STRATEGY RESEARCH PROJECT

JOINT ENGINEER SUPPORT TO THE WARFIGHTING CINCS

BY

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ABSTRACT

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Engineers are a key component for executing the National Security Strategy's imperative of engagement by helping to "shape" the international environment, "respond" to the full spectrum of crises, and "prepare now" for an uncertain future. Although Army, Air Force, and Navy engineers have provided complementary support in operations since World War II, Operation Desert Shield/Desert Storm and peace keeping and humanitarian assistance operations in the 1990s have demonstrated a greater need to execute joint engineer operations. While joint engineer training and doctrine have made great progress in helping the Services to work more closely together and to define responsibilities, there is still a lack of joint engineer planning on the CINC's staff. One reason is the Services' differences in scope of engineering support: civil (general) engineering for Navy and Air Force, while the Army and Marine Corps also encompass combat engineering. Another is the lack of General Officer-level joint engineer headquarters or staff to conduct early planning.

Both the Army and Navy have major commands that execute the Services' military construction (MILCON) programs and provide environmental and other engineering services: U.S. Army Corps of Engineers (USACE) for the Army and Air Force and Naval Facilities Engineering Command (NAVFAC) for the Navy and Marine Corps. These commands execute their missions through subordinate engineering divisions.

This project will analyze historical examples and Service engineer capabilities and recommend that each Geographical Unified Command be supported by an Army or Navy engineering division. As the CINCs' Engineers, these division commanders, with their civilian and active and reserve component military staffs, should be responsible for peacetime engagement, smaller scale contingency (SSC), and major theater of war (MTW) engineering planning and support.

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> The nature of modern warfare demands that we fight as a joint team. This was important yesterday, it is essential today, and it will be even more imperative tomorrow.
>
> —John M. Shalikashvili

From constructing siegeworks around Boston in the Revolutionary War to building base camps in Kosovo, military engineers have provided invaluable contributions to America, not only in supporting wars, but also in building infrastructure at home and abroad. While sometimes complementary, these engineer efforts have seldom been joint operations. In the Pacific theater during World War II, Navy Seabees and Army engineers worked together constructing harbor facilities, airfields, and depots. In Vietnam, Naval and Army engineers primarily supported their Services, while the Air Force created its own civil engineering capability. Sometimes Navy Seabees worked for Army engineers during Desert Shield/Storm, but primarily "each Service was responsible for providing its own engineering capability for receiving and supporting troops."[1] Peace keeping and humanitarian assistance operations in the 1990s have had to rely on ad hoc engineer command and control organizations to control contractor and military engineers from all Services.

With today's National Security Strategy of engagement and Joint Vision 2010's operational concept of focused logistics, engineers must optimize scarce resources to provide maximum support across the full spectrum of conflict from peacetime engagement to major theater of war (MTW). This support includes providing nation assistance, supporting military activities, and developing the infrastructure "to deliver tailored logistics packages and sustainment directly at the strategic, operational, and tactical level of operations."[2] Service engineers provide this support to the CINCs while executing their Title 10 Service requirements and Military Construction (MILCON) mission.

Military engineering covers a broad range of functions in peacetime and war, and can be categorized as: combat engineering, general (civil) engineering, and topographic engineering. Combat engineering is primarily an operations function supporting the land component commander by providing mobility and survivability on the battlefield. General engineering is aligned with logistics functions providing facilities for reception, staging, onward movement, and sustainment of ground forces, and operating bases for Air Force and Navy forces. Topographic engineering supports the operations and intelligence functions by providing maps and current geographical intelligence. In peacetime engagement and smaller scale contingencies (SSCs), general engineering operations can also be a key element of the operations plan.

Since the Goldwaters-Nichols Act of 1986, Congress has pressured the military to increase jointness in functions that overlap Services, e.g., intelligence and logistics. Military engineering has many overlapping functions within the Services; Naval Mobile Construction Battalions (NMCB), Air Force Rapid Engineer Deployable Heavy Operational Repair Squadron (RED HORSE) Squadrons, and Army Combat Heavy Battalions all are capable of horizontal and vertical construction, from airfields to base camps.

Each Service, however, has particular engineering expertise, which should be retained for Service needs. Joint engineer doctrine and training has progressed over the past five years to reduce redundancy and maximize effectiveness, however several issues remain unresolved in the current draft doctrinal manuals. Location of the engineer cell in joint headquarters and organization of engineer commands in a joint task force, for example, are left up to the joint force commander. The CINC has directive authority for engineering, allowing him to consolidate the Services' engineer assets under the CINC's control. However, in today's environment of multiple, complex, and dynamic contingency operations, ad hoc command and control arrangements to control these assets are not adequate. CINCs need an engineer command headquarters to supplement their engineer staff and provide a single engineer voice for advising them on engineer matters and coordinating assets from all Services. The U.S. Army Corps of Engineers (USACE) and the Navy Facilities Engineer Command (NAVFAC) headquarters and forward deployed engineering divisions can fulfill that role.

HISTORY OF JOINT ENGINEERS

SERVICE BACKGROUND AND CAPABILITIES

Army, Navy, and Air Force engineers are eminently qualified to perform today's engineer missions from their experience and training throughout their service to the Nation. Illustrated below are the Services' unique engineering capabilities as well as common ones that can result in redundant support to the CINCs.

Army

Army engineers have been a part of American military operations since the Revolutionary War. "The Second Continental Congress authorized a chief engineer and two assistants for the field army"[3] on 16 June, 1775, when it organized the New England Army. In March 1779, Congress created the Corps of Engineers, and sappers and miners played a significant role in conducting the siege of British defenses at Yorktown. Engineers built harbor fortifications in the War of 1812, and in 1818 the Office of the Chief Engineer was established. The Civil Works mission was legislated by Congress with the General Survey Act of 1824, which authorized "the President to employ Army engineers to facilitate river navigation and survey road and canal routes of national importance."[4] Army engineers constructed the vital siege batteries at Mexico City in 1848 and developed techniques for rapid bridging and hasty field fortifications during the Civil War. In March 1863, the Corps of Topographical Engineers was merged with the Corps of Engineers under the command of the Chief of Engineers. By the 1890s, engineer effort focused on coastal fortifications and from 1904 to 1914, "Army engineers undertook the Corps' largest single project to date, the building of the Panama Canal."[5]

Designated a combat arm in the early days of WWII, engineer forces were split into three groups: combat units supporting ground forces, aviation engineer units controlled by the Army Air Forces, and service support units employed in the communications zones. The U.S. Army Corps of Engineers

(USACE) was also given initial responsibility for developing the infrastructure for the Manhattan Project.[6] Since WWII, combat engineering has closely supported Army doctrine and planning, and was a key combat multiplier for the AirLand Battle doctrine of the 1980s. USACE's civil works and military construction missions expanded into foreign aid and overseas reimbursable construction projects. With the passage of the Clean Water Act of 1972 and focus on the environment in the 1980s and 90s, USACE has become a major player in environmental restoration and hydrologic ecosystem regulation.

Today's Army Corps of Engineers regiment is multi-component and multi-functional. The Chief of Engineers is responsible for the three major elements of the regiment: Army Corps of Engineers branch (combat and general engineering tactical units, including the Army Engineer School (USAES) centered at Ft Leonard Wood), the USACE Major Command (MACOM), and the Directors of Public Works (DPWs) on installations.

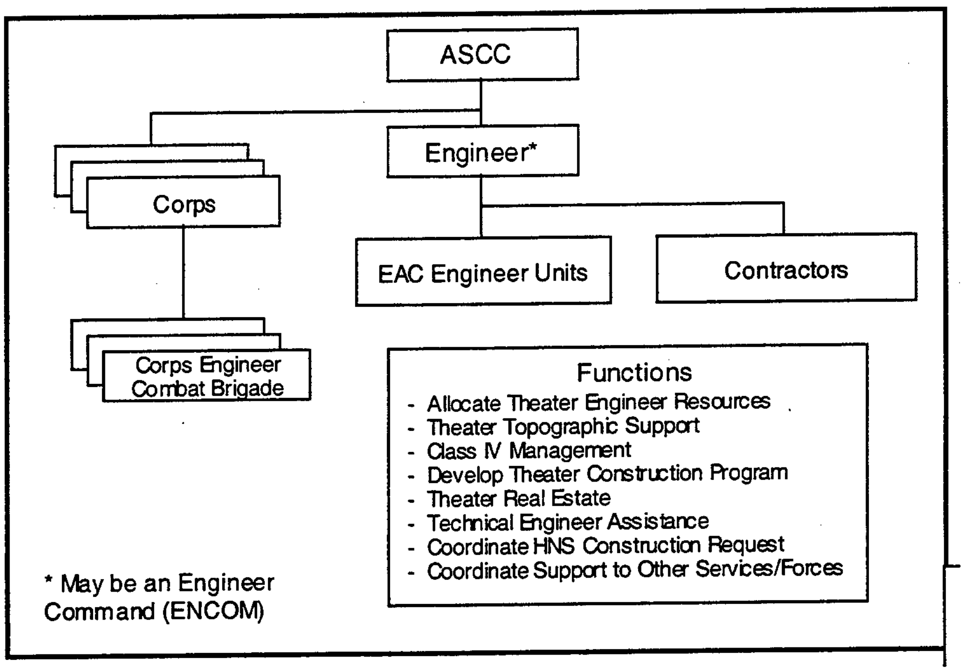

FIGURE 1 - OPERATIONAL-LEVEL ENGINEER ORGANIZATION AND FUNCTIONS

Tactical Army engineers are located throughout the battlefield performing combat engineering, (mobility and survivability), general engineering, and topographic operations. Combat engineer battalions are organic to each of the Army's divisions. Within heavy divisions an engineer brigade provides command and control of organic divisional battalions and other attached engineers. Corps combat engineer brigades have assigned combat engineer units, combat support equipment companies, and bridge units. For the Army Service Component Commander (ASCC) an operational-level engineer commander (brigade or engineer command (ENCOM)) provides command and control (C2) for engineer effort. Figure 1 shows a generic operational-level engineer organization and functions.[7] Echelons above corps (EAC) engineers reinforce corps engineer efforts, develop the theater support base, and maintain sustainment infrastructure.

Theater construction management often spans multi-Service requirements. The CINC may establish a regional contingency engineering manager (RCEM) to control all theater-level engineering and may designate the ASCC as the RCEM. The ASCC may delegate this responsibility to the operational level engineer headquarters. Construction battalions, designated as "combat heavy", augmented with combat support equipment companies and other specialty companies and detachments execute the construction missions. There are seven active component (AC) combat heavy battalions, each short one company, and 33 reserve component (RC) complete battalions.[8] These forces may be supplemented by contractors and host nation engineers. USACE may provide elements, which specialize in contract construction, design and technical assistance, and real estate to support the theater construction effort.

As a MACOM within the Army, the USACE, with 37,000 military and civilian members commanded by the Chief of Engineers, executes the nation's $4 billion annual civil works program and $2 billion annual military construction (MILCON) for the Army and Air Force.[9] USACE also provides reimbursable engineer support to other government agencies and emergency support in accordance with the Federal Response Plan. These missions are executed through the eight engineer divisions, research laboratories and technical centers, and a power generation battalion. The engineer divisions are commanded by flag officers (brigadier or major generals) and have subordinate engineer districts commanded by colonels or lieutenant colonels. All of the districts within U.S. territory have a civil works mission that includes construction, operations, and maintenance of water navigation, flood control, coastal protection, and environmental restoration projects. They also enforce environmental regulations on water resources under the Rivers and Harbors Act and the Clean Water Act. Additionally, districts support FEMA in disaster relief and provide nearly $1 billion in design and construction, environmental restoration, and other technical services to numerous federal and state agencies annually.[10] Figure 2 shows the civil works geographical boundaries for the eight divisions, which control 41 engineer districts worldwide.[11]

Some of these districts are also designated as MILCON districts and execute the AF and Army MILCON programs.[12] Additionally, USACE engineering capability includes the Engineer Research and Development Center (ERDC) composed of seven laboratories in four locations,[13] and five technical centers.[14] Installation Directors of Public Works (DPW) work for the installation commanders, but are supported by the Corps of Engineers and work closely with the engineer districts and laboratories. Facilities engineer detachments within the RC structure provide additional DPW expertise.

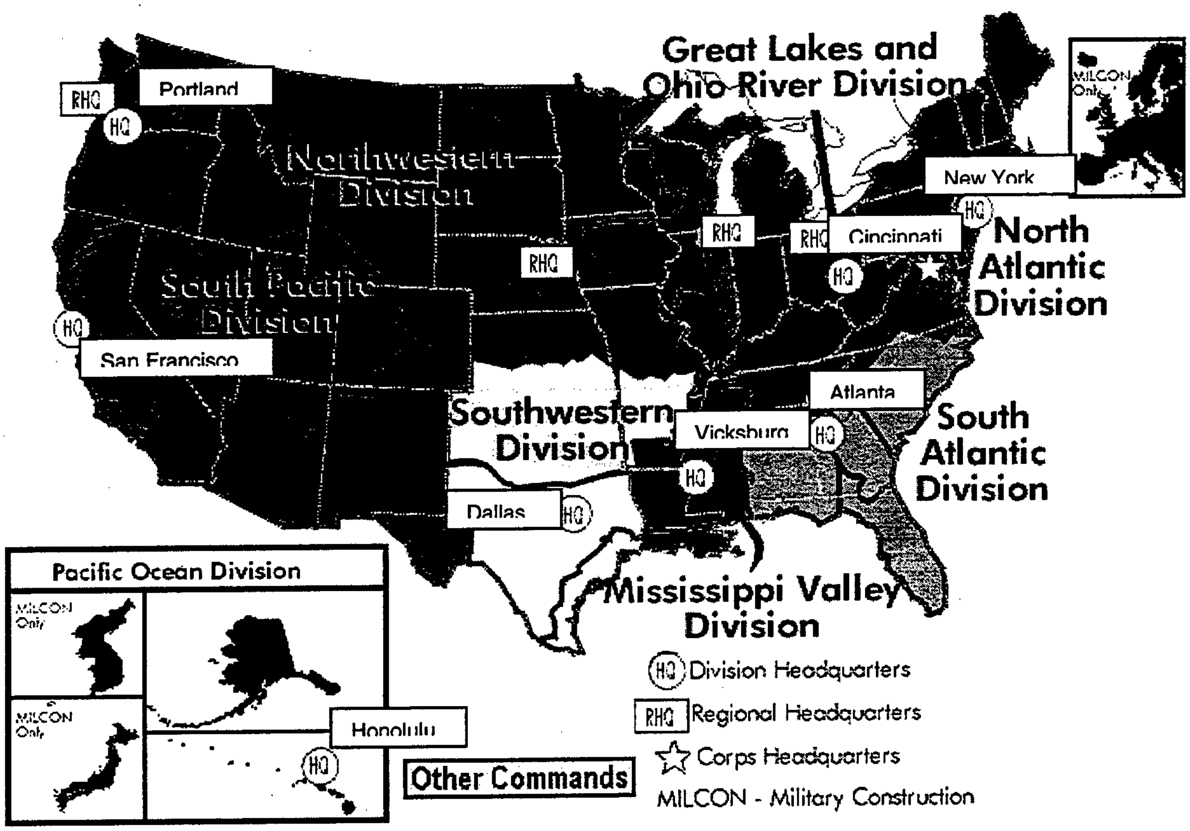

FIGURE 2 - USACE DIVISION BOUNDARIES

Navy

Naval construction dates back to American seamen being used for major shore construction in the War of 1812. In 1813, the USS ESSEX became the first Navy ship to carry the American flag into the Pacific Ocean. Needing a safe harbor for repairs and re-equipping, the ship's Captain selected a bay in the Marquesas Islands to construct the United States Navy's first advanced base. The nearly 300 skilled artisans from his seamen and approximately 4,000 friendly locals who undertook base construction were a precursor to today's Navy Seabees.[15]

Skilled Navy craftsmen were employed again in large numbers for naval shore construction activities during the First World War. In 1917 the Public Works Department, at the Naval Training Station, Great Lakes, Illinois, was organized into the Twelfth Regiment (Public Works) with three battalions. It planned the Great Lakes wartime expansion and supervised all military and contract construction. Throughout the latter part of 1917 and 1918, men were assigned in the United States and France where they assembled the Naval Railway Batteries and built and rehabilitated docks and wharves, laid railroad tracks, and built communication facilities. The regiment, which reached a peak strength of 55 officers and 6,211 enlisted men by November 1918, was disbanded after the war.[16]

In the late 1930s, with the tense international developments, Congress authorized expanded naval shore construction in the Caribbean and Central Pacific. To facilitate constructing large naval bases at many locations, including Guam, Midway, Wake, and Pearl Harbor, the Bureau of Yards and Docks, in the summer of 1941, organized military Headquarters Construction Companies overseeing civilian construction contractors. By the beginning of December 1941, the Navy needed a militarized construction force to build advance bases. In January 1942, the Bureau of Navigation authorized recruiting men from the construction trades for assignment to a Naval Construction Regiment composed of three Naval Construction Battalions, giving birth to the renowned Seabees, whose designation came from the initial letters of *C*onstruction *B*attalion. Commanded by Navy Civil Engineer Corps officers, the 325,000 Seabees who fought in WW II were concentrated in the Pacific Theater of Operations, where their unparalleled wartime construction efforts provided airfields and facilities for 1,500,000 men at over 400 advance bases.[17]

After WWII the Seabees, collectively known as the Naval Construction Force (NCF), were organized into two types of units: Amphibious Construction Battalions and Naval Mobile Construction Battalions (NMCBs). Seabees played a vital role constructing base camps and maintaining facilities for the Navy, Marines, Army, and Air Force in Korea, Viet Nam and Desert Shield/Desert Storm. They have also been employed as civic action teams, conducting nation building and disaster relief operations.[18]

Today the Navy's Civil Engineer Corps (CEC) consists of the Naval Construction Force (the Seabees) and the Naval Facilities Engineering Command (NAVFAC). The Navy's Chief of Civil Engineers commands NAVFAC, manages the 2,000 CEC officers and 17,000 enlisted Seabees, and has oversight of the Naval Construction Force.[19] The NCF mission is to provide responsive military advance base construction support, military construction in support of Marine Air-Ground Task Force (MAGTF) operations, amphibious assault construction battle damage repair operations, disaster control and recovery, and civic action employment. The force consists of two brigades, one each assigned to the Atlantic and Pacific fleets, with headquarters that are normally not deployed. Two AC and four RC deployable regimental headquarters are available to control the NMCBs and other NCF assets in theater. During peacetime, two additional active training regiments are responsible for the readiness of the NMCBs. Eight AC and 12 RC Naval Mobile Construction Battalions, consisting of two vertical companies, one horizontal, and one utilities and camp maintenance company, are the backbone of the NCF.[20] A seven-month deployment rotation of the active duty battalions ensures that units are constantly available for deployment while allowing them to return to the U.S. for recovery and training. Additional NCF units are shown in Table 1. The construction battalion maintenance units are 300+ person units capable of providing public works and minor construction to a forward base after construction has been completed. The two amphibious construction battalions deploy with amphibious forces to provide immediate over-the-beach support.[21]

UNIT	ACTIVE	RESERVE
Naval Construction Brigade	2	-
Naval Construction Regiment	2	4
Naval Construction Regiment (training)	2	-
Naval Mobile Construction Battalion	8	12
Naval Construction Force Support Unit	-	2
Construction Battalion Maintenance Unit	-	2
Underwater Construction Team	2	-
Construction Battalion Unit	19	
NAVAL BEACH GROUP		
Amphibious Construction Battalion	2	-

TABLE 1 – NAVAL CONSTRUCTION FORCE

The NAVFAC evolved from the Public Works Departments and now manages the planning, design, and construction of facilities for U.S. Navy activities around the world. With an $8 billion annual budget and 18,000 civilian and military members, it also provides engineering and program management for Navy and Marine Corps public works and housing, acquires and disposes real estate, and manages all shoreside environmental projects and programs. NAVFAC executes this mission through the five engineering field divisions (EFDs) and five engineering field activities (EFAs) shown in Figure 3.[22]

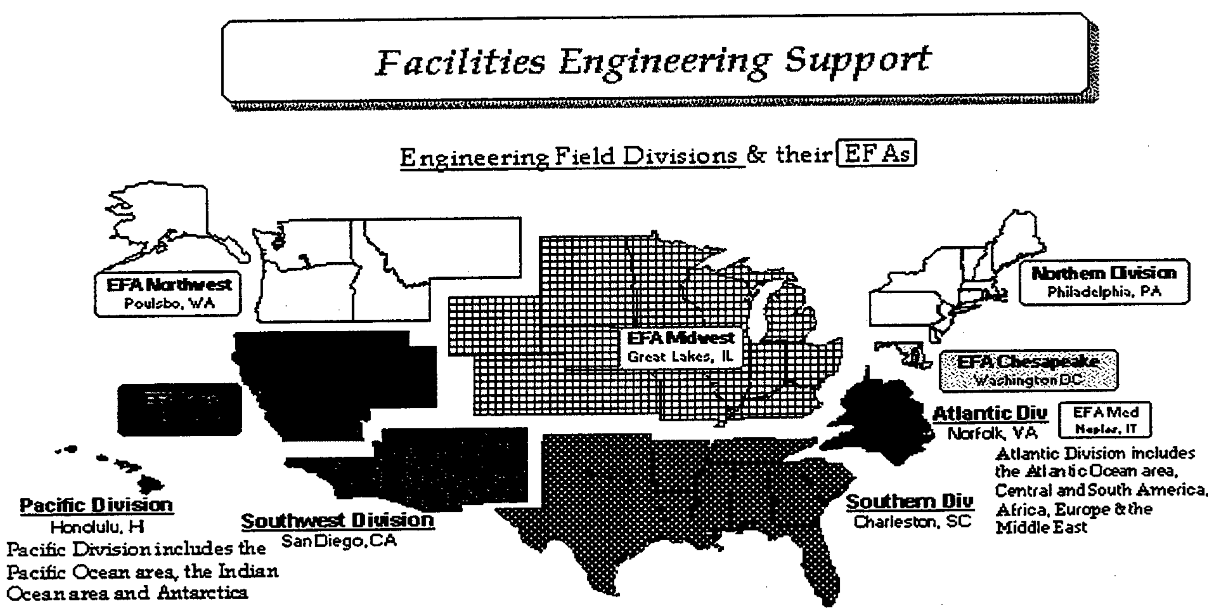

FIGURE 3 – NAVFAC ENGINEERING DIVISIONS

Air Force

The Air Force relied on Army engineers for military construction and general engineering until Vietnam with base civil engineers providing the only organic engineering capability. Prime Base Engineer Emergency Force (Prime BEEF) teams and RED HORSE Civil Engineer squadrons were established in 1965, after Secretary of Defense McNamara asked the Air Force Chief of Staff if the AF had a capability to rapidly construct airfields in the jungles of Vietnam. These tailored units have become an organic part of deployable air power assisting in constructing and repairing runways and bed-down facilities.[23]

The Air Force Civil Engineer Support Agency was established in 1966, initially as the Civil Engineer Field Activities Center to train replacements for the deployed RED HORSE squadrons. It continues to support the base civil engineers and deployable civil engineer units. Today the agency is headquartered in Tyndall Air Force Base and has five directorates and two regional sites to ensure all Air Force active-duty and Air Force Reserve Component engineer personnel are trained and equipped to deploy anywhere in the world to support wartime or peacetime emergencies. They work with planners from the Air Force, other Services, and Unified Commands to integrate engineer support into war plans and the theater engagement plans (TEPs). The Agency's Air Force Civil Engineer Readiness Center coordinates engineer support activities worldwide. Additionally, they administer the Air Force Contract Augmentation Program (AFCAP), which "can provide for a full range of civil engineer support capabilities for non-combat military operations other-than-war."[24]

Each flying wing has a base civil engineer staff to provide facilities engineering at home-station and is deployable with the wing. To augment the base civil engineers for constructing rapid bed-down facilities and providing rapid runway repair and maintenance, Prime BEEF teams are deployed in tailored packages. Backing up these teams are RED HORSE squadrons, which are self-sufficient, 404-person mobile construction squadrons capable of rapid response and independent operations in remote, high-threat environments worldwide. When requirements exceed normal base civil engineer capabilities and where Army engineer support is not readily available, they provide major force bed-down facilities, heavy damage repair, and base development and heavy engineering operations. In addition they possess special capabilities, such as water-well drilling, explosive demolition, quarry operations, concrete mobile operations, material testing, expedient facility erection, and concrete and asphalt paving. There are seven CONUS based RED HORSE squadrons: three active, one Air Reserve, and three Air National Guard. Squadrons can be deployed as complete entities or in echelons to support specific operational needs. The first echelon can be deployed within 12 hours after notification with 16 people to perform initial surveys and advance planning.[25]

HISTORICAL EXAMPLES

Service engineer support to the fight has been complementary in every major conflict from WW II to the present. With few exceptions, however, command has been retained by the Service engineer and support has been on a task basis. Although after action reports from these conflicts support the consolidation of engineer forces under a central command, there are few examples of such joint command and control of engineer efforts.

World War II

Theater engineers were vital in supporting both combat operations and constructing sustainment facilities in all operations of the Pacific and Europe. In most cases engineers supported their own Services, but there were operations with joint engineer support. For example, Seabees and Army engineers were among the first to go ashore on D-Day of the Normandy invasion to destroy the steel and concrete barriers. Seabees assembled pontoon causeways for the invasion force and later were instrumental operating the assault craft for the crossing of the Rhine.[26]

Operation Iceberg, the US seizure of Okinawa in WWII, was the best example of a joint operation. Operating under the command of Admiral Nimitz's Pacific Ocean Areas (POA) Forces, the main invasion force consisting of the 24th Army Corps and Third Amphibious Corps landed on Okinawa's west coast. Once ashore, Army Lieutenant General Buckner assumed command of all ground forces, and was responsible for the defense and development of the newly won bases.[27] Under his command he had five Naval construction battalions and an Army brigade headquarters with five combat group and five construction group headquarters to command and control 27 construction battalions, 17 combat battalions, a topographic battalion and 92 separate companies and detachments. This force established harbor facilities for unloading approximately 1,000,000 metric tons of supplies per month for a population of 450,000 military, and developed nine bomber strips, two fighter strips, and a field depot.[28] By the beginning of August 1945, 55,000 Seabees and 45,000 army and aviation engineers were in Okinawa under the command of the Commander, Construction Troops Commodore Andrew G. Bisset, a Navy Civil Engineer Corps officer.[29]

Vietnam

Engineer support to operations in Vietnam was primarily along Service lines. The Naval Construction Force in Vietnam grew to a force of 11,000 men in 21 battalions controlled by a brigade and two regiment headquarters. Seabees constructed base camps for the Marines, built and operated three major bases in the northern provinces of Vietnam, and performed nation assistance in support of the pacification mission. The US Navy public works district was responsible for the Hue-Phu Bai-Da Nang area.[30] In 1965, Military Assistance Command, Vietnam (MACV) and Military Assistance Command Thailand, directed the newly created AF Prime BEEF teams and RED HORSE squadrons to augment Army, Naval, and contract engineers in constructing base camps and airfields. The six RED HORSE squadrons that were eventually deployed to Southeast Asia were controlled by the newly activated 1st Civil Engineering Group, which reported directly to the 7th AF Engineer. AF engineers were also involved in civic action projects such as well drilling and building construction for the local communities.[31]

Army Engineers at echelons above division were organized under an Army Engineer command (Provisional) in December 1966. In March 1968 this command was consolidated with the Army Engineer

Command Staff of U.S. Army Republic of Vietnam to form the Army Engineer Construction Agency Vietnam, which directed and supervised all military and contractor construction and facility engineering. In February 1970, this command was reflagged as the Engineer Command (ENCOM) and remained until April 1972. In 1970, the ENCOM controlled three USACE Engineer Districts, two engineer brigades, six groups, 23 battalions, and several separate companies and detachments.[32] As engineer forces were drawn down, the two brigade headquarters, two of the six group headquarters, and five battalions were inactivated. The ENCOM commander, MG Noble, in his debrief, said that they were able to forego brigade echelon of command control because of the advantages of air mobility and modern communications. He stated that, "[t]his restructuring of the Engineer Command has tightened up the 'outfit', and improved control...the Army is heading for a quantum jump in command control made possible by modern air mobility, communications, and the 'IBM' machines,"[33] thus making the case for centralized control of engineer assets with fewer intermediate headquarters. The ENCOM's first priority, and about 40 percent of its effort, was to provide combat and operational support. Another fifty percent of its effort was to the Lines of Communication Program, which was working toward a goal of 4,076 kilometers of two-lane, all weather road connecting major population centers throughout Vietnam.[34]

Engineers from all Services made great efforts to meet the competing demands of providing mobility and sustainment facilities and, when needed, complementary support. However, by not having their efforts controlled by a joint engineer headquarters the three Services had redundant organizational structures providing the same type of support to MACV.

Desert Shield/Desert Storm

The U.S. has maintained an engineer presence in the Middle East since the 1950s, primarily in Saudi Arabia. From 1951 to 1956, USACE rebuilt the airfield at Dhahran, which was used by both U.S. Air Force and Navy aircraft.[35] In addition, "[t]hrough its Middle East Division (MED), headquartered in Riyadh, Saudi Arabia, the corps managed a design and construction program in Saudi Arabia that, by the late 1980s, totaled an estimated $14 billion."[36] In 1986, the Third U.S. Army signed a memorandum of agreement with USACE, establishing its role in providing engineer assistance. The MED was redesignated Middle East/Africa Projects Office (MEAPO) (now Transatlantic Programs Center) and its headquarters moved to Winchester, Virginia in the late 1980s. As the Department of Defense's construction agent in the Middle East, USACE, through MEAPO, provided engineering, procurement, and construction services for foreign defense forces and for other US government agencies.[37] When Saddam Hussein invaded Kuwait on 2 August 1990, the Saudis' positive experience with the Corps of Engineers helped convince them that they could trust the United States to respect their customs and defend their nation. This trust was critical to the successful execution of Desert Shield and Desert Storm.[38]

Shortly after the invasion, USACE deployed the deputy MEAPO commander with a cell of civilian personnel to execute contract, real estate, and construction management missions. As the only engineer command in theater, responsibility fell on the MEAPO-Southwest Asia (MEAPO-SWA) cell for executing contract construction and real estate requirements, which in the Third Army engineer's words were "immediate and massive."[39] Combat elements arrived in Dhahran "with no logistic structure to support them, no shelter in 120 degree heat and no sanitation facilities."[40] MEAPO-SWA was a theater asset under the operational control of CENTCOM and co-located with the CENTCOM engineer and the Regional Contingency Engineer Management (RCEM) team. The latter was a team composed of Service engineers who reviewed Service construction requests and recommended approval, priority, and construction method to the Deputy CENTCOM commander. Options for construction were military (Army, AF, Naval engineers), host nation contract, or the 100 million dollar Japanese-funded Gulf Peace Fund contract.[41]

Each Service primarily provided engineering support for its own forces. The AF deployed Prime BEEF teams with almost every flying squadron and one and a half RED HORSE squadrons. They provided air-conditioned tents, dining and bathroom facilities, and airfields for 1,200 aircraft and 55,000 AF personnel at more than 25 locations.[42]

The Marines operated along the Persian Gulf coast from existing bases. Engineer support was provided by the engineer battalion assigned to each of its two divisions in the theater plus four naval mobile construction battalions (Seabees) that were placed under the operational control of MARCENT. "Roughly 5,000 Navy Seabees built 14 mess facilities, a 40,000-person prisoner-of-war camp, 6 million square feet of aircraft parking aprons, 4 ammunition supply centers, and 4,750 other buildings. They improved and maintained 200 miles of unpaved four-lane highways in the desert."[43] The U.S. Navy basically stayed afloat and operated from established permanent bases in Bahrain.

The Army was slow to deploy engineer units to theater due to the higher priority of deploying "trigger pullers" and lack of available transport. The XVIII Airborne Corps' 20th Engineer Brigade arrived in October 1990 and "became the senior Army engineer headquarters, performing missions in both the forward and rear areas."[44] By late October, construction operations were hampered by a shortage of engineer equipment and personnel, and funding constraints for contracting. Local construction equipment available for leasing was poor quality and difficult to maintain. Four Naval mobile construction battalions and elements of the Air Force's RED HORSE civil engineering squadron were the only military construction assets available in the theater. "The only Army engineer units in Saudi Arabia were the 618th Engineer Company (Light Equipment) and the 27th Engineer Battalion (Airborne) from Fort Bragg, and the 887th Engineer Company (Light Equipment) from Fort Campbell."[45] As the build up of forces for offensive operations continued, the need for more engineer support was recognized and the 416th Engineer Command (ENCOM) was mobilized, deployed, and operating in Saudi Arabia by 12 December. It controlled only one brigade, the 411th, which supported operations at echelons above corps with two battalions and eight separate companies. The other two engineer brigades in theater, the 20th and 7th, remained under command of the XVIIIth and VIIth Corps, respectively. As shown in Table 2, only two battalions and eight companies were assigned to EAC engineer support by the end of Desert Shield.[46]

UNIT	EAC	VII	XVIII
Brigade Headquarters	1	1	1
Group Headquarters	0	3	3
Combat Heavy Battalion	2	3	4
Corps Combat (Mechanized)	0	5	0
Corps Combat (Wheeled)	0	2	5
Combat Support Equipment Company	2	2	1
Construction Support Company	3	0	0
Pipeline Construction Company	3	0	0
Medium Girder Bridge Company	0	1	1

TABLE 2. DESERT SHIELD ARMY ENGINEER STRUCTURE

"By the war's end, the engineer command and its units had built, upgraded, and maintained 2,000 miles of roads; installed approximately 290 miles of pipeline to move bulk petroleum; developed seven major logistics support bases; provided large-scale electrical power to critical facilities; and constructed four camps, which together could house as many as 100,000 prisoners of war."[47] Although a total of 23,681 engineers in 141 Army engineer units from the active (19,453) and reserve (4,228) components served in the Gulf, the shortage of construction engineers, particularly at EAC, led to a greater reliance on contractors. A CENTCOM engineer expressed "concern that U.S. forces risked becoming overly dependent on contractors."[48] Reliance on contractors for engineer support has continued for U.S. military operations throughout the rest of the decade.

Haiti

Engineer operations in Haiti were both combined and joint. During the initial deployment for Operation Uphold Democracy, the 41st Engineer Battalion staff became the joint task force engineer staff, with augmentation from both the Navy for real estate acquisition and the Air Force. The 20th Engineer Bridgade formed Joint Task Force (JTF) Castle, which provided command and control for all engineer assets in theater. JTF Castle included five engineer battalions, a RED HORSE squadron, a prime power detachment, and a Combat Support Equipment (CSE) company.[49]

Upon departure of the multi-national forces and assumption of duties of the U.N. Mission in Haiti (UNMIH) the engineers were organized under two commands. Under the U.N. flag there was a Canadian-American engineer battalion, which had a U.S. Army engineer headquarters and horizontal construction companies and Canadian vertical construction companies. Additionally Brown & Root provided engineer expertise under a U.N. contract. Under the U.S. Support Group Haiti there was a joint engineer force, which included about 150 Air Force RED HORSE personnel and 100 Navy Seabees to provide horizontal and vertical construction for civil-affairs projects.[50]

BG Anderson, dual-hatted as Deputy Commander of U.S. Forces Haiti and Commander of the U.S. Support Group Haiti, had several observations about joint and combined engineer operations. First was the "importance of joint engineer doctrine and our need to clearly understand joint engineer operations."[51] Second, on staff relationships and C2, the consensus was the JTF should have an independent engineer staff officer reporting directly to the commander and an independent command with all engineer organizations directly under the JTF commander, to be most responsive. Third, the value of multinational engineer operations was highly regarded: "Canadian engineers brought fantastic talent to the construction requirements in Haiti."[52]

Bosnia

A joint engineer force of over 2,400 personnel under the command of the Division's 1st Engineer Brigade accompanied the 1st Armored Division into Bosnia in Operation Joint Forge, December 1995. In addition to its two organic combat battalions, the brigade had diverse attachments, including "assault float bridge, combat support equipment, and power generating companies; fire fighting detachments; combat heavy and corps combat engineer battalions; as well as two U.S. Air Force REDHORSE squadrons and two U.S. Naval construction battalions."[53] In addition to bridging, route clearance, and countermine mobility operations; counter-mobility operations; and force protection survivability operations, the brigade constructed life-support facilities at 23 base camps in Hungary, Croatia, and Bosnia-Herzegovina. Military engineers quickly built essential facilities and turned them over to Brown and Root Services Corporation, under contract to USACE's Transatlantic Division (now Transatlantic Programs Center).[54]

In their second deployment, two years later, 1st Armored Division (AD) (Task Force Eagle) under the Stabilization Force (SFOR) actively engaged in demining and construction missions. Working closely with the United Nations (UN) Mine Action Center, supervising civilian demining operations, the engineers coordinated the military demining operations, which were transferred to the Bosnia-Herzegovina Mine Action Center. Combat engineers and special operations forces helped train and equip the Croatian and Serbian engineers for demining.[55]

Construction operations focused on airfield and road repair, hospital construction, and troop housing facilities. Housing facilities included construction of SEA-huts[56] to get soldiers out of tents. Another critical mission was working with the other government agencies, particularly U.S. Agency for International Development, developing projects to rebuild the nations' infrastructure and training Croatian and Serbian engineers to complete them. The engineer effort required all available resources, including military engineers from all Services, Brown and Root contractors, USACE expertise, and allied engineers and equipment.[57] Combined training and construction engineer operations, including those with Russian engineers were very successful in strengthening military to military contacts.[58] However, due to incomplete initial planning, the early efforts of military engineers and contractors were not synchronized, resulting in much of the initial base camp construction being relocated, and many facilities not being constructed for over two years after the initial deployment. Colonel Bostick, commander of the 1st AD engineer brigade, noting the synergistic effect of all of the engineer elements, said that in Bosnia "engineer teams designed and constructed several significant projects. Future operations must plan for these teams to come together quickly through a cadre of rapidly deployable experts."[59]

Kosovo

Kosovo-related operations represent the latest example of convoluted engineer C2 at the Unified Command/Joint Task Force level. Operation Noble Anvil, the U.S. portion of NATO's Allied Force operation against Serbia was primarily an air operation, but also included TF Hawk, an Army deep strike force from Albania and Operation Shining Hope, a humanitarian effort supporting NATO's Allied Harbour operation in Albania. The engineer-planning cell in JTF Noble Anvil was formed from an engineer officer from NAVFAC's Atlantic Command and a few Army and AF active and reserve officers. This small cell validated requirements, recommended allocation of engineer resources and construction priorities, and tracked status of construction projects and resources. Project planning and construction was executed by the Services using military engineers and contractors. In less than three months the results of engineer support of Noble Anvil's three operations were the following: for the air campaign, 75 projects on 14 bases in eight countries worth $21.8 million; for TF Hawk, basic troop facilities for 5,000 personnel, 58 helicopter pads, and 10.5 kilometers of roads at Tirana, Albania worth $38.8 million; and for TF Shining Hope, basic troop facilities for 1,000 personnel, seven airfield repair projects and two refugee camps in Albania worth over $40 million.[60] While these impressive results contributed to achieving the operation's objectives of removing the Serb military from Kosovo and returning Kosovo-Albanian refugees, the lack of theater-wide engineer planning by the Unified Command or the JTF and no joint/combined engineer headquarters resulted in duplication of C2 and contract effort, and competition for scarce resources. In the Balkans theater of operation, three Services were managing engineer operations using three separate contractors.

After the bombing campaign ended, Task Force Falcon deployed into Kosovo on 12 June 1999. Like Operation Joint Forge into Bosnia, a joint engineer force under the command of the 1st Infantry Division's Engineer Brigade provided mobility, survivability, and general engineering support to the force. Unlike in Bosnia, however, planners convinced decision makers at the beginning of the operation to construct wooden structures to reach base camp "end state" as fast as possible. Selection of the two base camp locations was aided by geologic data provided by USACE's Waterways Experiment Station and satellite imagery indicating possible underground water sources. The Engineer force of over 1750 assembled in Kosovo consisted of more than three battalions including a combat engineer battalion, a combat heavy battalion plus an additional company, two attached combat support equipment companies, and a Naval mobile construction (Seabee) battalion. Also attached to the brigade was a team of military and civilian engineers from USACE's Baltimore District. The USACE team, using video teleconferencing (tele-engineering) back to engineer districts in the U.S., integrated final requirements, assisted in final design, and ensured construction standards were met. Additionally, to complete the two base camps for over 7,000 troops in three months, approximately 1000 ex-pats hired by the contractor, along with over 7000 Albanian local nationals worked alongside the military engineers.[61] This operation is an example of joint engineering support using all available engineer assets under the control of a divisional engineer brigade serving as the TF Engineer.

The examples above demonstrate the tremendous amount of engineering support required for military operations and the need for early centralized planning and responsive execution by joint military engineers and contractors. For MTWs, engineer presence needs to be early to support deployment and forward movement of forces, and then provide facilities to sustain the force, potentially in an austere environment with little host nation infrastructure. For SSCs early planning and deployment of engineer assets are essential to get the right assets and facilities on the ground to accomplish the mission. To meet this requirement, the AF and Navy have retained active component (AC) and reserve component (RC) engineer construction assets proportional to the rest of the force. The Army retained a robust combat engineering capability in the AC force, but placed the bulk of its construction capability in the RC, as well as military staff expertise for planning and managing major projects. However, much of the RC engineer construction capability may not be available in sufficient time for early planning and execution.

FUTURE DIRECTION FOR ENGINEER SUPPORT

Future warfighting will be with smaller, more agile forces capable of rapid power projection from locations in the United States. Mobility and rapid execution will emphasize developing facilities early for air, sea, and land lines of communication and de-emphasize developing extensive base camps. In austere environments, host nation assets may not be available to accomplish this. Furthermore, contract support may not be available in the first few days of the conflict when rapid assessment and planning for engineering considerations by the CINC's staff is critical.

NATIONAL SECURITY STRATEGY

The President's National Security Strategy for a New Century stresses U.S. engagement and leadership abroad and states that we "must lead abroad if we are to be secure at home."[62] The three core objectives of the strategy are: enhancing American security, bolstering our economic prosperity and promoting democracy and human rights abroad. "Our strategy for enhancing U.S. security has three components: shaping the international security environment, responding to threats and crises, and preparing for an uncertain future."[63] An important element of shaping the international environment is through humanitarian assistance and humanitarian civic assistance, which includes projects for critical infrastructure, environment, and natural resources. Engineers have the expertise and capability to assist in these activities and are often the dominant military presence to organize and execute these missions.

Joint Vision 2010 "embodies the improved intelligence and command and control available in the information age and develops four operational concepts: dominant maneuver, precision engagement, full dimensional protection, and focused logistics."[64] Execution of these concepts requires engineer forces that are flexible and mobile to provide the infrastructure to deploy and sustain the forces needed to "dominate the full range of military operations from humanitarian assistance, through peace operations, up to and into the highest intensity conflict."[65]

SHAPING – CINCS' THEATER ENGAGEMENT PLAN (TEP)

The Unified Command Plan requires Geographic Unified Commands to develop Theater Engagement Plans (TEPs) for shaping the international security environment. U.S. national security includes ensuring the well being and prosperity of the nation by promoting democracy and free markets around the world, ensuring access to raw materials and markets for products. Shaping requires a long-term commitment to allies and friendly transitional nations through diplomacy, international assistance, and military activities, including overseas presence and peacetime engagement.

Military peacetime engagement activities include humanitarian civic assistance (HCA) (nation building), environmental planning, humanitarian assistance (HA), and military training exercises and information sharing. Humanitarian civic assistance activities are directed toward assisting transitional nations develop their infrastructure to stabilize the government, operate free market economies, and improve the standard of living for their people. Water supply and quality and demining are high concerns in many parts of the world. Industrial pollution and agricultural mismanagement, as well as overcrowding, create unique environmental challenges to the international community. These issues are addressed at Environmental Engagement Conferences attended by the Unified Commands. State partnership programs, which include HCA construction projects, are also included in the TEP. Preparing to respond quickly to natural and manmade disasters with medical and engineering humanitarian assistance, particularly with the increasing threat of Weapons of Mass Destruction, is another critical element of the TEP. Finally, combined military training exercises with exercise related construction contribute to U.S. forward presence and peacetime deterrence and foster interoperability training with partnership military engineers and contractors.

As demonstrated in Central and South America, these programs can be very effective in promoting economic growth and democracy and should be pursued. But, they are also engineer resource intensive and exceed the capacity of available military engineers. This offers an excellent opportunity for military led partnerships with construction and heavy equipment contractors to complete projects that shape the environment during peacetime engagement and prepare to respond in crises.

RESPOND

"Since Operation Urgent Fury in Grenada in 1983, Army engineers have supported more than 100 joint deployments for training, war, and operations other than war (OOTW). All of these deployments involved joint service engineer forces."[66] To plan effective engineer support for these operations, the CINC, or Task Force Commander should have an experienced military engineering staff, including real estate, geotechnical, water, and power experts.

Major Theater of War Missions

The purpose of the military is to deter and win our Nation's wars. Military engineers play a significant role in the deployment; reception, staging, onward movement, and integration (RSOI); combat operations; sustainment; and redeployment for a MTW. Host nation support and an established infrastructure may or may not be present. Contract logistics and engineering services will be a major element of the fight, but may not be available initially to support the combat forces. Ideally, contractors would be brought in as soon as the enemy (tactical) situation allows. Military engineers must be trained and deployable to provide the initial deployment and bed-down facilities and continue to support the development and maintenance of lines of communications.

Smaller Scale Contingencies (SSC)

The spectrum of military operations from peacetime engagement up to major theater of war, including peace keeping operations and humanitarian assistance, requires a wide range of engineering support.

Peace Keeping Operations

Peace keeping operations (PKOs) are inherently combined operations, normally under the UN or another collective multi-national authority. Typically these operations have been conducted in a relatively benign environment, allowing contractors to deploy with the PKO forces to build necessary support facilities, while military engineering efforts are focused on demining, initial force protection, and mobility operations. The U.S. model since Somalia has been to build a secure base camp from which forces operate. Contractors are well suited to operating in this environment and may reduce the military "footprint". However, the CINC, or Task Force Commander should still have an experienced military engineering staff to recommend locations and standards for base camps and prepare designs.

Humanitarian Assistance

Each geographical CINC develops contingency plans to respond to natural and manmade disasters within their Area of Responsibility (AOR). Speedy response to a crisis is essential for credibility of the host nation government and the relief agencies. This should include rapidly deployable assets to assess the situation and begin coordinating relief efforts. Since these operations inherently involve extensive engineering operations, the Humanitarian Assistance teams should have adequate communications with reach-back capability to tap into national military or preplanned contingency contract technical expertise and available construction assets. Additionally, such operations offer excellent training for military engineers.

Military Assistance to Civil Authorities

Military Assistance to Civil Authorities covers support functions to civilian authorities in responding to disasters and civil unrest in the U.S. Public Law (PL) 84-99, the Flood and Coastal Storm Emergencies Act, provides legal authority for USACE to fight floods and provide emergency water supplies. PL93-288, the Robert T. Stafford Disaster Relief and Emergency Assistance Act, authorizes mobilizing federal resources to assist state and local governments' response and recovery from a major disaster or domestic emergency. The Federal Response Plan (FRP), consisting of 12 emergency support functions (ESF) coordinates delivery of federal assistance to state and local governments. DOD supports all 12 ESFs and has the federal lead for ESF #3, Public Works and Engineering, for which it designated

USACE the planning and operating agent. For restoring essential public services and facilities, USACE developed an extensive pre-emptive command and control structure and response units equipped to support the Federal Emergency Management Agency (FEMA). At USACE, a security, plans and operations (SPO) office operates 24 hours a day, seven days a week providing intelligence and command and control (C2). As required it deploys a crisis management team (CMT) anywhere in the world with subject matter expert augmentation. Planning and response teams (PRT) from the divisions and districts are on call to respond to emergencies worldwide to provide power, water, structural and housing assistance. Uploaded vehicles and fly-away kits with sets of computer and communications equipment are pre-positioned across the country to be used as C2 nodes to coordinate with DOD and other federal and state agencies. Response contracts are in place to provide services and supplies such as ice, water, power, and debris removal. Fully Integrated with FEMA, USACE responds to disasters and provides engineer services to the Nation under its own emergency authorities and as FEMA's engineer under the Federal Response Plan.[67]

PREPARE: JOINT DOCTRINE/TRAINING/EQUIPMENT

A significant amount of work has been done on joint engineer doctrine in the late 1990s, particularly Joint Pub (JP) 3-34 – Engineer Doctrine for Joint Operations, and JP 4-04 – Joint Doctrine for Civil Engineering Support. JP 3-34 addresses an issue that has surfaced in every operational deployment after action review, the placement of the engineer cell on joint staffs. The Joint Force Commander (JFC) is provided options of placing the engineer cell under the J-4, J-3, or creating a separate special staff. It also permits task-organizing engineers under functional components, service components, or as a subordinate joint engineer force.[68] Likewise, Army doctrine in FM 100-16, Support Operations: Echelons Above Corps, does not mandate that an Army Service Component Commander place engineer forces under the Logistics Support Command. Lessons learned from Operations in Haiti, Somalia, and Rwanda all conclude that creating a separate engineer staff and, for engineer intensive operations, placing the engineers under an engineer headquarters reporting directly to the JFC are best for responsive engineer support to the Joint Task Force.[69] Doctrine gives the commander the flexibility to task organize and staff the JTF headquarters in this way as required.

Joint training has been a major initiative in establishing joint engineer operations. As a result, equipment operators and construction trade skills are being taught jointly at the Army, Navy, and Air Force training centers. A recurring AAR comment is that the Services need to learn more about the capabilities of the other Services.[70] Cross assignment of engineers in other Services' engineer organizations would help achieve this. To enhance interoperability and reduce costs, all Services should jointly purchase common commercial equipment.

ENGINEER SUPPORT OPTIONS

General engineering to support force deployment, RSOI, and bed-down is the primary focus for engineer support at the operational level of war. In addition, for SSCs, general engineering may be an essential element of the concept of operations. The historical examples show the importance of engineers to the success of all operations. Unfortunately, however, the historical record shows that engineer support has not been thoroughly planned and integrated into operational plans and has often been slowly executed due to lack of timely resources. As noted in the National Security Strategy, future joint military operations require that engineering considerations be an integral part of the CINCs' military operations and theater engagement planning. Adequate deployable military and contractor engineer resources should be available to support the force in accordance with JV2010's operational concepts of dominant maneuver and focused logistics. Table 3 shows the available types of assets and current alignment.

ECHELON	ENGINEER HQ	COMPO**	C2***
NCA*/DOD	Army – USACE Navy – NAVFAC	A A	Organic Organic
Unified Commands	USACE/NAVFAC Divisions Districts, Eng Field Activities	A A	Letter agreements
Sub-Unified Cmds/JTF Service Components	ENCOM Army/Navy Bdes/Regiment	R A/R	A/O A/O
Army Corps	Bde/Groups	A/R	A/O/S
Army/Navy Div; AF Wing	Div Bde, Bn, Squadron	A/R	A/O/S
*NCA – National Command Authority	**COMPO Component: ***C2 Command & Control:	A Active A Assigned S Support	R Reserve O OPCOM

TABLE 3 – ENGINEER SUPPORT ALIGNMENT

Military engineer assets are limited in the active component (AC) with only 18 battalion-equivalent construction battalions, plus some additional separate companies and units in all Services. The additional 49 battalion-equivalents in the reserve component (RC) have been called upon frequently to augment the AC in engineer intensive operations. The U.S. strategy of engagement and force projection will continue to place a tremendous requirement for engineer services on these units. This, combined with the inevitable competition with "bullet launchers" in the force composition and deployment queue, challenges the engineer community to creatively maximize use of all available military and civilian national engineer assets. A robust planning headquarters for centralized planning and management of engineer operations and decentralized execution is needed. Three options exist for meeting that challenge: enhance military engineering command and control (C2) capability, rely on contractor engineer planning and execution, and leverage the existing engineering command structure and capability.

ENHANCE MILITARY ENGINEERING C2 CAPABILITY

One alternative for providing a robust C2 headquarters is to create an AC brigade headquarters or Engineer Command (ENCOM) and assign it to Joint Forces Command as a deployable headquarters.

Existing or new AC Army or Navy brigades/groups/regiments could be assigned as required to the other geographical CINCs. An option for the Army is to convert combat engineer divisional brigade and battalion structure, cut from divisions with the proposed medium brigades, into theater army engineer brigade headquarters.

The advantages of military, as opposed to civilian contractor, engineers are worldwide deployability, force protection, and robust C2. Having an operational level organic AC military engineer headquarters with military construction units would allow Unified Commands to plan full spectrum operations with engineer support that is deployable and employable in any environment against any threat. Planners need not be constrained by contract limitations and restrictions on when and where contractors can be employed. Military engineers can also provide their own security, and if necessary, fight as infantry.

There are, however, disadvantages to "growing" sufficient AC engineer headquarters. The personnel and financial cost to resource new units is prohibitive in today's fiscally constrained environment. Second, the required engineering skills may not be sufficient for sophisticated construction projects in these headquarters where military construction skills are limited to austere base camp construction and rudimentary HCA projects. Also, there is a lack of contract administration and supervision skills in these units. And finally, the headquarters may have a Service rather than a joint focus in planning and allocating resources.

While unlikely that any of the Services will significantly increase its engineer force to meet the engineer demands imposed by the U.S. engagement strategy, further considerations should be given to the mix of AC/RC engineers and the composition of our military construction force. Army divisional engineer brigades and NCF regiments can, if augmented by USACE and NAVFAC technical and contract support, effectively provide engineer support for division-size SSC operations. In Bosnia and Kosovo, Army brigades functioned effectively as JTF engineers, controlling construction engineer units and contractor operations. Similarly, for Hurricane Mitch humanitarian assistance, a Navy Seabee regiment provided C2 for all of the engineer effort.

PRIMARY RELIANCE ON CONTRACTOR SUPPORT

Another option is increased reliance on contractor support for engineer services. All services have recognized the need for contractor augmentation and have a civil augmentation program contract in place to provide preplanned contingency construction. Since Vietnam, contractors have been essential in constructing and maintaining infrastructure in the theater of operations to support American military operations. In the Gulf War and military operations since, contractors have provided bases, routes, and other critical infrastructure. The Army's worldwide LOGCAP contract, developed in 1992, has been used in at least six operations since Restore Hope in Somalia. LOGCAP requires that a contractor provide all supplies and support, including designing, constructing, operating, and maintaining facilities. Using design-build engineer services, administered through logistics channels in a requirements contract, the task and associated risk of planning, resourcing, and constructing is placed on the contractor. A commander need only state his requirement, e.g., a base camp for 10,000 personnel. The Army formalized contracting (LOGCAP) as a component (COMPO 9) for resourcing force requirements in Total Army Analysis 07 (TAA07).[71] The Air Force and Navy meanwhile have retained a robust construction capability in the active force while establishing engineer civilian augmentation contracts for SSC operations.

The advantages of contract support are that contractors can fill the void of inadequate engineer assets while being outside of the force structure ceilings and being self-deploying and self-sustaining. Most contingency operations have caps for U.S. military forces, but contractors are not counted against those ceilings, consequently they represent a tremendous force multiplier. The contract is global, requiring the ability to mobilize anywhere in the world as well as subcontract locally for services and resources. Using foreign flag carriers and pre-positioned assets, the contractor can self-deploy without tying up U.S. assets. And finally, except in the most austere environment, contractors are self-sustaining for administration, shelter, equipment, and supplies.

There are costs and risks associated with total dependence on contractors: response to hostile environments, flexibility, early planning input, and loss of military capability. Experience with contracting in the 1990s has been in relatively benign environments. Even in the Gulf War, by the time contractors began construction work the major threat of an Iraqi invasion into Saudi Arabia had been reduced. Plans called for military engineers to go into Iraq and leave contractors in Saudi Arabia. So the question remains what will happen when casualties occur or are expected from conventional weapons or weapons of mass destruction. In the Sinai, Egyptian contract workers stayed home from work at the Multi-national Force and Observer's northern base camp when Desert Storm commenced. Will the U.S. pay a premium for the risk of contractor employees on the battlefield? Once operations begin, can assets be deployed fast enough to provide early force entry and sustainment? Will they be available in sufficient numbers? There is also a lack of flexibility because the contract process is slow in responding to immediate needs. As an example, in the Gulf War "ARCENT contracted for six life support areas and for helipads and heliports when units were concentrated along Saudi Arabia's eastern corridor. Then when VII Corps arrived, ARCENT repositioned the forces for an offensive action. Contractors who had just begun work could not respond to the change."[72] Another risk is having limited engineer analysis, or contractor input without experienced military oversight, injected into the early planning for key issues such as location, design standards, and utilities. Experienced engineer planners, assigned to the command and familiar with the area of operation, need to be involved early in the planning process. A final risk is the loss of military engineering expertise. While contracting services may be the best solution for SSC operations, it may not be acceptable for a MTW, due to a hostile environment or other considerations. If enough military engineer units have not trained to perform general engineering tasks, they may not be available or able to accomplish these tasks when called upon to execute missions contractors can't or won't.

After the Gulf War, "[s]enior engineers agreed that contractors were a valuable and sometimes essential means of supplementing troop construction, but they should and could not replace troops."[73]

Contracting should always include local contractors and vendors who can provide engineering materials and services at competitive prices. At the same time, however, an overall engineering headquarters should be in charge to monitor the use of critical resources and ensure that Services are not competing against each other for the same services and supplies. Thus, an engineer headquarters at Unified Command and JTF level should be involved in the early planning and execution of every operation.

EXISTING USACE AND NAVFAC ORGANIZATIONS

USACE and NAVFAC are national strategic engineering assets. Joint Pub 3-34 states that USACE and NAVFAC "provide the JFC a significant engineering capability to be leveraged in operations. USACE and NAVFAC are DOD's principal engineer organizations for planning, designing, constructing, and acquiring (leasing or buying) facilities and real estate."[74] As discussed above, USACE serves as the Nation's engineer, supporting FEMA in responding to disasters in the United States. One approach to centralizing DOD's engineer assets would be to form a joint engineer command to control all Services' engineers.[75] But with the large Service engineer construction missions, this is a concept whose time has not come. Both NAVFAC and USACE currently plan, design, and build military facilities worldwide.[76] In the absence of a joint engineer command, these commands, supported by the Air Force and Marines, could jointly perform the role of DOD's engineer for executing its 'shape', 'respond', and 'prepare' missions around the world. Engineer division commanders could be the CINCs' engineers and provide technical teams to augment the Unified Commands' engineer cells. Subordinate engineer districts and field activities could provide Service or functional component commanders with engineer planning and, if necessary, execution headquarters. Forward deployed, these headquarters can respond anywhere with minimal DOD strategic lift, while tapping into the technical capabilities of CONUS-based laboratories and centers of expertise through tele-engineering.[77] Command of engineer tactical units would normally remain under TOE headquarters, e.g., brigade or regiment.

Concept

An engineering division from NAVFAC or USACE would be designated as the CINC's engineer and lead organization for providing engineer support to augment the CINC's organic engineer staff cell. The other Services would coordinate their support in the CINC's AOR through the lead engineer division except for Service-related construction. Regular coordination would be maintained between the CINC and the MSC including: representation at staff meetings, fulltime engineer cell augmentation, and a crisis response unit for planning and execution. A possible alignment of Unified Commands and Engineer MSCs is shown in Figure 4.[78] Support to Joint Forces Command (JFCOM), a force provider also tasked with the missions of homeland defense and joint training and doctrine, could best be provided by a joint engineer task force (JETF). The JETF comprised of military engineers and civilian technical experts could provide a deployable joint C2 headquarters providing contracting and technical support and training.

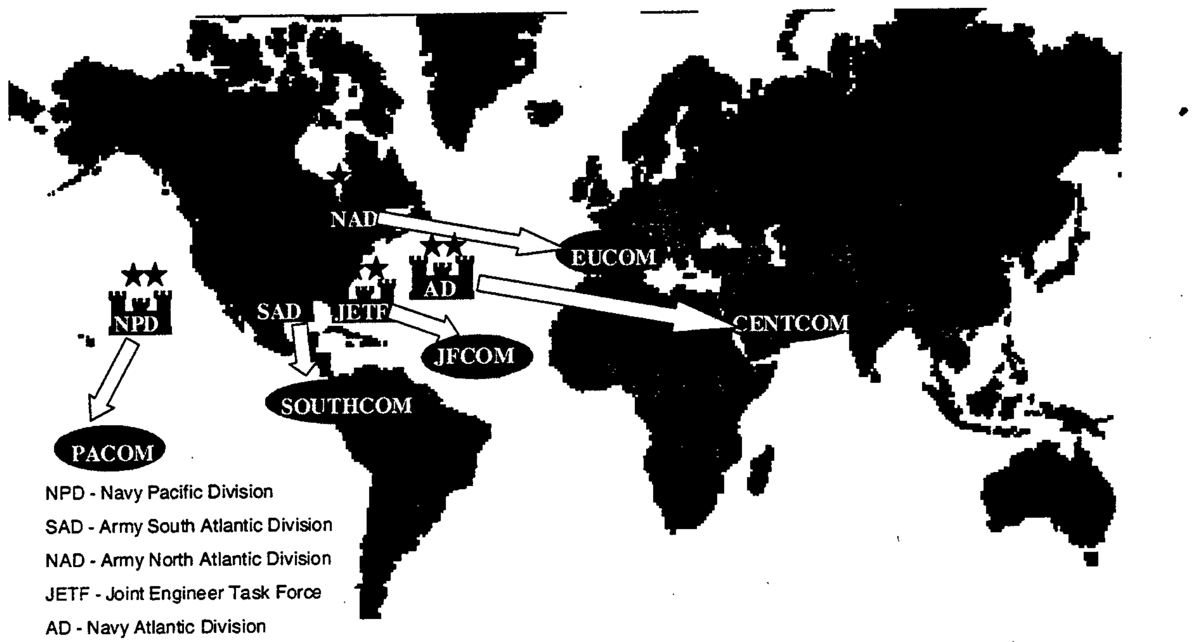

FIGURE 4 - ENGINEER SUPPORT ALIGNMENT

Command of the engineer divisions would remain under Service channels, except for JETF, which would be assigned to JFCOM. In a support relationship, the engineer commanders would have access to the CINC as a principal special staff officer. In addition, permanent division staff person would be assigned to the CINC's engineer cell to provide liaison and expertise in normal operations and crisis response. Existing Districts and Engineer Field Activities (EFAs) would continue to provide forward presence engineers for peacetime engagement, MILCON, and humanitarian civic assistance. They could also provide early response for humanitarian assistance and other military operations. By maintaining worldwide databases and developing experience and relationships with public and private sectors in foreign countries, these units could provide valuable contacts and information for planning contingency operations.

Engineer divisions have military commanders, deputies, and a few staff officers. Their staff is structured functionally, similar to a TOE division headquarters, with civilian leadership and staff. The staff would be augmented with reserve officers who could be activated and deployed to provide logistics and administrative functions not normally available in the engineer divisions. During an emergency, a crisis response unit (CRU) could be deployed from the division, led by the deputy commander, if required, and augmented by forward deployed district/EFA personnel and other engineer assets from all Services. The CRU would be largely self-deployable with necessary communications and computer equipment. Although a CINC asset, the CRU could also support a JTF or component command for planning and executing real estate, construction, and contracting activities. It could also function as the CINC's Regional Contingency Engineering Manager for an entire operation or until another headquarters such as an Engineer Command is operational. Additionally, the CRU could support the various boards, which the

CINC may establish to manage engineer activities,[79] and assist in preparing the Civil Engineering Support Plan (CESP) and the environmental considerations of the CINC's CONPLANs and OPLANs.[80]

Authority and funding for construction projects are always important legal and practical issues. DOD has designated geographic Contingency Construction Agent responsibilities to the Services (primarily Army and Navy), which are not currently aligned with the Unified Commands. These should be aligned with the Service lead for support to the CINC. Additional authorities are in Title 10 and 22, USC.[81] Some authorities cap the amount that can be spent on each project. For example, HA and HCA projects can not exceed $300,000.[82] The Services have the ability to shift operations and maintenance funding to support a theater of operations, provided Congress has not prohibited such use as they did in Bosnia. USACE and NAVFAC, as DOD's construction agents are best suited to determine the legal limitations and funding mechanisms for these projects.

RECOMMENDATIONS

Early assessment and planning for engineer considerations in deliberate and crisis action planning is critical for any operation. Once operations begin a mix of contractor and military engineering resources should be deployed early. Coordinating this effort is beyond the capability of a Unified Command's small engineer cell. To augment that staff, an active duty engineer headquarters with a senior (general officer) commander and robust technical staff is needed. The USACE and NAVFAC headquarters and subordinate divisions, if augmented with RC staff, can provide that function. Aligning the divisions with a CINC could provide support for peacetime engagement that would transition to SSCs and wartime operations without duplication of effort by the Services. They can also best manage the deployment of RC and AC echelon above corps military engineer units through coordination with their assigned MACOMs to ensure a trained and ready force of military engineers.

WORD COUNT = 10,114

ENDNOTES

[1] Janet A. McDonnell, Supporting the Troops: The U.S. Army Corps of Engineers in the Persian Gulf War, (Alexandria, Virginia: Office of History U.S. Army Corps of Engineers, February 1996), 13.

[2] General John M. Shalikashvili, "Joint Vision 2010," in U.S. Army War College Selected Readings Academic Year 2000: Course 1 Strategic Leadership Volume II, (Carlisle, PA, 1999), 351.

[3] "The Regiments," Army (March 1990): 55.

[4] Ibid., 56.

[5] Ibid.

[6] Ibid., 58.

[7] Department of the Army, Decisive Force: The Army in Theater Operations, FM 100-7 (Washington D.C.: U.S. Department of the Army, 31 May 1995), A-15.

[8] "Engineer Force Structure Master List," U.S. Army Engineer School, 18 March 2000.

[9] George Hays, "Army and Air Force Military Construction for FY 2000," U.S. Army Corps of Engineers News, II, no. 3, (September/October 1999): 3-4.

[10] "Interagency and Intergovernmental Support Program," n.d.; available from <http://www.hq.usace.army.mil/cecs-i/IISWWW/Web399/iishmpg.htm>; Internet; accessed 21 February 2000.

[11] Active U.S. map of USACE, n.d. ; available from <http://www.usace.army.mil/inet/locations/bdry-pages/>; Internet; accessed 17 December 1999.

[12] Corps of Engineers Military Boundaries, n.d.; available from <http://www.usace.army.mil/inet/locations/bdry-pages/>; Internet; accessed 17 December 1999. MILCON districts include Europe (Germany), New York, Baltimore, Norfolk, Savannah, Mobile, Louisville, Little Rock, Tulsa, Kansas City, Omaha, Ft. Worth, Albuquerque, Los Angeles, Sacramento, Seattle, Far East (Korea), and Japan.

[13] Waterways Experiment Station at Vicksburg, Mississippi; Construction Engineering Research Laboratory at Champaign, Illinois; Cold Region Research and Engineering Laboratory at Hanover, New Hampshire; and Topographic Engineering Center at Ft Belvoir, Virginia.

[14] The U.S. Army Engineering and Support Center at Huntsville, Alabama; the Transatlantic Program Center at Winchester, Virginia; the Humphreys Engineer Center Support Activity at Ft Belvoir, Virginia; Marine Design Center; and the Water Resources Support Center.

[15] "Seabee History: Introduction," n.d.; available from <http://www.history.navy.mil/faqs/faq67-2.htm>; Internet; accessed 25 January 2000.

[16] Ibid.

[17] "Seabee History: Formation of the Seabees and World War II," 13 November 1997; available from <http://www.history.navy.mil/faqs/faq67-3.htm >; Internet; accessed 25 January 2000.

[18] "Seabees We Build, We Fight," n.d.; available from <http://www.chinfo.navy.mil/navpalib/factfile/personnel/seabees/seabee1.htm>; Internet; accessed 3 December 1999.

[19] Elain McNeil, "NAVFAC Facts," n.d.; available from <http//www.navfac.navy.mil/hqorg.htm>; Internet; accessed 25 January 2000.

[20] "Seabees We Build, We Fight," n.d.; available from <http://www.chinfo.navy.mil/navpalib/factfile/personnel/seabees/seabee1.htm>; Internet; accessed 3 December 1999. Plans for Seabee support of two MTWs require 17 NMCBs, leaving the remaining three to continue support to the fleets.

[21] "Navy Seabees and the Civil Engineer Corps: Providing Skills for the Joint Environment," Engineer, PB 5-94-4 (December 1994): 15.

[22] Elain McNeil, "NAVFAC Facts," n.d.; available from <http//www.navfac.navy.mil/hqorg.htm>; Internet; accessed 25 January 2000. NAVFAC functions include planning; facilities, energy, and utilities management; environmental services; fire and emergency services and transportation support for Navy and Marine Corps public works offices and centers. Other NAVFAC agencies include the Naval Facilites Engineering Service Center, Seabee Logistics Center, and Navy Crane Center

[23] Ronald B. Hartzer, "A Horse with Wings: RED HORSE History," n.d.; available from <http://www.malmstrom.af.mil/819rhs/redhors.html>; Internet; accessed 17 February 2000.

[24] "AFCESA Fact Sheet," n.d.; available from <http//www.afcesa.af.mil>; Internet; accessed 17 February 2000.

[25] "Factsheet: Civil Engineer RED HORSE Squadrons," September 1996; available from <http://www.afcesa.af.mil/Directorate/ES/Factsheet/redhorse.doc>; Internet; accessed 21 February 2000.

[26] "Seabee History: Formation of the Seabees and World War II," 13 November 1997; available from <http://www.history.navy.mil/faqs/faq67-3.htm>; Internet; accessed 25 January 2000.

[27] Roy E. Appleman, et al, The War in the Pacific Okinawa: The Last Battle, (Center of Military History, US Army Washington, DC, 1984) 11.

[28] Lieutenant General Robert C. Richardson Jr., "Participation in the Okinawa Operation," in U.S. Army Forces in the Pacific Ocean Areas, Vol I (Washington, D.C., July 1948), 58.

[29] "Seabee History: Formation of the Seabees and World War II," 13 November 1997; available from <http://www.history.navy.mil/faqs/faq67-3.htm>; Internet; accessed 25 January 2000.

[30] "Seabee History: Southeast Asia," 13 November 1997; available from <http://www.history.navy.mil/faqs/faq67-5.htm>; Internet; accessed 25 January 2000.

[31] HQ AFCESA/CEX, "RED HORSE Deployment," n.d.; from <http//www.afcesa.af.mil>; Internet; accessed 21 February 2000: 24-25.

[32] Department of the Army, U.S. Department of the Army Assistant Chief of Staff for Force Development. Debriefing of Senior Officers: MG Charles C. Noble (Washington D.C.: U.S. Department of the Army, 21 October 1971), 1.

[33] Ibid., 1-2.

[34] Ibid., 7.

[35] Lieutenant General Henry J. Hatch and Janet A. McDonnell, "Corps of Engineers: Laying the Groundwork for Theater Operations," Military Review LXXII (March 1992): 3.

[36] Janet A. McDonnell, Supporting the Troops: The U.S. Army Corps of Engineers in the Persian Gulf War (Alexandria, Virginia: Office of History U.S. Army Corps of Engineers, February 1996), 34.

[37] Ibid., 39.

[38] Ibid., 35.

[39] Ibid., 19.

[40] Ibid., 5.

[41] Ibid., 84-85.

[42] Ibid., 13.

[43] Ibid., 13-14.

[44] Ibid., 19.

[45] Ibid., 22-23.

[46] Ibid., 26.

[47] Ibid., 28.

[48] Ibid., 30.

[49] Captain Darren Klemens and Captain Kelly Slaven, "Task Force Castle: Joint Engineer Operations in Haiti," Engineer, PB5-95-1/2 (April 1995): 36-38.

[50] Brigadier General Phillip R. Anderson, "Engineer Roles in Stabilizing Haiti," Engineer, PB-96-1 (March 1996): 24.

[51] Ibid., 27.

[52] Ibid.

[53] Major David L. Treleaven, "Engineers in Bosnia," Engineer, PB-96-1 (March 1996): 19.

[54] Ibid.

[55] Colonel Thomas P. Bostick, "Bosnia: The Second Time Around," Engineer Professional Bulletin, 29 (April 1999), available from <http://www.wood.army.mil/ENGRMAG/PB5992/bostick.htm; Internet; accessed 21 February 2000: 1-2.

[56] Ibid., 4. SEA-hut is short for Southeast Asia hut modeled after Vietnam era field barracks construction. Each 32- by 92-foot plywood construction SEA-hut includes a latrine and five rooms for six to eight people.

[57] Ibid., 5-8.

[58] William H. Haight III and Leonid I. Ysik, "Building Bridges Between Nations," Engineer Professional Bulletin 29 (April 1999): 6.

[59] Colonel Thomas P. Bostick, "Bosnia: The Second Time Around," Engineer Professional Bulletin, 29 (April 1999), available from <http://www.wood.army.mil/ENGRMAG/PB5992/bostick.htm; internet; accessed 21 February 2000: 5.

[60] Commander Eric S. Odderstol, "Joint Task Force Noble Anvil: Chief Engineer Brief," briefing slides, Norfolk, VA, Naval Facilities Engineering Command, 31 March 2000.

[61] Colonel Robert L. McClure, "The Engineer Regiment in Kosovo," Engineer, 30 PB 5-00-2 (April 2000): 8-9.

[62] William J. Clinton, "A National Security Strategy for a New Century," December 1999; available from <http://www.pub.whitehouse.gov/uri-res/I2R?urn:pdi://oma.eop.gov.us/2000/1/7/1.text.1>; Internet; accessed 31 January 2000: 6.

[63] Ibid., 7-8.

[64] General John M. Shalikashvili, "Joint Vision 2010," in U.S. Army War College Selected Readings Academic Year 2000: Course 1 Strategic Leadership Volume II, (Carlisle, PA, 1999), 328.

[65] Ibid., 352.

[66] Vern Lowery, "Lessons Learned: Joint Engineer Operations," Engineer Professional Bulletin, PB 5-95-3 (August 1995): 46.

[67] Lieutenant Colonel David S. Cottrell, Contingency Operations District/Division Commander's Workbook, Washington, D.C. 16 August 1999: 15-28.

[68] The Joint Staff, Engineer Doctrine for Joint Operations, Joint Pub 3-34 (Washington D.C.: The Joint Staff, coordination draft 15 November 1999), II-7.

[69] Vern Lowery, "Lessons Learned: Joint Engineer Operations," Engineer, PB 5-95-3 (August 1995): 47.

[70] Ibid.

[71] Jim Camp, "Total Army Analysis (TAA)," briefing slides, Fort Belvoir, Army Force management School Action Officer Force Integration Course, 26 March 1999.

[72] Janet A. McDonnell, Supporting the Troops: The U.S. Army Corps of Engineers in the Persian Gulf War (Alexandria, Virginia: Office of History U.S. Army Corps of Engineers, February 1996), 192.

[73] Ibid., 193.

[74] The Joint Staff, Engineer Doctrine for Joint Operations, Joint Pub 3-34 (Washington D.C.: The Joint Staff, coordination draft 15 November 1999), I-7.

[75] Colonel Jerry L. Anderson and Colonel James H. Robinson, "Joint Forces Engineer Command: A Proposal," Engineer, PB 5-95-1/2 (April 1995): 18. Colonels Anderson and Robinson proposed making one the Army's ENCOMs a Joint Engineer Headquarters to control all of the Services' engineers.

[76] USACE supports the CINCs with district offices in Germany, Korea, and Japan, and local area offices in Central and South America and the Middle East, providing engineer services in 90 countries.

[77] Colonel Robert Slusar, "USACE Engineering Services," briefing slides, HQUSACE, Washington, D.C., 14 February 2000.

[78] Ibid.

[79] The Joint Staff, Engineer Doctrine for Joint Operations, Joint Pub 3-34 (Washington D.C.: The Joint Staff, coordination draft 15 November 1999), II-6-II-8. These boards include: Joint Civil-Military Engineer Board (JCMEB) Joint Facilities Utilization Board (JFUB), Joint Environmental Management Board (JEMB)

[80] Ibid., III-5.

[81] Title 10, USC Emergency Construction, Contingency Construction, Unprogrammed Minor Construction, War/National Emergency, Damaged Destroyed Facilities, Humanitarian Assistance; Title 22, Foreign Assistance and DOD Emergency, Contingency, and Other Unprogrammed Construction Projects

[82] Department of Defense, "DOD Emergency, Contingency, and Other Unprogrammed Construction Projects," Directive 4270.36, (Washington, D.C., 17 May 1997), 1-3.

BIBLIOGRAPHY

Active U.S. map of USACE. Available from <http://www.usace.army.mil/inet/locations/bdry-pages/>. Internet. Accessed 17 December 1999.

"AFCESA Fact Sheet." Available from <http//www.afcesa.af.mil>. Internet. Accessed 17 February 2000.

Anderson, Jerry L., Colonel. and Colonel James H. Robinson. "Joint Forces Engineer Command: A Proposal," Engineer, PB 5-95-1/2 (April 1995): 17-19.

Anderson, Phillip R., Brigadier General. "Engineer Roles in Stabilizing Haiti." Engineer, PB 5-96-1 (March 96): 23-27.

Appleman, Roy E., et al. The War in the Pacific Okinawa: The Last Battle. (Center of Military History, US Army Washington, DC, 1984).

Berndt, Martin R., Major General and John A. Clauer. "The USACOM Joint Warfighting Center." Engineer, (April 1999): 1-7 Database on-line. Available from UMI ProQuest Direct, Bell & Howell, UMI publication no. 00461989.

Bostick, Thomas P., Colonel. "Bosnia: The Second Time Around." Engineer, 29 PB 5-99-2 (April 1999). Available from <http://www.wood.army.mil/ENGRMAG/PB5992/bostick.htm>. Internet. Accessed 21 February 2000.

Camp, Jim. "Total Army Analysis (TAA)." Briefing slides. Fort Belvoir, Army Force management School Action Officer Force Integration Course, 26 March 1999.

Clinton, William J. "A National Security Strategy for a New Century." Washington, D.C.: The White House, December 1999. Available from <http://www.pub.whitehouse.gov/uri-res/I2R?urn:pdi://oma.eop.gov.us/2000/1/7/1.text.1>. Internet. Accessed 31 January 2000.

Cottrell, David S., LTC, Contingency Operations District/Division Commander's Workbook, Washington, D.C. 16 August 1999.

Davis, Scott, SSgt. "Prime BEEF Improves Joint Forge QOL. Soldiers, 54, no. 6 (June 1999): 9. Database on-line. Available from UMI ProQuest Direct, Bell & Howell, UMI publication no. 00938440.

Department of Defense, "DOD Emergency, Contingency, and Other Unprogrammed Construction Projects," Directive 4270.36, (Washington, D.C., 17 May 1997).

Department of Defense, "Military Construction Responsibilities," Directive 4270.5, (Washington, D.C., 2 March 1982).

"Factsheet: Civil Engineer RED HORSE Squadrons." September 1996. Available from <http://www.afcesa.af.mil/Directorate/ES/Factsheet/redhorse.doc>. Internet. Accessed 21 February 2000.

Finney, Dana. "Kosovo Base Camps: In the August meltdown, the Army readied for Snow." Engineer, 30 PB 5-99-4 (November 1999). Available from <http://www.wood.army.mil/engrmag/PB5994/finney.htm>. Internet. Accessed 21 February 2000.

Haight, William H., III, and Leonid I. Ysik. "Building Bridges Between Nations." Engineer, 29 PB5-99-2 (April 1999): 6-8.

Hartzer, Ronald B., Dr. "A Horse with Wings: RED HORSE History." Available from <http://www.malmstrom.af.mil/819rhs/redhors.html>. Internet. Accessed 17 February 2000.

Hatch, Henry J., Lieutenant General, and Janet A. McDonnell. "Corps of Engineers: Laying the Groundwork for Theater Operations." Military Review LXXII (March 1992): 2-13.

Hays, George. "Army and Air Force Military Construction for FY 2000." U.S. Army Corps of Engineers News, II, no. 3, (September/October 1999).

HQ AFCESA/CEX. "RED HORSE Deployment." Available from <http//www.afcesa.af.mil>. Internet. Accessed 21 February 2000.

"Interagency and Intergovernmental Support Program." n.d. Available from <http://www.hq.usace.army.mil/ cecs-i/IISWWW/Web399/iishmpg.htm>. Internet. Accessed 21 February 2000.

"Joint Forge Log Support Continues," Army Logistician 31 (May/June 1999): 1 Database on-line. Available from UMI ProQuest Direct, Bell & Howell, UMI publication no. 00042528.

Klemens, Darren, Captain, and Captain Kelly Slaven. "Task Force Castle: Joint Engineer Operations in Haiti." Engineer, PB 5-95-1/2 (April 1995): 36-43.

Lecuyer, Jack A. "Military Engineers: Nation Assistance in the New World Order." In Warriors in Peacetime: The Military and Democracy in Latin America, ed. Gabriel Marcella, 118-134. Portland, OR: Frank Cass c/o International Specialized Book Services, Inc., 1994.

Lowery, Vern. "Lessons Learned: Joint Engineer Operations." Engineer, PB 5-95-3 (August 1995): 46-48.

McClure, Robert L., Colonel. "The Engineer Regiment in Kosovo," Engineer, 30 PB 5-00-2 (April 2000): 6-10.

McDonnell, Janet A. Supporting the Troops: The U.S. Army Corps of Engineers in the Persian Gulf War. Alexandria, Virginia: Office of History U.S. Army Corps of Engineers, February 1996.

McNeil, Elain. "NAVFAC Facts," n.d. Available from <http//www.navfac.navy.mil/hqorg.htm>. Internet. Accessed 25 January 2000.

Mlakar, Paul F., Dr. "Bridge to the Future: Tele-Engineering and Bubiyan Bridge Assessment." Engineer, 29 PB 5-99-2 (April 1999). Available from <http://www.wood.army.mil/ ENGRMAG/PB5992/mlakar.htm>. Internet. Accessed 21 February 2000.

"Navy Seabees and the Civil Engineer Corps: Providing Skills for the Joint Environment." Engineer, PB5-94-4 (December 1994): 11-17.

Odderstol, Eric S., Commander. "Joint Task Force Noble Anvil: Chief Engineer Brief." Briefing slides. Norfolk, VA, Naval Facilities Engineering Command, 31 March 2000.

Richardson, Robert C., Jr., Lieutenant General. "Participation in the Okinawa Operation," in U.S. Army Forces in the Pacific Ocean Areas, Vol I, 6 July 1948.

"Seabee History: Formation of the Seabees and World War II." 13 November 1997. Available from <http://www.history.navy.mil/faqs/faq67-3.htm >. Internet. Accessed 25 January 2000.

"Seabee History: Introduction." 13 November 1997. Available from <http://www.history.navy.mil/faqs/faq67-2.htm >. Internet. Accessed 25 January 2000.

"Seabee History: Southeast Asia." 13 November 1997. Available from <http://www.history.navy.mil/faqs/faq67-5.htm>. Internet. Accessed 25 January 2000

"Seabees We Build, We Fight." Available from <http://www.chinfo.navy.mil/navpalib/ factfile/personnel/seabees/seabee1.htm >. Internet. Accessed 3 December 1999.

Slusar, Robert, Colonel. "USACE Engineering Services." Briefing slides. HQUSACE, Washington, D.C., 14 February 2000.

Spellman, Scott, Major. "Joint Doctrine Update." Engineer, PB 5-99-2 (April 1999). Available from <http:// www.wood.army.mil/ ENGRMAG/PB5992/spellmon.htm>. Internet. Accessed 21 February 2000.

The Joint Staff, Engineer Doctrine for Joint Operations, Joint Pub 3-34. Washington D.C.: The Joint Staff, coordination draft 15 November 1999.

The Joint Staff, Joint Doctrine for Civil Engineering Support, Joint Pub 4-04. Washington D.C.: The Joint Staff, draft 15 December 1999.

"The Regiments." Army (March 1990): 55-58.

Treleaven, David L., Major. "Engineers in Bosnia." Engineer, PB 5-96-1 (March 1996): 18-29.

U.S. Army Engineer Command Vietnam. "Annual Status Report." December 1967. Available from Military History Institute, Vietnam History File.

U.S. Department of the Army. Amy Operational Support, FM 100-16. Washington D.C.: U.S. Department of the Army, 31 May 1995.

U.S. Department of the Army. Decisive Force: The Army in Theater Operations, FM 100-7. Washington D.C.: U.S. Department of the Army, 31 May 1995.

U.S. Department of the Army. Engineer Operations: Echolons Above Corps, FM 5-116. Washington D.C.: U.S. Department of the Army, 7 March 1989.

U.S. Department of the Army. Theater Support Command (Final Draft), FM 63-4. Washington D.C.: U.S. Department of the Army, 1 July 1999.

U.S. Department of the Army. U.S. Department of the Army Assistant Chief of Staff for Force Development. Debriefing of Senior Officers: MG Charles C. Noble. Washington D.C.: U.S. Department of the Army, 21 October 1971.