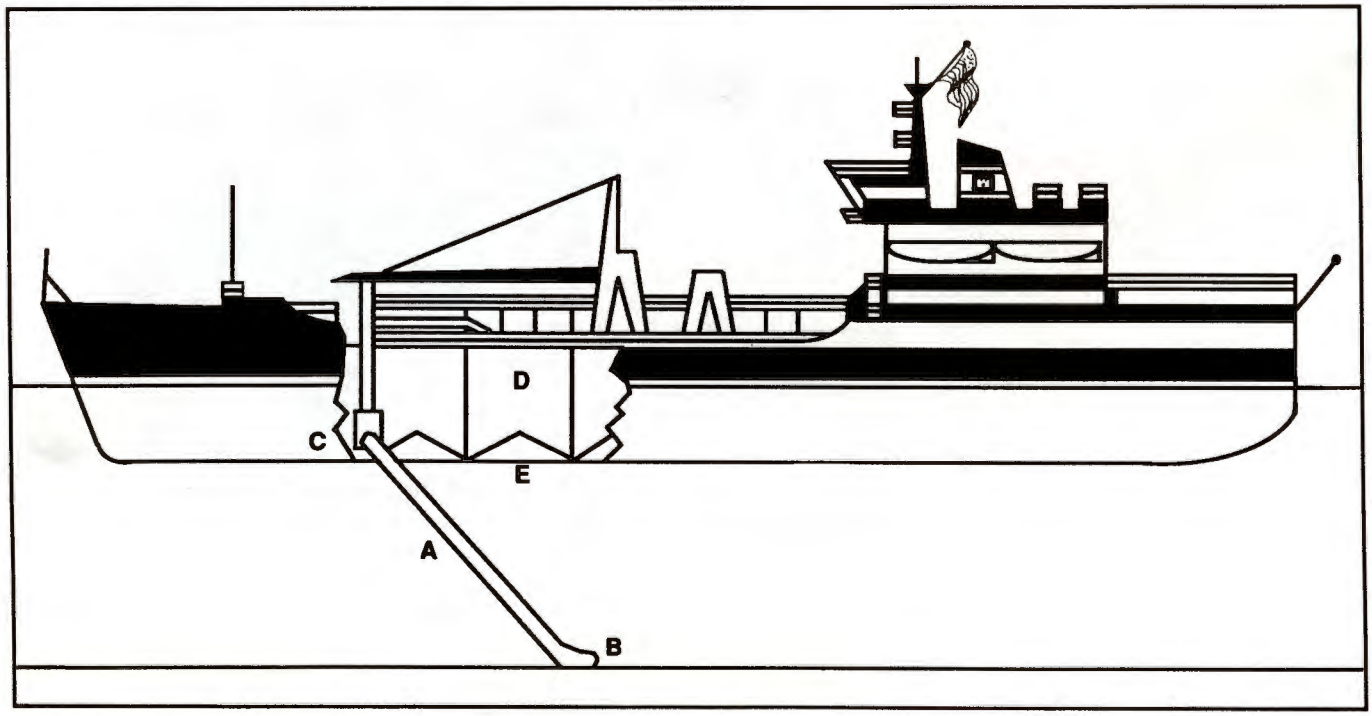
The Dredges

The Yaquina and the Essayons are hopper dredges, designed to dredge material from waterway bottoms, transport it to open water, and dump it. A simplified drawing of a typical hopper dredge below, shows a drag arm (a) with a drag head (b) extending from each side of the ship's hull.

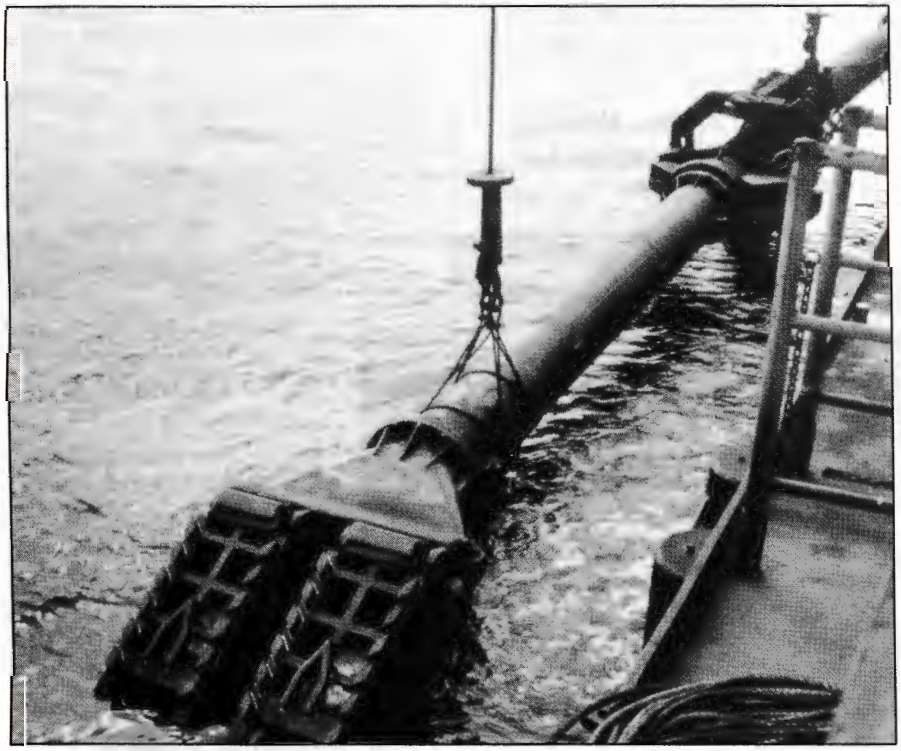
During dredging operations, the drag heads are lowered to the channel bottom and slowly pulled over the area being cleared. The vessel's pumps (c) create suction in the drag arms, and the silt or sand is drawn up through the drag arms to be deposited in the hopper bins (d). The solids settle out, and excess water escapes through weirs in the hoppers.

When the hoppers are full, the dredge sails to a disposal area and dumps the dredged material by opening the hopper doors (e) in the bottom of the hull. The pumps on the dredge are capable of moving more than 15,000 gallons of water and dredge material a minute. A typical dredge can store more than 6,000 cubic yards of dredge material.

The initial concern of government and corporate officials directing the cleanup was that hopper dredges would not be a productive asset for oil recovery. Neither dredge was outfitted for oil recovery or had ever participated in such operations. The dredges' first attempts at oil recovery justified their concern. Initial recovery efforts involved lowering a dredge's drag arm onto the surface of the water, and then "vacuuming" up the oil. These







Top: The Navy's U.S.S. Juneau anchors in Prince William Sound, where it quartered and controlled hundreds of clean up workers.

Bottom: The inverted Army dredge drag head, which allowed efficient removal of oil and debris, while minimizing the amount of water taken into the ships' hoppers.

attempts failed, primarily because it was impossible to maintain the necessary vacuum pressure on the relatively thin layer of oil.

To solve this problem, a crew member suggested that the drag head be rotated 180 degrees. This positioned the head's intake openings to face up instead of down. The inverted drag head was then placed just under the water's surface, and oil and water were drawn downward into the drag head. The initial attempt at oil recovery using the modified drag head allowed the recovery of more than 1,500 barrels of oil in less than 15 minutes.

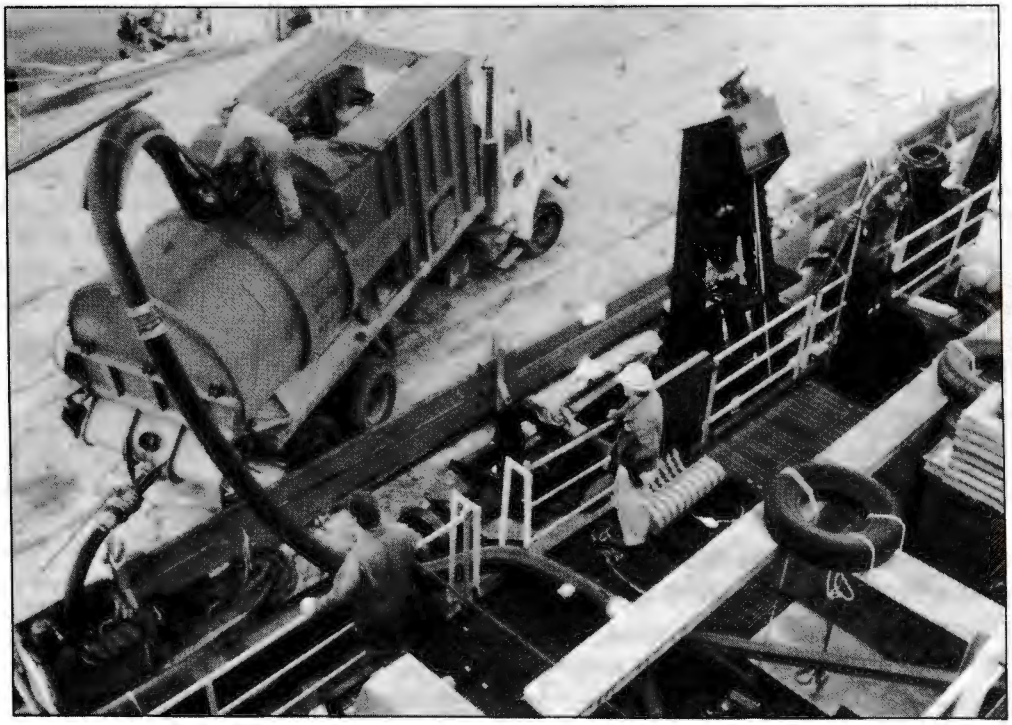
Oil Recovery

The most common method of recovering oil called for the use of an oil containment boom and two smaller vessels, usually fishing boats. The boats would maneuver an oil boom around a floating oil mass and enclose the oil in a



Above: An Army crewman maneuvers a small "donut," of oil, using ropes and a container boom. Such booms allowed the Army ships to place oil over the dredges' drag heads for collection.

Below: A "Supervac" truck offloads oil from the Yaquina. Although slow and laborious, this was the most effective means available to transfer the thick oil from the dredge to collection barges.



"donut." A typical donut was approximately 200 feet in diameter and approximately one foot thick. The oil in these booms was so thick that when a crewman pushed a shovel into the goo, it could not be pulled out again.

Since the drag arm does not move laterally out from the hull of a dredge, the booms were maneuvered into a position against the ship's hull. Before activating the drag head, the portion of the boom against the ship was securely fastened to the hull. The rest of the boom was then maneuvered to position the oil over the drag head.

This method was not without hazards. If the boom was not securely fastened to the hull, the powerful suction from the drag head would grab the boom and damage it badly. Unfortunately, this happened several times during the course of recovery operations.

Both dredges had sufficient power to pump the oil on board. The Essayons' pumping rate is about 360 barrels per minute, and the ship has a 29,000-barrel hopper storage capacity. The smaller Yaquina pumps about 100 barrels per minute, and can store about 4,000 barrels.

During loading of the oil, the most critical factor was maintaining a suitable drag head depth. If the head was located too far beneath the surface of the oil, it would not be able to collect enough oil to be effective. If the head was too high, the suction force of the drag head would be lost because of air being drawn into the system. Because drag head position was so critical, a drag arm pumpman was assigned to control its vertical position and the speed of the dredge pump.

The high volume of water taken aboard the dredges during the recovery process made it necessary to decant the oil/water mixture in the hoppers. Since oil is lighter than water, it naturally rises to the surface. As the oil/water mixture rises in the hopper, the level has to be monitored to ensure that it does not rise high enough to allow oil to escape through the hopper weirs.

Decanting was accomplished by opening one of the hopper doors 2 or 3 inches. This released water slowly, and when the desired level was reached, the doors were closed. A problem encountered during the operation was the large amount of debris, including wood, that was mixed with the floating oil. The wood had a tendency to get lodged in the hopper door openings, and sometimes prevented the doors from closing.

Off-Loading the Oil

Surprisingly, off-loading the collected crude oil mixture was almost a bigger problem than collecting it. The Essayons, because of its large storage capacity, did not have to unload until after the recovery operation was complete. The Yaquina however, had to off-load several times. Barges were provided to receive the collected oil and debris.

Because of the extreme thickness of the oil, it was impossible to off-load the dredges using conventional pumps. During the operation, several different pumps were tried—all with only limited success. A 3-inch submersible and a 3-inch diaphragm pump were placed on board the Yaquina at the start of the operation. Neither of these pumps was able to move the oil, which was so thick it wouldn't even flow toward a vacuum draw.

The largest pump used in off-loading attempts was a 12-inch centrifugal pump with 12-inch suction and discharge hoses. Even this large pump fell victim to the viscosity of the oil and the associated debris.

The most successful pump used for off-loading was the truck-mounted "Supervac." The Supervac is a vacuum truck typically used to empty sewage tanks or similar containments. The Supervac uses a large hose which can be readily moved around the surface of the material being removed.

Unfortunately, the oil and debris in the hoppers was so thick that suction from the Supervac's hose would create a hole in the material. The material was so viscous that often it would not even fill in the hole left by the Supervac. To get any results at all, crewmen had to constantly move the vacuum hose around the surface of the material. This was very time-consuming and physically demanding on the crew.

One of the limiting factors in using the Supervac was its small capacity. It would quickly fill with material from the hoppers, and would have to be emptied.

The vacuum truck was designed to discharge its load through a hose into a collection barge, although this proved to be a troublesome and lengthy procedure. The crew of the Yaquina speeded the process by constructing a large rectangular box around the barge's hatch opening. This allowed the truck to open up its rear like a dump truck and discharge its load directly into the barge.

While other off-loading options were tried, the problem of transferring oil from the dredges to barges was never totally resolved. Hopefully, further study will ensure that an effective off-loading method is available for use in future dredge oil-recovery operations.

The Final Analysis

Army hopper dredges played an important role in the Valdez oil recovery effort. The Essayons and Yaquina remained in Alaska until mid-July, when they returned to their normal west coast dredging duties. During their duty as oil recovery vessels, they recovered nearly 380,000 gallons of oil.

In addition to oil collection, the dredges proved their versatility by supporting other operations crucial to the recovery effort. The dredges were able to act as command and control vessels with full communications capabilities, as mother ships to fleets of smaller vessels (by supplying fuel, water and other supplies), and as rapidly deployable work stations with full housekeeping services.

While equipment and procedures need to be fine-tuned, the Valdez operation proved the value of the hopper dredges. And they remain an effective option for meeting the challenge of oil recovery operations.

Captain Heaton is a project manager for the Defense Environmental Restoration Branch of the Alaska District. He previously served as a company commander with the 43rd Engineer Battalion. Other assignments include liaison officer for the Directorate of Combat Developments, Infantry School, and platoon leader and executive officer in the 5th Engineer Battalion. He is a graduate of the Engineer Officers Advanced Course, and the Combined Arms and Services Staff School. He holds a degree in civil engineering from Carnegie Institute of Technology.





Dust Control in Saudi Arabia

Dust has always been a headache for tactical units, particularly armor, mounted infantry and aviation. It obscures battlefield vision, coats sighting instruments, and gives the enemy an excellent location signature. And that's in addition to the usual maintenance problems associated with all the grit.

Of course, there's not much you can do about dust on the battlefield. But initial reports from Operation Desert Shield have indicated deeper than usual effects on the full range of Army field operations. From aviation parking areas to refueling points, and field billeting areas to maintenance parks, dust is making itself an unwelcome guest.

Imagine yourself an engineer on the ground in that region. You're in a brigade tactical operations center (TOC), and an aviator has just finished briefing the commander. The aviator has indicated that his Blackhawks were unable to take on JP4 at a refueling point because of heavy dust swirling around the immediate area. The colonel shifts in his chair, looks over his shoulder, finds you, and says matter-of-factly: "Fix it!"

You wouldn't be alone. There have been many requests to the Engineer Center for technical assistance and advice on dust control in Saudi Arabia. While most organized studies on soil behavior and dust assume a temperate or tropical environment, research done by the Center's Department of Military Engineering has highlighted the demanding nature of that country's climate and geology.

The Saudi Climate

Saudi Arabia has the internal drainage pattern typical of arid regions. In more temperate climates, water systems are the prime mover of soil particles. The finer the particle, the further it moves—with the finest ones eventually finding their way to the sea. With interior desert drainage, as in Saudi Arabia, what little rain there is simply moves fine soil particles to the center of the desert bowl. Arid regions are thus collectors of these dust-sized particles. And with the massive size of the Saudi desert, that

By Major Michael F. Hullihan

country has one of the largest collections of dust in the world.

Wind is a constant feature of the desert climate. High daily temperature ranges (from 77 to 130 degrees Fahrenheit), and great regional temperature variations cause continuous pressure gradients. The resulting winds are the primary vehicle for moving soil.

Normally, any particle under 4 millimeters (mm) is subject to movement by wind. As soil particles are blown across the desert surface, they are gradually worn to very small sizes—typically less than 0.06 mm.

Because of these conditions of extreme heat, low humidity, high winds, and uniformly small sand grains, soldiers taking part in Desert Shield routinely face dust problems much worse than those encountered at the National Training Center (NTC), in the Mojave Desert.

Available Methods

Several references are available for technical guidance on dust control, including TM5-330, TM5-830-3, and FM5-541. However, after considering the harsh Saudi environment, the number of workable options is drastically reduced. Let's look at some of the available methods and their potential usefulness in the Desert Shield environment:

Mats and Membranes. Airfield matting like M19 and AM2, and membranes like T17, will effectively prevent dust. Their only drawback is cost. Since it isn't feasible to mat all areas adjacent to runways and helipads, additional control methods are needed for areas surrounding the matting.

Bituminous Products. These include asphalt cutbacks, asphalt emulsions, and road tars. Bituminous products act as adhesives in the soil mass. They will prevent dust as long as the treated surface layer is not broken by vehicles or aircraft.

Bituminous materials may be applied as a penetration treatment or an admixture. For a penetration treatment to be effective, the soil must be sufficiently free of fines to allow adequate penetration depth. In extremely fine-grained soils like those in Saudi Arabia, such treatments produce a thin crust of bituminal soil which is only effective in nontraffic areas.

In an admixture application, the soil is scarified, and a bituminous product is sprayed onto the soil. After mixing by windrowing, harrowing, or rototilling, the treated soil is shaped with a motor grader. Compaction with a rubber-tired or sheepsfoot roller completes the treatment. The admixture method strengthens the soil and acts as a dust palliative.

In choosing between a bituminous penetration treatment and an admixture, the realities of an operational environment must be considered. Vehicle operators have a natural tendency to drive on anything that looks black. Even if an area is designated as nontraffic after treatment with a penetration application, vehicles will traverse the area unless effective measures are taken to restrict traffic.

Bituminous products are the cheapest form of dust control, costing about $1.80 per square meter for an admixture. Asphalt emulsions are performing very well in Saudi Arabia, although caution must be exercised with mix water. Good results can be obtained with commercial, premixed emulsions, but the use of local brackish emulsion water can cause premature breaking and ruin distributors.

Helicopters with skids also present a special problem for bituminous surfaces. Skids tend to "knead" a bituminous surface, eventually causing it to fail. Helicopters with skids should be parked on matting or coarse aggregate.

Coarse Aggregate. Coarse aggregate with a uniform gradation of about 5 inches serves as both a good bearing surface and a dust palliative. When placed in a 12-inch-thick lift, this coarse aggregate functions well as a helipad. Grain size should be no less than 3 inches to avoid foreign object damage (FOD) problems.

Vegetation and Deflation Armor. Vegetation acts as a natural dust agent. Similarly, the rocky crust (or deflation armor) found in deserts is an effective dust palliative until it is disturbed. Again, control of vehicle traffic can help preserve this natural cover and reduce the scope of dust problems.

Resins. Petroleum-based or naturally occurring resins (like lignin) work like bituminous products. Resins are applied as penetrants or admixtures, and their performance is comparable to bituminous products. Organic resins such as lignin are environmentally safe, and they do not discolor the soil as much as bitumen. These characteristics may justify the use of resins in special circumstances, despite their higher cost of about $4 per square meter.

Brine Solutions. Salt solutions, including CaCl, MgCl and NaCl, suppress dust through two mechanisms. First, they pull moisture from the air, causing dust particles to stick together. But this will occur only if the relative humidity is higher than 30 percent. A second effect of brine solutions is the formation of a salty crust on the soil. If it remains unbroken, this crust can be effective in reducing dust.

But conditions in the Saudi desert do not support the use of brine solutions. Relative humidity is near zero everywhere except coastal regions, and heavy traffic makes the life expectancy of a brine dust-suppression application very short.

Cement and Lime. Cement and lime hydrate in the presence of water and form a soil-cement mass which will reduce dust. However, this technique is sensitive to the quality and amount of water used. In



Swirling dust around support operations like this helicopter refueling point can impede combat operations. Properly employed, available dust control measures can minimize airborne soil particles.

an arid climate like Saudi Arabia, getting enough potable water into the soil mass and mixing it sufficiently is difficult. In more tropical regions, existing water in the soil usually makes up for the lack of added water. In the desert though, the cement and lime will remain anhydrous, and could even add to the dust problem.

Crude Oil and Waste Oil. While reference manuals list applications of crude or waste oil as a temporary dust palliative, these products should be used only as a last resort. Unlike graded asphalt or tar cutbacks, oil does not cure and adds no structural strength to the soil. Since it remains liquid, oil tends to turn loose soil into a black, oozing mass which coats vehicles, equipment and personnel. Too, the presence of oil makes subsequent use of bituminous products less effective.

We must also be sensitive to the environmental concerns of the host nation. While graded bituminous products cure to form a stable type of soil asphalt concrete, oil remains liquid and must be regarded as a potential pollutant.

Planning Considerations

Based on the preceding evaluation of techniques, here are some general recommendations for dust control in Saudi Arabia:

- Bituminous treatments in an admixture application are effective. Ensure the depth of admixture layer is greater than potential ruts (4-inch minimum).
- Resin products, such as lignin, are effective when used as admixtures. For special use areas, the neutral color and biodegradable nature may justify the greater cost.
- Mats and membranes effectively control dust in aircraft landing and parking areas. Adjacent areas subject to rotor or prop wash must receive a dust palliative.
- Uniformly graded coarse aggregate performs well as both a wearing surface and a dust palliative.
- Restrict traffic from deflation armor areas or areas protected by a penetration spray.
- Avoid brine solutions and cement/lime mixtures.
- Include dust control analysis as an engineer planning factor.

We know there's not much that can be done about battle-generated dust. But we can initiate significant dust control measures designed to improve support operations and troop health and welfare. The last thing a battle-bound helicopter needs is to be hampered in its refueling attempts by heavy dust at the refueling point. And anyone who's spent much time in a windy desert environment can appreciate what it means to have some respite from the sand and grit that constantly filters through your tent and sleeping bag.

Successful dust control in Saudi Arabia sounds like an impossible pipe dream. But through sound engineer analysis, and learning from early field experiences, engineers are finding solutions to the problem.

Major Hullihan is assigned to the Combat Construction Division of the Engineer School's Department of Military Engineering. He previously served as executive officer of the 35th Engineer Battalion. He has also served as a battalion S-3, company commander, and deputy district engineer for the Army Corps of Engineers, New Orleans District. He is a West Point graduate, and holds a masters degree in civil engineering from the University of Illinois.

CIVIL WORKS—

ANOTHER SIDE OF THE ARMY ENGINEERS' MISSION

Civil works is a broad-range, ever-changing mission of the Corps of Engineers that provides exciting challenges for young engineer officers. Many senior officers in the Corps will tell you that the best assignment they ever had was that of a district engineer involved in civil works.



In the 19th century, Corps engineers surveyed roads and canals and explored and mapped the western frontier.

The Corps' History

In 1824, our nation struggled to open up and develop new lands west of the Appalachian Mountains. To aid in this effort, the U.S. Congress authorized President James Monroe to direct Army engineers to survey roads and canals needed for commercial, military, or postal purposes. In that same year, Congress authorized the first projects designed to improve navigation on the Mississippi and Ohio Rivers, accelerating the newly emerging westward movement.

During this period, the Corps also constructed harbor improvements such as breakwaters, jetties and piers. The Corps still has responsibility for maintaining federal channels in more than 100 major ports and 400 small boat harbors around the country.

Today, the Assistant Secretary of the Army (Civil Works) is responsible for all aspects of the Army Civil Works program, which is implemented by the Corps of Engineers and carried out by some 300 engineer officers and 28,000 civilians. This program includes policy formulation and program direction for the development of more than 1,500 projects. Among these are navigation, flood control, hydropower, water supply, hurricane and coastal storm protection, beach erosion control, recreation, and fish and wildlife conservation. The Corps also helps to regulate wetlands and navigation, and provides emergency response to natural disasters.

By Major General Patrick J. Kelly, Director of Civil Works



The largest shipment of military equipment on inland waterways since World War II moved through Lock and Dam 4, on the Arkansas River, in 1989. The equipment was enroute to the Joint Readiness Training Center at Fort Chaffee. (Photo by P.J. Spaul)

Since passage of the Flood Control Act of 1936, the Corps has built about 400 flood control dams and thousands of miles of levees, floodwalls, floodways and channels. While costing more than $25 billion, these flood control facilities have saved more than $175 billion in damages. This equates to the prevention of $7 in damages for every $1 spent.

The Corps' civil works program has helped move America forward over the years. Today, in order to meet the needs of the nation and the world, an environmental ethic must be integrated into the way the Corps conducts its business.

The Corps is committed to promoting environmentally sustainable development while continuing to build and support our national infrastructure. The environmental consequences of Corps operations are an important part of the organization's decision-making process. In other words, environmental issues are more than simply a consideration; they are part of the "go-no-go" test along with economics and engineering.

The Districts

District assignments are challenging and demanding. They provide an opportunity for an officer to exercise a full range of leadership, engineering, and construction skills.

There are 39 districts in the Corps of Engineers, and 37 of them have civil works missions. Districts are organized like mini-installations and are primarily staffed with civilians. The staffs range in size from 200 to 1,800 personnel and include from two to 20 military officers.

Company grade officers are usually assigned to construction field offices, where they gain experience in construction contract supervision and administration. The names of each field office reflects the quantity of work supervised, and include area, resident, or project offices.

Military officers supervise all aspects of contract management, including construction quality control, safety, change order negotiation, dispute resolution, and warranty enforcement. After they are fully schooled in field operations, officers may move to the district office to learn other aspects of district operations. Duties as a project manager in either a construction or engineering division would be a typical assignment.

A district assignment is a career-broadening experience that provides an opportunity to work with a civilian work force. Such assignments prepare officers for future field grade assignment as a deputy or commander in a district. They also allow officers to apply their technical engineering education to the solution of complex problems.

1986 Water Resources Act

The Water Resources Development Act of 1986 was the first major authorizing legislation for civil works in 16 years, and it fundamentally changed federal water policy. Besides authorizing many new projects, this act included new cost-sharing rules for nonfederal participation in project funding. Basic

policies introduced by this law will profoundly affect Corps water resources development for many years to come. As a result, Corps' district engineers and their staffs now work closer than ever with various project sponsors on all phases of a project, including planning, design, and construction.

Numerous harbor-deepening projects have been started, and many have been completed, since this act was passed. New projects include those at the ports of Baltimore, Mobile and Norfolk. Because these projects require significant involvement with local agencies, strong partnerships have been forged between the Corps and individual project sponsors.

Flood Control

Large-scale flood control projects are also underway. The $1.35 billion Santa Ana River flood-control project in California consists of two large dams and 50 miles of channel. It will provide flood protection for a three-county area near Los Angeles, one of the fastest growing regions in the nation.

The Passaic River flood-control project, in northern New Jersey, is in the design stage. It will provide an innovative solution to flood control that involves two diversion tunnels, as well as some channel modifications, levees, and flood walls.

With opportunities such as these, today's engineer officers can gain excellent experience in all phases of construction management. Training in the construction management of navigation, flood control and other projects prepares officers for a wide variety of assignments.

National Emergencies

The Corps has a proud history of responding to the nation's needs in time of emergency or disaster. Response can be under the Corps' own statutory authority for floods, hurricanes or coastal storms, or it can be in support of other agencies, such as the Federal Emergency Management Agency (FEMA).

Corps assistance often includes long-term recovery efforts to meet public needs. To accomplish these response missions, the Corps is heavily involved in the development of necessary plans, training of response personnel, testing, and coordination of all these efforts with affected federal, state, and local entities.

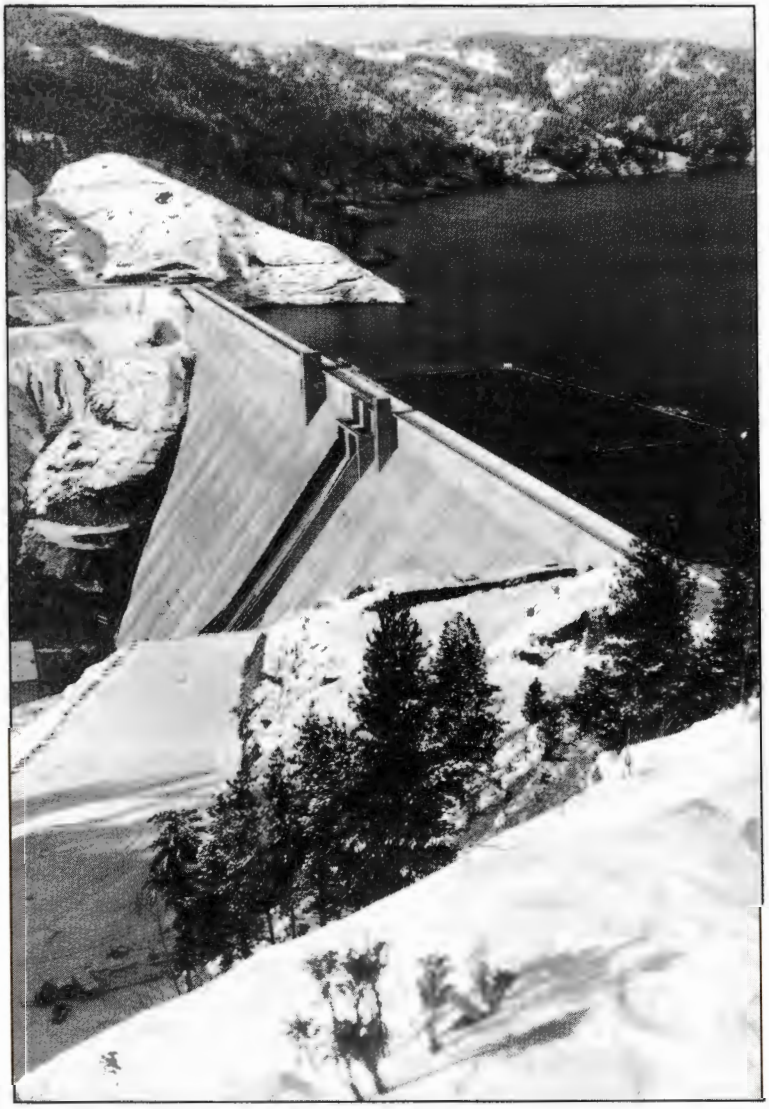
Another important responsibility of the Corps' civil works mission is responding to major emergencies that have an impact on our nation's security. Toward this end, the Corps has developed its National Security Emergency Preparedness (NSEP) program, which is designed to meet defense and essential civilian needs during any national emergency. The Corps, in coordination with state, local and other federal agencies, has prepared support plans that can be implemented both here and overseas.

Resource Protection

Civil works projects also provide public recreation facilities featuring boating, swimming, fishing, hunting, camping and hiking. The Corps manages more than 2,000 separate recreation areas at 472 water resource development projects in 41 states. Next to the U.S. Forest Service, the Corps is the second largest



The Corps of Engineers has a proud history of responding to national emergencies. Here, crewmen offload oil from an Army dredge during the Valdez, Alaska, clean-up operations. Corps' dredges pulled in about 7,000 barrels of oil as part of the clean-up activities.



federal provider for recreation opportunities.

Corps multiple-purpose projects have provided many communities with their prime source of drinking water. In meeting water supply needs, the Corps has impounded more than 9,000,000 acre-feet of water in 101 lakes throughout the United States.

The Corps also has been active in shoreline protection and in developing new technologies in this area. Both structural and nonstructural measures are used to protect the country's seacoast and shores of the Great Lakes from erosion and hurricane or storm flood damage. Structures include groins and breakwaters. Nonstructural measures, such as adding sand or planting beach grasses, are often more economical and practical.

By conducting civil works programs during peacetime, the Corps ensures its readiness for potential mobilization. It also allows engineer officers an opportunity to represent the Army to portions of the American public who might not otherwise have contact with the Army.

Research

As its missions expand, the Corps of Engineers is seeking new ways to do its job better. Research to support the civil works effort, as well as military construction, is carried out by some 1,200 scientists and engineers at four major research centers. Officers with an interest in the practical application of scientific principles, and who possess training in a related discipline, will find these assignments challenging and rewarding.



Top left: Idaho's Dworshak Dam is one of the largest dams ever built by the Corps of Engineers. This multipurpose project provides flood control, hydropower, and navigation opportunities.

Left: The Corps often works with other agencies when cleaning up toxic materials. These Corps personnel, in cooperation with the Environmental Protection Agency, are cleaning up hazardous waste.

The Army Construction Engineering Research Laboratory (CERL) in Champaign, Illinois, works with the University of Illinois in conducting research and engineering studies in materials, energy, construction management and environmental quality.

The Army Engineer Topographic Laboratories (ETL) at Fort Belvoir, Virginia, is committed to advancing state-of-the-art technology in geodetic, topographic and geographic systems for the Army and Department of Defense. The Global Positioning System, a well-known battlefield aid, was used by ETL researchers to develop a precise structural tool to measure deformation on large dams.

The Army Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, New Hampshire, supports civil and military construction through research, investigations and engineering studies of cold environments, including the mechanics of snow, ice and permafrost. CRREL supports civil works programs by studying methods to control the impact of ice on navigation structures and the effect of ice and snow on the environment.

The Waterways Experiment Station (WES) in Vicksburg, Mississippi, pursues a spectrum of activities in six component technical laboratories.

- The Hydraulics Laboratory studies flood control, navigation and sedimentation problems in waterways and harbors.
- The Structures Laboratory studies the response of structures to various kinds of stress.
- The Environmental Laboratory investigates the effects of water resources development projects on the environment, and the interaction between military activities and the environment.
- The Coastal Engineering Research Center provides national expertise in coastal engineering to help solve navigation, coastal flooding, beach erosion, storm protection and marine construction problems.
- The Geotechnical Laboratory studies soils, pavements, off-road mobility of military vehicles, earthquake effects and engineering geology.
- The Information Technology Laboratory does research, development, and support in interdisciplinary computer-aided engineering fields and computer science fields.

The Corps also has entered into a new research and development (R&D) partnership with the nation's construction industry to make it more competitive with foreign firms. This partnership, referred to as construction productivity advancement research (CPAR), is making Corps R&D labs available to industry for research, development and the application of advance technologies through cooperative research, field demonstrations, licensing agreements and other forms of technology transfer.

As part of its over-all civil works mission, the Corps is working with the Federal Railroad Administration in the development of a high-speed, high-tech, surface transportation system. This system is designed to move large numbers of passengers over distances up to 600 miles at speeds of 300 miles per hour, or more. The technology, known as magnetic levitation (MAGLEV), would use magnetic force to lift and propel train-like vehicles on guideways in a manner that is safe, energy efficient and environmentally sound.

Infrastructure Upgrades

In addition to the work on MAGLEV, the Corps, has set up an infrastructure task force. This group will help implement a strategic plan to assist the nation in upgrading its infrastructure, including navigation facilities, flood control structures, waste water management, solid waste management, hazardous-toxic-waste cleanup, and other environmentally sensitive work. During FY 1991, the Corps will open discussions with federal, state and local agencies and private sector officials to develop a national strategy for America's infrastructure needs.

Closely tied to the question of infrastructure is the development of a public-private partnership to provide environmental services that have traditionally been the responsibility of state or local governments. This could include drinking water supply, wastewater management, and solid waste disposal. The Corps is working with the Environmental Protection Agency to increase private sector involvement in these areas.

As the nation prepares to enter the 21st century, it faces many of the same problems that confronted a young and restless America in the early 19th century. Today, in addition to navigation and flood control, there is a whole range of challenges associated with protecting and restoring the environment, rebuilding the national infrastructure, and making sure that adequate water resources are available to serve the needs of our nation and the world.

Through civil works projects the Corps will continue to be part of the effort to strengthen this nation. Officers assigned to civil works projects can expect exceptionally rewarding challenges and the opportunity to make a significant contribution to our country's future.

Major General Kelly is currently assigned as Directo of Civil Works in the Office of the Chief of Engineers, U.S. Army Corps of Engineers. Previous as signments include Commander and Division Engineer of the Corps' South Pacific Division; and Co mander, U.S. Army Engineer District, Mobile, AL.

Engineer Problem

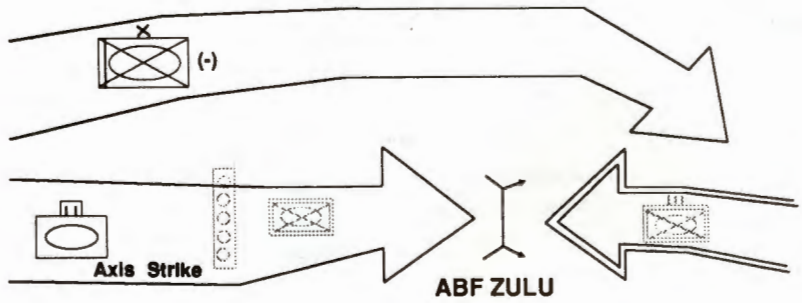
This is the first of four engineer problems dealing with breaching operations; the remaining three will appear in future issues of ENGINEER Professional Bulletin. The problems reflect concepts outlined in FM 90-13-1, Combined Arms Breaching Operations, *which is scheduled for distribution in the 2nd quarter of 1991. Each will focus on a particular type of breaching operation: in-stride, deliberate, assault, and covert.*

The scenario depicted in each problem illustrates specific teaching points on that type of breach. An excerpt from FM 90-13-1 is provided to describe the characteristics of the breach and when it will be used. The problem-solving process is presented using the engineer estimate process and includes some key discussion points. Our first problem focuses on an in-stride breach.

As the task force (TF) engineer and engineer company commander, you are to recommend a task organization of mobility assets to the TF tank commander. The intent is to organize the task force for an in-stride breach from phase line (PL) Red to PL Blue.

SITUATION: You are the commander of Company A, 52d Engineer Battalion (Co A/52d EN Bn), a divisional combat engineer company. Your unit is attached to TF Tank for their offensive operation. The brigade's mission is to destroy an attacking motorized rifle regiment (MRR), which is being committed into your area of operations. Your TF mission is to lead the brigade's attack through a defeated main defensive belt and destroy the MRR's vanguard of motorized rifle battalion (MRB(+)) strength. This will allow the main body of the brigade to pass through and destroy the MRR's main body.

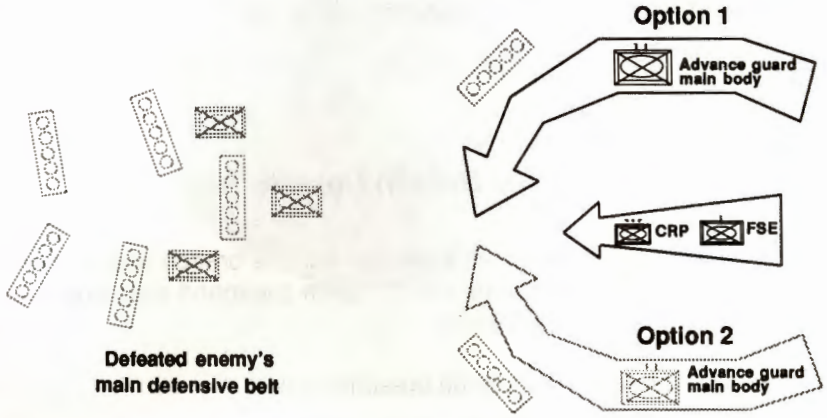
TF Tank is to attack along Axis Strike and destroy the lead MRB(+), as shown on the Brigade Operations Overlay. The TF commander expects a meeting engagement and believes the key terrain near attack by fire (ABF) ZULU will give his force a needed advantage. The commander focuses his TF planning on conducting a movement to contact that will end in a meeting engagement.



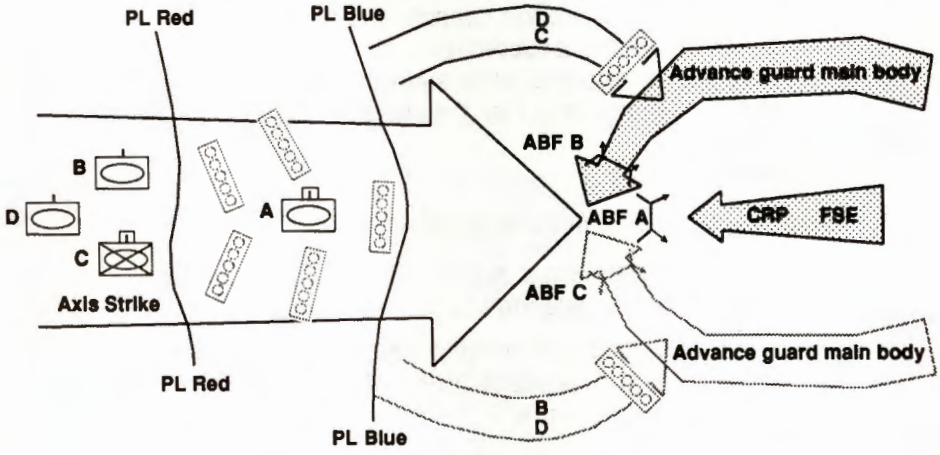
Brigade Operations Overlay

Engineer Problem

As a result of the intelligence preparation of the battlefield (IPB) process, you and the intelligence officer (S-2) developed the enemy Situation Template, below. The TF commander selected the maneuver plan shown on the Task Force Operations Overlay.



Situation Template



Task Force Operations Overlay

The plan is designed around rapid maneuver on Axis Strike to attack by fire positions that will fix the enemy's combat reconnaissance patrol (CRP) and forward security element (FSE). The company/team moves to the appropriate ABF position in order to fix the advance guard main body. The TF's main effort will shift to forces in the TF's main body as they attack into the flank of the advance guard's main body. The TF's main body will deploy either north or south, depending on the situation developed by the TF's advance guard.

Engineer Problem

During the planning process, the commander and staff identified rapid movement through a previously defeated MRB main defensive belt (PL Red to PL Blue) as an essential implied task. Because rapid movement is critical and the obstacle and enemy situation in this area are relatively unknown, the TF commander gave you guidance to organize his mobility assets for an in-stride breach.

Engineer Solution is on page 29.

In-stride Breach Description

Definition: A force breaches in-stride when the breach operation can be successfully executed under the complete command and control of a task-organized subordinate unit.

A commander uses an in-stride breach when—

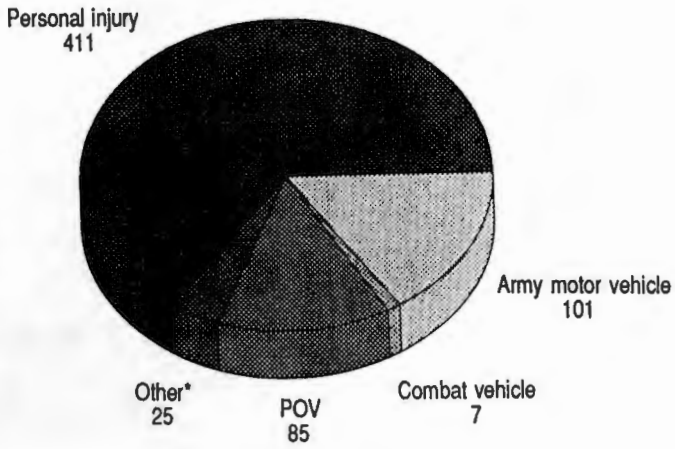
- The situation is unclear (enemy and friendly obstacle locations are unknown) and several lead subordinate units are capable of independent breaching operations to accomplish the mission.
- The enemy's defense (obstacles and fires) is so weak that the forces required to support, breach, and assault can be task-organized into a subordinate unit. Breach success does not require the maneuver of other subordinate units to adequately suppress, secure, or reduce the obstacle.

Characteristics:

- Breach is conducted at the subordinate level.
- The brigade or task force is capable of quickly overcoming unexpected or lightly defended obstacles.
- The resources necessary for independent application of suppress, obscure, secure, and reduce (SOSR) are allocated to the task forces, companies, or teams.
- Application of SOSR and breach synchronization are the subordinate commander's responsibility.
- Mobility assets (engineer and maneuver) are generally decentralized to support independent breach operations.
- Maneuver and engineer plans address the quick transition to a deliberate breach; the engineer maintains a mobility reserve that can shift to any location required.

Engineer Accident Review for FY90

The number of accidents involving engineer soldiers increased in fiscal year (FY) 90, reversing last year's downward trend. The narratives of accident reports tell what can happen when standards are not enforced and adequate supervision is not provided. They also show areas where we must improve our performance.



Total Accidents, FY 90 = 629

Cost = $10, 170,000

*18 Other Army vehicles, 4 fire, 3 explosives

Statistics tell the story. As of October 29, 1990, there were 629 engineer-related accidents reported, compared with 608 in FY 89. The good news is that accident costs dropped 13 percent during the same period—from $11,120,000 in FY 89 to $10,170,000 in FY 90. This article focuses on the major types of engineer accidents and countermeasures we can take to reduce their number.

There were 23 fatalities involving engineer soldiers in FY 90, compared with 24 in FY 89. Two of them occurred in an M9-ACE accident; these were the only training fatalities. Of the others, 19 occurred in privately owned vehicles, one in a fall from a cliff, and one soldier was struck by a train. Another, not included in the above total, involved a civilian who was run over when a road grader backed up on a construction site.

Personal injuries, 65 percent of all accidents, included mainly human locomotion (walking and running) and sports accidents. Other top accident producers in this category are material handling, maintenance, and tactical parachuting.

Human locomotion and sports made up 24 percent of all engineer accidents. Poor housekeeping or police of the work area caused most of the human locomotion accidents; they occurred when an employee fell, slipped or tripped while walking. Leg and ankle injuries incurred during touch football and basketball games produced most of the sports injuries. We can reduce these accidents by following proper procedures—on and off the job.

Material handling injuries center around soldiers who work with loads that are being moved with engineer equipment. Narratives from these accident reports describe poor communications/supervision between operators and handlers. Frequently hand signals and ground guides were not used or were used improperly. Supervisors must ensure ground guides are used properly and that hand and arm signals are understood by all soldiers involved in the operation.

Most of the maintenance accidents occurred while soldiers were installing repair parts or repairing tires. Here, too, failure to follow proper procedures was the underlying cause.

Tactical parachuting remains as the top combat soldiering accident producer for engineers. Poor exits and improper PLFs are major problems. The Safety Center is involved in several tactical parachute awareness and equipment challenges aimed at improving the safety of this mission.

Of the engineer Army motor vehicle (AMV) accidents, almost 30 percent involved 5-ton trucks, and most were caused by operators who failed to follow established procedures.There was an average of two dump truck accidents every month. Failure to use ground guides, speeding, and disregard of traffic rules were major causes. These are areas supervisors can influence. And, an exportable training package for 5-ton vehicles, recently released by the Transportation School, is aimed at improving driver awareness.

(Continued on page 43)

Some of the Best Training Anywhere

The Latin American theater gives the Army, and engineers in particular, some of the best training available anywhere in the world. And like the proverbial two-edged sword, it gives soldiers the chance to hone their military skills and, at the same time, improve the quality of life for local civilian populations.

Honduras is one of the most active areas for such dual-purpose military deployments. A close relationship with the United States and a long string of productive U.S. operations there have made the Central American country a favorite for military and nation assistance missions.

Early last year, the 27th Engineer Battalion from Fort Bragg deployed to Honduras for a three-month tour. Both military construction and nation assistance missions were completed by the unit as part of the Joint Chiefs of Staff exercise Ahuas Tara '90.

The battalion headed a task force of more than 1,000 soldiers. Giving additional muscle to the airborne unit was Alpha Company of the 92d Engineer Battalion (Combat) (Heavy), which provided heavy engineer equipment and concrete mobiles, an asphalt spraying capability, and sorely needed compaction equipment. Additional haul assets were provided by the 264th Assault Bridge Company (MGB). Logistics support was provided by a composite force under the control of the 189th Maintenance Battalion. A Company, 50th Signal Battalion, and the 28th Combat Support Hospital completed the task force package.

The primary military construction project was a 4,200-foot, C-130-capable airstrip, along with a taxiway, parking apron, cargo staging area, and a fuel storage area. The strip was built near the city of Choluteca, about 17 kilometers from Nicaragua. Additional exercise-related construction (ERC)



An aerial view of the Choluteca strip. The strip's single surface treatment is complete through stage 30. The Pan American Highway is just to the left of the field.

By Captain William E. Rapp



projects included lime stabilization repair of the San Lorenzo taxiway, the construction of an 18-pad CH-47 heliport, and fuel and cargo staging areas near the port of San Lorenzo.

Nation-assistance projects included the construction of four concrete masonry unit (CMU) buildings in four different villages. Three of these would serve as school buildings, and one as a town hall. The task force also dug seven new wells at sites selected by the Honduran government. A small group of Air Force Reserve engineers, working with the task force, also built two additional buildings in Choluteca.

The Choluteca FLS

The Choluteca forward landing strip (FLS) was constructed as a 4,200-foot, compacted aggregate airstrip. The task force used a non-woven geotextile fabric (8NP) over the subgrade, a 9-inch compacted lift of 3 inches (-), a 6-inch compacted lift of 3/4 inch (-), and a single surface treatment. The geotextile saved an estimated 14,000 cubic yards (CY) of aggregate.

Two sets of triple 36-inch culverts aided drainage under the taxiway crossovers. The soldiers used Reno mattresses filled with 3-inch (-) aggregate in the drainage ditches to control erosion during the rainy season. Construction was done with small, airborne engineer equipment, D-5B dozers, CAT 621 graders, and CAT 613B scrapers and water distributors.

Following construction of a gravel civilian bypass road around the strip, the battalion built



Top left: The villagers of Santa Maria gather around their new school building built by the 27th Engineers.

Left: The unit began their deployment with an airborne operation. Here, a small emplacement excavator (SEE) lands on the El Espino drop zone.

the cargo staging area and the fuel storage area. The asphalt section from Alpha Company placed MC-70 as a prime coat over the FLS, and then sprayed RC-250, followed by the spreading and rolling of 3/8-inch aggregate (washed) to complete the single surface treatment. The region's high temperatures (over 100 degrees Fahrenheit every day), retarded the curing process, but careful traffic control gave the treatment a chance to cure properly.

San Lorenzo Stabilization

The San Lorenzo taxiway, constructed the previous year adjacent to the San Lorenzo FLS, was showing signs of premature failure. Examination by the engineers of the Waterways Experiment Station (WES) at Vicksburg, Mississippi, indicated that the taxiway needed significant lime stabilization repair.

Bravo Company began the mission by removing 18 inches of stabilized topsoil from the affected areas, and bringing in new soil. Using one BOMAG recycler, BOMAG vibe roller, and two water distributors, the company re-stabilized the taxiway using dry lime instead of the lime-slurry method. The dry lime method required spreading the lime above the new topsoil in precise quantities. The recycler was then used to mix the lime, soil and water at an even rate. The vibe roller brought the resulting soil mixture to compaction standards in 10-12 passes.

El Caimito Heliport

Eighteen 25-foot by 50-foot concrete pads were used to construct the CH-47 heliport near the town of El Caimito. A supporting road network and fuel berms were also part of this project.

CMU Buildings

Although wooden buildings were originally planned for the battalion's nation assistance work, the task force was notified enroute to Honduras that CMU construction must be used. The greater life expectancy of the CMU design was given as the reason.

On arrival, the task force purchased the required materials locally, and the engineers adapted and improvised when faced with wide variations in material quality. The concrete mobiles again did yeoman service by placing the concrete pads for the buildings at very remote sites.

The task force constructed four CMU buildings: one each in Orocuina, Tierra Blanca, Santa Maria, and El Pillado.

Wells

During the dry season in southern Honduras, the availability of potable water becomes a critical factor in the health of villagers. Poor quality water often leads to serious health problems for people with no alternate water sources.

The 38th and 865th Well Drilling Detachments dug seven wells for the Hondurans. The units used the new 600-foot drilling rig, and installed hand pumps on the wells they left the villagers. Pea gravel, necessary for development of the wells, forced combat engineers to improvise. Several cubic yards of the critical material was obtained by screening river gravel by hand.

Lessons Learned

Once in country, obtaining missing critical equipment is very difficult and/or extremely expensive. Forethought prior to deployment brings to mind Roger's standing order to his rangers in 1759: "Don't forget nothin'."

The following points are critical:

- Plan for significantly more compaction equipment than expected. This equipment is always critical during the haul/spread/compact phase, and even rollers break down.
- Dry environments require vast water distribution capability. Lack of sufficient water results in poor compaction.
- Lack of adequate spare parts for low-density equipment can be a show-stopper. Engineer equipment doing hard work—even with conscientious maintenance—will eventually break down. And the lack of needed parts will keep it down.

Construction deployments to Latin America continue to offer significant challenges and rewards for engineers. A tough environment, demanding mission assignments, and the difficulties inherent in being so far from home base all add up to tougher, better training for soldiers. And Honduras offers some of the best.

Captain Rapp is the assistant S-3 for the 27th Engineer Battalion. He previously served with the 16th Engineer Battalion, and the 1-1 Cavalry Squadron. He is a graduate of the Engineer Officers Advanced Course. He received his degree from the U.S. Military Academy.

District Project Engineer:

The Road Less Travelled

The "road less travelled" is often touted to be the most rewarding. For junior engineer officers, that road is often an assignment as a project engineer for a U.S. Army Corps of Engineers district.

Alaska & John Nelson

There are many choices available to officers who have successfully completed company command. Most would like to continue in a troop assignment, but often this is simply not possible. Some officers don't realize the professional development that a district assignment can offer. Many others often don't know that the assignment even exists. But it is well worth investigation. For an engineer officer interested in furthering his career, particularly in construction management, I think there is no better opportunity than working in an engineer district.

The Corps is the largest engineering and contracting agency in the free world. It regulates the nation's navigable waters and wetlands, and handles real estate functions for most Army and Air Force installations throughout the world.

Each district office is normally commanded by a colonel and staffed primarily with civilian employees—along with several military engineers. The primary mission of a Corps district office is to plan, design and monitor construction projects.

For officers interested in such an assignment, a degree in engineering is often preferred, but is not mandatory. What really counts is managerial skill. The ability to gather accurate information quickly, deal with all types of people, and make sound decisions are the keys to success in a district job.

My four-year tour with the Alaska district ended last summer, bringing to a close one of the most challenging and rewarding experiences of my career. I first served as the assistant resident engineer, and then moved to the position of assistant to the chief of the regulatory branch.

As assistant resident engineer of the Richardson office, I was responsible for about 20 projects with a contract value of $138 million. This is a position that a captain could typically expect to receive for at least one year of his tour with a district. And this is where the rubber meets the road. The project officer works directly with contractors to ensure a quality finished product that's on schedule and within budget.

To be able to do that requires on-site visits to the contract sites, and extensive travel is an integral part of the project engineer's life. In the case of the Richardson office, these contract sites are spread over a vast area, reaching from the tip of the Aleutian Islands, to Haines in the southeast, and Galena in the north.

In fact, the first contract negotiation I handled was located near Cold Bay, in the Aleutian Islands. It wasn't the most difficult or costly negotiation I was to have, but it served to drive home the sometimes emotional aspect of my duties.

In March 1985, I had been in my job for two months when the claim was presented. A contractor working near Cold Bay had to stop

By Major John Nelson and Captain Donald R. Curtis, Jr.



John Nelson, right, confers with other engineers during a project site visit at Prudhoe Bay, Alaska. From left are Bob Oja, Lieutenant Colonel Roy Carlson, and Colonel William Kakel, district engineer for the Alaska region.

work for more than a month because of frozen ground conditions. He claimed that relic ice (a permanent frost condition) was present in the site he was contracted to excavate, and asked that he be compensated for a $90,000 loss for work stoppage.

The case required some research on my part, and the district's geology department assisted me in this effort. A primary factor in my decision was that the ground in the Aleutians rarely develops a deep, penetrating frost. The temperature range is between 5 and 55 degrees Fahrenheit, with a typical average winter temperature near the freezing mark.

The winter of 1984-1985, however, was unusually cold. The months of January and February in particular were far below normal, with temperatures never rising above freezing. The contractor failed to anticipate the possibility of significant frost problems, and did not bring adequate equipment for the job. He was faced with the decision to fly in a larger dozer, or wait and hope for a quick thaw. Unfortunately, he chose to wait.

My final decision was in favor of the government, since the frozen ground encountered by the contractor was not relic ice, and the government is not responsible for the normal forces of nature. The decision was upheld on the contractor's appeal to the district engineer.

It was not an easy decision to make. The contractor endured a significant time delay because of an ice condition that he had no control over. It wasn't a very big company, and the loss of revenue hurt. While it could be argued that he should have planned the job better, all of us know that it is impossible—or sometimes too expensive—to try and be prepared for all contingencies. This case, like many others to follow, tested my knowledge, judgement, and emotions. But the job made me a better engineer and contributed significantly to my professional development as an officer.

Officers will normally rotate through two or three different jobs while serving a district tour. A variety of jobs are open to junior military officers in planning, design, safety, environmental or regulatory branches of a district operation.

After a year as a project engineer, I spent the remainder of my tour in the district's regulatory branch. This branch regulates the use and development of navigable waters and most wetlands within its jurisdiction. The office receives permit applications seeking use of certain land or waters from private citizens or companies. It then evaluates them in coordination with other local, state and federal agencies, and makes a determination on whether or not to issue a permit to the applicant. Unfortunately, the final decision is not always well received.

A case in point was the application for construction of causeways in the Beaufort Sea to support Niakuk oil field development. A prime factor we had to consider from the Corps' point of view was the effect the causeways would have on wildlife. Two causeways that had been constructed earlier were already causing a disturbance of fish migration habits.

Based on years of study of fish migration in the area, a decision was made to deny permission for the additional causeway. A variety of experts believed that the extra causeway would deter the fish from migrating to their spawning grounds, and threaten their existence as a species. The





Top: Don Curtis, center, checks the progress of work on the new Engineer School facilities at Fort Leonard Wood.

Bottom: An aerial view of the same site. Junior officers often get to oversee such construction as part of their project officer duties in a Corps district.

fact-gathering in the case was done by our regulatory branch, which contracted studies on the subject by private organizations. Studies conducted by environmental organizations were also considered in making the final decision.

The oil companies did not agree, but the decision held. The risk to the fish migration was considered too great when compared with the expected benefit of the causeway.

My last district mission came when the Exxon Valdez ran aground in March 1989. The Alaska district set up a 24-hour emergency operations center and became an integral part of the clean-up effort. The Corps dredges Essayons and Yaquina were brought in to aid the clean up, and were controlled by the Alaska district. During the first months of the operation, I was a briefer and guide for Corps personnel assigned to assist in the effort. With a lot of hard work on the part of both the Corps' military and civilian personnel, the Army's effort made a real contribution to recovering spilled oil.

I wouldn't hesitate to recommend a district tour of duty to a junior officer. The challenges are great, and the job will demand all of your technical expertise and managerial skills. But the rewards are just as great. You will grow both as an engineer and as an officer. And that means you'll be better equipped when the time comes later in your career for a battalion XO or command slot.

Missouri & Don Curtis

My assignment as an assistant resident engineer for the Fort Leonard Wood Resident Office of the Kansas City district offered me challenges and opportunities that I could not have found anywhere else.

I was fortunate enough to be able to tackle the challenge of ensuring the timely delivery of the new Engineer School facilities to the Army. It was the opportunity of a lifetime to oversee a $42 million construction program, and a little nerve-wracking at times making sure that the Engineer School's critical need dates were met.

There were daily chances for professional growth. Graduate school study was put to good use, particularly in the areas of network analysis and construction scheduling. For example, toward the end of the project, there were five contractors attempting to work in the same building, and many scheduling conflicts had to be resolved every day.

The Kansas City district took the lead in compiling a master critical path method (CPM) schedule to keep everyone working to complete the job on time. The plan worked, and the new Engineer School headquarters, academic facility, and unaccompanied officers' quarters were ready in time for the start of the first scheduled classes.

Daily problem solving during the project was routine. To help with my contract administration responsibilities, I was fortunate in being able to attend several proponent-sponsored engineer corps training (PROSPECT) courses. These covered subjects like contract negotiations, duties of the contracting officer's representative, and the district officer's introduction to contracting. All the courses are designed to provide officers with the basic skills needed for jobs like mine—but they'll also be of value later in my career. I've found that the Corps makes a considerable investment in training its people, and officers assigned to a district job can expect to regularly upgrade their professional knowledge.

Another benefit of serving in a district is the chance to serve with a largely civilian workforce. These are a cohesive, technically proficient group of people, dedicated to serving both the military and civil populations. Working with resident engineers, who routinely manage hundreds of millions of dollars in high-visibility construction contracts, has provided me with important lessons in leadership and management.

In addition to the Engineer School facilities, I've had the chance to administer contracts for the Defense Mapping Agency Aerospace Center and the Harry S. Truman Dam. These projects included new construction, maintenance and repair, and toxic and hazardous waste cleanup.

An officer serving in a district can expect a fulfilling job that will expand his professional abilities, and prepare him well for later career assignments. For someone with an engineering background, a district assignment is one of the most rewarding opportunities to be found anywhere.

Major Nelson is executive officer of the 577th Engineer Battalion. He previously served as chief of the Roads and Airfields Branch of the Engineer School's Department of Military Engineering. In addition to his Alaska tour of duty, other assignments included engineer advisor for Readiness Group, St. Louis; company commander for the 937th Engineer Group, and senior instructor for the Engineer School. He holds a degree in business management from the University of Southern Colorado.

Captain Curtis is currently attending Command and General Staff College. He previously served as assistant resident engineer for the Fort Leonard Wood Resident Office, Kansas City District. He previously served as a company commander with the 44th Engineer Battalion, and platoon leader with the 902d Engineer Company. He is a West Point Graduate, and holds a masters degree in civil engineering from Ohio State University.

(Personal Viewpoint continued)

employment of engineering principles. A well known sports adage states that "you play the way you practice." If we are going to fight in a joint arena, then certainly joint training exercises will help us prepare for that end.

A recent visit to Fort Leonard Wood by Colonel J. A. Marapoti, Commanding Officer of the Marine Corps Engineer School, helped to rekindle the spirit of sharing our concerns, issues, and experiences. Both sides agreed that the exchange of information, ideas, and lessons learned must continue, and the groundwork was laid for future visits.

Let us continue the momentum. Whether you are a commander, a staff officer, or a trainer, you are in a position to influence future engineering excellence. Because the Marine Corps places special emphasis on small unit leadership, junior officers and especially noncommissioned officers (NCOs) become the focal point for training. In most cases, NCOs are the trainers.

Staff NCOs (E-6 through E-9) also play a critical role as instructors at the Marine Corps Engineer School. Therefore, it is of utmost importance that these educators, as well as their Army counterparts, remain involved and up-to-date on all current doctrine, equipment, and training innovations.

I submit that we must all take advantage of the opportunity that lies before us by ensuring interservice coordination of engineer matters at every level. I challenge all engineers to make a commitment to the concept that will bring success—TEAMWORK.

LtCol Drury is assigned as the Marine Corps representative to the Army Engineer School and Commanding Officer, Marine Detachment, Fort Leonard Wood. He was previously assigned as the Commanding Officer, 9th Engineer Support Battalion, 3rd Force Service Support Group, Fleet Marine Force, Okinawa, Japan.

Engineer Solution

Step 1. ***Analyze the relative combat power.*** Analysis of relative combat power is based on the situation template and an engineer battlefield assessment of enemy and friendly mobility/countermobility/survivability (M/CM/S) capabilities.

- *Enemy M/CM/S capability:* The area between PL Red and PL Blue will have extensive tactical and protective obstacles, most of which will be minefields. Because this area was a main defensive belt, there may be a combination of buried and surface-laid mines, with some having anti-handling devices. Most minefields near PL Red will contain anti-tank mines, while those near PL Blue will be mixed or anti-personnel mines.

The brigade and task force S-2 believe that the lead MRB(+) is the advance guard of a motorized rifle regiment (MRR). The MRB(+) will be organized for a meeting engagement with a CRP, FSE, and advance guard main body. The enemy MRR can rapidly emplace mines to protect its flanks.

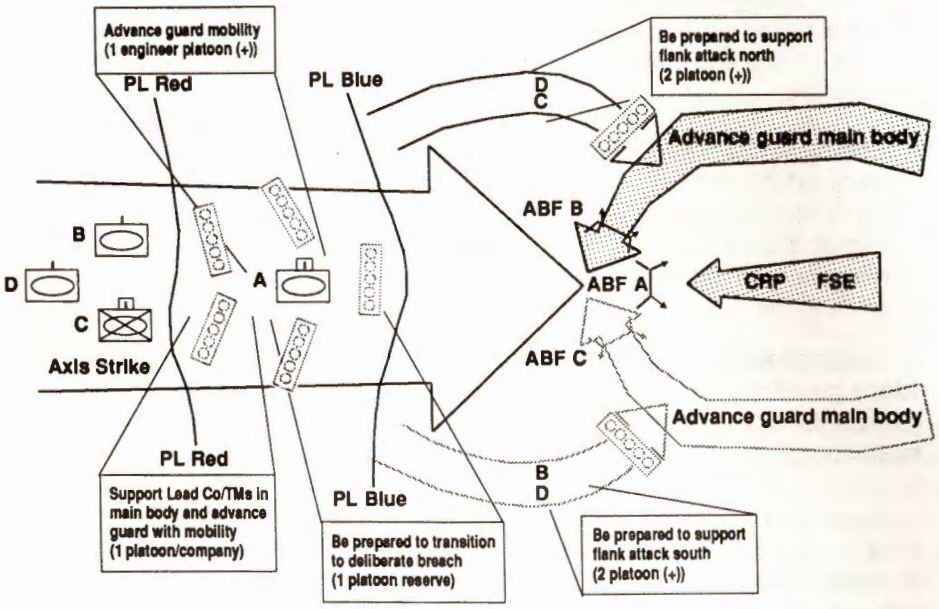
Based on its doctrine, the MRR will organize a mobile obstacle detachment (POZ), which will travel in or behind the vanguard. The POZ may be deployed to protect the flank of the advance guard's main body as it maneuvers to attack our flank after the FSE is deployed. You and the S2 configure the enemy's offensive use of minefields, as shown on the Situation Template (page 19).

- *Friendly M/CM/S capability:* For this problem, assessment of friendly capability focuses on the mobility assets available. TF Tank's mobility assets, based on its task organization and mobility assets organic to CO A/52d EN BN, include—

TF MOBILITY ASSETS (ORGANIC)	A/52d EN BN MOBILITY ASSETS
3 Mine rollers	9 Sapper squads
9 Mine plows	6 M9 ACEs
3 Infantry platoons	2 CEVs
	4 MICLICs
	4 AVLBs

Step 2. ***Identify missions and allocate forces:*** In this step, use the reverse planning process to identify M/CM/S tasks, working from the objective back to the line of departure (LD). Each time a M/CM/S task is identified, allocate the force needed to accomplish it. Do not constrain the forces allocated to each task by the assets in your task organization.

Engineer Solution



Engineer Working Overlay

A good technique is to write each task and force allocation on your copy of the course of action sketch or Task Force Operations Overlay, page 19. They will show the M/CM/S tasks and force allocations required for each mission in the battlefield placement. This overlay will be used to develop the engineer task organization and scheme of engineer operations, as shown in the Engineer Working Overlay, above. Note that some, if not all, of the M/CM/S tasks were identified during the mission analysis phase of the engineer estimate.

Step 3. ***Develop a scheme of engineer operations:*** The goal of this step is to integrate force allocation, execution of engineer tasks, and engineer priorities into the scheme of maneuver and task organization. The scheme of engineer operations is developed by working the maneuver plan from LD through ABF ZULU to consolidation. As you "wargame" the maneuver plan, note the engineer tasks that must be accomplished and the forces required. Task organize these forces to the appropriate maneuver subunit. In some cases the task may be accomplished better under task force or engineer company control.

As assets become scarce, determine where mobility assets can reasonably be expected to accomplish several tasks. Do not omit mobility assets that are

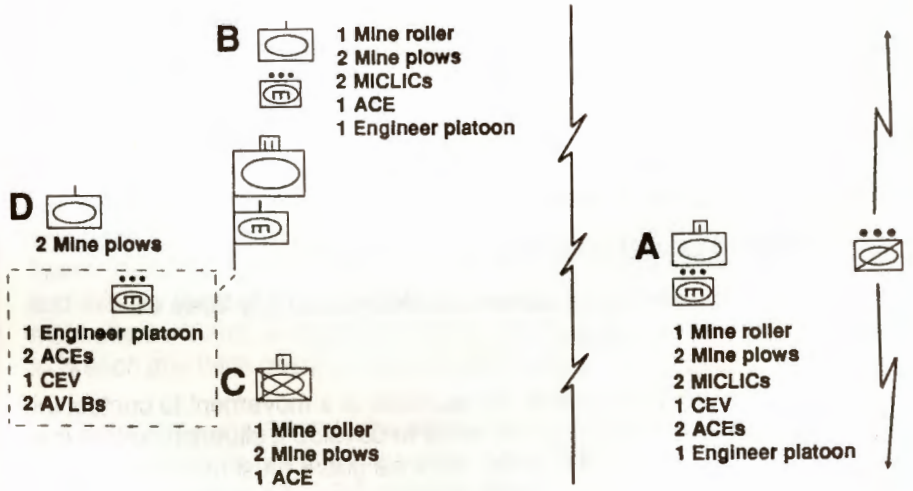
Engineer Solution

organic to the maneuver unit; remember, you are the TF engineer not just the engineer company commander.

And, as you allocate mobility forces, remember that the maneuver commander's intent is to organize his force for an in-stride breach. Refer to the In-Stride Breach Description, on page 20.

Possible Scheme Of Engineer Operations Solutions

The task force will cross the LD organized for an in-stride breach, with mobility assets attached to the advance guard (Team A) and in the main body (Company B and Team C). A mobility reserve will initially remain under task force control and move center of the task force (-) VEE, as shown below in the Task Force Formation.



Task Force Formation

The engineers' initial main effort is to provide Team A with mobility through enemy obstacles from PL Red to PL Blue. The mobility reserve will be prepared to support Team A or Company D. If transition to a deliberate breach is necessary, the mobility reserve will shift to Team C as the TF breach force. In this scenario, Company B will become the support force and Company D the assault force.

Engineer Solution

After Team A makes contact with enemy CRP and FSE, priority of engineer effort shifts to passing the main body through Team A's breaches. Team A engineers assist in the passage. On order, the mobility reserve shifts to Company D, and the engineers' main effort shifts to supporting the flank attack on the enemy's advance guard and breaching POZ flank obstacles. The allocation of mobility assets is shown in the Task Force Formation, page 31.

Some major considerations that should become apparent as you develop a scheme of engineer operations, working from LD to destruction of the enemy in ABF ZULU, include:

Supporting the scouts. A critical task in any movement to contact is to develop the situation. This includes the identification of enemy obstacles. Early detection of enemy obstacles in the old enemy defense area helps to ensure force mobility. Also, enemy obstacle activities identified during the meeting engagement may indicate the enemy's intentions.

Normally engineer forces augment the scouts with an engineer sapper squad to assist in the reconnaissance effort. In this problem, the scouts are screening in front of the advance guard as it attacks on Axis Strike. This allows too little time for an engineer squad to close with the obstacle and provide information quickly to follow-on forces. Therefore, an engineer squad will be of no help. The scouts need to:

- Report any obstacles they encounter
- Be equipped to extricate themselves from a minefield
- Be equipped to mark all obstacles encountered and any lanes or bypasses they find or create.

Supporting the advance guard. The success of a movement to contact initially depends on the advance guard's ability to develop a situation so that the main body can act decisively. Thus, the advance guard must maintain freedom to maneuver and control the support, breach, and assault forces. They must have the ability to conduct numerous breaches against diverse obstacle types. Maintaining the advance guard's mobility from PL Red to PL Blue is the engineer company's main effort and primary task.

Supporting the main body PL RED to PL BLUE. Because the task force (-) is attacking in a VEE formation, Company B and Team C must maintain control of mobility assets so they can conduct company- or team-level breaches (TF in-stride). Only light contact is expected from PL Red to PL Blue,



Engineer Solution

and both Company B and Team C have adequate forces to effectively suppress and secure during a breach. By providing both of them with mobility assets under company/team control, the main body is organized for a TF instride breach. This allows the main body to breach obstacles with minimum TF-level maneuver, command, and control.

Company B and Team C are organized with mobility assets based on their organic mobility weaknesses. Company B is tank pure and needs dismounted breach capability; he is allocated an engineer platoon. Team C, which has no means of mechanical breach or detection, is allocated mine rollers, plows, and ACEs. Team C is not given an engineer platoon and must rely on its own infantry for dismounted breach capability. An engineer platoon (+) maintained under TF control allows mobility assets to be shifted and massed in a breach force if a deliberate breach becomes necessary. The mobility reserve will shift to support Company D if necessary.

Supporting actions on contact/actions on ABF ZULU. Based on the maneuver plan, Team A's mission is to destroy the enemy's CRP and FSE. Thus, M/CM/S support requirements become minimal and are no longer the engineers' main effort. Deployment of the main body depends on the direction of attack by the enemy's advance guard. Rapid maneuver of the TF main body becomes the main effort, and engineers with Team A assist in passing the main body through Team A's breaches.

If the advance guard attacks from the north, Company B will establish an attack by fire (ABF) position echelon left of Team A to fix the enemy's advance. Team C and Company D will attack by fire and maneuver around to the north and into the flank of the enemy advance guard's main body. The engineers' main effort will shift to massing mobility assets with Team C and Company D to breach any flank obstacles emplaced by the POZ.

If the enemy attacks from the south, priority shifts to Company B's and Company D's attack by fire and maneuver, while Team C anchors off Team A's right flank. In either case, the mobility reserve will shift to support Company D. Engineers with Company B and Team C must be prepared to shift to the flanking maneuver.

This Engineer Problem was submitted by Captain Watson, currently serving in Saudi Arabia. He was an instructor/writer at the U.S. Army Engineer School, Department of Combined Arms, at Fort Leoanrd Wood. He is a graduate of the U.S. Military Academy and the Infantry Advance Course, and has served as an observer/controller at the National Training Center.

CADD Makes Its Mark

In the military, the phrase "do more with less" has become as common as it is unwelcome. But often, the drive for economy and efficiency can lead to decisions whose value goes far beyond mere dollar signs.

The Army's implementation of the Computer Aided Drafting and Design (CADD) system is an example of one of those decisions. A boon to productivity, the system allows faster design and modification of drawings for engineering, architecture, facility management, and allied disciplines. Users can produce quality drawings up to four times faster than manual drafting.

While the system has received only limited distribution to the field so far, it has proven so effective that CADD units have been sent to Saudi Arabia for use during Operation Desert Shield. Draftsmen (81B) and construction officers in combat heavy battalions have been targeted as the primary users.

The CADD hardware package consists of a 386 personal computer with a math co-processor, a multicolor plotter, high-resolution monitor, and a digitizer tablet.

A primary feature of CADD is the access it gives to computer-stored information. The system is designed to access digitized Army Facilities Component System (AFCS) catalogs. These catalogs contain more than 4,000 drawings of buildings and other facilities deemed critical to military operations.

In addition to allowing greater speed in producing new facility plans, CADD gives users the ability to modify existing drawings, like those in AFCS, to meet the specific needs of their engineering projects. The system will also import other data from the theater construction management system (TCMS) database, site survey data generated by the automatic integrated survey instrument (AISI), and standard symbols libraries. Drawings and other data generated by users will be exported back to the TCMS database for use by other CADD operators.

CADD has other features designed to speed the facilities engineering process. With its multicolor plotter, a user can show several systems, i.e., plumbing, electrical, and communications, on the same drawing. This often makes it easier to convey the designer's concept and intentions for the facility.

The development of a bill of materials (BOM) and cost estimates will also be easier with CADD. For example, if an engineer has an existing 30 x 50 foot building and needs to add a 30 x 20 foot room, the additional cost and BOM can be computed automatically after material prices have been entered into the database. CADD can give a line-by-line description of materials needed for the extra space, the quantity of materials needed for the structure, and both the item and total costs of the project.

Standardization has been carefully planned into the Army's CADD program. As engineering-related fields, both military and civilian, adapt to the CADD technology, the Army Corps of Engineers continues to be an important participant in several CADD standardization boards.

One of these is the Task Force on CADD Layer Guidelines, organized in September 1988. Four professional associations and three government agencies participated:

The American Institute of Architects

The American Consulting Engineers Council

The International Facility Management Association

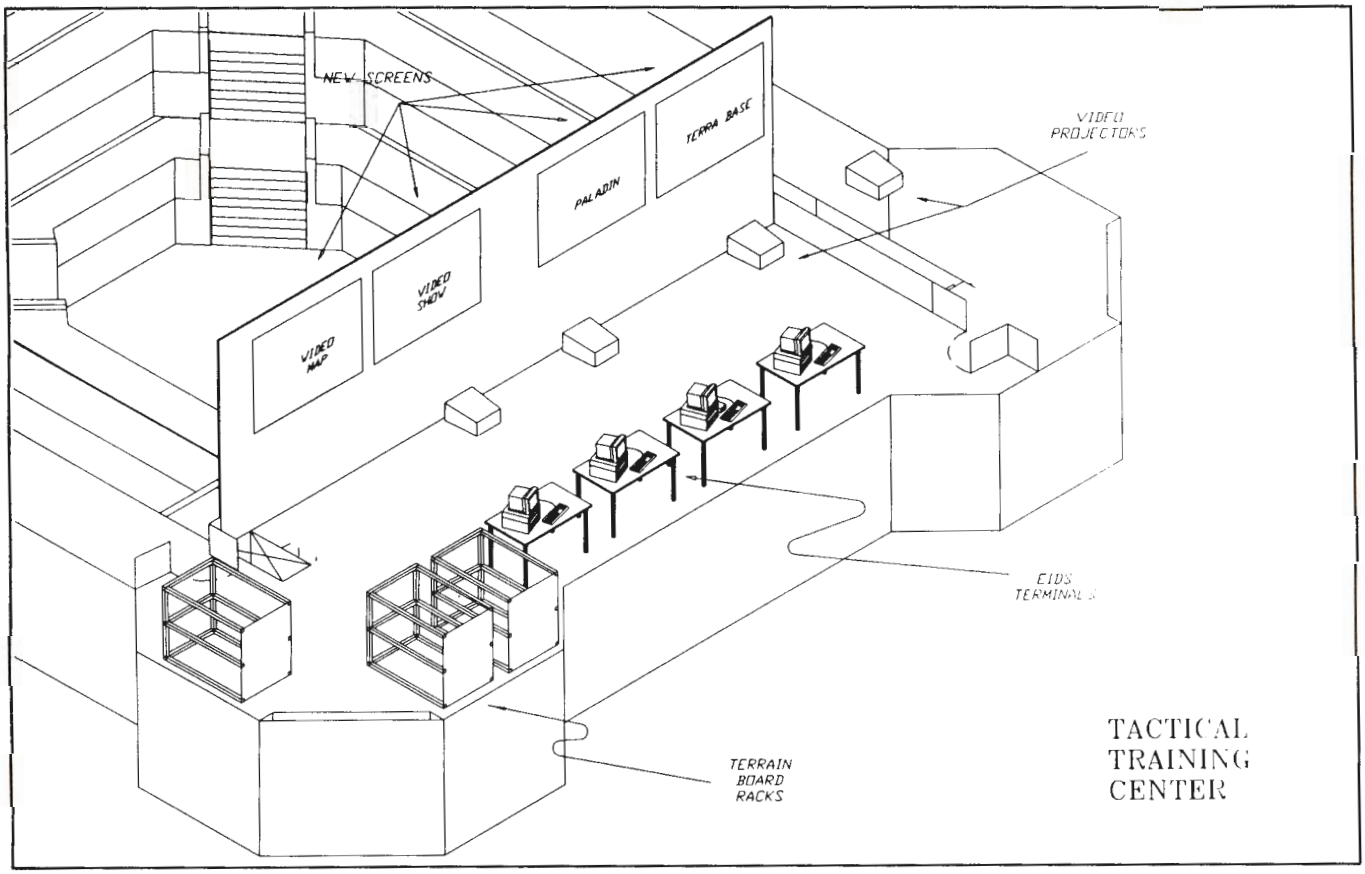
The American Society of Civil Engineers

The U.S. Army Corps of Engineers

The Naval Facility Engineering Command (NAVFAC)

The Department of Veteran Affairs

By Rick Seams and Ron Wenrich



An original facilities drawing made with the CADD system, like this tactical training center, can be easily modified for other building projects. Tapping into the Army Facilities Component System (AFCS), CADD users also have access to more than 4,000 additional military-related drawings.

After almost two years of work, these organizations recently completed release 1.0 of the CADD Layer Guidelines. The completion of these initial guidelines represents a significant step in providing all engineer-related groups with shared graphic information through a computer-aided design program.

And the CADD train is moving fast. Drawings and design information that used to be available in TM 5-302, *Construction in the Theater of Operations*, and in the Navy/Marine Corps Facility Manual (NAVMC), have already been converted to the CADD format and will be available only on floppy disk. This will require engineers to have the CADD capability to use existing drawings for theater of operations construction.

The old design tools for facilities engineering are fading fast. While there will always be a place for the "stubby pencil," CADD is the future for improved productivity and quality.

Mr. Seams is chief of the Technical Engineering Branch of the Department of Military Engineering at the Engineer School.

Mr. Wenrich is a training specialist and acting course chief for the 81B technical drafting specialist course, 87th Engineer Battalion, Fort Leonard Wood.

Building to Last in the Tropics

By Captain Kevin S. Porter

Most Army engineers don't get the opportunity to undertake construction projects in tropical environments. And if they do, their personal experience and "how-to" manuals often don't cover the special construction problems they face.

A vertical construction team from B Company, 84th Engineer Battalion, faced just such a challenge recently when they deployed to Mirpur, Bangladesh, to build three school buildings for the town. Their experiences with the area's extreme weather, the project's shortage of materials and equipment, and their ability to overcome those conditions should be added to the notebooks of fellow engineers.

Materials

Each of the school buildings was to be 26 feet by 60 feet, and the choice of materials used for their construction was critical.

Brick is the most plentiful and frequently used building material in the country, and was considered for the school buildings. However, the local bricks are not durable enough to withstand the violent storms of the monsoon season and the accompanying heavy floods. An existing school near the construction site was destroyed by a storm during the engineers' deployment.

Wooden construction was ruled out because lumber is prohibitively expensive in Bangladesh, which has been largely deforested. Too, untreated wood would have been susceptible to termites and other wood-damaging insects in the region.

Concrete was eventually selected as the building material, though this created its own set of difficulties. For instance, the country is situated on a huge river delta, and the land is mostly silt. The aggregate necessary for making concrete is not available.

Fortunately, the abundant supply of bricks gave the engineers a solution: break the bricks into small chips as a substitute aggregate.

Equipment was another hurdle for the 84th engineers. A platoon of Bangladesh Army engineers had been assigned to work with the Americans, but they did not have access to a large selection of equipment. No concrete trucks were available, so all concrete had

to be prepared in a small mixer.

Precast Concrete

The lack of sufficient mixing capacity made large concrete placements impossible, and led to a decision to construct the buildings from precast concrete slabs. The buildings' beams, columns, trusses and roof slabs were also made of precast concrete. The slabs were designed to allow placement by hand, and the roof slabs and trusses were lifted into place with a Chinese-made crane.

The project marked the first time that such a construction technique was used in Bangladesh, and allowed the engineers to complete the buildings with a minimum amount of equipment. The crane, cement mixer, a Vietnam-era road grader, and a military surplus loader on a 2-day loan from a civilian contractor were the only pieces of equipment used for construction.

Defects

Use of the precast concrete technique posed some difficulties for the local contractor hired to make the prefabricated members. Although he was provided design specifications by the engineers, he had no experience in making the required parts.

Because the quality of the precast concrete was questionable, the engineers decided to load test all of the parts before using them in construction. As it turned out, the concrete purlins that supported the roof slabs failed below their designed strength, with quality control appearing to be the culprit.

To save time and money, the engineers opted to reinforce the purlins instead of having them recast. Two days later, after being reinforced with steel plates, the purlins passed the load test.

Concrete = Money

The cost of locally procured materials was a significant factor in construction of the buildings. While durable in the long run, concrete was also extremely expensive in Bangladesh. Because funds available for the project were limited, every effort was made to reduce the amount of concrete used, while maintaining safety and quality. For example, the amount of concrete needed for the floor slab was reduced by using the ever-present Bangladesh bricks. They were used as a subbase for the slab, and then a four-inch-thick layer of concrete was placed over the bricks. This provided a stable base, while saving much cement and money.

The crushed-brick aggregate had a tendency to "float" in the floor slab cement, and it was impossible to get a good surface finish. The solution was to leave the floor rough, and then finish it



American and Bangladesh engineers push their small cement mixer to the school construction site. Lack of equipment made manual labor one of the primary means of construction for the project.



Roof slabs for one of the buildings are lifted into place with the crane. A pile of the ever-present Bangladesh bricks is on the right.

with a thin, cement-rich mortar. While not possible in climates with a freeze-thaw cycle that would crack the floor, this method works well in the tropics.

And...

The climate of the country was a constant hinderance, with temperatures routinely exceeding 100 degrees Fahrenheit. The heat was so bad that water evaporated from concrete before hydration was complete. This required a considerable number of manhours just to move water bucket-by-bucket to wet new concrete.

The final challenge to the Bangladesh deployment was culture. Language was not a significant barrier because the Bangladesh platoon leader spoke fluent English. However, during the project, his Moslem soldiers observed a religious fast called Ramadan. This limited most of the Bangladesh engineer platoon to one meal a day, at 8 p.m. In addition, the soldiers could not drink water during the day, which greatly affected their productivity and slowed construction progress. This problem had not been foreseen, and all engineers engaging in such projects should research local customs and religions to determine their potential impact on construction schedules.

Despite a few out-of-the-ordinary complications, the mission was completed in 45 days and was considered a success by everyone involved. The project gave the engineers training and experience they couldn't have gotten anywhere else, Bangladesh and American engineers built a new working relationship, and the local community received three new buildings.

The real winners though, were the school children of Mirpur. Safe in their storm-resistant school buildings, they are sure to remember the American engineers for years to come.

Captain Porter is the civil engineer for the 84th Engineer Battalion. He previously served as a company commander with the 84th, and a platoon leader and executive officer with the 43rd Engineer Company. He is a graduate of West Point, and the Engineer Officers Advanced Course.

MOBNET

and Army Mobilization Planning

By Terry Atkinson

Just before Iraq swallowed Kuwait, the world was fairly awash with optimism. Democratic and free-market principles had breached the Iron Curtain. Bloody clashes in Afghanistan and Nicaragua had faded away. Iran and Iraq were both licking their wounds at the end of a years-long war. It seemed as though a contagious peace virus had been loosed on the planet.

Amidst that kind of euphoria, and strong talk of how to spend the "peace dividend," the call for comprehensive war planning—much less mobilization—tends to fall on deaf ears.

But then we were called upon to mobilize forces for deployment to Saudi Arabia, and prepare ourselves for battle with the Iraqi military. Less than a year ago, most people would have dismissed the possibility of such a confrontation.

New questions are being asked about the best way to handle large-scale mobilization of American forces, and the Army's mobilization network (MOBNET) system may be one of the answers.

Originally designed by the U.S. Army Engineer Studies Center for mobilization and industrial base planners, MOBNET is a potential cornerstone for virtually all Army planning. It links a variety of decision-support systems, allowing the collection and sharing of critical data. The system is designed to measure ammunition and major equipment requirements for extended combat, and can be expanded to include other supply needs and personnel requirements.

A Continuing Need

Since World War II, it can be argued that mobilization preparedness has not received its fair share of attention. Most planning emphasized requirements for wars lasting six months or less. When the Soviet Union was our prime adversary, we believed that a conventional war with that country and its Warsaw Pact allies, should it ever occur, would be short in duration. A quick progression to

"...despite the apparently defused superpower confrontation, the United States must still contend with... other powerful military forces in today's world..."

COUNTRY	ARMED FORCES
Soviet Union	4.4 million
China	3.5
United States	2.3
India	1.5
Vietnam	1.3
Iraq	0.9
Turkey	0.9
North Korea	0.8
South Korea	0.6
Pakistan	0.6
France	0.6
Brazil	0.5
Italy	0.5
[West] Germany	0.5
Egypt	0.5
Poland	0.4
Syria	0.4
Taiwan	0.4
Iran	0.4
United Kingdom	0.3

Data taken from *World Military Expenditures and Arms Transfers, 1988* (U.S. Arms Control and Disarmament Agency, June 1989) page 3.

Figure 1

nuclear weapons was almost always a part of any planning scenario. In these circumstances, there was little need to answer questions like:

- How many units—and what types—will be needed in a prolonged conflict, once available Active and Reserve forces are committed?
- What new manufacturing and production capabilities will be needed to support such a conflict?

These are questions that are best asked—and answered—in advance. Transition from a peacetime to a wartime economy is a lengthy, complicated process. Such a transition demands a strong foundation of planning if it is to succeed with optimum economies in time and money—and maximum efficiency in materiel production and other support of a mobilization effort.

The simplistic cold war conflict between America and the Soviet Union tended to overshadow other threats to our security. But military power has seen steady growth in other parts of the world.

According to the U.S. Arms Control and Disarmament Agency, only eight of the 20 largest military forces are controlled by countries traditionally aligned with America or the Soviet Union (Figure 1). Only three of the top 10 countries are so aligned.

The arms export business is booming among nations outside the circle of the world's major suppliers like the United States, Soviet Union, France, and Great Britain. In 1977, developing nations held about 4 percent of the world's arms export business. By 1987, the figure had risen to 8 percent.

Today's arms traders among developing nations include China, Brazil, North Korea, Yugoslavia, Bulgaria, Israel, Chile and Argentina. The days when larger nations could dominate emerging ones by cutting off arms supplies are rapidly fading. Customers denied access to arms from major suppliers can turn to a variety of smaller, but eager, vendors.

High technology, too, is no longer limited to the exclusive superpower club. Two of the six nations which admit to possessing nuclear weapons, China and India, are considered developing nations. Speculation over other nations that may have an unannounced nuclear capability has raised the names of Israel, Argentina, Pakistan, Saudi Arabia, South Africa, and Syria. Iraq, as news reports have suggested, may be well on the way to a nuclear weapons capability.

So, despite the apparently defused superpower confrontation, the United States must still contend with the possibility of conflicts with other powerful military forces in today's world. And such conflicts can strain the resources of even the world's most powerful nations.

MOBNET

MOBNET is a simple concept (Figure 2, page 41). There are four decision points, 1.0 through 4.0. Each is tagged with a descriptive phrase which characterizes the point's desired output. Each decision point accepts data, manipulates it, and exports new data to other decision points. The direction of the data flow is portrayed by arrows, which are labelled to show the specific information required by each receiving decision point.

Decision Point 1.0

The most critical step within the MOBNET framework is decision point 1.0, which identifies theater Army forces. Using operations plans and combat simulations, the Army defines the forces required to execute its portion of the nation's strategy. This decision point manipulates data to produce a list of combat, combat support and combat service support units needed in a combat theater. The units' tables of organization and equipment (TOE) will define their structure.

The force list produced by decision point 1.0 accounts not only for the current Active and Reserve forces, but also any new forces which must be added in order to ensure the Army's success. This force information is key to developing wartime requirements for the Army. The forces deployed to a theater are not only

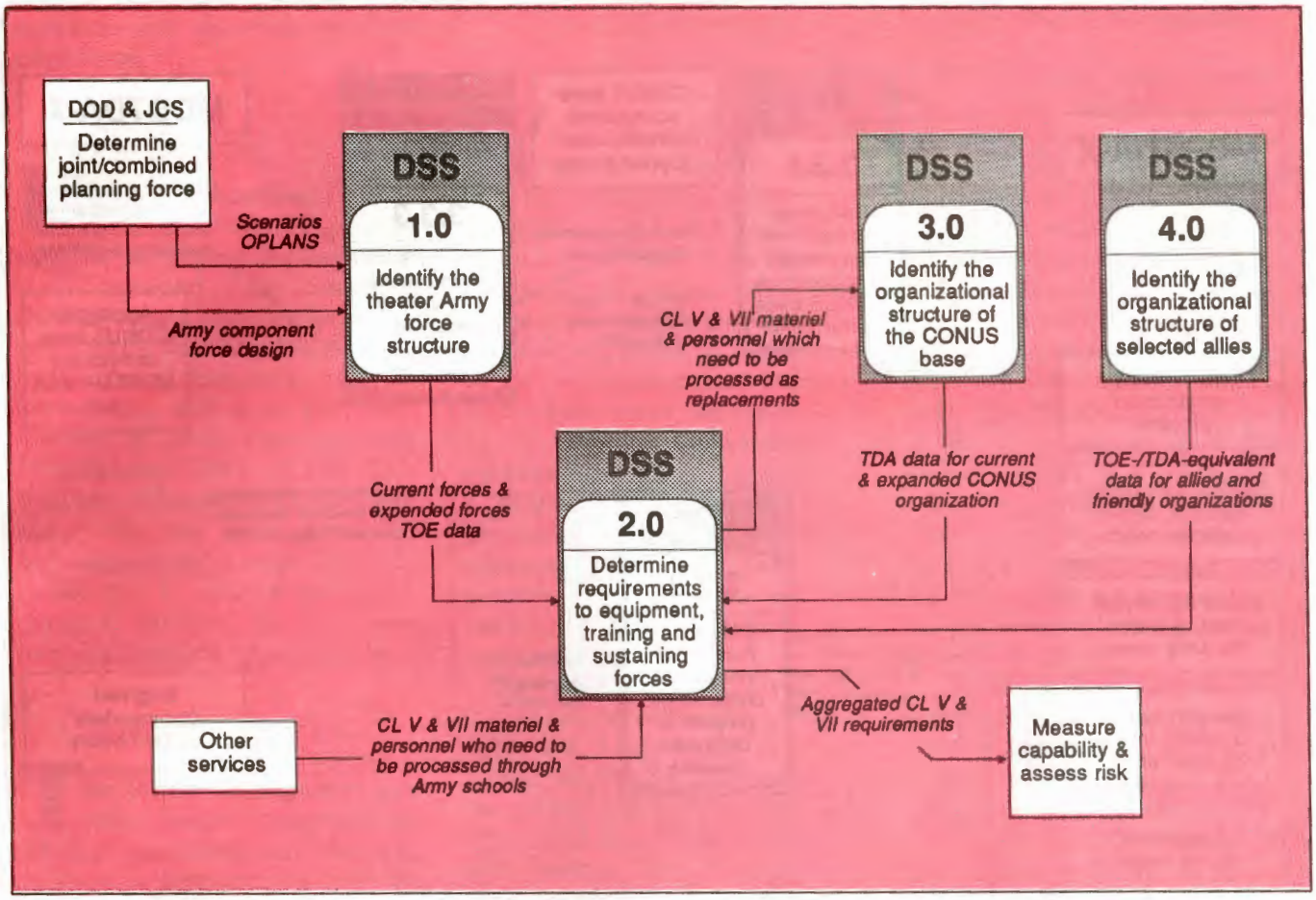


Figure 2

the greatest consumers of materiel—they directly affect the size and structure of the Army's support base in the continental United States (CONUS).

Decision Point 2.0

Decision Point 2.0 accepts TOE data for the theater forces. It converts the organizational data into specific equipment and ammunition requirements needed to equip, train and sustain all forces. It also accepts equivalent organizational data for Army units which remain in CONUS; allied formations supporting U.S. efforts, and the other military services. All of these groups represent potential claimants for Army-managed goods.

Decision Point 3.0

During a prolonged war, the support base in CONUS must provide resources for treating casualties, training replacements, transporting troops and materiel within CONUS, and performing administrative activities critical to the war effort. Should the plans require additional forces to bolster the Army's Active and Reserve units, then the CONUS support base must build and train new units from scratch.

Building and training new units may occur while the CONUS support base processes individual replacements for combat losses. This added activity may compel the enlargement of the CONUS base. Adding personnel and units places a greater burden on the support base: the new units and their staffs must be trained, equipped and sustained.

For example, as more trainees enter the system, the Army needs more trainers and training equipment. In turn, the need for more trainers stimulates the need to train more trainers. This iterative process is inferred from the two data arrows: one exiting decision point 3.0 and entering 2.0, and the other exiting 2.0 and entering 3.0.

Decision Point 4.0

Decision point 4.0 accounts for the materiel that selected allied or friendly forces might claim. Military support to certain allied nations and friendly foreign countries will be critical to the strategic goals of the

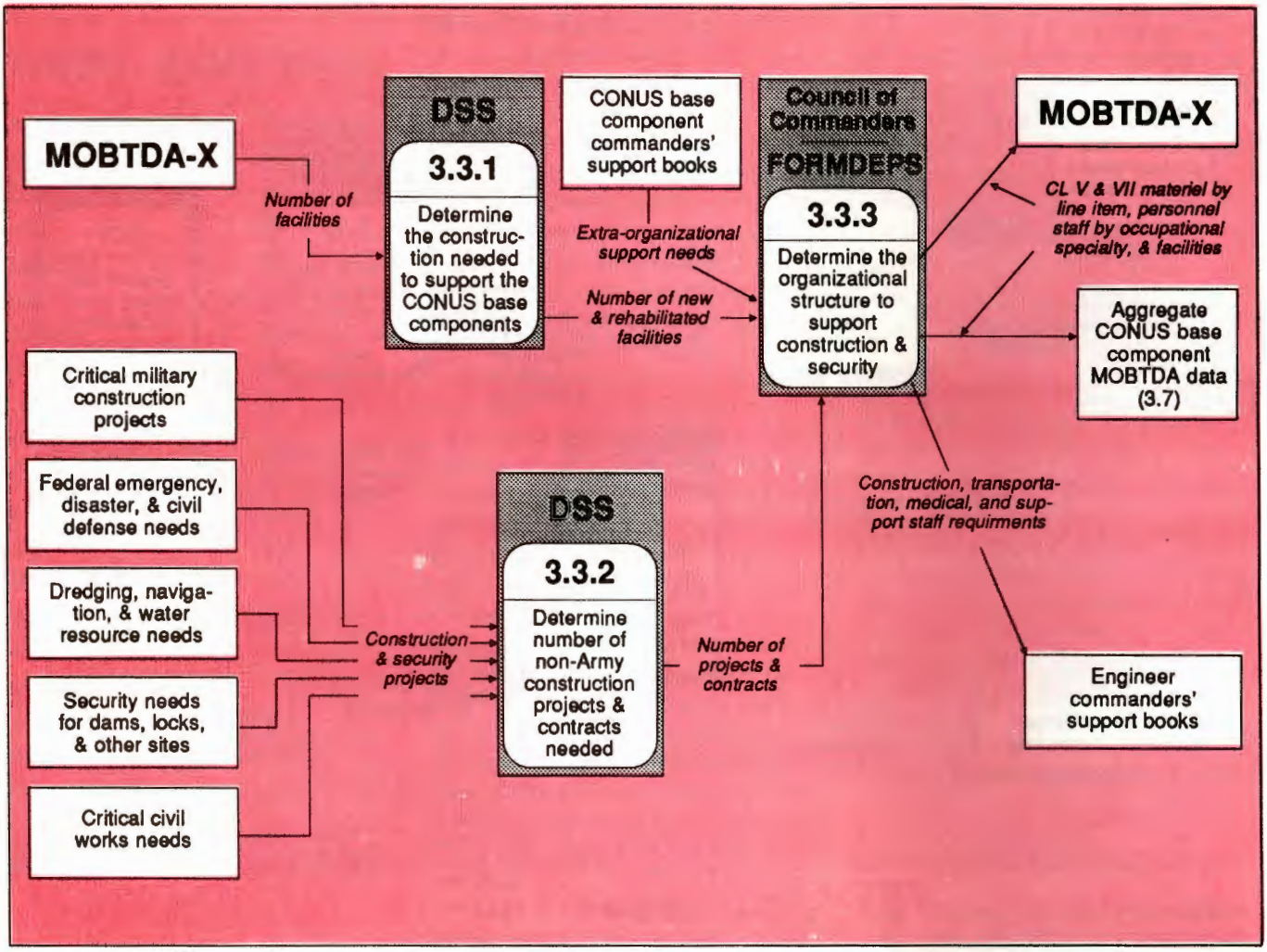


Figure 3

United States. A decision to support such groups with U.S.-produced materiel will compete with the needs of American military forces, and might also strain the nation's production capabilities.

Today's coalition planning calls for a policy of national responsibility, that is, the material needs of each coalition partner are the responsibility of that partner. Complete planning for mobilization requirements, however, demands that planners give credence to the possibility that non-U.S. forces will solicit American materiel assistance. Other services will also lay claim to Army-managed support (Figure 2, lower left). For example, the Army supplies the other services with artillery and small-arms ammunition produced at Army munitions plants.

Subordinate Decision Points

The Engineer Studies Center separated each of the four decision points shown into their underlying processes of data flows and decision points. In some cases, these subordinate decision points were broken down further into their component parts.

The Center produced no less than 13 schematics which define the MOBNET process in greater detail. Certain modules examine the process for identifying the theater force, and determining the requirements to equip and train all forces. Others examine the process for determining the structure of the CONUS support base engineer, medical, transportation, mobilization, training and materiel procurement elements. A final module examines the details of allied requirements.

The Engineer Module

The engineer component of MOBNET is designed to develop the personnel and equipment needs of the staffs that form the Corps of Engineers portion of the CONUS support base. Figure 3 shows the decision

elements and data that must be considered.

Decision Point 3.3.1

Under mobilization conditions, the Corps is responsible for managing the construction needed to support CONUS-based organizations. Requirements for facilities such as barracks, classrooms, ranges, hardstands, and so on are documented in each organization's Mobilization Table of Distribution and Allowances (MOBTDA), along with the unit's personnel and equipment needs. Decision point 3.3.1. determines how many of the facilities represent new construction requirements.

Decision Point 3.3.2.

The Corps of Engineers has other support requirements during mobilization. Critical military projects not included on any installation's MOBTDA will require resources. Engineer support for disaster relief and civil defense, the nation's waterways, critical civil works projects, and special security needs must be resourced from somewhere. Decision point 3.3.2. considers all these variables and determines the number of projects and contracts needed.

Decision Point 3.3.3.

Decision point 3.3.1. and 3.3.2. develop organizational staffing requirements data that need to be further refined by processes outlined in Forces Command's guidance: the U.S. Army Forces Command Mobilization and Deployment Planning System. The resulting information is fed into the engineer organization's MOBTDA.

Commander's Support Books

When the engineer commander is also the installation commander, the unit MOBTDA will include activities shared by tenant units (for example: central mess, health and motor pool facilities). When the engineer organization is a tenant on an installation, the engineer commander must negotiate such support from the installation commander.

MOBNET promises to be a giant step forward in the Army's planning process, and can provide the means to link national strategy to mobilization requirements.

The Information Systems Command is currently working with the Army staff to incorporate MOBNET concepts into the Army World Wide Military Command and Control Information System. Copies of the final study report, Army System for Mobilization Requirements Planning: Supply Classes V and VII (Ammunition and Equipment), are available through the Defense Technical Information Center (Report No. DA313826), Cameron Station, Alexandria, VA 22304.

Mr. Atkinson is a project manager for the U.S. Army Engineer Studies Center at Fort Belvoir. He is a West Point graduate, and served in armor and aviation units in Europe and Vietnam. His postgraduate education includes law and information systems management.

(Engineer Safety continued)

The 18 incidents involving M915-series vehicles accounted for only 3 percent of the total engineer accidents, but they caused more than $1 million in damages. The most costly accidents were caused by vehicles striking overpasses and improper clearance of loads. Loss of vehicle control due to air pressure loss on downgrades and improper hazard avoidance are other significant errors.

Training operators of M915 series vehicles is a challenge for engineer commanders. To aid in this effort, the Transportation School has developed an exportable training package which is scheduled for release in the second quarter of FY 91.

The Engineer School has taken the initiative in reducing work-related accidents by adding risk-management training to the program of instruction (POI) for officer and NCO courses. Risk management is the systematic process of making operations safer without compromising the mission. (See article in July 1989 issue of ENGINEER).

Accidents cost precious resources—people, equipment, and the costs of damages. To reduce these losses, engineer leaders must stress the importance of performing to standards and following established procedures. Engineer soldiers must follow the established standards—and we must all take the initiative to prevent accidents both on and off duty. Let's work together to reduce this needless waste.

Captain Torres is the engineer branch liaison officer at the U.S. Army Safety Center, Fort Rucker. Mr. Paul Rusinko is a safety specialist in the Engineer Branch Safety Office, Fort Leonard Wood.

Directorate of Training and Doctrine (DOTD)

Distribution to Persian Gulf Area. The ENGINEER Professional Bulletin will be distributed to engineer units in the Persian Gulf area. Therefore, it will not be necessary for units to forward copies mailed to addresses on our regular distribution list.

Live Mine Training. Engineer units are now authorized live mine training, subject to the following policy guidance:

- Training will be allowed with live M15, M16, M19, and M21 mines.
- No training will be allowed with live M14 mines.
- All approved mines will be armed/disarmed not more than 25 iterations per mine and/or fuse.
- No trip wires or booby traps will be used.
- Use of tilt rods with live mines is prohibited.
- Training with the M16 antipersonnel mine will be done with the positive safety pin remaining in the M605 fuze.
- No pre-1957 M605 fuzes will be allowed in training with the M16 antipersonnel mine.
- Live mine training and simulator training will not take place concurrently at the same location in order to preclude a live mine being mistaken for an inert mine.

The Engineer School will forward a live mine training model risk assessment plan to engineer units by March 1991. POC is CPT Jim Glass, AV 676-7784 or (314) 563-7784.

Engineer Publication Support. Field units must order engineer publications from the Distribution Center in Baltimore, MD, using their unit publication account number. The Engineer School is unable to fill these requests. If you are in a hurry, use the Distribution Center's hotline—it can handle requests for a limited number of some publications. Call AV 584-2533 or (301) 682-8529.

Standards in Weapons Training, DA PAM 350-38. The training standards, strategies, and resource requirements to conduct training with engineer systems, mines, and demolitions are updated in DA PAM 350-38, dated 24 September 1990. Training programs are now tied directly to the soldier's training publications (STP) and mission training plans (MTP). Revised standards, strategies, and ammunition requirements for light engineer units are also provided. For more information, call CPT Jim Glass, AV 676-7784 or (314) 563-7784.

ARTEP 5-415-MTP Series Update. Coordinating drafts for the following six manuals in this series are scheduled for distribution to appropriate units for review in February 1991.

ARTEP No.	Unit
5-415-MTP	Headquarters and Support Company
5-415-13-MTP	Construction Equipment Platoon
5-415-14-MTP	Maintenance Platoon
5-415-15-MTP	Equipment Support Platoon
5-415-17-MTP	General Construction Platoon
5-415-31-MTP	Engineer Company

POC is CPT Robert Kurtz or SFC William King, AV 676-7599 or (314) 563-7599.

Reserve Configured Courses. The following Reserve Configured Courses, developed in FY 90, can now be ordered through normal channels:

MOS Reclassification	BNCOC	ANCOC
12B10	12B30	CMF81
12C10	12C30	
62F10	12F30	
62H10	62N30	

POC is Don Rowland, AV 676-7520, or Jim Fitzgerald, AV 676-7521 or (314) 563-7520/7521.

Directorate of Combat Developments (DCD)

Safety Flash! Mine Malfunction Accidents. Units must report near-miss accidents or problems with munitions promptly. Frequently near-accidents are not reported because "No one got hurt" or "It's too much paperwork." Not true—reporting one defect in time may save lives or prevent accidents. We need this information at the Engineer School to know where potential problems exist.

Soldiers can use the Engineer hotline to report munitions problems and near-miss accidents. Call AV 676-7324 or (314) 563-7324. Messages should include a POC (name, unit, and telephone number), ammunition type, and lot number. We will do the paperwork and get back to you for details.

If possible, do not destroy the evidence. Alert your local logistics assistance representative or quality assurance specialist for ammunition surveillance (QASAS) before you blow the munitions in place. POC is SFC Adams, AV 676-7330.

Engineer Branch Safety Office (EBSO)

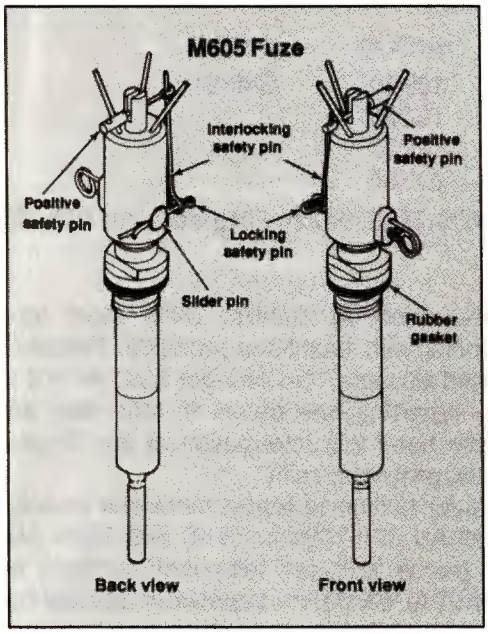
Caterpillar (Cat) M130G Road Grader Battery Removal. When removing or installing batteries in the Cat M130G, soldiers must disconnect the positive cable from the right side battery first and reconnect it last. Failure to do so will damage the grader's electrical system. This information is in Change 1 to TM 5-3805-261-14&P-2, page 1-82.

Road Grader Operation. As a result of a fatal accident, the following instructions have been added to training for road grader operators: Before shifting into reverse, road grader operators must stand up and look to both sides and the rear. The operator will remain standing while moving in reverse. All mirrors will be adjusted for maximum rearward vision of the individual grader operator when seated. We recommend that the camouflage net be carried in a support vehicle or on top of the cab, where it cannot obstruct vision. POC is Paul Rusinko, AV 676-5002 or (314) 563-5002.

Department of Combined Arms (DCA)

Field Manual (FM) 90-13-1. The combined arms breaching operations manual, FM 90-13-1, is scheduled for distribution in the 2nd quarter of FY 91. The Engineer School recommends all combat engineer units make it required reading for officers and senior NCO. The manual describes the combined arms doctrine and some tactics, techniques, and procedures needed to successfully overcome obstacles. An example of an instride breaching operation is described in the Engineer Problem/Solution, beginning on page 18. POC is CPT Bob Wray, AV 676-5456 or (314) 563-5456.

Department of Military Engineering (DME)



Arming/Disarming Procedures for M16 Series Antipersonnel Mine (M605 Fuze). The following instructions and warning regarding arming/disarming procedures are in addition to those contained in FM 20-32, dated December 1985. This information updates only arming/disarming procedures. It does not modify in any way Department of Army policy on training with live mines.

- Individual must be in a prone position prior to arming/disarming the mine.
- ***Warning:*** *After the positive safety pin is removed, the slider may detonate the mine if it is pushed in accidentally.*

- The slider is the mechanism that holds the striker up (keeps it from firing) after the positive safety pin is pulled.

- Before it is pulled, the locking safety pin is located in the hole in the rear of the slider.

- Individuals should keep their fingers away from the rear of the slider when arming/disarming the M16 series antipersonnel mine with the M605 fuze.

POC is CPT Green, AV 676-5596, (314) 563-5596.

Professional Engineer Application Deadline. The deadline for submitting applications for the 25 October 1991 Professional Engineer (PE) Exam is 27 June 1991. This deadline applies to most states. The Commonwealth of Virginia allows the PE exam to be taken in other locations. If you wish to receive a Virginia application, call (804) 367-8512.

Department of Topographic Engineering (DTE)

Engineer Officer Advance Course (EOAC) Update. Instruction on the intelligence preparation of battlefield process (IPB) has been incorporated into EOAC to ensure officers receive the most current terrain analysis and intelligence training available. Officers attending EOAC after Class 1-91 will receive this improved training.

The IPB instruction will be taught in one day to help students better understand the process. Students will prepare a terrain analysis product and decision support template, which will be used to support tactics training. POC is CPT Wood, AV 676-5416 or (314) 563-5416.

Task/Site Selection Boards. A task/site selection board for MOS 81C (cartographer) was held in January 1991. The resulting task list for the Soldier's Manual and resident training is expected to be available for distribution in 3rd quarter, FY 91. POC is SFC Robert Knoll, AV 676-5417.

A task/site selection board for MOS 83E (photo/layout specialist) is tentatively scheduled for April 1991. POC is SFC Bobby Odom, AV 676-5404.

Engineer Personnel Proponency Office (EPPO)

Engineer Officer and Warrant Officer Directory. The new active duty Engineer Officer and Warrant Officer Directory is available for purchase from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Copies are $12 each. You may call (202) 783-3238 and use VISA or MasterCard. The stock number for the directory is 008-022-00268-5.

1st Brigade

Sapper Leader Course Openings. Several Sapper Leader Course classes for FY 91 are only partially filled due to Operation Desert Shield. The following classes and slots are available:

Class	Dates 1991	No. Slots Available
4-91	25 Feb - 25 Mar	25
5-91	18 Mar - 15 Apr	25
6-91	8 Apr - 6 May	25
7-91	29 Apr - 27 May	25
10-91	1 July - 29 July	25
13-91	2 Sept - 30 Sept	25

The Sapper Leader Course is open to any U.S. Army engineer unit, with priority given to light, airborne, divisional, and corps combat engineer units. Combat heavy and Reserve Component units are invited to apply for class slots. Units should contact Fort Leonard Wood's Directorate of Plans, Training, and Mobilization (DPTM), at AV 581-3195/3148, or (314) 596-3195/3148. For more course information, call AV 581-6725/6225 or (314) 596-6725/6225. POC is 1LT Jeffrey Harrison.

Reserve Component (RC)

Engineer Officer Basic Course (EOBC-RC). Soldiers must complete the correspondence phase of EOBC-RC prior to attending the 8-week resident phase (OCS graduates). This is a change! POC is LTC Charles Doll, AV 676-7742 or (314) 563-7742.

Engineer Commanders Conference. The conference, now known as the Senior Engineer Leaders Conference, is scheduled for 17-20 April 1991, at Fort Leonard Wood. It is for battalion and above commanders and their command sergeant majors. POC is CPT Bonhurst, AV 676-7015 or (314) 563-7015.

News and Notes

Battle Staff NCO Course. Starting in January 1991, a new Battle Staff NCO Course, at Fort Bliss, Texas, will train battalion and brigade staff NCO (S1 through S4 and G1 through G4) to serve as integral members of the battle staff and to manage day-to-day operations of battalion command posts. The 6-week course will train battle staff NCO to function and fight as an effective team. Beginning class dates for 1991 are: 14 January, 1 April, 20 May, 8 July, and 26 August. For more information, call the chief instructor, AV 978-9165 or 8145, or (915) 568-9165 or 5145.

Senior Officer Logistics Management Course (SOLMC). A 1-week course designed to update commanders and their primary staff at the battalion and brigade levels in the logistics arena is available at Fort Knox, KY. The course is open to officers in grade major or above in active and reserve Army, U.S. Marine Corps, and allied nations, and DOD civilians in grade GS-11 or above. Ten classes are planned for FY 91. For more information, call CPT Hammerle, AV 464-7133 or (502) 624-7133.

The Corps of Engineers' 124th Annual Engineer Dinner. All Active, National Guard, Reserve, and retired officers, non-commissioned officers, and Corps civilians are invited to the 124th Corps' Annual Engineer Dinner. It will be held on Thursday, February 21, 1991, 1830 hours, at the Fort Myer Officers' Club, Fort Myer, VA. Cost is $32 per person. Payments may be mailed to 124th Annual Engineer Dinner, ATTN: DAEN-ZCA (T.Kay), Room 1E676, the Pentagon, Washington, D.C. 20310-2600. POC is MAJ Joe Miller, (703) 693-4583.

Engineers as Infantry in the Korean War

Not all wars start with prior warning. The Korean Conflict was one such war. And, it was one that illustrates the United States' ability to respond quickly to armed aggression.

When the North Koreans launched an attack across the 38th parallel into the Republic of Korea (ROK) on June 25, 1950, they hoped for a speedy victory. Two days later, the United Nations Security Council passed a resolution asking members to assist the ROK in repelling the attack and restoring peace. On June 29, President Truman authorized General of the Army Douglas MacArthur to use ground units in Korea.

No American combat units were in Korea when the communists invaded, and there were few trained U.S. Army divisions available for immediate commitment. The Eighth U.S. Army, stationed in Japan, immediately alerted its four divisions for combat in Korea, even though the units were under strength and mainly unprepared occupation troops. As a result, many noninfantry units were used as infantry in the early days of the war.

The first two divisions to reach Korea, the 24th and 25th Infantry Divisions, arrived in early July. Third to arrive was the 1st Cavalry Division, to which the 14th Engineer Combat Battalion (ECB) was attached. Initially short two companies, the battalion was assigned two more, one from the 43rd ECB and one from the 13th ECB. The battalion's strength was then 32 officers, 3 warrant officers, and 648 enlisted men.

The 14th ECB arrived at P'ohang-dong, Korea, on July 18. Relieved of attachment to the 1st Cavalry Division, the battalion went to Pusan to support the 25th Division. At the end of July the battalion moved to Taegu, where it was attached to the 24th Infantry Division, with further attachment to the 21st Infantry Regiment. The regiment was located along the Naktong River, and the battalion established a forward command post near Tukson-dong.

For the next three weeks, the 14th ECB helped hold the Pusan Perimeter. The unit performed a mix of engineer and infantry missions in several actions scattered throughout the 24th Infantry Division area. Their actions typify those of other engineer units called on to provide engineer support and accomplish infantry missions.

Company A's first mission was to prepare a 650-foot steel girder bridge across the Naktong for destruction, while Company C prepared the road out of Koryong for demolition. The demolitions were blown on August 3, when new defensive positions were established in the rear, further shrinking the Pusan Perimeter. The battalion then re-established its command post near Ch'angnyong.

In an effort to hold the positions against North Korean attacks, the 21st Infantry Regiment tasked Company C to send 12 men and four .50-caliber machine guns to its defensive line along the Naktong River. Engineers ended up manning seven .50-caliber machine guns, including three guns belonging to the infantry. On August 5th, the company was ordered to man the defensive line along the Naktong. Company A was tasked to lay an anti-personnel minefield with booby traps in front of the division.

The following day, Company B dug defensive positions for the regiment. Company C moved to a new position on line. After digging in, Company C made contact with a 50-man enemy patrol trying to cross the Naktong and killed or wounded 46 of the enemy. For the next several days Company C sent out patrols and set listening posts along the river.

On August 10, the 21st Infantry Regiment assigned Company B the mission of perimeter defense for units of the division's artillery. Company A installed 200 yards of double-apron barbed wire fence and an anti-personnel minefield as part of the perimeter defense.

A period of intense enemy activity began on August 11. That morning, Company A and elements of Headquarters and Service Company were tasked to

By Dr. Barry W. Fowle

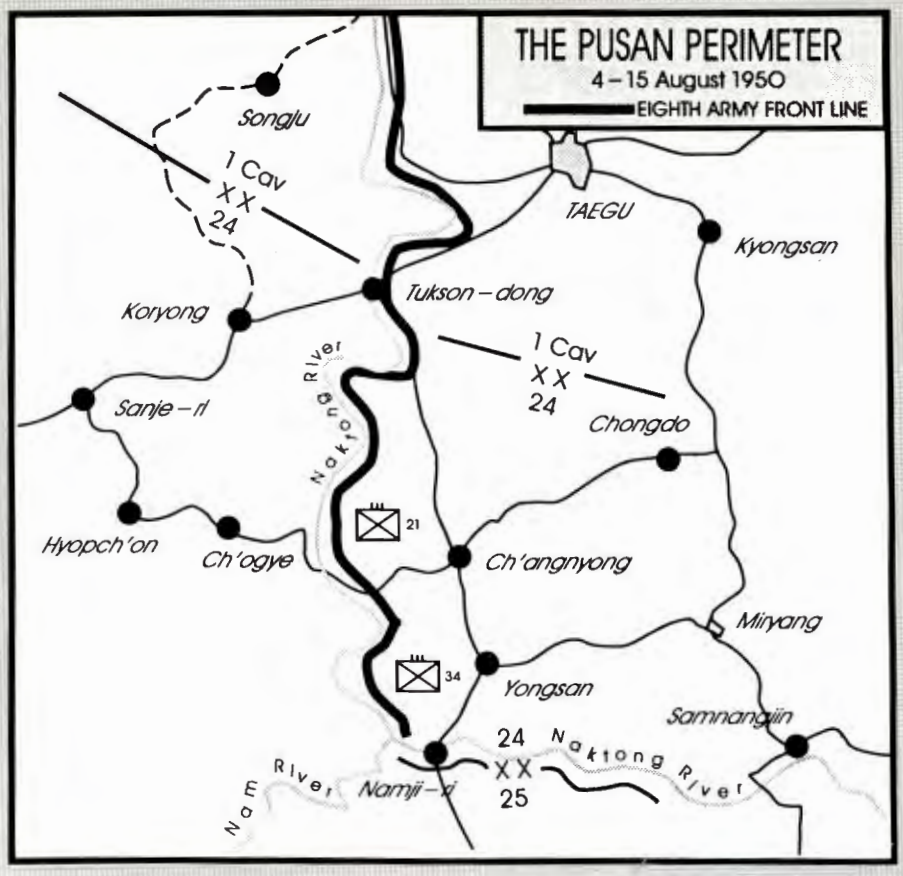
perform infantry missions. North Koreans had infiltrated into the 24th Infantry Division's sector of the Pusan Perimeter. Enemy artillery fire rained down on Yongsan, while sniper fire harassed traffic on the road from Yongsan to Miryang. South of Yongsan, North Koreans killed all members of a squad of K Company, 34th Infantry. The squad had been guarding a bridge over the Naktong at Namji-ri, which connected the 24th and 25th Divisions.

In response to the enemy threat in the rear against the main supply route (MSR) between Yongsan and Miryang, the 24th Infantry Division sent engineers to an area just east of Yongsan. This detail was ordered to keep open a 3-mile section of the MSR between Yongsan and Miryang.

Beginning at a point 2 miles outside of Yongsan, the engineers set up four road blocks extending from west to east. A five-man jeep patrol was to check each post every hour. The patrol's first trip went smoothly, but on its second trip enemy fire wounded the driver. Road block 3 received small arms fire.

When road block 4 began to receive considerable fire, the platoon leader sent his men to an infantry platoon's position one-half mile to the east. He and two noncommissioned officers (NCO) then headed for road block 3, which was under attack by enemy machine guns, rifles, and grenades. They never made it. North Koreans killed one NCO and captured the other two.

Enemy fire was now heavy at road block 3. A hand grenade killed the platoon leader and wounded three enlisted men. When an NCO tried to lead eight men to road block 2, enemy fire killed all except the NCO, who finally reached safety. At road block 2, the communications officer was wounded by three rounds as he tried to adjust a machine gun.



Engineers at road blocks 1 and 2 successfully defended their positions until the 34th Infantry Regiment ordered them to stop infiltrators at a hill northeast of Yongsan. Enemy troops posing as civilians had moved behind the line using a draw to the south of the hill. Late on the 13th, having stopped the North Korean infiltration, the engineers reported back to their command post. That evening it became apparent that the prompt action of the 24th Infantry Division in committing engineer troops to the MSR had checked the dangerous enemy penetration in the Yongsan area.

In three days of fighting, the battalion lost 24 men killed, three missing in action, and four wounded in action. Four soldiers earned the Silver Star.

Until relieved from attachment to the 24th Infantry Division on August 24, the 14th ECB continued in its dual role as engineers and infantry. Company A maintained the MSR from Chongdo to Ch'angnyong, Company B established a perimeter defense for the field artillery, laid a 300-yard minefield along the Naktong, and did limited work on the MSR from Ch'angnyong to the front. Company C continued in its defensive position along the Naktong.

Because no engineer unit knows when it will be called upon to perform an infantry mission, soldiers must be prepared to respond to such missions at a moment's notice. The 14th Engineer Combat Battalion was one unit called on to fulfill both functions in an emergency situation, and it responded brilliantly.

Dr. Barry Fowle is a historian, Office of History, Headquarters, U.S. Army Corps of Engineers, Fort Belvoir, VA. He earned a Ph.D. in history from the University of Maryland.

DEPARTMENT OF THE ARMY
ENGINEER PROFESSIONAL BULLETIN
US ARMY ENGINEER SCHOOL
ATTN: ATSE-TDM-PB
FORT LEONARD WOOD, MO 65473-6650

USPS 522-390
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