Engineer

THE MAGAZINE FOR ARMY ENGINEERS

Spring 1982

BRIGHT STAR 82

The Engineer Story

Ellis Named Engineer School Commandant

Maj. Gen. James N. Ellis

Maj. Gen. James N. Ellis assumed command in March of the U.S. Army Engineer Center and Fort Belvoir from Maj. Gen. Max W. Noah who becomes director of Program Analysis and Evaluation, Office of the Chief of Staff of the Army.

Ellis comes to Fort Belvoir from Atlanta where he served as division engineer of the South Atlantic Division, U.S. Army Corps of Engineers (COE).

A U.S. Military Academy graduate, Ellis has a master's degree in civil engineering from the University of Illinois, is airborne and ranger qualified and is a graduate of the Army War College.

He served two tours in Vietnam; commanded companies twice in the 82d Airborne Division; was commander of the 4th Engineer Battalion, 4th Infantry Division (Mechanized); and rose to the rank of associate professor of earth, space and geographic sciences at the U.S. Military Academy.

His COE assignments include district engineer, Louisville District; executive director, Office of the Chief of Engineers; and division engineer, Middle East Division.

Ellis is a native of Cape Girardeu, Mo; he and his wife, Mareth, have three children.

Engineer

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FEATURES

DEPARTMENTS

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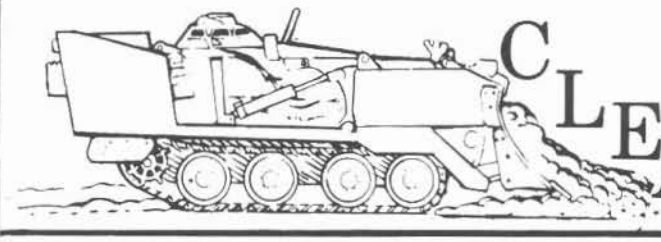


CLEAR THE WAY

by Maj. Gen. Max W. Noah

Sharing the responsibility for training developments

We often hear that finding answers to the question, "How and with what do we fight?" is the business of the Engineer School's Directorate of Combat Developments, and most of us tend to leave that issue to the designated "thinkers" in our ranks. In peacetime, a natural and vital additional question is, "How and with what do we *train* to fight?" When we look for answers to this question, we enter the world of training development. This is the milieu of the Army Training and Evaluation Program (ARTEP), *Soldier's Manual, Trainer's Guide* (formerly called *Commander's Manual*), *Job Book*, Skill Qualification Test (SQT), Training Extension Course (TEC), etc., etc., . . . all of the materials designed to help you and me plan, conduct and evaluate the training of the soldiers and units for whom we are responsible. Because we all share training responsibility to one degree or another, we need to be familiar with this world of training development. Accordingly, I'd like to discuss several points regarding some of our common training concerns.

The ARTEP

As a unit leader, the ARTEP has to be your guide for evaluating and training your unit on *most* of the tasks expected of it in combat. There may very well be additional tasks required of your unit by specific operations plans or other situations unique to your parent command. If your unit has specific combat tasks assigned to it which are not in your ARTEP, include them in your training program by all means. If you need our help in training these tasks, please let us know.

The ARTEP for most units contains a greater number of tasks than the unit can realistically train on or maintain proficiency during the course of a normal training year. Accordingly, commanders, you are expected to use the ARTEP task lists as a menu and to select from them training tasks most critical to your unit. It is a chain-of-command function to determine the criticality of tasks and training priorities. If you have any question about which tasks are critical for your unit, see your boss.

We all know that most commands use the external evaluation feature of the ARTEP as a test of unit training readiness and sometimes this bothers unit commanders. It is true that the ARTEP itself was designed as a diagnostic tool, but commanders may want to use selected elements from it for tests. Hopefully, however, such use does not inhibit use of the ARTEP for its broader, designated purposes.

Soldier's Manuals

Documenting the tasks expected of each soldier and the conditions and standards by which they are to be performed is an extremely ambitious undertaking. I recognize that the size and number of these manuals are formidable obstacles to their intended use. We are looking for your ideas on how manuals can be streamlined and still fill their intended purposes. *The Common Task Soldier's Manual* was published in June 1981. Thereafter, new or revised soldier's manuals will not duplicate the tasks contained in the common task manual. This should reduce the size of our manuals considerably.

One of the frustrations frequently expressed by unit trainers is that the soldier coming out of the training base isn't "MOS qualified." At a minimum, unit trainers need to look in the *Trainer's Guide* to find out the tasks in which the soldier should have been trained at the training base and the training tasks for which the unit is responsible. We know that the

soldier coming out of the training base isn't "MOS qualified" because he has yet to be trained in all the tasks of his MOS. He, however, should be proficient in those tasks indicated as a training base responsibility in the *Trainer's Guide.* Resource constraints preclude training the new soldier to a higher level of proficiency at the training base. As a general rule, you can expect the new soldier arriving in your unit from the training base to be about 40–50 percent MOS qualified. The remaining 50–60 percent is the training job for unit commanders.

Another frustration of unit trainers is that there is no ready way to correlate the collective (unit) tasks in the unit's ARTEP with the individual tasks in the *Soldier's Manual.* If this could be done, it would make it simpler for units to concurrently train on specific individual and collective tasks, thereby making better use of precious training time. These needed "crosswalks" between collective and individual tasks are being developed, and we are furnishing them to the units concerned as they become available. Some of these crosswalks have been provided to us by field units, and we appreciate them sharing the fruits of their efforts. By the way, National Guard and Reserve units seem to be the leaders in this effort.

SQT

We, as a community, undoubtedly spend more time and effort developing and administering SQTs than on anything else in our training system. The SQT is one of the more controversial features of the system. Our common challenge, within the constraints of the SQT system, is to make the SQT supportive of the training needs of the unit as well as the individual. Ideally, I would like to see our soldiers—at all skill levels, and officers, too—demonstrate battlefield survivability skills, with each commander being able to select most of the tasks to be evaluated based on the situation in his or her particular unit.

Making Things Better

I'll be the first to admit that all of our training development products could be improved and that some of them, in fact, contain errors. We at the Engineer School don't want to be in the business of suggesting that you do something "dumb" in training your unit or your soldiers. If you find something in our products that doesn't make sense, then don't do it that way. (Unless, of course, your boss says otherwise. In that case, you have a problem with your boss, not with the product.) Please don't keep potential training improvements a secret. We're never going to get our training development products healthy if you don't let us know what is wrong with them and share your suggestions for improvements. We may not be able to make all the changes you suggest, but I guarantee that they will be given honest consideration. Address your comments to:

Commandant
U.S. Army Engineer School
ATTN: ATZA-TD
Fort Belvoir, VA 22060

or call us on the Engineer Hotline.

This is my final article as commandant. My year-and-a-half at the School has been much too short, but we have a number of new initiatives started in the combat engineering arena which you out there in the Army need to push. Doctrine and training is the business of all of us. Mobility and countermobility is our game. Topographic information is an important piece. And all this needs to be more up front where the shooting is. Fast, survivable, deployable—that's what we need. Your Army deserves no less. Let's "Clear the Way!"

Noah
Engineer

ENGINEER HOTLINE

Engineer related problems, questions and comments can be addressed telephonically to the U.S. Army Engineer School's "Engineer Hotline." The Hotline's auto-answer recorder operates 24 hours a day, seven days a week. Callers should state their name, address and telephone number, followed by a concise question or comment.

The School's Coordination and Review Branch, part of the Training Literature Division, Directorate of Training Developments, has experts analyze your problem and reply directly to you within three to 15 days. The Hotline is not intended as a receiving agency for formal requests.

Call commercial (703) 664–3646; WATS 800–336–3095, extension 3646; or AV 354–3646.

News & Notes

NEW BRIDGE REINFORCEMENT SYSTEM

The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) has awarded $370,050 to Fiber Materials, Inc., to develop a bridge reinforcement system using organic composite materials. The contractor will design a reinforcement system, test the system according to MERADCOM standards, develop a pilot production line and produce 20 composite tensile elements from the pilot production line.

The new reinforcement system is similar to the one currently developed as part of the Bridging For The 80s program. Use of graphite epoxy composites, however, will reduce the system's weight from 95 pounds for the developed steel version to 26 pounds for the new design. Delivery of the reinforcement sets is scheduled for September 1982.

MSgt. Boyd Crawford displays the inert training round he developed with the help of the Fort McCoy, Wis., Training Aids Services Office.

INERT ROUND DEVELOPED FOR CEV

MSgt. Boyd Crawford, U.S. Army Readiness Group, Fort McCoy, Wis., and the post's Training Aids Services Office (TASO), have developed an inert practice round for the combat engineer vehicle (CEV) main gun.

The dummy round, made of elastomer polyurethane plastic, costs about $70 and weighs 41 pounds. A live round weighs 65.5 pounds; the weight of the inert round can be increased if necessary.

The Wisconsin Army National Guard's 32d Engineer Company, 32d Infantry Brigade (Mech), Onalaska, Wis., reports the round shows almost no wear after more than two months testing.

Contact MSgt. Crawford at (608) 388-3991 for more information.

RDF TO RECEIVE WATER PURIFIERS

A $4.5 million contract for water purification units for the Rapid Deployment Joint Task Force has been awarded to Cosmodyne, Inc. by the U.S. Army Mobility Equipment Research and Development Command. Cosmodyne, a division of Avel Corp., is producing 14 reverse osmosis water purification units each capable of purifying 150,000 gallons of water per day. The commercial units will be used until larger militarized systems are developed.

The first finished units were expected to be delivered in February.

ENGINEER WET GAP TRAINING

Selecting a CONUS wet gap training site for engineer units is in its final stages. The leading contender seems to be the Arkansas River wet gap training site at Fort Chaffee, Ark. Although final selection and site development are several months away, the area is now available for use by active, Reserve, or National Guard units year round.

The area has one mile of frontage and 2,500 acres of maneuver area, with access routes to the river but no prepared launch sites yet. Water gap width ranges from 750 to 1,000 feet, with an average depth of 25 feet. The water runs three-to-eight feet per second; the near shore is sandy and the far shore is riprap.

Plans call for construction of three tactical crossing sites during summer 1982. Road net and bivouac areas can be improved/constructed as required by training units. Barracks are available year-round. Contact Lt. Col. Richard L. Brown, AV 962-2840, for further information.

ENGINEER DINNER DATE IS SET

Active and retired engineer officers worldwide are cordially invited to celebrate the Corps' 207th anniversary at the 115th Annual Engineer Dinner at Fort Belvoir, Va., May 14.

Highlight of the evening will be the annual presentation of the Itschner Awards to the year's most outstanding engineer company of the active Army, Reserve and National Guard, and the Sturgis Award to the Corps' preeminent enlisted soldier.

The dinner begins at 6:30 p.m. at Mackenzie Hall (post officers' club). Spouses of attending officers are invited to the 6th Annual Counterpart Dinner scheduled concurrently at the Fort Belvoir Main Club (NCO club).

Theme for the counterpart dinner is "Das Heidleberger Schloss" and attendees will be treated to a performance of "The Student Prince."

Following the dinners, at 10 p.m., is the Castle Ball at Mackenzie Hall.

Tickets for the engineer dinner are $14 each and available in advance by sending a check or money order, payable to the 115th Annual Engineer Dinner, to Post Office Box 552, U.S. Army Engineer Center, Fort Belvoir, Va., 22060.

Tickets for the counterpart dinner cost $10.50 each; $5 each for the Castle Ball. For tickets, send check or money order payable to Annual Counterpart Dinner and/or Castle Ball to Mrs. John T. Miller, 9813 Doulton Court, Fairfax, Va., 22030.

Reservations and ticket purchases for all events must be made by May 7.

CORPS TO CONSTRUCT SINAI INSTALLATIONS

The U.S. Army Corps of Engineers has been designated construction agent for the Multinational Force and Observers (MFO), an international peacekeeping force established as a result of the 1979 Camp David Accords between Israel and Egypt.

Construction for the MFO includes two base camps, one in northern Sinai at Eitam Air Base and one in the south near Sharm el Sheikh. The base camps will support a force of about 2,500.

Under the terms of the Camp David Accords, the Sinai is to be demilitarized by April 25, 1982; the peacekeeping force must be in place prior to that date.

Col. William E. Lee Jr., the contracting officer, has assumed command of the Sinai Construction Office in Tel Aviv, Israel, with a resident engineer office established at each of the two construction sites.

GEOTECHNICAL LAB DEDICATED TO CASAGRANDE BY CHIEF

The new $4.6 million geotechnical laboratory at the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., has been dedicated the Arthur Casagrande Building by Chief of Engineers Lt. Gen. Joseph K. Bratton.

The 82,000 sq. ft. building houses research facilities for soil mechanics, geology and rock mechanics, earthquake engineering, pavement systems, and both the soils testing facility and the soils research center. The laboratory also includes a center of mobility expertise.

Casagrande was recognized as the world's foremost specialist in soil mechanics and foundation engineering and their application to civil engineering works. He served as a teacher and consultant to the Corps of Engineers for 46 years and was a Gordon McKay Professor in soil mechanics and foundation engineering at Harvard University until his recent death.

News & Notes

AIRBORNE ENGINEERS WALK ON WATER

(photo by Richard E. Sharp)

With help from a "no visible means of support" bridge, soldiers of the 3rd platoon, Company B, 307th Engineer Battalion, 82d Airborne Division, walk on water.

Responding to a challenge from their battalion commander, the men rappelled into an area near Fort Bragg's McArthur Lake, conducted a mock river assault and, after securing both shores, began this unique bridge construction task.

Twelve-foot 'deadmen' on both shores served as anchors and three cables were stretched across a 150 foot wet gap. To them was attached a continuous ribbon of aluminum mats. The finished product provided an invisible bridge for ¼-ton trucks, and supported the weight of a Gamma Goat.

BERRY IS NAMED MISSOURI YOUNG ENGINEER

Reserve Capt. Robert T. Berry has been named 1981 Missouri Young Engineer of the Year by the Missouri Society of Professional Engineers.

Berry, a civil engineer on the Kansas City Survey Team, an element of the 416th Engineer Command (USAR), previously served with the 471st Engineer Company (USAR), Rolla, Mo. During four years of active duty, he served in Germany with the 317th Engineer Battalion (Combat) and with the 1st Engineer Battalion (Combat), Fort Riley, Kan.

He currently works for a Kansas City engineering company as project manager for wastewater facilities, design and construction and other public works.

Berry received a degree in civil engineering from the University of Missouri and a master's in engineering management from Boston University. Additionally, he has a M.S. in environmental health engineering and a doctorate of engineering degree from the University of Kansas.

NEW RIFLE RANGE FOR RAMSTEIN

A $400,000 rifle and pistol range was constructed by the 1st platoon, Company C, 79th Engineer Battalion (Combat) (Heavy), for the 86th Tactical Fighter Wing (USAF), at Ramstein, West Germany.

The facility includes a 25-meter pistol range, 50 and 100-meter rifle ranges and a 50-meter track mounted, moveable targets system range. The ranges will be used by the U.S. Air Force and Army, the German polizei special weapons teams and by enthusiastic sportsmen in the Kaiserslautern area.

CAPSTONE CONFERENCE

Key participants in a major CAPSTONE training conference sponsored recently by the 264th Engineer Group, Wisconsin Army National Guard, included, from left, in photo below, Col. Richard Polo, commander, 7th Engineer Brigade, USAREUR; Maj. Gen. Raymond Matera, Wisconsin Guard adjutant general; and Col. Jerome Berard, commander, 264th Engineers.

The two-day conference brought together in Eau Claire, Wis., representatives from 23 active and reserve component (RC) units.

Also present were syndics from FORSCOM, the Engineer School, two readiness and mobilization regions, two reserve maneuver training commands, and readiness group personnel from four states.

Unit commanders were briefed on relationships and training priorities while RC staff personnel were able to coordinate directly with their active Army counterparts.

The CAPSTONE program provides planning and training association between active and RC units to expedite wartime deployment.

TRAPPED!

An antitank ditch constructed by the 15th Engineers, 9th Infantry Division, snags a M-60 tank from the division's 2/72d Armor during a Fort Lewis, Wash., FTX.

USAR UNITS MAY WEAR ACTIVE PATCHES

Army Reserve units having training affiliations with an active Army unit are now authorized to wear the shoulder sleeve insignia of the active component unit.

DA Uniform Board officials have noted that local approval to wear the insignia is subject to mutual agreement between the reserve unit's Major U.S. Army Reserve Command and the active Army unit commander.

The new policy is included in an interim change to AR 670–1, which was published last fall.

Previously, only Army National Guard units were authorized to wear the patches of their affiliated units.

ENGINEERS CONSTRUCT AIR STRIP AT A.P. HILL

The 618th Engineer Company (LE)(ABN) recently parachuted into Fort A.P. Hill, Va., along with 29 pallet-loads of equipment to begin a 12-day, around-the-clock marathon to construct a 5,000-ft. assault air strip. Commanded by Capt. George D. Mitroka, the unit is attached to the 307th Engineer Battalion (CBT)(ABN), 82d Airborne Division.

Assisted by the 11th Engineer Battalion (CBT)(HVY), Fort Belvoir, Va., the strip was completed three days ahead of schedule. The strip allows units to be airlifted to Fort A.P. Hill, avoiding time consuming truck convoying.

Air Force pilots will use the strip to practice landings and takeoffs from unimproved facilities.

— FORUM —

"Pro-Pay" For Degrees?

by Capt. Robert L. McClure

With the Reagan administration's increase in defense spending, an interesting possibility for Engineer officers has appeared. It may now become feasible to pay Army engineers and scientists for their talents, much the same as is now done with military doctors. The reason cited for doing so is to combat the low retention rate for such officers in all services. While the Air Force and Navy may have problems unique to them that only money will solve, paying Army Engineers extra is a mistake.

To deny that the services don't need scientists and "hard core" engineers is foolish. The Air Force definitely needs aeronautical engineers and scientists for its highly technical equipment. With the civil works mission in the Army Corps of Engineers, those of us with castles on our collars also fully recognize the need for career officers with a formal engineer education. Even though it is possible to have a successful career in the Engineers without a PE or engineering degree, the perception still exists that to get a battalion command or choice district assignment one needs to be a certified engineer. The perception, especially from the company grade officer, is that only certified engineers (engineering or PE) make it to "the top" in the Corps. At the least, they believe certain assignments will forever elude those officers not "hard core" engineers.

But the Corps of Engineers isn't *all* technical and engineer intensive. Anyone who has

served in a combat engineer battalion knows that constructing a tank ditch does not require a civil engineering degree from Georgia Tech. This is one reason the Army accepts into the Corps so many officers without engineering degrees.

Recent Engineer Officer Basic Course classes have averaged from 40 to 60 percent "hard core" engineers in terms of education. The remainder have included officers with a variety of degrees ranging from music to biology to history.

While the need for an engineering degree at the junior officer level is not critical, its importance increases above the rank of major. This is when the percentage of assignments requiring an engineer background rises due to the district and research missions given the Corps. Today a rejuvenated civilian engineer job market hires away "hard core" Engineer officers at a high rate, while the need for such talent in the Army has not decreased. To cover the shortfall, some officers from other branches (Infantry, Armor, etc.) now have a Skill Code (SC) 21 additional specialty. Usually their educational background has earned them assignments to a variety of civil works districts. However, this practice of assigning SC 21 as an additional specialty still fails to address the *retention* problem for engineer skilled officers.

The foregoing begs the obvious question: Why not pay officers with engineering and science degrees a bonus to help stem the tide of resignations? Combat engineer purists abhor the idea. For the past several years, we Engineers have tried hard to be a combat arm and have done a fairly good job. In war, engineers will be critical on the battlefield; the infantry and armor will not be able to move and to survive without us, it's that simple. Army, not Engineer, doctrine has us a member of the combined arms team—where we belong. In war, we have a battlefield, not a technical mission. If for no other reason, the teamwork demanded of combined arms operations says no branch is more equal than the other. In such a situation, why should the engineer be paid more than the artilleryman?

Leaving that argument aside for a minute, let's examine this "pro-pay." Who should we pay? Obviously not all Engineers because not everyone has an engineering degree. Perhaps a performance standard is desired. To receive the bonus, an Engineer officer would need a technical degree (of a type to be specified) and a professional engineer license. This sounds logical, but what impact would it have on promotion/selection boards? It would probably exacerbate the already perceived split between those with and without engineer credentials.

How about creating a new specialty code? This would be an additional specialty meant primarily for those interested in district engineer assignments, facilities engineering, or specialized research connected with their degree. To get the bonus, an officer must have the required education/credentials *and* work in a specified job. A new specialty code would also address another problem vexing personnel managers. Currently with SC 21 used as both an initial *and* additional specialty, it is (theoretically) possible for an Infantry officer with an SC 21 additional specialty to command an engineer battalion. A new specialty code would solve this problem by reserving SC 21 for exclusive use as an initial entry specialty.

With the real problem being engineer retention, could we not make other incentives available rather than money? Instead of spending money buying "hard core" engineers, let's transfer that money into increased educational opportunities for the junior officer. More education earlier may increase the number of Engineer officers that stay beyond their initial term of service, thereby slowing the resignation rate. Let's face it, the Army needs "hard core" engineers but is not retaining them at an acceptable rate. Simply throwing money at the problem will not solve it. I contend that paying bonuses to Engineer officers is inappropriate and would be a mistake.

Capt. Robert L. McClure is a graduate of the U.S. Military Academy and the Engineer Officer Advanced Course. He completed airborne and ranger training and served in Germany with the 12th Engineer Battalion as a platoon leader and company commander. Capt. McClure is currently assigned to Headquarters, U.S. Army Engineer Center, Fort Belvoir, Va.

Nonjudicial punishment

Company Commander As Judge and Jury

by Maj. Raymond F. Powell

When it comes to handling minor military offenses and misconduct, one of the most valuable aids to the unit commander is nonjudicial punishment. The president of the United States grants commanders the authority to punish in accordance with Article 15 of the *Uniform Code of Military Justice* (as stated in the *Manual for Courts-Martial*), however, *proper use* of the Article 15 is the key to a successful command.

The Article 15 is not always the answer, and commanders must know when and whether to use it. The following discussion considers proper actions commanders should take, beginning with the discovery of an offense through the imposition of punishment, including the effects of punishment on the individual soldier and his unit.

"Why did this offense take place?" "What could have been done to prevent it?" These questions continually plague commanders. However, leadership and true concern for the individual soldier will normally reduce the number of offenses within a unit. Absent without leave (AWOL), for example, is a specific offense often preventable. Sincere, positive and concerned leadership is the most important element in the prevention of AWOL.[1] Good leadership in the military is important, especially at lower command echelons where it directly interacts with individual soldiers. A good leader, one who knows and cares for his subordinates and keeps them informed, can prevent many offenses frequently punished under Article 15. But when misconduct does occur, commanders must carefully consider the evidence before deciding what course of action to take. Evidence must be complete and valid.

Will the evidence stand up in a court of law? Inexperienced leaders often request punishment based on evidence that is biased, unfounded or where the rights of the individual were violated. The severity of the offense and the record of the individual must be judiciously considered.

Punishment must be understood by the commander. Punishment only maintains minimum standards by motivating behavior up to a minimally acceptable level. It should be used when an individual fails to respond to positive incentives or for a lack of motivation, not a lack of ability or training. Punishment is not always the solution. If an individual has failed, but tried hard, and was punished, he will not try again. Lack of ability should be corrected by means such as extra training, most probably on the individual's own time.[2]

Alternatives to punishment have a greater corrective impact than punishment. Extra training, reprimands, suspension of privileges and formal counseling all have their effect. The main point is that the individual is aware of his misconduct. He knows his superior is aware, and he knows that recurring actions will be dealt with more severely. A basic leadership point is that a minor offense does not have to go to the commander, but may be corrected with alternatives at the lowest level appropriate.

The commander should decide how to handle alleged misconduct after reviewing evidence and the recommendations of his subordinates. Throughout this detailed process, the individual still has the right to a speedy trial and delays cannot be tolerated. The commander should re-

view alternatives to punishment, and especially, learn what subordinate leaders have previously done to prevent the alleged misconduct.

The commander deciding to use nonjudicial punishment (Article 15), must do it properly, as in a court of law. Legal advice may be necessary. The charges must be prepared explicitly in accordance with the *Manual For Courts-Martial.* Charges must be able to stand in a court-martial; if they cannot, punishment under the provisions of Article 15 should not be imposed. There are specific rules and guidance to follow for the imposition of Article 15 punishment. Further guidance is to use common sense leadership and human relations.

At Article 15 proceedings, the commander is both judge and jury, and his office is the court room. Proceedings must be held in a professional manner with military bearing and dignity. Distractions such as telephone calls and clutter on a desk should be eliminated. The individual's chain-of-command should be present not only to tell their side but to hear exactly what the commander tells the individual. Every proceeding should be considered a counseling session, not just as a time set aside for the imposition of punishment. If witnesses or other evidence are required, the proceedings should be recessed and properly completed later to ensure the full rights of the individual are respected.

The judge/commander must communicate in a fair and equitable manner without playing favorites. He must listen to the facts and to the individual and must remove any prejudices or preconceived notions he may have. He must *prove* the soldier guilty (if, in fact, he is guilty), not just try to see if he is innocent. The most important part of the proceeding is that the commander must communicate with the individual. Barriers to communication will definitely hinder any results. As with any good form of leadership activity, there is no room for profanity, which is only an excuse for poor language and communication abilities. The entire process is centered around communication and respect.

"Fourteen days extra duty, reduction to grade E–3..." The actual imposition of punishment, no matter to what degree, should be completely thought out. The purpose of punishment under Article 15 should be corrective in nature.[3] The goals of punishment should be to protect society against a repetition of the offense, to reform the individual so he will be less likely to repeat the offense, and to deter others from considering and undertaking such an offense.[4] The commander must make the punishment fit the crime and the individual, plus set the example for others. He must also evaluate the probable effects of the punishment upon the individual and the unit. Care should be taken not to compound existing problems. Properly used, suspension of punishment provides a behavioral incentive to the offender and an excellent opportunity to evaluate the individual during the period of suspension.[5] With well considered and explained punishment, the individual knows why he is being punished. He also perceives that the punishment and his hearing were fair and will think twice about committing the offense again.

There are many benefits of properly conducted proceedings, including that the individual gains respect for the commander and supervisors despite punishment. This infectious respect along with the group's knowledge of the commander's standard will result in a unit with fewer problems. Individual soldiers should be allowed to progress upon completion of punishment, the purpose being to help them improve as soldiers and to motivate them to do their jobs without carrying the burden of a previous punishment. Many times a good soldier is left improperly punished, without a chance to improve and a potential is therefore lost by the military.

The commander's job is vast with administering nonjudicial punishment under Article 15 only one of his responsibilities. However, the number of offenses he must review will be reduced when they are properly and expeditiously handled. With fewer offenses, all leaders within the chain-of-command will have more positive time for the individual soldier, creating a more harmonious and stronger Army.

Maj. Raymond F. Powell is a graduate of the Engineer Officer Advanced Course and Command and General Staff College. He graduated from Rutgers University with a B.S. in engineering and the University of Missouri at Rolla with an M.S. in engineering management. He served two tours in Vietnam, including duty as an aviation platoon leader and as the S–3 of Engineer Region III. Other duty includes company commands with the 75th and 5th Engineer Battalions, assistant PMS at Princeton University and XO of the 43rd Engineer Battalion. He is currently on the staff of the Command and General Staff College.

FOOTNOTES:

1. U.S. Army FM 22–100, *Military Leadership*, page 16–3.
2. U.S. Army FM 22–100, *Military Leadership*, page 8–5.
3. *Manual for Courts-Martial*, 1969, U.S. Government Printing Office, page 26–3.
4. U.S. Army FM 27–1, *Legal Guide for the Commander*, page 8–1.
5. *Manual for Courts-Martial*, 1969, U.S. Government Printing Office, page 26–3.

Your Unparalleled Heritage

Secretary of the Army John O. Marsh Jr. speaks to Engineer Officer Basic Course 7-81.

Last month, the nation marked the 200th anniversary of the battle where our independence was won—Yorktown. The freedom and independence declared in Philadelphia was won after six and one-half years of war on a peninsula in Virginia. Those great words—life, liberty and the pursuit of happiness—were given real meaning.

The last line of that declaration pledged the lives, fortunes and sacred honor of the signers. Washington, our first commander-in-chief, did not sign the Declaration of Independence because he had resigned from the Continental Congress to take command of the Army. If that document could have been submitted to him, along with the surrender agreement, the same comment he placed on the surrender agreement with his signature he might have penned on the bottom of the declaration: "Done in the trenches before Yorktown, October 19, 1781".

Many times the Army has gone into the trenches to achieve or preserve freedom. The final victory in the Revolution was the result of a great operation by the engineers of Washington and Rochambeau, who employed in a classic way the techniques of siege engineering.

The engineers are a key part of our Revolutionary history and go back to the founding of the Army. This Revolution led to the establishment of a school of engineering which in 1802 became the United States Military Academy. The rationale for educating officers focused on training engineers. The need to train engineers led to the establishment of the Virginia Military Institute and Norwich University.

After the Revolution, two great events further emphasized the importance of Army engineers; the Louisiana Purchase in 1803 and the Mexican War. With them came vast land areas to be explored and surveyed, roads to be opened and canals to be built.

The War Between the States, or the Civil War, has been called the first of the modern wars. Also, it was a war of firsts:

- The first to use the railroads. This impacted on logistics and troop movements;
- The first to employ the telegraph which collapsed time and distance in communications;
- The first to employ ironclads;
- The first to use aerial reconnaissance: and,
- The first to be recorded photographically thanks to Mathew Brady.

It was the first war of modern engineering. Legendary feats were undertaken by the engineers in both armies. The war saw constructed one of the first, and also the longest, pontoon bridges ever built. It crossed the James River and its span was 2,200 feet. History records that on one occasion Union engineers built a 2,000 foot pontoon bridge in seven hours. This type of bridging over major rivers was commonplace by both armies during that struggle.

Today, the role of the Corps of Engineers continues to be unique. It has a dual mission—one military and one civil. The civil mission goes back to the earliest days of the republic when the country looked to the Corps for engineering experience as America moved west. This took the Corps into rivers and harbors, flood control, dredging, dams, canals and other significant construction projects. You have a great heritage of building America, and your monuments are to be found in every state. This experience in the civilian sector makes available a trained force, constantly ready to meet mission requirements of a wartime environment.

We live in a critical time where readiness not only of the Corps but the Army and of our sister services is essential. I will not cite the many problem areas that are so prevalent around the globe, but let me say there are seven major geographical areas of concern. These areas are:

Europe. Where NATO forces are counter-poised to prevent aggression by the Warsaw Pact;
Africa. That continent that is the scene of great instability and political crosscurrents, but is so vital to the West because of its resources;
The Middle East. What at times appears to be a tinderbox of conflict;
Southwest Asia. Where we find Soviet combat forces in Afganistan;
Northeast Asia. Where U.S. forces, along with our Korean allies, safeguard the Korean peninsula;
Southeast Asia. Which is still gripped by oppression; and,
Latin America. Where we see instability in parts of our own hemisphere.

To an audience such as this, it is not necessary for me to dwell on the challenges we face, or the need for a strong defense. You are aware of this. Wherever U.S. forces may be deployed—as the president has noted—it is our purpose to prevent conflict and deter war through a strong strategic and conventional capability. Fundamental to this strength is the Corps of Engineers. That strength is directly related to you and the kind of person you are and the officer you become.

As you pursue your career, let me make several suggestions which I hope will stand you in good stead. Some of these are drawn from an examination of the life of George Marshall—chief of staff of the Army, secretary of defense, secretary of state and Nobel Prize winner.

Throughout his military career, from the time he entered the Virginia Military Institute as a cadet, until his retirement from active service in 1945, his life was one of training, self-learning and self-discipline.

The American poet, Longfellow, wrote:

"Lives of great men all re-

mind us
We can make our lives sublime,
And departing, leave behind us
Footprints on the sands of time."

Marshall had the ability to select priorities and pursue them with perseverence. Early in his career he developed a sense of cost discipline and the careful management of resources. He developed the ability to take a complex matter and reduce it to a simple, understandable, workable plan. The secret to this is thoroughness which produced understanding and mastery of a subject.

Marshall was also receptive to new ideas. He was innovative and creative and was willing to take risks with new ideas. Time for Marshall was a resource. Because you are young, you may not realize that time is a resource. Longfellow, wrote:

"The heights by great men reached and kept,
Were not attained by sudden flight,
But they while their companions slept,
Were toiling upward in the night."

Because time is a resource, there are four areas in which I would like to see you devote more of your time. They are in the nature of self-improvement and study.

First, I urge you to acquire a greater knowledge of geography so that you have a better understanding of place and people, terrain and resources. This takes you into demographics and economic geography. A greater understanding by Americans of the world's people and where resources are located is important.

A second area in which I would like for you to invest time is developing a language capability. In a world that is not only competitive, but also one in which there is a great need for cooperation, Americans and American interests are handicapped by the lack of this ability.

I would like for you to place greater emphasis on writing and the ability to present your thoughts cogently, with clarity and understanding in written form. This is a difficult task. However I was once told that hard writing makes easy reading.

Lastly, you should develop a program for maintaining physical fitness. It will require self-discipline.

Essential to the Corps are the young officers who provide leadership. In your ranks have marched such American military leaders as Robert E. Lee and George Meade, who commanded opposing armies at Gettysburg.

You have an unparalleled heritage. It was an Army engineer who, at the request of the Russian czar in 1842, built the first railroad in Russia from Saint Petersburg to Moscow.

It was men in the 11th Engineer Regiment—today the 11th Engineer Battalion stationed at Fort Belvoir—that took the first casualties in World War I as they sought to make a passageway across no-man's land for an Allied assault.

It was U.S. combat engineers that landed at Normandy and Utah Beach on D-Day an hour before the first wave of American infantry.

In World War II, the Corps of Engineers, under the most adverse terrain and climate conditions, built the Alcan Highway which was 1,500 miles in length. It took only eight months to complete.

Army engineers, under Col. George Goethals, constructed one of the great engineering marvels of the world when they built the Panama Canal—a task which the builders of the Suez Canal failed to achieve in seven years time, and cost the lives of 22,000 workers.

It might surprise you to know after the War Between the States, it was Army engineers who redesigned and completed the construction of the Washington Monument.

If you were to ascend the steps of the Washington Monument, you would find placed in the sides of the monument, stones taken from various states, reminders that ours is a union of many. At about the 500 foot level, you can see a white, polished stone taken from the ruins of ancient Carthage.

Other than an identification of the donor who gave the stone during the last century, there is nothing to indicate why, in a monument that is uniquely American, there is displayed a stone taken from a city the 20th century does not know. Carthage once flourished on the southern shores of the Mediterranean Sea; prosperous in trade and in commerce, and material wealth, it was the pride and envy of the ancient world. But, Carthage was destroyed by Rome.

Could it be this stone from that great but forgotten city was placed there to remind us that material wealth and progress are never substitutions for national will?

However, this is not the end of the story. Remember something else when you see that monument. I mentioned to you earlier that the Army engineers redesigned and finished the construction of the Washington Monument. At the peak of the monument, the capstone, is a small pyramid made of 100 ounces of aluminum—the largest piece of aluminum that had been cast up to that time. It was placed there on the 6th day of December 1884. Inscribed on its base are these words:

"Chief Engineer and
Architect,
Colonel Thomas Lincoln
Casey,
Corps of Engineers."

Today is a time of farewells. Shortly, you will go your separate ways. Some to the Regulars, some to the Reserves, some to the Guard. Wherever duty takes you, I am proud you are officers in the Army. I thank you for your service to our country.

Emerson wrote:

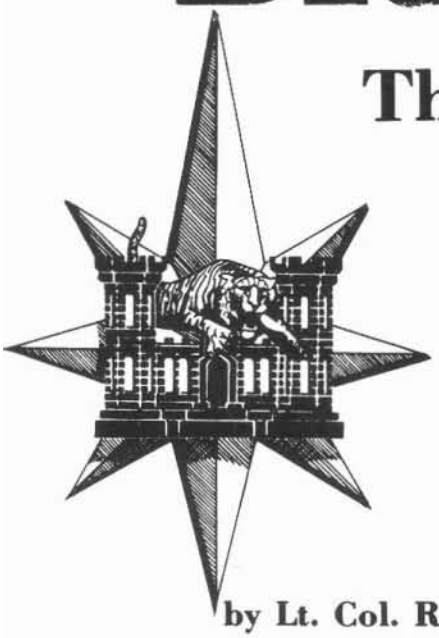
"So nigh is granduer to our dust,
So close is God to man:
When duty whispers low thou must,
The youth replies, I can."

And, I know that is the reply of this graduating class today.

Secretary of the Army John O. Marsh Jr., an infantry officer with U.S. occupation forces in Germany following World War II, is a law school graduate of Washington and Lee University. He served in the U.S. House of Representatives from 1963–71 and was Vice President Ford's assistant for national security in 1974. As a Virginia Army National Guardsman, he completed airborne and jumpmaster schools, and retired from the Guard as a Lt. Col. in 1976. His son, Scot, was a graduate of EOBC 7–81.

BRIGHT STAR

The Engineer Perspective.



by Lt. Col. Raymond E. Knell

Remember those recruiting posters that promised to show you the world? Remember hoping that your unit would be selected for a special off-post exercise? For the members of Task Force Tiger, those dreams came true during Joint Training Exercise (JTX) Bright Star 82, the second in a series of deployment and training exercises in Southwest Asia sponsored by the Rapid Deployment Joint Task Force (RDJTF).

JTX Bright Star 82 was conducted in November-December, 1981, in Egypt, Sudan, Oman and Somalia. While the operations in Egypt were widely publicized, the exercise in Somalia was particularly important to engineers. The RDJTF mission to the 20th Engineer Brigade (Combat) (Airborne) of XVIII Airborne Corps at Fort Bragg, N.C., was to form a task force of engineers, accompanied by medical teams, military police and terminal port personnel, to deploy by air and sea to Berbera, a small village on the north coast of Somalia. Once deployed, the unit would conduct a logistical assessment of the area.

The 20th Engineer Brigade, in turn, tasked its 27th Engineer Battalion (Combat) (Airborne) to organize, train, equip and to deploy a self-contained joint task force (JTF) by air and sea to the vicinity of Berbera; to exist in an unknown, harsh desert environment; to be good guests in a foreign land; to gather medical and terrain information; to train in a realistic mission environment; to complete quick, visible, high-impact action projects as a token and remembrance of our presence; to redeploy, debrief, and disband; and to capture and disseminate terrain information and lessons learned.

The mission was historic. This would be the first significant U.S. military presence in Somalia since the Russians were expelled in 1977. Somalia is the horn of Africa; to the north lies the Gulf of Aden and the narrow straits to the Red Sea, to the east the Indian Ocean. Berbera is a small village with a deepwater port. In the mid-1970's the Soviet Union initiated a massive construction program near Berbera building a 400 bed hospital, a water distribution system, a desalination plant, a causeway and pier, a POL tank farm and jetty, a missile support and maintenance area and an airfield capable of handling any aircraft in the world.

When the Somalis demanded that the Russians leave the country, the Soviets left in extreme haste, leaving most of the construction program unfinished.

The JTF, dubbed Task Force Tiger for the 27th's nickname, the Tiger Battalion, was a composite, short-term, self-sustaining organization. Some 35 different company-sized units were represented. Elements of the 20th Engineer Brigade's 27th and 548th Engineer Battalions provided the general engineer capability of the force. Cartographers, terrain analysts, bridge specialists and surveyors represented the remaining units of the brigade. The Air Force's Air-Land Control Element, Red Horse and Prime Beef teams as well as elements of the Army's 7th Transportation Group, 16th Military Police Brigade and Fort Bragg medical teams provided airhead, port, security and field hospital capability. A Joint Services Communication Element (JSCE) satellite communications terminal pro-

vided Task Force Tiger access to reliable communications by teletype and voice with the RDJTF exercise headquarters near Cairo, Egypt. Task Force Tiger was capable of sustained independent operation, requiring only air resupply of rations and local procurement of raw water and fuel.

JTX Bright Star units in Egypt experienced many of the problems of desert warfare, including severe sandstorms. This was not the case for Task Force Tiger. Although there was heat and sand, the climate was not severe. The terrain near Berbera is a desert coastal plain; the soil is sandy silt with angular rock fragments up to the size of a fist. The top 4 to 6 inches of soil is extremely dry and appears to be porous, but is not. Below the dry surface, the soil is the same composition but very densely packed. Significant time and effort are required to dig sumps, latrines, or fighting positions with hand tools; entrenching tools are almost useless. Scrub trees up to 20 feet tall dot the plain, providing concealment from ground-level observation for up to 2½-ton trucks. The trees provide no concealment for vehicles from aerial observation. The coastal plain ends 10 to 20 miles inland, becoming a highland plateau. Weather and terrain data vary drastically between the coastal plain and the highlands; data from one area cannot be used for the other area.

In the June-August hot season, the temperature in Berbera reaches 115 F in the shade, and a stiff wind is routine. The coastal weather during the exercise, however, was sunny, with highs in the upper 80s, lows in the upper 60s and a light 5 to 8 knot breeze.

The exercise provided the engineers unique challenges in planning the deployment, coordinating among task force members and with other agencies, deploying to a strange area and conducting training and operations with their Somali hosts.

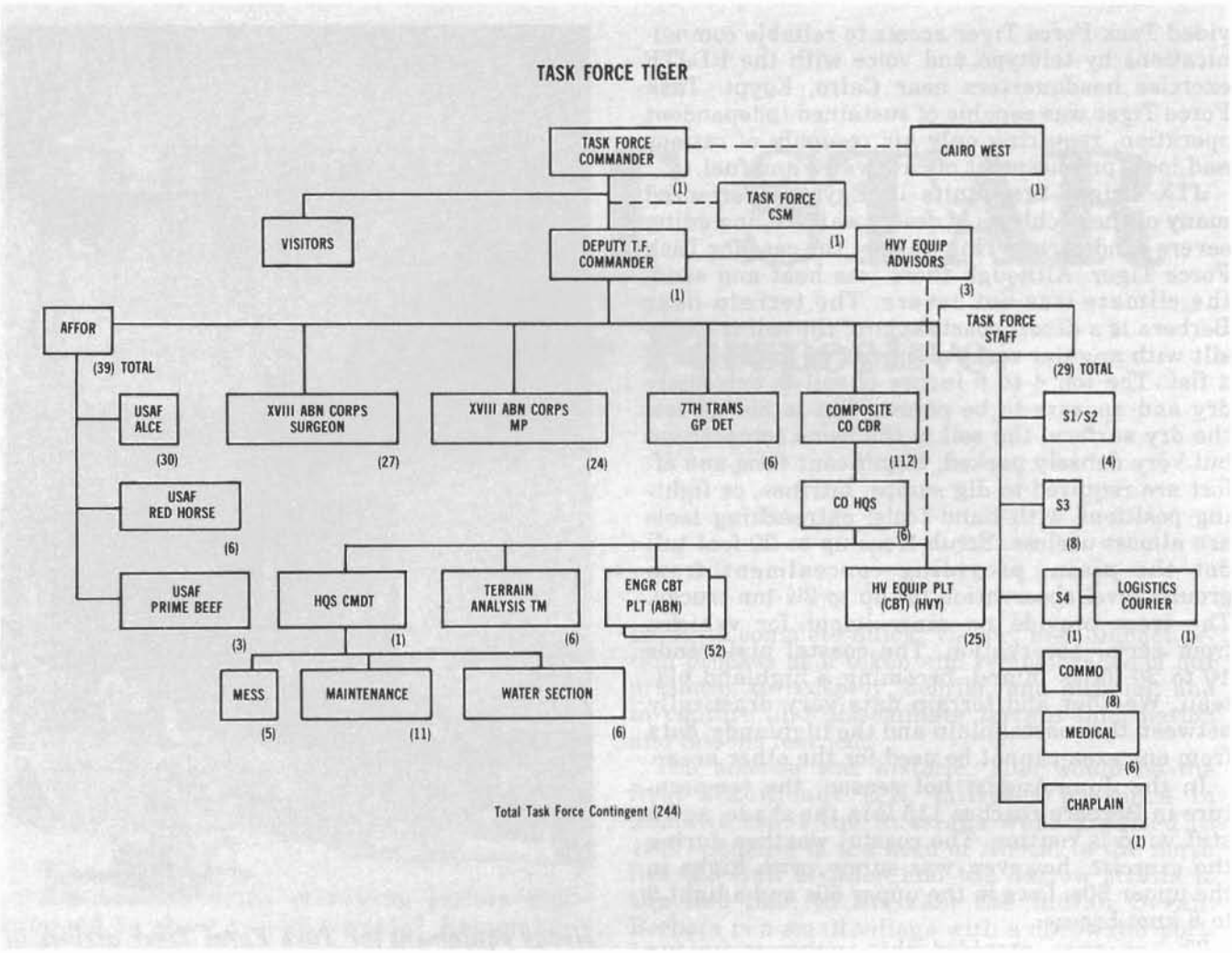
Planning for the exercise was based on only limited knowledge of the exercise area. Although a RDJTF and 20th Engineer Brigade survey team visited Berbera for a few hours in September, detailed information about the area was scarce. The most critical planning task was defining the task force organization and mission. Simultaneous planning for the Somali portion of JTX Bright Star occurred at RDJTF headquarters, at XVIII Airborne Corps and at the multiple units represented in Task Force Tiger. Daily, vigorous coordination was necessary to keep abreast of new initiatives.

Operational security also influenced planning and coordination. The location and dates of the exercise were classified until immediately prior to deployment. Initially, soldiers knew that they were deploying to Southwest Asia. Only key leaders, however, knew the country and deployment schedule. Most of the soldiers believed that they were going to Egypt. Immediately prior to deployment, the task force was assembled and isolated in a secure "lock-in" area, and operational briefings revealed the destination and schedule.

Heavy equipment for Task Force Tiger arrives in Berbera by sea from Savannah, Ga.

Many of the preparations for the deployment were normal procedures for members of the Rapid Deployment Force or for other units whose contingencies call for overseas deployment. Medical and personnel records review, immunization update, equipment preparation and personnel roster reconciliation were all normal preparations for overseas exercises. The only special training required was for operation of the new 600-gallon-per-hour reverse osmosis water purification unit (ROWPU) and the water chiller attachment for the 400-gallon water trailer.

The development of deployment load plans on the other hand, posed unique challenges. Limited information was available about the area, and the absence of previous exercises in Somalia meant that no after-action reports were available to help determine what to take and how to move it. The task force was allocated one C5A and a fixed amount of deck space on the roll-on/roll-off ship *Cygnus* for oversized equipment, and nine C141 aircraft for troops and the remaining equip-



ment. What should go by ship? How should the remainder be distributed among the aircraft? Would the first plane to take off be the first to land? What prime movers had to be available at Berbera to unload non-motorized equipment? Deployment load plans were the greatest challenge of the exercise. Four constraints were adopted for all load plans.

(1) Only bulk amounts of petroleum, oils and lubricants (POL) and raw water would be available from the Somalis. Everything else had to fit on available transportation.

(2) Food and drinkable water would accompany the soldiers on each aircraft to sustain them until the ROWPU and the food resupply cycle from Egypt were operational.

(3) The troop and equipment list would be general enough to provide for reasonable changes in the mission after arrival in Somalia.

(4) The loss or delayed arrival of any one piece of equipment would not endanger mission accomplishment.

Equipment for the sea shipment left Fort Bragg on October 16 and the *Cygnus* sailed from Savannah, Ga., on October 19. With one intermediate stop at Alexandria, Egypt, and a day-long delay through the Suez Canal, the *Cygnus* arrived at Berbera on November 17. The air deployment left Pope Air Force Base (adjacent to Fort Bragg) on November 14 and 15 and arrived on the 15th and 16th. Although some aircraft took longer to arrive than the planned 18 hours and the sequence of arrival differed from that of departure, all sorties arrived at Berbera by the scheduled end of the airflow. The planning for out-of-sequence arrival paid off; there was temporary inconvenience but no mission or safety reduction.

Once in country, all elements of Task Force Tiger moved quickly to accomplish their mission. Teams designed to gather medical and terrain information found many opportunities to improve U.S. knowledge of the local facilities and terrain. A terrain analysis team from the 283d Engineer Detachment at Fort Bragg spent most of its time on the road, gathering data for map revisions and verifications, such as the new major highway linking Berbera and Mogadishu which replaces significant portions of the route currently shown on 1:250,000 scale maps. Preventive medicine teams gathered water samples from each of the fresh water sources for Berbera. No harmful bacteria or virus was found in any sample.

Specific Projects

Engineer projects were designed to leave behind a lasting reminder of United States assistance. At the water stand for all nearby military garrisons, water tankers had made a mudhole of the area. Combat engineers placed a concrete pad under the spout and ditched a runoff channel. Combat heavy engineers repaired water erosion on an older portion of the road linking Berbera and Mogadishu where over half of the road surface had been eaten away. Engineers replaced and recompacted the soil, added a six-inch layer of rock from local quarries, and applied an asphalt and rock-chip surface treatment to extend the life of the road.

The Air Force Prime Beef team from Wright-Patterson AFB painted the unmarked runway to international standards using hundreds of gallons of special paint mixed with over 13,000 pounds of reflective glass beads.

All elements of Task Force Tiger participated in desert training and in joint training with Somali military forces stationed at Berbera. Somali soldiers rigged and detonated American 40-pound

American Sappers in Somalia

by Capt. Kerry K. Pierce

Objectives for Task Force Tiger in Bright Star 82 placed heavy emphasis upon survival and security, a mission requiring excellent training in tactical wire and bunker construction. Soldiers from Charlie Company, 27th Engineer Battalion (Combat) (Airborne) erected over 900 meters of half-apron and cattle fencing to provide a minimum security boundary for the bivouac. Two reinforced bunkers for machine guns were also constructed at critical points on the perimeter. During the excavation of the bunkers, the engineers received their first experiences with the "desert sand" of Somalia. Along the coastal plain, the soil appeared loose and fine; however, it proved to be mostly silt which was compacted to the consistency of concrete just a few inches below the surface. All digging was an extreme challenge for both hand tools and the light, airborne engineer equipment. Addition of water only made the soil harder.

With the establishment of the base camp, the Composite Engineer Company focused upon construction and training opportunities. Somali units around Berbera were eager to interact with their American guests. During the first week, for example, a joint inspection of host-nation Soviet-built vehicles, air defense weapons and communications equipment was arranged. The engineers were able to examine the equipment, to send messages over the wireless and to perform actual crew drill on antiaircraft guns.

Much of the subsequent training involved teaching Somali soldiers American techniques and doctrine. A good example was the joint demolitions training which began with demonstrations of standard explosives and expedient charges. The U.S. engineers went on to conduct hands-on training in the use of det cord, electric and nonelectric priming and the use of expedient cratering charges (ammonium nitrate). This was the Somali soldiers first experience with demolitions. The Americans learned valuable lessons on the effectiveness of cratering techniques in the desert—subsoil hardness resulted in more favorable blast results than expected.

Maintaining physical conditioning was also a key part of the training in Somalia. Twice Charlie Company conducted rucksack marches and on their second march, were accompanied by a platoon of Somali marines.

Just prior to redeployment, a joint weapons exercise was organized. The combat engineers first demonstrated basic marksmanship with the .45 caliber pistol, M-16, M-203, and M-60 to Somali marines, then coached them in actual firing. The Americans then got the rare opportunity to engage targets with the AK-47 assault rifle, which was impressive in its semiautomatic accuracy but proved inferior to the M-16 when fired on automatic.

As part of their physical training regimen, task force personnel participated in rucksack marches.

The training experiences in Somalia left the engineers confident in their basic skills. JTX Bright Star 82 validated numerous techniques and procedures in the different environment of Southwest Asia and revealed other combat engineer training needs to support the RDF mission.

Capt. Kerry K. Pierce is commander of Co. C, 27th Engineer Battalion (CBT) (ABN). During Bright Star 82 he was Composite Company commander. A 1974 U.S. Military Academy graduate, he is a registered professional engineer in Virginia.

shaped charges, and Somali marines learned new skills as medical aidmen. Other joint training included firing U.S. and Soviet weapons and operation of other Soviet equipment. The Air Force fire truck team from Ramstein AFB, Germany, taught the Somalis to fill and to operate two local

The 244 task force troops were issued desert camouflaged fatigues and Vietnam style bush hats.

Fiat fire trucks. The proof of their learning came before the task force departure when, according to the Somali commander, both trucks were used to assist the town of Berbera in extinguishing a warehouse fire.

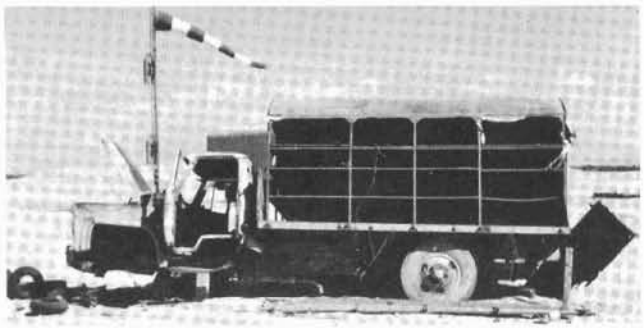
ROWPU Success

The two new items of water treatment equipment performed well in Somalia. The ROWPU made excellent potable water from both fresh and salt water. At the Berbera port, the ROWPU processed salt water which was twice as salty as the maximum for which the ROWPU was designed to process, yet easily met both water quality and quantity standards. The five-day shakedown and training period at Fort Bragg prior to deployment was a key factor in the performance of the ROWPU. Although the maximum air temperature of 91 to 93 F did not tax the capability of the water chiller to reduce water temperature from 120 to 60 F, the unit reliably produced pleasantly cool water, even without the special water-tank cover.

Redeployment from Berbera to Fort Bragg was far easier than the deployment. Everything had already fit together on the way over and it was obvious what had to be returned. The *Cygnus* was reloaded on November 24 and airflow commenced from Berbera the same day. All aircraft arrived at Pope AFB by November 27, the *Cygnus* off-loaded at Savannah on December 13 and the task force was completely closed at home stations on December 16.

In assessing lessons from JTX Bright Star 82, some caution must be used in extrapolating the accomplishments of Task Force Tiger for future exercises. The exercise in Somalia was a logistical exercise in the coolest period of the year and there was no significant off-road movement. Temperatures were similar to those the units experienced at Fort Bragg. The force remained within a 25-mile radius of base camp and on level terrain. No rain fell; no flash flooding was experienced.

On the other hand, some of the lessons of the exercise in Somalia are applicable to future deployments of composite units to an unfamiliar overseas area. The task force demonstrated that a small force can enter by air an area where no prior basing exists and establish a support base. The organization and staffing levels of the task force proved to be well founded. Good people from many units took less than two days to develop



Canabalized remnants of a Soviet truck serve as a reminder of an earlier Russian presence.

SOPs and cohesion. Equipment proved reliable as well—the ROWPU and chiller worked extremely well. Units encountered no trafficability problems in the area with current equipment. FM radios transmitted clearly at normal operating ranges. The 250 cfm air compressor was very valuable in preparing for redeployment: it blew off dust, leaving little required washing. One important note for anyone planning a future exercise—B-rations take more cooks and KPs than A-rations; more preparation is also required.

The accomplishments of Task Force Tiger were significant and every member of the force has great pride in those successes. The task force organized, deployed, lived, learned, trained and redeployed without accident, incident, lost time or heat injury.

Lt. Col. Raymond E. Knell commands the 27th Engineer Battalion (CBT) (ABN). A 1964 U.S. Military Academy graduate, he has completed airborne and ranger training, Command and General Staff College, and has a master's degree in civil engineering from the University of Illinois. He is a registered professional engineer in Illinois and has served on the engineering department faculty, U.S. Military Academy. Other assignments include the 168th and 23d Engineer Battalions; 159th Engineer Group; Seattle Engineer District and the Office of the Secretary of the Air Force.

The Critical Path Method

Is It Time To Change?

By Capt. Andrew Hamlin, Capt. Robert J. Huff and 1st Lt. Michael J. Harris

The "critical path method" (CPM) is widely recognized as a powerful management tool. The CPM allows supervisors to effectively allocate their available resources throughout the planning, scheduling and controlling phases of a construction project. The Engineer School has taught a traditional version of CPM called "activity-on-the-arrow (AOA)," for over fifteen years. This form of CPM has been a reliable workhorse for shaping the thought process of young engineer officers and it has helped speed countless construction projects through to timely completion.

However, the School is considering a less traditional version of CPM called "precedence diagraming (PD)" or "activity-on-the-node." This article will discuss concepts of network analysis systems in general, then address specific advantages and disadvantages of CPM (activity-on-the-arrow) versus PD (activity-on-the-node). Reader comments or suggestions are welcome and can be directed to the address or telephone number at the end of this article.

Although network analysis systems vary in format and usefulness, the general approach to solving management problems is the same. The initial step involves breaking the project into component parts (activities) and developing a network model. This network graphically depicts the logical interrelationships of activities which make up an entire project. In this initial step, the manager constructs the network as if he has unlimited resources, and therefore no consideration is given to constraining factors such as men and equipment. Manpower or equipment conflicts are eventually resolved as the construction schedule is developed, and this is the real strength of a network analysis system. The manager is able to proceed in a systematic fashion, developing a feasible construction schedule without becoming overwhelmed by a complicated project in the early stages of planning.

The key to a successful construction schedule is the manager's ability to obtain reasonably accurate estimates of material, manpower and equipment requirements for each activity in the network. This analysis will lead to an estimate of how long each activity will take to accomplish (activity duration).

At this point the manager begins a time analysis of the network. By knowing the logic relationships and activity durations, the following time data can be calculated for each activity:

Early start and early finish times,
late start and late finish times
and total float.

Critical activities and activities which cannot be delayed without extending the overall project duration can now be identified. These critical activities form one or more continuous paths through the network and dictate the minimum project duration. The information acquired up to this point is then placed on an early start schedule, so-called because the constraining factors of men and equipment have not yet been considered. This final, most difficult step to master, is to "resource constrain" the early start schedule and original logic diagram. If the resources demanded by the early start schedule exceed the resources available to the manager, a modification to the schedule and network results. The resequencing of activities on the schedule and network is accomplished by establishing resource relationships between activities. On the network, these new relationships appear as resource arrows. Resource arrows can have a profound impact on the time analysis and therefore alter the critical path(s).

When the final construction schedule is developed, it should be used throughout the remainder of the construction project. The manager is constantly required to provide data on the current project status and often must make decisions on how better to employ his resources. If the network analysis system is properly updated and the data provided is understood, the manager has an invaluable tool to assist him in accomplishing his mission.

The use of a network analysis system should be considered for complicated projects which can be broken into well defined activities. It should be used when resource constraints are expected and when the manager is prepared to keep his construction schedule updated and accurate.

A network analysis system is not a panacea to be used in all situations. For example, a network should not be used for simple projects of short duration. For these projects, some other management technique, such as a bar chart, would be just as effective and less time-consuming. A network analysis system may be inappropriate when activities cannot be easily defined or are difficult to estimate accurately, or in projects where the same cycle of activities is performed daily or periodically. Here, a representative flow diagram may be a better management tool. Most importantly, a network analysis system is not useful to a manager who does not understand the system in sufficient detail or to one who is unwilling/unable to properly update the schedule throughout the course of the construction.

When the manager decides a network analysis system is appropriate he must choose which technique to use. Two popular systems of CPM are activity-on-the-arrow and activity-on-the-node. To explain the differences, a sample project is visualized and plotted using both techniques.

The Critical Path Method, AOA, was developed by the DuPont Corp. in the late 1950s. The network diagram is produced using three graphic symbols: "solid" activity narrows, "broken" dummy arrows, and circular event nodes. The familiar representations are shown in Figure 1. Note the effect added resource relationships have on the critical path.

The Critical Path Method, activity-on-the-node, which will be referred to for the remainder of this article as PD (precedence diagraming), was developed by J.W. Fondahl of Stanford University. This modification of the original CPM is not a recent development. It is widely used and often brought up when the subject of future trends in construction management is discussed. The precedence diagram is produced using, primarily, two graphic symbols, activity nodes and

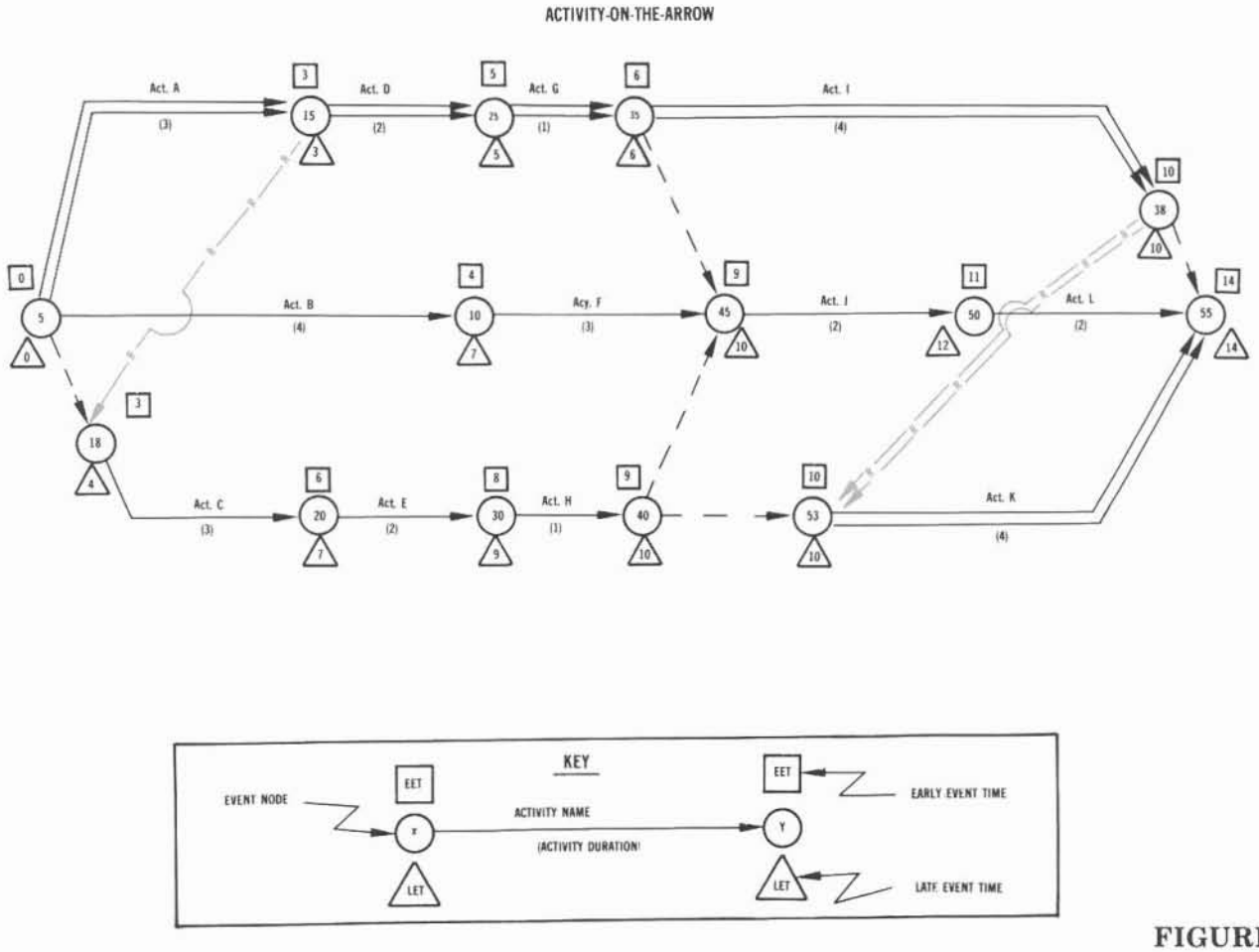


FIGURE 1.

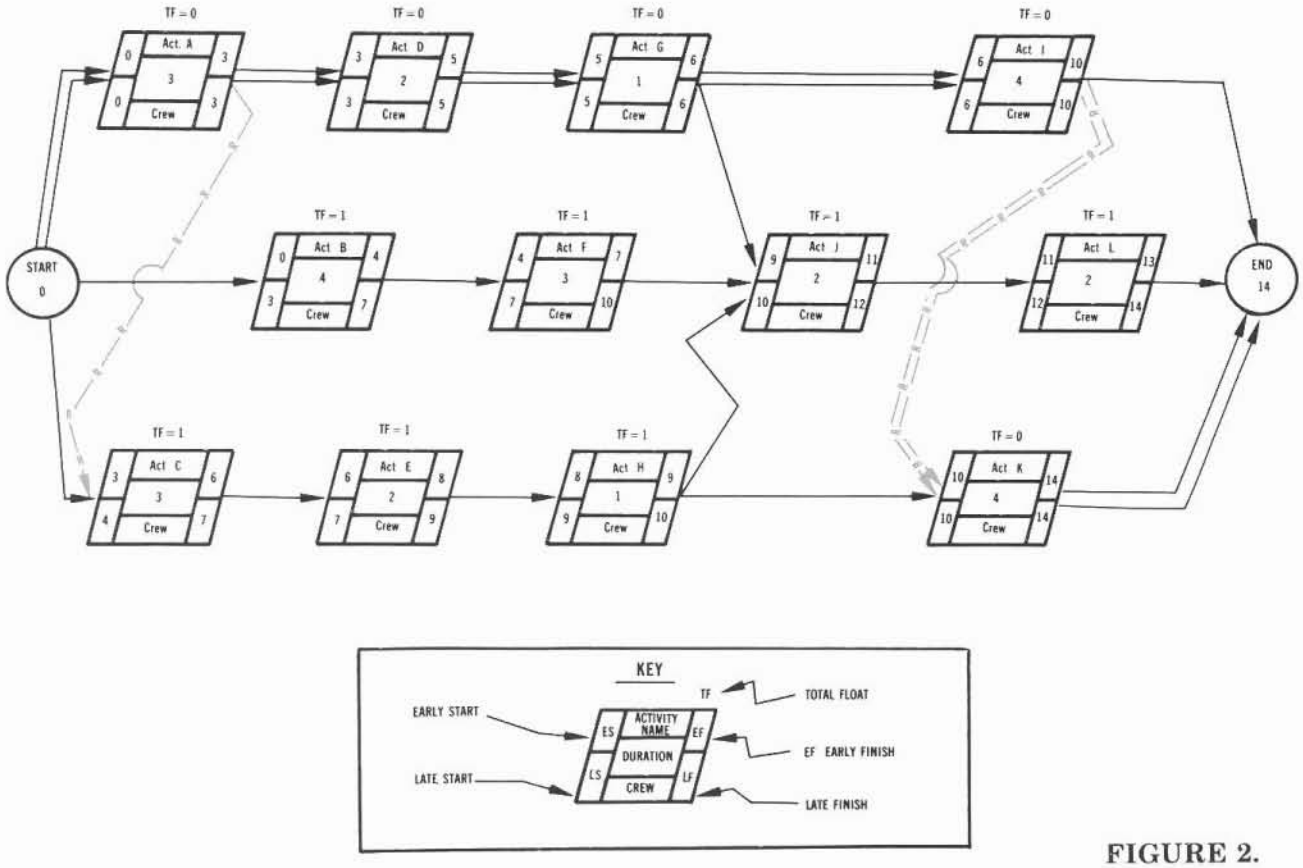
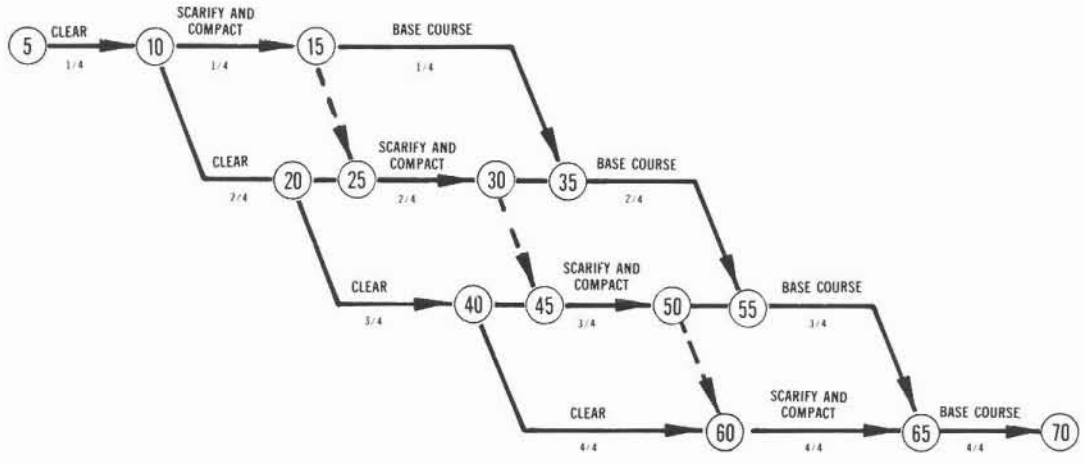


FIGURE 2.

LAG FACTOR MODIFICATIONS OF NORMAL ACTIVITY SEQUENCE

Activities considered: Clearing; Scarifying and Compacting; and Placement of Base Course.

Activity-on-the-Arrow



Activity-on-the-Node

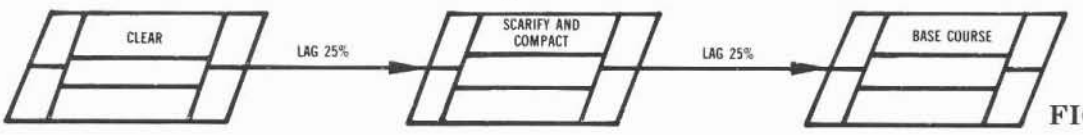


FIGURE 3.

relationship arrows. The project now takes on a different appearance, as shown in Figure 2.

Before comparing the merits of each system, the reader is encouraged to study Figures 1 and 2. The glossary of terms on the right should clarify data within each figure.

The precedence diagram presents a simpler, cleaner logic diagram than the AOA diagram. There is no need for dummy arrows in the precedence network, eliminating a major source of confusion for the less experienced managers of network analysis systems. The PD is less cluttered than the AOA diagram and relationships between activities are more readily apparent. The PD is also more goal or "milestone" oriented and is therefore easier to learn and understand.

Information on an activity's early start, late finish, early finish, late start and total float is easily accessible on the precedence network. The information for each activity is consolidated at the node representing that activity. In an AOA diagram only the early start and late finish times are on the diagram. To find these, the user must refer to both the head and tail of the activity arrow. The early finish, late start and total float are not listed on the AOA diagram. They can, however, be quickly calculated and listed on a separate tabulation sheet. As the project progresses, it often becomes necessary to update the logic diagram. Since the information for an activity is on the node in precedence diagraming, blank preprinted or computer printed nodes with the updated information can be placed over the original node, causing minimal draftsmanship problems.

Resource constraining an AOA diagram often requires the use of several new nodes and dummy arrows, in addition to the resource arrow. This is done to avoid overconstraining other activities in the network. In a PD, there is one resource arrow for each resource relationship. The diagram remains concise and the resource relationships clear.

Sometimes an activity can begin before a related preceding activity has been completely finished. Therefore, two activities that are related can actually overlap each other. These "leads" or "lags" can be represented in both systems, as seen in Figure 3. One of the real strengths of precedence diagraming is its ability to handle these lead and lag factors. The graphic representation is less involved and still depicts the main activities. The lead or lag factor can be entered into a computer with much less difficulty than in AOA.

Precedence diagraming has many avid supporters in the construction arena. However, this system is not seen as being superior to AOA by every management expert. PD can be difficult to update manually if lag factors or other "wrinkles" are used by the manager. This can be a seri-

Glossary

Activity arrow: Each activity is represented by one solid arrow in a CPM (AOA) diagram. An activity may be referred to by its tail-head node numbers.

Activity node: Each activity is represented by one node in a Precedence Diagram (activity-on-the-node). An activity may be referred to by a single activity number.

Critical activity: A critical activity has no float time (see Float). Its accomplishment cannot be delayed without causing an extension in the overall project duration.

Critical path: Every network has one or more continuous critical paths which dictate the minimum project duration. The critical activities in the project form the critical path(s). The critical path may also contain "critical" resource and dummy arrows. The critical path is highlighted by using a double line.

Dummy arrows: Dummy arrows do not represent activities. They are used to transmit logic and insure all the relationships between activities are properly depicted by the network. Dummy arrows are not needed for most variations of precedence diagrams.

Early event time: Each node in an AOA diagram has its own early event time. The early event time represents the earliest possible time the event node can occur.

Early start: This is the earliest time an activity may begin. In an AOA diagram, the early start is found by referring to the early event time above the tail node of a particular activity.

Early start schedule: This is a preliminary construction schedule which has not been analyzed for resource constraining problems. Every activity is scheduled to begin at the earliest possible time.

Event node: This is one of the graphic symbols used for AOA. It is a control device which re-

Capt. Robert J. Huff is a construction management instructor at the U.S. Army Engineer School. A 1977 graduate of the U.S. Military Academy, he has attended airborne and ranger training. He last served as executive officer of Co. D, 10th Engineer Battalion, Germany. Capt. Andrew T. Hamlin and 1st Lt. Michael J. Harris are

of Terms

strains the start of any activity leaving it until all the necessary preceding activities have been completed. An event node occurs when all preceding activities have been accomplished. The projected occurrence of event nodes is indicated by the early and late event times associated with each node.

Float: This is the amount of time an activity can be delayed before it begins to impact on the overall project duration (total float). The amount of time an activity can be delayed before it impacts on the early start of other activities is called free float and is a component of total float. The remaining component of total float is called interfering float. An activity delayed into this time period will interfere with the early start of other activities but will not extend the project duration.

Relationship arrow: These arrows are used in precedence diagrams and show how the activity nodes interact. Relationship arrows do *not* represent activities.

Resource arrow: These relationship arrows indicate how the initial logic of the network has been modified to insure that the available resources for the project are not exceeded. They are used in both AOA and PD.

Resource constrained schedule: This is the final construction schedule which the manager prepares. It is a modified early start schedule and insures that the available resources for the project are not exceeded.

Late event time: This time represents the latest time an event node can occur without delaying the overall project duration.

Late finish: This time indicates when an activity must be finished in order to keep it from extending the project duration. In an AOA diagram, the late finish is found by referring to the late event time below the head node of a particular activity.

both instructors of engineer management at the Engineer School. Harris is a Cornell University graduate who recently served as platoon leader of Co. A, 11th Engineer Battalion, Fort Belvoir. Capt. Hamlin formerly served as a platoon leader and company commander with the 9th Engineer Battalion, Germany.

ous drawback. The manager has no simple way to check a computer-assisted project. The potential for this problem is also present, to some degree, when using AOA.

It is recognized that neither technique is totally superior to the other and that each system has its advantages and disadvantages in different situations. If the Engineer School adopts precedence diagraming as *the* primary construction management technique, AOA will have to remain visible, as it will be regularly encountered by managers for years to come.

One obvious impact of the transition from AOA to PD is that of a break in communication between incoming officers/NCOs who understand the PD system and their chain-of-command who are more familiar with AOA. This is not as significant a problem as a first impression may indicate. Precedence diagraming is very similar to AOA in many areas. Whether using AOA or PD, the manager is responsible for providing a certain amount of review and reeducation to his subordinate supervisors to insure the plan and schedule are correctly followed.

How will a change in instruction influence existing Army literature, regulations, ARTEPs, soldier's manuals, TMs and SOPs? Precedence diagraming is still a critical path method. Any references to this management technique will remain applicable with little if any modification. TM 5-333, *"Construction Management,"* provides a discussion of both AOA and PD.

The Engineer School would emphasize PD not because it has overwhelming advantages over AOA, but because precedence diagraming has certain merits over AOA for managing smaller projects which are not supported by computers. Since the bulk of projects managed by the recently graduated Engineer School students are not complex, they normally contain a limited number of activities and are managed without the aid of computers. As a result, PD is a logical choice. Precedence diagraming is preferred for managers just learning to use a network analysis system. As more experience is gained, the engineer manager becomes familiar with both systems. Since both AOA and PD are valid and effective management tools, senior managers can choose the technique they feel most comfortable with.

Comments from the field are encouraged. Managers with experience in one or both of the systems should express their viewpoints to the USAES project officer, Capt. A. Hamlin, at the following address:

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Self-Help Programs And Company Maintenance

by Capt. Merrit P. Drucker

Army units occupy a large number of facilities of varying ages and conditions and these facilities represent an important, extremely valuable asset. Every effort should be made to maintain them in the best condition possible.

Current doctrine holds that facilities maintenance begins with and is the responsibility of the installation commander. This is indeed correct since failure to give facility maintenance command attention leads to run-down barracks, mess halls and motor pools; lowered morale; and ultimately, to decreased combat effectiveness.

Army Regulation 420–22, *Preventive Maintenance and Self-Help Programs*, defines preventive maintenance as the systematic care, servicing and inspection of equipment utility plants and systems, buildings, structures, and grounds facilites to detect and correct incipient failures and to accomplish minor maintenance. Although most preventive maintenance is handled by the post facility engineers, self-help programs allow military personnel and occupants of family/troop housing to themselves accomplish limited maintenance, repair work and to make minor improvements. This article explains how the company-level self-help program fits into the Army Real Property Maintence System and suggests ways to make self-help programs more effective.

Effective facilities maintenance is difficult to accomplish without the support of the installation commander and all subordinate leaders. When a company commander inventories unit equipment prior to assuming command, for example, he should also inspect and inventory the buildings, maintenance areas and grounds assigned to the company. Commanders sign for their buildings on DA Form 2062, *Hand Receipt/Annex No*; authorized repairs are made by unit personnel or, as required, reported to the facility engineer.

The facilities maintenance plan should be an integral part of the total leadership plan for the unit. Maintenance of facilities at company level is a direct responsibility of the enlisted chain-of-command; first sergeants, platoon sergeants and squad leaders should be held accountable for the maintenance of their assigned facilities. Each soldier, in turn, should be responsible for performing minor repairs in his assigned area. The commander should hand-receipt individual rooms to the soldiers who occupy them. All inspections by the chain-of-command should also include inspection of buildings and grounds.

Most units find it necessary to appoint one individual to perform authorized minor repairs, to draw supplies and equipment and to serve as unit representative to the facility engineer. This soldier, usually known as the "self-help NCO," must be chosen carefully. The soldier selected should be competent, motivated, capable of working with tools and able to work with little or no supervision. It may be advantageous to make this an additional duty. Many installations conduct a short school which self-help NCOs must attend. If the training is available, commanders should consider sending one individual per platoon to the school. This will enable the company to distribute the maintenance workload and will enhance the unit's overall maintenance program.

Most company-sized units have an adequate supply of tools available to the self-help NCO; a review of the unit Table of Organization and Equipment will indicate the location and type of tools available. Usually, the appropriate tool sets will be located in the company headquarters section. The engineer squad tool box, the general mechanic's tool set or the No. 1 common tool set, will contain the tools needed to perform building maintenance. All tools must be properly hand-receipted and accounted for. Items such as paint brushes, paint, putty, hardware and glass may be obtained from the Self-Service Center or through the facility engineer. Expendable supplies must be carefully controlled to prevent loss or theft.

It is absolutely critical for the self-help NCO to maintain communications with the supporting facility engineer. Problems beyond the capabilities of the unit must be reported to the facility engineer promptly. A log should be maintained of telephonic service orders and of work requests submitted on forms. The service order number or document number for each job should be readily available to the commander or to anyone inspecting the unit. The log should be updated and purged regularly so it can be used as an effective management tool.

The commander should instill in members of the company a sense of responsibility for assigned facilities. Almost without exception, soldiers can be trained to maintain their facilities in an outstanding manner. If troops are provided with materials, leadership and strong command emphasis, facilities can be maintained in an above average condition. Troop involvement promotes an attitude of personal responsibility for the barracks.

In any given company, there are usually several soldiers who have been carpenters, plumbers, painters or electricians in civilian life. These soldiers are an asset to the unit since they can do a significant amount of repair and maintenance work. Proj-

ects like regrouting latrines and showers or installing tile floors and sidewalks can be done quite professionally by unit members if such projects are authorized by the facility engineer. Authorization for such projects is mandatory since they are out of the realm of self-help and into the area of minor construction.

There are many things a commander can do to improve facilities. The company charge-of-quarters can be used to inspect the barracks and orderly room and make a list of problems so the unit self-help personnel can start correcting problems without having to inspect the entire facility. When the mess officer or staff duty officer inspects the dining facility, the building and installed fixtures should be thoroughly inspected, too. If problems are identified on a daily basis, they can be corrected before becoming severe.

Another opportunity for increased building maintenance occurs when the company goes off post or to the field leaving a detachment behind. The rear detachment should be responsible for securing, inspecting, cleaning and maintaining the unit's facilities. The detachment should have specific, identified missions regarding the facilities. For example, this is an ideal time to do painting without disrupting the entire unit; maintenance involving turning off water, gas or electricity is also easier to accomplish. Motor pool maintenance, such as repairing pavement, painting lines or cleaning, is also easier since most of the vehicles may be out of the motor pool.

Building exteriors deserve special attention; many times cracked walls, broken electrical outlets or stopped up drains are overlooked. The outside of buildings must be maintained to prevent the elements from damaging the interior, to conserve energy and to present a good appearance. The roof of a building should be inspected regularly by facility engineer personnel for leaks, water damage, cracks and stopped up rain gutters.

Another often neglected facility is a structure located distant from the company or in an isolated area. These facilities must be checked periodically and repairs made rapidly. Buildings in areas where the temperature falls below freezing must be winterized when not used, a task normally accomplished by the facility engineer. If buildings are unoccupied for a short period during freezing weather, they should be inspected daily to check for frozen pipes.

Grounds, fences, sidewalks, roads, curbs, parking lots, culverts and street lights within company boundries should be inspected regularly and work orders initiated as required. Many repairs in these areas will have to be made by the facility engineer. The company can help by reporting problems promptly and by not allowing practices which damage the grounds, such as driving vehicles over sidewalks and grounds. Gutters and culverts should be kept free of debris and consideration should be given to erosion control. Maintaining adequate ground cover is one method of controlling erosion. The drainage of water from large paved areas, drain pipes and culverts should be checked to insure that soil erosion is not taking place.

The battalion S-4 has staff responsibility for facilities maintenance. There are several things the S-4 can do to assist the company maintenance program. The S-4 should hand-receipt facilities from the installation and then, in turn, hand-receipt the facilities to company commanders. The S-4 should supervise the inspection, inventory and transfer of buildings to new company commanders. The S-4 self-help NCO can draw supplies and equipment for the battalion or supervise composite details from companies to accomplish specific self-help missions. The battalion self-help NCO should conduct frequent inspection and assistance visits to the companies. These visits should stress teaching, coaching and helping the company self-help personnel to maintain and repair their facilities. If properly selected and trained, the battalion self-help NCO can handle most of the S-4's facilities management responsibilities.

Some units operate a consolidated battalion self-help program with each company designating one soldier to work for the battalion self-help NCO. Such centralization can greatly increase the efficiency and effectiveness of the self-help program. The decision to consolidate depends upon the specific unit situation and is made by the battalion commander.

Fire prevention, safety, physical security, sanitation and energy conservation are all interrelated areas and each is dependent, to some degree, upon well maintained facilities. Every effort should be made to integrate these areas with the unit facilities maintenance program. Communication must be maintained between those who have responsibilities in these areas, and effective planning is required to prevent conflicts or duplication of effort.

"The (service order) log should be updated and purged regularly . . ."

Of the five functional logistical areas—supply, maintenance, transportation, services and facilities—facilities is equal in importance to the other four. The type and condition of a unit's facilities have a distinct impact upon the effectiveness and morale of the unit. A well maintained, functional, clean barracks or vehicle maintenance building is an indicator of an organized and disciplined unit.

Additional information on self-help programs can be obtained from AR 420–22, *Preventive Maintenance and Self-Help Programs*, and TM 5–610, *Preventive Maintenance, Facilities Engineering—Buildings and Structures*.

Capt. Merrit P. Drucker is an infantry officer and instructor in the Command and Leadership Branch, U.S. Army Engineer School, Fort Belvoir, Va. A graduate of St. John's University, the Infantry Officer Advanced Course and the Supply Management Officer Course, he has served in several command and staff positions with the 1/508th Infantry, 82d Airborne Division. He has had articles published in Army Logistician and Infantry *and has been selected for instructor duty at the U.S. Military Academy.*

A Different Kind Of Training Project

by Capt. Douglas D. Gransberg

Let's set the scene. The XYZ Engineer Battalion (Combat) (Heavy) is planning a battalion field training exercise (FTX). The S-3, Major Oakleaf, and his assistant, Second Lieutenant Goldbar, are discussing their plans.

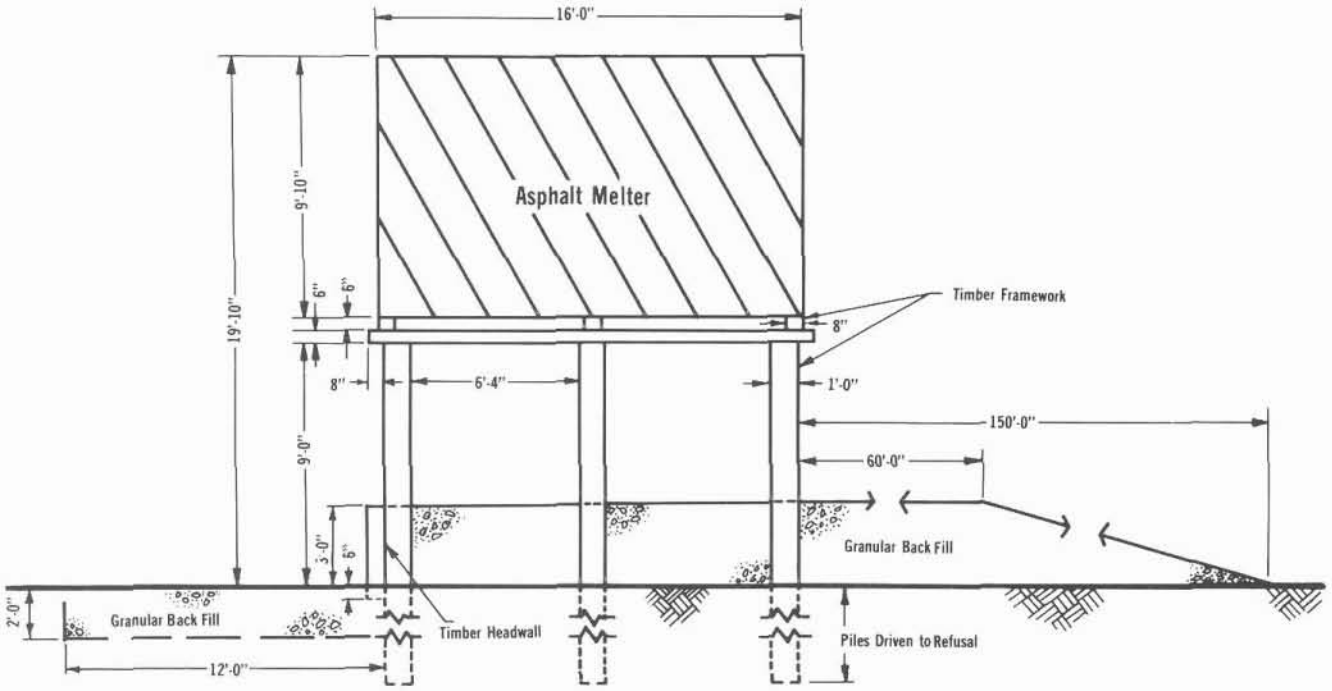
Major O: "Well, we've got the line company construction missions set. Now what are we going to do to keep the A Company equipment platoon busy?"

Lieutenant G: "No sweat, sir! They can send their dozers to the B Company tank ditch. C Company will probably request all their dump trucks and bucket loaders for the haul mission. S-4 always needs a forklift and a light set, and the rest of them can pull security around the battalion TOC."

Sound familiar? As those who served in the Alpha Company of a combat heavy battalion know, it's often the same old story on FTXs; piecemeal employment of the 62E and 62F equipment operators and endless hours of guard duty for the 62H asphalt/concrete specialists and the 62G quarrymen. However, with a little imagination and some easily obtainable construction materials, the equipment platoon can be assigned a small project challenging their construction abilities and utilizing every Military Occupational Specialty in the platoon.

The mission given the equipment platoon, A Company, 864th Engineer Battalion, was to construct a field expedient "de-drumming plant." When bituminous material is issued, it often comes in fifty-five gallon drums. This requires the bitumen to be emptied out of the drums (hence the name "de-drumming") into a machine that heats it to a temperature at which it can be pumped. The skid-mounted, 750 gallon-per-hour asphalt melter is the ideal machine for this purpose. Furthermore, when the melters are placed at a height that permits gravity flow into the distributor trucks, a great deal of minor maintenance hassles are eliminated.

Constructing a de-drumming plant was the idea of the junior NCOs of the equipment platoon and consisted of four phases. The first phase was site preparation. A trench 2 feet deep was cut and lined with polyethylene sheeting. Two inches of sand was placed above and below the sheeting to protect it from punctures and the trench was backfilled with a granular material. This provided a spillage protected lane in which the distributors could be loaded. Additionally, the remainder of the area was compacted. Phase two consisted of erecting an elevated platform on which to set the melters. Six timber piles per melter were driven to refusal and cut off 10 feet above the ground. A timber framework was then installed on top of the piles. A timber headwall was constructed on the front side of the structure and backfilled to a depth of 3 feet. The third phase involved installing, leveling and plumbing the melters on top of the platform; an earthfill ramp was built behind the platform as the final phase. Once the



The equipment platoon, A Company, 864th Engineer Battalion, Fort Lewis, Wash., constructed this field expedient "de-drumming" plant during two FTXs. The training project provided an excellent opportunity to evaluate the platoon's capabilities to perform a realistic construction mission under tactical conditions.

ramp was completed, de-drumming could begin utilizing a forklift on the ramp to lift the drums to a height at which they could be emptied into the melter.

Half the project was completed during a battalion FTX in late March 1981, and the other half was done during the battalion ARTEP in April 1981. This enabled the unit to be evaluated on ARTEP Task 14-1, *Conduct Piledriving Operations*, for the first time in eight years and allowed the equipment platoon to be evaluated on its ability to function as a single unit. The entire project was accomplished under tactical conditions with much of the work done during the hours of darkness. The total process took approximately three days during each week-long exercise. Inexperience at piledriving was the primary factor lengthening the time to completion; however, simulated enemy threat, NBC play, inclement weather and minor maintenance problems took their toll as well.

The following describes which tasks were performed in each MOS:

• 62G, Quarryman: The quarry section was required to open and to operate a borrow pit to provide fill for the ramp. Additionally, they operated their 75 ton-per-hour crusher continuously to

The ENGINEER Problem

The following portland cement mix proportion was provided to you.

Water-cement ratio	= 5.5 gallons/sack
Cement factor	= 6.5 sacks/cubic yard
Fine aggregates	
Specific gravity	= 2.60
Proportion by volume	= 40%
Absorption	= 0.6%
Total moisture content	= 6.0%
Coarse aggregates	
Specific gravity	= 2.70
Proportion by volume	= 60%
Absorption	= 0.5%
No free-surface moisture	
Air content	= 6.0%

Determine the weights of the fine and coarse aggregates and the water added to batch 1 cubic yard of concrete.

Lifting and loading specialists, MOS 62F, drove piles and used cranes and forklifts during the battalion FTX. (Photos by Robert J. Walz.)

provide granular backfill for the trench as well as to stockpile gravel for later use by the battalion.

•62H, Asphalt Concrete Specialist: The asphalt section was required to compact the site using their 10– 14 ton steel wheel roller. They installed the plastic sheeting, spread the protective sand blanket and installed the melters when the platform was completed.

•62F, Lifting and Loading Specialist: The primary task given the 62Fs was driving the piles. Additionally, they utilized the cranes and forklifts to lift timber framework to the top of the piles and to set the melters.

•62E, Construction Equipment Operator: The 62Es operated both the bulldozers and bucket-loaders at the project site, the borrow pit and the quarry.

•62J, General Construction Machine Operator: A 250 cfm air compressor and pneumatic tool set were used for several purposes. First, the pneumatic chain saw was used to cut the timbers for the framework and the headwall, then it was used to cut the piles to the appropriate height. Both the jackhammer and the pneumatic drill were used to pin the timbers to the piles. The 62Js were also given the responsibility to provide lighting at the project site, the borrow pit and the quarry.

•64C, Vehicle Operator: The dump truck drivers utilized both the 5-ton and 20-ton dump trucks throughout the project.

•Additionally, both engineer (62B) and ordnance (63B) mechanics were used during the project.

In all, fourteen ARTEP tasks were evaluated as a result of the project. The task numbers from ARTEP 5-115, dated 1 October 1980, were: 3-4, 4-4, 4-7, 4-8, 4-13, 11-12, 12-2, 13-2, 13-7, 13-8, 13-11, 13-20 and 14-1.

General construction machine operators, MOS 62J, pinned timbers to piles and provided lighting to various project sites.

The de-drumming plant construction project proved a useful training endeavor. Allowing the equipment platoon to maintain unit integrity enhanced the morale and efficiency of the unit. It also allowed the equipment platoon leadership to coordinate the efforts of the platoon in concert. Best of all, the project provided a great deal of valuable experience in little used construction skills.

Capt. Douglas D. Gransberg is commander of Company A, 864th Engineer Battalion (Combat) (Heavy), Fort Lewis, Wash. He served previously with the 78th Engineer Battalion, and later this spring will join the St. Paul District. Capt. Gransberg has a master's degree in civil engineering from Oregon State University and is a registered professional engineer in Oregon.

The ENGINEER Solution

The absolute volume method is used to solve this problem.

$$\text{Absolute volume} = \frac{\text{Weight of a material}}{(\text{Specific gravity})\ (62.4\ \text{lbs/cu ft})}$$

CEMENT

Weight of cement	= (6.5 sacks/cu yd) (94 lbs/sack)	= 611 lbs
Absolute volume	$= \frac{611\ \text{lbs}}{(3.15)\ (62.4\ \text{lbs/cu ft})}$	= 3.1 cu ft

WATER (Unadjusted for aggregate moisture)

Weight of water	= (6.5 sacks/cu yd) (5.5 gals/sack) (8.33 lbs/gal) = 298 lbs	
Absolute volume	$= \frac{298\ \text{lbs}}{(1)\ (62.4\ \text{lbs/cu ft})}$	= 4.8 cu ft

AIR

Volume of air	= (0.06) (27 cu ft/cu yd)	= 1.6 cu ft
VOLUME SUBTOTAL	= 3.1 + 4.8 + 1.6	= 9.5 cu ft
VOLUME OF AGGREGATES IN A 1 CUBIC YARD BATCH	= (27 cu ft) − (9.5 cu ft)	= 17.5 cu ft

FINE AGGREGATES

Absolute volume	= (0.40) (17.5 cu ft)	= 7.0 cu ft
Weight (dry)	= (7.0 cu ft) (2.60) (62.4 lbs/cu ft)	= 1136 lbs
Weight (wet)	= (1136 lbs) (1.06)	= 1204 lbs

COARSE AGGREGATES

Absolute volume	= (0.60) (17.5 cu ft)	= 10.5 cu ft
Weight (dry)	= (10.5 cu ft) (2.70) (62.4 lbs/cu ft)	= 1769 lbs

WATER ADJUSTMENT: The water added must be adjusted for the free-surface moisture and the water absorbed by the aggregates.

Free-surface moisture

Fine aggregates	= 6% − 0.6% = 5.4%
Coarse aggregates	= −0.5%

Water added

= 298 lbs − (1136 lbs(0.054)) − (1769 lbs(−0.005))
= 298 − 61 + 9
= 246 lbs

FINAL SOLUTION

Water added	= 246 lbs
Fine aggregate weight	= 1204 lbs (wet)
Coarse aggregate weight	= 1769 lbs (dry)

1st Lt. Thomas Baltazar, commander, 86th Engineer Detachment (Diving), 30th Engineer Battalion, is assisted from the icy Potomac River by 2d class diver Sp5 Andre Simbeck during operations to recover a crashed jetliner. The plane crashed into the river near Washington, D.C., during a January snowstorm.

(photo by Mary Storms)