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# Engineering Operations

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U.S. Marine Corps

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DEPARTMENT OF THE NAVY  
Headquarters United States Marine Corps  
Washington, D.C. 20380-1775

14 February 2000

FOREWORD

Marine Corps Warfighting Publication (MCWP) 3-17, *Engineering Operations* provides doctrine and supporting tactics, techniques, and procedures (TTP) for the planning and execution of engineer support to the MAGTF. This publication provides general information on the numerous capabilities engineers bring to the battle, from planning through to the execution of an operation. Engineers provide one of the most versatile resources a commander has in a MAGTF. They can provide the means to creatively apply the art and science of tactics in any situation encountered.

This publication reflects the Marine Corps warfighting philosophy and explains how engineer operations contribute to our ability to wage maneuver warfare. It provides guidance for planning and coordinating engineer support and explains the unique command and support relationships of engineers. MCWP 3-17 is the lead publication in a series of engineer-related doctrinal publications. As such, it ties the specific TTP described in supporting publications with applicable engineer functions. This publication is designed primarily for engineer unit commanders, their staffs, and anyone involved in engineer planning, but is also useful to any commanders and their staffs that work with engineer units.

MCWP 3-17 supersedes FMFM 13, *MAGTF Engineer Operations*, dated 10 February 1992.

Reviewed and approved this date.

BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS

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## Chapter 1

# MAGTF Engineering

The role of today's engineers in Marine air-ground task force (MAGTF) operations was founded in the needs and experiences of World War II. Geographic isolation and dispersion of objectives compounded with the limits of then existing technology required the ability to improve remote sites in order to effectively use these locations to prosecute the war.

This new mission requirement for the Marine Corps meant creating organic units with the specialized equipment and training needed to support the existing warfighting mission. This necessity for engineering support also led to the Naval Construction Force (NCF) becoming integral to some Marine engineering operations. By the end of the war, engineering had progressed to the level of providing warfighting skills that allowed commanders to modify the battlespace to their advantage through the applications of mobility, countermobility, survivability, and general engineering.

Today, the combat engineer brings both constructive (e.g., building bunkers, providing utilities) and destructive (e.g., demolition, breaching) support capabilities to the battlefield. This unique combination of diametric capabilities provides knowledge, experience, and skills to commanders at the operational and tactical levels with which they can, for example, reduce friction, facilitate maneuver, and improve the morale of friendly forces or create friction and disorder for the enemy. Examples of these include maintaining roads to reduce maintenance of motor transport assets or providing showers to front-line combatants. Establishing obstacles or destroying existing roads or bridges can inhibit the enemy's ability to quickly maneuver forces in the attack or defense. Modifications to the physical battlespace permits commanders to achieve faster tempo and better focus of military power. Examples of these would be the establishment of forward arming and refueling points

(FARPs) to reduce turnaround time of aviation assets or reinforcing an infantry position with obstacles, bunkers, and mines. This allows a commander to shift combat power to another location to support a main effort while minimizing risk by not compromising security of the remaining forces.

Although current doctrine calls for attacking and exploiting the enemy's vulnerabilities, factors outside of the commander's control (e.g., time, terrain, weather, the enemy's actions) can force commanders into actions against enemy strengths. Combat engineers earn their title most notably through assault breaching of enemy fortifications or by their contribution of firepower in the form of provisional infantry support. These capabilities can be decisive in maintaining momentum in the attack or responding quickly to the enemy's actions or reactions. In military operations other than war (MOOTW) engineers play a significant role in diverse situations such as disaster recovery, humanitarian relief, and peacekeeping operations. These are a few examples of when an engineer unit can bring to bear its unique skills and capabilities to support commanders in achieving their mission(s).

MAGTFs normally contain engineer units in each of their major subordinate commands. The engineers found in a MAGTF are engineer staff personnel in the command element (CE), a combat engineer unit supporting the ground combat element (GCE), a support engineering unit supporting the aviation combat element (ACE), and a support engineering unit in the combat service support element (CSSE). Task force mission requirements may require augmentation of the engineering assets with NCF. See figure 1-1, on page 1-2. As part of mission planning, a MAGTF commander may elect to task-organize certain capabilities (e.g., engineers, artillery, and reconnaissance units) to support the concept of operations for specific operations or missions.



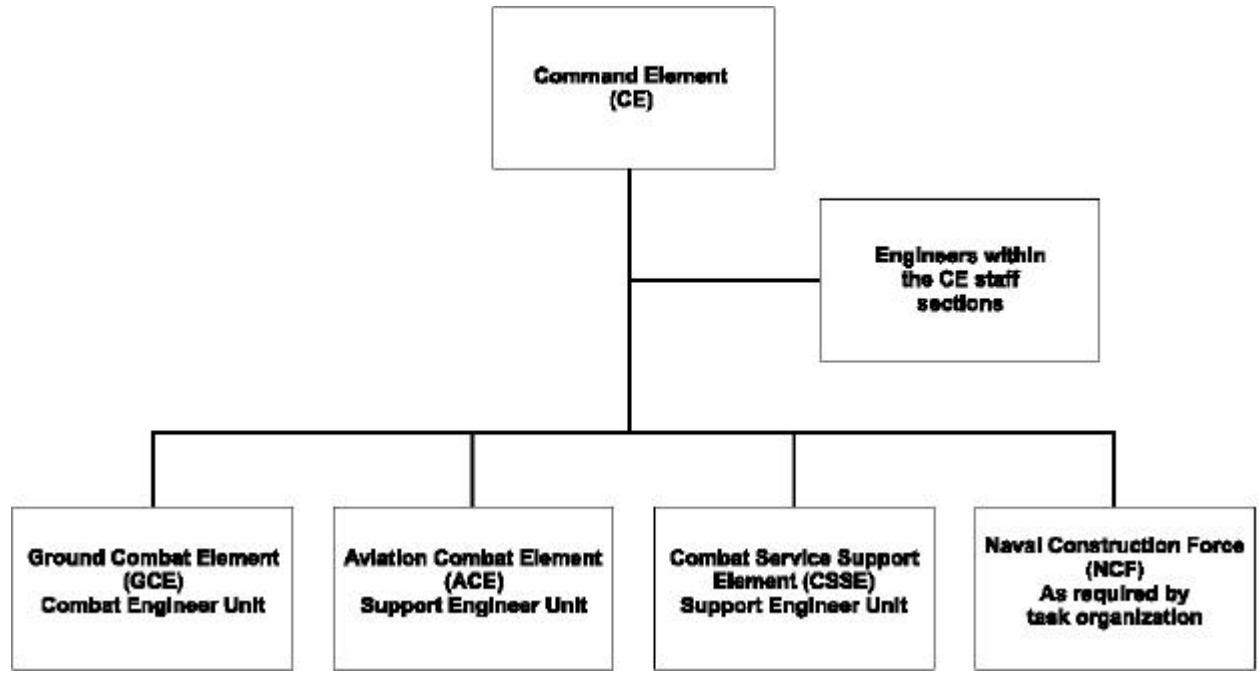


Figure 1-1. MAGTF Engineer Assets.

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## MAGTF ENGINEER STAFF

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The MAGTF commander’s staff engineers develop engineer policy, guidance, and standards for the engineer effort throughout the battlespace. The engineers are the focal point for planning, monitoring, and coordinating engineer efforts supporting air, ground, and combat service support operations and providing engineer assistance to the principal staffs. The engineers are responsible for estimating, recommending, and determining requirements and preparing engineer annexes and detailed plans for publication.

### Organization

The number of engineers in the MAGTF command elements will depend upon the mission, structure of the MAGTF, and the magnitude of engineer effort. MAGTF tables of organization (T/Os) provide for engineers and will likely be staffed based on expected missions. When the MAGTF command element is the nucleus of a joint force or combined headquarters, the engineer staff can be augmented with other U.S. or allied service engineers to provide the necessary personnel and experience required to conduct complex joint force and multinational operations. Because engineers are normally located in several sections of the headquarters, they can

provide great flexibility in orchestrating diverse engineer operations and allow for the greatest visibility of engineer capabilities, requirements, and responsibilities.

### Functions

The engineers must work closely with other staff sections to integrate engineer considerations and requirements into all phases of planning and execution. These phases include—

- 1 Intelligence. Throughout the intelligence cycle, the engineers assist the G/S-2 in coordinating intelligence requirements. The engineers provide technical assistance in identifying, prioritizing, and validating engineer intelligence needs and in coordinating the collection of engineer information (see chapter 2).
- 1 Operations. The engineers monitor the deployment, employment, and mission status of MAGTF engineer forces. The engineers focus the use of engineer capabilities to support the concept of operations. It is vital that engineers maintain situational awareness of the maneuver forces’ current and future courses of action (COAs) so that existing facilities (e.g., main supply route (MSR), tunnels, and bridges) do not constrain their

proposed actions. During the targeting process, the engineers provide engineer target and risk analysis to help minimize the destruction of facilities so the damage does not exceed our ability to repair them for use in future operations.

- I Plans. The engineers work with the planners to maintain knowledge of future plans and their implications for engineer requirements. Engineer planners will identify all potential engineer requirements (e.g., mobility, countermobility, survivability, topographic support, civil-military operations support, facilities, real estate, real property maintenance, engineering services, environmental control, and construction support) during the planning process. Chapter 3 provides information on potential engineer requirements.
- I Facilities. A real property entity consisting of one or more of the following: a building, a structure, a utility system, pavement, and underlying land. (JP 1-02) The engineers coordinate facility services for the MAGTF and organizations supporting the MAGTF in the area of operations (AO).

**Real Estate.** The engineers are responsible for obtaining property during operations, based on the law of land warfare, host nation agreements, or other agreements. Property is obtained based on MAGTF facility requirements. Property is seized only when it is imperative to the necessities of war. Priorities for property acquisition are established based on the time the property is needed.

**Real Property Maintenance.** The engineers manage the leased properties and facilities so they are maintained according to the conditions of the lease, and that the property meets its functional purpose.

**Construction.** The engineers monitor the construction efforts of the MAGTF engineer forces, and based on commander's guidance, formulates construction policies, priorities, and standards.

## Environmental Considerations

Operations should be planned and conducted with appropriate consideration for their effects on the environment in accordance with applicable U.S. and host nation agreements, environmental laws, policies, and regulations. Engineers are responsible for coordinating the environmental protection effort in the AO. Engineers assist the MAGTF commander

in coordinating environmental protection efforts in the AO. Environmental concerns are a part of any operation to include policies originating in the U.S., host nations, and allied forces. Specifically, engineers may be required to advise commanders how to minimize adverse effects of operational plans or how to resolve existing situations created by friendly or enemy forces.

## Logistics

Engineers manage the bulk storage of fuel and water throughout the AO. Additionally, the engineers also assist logistics forces in monitoring the inventory and flow of Class IV material and recommend reordering levels.

## Explosive Ordnance Disposal

Engineers are normally responsible for planning and coordinating explosive ordnance disposal (EOD) support. These activities include incidence response, area clearance operations, and foreign ordnance exploitation.

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## ENGINEER ORGANIZATIONS IN THE GROUND COMBAT ELEMENT

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The combat engineer battalion (CEB) is the Marine division commander's organic combat engineering force. The CEB enhances the momentum and tempo of maneuver units and helps shape the battlespace for the Marine division. The battalion supports task-organized ground combat elements with combat engineer support to meet mobility, countermobility, and survivability requirements during offensive and defensive operations.

## Mission

The CEB's mission is to enhance the mobility, countermobility, and survivability of the Marine division through combat and limited general engineering support. The CEB performs the following tasks:

- I Conduct engineer reconnaissance to support the division's intelligence collection plan.
- I Plan, organize, and construct obstacle systems.
- I Plan, organize, and conduct breaching operations.
- I Conduct demolition operations beyond the ability of other division units.

- | Employ assault bridging and other standard bridging systems when augmented with equipment and trained personnel.
- | Provide expedient repair and reinforcement of existing bridges.
- | Construct expedient short span bridges from local material.
- | Construct and maintain limited combat roads and trails in support of division operations (construction and maintenance requirements are limited to those that can be performed with organic equipment and personnel).
- | Provide mission essential temporary vertical and horizontal construction.
- | Provide provisional infantry.

## Organization

Figure 1-2 illustrates the CEB organization.

## Command and Control

The battalion commander organizes the battalion staff to enable command and control of the battalion and any engineer reinforcing elements (e.g., support from engineer support battalion). Collection efforts of higher and subordinate units, external agencies, and the battalion's S-2 are integrated to meet all intelligence requirements. The CEB intelligence officer actively participates in the engineer portion of the division intelligence collection effort. The battalion is capable of self-administration.

## Firepower

The CEB's organic firepower consists of individual weapons, machine guns, and light antiarmor weapons.

## Transportation

The battalion requires motor transport support to move the battalion as a unit. However, there are adequate ground transportation assets (e.g., medical and logistic support vehicles including heavy trucks) organic to the battalion to accomplish its primary mission. Most of the battalion's engineer assets require surface transportation; however, some engineer equipment is helicopter transportable.

## Combat Service Support Capabilities

Combat service support (CSS) capabilities provide—

- | Organic supply support.
- | Organizational (1st and 2d echelon) maintenance on organic equipment. Intermediate (3d and 4th echelon) maintenance is provided by Maintenance Battalion, force service support group (FSSG).
- | Organic transportation support required to accomplish its mission.
- | Limited general engineering capability.
- | Routine and limited emergency medical support to the battalion.
- | Administrative, postal and chaplain support to the battalion.

## Concept of Employment

The CEB organizes to support the engineering requirements of the division. The battalion can task-organize elements in support of subordinate units or can mass to concentrate engineer effort. If ground operations require decentralized combat engineering, the CEB still supports engineer requirements behind the forward line of own troops (FLOT).

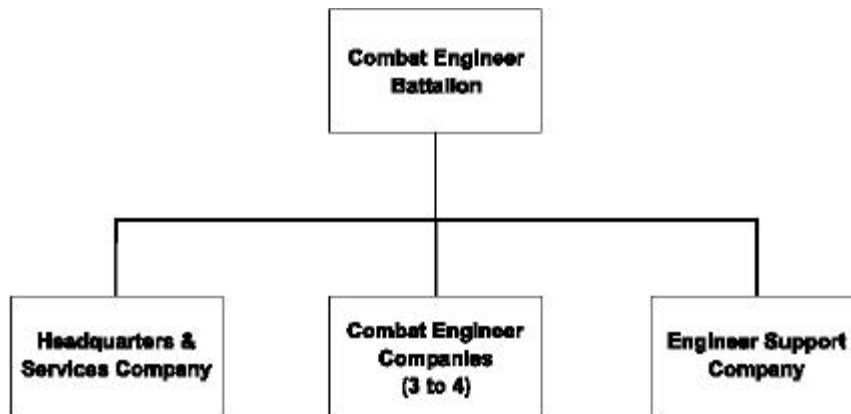


Figure 1-2. Organization of the CEB.

For planning and training purposes, each combat engineer company maintains a traditional direct support relationship with an infantry regiment or a regimental landing team (RLT) and each subordinate combat engineer platoon regularly supports an infantry battalion or battalion landing team (BLT). However, in planning for contingencies, a regiment or RLT may require a CEB (-) vice a reinforced company to provide broader scope and greater depth for tactical mobility and other combat engineering support. Combat engineer units are typically reinforced by elements of engineer support and headquarters and service (H&S) companies to provide the full spectrum of combat engineer support. Likewise, engineering support to a BLT can be increased. The fourth combat engineer company of the CEB is normally kept in general support of the division. Traditional support relationships can be altered if mission analysis indicates that combat engineer support to other units (e.g., tanks company, assault amphibious vehicle [AAV] company, light armored vehicle [LAV] platoon) is more efficient. Mission, enemy, terrain and weather, troops and support available-time available (METT-T) is always considered in task-organizing and attaching combat engineer units to best support the concept of operations.

If the requirement for combat engineer support exceeds the capability of the CEB, engineer support battalion (ESB) assets located in the CSSE provide reinforcement. The ESB, NCF, U.S. Army, host nation or other sources can also provide general engineering support capabilities beyond those organic to the CEB.

The scope of division combat operations may require reinforced combat engineer companies to directly support infantry or other task groups. This direct support relationship permits efficient control, maximizes productivity, and reduces administrative and logistical burdens. Direct combat engineer support of a maneuver company should be for limited duration and for specific tasks.

### Headquarters and Service Company

**Mission.** The primary mission of the H&S company is to provide command, control, and administrative support for the battalion. This includes the provision of supply, food services, communications, chaplain services, and medical support.

**Concept of Employment.** The H&S company decentralizes its support functions of supply,

communications, medical, chaplain, and messing to the extent necessary to meet battalion operational requirements. The company headquarters directs and controls all matters regarding internal administration, logistics, and security of the company.

### Combat Engineer Company

**Mission.** The mission of the combat engineer company is to enhance the mobility, countermobility, and survivability of the supporting ground combat element with combat engineering.

**Concept of Employment.** A combat engineer company normally operates under the control of the CEB commander when the battalion headquarters is ashore. The company may operate under the centralized control of the company commander or be in widely dispersed areas with the platoon commanders exercising more direct control of the companies assets, and the company commander acting as advisor to the infantry regimental commander. Additionally, combat engineer companies can provide general support to the division and other task-organized maneuver units (e.g., light armored reconnaissance, tank, and AAV battalions).

### Engineer Support Company

**Mission.** The mission of the engineer support company is to provide personnel and equipment or task-organized heavy equipment, utilities, maintenance, and motor transport support to other elements of the battalion.

**Concept of Employment.** The engineer support company provides essential engineering support in the forward areas and supports all CEB functional responsibilities. The company employs specialists, as individuals or in small units, for a specific mission in support of the combat engineer companies, however, the company is normally centrally controlled by the CEB commander.

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## ENGINEER ORGANIZATIONS IN THE AVIATION COMBAT ELEMENT

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The MAGTF requires responsive support to the landing force (LF) during all phases of an amphibious operation and subsequent operations ashore. To support the MAGTF, the ACE must be capable of operating from sea- and shore-based

airfields. To operate in a variety of forward-based environments requires a full range of aviation ground support (AGS) capabilities which are organic to the ACE. When an ACE operates from the sea or a forward base, AGS is essential to operations.

To provide AGS to the ACE requires organic task-organized units. In the Marine aircraft wing, the Marine wing support groups (MWSGs) and their subordinate Marine wing support squadrons (MWSS) are responsible for providing AGS. The following functional areas of support comprise AGS and the services provided by the MWSG and/or MWSS. These 13 functional areas are further categorized under two main categories: ground services support and air base services support.

### Ground Services Support

Ground services support are activities and tasks necessary to establish and maintain base camp operations associated with an airfield. The following AGS functions are under ground services support:

- | Internal airfield communications.
- | Construction.
- | Utilities.
- | Materials handling equipment.
- | Motor transport.
- | Field messing.
- | Medical services.
- | Law enforcement services.

### Air Base Services Support

Air base services support are activities and tasks necessary to establish and operate tactical air bases. The following AGS functions are found under the air base services support:

- | Explosive ordnance disposal.
- | Aircraft rescue and firefighting.
- | Aircraft recovery services.
- | Fuel services.
- | Weather services.

### The Marine Wing Support Group

Engineer support is integral to the success of the ACE. Ground services and air base operations require extensive engineer support. The MWSG and MWSS engineer section provides engineering support for forward-based air operations.

**Mission.** The MWSG provides essential AGS to the Marine aircraft wing (MAW) and its components. MWSG engineer assets support airfield operations and aviation combat elements in both expeditionary and fixed-base locations. Engineer tasks and functions performed by the MWSG are primarily general engineering oriented.

**Organization.** Four squadrons compose the MWSG. All squadrons routinely operate in direct support of the MAW, and are structured to provide AGS for one airfield and two remote sites. The Personnel Support Detachment (PSD) provides administrative support to the MWSG and its squadrons (See figure 1-3).

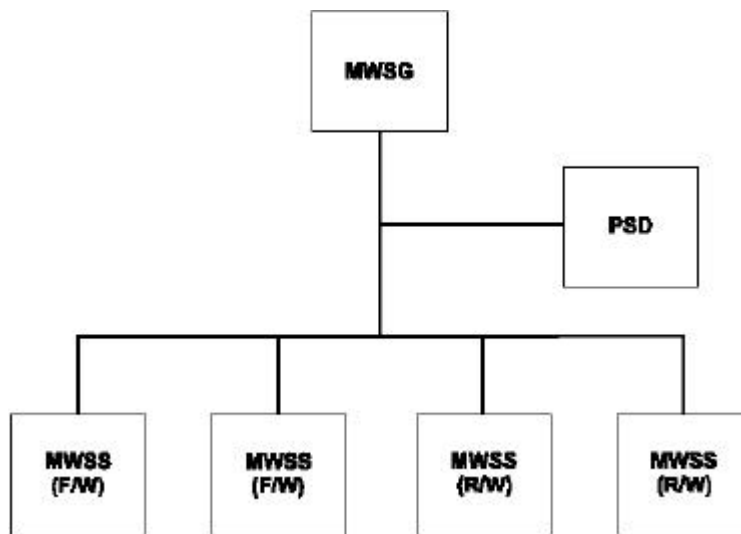


Figure 1-3. Organization of the MWSG.

**Command and Control.** The MWSG normally has four support squadrons, two for fixed-wing aircraft and two for rotary wing aircraft. Each squadron provides direct support to a designated Marine air group (MAG).

**Firepower.** The MWSG’s firepower consists of individual weapons for self-defense purposes only.

**Mobility.** Adequate ground mobility (command, medical, and logistic support vehicles including heavy trucks) is organic to the MWSG. The MWSG requires external transportation support to effect displacement of the entire unit.

**Combat Service Support Capabilities.** CSS capabilities provide—

- 1 Organic supply support.
- 1 Organizational (1st and 2d echelon) maintenance on organic equipment. Intermediate (3d and limited 4th echelon) maintenance is provided by Maintenance Battalion, FSSG.
- 1 Organic transportation support required to accomplish its mission.
- 1 Organic engineering support required to accomplish its mission.
- 1 Routine and limited emergency medical support.
- 1 Airfield security and law enforcement services.

**Concept of Employment.** The MWSG provides essential AGS for the MAW and organizes to provide one or more MWSS’s in support of a designated fixed-wing and/or rotary wing component of an ACE. MWSG maintains decentralized control of support squadron operations, except for squadrons collocated with or near the MWSG headquarters. The MWSG and its subordinate elements provide a wide variety of AGS of which engineering is only a portion. Since the bulk of the engineering support required is general engineering oriented, the MWSG is assisted by the ESB and the naval mobile construction battalions (NMCB) as required.

### Marine Wing Support Squadron

**Mission.** The MWSS provides essential AGS support to a designated fixed-wing and/or rotary wing component of an ACE and supporting or attached elements of the Marine air control group.

**Organization.** The MWSS is an integral part of the ACE. Both fixed-wing and rotary wing support squadrons organize identically with only slight variations in their authorized tables of equipment and personnel. The MWSS, as shown in figure 1-4, consists of a squadron headquarters, executive staff (S-1 through S-4), military police and flight line security department, and equipment maintenance department. The S-3 holds staff cognizance over internal airfield communications, airfield operations

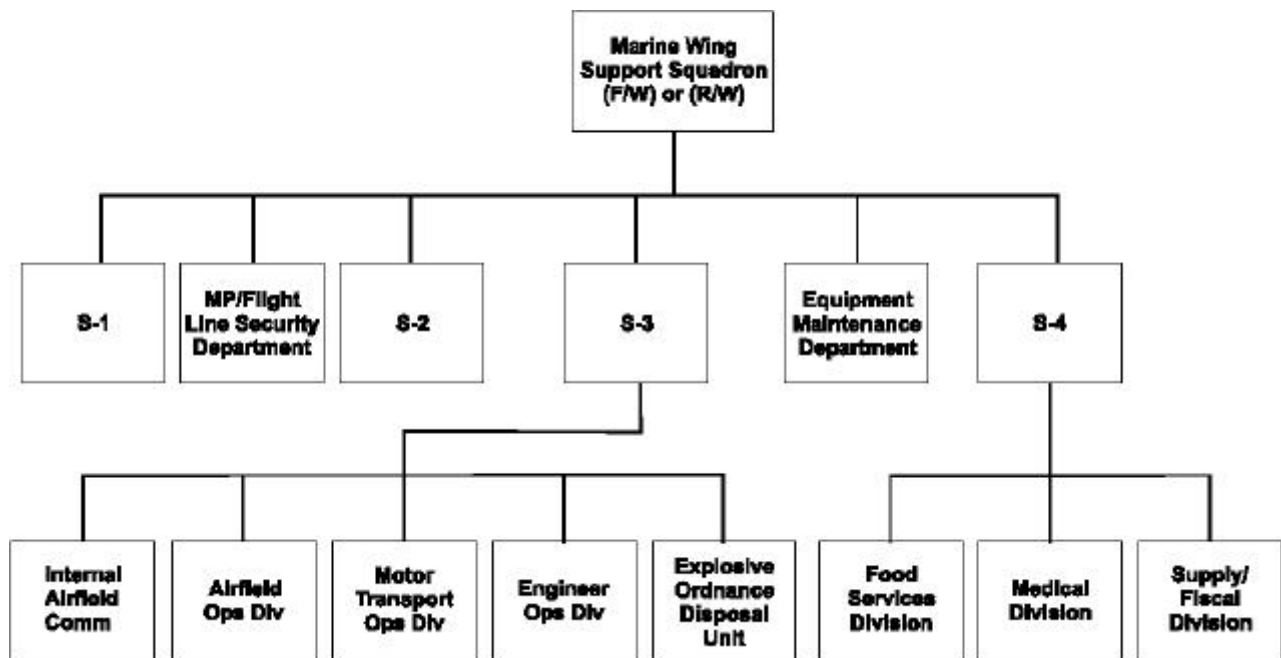


Figure 1-4. Organization of Marine Wing Support Squadron.

division, motor transport operations division, and engineer operations division. The S-4 holds staff cognizance over food services, medical, supply, maintenance, and fiscal divisions.

The engineer operations division of the MWSS organizes to provide limited combat and general engineering support to designated components of the ACE. Engineers located in the airfield operations division receive, store, and dispense aviation and ground fuels from various types of expeditionary fuel systems.

The engineer operations division is capable of—

- | Providing engineer reconnaissance and survey.
- | Repairing, improving, and maintaining existing road networks for the ACE.
- | Constructing and maintaining expedient roads.
- | Constructing, maintaining, and improving vertical or short takeoff and landing sites.
- | Constructing and maintaining mission essential base camp requirements (temporary bunkers, aircraft revetments, and strongbacks).
- | Providing technical and equipment assistance for erection of pre-engineered buildings.
- | Providing utilities support (mobile electric power, water, potable water production, bath and laundry facilities, and refrigeration services).
- | Developing, improving, and maintaining drainage systems.
- | Providing technical assistance to support camouflage requirements.
- | Assessing bomb damage and providing minimal rapid runway repair (RRR).
- | Providing material handling equipment services.
- | Providing for EOD.

**Command and Control.** The squadron commander performs command and staff functions necessary for planning, directing, and supervising assigned missions. The MWSS operates under the centralized control of the MWSS commander, however, task-organized units may provide direct support to forward airbases or FARPs.

**Firepower.** The MWSS's firepower consists of individual weapons and machine guns.

**Mobility.** Organizational vehicles of the squadron provide sufficient transportation for command,

control, and routine support activities. The squadron requires external transportation to displace as a unit.

**Combat Service Support Capabilities.** CSS capabilities provide—

- | Organic ground supply support except for Navy funded equipment that requires support from a designated aviation supply element.
- | Organizational (1st and 2d echelon) maintenance on organic equipment; intermediate (3d and 4th echelon) maintenance is provided by maintenance battalion, FSSG.
- | Sufficient motor transport equipment to accomplish its mission.
- | Limited general engineering capability required for the squadron's mission.
- | Routine and limited emergency medical support.
- | Service company, H&S battalion, FSSG, provides service support.

**Concept of Employment.** The MWSS provides all AGS, including engineering, to designated components of the ACE and simplifies command relationships by providing a single commander for all matters pertaining to AGS.

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## ENGINEER ORGANIZATIONS IN THE COMBAT SERVICE SUPPORT ELEMENT

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The multitude of tactical engineer tasks required to support air and ground forces far exceed the organic engineer capabilities of the Marine division and wing. Simultaneously, at the operational level of war, the force must be able to move between engagements and battles within the context of the campaign. Creating operational mobility requires the synergism of the entire MAGTF; its engineers are vital to that effort. By physically shaping the space between the battles, engineers enable the force to rapidly move at will—generating tempo and momentum. Additionally, operational logistics involves the creation of a logistical delivery system sufficient to sustain the force throughout the length of the campaign and the breadth of the theater or area of operations. Marine and Navy engineers aid the operational logistics effort by creating and maintaining the lines of communication and facilities sufficient to support the movement of those resources.

## The Engineer Support Battalion

The ESB exists to provide a combat engineering capability for the entire MAGTF. The battalion provides the initial engineering support necessary to meet the combat and general engineering, bulk liquid, and utility support requirements of the MAGTF.

**Mission.** The mission of the ESB is to provide combat engineering and limited general engineering, bulk liquid, and utility support to the MAGTF. The ESB performs the following tasks:

- 1 Combat engineering support.
- 1 Standard and nonstandard bridging.
- 1 EOD support.
- 1 Handling, storing, and dispensing bulk fuel (Class III and Class III[A]).
- 1 Tactical utility support.
- 1 Expeditionary vertical and horizontal construction.

**Organization.** Figure 1-5 shows the organization of the ESB. The Bridging Company may be found assigned as a Reserve unit vice an active fleet asset.

**Command and Control.** The staff administers, directs, and supervises operations of the battalion and engineer reinforcing elements. The battalion normally operates under the centralized control of the battalion commander. Engineer companies and platoons are sometimes attached to combat service support detachments in order to provide direct support to units throughout the MAGTF.

**Firepower.** The ESB's firepower consists of individual weapons, machine guns, and light antiarmor weapons.

**Mobility.** Adequate ground transportation to move essential command and operational elements is organic to the battalion. External motor transport support is required to move all assets (e.g., bulk fuel [Classes III and Class III (A)], bulk water, bridging, and heavy engineer equipment).

**Combat Service Support Capabilities.** CSS capabilities provide—

- 1 Organic supply support.
- 1 Organizational (1st and 2d echelon) maintenance on organic equipment; Intermediate (3d and 4th echelon) maintenance support is provided by maintenance battalion, FSSG.
- 1 Organic transportation support required to accomplish its mission.
- 1 Limited general engineering support.
- 1 Routine and limited emergency medical support to the battalion.
- 1 Administrative, postal, and chaplain support to the battalion.

**Concept of Employment.** The ESB provides combat and limited general engineering in general support of the MAGTF. The battalion can provide separate units to support specific requirements; i.e., a combat engineer company to reinforce the CEB or MWSG. The battalion regains operational control of all of its committed assets when the FSSG is established ashore. Operating under centralized control, the battalion gives depth to the overall engineering effort by providing the GCE and ACE engineer support that exceeds their organic capabilities. The battalion works in concert with the NCF to provide comprehensive engineer support to the MAGTF.

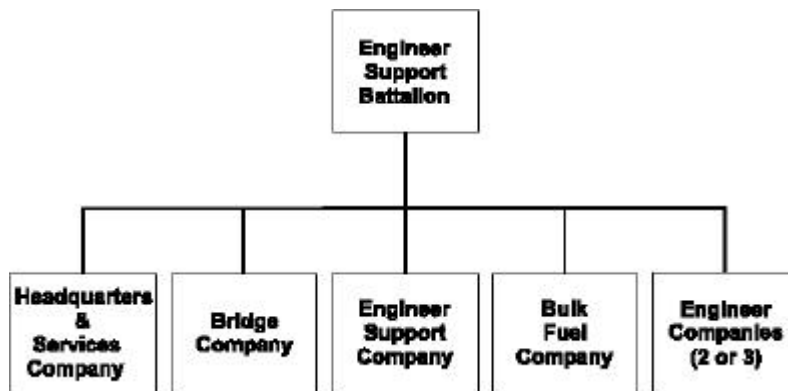


Figure 1-5. Organization of the Engineer Support Battalion.



## Headquarters and Service Company

**Mission.** The mission of H&S company is to provide command and control, administration, and command support functions for the ESB. The H&S company also provides EOD support to the MAGTF.

**Concept of Employment.** The H&S company provides the necessary command and control and command support functions for the coordination of battalion operations. Additionally, it provides EOD support to the MAGTF by providing EOD personnel to fill T/O requirements or task-organized EOD teams to support specialized missions.

## Engineer Support Company

**Mission.** The mission of the engineer support company is to provide direct maintenance support for specified equipment organic to the battalion, direct transportation and services support to the battalion, and general support and/or reinforcing augmentation to the combat engineer companies of the battalion. The engineer support company is responsible for maintaining and providing—

- | Engineer equipment for all units of the battalion.
- | Utility support throughout the MAGTF.

**Concept of Employment.** The engineer support company provides task-organized elements as part of a battalion unit that is capable of rendering combat engineering, general engineering, and utilities capabilities to the MAGTF.

## Combat Engineer Company

**Mission.** The combat engineer company provides combat engineering and limited general engineering support to the MAGTF.

**Concept of Employment.** The company normally operates under the centralized control of the ESB but can operate independently when reinforced with equipment and personnel.

## Bridge Company

**Mission.** The mission of the bridge company is to provide standard bridging and ferrying support to enhance the mobility of the MAGTF.

**Concept of Employment.** The bridge company provides standard prefabricated bridge and ferry assets for the supported unit and limited construction manpower. When necessary, combat engineer

companies or other labor sources within the supported organization construct bridges and ferries from bridge company assets.

## Bulk Fuel Company

**Mission.** The mission of the bulk fuel company is to receipt, store, and provide limited distribution of bulk fuel (Class III and Class III [A]) to MAGTF elements.

This support includes—

- | Distribution to, but not within, air bases during amphibious operations and subsequent operations ashore.
- | Distribution of Class III (A) products of the required type, quality, and purity to supported air elements.

**Concept of Employment.** The bulk fuel company provides detachments to the MAGTF's CSSE. During amphibious operations, bulk fuel company elements are responsible for receiving fuel from lines established by the amphibious construction battalion of the naval beach group at the high water mark. The amount of fuel required and the systems necessary to support the requirement determine detachment size. Smaller detachments can use components of the expeditionary refueling system (e.g., 500-gallon fabric fuel tanks) to establish forward vehicle refueling points using either ground or helicopter transportation. Normally, the entire company deploys to support a MEF.

## Explosive Ordnance Disposal Platoon

**Mission.** The EOD platoon's mission is to neutralize hazards associated with unexploded U.S. and foreign ordnance and to disseminate technical information on enemy weapons and explosive ordnance material. This includes detection, identification, recovery, evacuation, and disposal of items of unexploded ordnance. Disposal can include disarming, destruction onsite, or removal and destruction off site. Ordnance types include—

- | Conventional.
- | Improvised.
- | Nuclear.
- | Biological.
- | Chemical.
- | Weapons situated in such a manner as to constitute a hazard to personnel, installations, material, or operations that are beyond the

capabilities of other components of the MAGTF organizations to neutralize.

EOD personnel support the MAGTF by providing—

- 1 Enhanced mobility through ordnance disposal (conventional, improvised, nuclear, biological, and chemical [NBC]).
- 1 Foreign ordnance information and/or intelligence through collection, evaluation, and exploitation.
- 1 U.S. ordnance information and/or intelligence through collection, evaluation, and exploitation.
- 1 Direct action (DA) role supporting MEU (SOC [special operations capable]) operations.

**Concept of Employment.** The EOD platoon provides task-organized teams to the combat service support element of the MAGTF.

## Naval Construction Force

Joint Pub 4-04, *Joint Doctrine for Civil Engineering Support*, describes the basis for NCF support to the Fleet Marine Forces stating (see also publications MCWP 4-11.5/NWP 4-04.1, *Seabee Operations in the MAGTF*):

In addition to, or coincident with, component missions specified by the Commander in Chief (CINC), the Navy provides general engineering support to MAGTFs. *This support consists of NCF units under the operational control of a MAGTF.* These NCF units are necessary to reinforce and augment the MAGTF's limited engineering capability. They are integral to the organization of the MAGTF and ensure immediate and effective delivery of CSS tasks. [emphasis added]

## Terms of Reference

Although an informal and deeply rooted relationship between Marines and Seabees existed since World War II, this relationship had no formal basis until 1 May 1987 when the Marine Corps and Navy adopted the terms of reference (TOR). The overall objective of the TOR is to achieve a coordinated program ensuring the full and effective use of Seabee capabilities when employed in support of MAGTF operations. An evolving document, the TOR provides a means to address and resolve matters of mutual concern related to Seabee operations in the MAGTF.

The TOR provides historical background for the relationship between Marines and Seabees and

describes the Seabees' organizational and functional capabilities, to include those Seabee units that would not normally be under the operational control of a MAGTF. It also establishes tactics, techniques, and procedures aimed at improving the interoperability of the Marines and Seabees. For details on the TOR, NCF organizations, and operations, see MCWP 4-11.5/NWP 4-04.1, *Seabee Operations in the MAGTF*.

**Mission.** Seabee units reinforce and augment the limited general engineering capabilities of the MAGTF and broaden the naval civil engineering spectrum of construction to enhance and sustain MAGTF operations ashore. Along with their general engineering efforts, Seabees also contribute military and amphibious assault construction support and enhance the MAGTF's capability to provide disaster relief and forces for civic action operations.

**Concept of Operations.** As assets of Commander, United States Atlantic Fleet (LANTFLT) and Commander, United States Pacific Fleet (PACFLT), the Seabees consist of active and reserve operational units. Most units are under operational control (OPCON) of either Commander, Second Naval Construction Brigade (COMSECONDNCB) or Commander, Third Naval Construction Brigade (COMTHIRDNCB) which are type commanders reporting directly to the two fleet commanders. The backbone of the Seabees is the naval construction regiments (NCRs) and their highly capable NMCB. There are also several other types of Seabee organizations fulfilling varying roles and missions. Active NMCBs, deploying to four permanent overseas deployment sites, constitute forward presence for the Seabees. An additional four NMCBs are in homeport status at any time, training for upcoming deployments. The bulk of the NCF is reserve units that provide additional and specialized contingency engineering and construction capabilities.

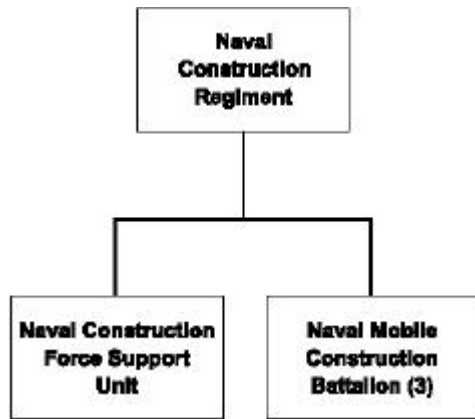
## Naval Construction Regiment

The NCR consists of two or more NMCBs and a CE operating in a specific geographic area or operating in support of a specific military operation. The NCR is the command and control element for all subordinate Seabee units assigned to support a MEF-sized MAGTF.

**Mission.** The mission of the CE is to develop construction plans, assign construction projects to NMCBs, and direct redistribution of units'

equipment and materials. The CE has a planning, estimating, and engineering capability above the NMCB's.

**Organization.** Figure 1-6 illustrates the NCR organization.



**Figure 1-6. Observation of the Naval Construction Regiment.**

**Combat Service Support Capabilities.** Combat service support capabilities provide—

- | Organic supply support. The MAGTF G/S-4 coordinates procurement of Class IV materials for tasked projects undertaken by subordinate Seabee units.
- | Organizational and intermediate (first through fourth echelon) maintenance on engineer organizational equipment. Organizational (second echelon) maintenance of communications equipment and assigned weapons, less optical equipment.
- | Organic transportation support to accomplish assigned missions. However, additional support is required to displace as an entire unit.
- | Construction engineering only.
- | Self-administration, limited organic disbursing, postal, security, legal, civil affairs, graves registration, and information systems support.
- | Food services support to itself only.

CSS has no capability for organic medical or dental capabilities, it is dependent on collocated MEF and/or NMCB medical and dental assets.

**Concept of Employment.** The NCR CE is task-organized and equipped for employment as an assigned force in support of MEF-sized operations

when two or more NMCBs, operating in a specific area, are supporting the MEF. The NCR CE structure provides air- or surface-deployable elements in support of a specific military operation.

Generally, the NCR CE can—

- | Conduct operations in all climate extremes.
- | Maintain an organic table of allowance (TOA) capable of sustaining operations planned or envisioned under contingency or general war conditions for 60 days without resupply, except that Class I material is limited to 5 days, Class III is limited to 3 days, and Class V is limited to 15 days. Organic Class IV is limited to those materials required to construct the command element's base camp. Resupply past the time frames noted is the responsibility of the supported MAGTF.
- | Perform its mission using basic individual protective measures in a chemical, biological, and radiological (CBR)-contaminated environment for 30 days.

Depending on the unit size and scope of the NCF support, an NCR (or NMCB) may be assigned OPCON to the FSSG or designated as a separate major subordinate command (MSC) by the MAGTF or MEF commander.

### Naval Mobile Construction Battalion

The mission of the NMCB is to provide responsive military construction support to Navy, Marine Corps, and other forces in military operations; to construct and maintain base facilities; to repair battle damaged facilities and to conduct limited defensive operations as required by the circumstances of the deployment situation. It can also accomplish disaster control and recovery efforts when required. Specifically, the NMCB—

- | Performs tactical construction including pre-engineered buildings, bunkers, and towers; horizontal construction including unpaved roads and expeditionary airfields for fixed- and rotary wing aircraft consisting of mat runways and taxiways, helicopter landing areas, parking aprons, revetments, and FARPs; contingency staging facilities such as ammunition supply points (ASPs); power generation and water purification systems; beach improvements, beach exits, helicopter pads, and minor roads and camps; installation of standard bridging (e.g., medium girder bridges [MGBs]) and

non-standard bridging; and maintenance, repair, and construction of MSRs.

- | Performs base construction, to include pre-engineered buildings, concrete and masonry buildings, and steel and concrete non-standard bridging; horizontal construction including asphalt roads, asphalt and concrete runways, and paved storage, staging, or parking areas; and base power plant, sewage and water systems, water purification and desalination systems, and wire communication systems.
- | Performs construction engineering including surveying and drafting; materials testing; and planning, estimating, and designing for local expedient projects.
- | Performs specialized construction including well-drilling operations and other operations of limited scope (e.g., batch plant, quarry, rock crusher, dredging, block plant, sawmill, and pile driving operations).
- | Conducts war damage repair (WDR) and RRR operations to include repairs to base camp utility systems; Petroleum, oils, and lubricants (POL) and bulk liquid distribution and storage systems; and communications facilities.

The NMCB normally functions as an integral unit. The NMCB generally consists of a headquarters company, one equipment company, one shop and

utilities company, and two to three general construction companies. See figure 1-7.

Combat service support capabilities provide—

- | Organic supply support. Procurement of Class IV materials for tasked projects is coordinated with the supported MAGTF G/S-4.
- | Organizational and intermediate (first through fourth echelon) maintenance for engineer organic equipment and for naval construction for a support unit (NCFSU) augmentation equipment, as well as organizational (second echelon) maintenance of communications equipment and assigned weapons, less optical equipment.
- | Organic transportation equipment to accomplish assigned missions and tasks.
- | Construction engineering
- | Routine and limited organic emergency medical and dental support. Has limited ancillary capability (e.g., laboratory and X ray).
- | Self-administration, organic ship services, disbursing, postal, legal, chaplain, and graves registration services support. The NMCB is capable of providing food services support to itself and collocated NCF units.

The NMCB can function as an integral unit of the NCR or operate as a separate unit. The NMCB can

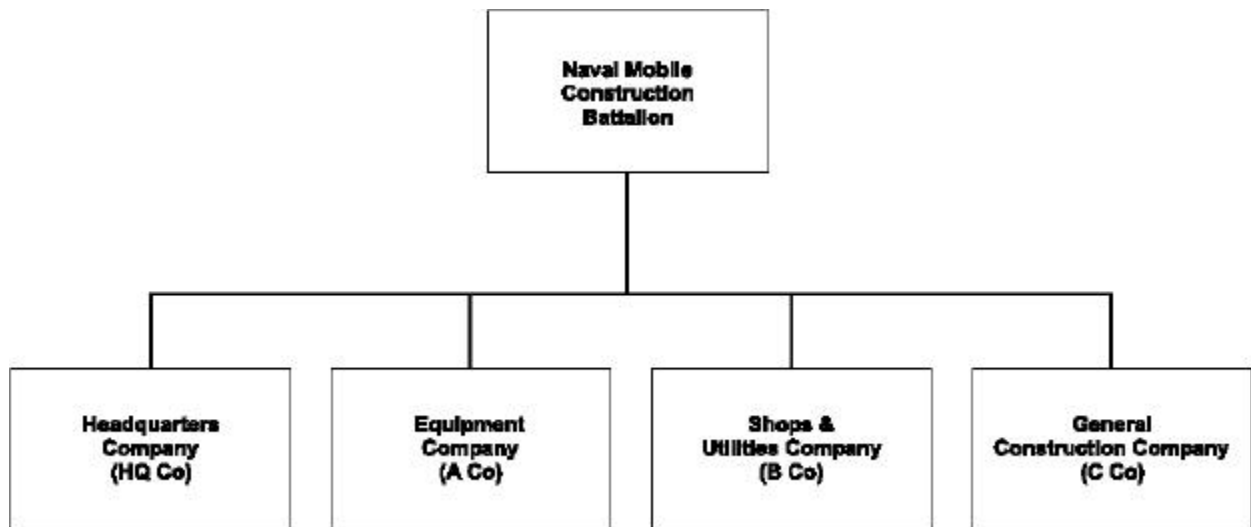


Figure 1-7. Naval Mobile Construction Battalion.

provide task-organized detachments, up to 50 percent of its organizational size, to address specific support requirements. Nearly 85 percent of each NMCB can deploy as an air echelon via strategic airlift (approximately 87 C-141, 44 C-17, or 30 C-5 equivalent lifts), with the remaining 15 percent (known as the sea echelon) following via sealift. Additionally, the NMCB—

- I Conducts operations in climate extremes ranging from cold weather to tropical or desert environments.
- I Maintains an organic TOA capable of sustaining construction operations planned or envisioned under contingency or general war conditions for 60 days without resupply, except that Class I material is limited to 5 days, Class III is limited to 3 days, and Class V is limited to 15 days. Class IV is limited to those materials required to construct the NMCB's base camp. Resupply past the time frames noted is the responsibility of the supported MAGTF's G-4, to be coordinated through the cognizant NCR's command element if the NMCB is task-organized in a naval construction regiment.
- I Conducts construction operations in a MOOTW environment and in unsecured and isolated locations without protection of the supported MAGTF.

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### **SPECIALIZED COMMAND AND SUPPORT OF ENGINEER ORGANIZATIONS**

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The concept of task organization dictates that the mission parameters drive the decision on the best way to organize MAGTF elements to support the mission. A number of combat and support organizations have proven effective in facilitating timely and adaptive engineer support. Two of those organizations, engineer groups and liaisons, can have a great impact on small- and large-scale engineer operations.

### **Engineer Groups**

An engineer group is a large, task-organized unit of combat support and CSS units from available Marine Corps, NCF, and engineer attachments from other U.S. military forces and host nation assets. The group supports a specific operation and disbands at the end of the operation. The establishment of an engineer group to support operations requiring extensive engineer support can provide the MAGTF commander with better visibility of infrastructure requirements and development and greater flexibility managing scarce engineer resources.

### **Liaison**

Liaison is not a specific command and control structure in normal MAGTF organizations, but it provides advantages to the commander that would not otherwise exist. Liaison is the contact maintained between military force elements to provide mutual understanding and unity of purpose and action. Liaison between maneuver forces and engineer units ensures identification of operational requirements and aids in resource management. Formal and informal contact between staffs and commands at higher, lower, adjacent, supporting, and supported command levels is essential to the planning and execution of military operations. Engineer staffs and commands should develop temporary and permanent liaison elements to facilitate engineer planning and effective communications.

The introduction of allied, host nation, and non-government engineer assets in the AO may require the use of liaison staffs. This enables the MAGTF commander to better understand and use all engineer support available in the AO. Political constraints, command structure, statutory restrictions, or other circumstances may prevent the MAGTF commander from exercising direct command over non-MAGTF assets. Liaison provides a means for commanders to efficiently coordinate and plan the use of these other assets while the existing command structure fulfills the commander's request for support. Liaison staffs are an organizational structure, not under direct command, that monitor the MAGTF's interest.

## Chapter 2

# Engineer Information

Engineer information is the result of organizing, collating, comparing, processing, analyzing, and filtering raw data requested by or provided by engineer units. It is then related to specific military activities and used by commanders in planning military operations and construction. Engineer information is comprehensive—it covers fields and levels of MAGTF engineering activity. It is also a part of geospatial intelligence. Engineer information includes, but is not limited to—

- 1 Terrain, encompassing the location, identity, and physical description of natural and manmade features.
- 1 Research, design, and employment of materials; techniques corresponding to that material; and techniques of interest and use to engineers.
- 1 Order of battle of engineer units and similar information on civilian organizations capable of performing engineer missions.

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### INTELLIGENCE PREPARATION OF THE BATTLESPACE

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Intelligence preparation of the battlespace (IPB) is a systematic and continuous approach to analyzing the enemy, weather, and terrain in a specific geographic area. IPB uses enemy doctrinal norms and orders of battle to template enemy forces. It also attempts to anticipate their capabilities and predict their intentions. Engineers must understand the G/S-2 doctrinal and situation template to analyze threat capabilities and the order of battle. The situation template becomes the foundation for the G/S-2 and engineer coordination. For example, obstacle intelligence and templating are developed in concert with the G/S-2's templating of a motorized rifle battalion's defense. The engineer G/S-2 will use the situation template to further develop intelligence requirements (IRs), priority intelligence requirements (PIRs), and named areas of interest (NAIs) to support the event template and the collection plan. The engineer will ensure obstacle intelligence collection is integrated into the collection plan.

The IPB consists of the following three elements:

- 1 Modified combined obstacle overlay.
- 1 Enemy mission and capabilities.
- 1 Friendly capabilities.

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### ENGINEER BATTLESPACE ASSESSMENT

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The engineer battlespace assessment (EBA) is developed in conjunction with the IPB, and focuses on engineer-specific intelligence. The engineer develops facts and assumptions and supports the IPB process by analyzing the terrain and weather and assessing their impact on military engineer operations.

The engineer will analyze the terrain using the following five military aspects of terrain:

- 1 Key terrain.
- 1 Observation and fields of fire.
- 1 Cover and concealment.
- 1 Obstacles.
- 1 Avenues of approach (AA).

Terrain analysis reduces the uncertainties regarding the effects of natural and manmade terrain on friendly and enemy operations.

### Modified Combined Obstacle Overlay

Analyzing the military aspects of the terrain is accomplished primarily through preparing the modified combined obstacle overlay (MCOO) developed by the G/S-2 with the engineer's assistance. The MCOO graphically identifies AAs, cross-country mobility classifications, mobility corridors, and existing and future obstacle systems. A slope overlay can determine trafficability and intervisibility for intelligence collection, target acquisition, weapons capabilities, and obstacle integration. These products will be used for COA development and analysis.

### Enemy Mission and Capabilities

The second component of the EBA is to analyze the threat engineer mission and capabilities. The first step is to understand the enemy's mission and

consider its doctrinal use of engineers. The engineer staff uses the G/S-2's doctrinal and situation template to develop the threat engineer order of battle. The engineer staff officer will further assess the enemy's mobility, countermobility, and survivability capabilities and template the enemy's engineer effort. In coordination with the G/S-2, engineers will recommend IR and/or PIRs, attempt to augment the reconnaissance effort, and monitor the collection effort to confirm or deny the situation template.

In the defense, the engineer templates the enemy's—

- | Mobility capabilities and locations.
- | Use of scatterable mine (SCATMINE) and other mines.
- | Engineers in the reconnaissance effort.
- | High-value targets (HVT) (e.g., bridging and breaching assets).

In the offense, the engineer templates the enemy's—

- | Tactical and protective obstacle effort and reinforcing fires.
- | Use of SCATMINE and other mines.
- | Survivability and fortification effort.

### Friendly Capabilities

Friendly capabilities are based on available manpower, equipment, resources, and training. Specific friendly considerations include relationship between survivability and countermobility (e.g., construct antitank ditch versus construct hull defilade positions versus construct turret defilade positions). The engineer staff uses the information developed in the mission analysis to produce the friendly capabilities analysis. While task-organizing the engineer organizations, the engineer staff considers the possibility of additional support from the maneuver force and the higher-ranking engineer. Engineers must also consider the availability of critical resources. After determining the total assets available, the engineer staff uses planning factors or known unit work rates to determine the friendly capabilities.

The engineer staff officer combines the analysis of the terrain and the enemy and friendly capabilities to form facts and assumptions about—

- | Enemy engineer effort and the most probable enemy COA.
- | Critical friendly and enemy tactical events.

- | Enemy vulnerabilities.
- | Potential effect of these factors on the mission.

The facts-and-assumptions process is lengthy, and the engineer staff must focus on the information required by the maneuver commander and the commander's staff to make decisions. The EBA is a continuous process. Each time new information is collected, the engineer must evaluate the impact and/or effect on the mission and refine the facts and assumptions as necessary.

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## TARGETING

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The purpose of targeting is to attack vulnerable enemy installations, units, or equipment that best support the mission's accomplishment. The targeting effort is focused on the commander's intent. Targeting is "The process of selecting targets and matching the appropriate response to them, taking account of operational requirements and capabilities. The analysis of enemy situations relative to the commander's mission, objectives, and capabilities at the commander's disposal, to identify and nominate specific vulnerabilities that, if exploited, will accomplish the commander's purpose through delaying, disrupting, disabling, or destroying enemy forces or resources critical to the enemy. See also joint targeting coordination board." (JP 1-02)

The engineer's role in the targeting process is analyzing facility targets and providing targeting information on obstacle plans to the fire support coordinator (FSC). Target analysis examines potential targets to determine military importance, priority of attack, and weapon effects required to obtain a desired level of damage. The engineer staff must analyze the loss or damage to terrain, facilities, and infrastructure and their effect on the mobility, survivability, and sustainability of the force. If the facility or infrastructure is only targeted for damage, the engineer staff needs to determine the level of destruction the target can withstand yet be repairable with organic engineer capabilities for friendly use.

The engineer staff must provide the FSC the following information on obstacles for inclusion in the target list:

- | Location.
- | Altitude.

- | Description (type of obstacle and construction).
- | Vulnerability.
- | Recovery time (estimated time for the enemy to repair obstacle).
- | Accessibility (location of the obstacles to other terrain or cultural features that may limit the direction or angle of attack).
- | Importance.

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## Chapter 3

# Engineering Reconnaissance

Engineer reconnaissance collects data that provides engineers within a MAGTF information on terrain, hydrographics, meteorological, and infrastructure (e.g., built-up areas, transportation networks, utilities, existing natural or manmade obstacles) necessary to support the commanders with their planning for ongoing or future operations. Engineer reconnaissance is vital to successful MAGTF operations. The following are the fundamentals of engineer reconnaissance:

- | Orient on the location or movement of the objectives relative to engineers.
- | Discover gaps and other weaknesses in enemy dispositions.
- | Confirm trafficability and other terrain characteristics.
- | Report all information accurately.
- | Avoid decisive engagement.
- | Develop situation and rapidly—
  - n Deploy.
  - n Reconnoiter.
  - n Take a course of action.
  - n Report.
  - n Egress.

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## RECONNAISSANCE MISSIONS

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The reconnaissance mission relates not only to the engineer mobility mission but also to countermobility, survivability, and general engineer missions. See MCRP 3-17A/FM 5-34, *Engineer Field Data*, and MCRP 3-17B, *Engineer Forms and Reports*, for the appropriate forms to support the following missions.

### Route Reconnaissance

Route reconnaissance obtains information about enemy obstacles (including NBC contamination), route conditions, and critical terrain features along a specific route. The techniques are less time-consuming and are performed more rapidly than other types of reconnaissance. Imagery, maps, and intelligence studies identify likely beach, landing zone, or inland exits and movement routes.

### Zone Reconnaissance

Zone reconnaissance is used when the enemy's location is in doubt or if it is desired to locate suitable routes or determine conditions of cross-country trafficability. It obtains detailed information about routes, obstacles, key terrain, and enemy activity in a zone established by definite lateral boundaries.

### Area Reconnaissance

Area reconnaissance obtains detailed information about all routes, obstacles, and enemy forces within any clearly defined area. Details can include size and layout of towns; types, densities, and locations of woods; or possible fording sites of water obstacles. It is the most time-consuming of the three types of reconnaissance. Types of area reconnaissance include—

**Water Reconnaissance.** Initially, the landing force brings potable water ashore. Engineer reconnaissance locates and develops additional water sources ashore. Ground engineer reconnaissance confirms sources previously determined by aerial photos, maps, and intelligence studies.

**Engineer Material Reconnaissance.** Engineer reconnaissance locates sources of lumber, timbers, standing timber, gravel, rock, sand, and other local construction materials. It may also locate enemy engineer construction equipment and/or facilities such as parts stores, asphalt or concrete batch plants, and heavy machinery.

**Airfield Site Reconnaissance.** Airfield site selection begins prior to friendly forces going ashore. This can be accomplished by studying maps, photos, and products from other imagery and intelligence sources and flying over the site. Because micro-terrain can severely affect airfield operations, final selection is not done until physical reconnaissance confirms the utility of the landing sites designated prior to the assault and quantifies upgrade and/or repair requirements.

### Reconnaissance Considerations

An important consideration in all reconnaissance activities is the impact of large quantities of unexploded ordnance. The EOD support in the

MAGTF should be involved in evaluating the impact of this on any mission. Reconnaissance considerations for missions also include—

- l Mobility—
  - n Route reconnaissance. Enemy obstacle barrier reconnaissance.
  - n Bypasses identification.
- l Countermobility—
  - n Barrier Planning.
  - n Target and/or obstacle folders and target analysis.
- l Survivability—
  - n Friendly forces emplacement.
- l General Engineering—
  - n Utility assets location.
  - n Water points location.
  - n Local construction materials identification.
  - n Existing facilities location.

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## **OFFENSIVE AND DEFENSIVE OPERATIONS**

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Engineer reconnaissance in the offense should be placed far enough forward of the maneuver elements perform proper route and obstacle reconnaissance. This must be done in order to return information to the rear in a timely manner. Engineer reconnaissance should have the capability to—

- l Provide a detailed report of all existing and reinforcing obstacles along the maneuver

element's axis of attack. The reports should include estimates for breaching.

- l Provide information on routes along the axis of advance that may influence the commander's plan such as vulnerabilities and critical choke points.
- l Provide information on water, electric, fuel, and other engineer resources.
- l Locate bypasses far enough in advance of the lead element to prevent slowing the momentum of the maneuver element's attack.
- l Provide information about the countermobility capability of the enemy.

The major use of the engineer reconnaissance in the defense is to provide information for the obstacle and/or barrier plan. This information may be obtained forward of the forward edge of the battle area (FEBA), to the rear of the FEBA, or to the flanks. Specific requirements in the defense are—

- l Detailed information on choke points.
- l Detailed demolition estimates for the creation of obstacles.
- l Resources for obstacle construction.
- l Routes in support of a retrograde or lateral movement.
- l Route reconnaissance on likely avenues of approach for the enemy.
- l Enemy's breaching capability.
- l Obstacle emplacement in the enemy's rear capability.
- l Close lanes in obstacles during delay and/or defend operations.

## Chapter 4

# Combat Engineering Operations

*“Every successful military operation is directed toward a clearly defined, decisive, and attainable objective. The ultimate military objective is to defeat the enemy’s forces or destroy his will to fight.”*

—MCWP 3-1, *Ground Combat Operations*

Combat engineering is an integral part of the MAGTF’s ability to maneuver. Combat engineers enhance the force’s momentum by physically shaping the battlespace to make the most efficient use of the space and time necessary to generate mass and speed while denying the enemy unencumbered maneuver. By improving the battlespace, combat engineers accelerate the concentration of combat power, increasing the velocity and tempo of the force necessary to exploit critical enemy vulnerabilities. By reinforcing the natural restrictions of the battlespace, combat engineers limit the enemy’s ability to generate tempo and velocity. These limitations increase the enemy’s reaction time and physically and psychologically degrade his will to fight.

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### **BARRIER, OBSTACLES, AND MINES**

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“Employment of barriers, obstacles, and mine warfare can, in concert with other capabilities, enhance a commander’s ability to mass combat power, sustain the force, conduct offensive or defensive operations, achieve surprise, and use key terrain, airfields, or sea routes. A commander must consider both friendly and enemy employment of these capabilities in preparing plans and conducting operations.” (JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare*) Barriers, obstacles, and mines have a significant impact on operations. Commanders must constantly consider the advantages and disadvantages of their employment and countering them during planning and execution.

Barriers, obstacles, and mines—

- 1 Inflict significant equipment and psychological damage and personnel casualties on the enemy with minimal risk to friendly forces.

- 1 Extend, strengthen, and deepen other defensive and offensive measures to support the concept of operations.
- 1 Immobilize the enemy until barriers, obstacles, or minefields are bypassed, breached, or cleared.
- 1 Exploit geographic features.
- 1 Free forces for other employment.
- 1 Create uncertainty for the enemy commander.

Disadvantages of barriers, obstacles, and mines include—

- 1 Amount of time, material, equipment, and transportation that their creation and removal can consume. Creation and removal will be manpower-intensive and hazardous.
- 1 Bypassability, breachability, or clearability.
- 1 Unintended casualties to friendly forces and noncombatants, as well as limited friendly mobility.
- 1 Defensive minefields must be rendered safe following their operational usefulness. (JP 3-15, *Joint Doctrine for Barriers, Obstacles, and Mine Warfare*)

### **Rules of Engagement**

Rules of engagement (ROE) are mission-oriented and action-specific directive guidance that authorize and delineate the circumstances and limitations of the use of force. ROE are published by the geographic combatant commander based on guidance from the National Command Authorities. MCRP 5-12.1A/FM 27-10, *The Law of Land Warfare*, and JP 3-15 provide details on the rules governing the employment of barriers, obstacles, and mines. Commanders should address the authority to emplace barriers, obstacles, and mines in operation plan (OPLAN) development and when determining post-hostility ROE.

## Planning Considerations

To achieve the maximum effect from a barrier, obstacle, or minefield—

- | Form barriers, obstacles, and minefields around an existing terrain feature (e.g., mountain chain or a strait) or a manmade structure (e.g., air base, canal, highway, or bridge).
- | Cover them with observation and fire. Fields not covered by observation and fire are rarely effective.
- | Analyze the friendly and enemy forces' ability to maneuver on land and sea or to conduct effective air operations.

Offensive considerations include—

- | Enhancing and protecting the friendly force's ability to maneuver.
- | Preventing enemy reinforcement or counterattack.
- | Facilitating economy of force.
- | Providing security.
- | Degrading enemy air and naval capabilities.
- | Fixating on the enemy.

Defensive considerations include—

- | Directing toward degrading the enemy's ability to maneuver.
- | Integrating systems of barriers, obstacles, minefields, and fires.
- | Identifying reinforcing obstacles and minefields early.
- | Identifying assets to restore the integrity of a barrier, obstacle, or minefield if breached by the enemy.
- | Creating massive obstacles in land operations.

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## OBSTACLES

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Obstacles are any physical objects that impede the mobility of a force.

### Categories of Obstacles

**Existing Obstacles.** Existing obstacles are obstacles that are present on the battlefield as inherent aspects of the terrain. The two types of existing obstacles are natural and cultural. Natural obstacles are terrain features, such as rivers, forests, or mountains.

Cultural obstacles are manmade terrain features, such as towns, canals, railroad embankments, or buildings.

**Reinforcing Obstacles.** Reinforcing obstacles are obstacles specifically constructed, emplaced, or detonated by military forces. The categories of reinforcing obstacles are—

- | Tactical. The primary purposes of tactical obstacles are to restrict enemy maneuver and multiply the effects and capabilities of firepower.
- | Protective. Hasty or Temporary obstacles created next to positions to protect defending forces.
- | Deliberate. More permanent obstacles created at strong points or fixed sites.
- | Phony Obstacles. Units may also use phony obstacles that give the appearance of actual obstacles but require only minimal resources to emplace.

### Obstacle Effects

Tactical obstacles and fires manipulate the enemy in a way that supports the commander's intent and scheme of maneuver. The intended effect that the commander wants the obstacles and fires to have on the enemy is called the obstacle effect. Obstacle effects—

- | Drive integration.
- | Focus subordinates' fires.
- | Focus obstacle effort.
- | Multiply the effects of firepower.

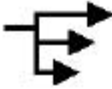
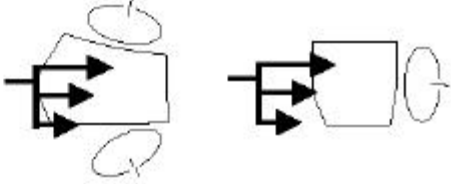

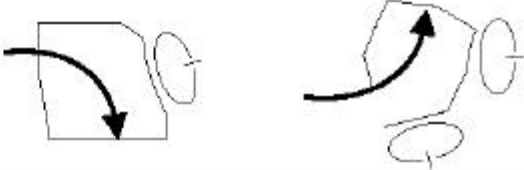
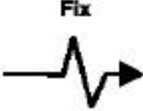
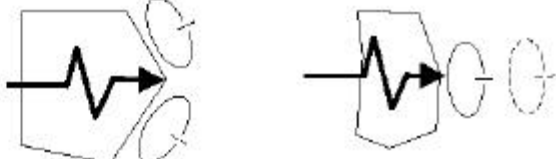


Obstacle effects occur because of fires and obstacles, not just obstacles alone. All tactical obstacles produce one of the following obstacle effects (see fig. 4-1):

**Disrupt**—focuses fire planning and obstacle effort to cause the enemy to break up formation and tempo, interrupt timetable, commit breaching assets prematurely, and piecemeal the attack.

**Turn**—integrates fire planning and obstacle effort to divert an enemy formation.

**Fix**—focuses fire planning and obstacle effort to slow an attacker within a specified area, normally an engagement area.

**Block**—integrates fire planning and obstacle effort to stop an attacker along a specific AA or prevent him from passing through an engagement area.

OBSTACLE EFFECT GRAPHIC	APPLICATION	EXAMPLES CONVEYING INTENT
<p><b>Disrupt</b></p> 	<p>Short arrow indicates where enemy is attacked by obstacles.</p> <p>Long arrows indicate where bypass is allowed and attacked by fires.</p>	
<p><b>Turn</b></p> 	<p>Heel of arrow is anchor point.</p> <p>Direction of arrow indicates desired direction of turn.</p>	
<p><b>Fix</b></p> 	<p>Irregular part of arrow indicates where enemy advance is slowed by obstacles.</p>	
<p><b>Block</b></p> 	<p>The ends of the vertical line indicate the limit of enemy advance.</p> <p>The ends of the vertical line also indicate where obstacles lie in NO-GO terrain.</p>	

**Direction of enemy attack** →

Figure 4-1. Obstacle Effects.

## OBSTACLE PLANNING

Commanders and staffs consider the use of obstacles when planning offensive and defensive operations. During the decisionmaking process, obstacle planning is incorporated to ensure obstacle integration effectiveness and that the obstacle plan is flexible enough to allow changes during the phases of the operation. Obstacle planning requires integrating information from the staff and includes—

- l Intelligence—
  - n AA (friendly and enemy).
  - n Enemy combat power.
  - n Location of enemy forces (location and formation).
  - n Enemy objectives, main effort, and options.
- n NAI and/or target areas of interest (TAI) and/or decision points (DPs).
- n Enemy vulnerabilities and enemy DPs.
- n Enemy breaching capabilities.
- n Time in the battle zone that friendly and/or enemy forces will be active.
- l Logistics—
  - n Type and quantity of material available.
  - n Location of the material.
  - n Where the material is required.
  - n Distance from current location to required location.
  - n Transportation assets available to move the material.
  - n Schedule for moving the material.
  - n Availability of personnel.
  - n Availability of construction equipment.

- l Fire Support—
  - n Total fire-support capability (such as batteries, battalions, attack helicopters, or fixed-wing sorties).
  - n Family of scatterable mines (FASCAM) capable assets (artillery- or air-delivered; priority of fires, and deployment authority).
- l Engineers—
  - n Terrain analysis.
  - n Enemy engineer mission and mobility and/or survivability capabilities.
  - n Friendly mobility and/or survivability capabilities.

### Obstacle-Control Measures

Obstacle-control measures are used to ensure that subordinates emplace obstacles that support the higher commander's scheme of maneuver and that do not interfere with future operations. Obstacle control measures are groups, belts, and zones (see fig. 4-2).

**Obstacle Groups.** Obstacle groups are two or more obstacles grouped to provide a specific obstacle effect. For example, three obstacles are planned to turn the enemy into the battalion's AO. While each obstacle could have a different effect such as fix, turn, disrupt, or block, the overall effect would turn the enemy into a kill zone.

**Obstacle Belts.** Obstacle belts are a collection of obstacle groups that provide a specific effect. In the same way that obstacle groups use individual obstacles to achieve a desired effect, a series of groups are used to disrupt, turn, fix, or block the enemy on a larger scale. Belts are also a control measure for the regimental commanders to constrain tactical obstacle employment. They plan obstacle belts within assigned AO to grant obstacle emplacement authority to their major subordinate units to achieve a specific effect and/or outcome. Obstacle belts also focus obstacles in support of the regiment's scheme of maneuver and ensure that obstacles do not interfere with the maneuver of higher headquarters (HQ).

**Obstacle Zones.** Obstacle zones are used in the infantry division plan and are composed of a group of obstacle belts. Divisions plan obstacle zones based on regimental AO and ensure they do not impede future operations.

### Situational Obstacles

Situational obstacles are obstacles that units plan and possibly prepare before starting an operation; however, do not execute unless specific criteria are met. The commander can use situational obstacles to attack an enemy vulnerability, exploit success, separate follow-on enemy forces, or provide flank protection. Unlike directed or reserve obstacles, a

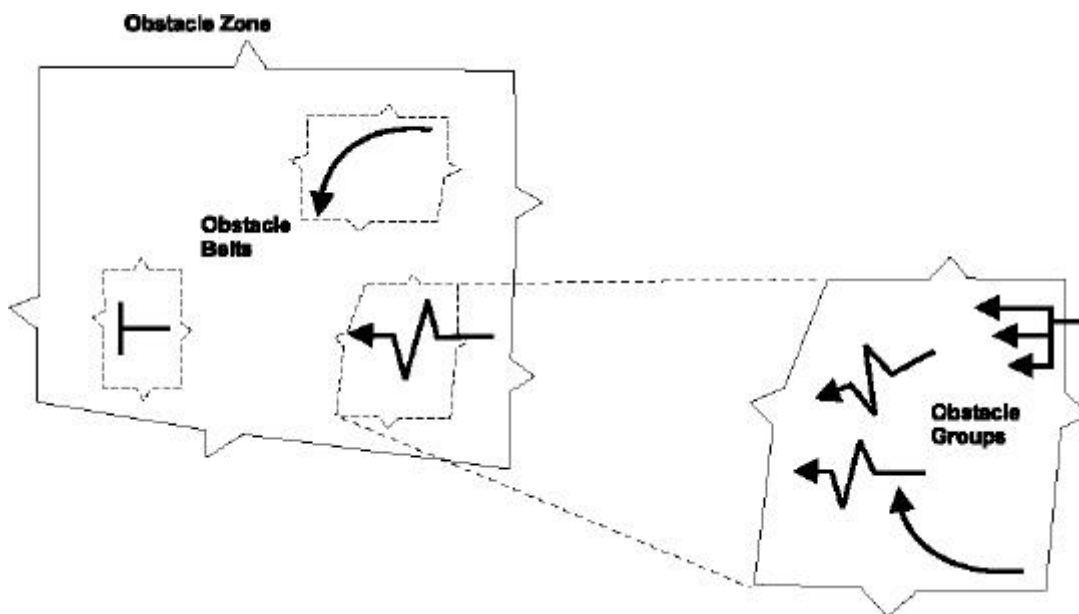


Figure 4-2. Obstacle Groups, Belts, and Zones.

situational obstacle may be executed. Normally, units plan several situational obstacles that rely on the same assets for emplacement. This allows the commander to shift scarce assets to the location where he needs them the most. When planning, preparing, and executing situational obstacles, commanders and staffs—

- 1 Identify the need and prioritize.
- 1 Plan for appropriate resources.
- 1 Integrate the obstacle with friendly fires.
- 1 Plan the obstacle.
- 1 Identify obstacle execution triggers.
- 1 Withhold execution of the obstacle until it is needed.

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## MINE WARFARE

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*Note: The United States (U.S.) military does NOT employ non-self destructing antipersonnel land mines (NSDAPLs). All instruction and training on the employment of NSDAPLs by the U.S. will stop. However, it is understood that allies of the U.S. as well as other nations of the world continue to use these weapons. Therefore, it is imperative that USMC engineers understand the mechanics and standard layout of minefields containing NSDAPLs. It is also imperative that USMC engineers continue to train to breach and clear ALL types of mines.*

Land mines are a unique weapon system in the battlespace. They are inexpensive, easy to use, and as complex or simple as the user needs. Mines can be employed miles ahead of the FLOT to disrupt, fix, turn, or block the momentum of the enemy without endangering friendly forces. Land mines can silently reinforce ground forces deceptively creating surfaces that appear as gaps, or be hidden in streams and surf to deny the transit of the shallow water areas. Psychologically, mines can unnerve a force creating uncertainty, low morale, and even an unwillingness to fight. Most importantly, they are used by friendly and enemy forces.

Combat engineers are responsible for employing or countering the use of this weapon in support of offensive and defensive operations. Detailed planning and coordination are required with all levels of command to ensure the use and location of the mines supports the operation.

## Conventional Mine Categories

Standard land mines consist of a small amount of high explosives contained in a metallic or nonmetallic casing, fitted with a fuze and/or a firing device for actuation by enemy vehicles or personnel.

**Antipersonnel Mines.** Antipersonnel mines consist of a small amount of high explosives in a container, fitted with a detonating fuze arranged for actuation by pressure, release of pressure by pulling on a tripwire, or release of tension.

**Antitank Mines.** Antitank mines consist of a charge of high explosives in a metallic or nonmetallic case. Antitank mines require a pressure of 290 to 500 pounds to actuate a detonation. There are a variety of antitank mine fuzing systems (e.g., pressure, tilt-rod assembly, magnetic influence).

**Chemical Mines.** Chemical mines are antipersonnel mines with target contact or command-detonated fuses. They are filled with a persistent chemical agent (nerve agent or blister agent). National policy, as announced by the theater commander, will govern the use of chemical mines in the joint operating area or amphibious operation area. When authorized, they are normally used in defense and retrograde operations, and mixed with high explosive mines to form a combined high explosive chemical minefield. Adding chemical mines to existing high explosive minefields is done by laying additional strips of chemical mines in a random pattern, or by adding high explosive-chemical strips to the front or rear of existing fields. Chemical mines may be included in tactical, interdiction or point minefields, but not in protective minefields. When an integrated high explosive-chemical minefield is laid, it discourages the use of explosive rapid mine clearing devices. Use of such devices creates a chemical hazard in the area. High explosive mines reduce the speed of enemy forces crossing the minefield. Speed is further reduced by forcing the enemy to use protective clothing and masks.

**Anti-helicopter Mines.** Anti-helicopter mines (AHM) have been prefabricated using explosives configured to direct projectile material (nails, metal scrap, rocks, etc.) toward airborne targets. First used in Vietnam, they were actuated by the rotor wash of descending helicopters into potential landing zones. AHM systems currently under development will use acoustic sensors and have a range more than 200 meters. Antitank mines may also have their tilt rods

fitted with a small parachute that will catch the rotor wash and activate the mine.

**Family of Scatterable Mines.** FASCAM type mines are air, artillery, mechanical or hand emplaced. They can be either antipersonnel or antitank mines. The U.S. Army, Air Force, Navy, and Marine Corps all employ a variety of FASCAM systems. Three of the most common FASCAM systems employed by the U.S. Marine Corps are described in appendix A.

### Purpose of Minefields

In land warfare, a minefield is an area of ground containing mines laid with or without a pattern. They are the most effective means of reinforcing the terrain to stop, slow, or channelize the enemy into areas where he can be killed. Mines and minefields can and should be emplaced where and whenever the tactical situation dictates. Additional information on the employment of mines and minefields can be obtained in FM 20-32, *Mine/Countermine Operations*, and FM 90-13-1, *Combined Arms Breaching Operations*.

### Classification of Minefields

Minefields are classified according to their tactical purpose.

**Hasty Protective Minefield.** Used as a part of a unit's defensive perimeter to give close-in protection and warning, a hasty protective minefield is usually emplaced by squad-sized units. It is laid on short notice, for a limited time, and mines must be detectable. If time permits, the mines should be buried or camouflaged, but they can be laid on top of the ground in a random pattern. No antihandling devices are used. The mines are employed outside hand grenade range, but within small arms range. A Minefield Record Form (DA Form 1355, March 87) is prepared and held as a record at the company level. Copies are forwarded to the approving (normally battalion-level) headquarters. Several Marines should know the exact location of each mine. As authorized by the GCE, a battalion commander can normally approve the emplacement of hasty protective minefields.

**Deliberate Protective Minefield.** This type minefield is used to protect static installations such as airfields, ammunition depots, etc. The mines are normally emplaced by engineers in standard patterns and remain so for an extended time. The minefield is usually fenced, marked, and covered by fire and

observation. FASCAM type mines will not normally be used in deliberate protective minefields.

**Point Minefield.** Point minefields are used to disorganize enemy forces and hinder enemy use of key areas. They are of irregular size and shape and include all types of antitank and antipersonnel mines, as well as antihandling devices. They are used to reinforce obstacles or rapidly block an enemy AA. Marine infantry personnel may be required to provide security and/or assist engineers in the installation of a point minefield to expedite its construction. FASCAM mines may be used exclusively or in conjunction with standard mines to construct, reseed, close breached lanes or augment a point minefield.

**Interdiction Minefield.** These minefields are emplaced by special operations forces in enemy-held areas. They are designed to kill, disorganize, and disrupt lines of communications and degrade the efficiency of command and control facilities. Combat engineers assist in the planning and execution of tactical operations employing interdiction minefields. FASCAM type mines may be used exclusively or in conjunction with conventional mines to construct an interdiction minefield.

**Phony Minefield.** A phony minefield is an area of ground used to simulate a live minefield and deceive the enemy. Phony minefields can supplement or extend live minefields and are used when construction time, effort, or material for live minefields is limited. Marine infantry personnel may be required to provide security and/or assist engineers in the installation of a phony minefield to expedite its construction.

### Minefield Installation

Engineer organizations are currently only capable of installing minefields by hand emplacement. The exact location, size, type, fuzing, and antitampering devices on each mine should be accurately recorded. This information is extremely useful if the field requires future maintenance. Normally, a minefield is considered effective if 60 percent of the mines emplaced are still functional. Although slow, time-consuming, and a significant logistic burden, the hand emplaced minefield offers one major advantage to maneuver warfare over other mechanical, artillery, or air delivered systems (e.g., FASCAM). Lanes can be constructed and accurately identified, thus eliminating the minefield as an obstacle to the MAGTF commander yet maintaining its



effectiveness as an obstacle to the enemy. Minefields, regardless of how they are constructed, are obstacles used by the commander to shape the battlefield.

## Marking of Minefields

When enemy minefields are discovered in any area to the rear of positions along the forward edge of the battle area (FEBA), an immediate spot report will be initiated and, time permitting, the discovering unit will attempt to mark the outer boundary of the mined area. The following guidelines govern the marking of standard minefields.

**Minefields to the Rear of Positions Along the FEBA.** At the time of laying, the minefield must be completely fenced on all sides with two strands of barbed wire or concertina. To avoid indicating the exact boundary of the field, the fence does not follow the minefield trace exactly. The fence is not less than 15 meters from the nearest mine. The top strand of barbed wire fence is about waist-high, the lower strand about ankle-high. Standard mine marking signs spaced approximately 10 to 50 meters apart, depending upon terrain, are hung on the upper strand with the word “Mines” facing away from the field. As an alternative to barbed wire fencing, concertina wire may be used. The distance between lane markers and marking signs is determined by terrain and visibility conditions. Minefield lanes in rear areas are fenced on both sides, and the fences are linked with the minefield perimeter fencing at entrances and exits. In addition, lane entrances and exits, as well as the passage itself, are marked with signs to indicate the safe and dangerous sides. In darkness or poor visibility, lane markers are illuminated. In non-English speaking areas, signs in the native language must also be erected. It may be necessary to post guards at lane entrances to prevent friendly personnel from entering dangerous areas. Additionally, large animals and/or animal herds may require modified or additional fencing to prevent their entry into mined areas.

**Minefields Forward of Positions Along the FEBA.** Minefields forward of positions along the FEBA are usually fenced on the friendly side and/or the flanks as necessary to protect friendly troops. These minefields may also be completely enclosed to influence the enemy to bypass the field. Lanes in forward areas are marked inconspicuously because use of standard methods would expose lane locations to the enemy. Suggested methods of lane marking include placing wire, tape, or closely spaced objects

on the ground on each side of the lane, with an easily identifiable lane entrance made by markers such as pickets wrapped with tape or piles of stones. All lanes in standard minefields should be registered artillery targets to allow mine re-seeding with FASCAM systems to prevent entry.

**Minefields in Enemy Territory.** Minefields established within enemy territory are reported but not marked.

## Reporting and Recording Minefields

Reporting and recording minefields are essential steps in mine warfare. The following reporting and recording criteria govern mine warfare conducted by the MAGTF. Forms for minefield reports can be found in MCRP 3-17B, *Engineer Forms and Reports*.

A minefield report is a verbal, electronic or written communication concerning mining activities, friendly or enemy. The exact format of the report is specified within the MAGTF operation order (OPORD). These reports are submitted by the emplacing unit commander through operational channels to the operations officer (G/S-3) of the authorizing headquarters or command element. That headquarters integrates the reports with terrain intelligence and disseminates them with tactical intelligence. The reports will be sent by the fastest, most secure means available. The following reports are used to convey mine warfare information:

**Report of Intention.** The report of intention serves as notification to a unit’s higher headquarters that the unit intends to emplace a minefield. The report of intention doubles as a request when initiated at levels below those with emplacement authority. Conventional minefields that are part of an OPLAN approved by the authorizing commander do not require a report of intention; that the minefields are included within such a plan implies an intention to lay. Minefields not authorized in an OPLAN require a separate report of intention. The report includes data regarding the tactical purpose of the minefield, the estimated number and type of mines to be emplaced, the location, and the proposed start and completion times.

**Report of Initiation.** The report of initiation is a mandatory report that informs higher headquarters that emplacement has begun, and the area is no longer safe for friendly movement and maneuver. It should specify the time emplacement began and

identify the location and target number of the minefield.

**Report of Completion.** The report of completion is usually an oral report to the authorizing commander that the minefield is complete and functional.

**Report of Change.** The report of change is made immediately upon any change or alteration made in a previously reported minefield and is sent to the next higher commander. It is then sent through channels to the headquarters that keeps the written minefield record.

### Additional Reports

**Progress Report.** During the emplacing process, the commander may require periodic reports on the amount of work completed.

**Report of Transfer.** The responsibility for a minefield is transferred from one commander to another in a report of transfer. This report is signed by both the relieved and relieving commanders and includes a certificate stating that the relieving commander was shown or otherwise informed of all mines within the commander's zone of action or sector of defense. The report states that the relieving commander assumes full responsibility for those mines. The report of transfer is sent to the next higher commander who has authority over both relieved and relieving commanders.

**FASCAM Minefield Report and Record.** Since the locations of individual scatterable mines are unknown, the reporting of the minefield is based on the aiming point or points. For example, a remote anti-armor mine system (RAAMS) or Gator minefield would be recorded based on the target location (the grid coordinates given to the firing battery). The size of the minefield would depend on the number of rounds fired (ordnance delivered), the number of aim points, and the angle of fire. Artillery- and air-delivered minefields are recorded by plotting them on a map based on the aim point(s) and a safety zone area specified in the scatterable minefield report and record prepared by the delivering unit. To facilitate the reporting and recording of scatterable minefields, a simple uniform procedure is used. This procedure combines the report and the record into one document—the Scatterable Minefield Report and Record—applicable for all FASCAM delivery systems.

**FASCAM Warning.** Along with the scatterable minefield report and record, a separate report of the

scatterable minefield warning (SCATMINEWARN) is used to notify affected units that scatterable mines will be employed. The SCATMINEWARN report is designed to give units that may be affected by the employment of scatterable mines the necessary warning to plan and execute their operations. The information in the report is kept to a minimum to ensure rapid dissemination. The report is sent by voice, digital, or hard copy means, either prior to or immediately after the mines have been emplaced.

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## MOBILITY

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Mobility is a quality or capability of military forces that permits them to move in time and space while retaining their ability to fulfill their primary mission. A commander must be able to mass forces quickly at a chosen place and time to accomplish the assigned mission. The commander must be able to achieve superior tempo through a relatively quicker observation, orientation, decision, action (OODA) loop than the enemy. Mobility is critical to achieving this situation and maintaining it for extended periods of time over great distances.

### Functional Areas

Mobility operations are intended to maintain this freedom of both tactical maneuver and operational movement through five functional areas which are—

- 1 Countermine activities—the detection, neutralization (by breach or bypass), marking, and proofing of mined areas.
- 1 Counter Obstacles—the employment of tactics and equipment to breach or bypass and ultimately reduce obstacles other than mines.
- 1 Gap-crossing—fills gaps in terrain in order to allow passage of personnel and equipment.
- 1 Combat Roads and Trails—expedient preparation or repair of routes of travel for both personnel and equipment.
- 1 Forward aviation combat engineering (FACE) is the preparation or repair of expedient landing zones, FARPS, landing strips, or other aviation support sites in the forward combat area.

### Countermine Operations

Countermine operations are all efforts taken to counter an enemy mine effort. Countermine operations are difficult because detection systems are imperfect and mine neutralization systems are only

partially effective. Normally, countermine operations using explosive systems will be conducted under enemy observation and fire. Countermine operations include—

- 1 Mine detection.
- 1 Reconnaissance for enemy minefields.
- 1 Breaching.
- 1 Prevention of enemy mine operations.

## Detection of Mines

**Visual.** Visual detection of mines is a reliable and increasingly effective method of locating minefields. The increasing proliferation of FASCAM type mines produces a high percentage of surface laid evidence. FASCAM mines can be recognized from a combat vehicle from a distance of up to 20 meters given normal ground vegetation. Visual detection and recognition of mines should be emphasized during MAGTF employment. The following indicators suggest the presence of FASCAM mines:

- 1 Dust clouds in the terrain without the presence of vehicles or equipment movement or recognizable shell explosions (clouds of dust are created by impact of scatterable mines).
- 1 Small parachutes in the air or spotted blowing on the ground.
- 1 Breaks in an area with otherwise uniform vegetation.
- 1 Mines or dispensing debris (casings, parachutes, etc.) hanging in trees and in underbrush.
- 1 Approaching or departing aircraft (fixed- or rotary wing) in association with any of the indicators.

**Auditory.** Listening for evidence of FASCAM type mine systems during their employment is a viable method. When artillery or multiple-launched rocket systems project their ordnance overhead and the impact report cannot be heard, the use of FASCAM mines may be suspected.

**Probing.** Probing is the method of detecting mines by penetrating the ground with an instrument such as a non-metallic or wooden mine probe. Metal objects such as a bayonet or stiff wire are not recommended. When the mines are armed with pressure-only type fuzing, probing is the safest way to locate mines. Modern fuzing systems that employ magnetic,

acoustic and/or seismic sensors cannot be safely located by the probing method.

### Electronic Detection

**Hand-held Systems.** The Marine Corps currently employs the PSS-12 mine detector to locate electronically mines below the surface (soil or water). It is a hand-held, battery-powered system.

**Vehicular-mounted Systems and Aircraft-mounted Systems.** They are currently under development. Systems that identify potential mines from a distance and in some cases, prematurely detonate them before they can endanger a vehicle. Although not yet fielded, these countermine systems have great potential for defeating the mine threat.

## Reconnaissance for Enemy Minefields

After detection, the characteristics and limitation of enemy barriers, obstacles, and minefields must be determined using both ground and aerial reconnaissance and remote imagery. Reconnaissance must—

- 1 Locate enemy barrier, mine, and obstacle locations.
- 1 Identify and locate enemy fire support.
- 1 Identify remaining enemy employment capabilities.
- 1 Locate enemy breaching assets.

If possible, it is important to determine the types of mines used and their physical characteristics, i.e., dimensions and material from which manufactured. This can aid the planning of how to clear the minefield.

## Breaching Operations

Enemy obstacles that disrupt, fix, turn, or block the force can affect the timing and force of the operation. Most obstacles can and will be observed by the enemy and protected with fires; they should be bypassed if possible. For those that must be breached, constant coordination and integration of all elements of the MAGTF is vital for success. Combat engineers are the key to the orchestration of the operation and are responsible for employing the tactics and techniques necessary to penetrate obstacles in the path of the force.

Breaching operations are some of the most complex of modern warfare, but are not an end unto themselves. They exist as only a part of the maneuver forces operation that is focused on the objective.

The goal of breaching operations is the continued uninterrupted momentum of ground forces to the objective. They should be planned and executed in support of the ground forces' needs to ensure actions at the objective are supported by actions at the breach. Breaching operations require the constant application of the fundamentals of ground combat and the concentrated uses of supporting arms. Fundamentals of breaching operations have evolved in concert with the fundamentals of ground combat and provide a logical and time-proven set of rules. These fundamentals are—

- 1 Suppress the enemy to maneuver and fire.
- 1 Obscure the enemy's ability to observe the operation.
- 1 Provide security for the breach force.
- 1 Reduce the obstacle.
- 1 Reconstitute.

### Prevention of Enemy Mine Operations

The most effective means of countering a mine threat is to prevent the laying of mines. Proactive countermine operations destroy enemy mine manufacturing and storage facilities or mine-laying capabilities before the mines are laid. Planners must consider enemy storage and mine production facilities and assets for inclusion on the target lists.

### Counter-Obstacle Operations

Many issues encountered in countermine operations apply to non-mine obstacles. Engineer reconnaissance should detect the presence of enemy obstacles and determine their type(s) and provide the necessary information to plan appropriate breaching or by-pass plans developed to negate their impact on the scheme of maneuver.

Another important consideration to be gained from reconnaissance is to anticipate when and where the enemy may employ obstacles that could impede the MAGTF's operations. It is prudent to incorporate plans to deny the enemy the opportunity to establish effective obstacles whenever possible. Achieving this goal can be accomplished by—

- 1 Occupying the area before the enemy can exploit it.
- 1 Preplanning artillery and close-air support to deny or harass enemy units attempting to establish obstacles.

- 1 Looking for or creating alternative routes for the MAGTF's units.
- 1 Using engineering knowledge of obstacles to create contingency plans for breaching or bypassing to allow quick neutralization of the obstacles, if established by the enemy.

### Gap-Crossing Operations

Combat engineers can aid gap crossing through employment of their heavy equipment to modify the existing gap or through the use of expedient bridging (e.g., rope bridges, small nonstandard bridging using local materials). However, CEBs do not possess organic standard bridging equipment. If the plan calls for this type of gap-crossing asset or the situation arises unexpectedly they will need support from the engineer support battalion. See additional information in chapter 5.

### Combat Roads and Trails

The ability to move personnel and equipment is essential to maneuver warfare. This ability provides the commander with the means to increase tempo, increase speed, and concentrate mass at crucial times and places. The construction and maintenance of trails and roads are normally considered general engineering tasks and are therefore performed by engineering support units. However, areas at or near the FLOT or time constrictions may require the forward combat engineer units to perform these functions in an expedient manner or for short durations of time until support engineers are available.

The two most likely scenarios that would involve this requirement would be by-pass operations or to support FACE operations. It is important for the engineer commander and staff to only perform this function in support of the maneuver plan. They should not allow engineering assets to be dissipated and thus unable to perform their primary role of supporting the MAGTF commanders operational scheme of maneuver.

Engineers should always strive to take full advantage of existing infrastructure and natural terrain features when constructing combat trails and roads.

### Forward Aviation Combat Engineering

Engineers acquired a mission in the battlespace to support aviation assets with the advent of airpower and its associated support requirements. This

frontline support will normally take the form of creating expeditionary landing zones for helicopters and vertical and/or short taking off and landing aircraft or parachute drop zones for personnel, equipment, or supplies. Engineers should always strive to take full advantage of existing infrastructure and natural terrain features when constructing expeditionary landing and/or drop zones. Airpower is important to the MAGTF's maneuver warfare and the use of expeditionary landing and/or drop zones can increase the speed and tempo of operations by decreasing turn-around time for aircraft (e.g., FARP sites), decrease travel from rear areas to the forward combat area of personnel, equipment, and supplies, or decrease response times of close-air support mission.

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## **COUNTERMOBILITY**

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Countermobility is the physical shaping of the battlespace to alter the scheme of maneuver of the enemy. Countermobility operations block, fix, turn, or disrupt the enemy giving the MAGTF commander opportunities to exploit enemy vulnerabilities or react effectively to enemy actions.

When planning countermobility obstacles, it is important to understand the commander's intent, timetable, and scheme of maneuver. Along with available manpower, equipment, and materials, these ultimately determine what is feasible to support the OPLAN. Two key actions in obstacle plans are—

- 1 Avoid obstacle plans that require so much materials and manpower they can not be emplaced in a timely manner to provide useful support to the MAGTF's maneuver plan, i.e., the maneuver elements bypass the obstacle field before it is completed, and the engineer units lose pace with the combat elements.
- 1 Do not impede friendly forces later in the operation with friendly obstacles.

The engineering staff must consider these in the operational plan and ensure the commander is aware of these issues. What is used to impede the enemy may also impede friendly forces in another phase of the operation.

Rarely does the engineer unit have sufficient time, materials, personnel, or equipment to emplace the 'perfect' obstacle plan. Engineers must be creative in their operations. The adage ". . . a good plan implemented in a timely manner is better than a

perfect plan implemented too late" is especially true for engineers.

Another consideration is that nonengineer units may need to augment the engineer unit with security and personnel in order to execute countermobility operations. The MAGTF commander and various unit commanders must be aware of this support requirement in planning operations.

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## **SURVIVABILITY**

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Survivability is the ability of personnel, equipment, and facilities to continue to operate within the wide range of conditions faced in a hostile environment. It includes all aspects of protecting personnel, weapons, and supplies. In order for the MAGTF to survive, it must be able to reduce exposure to threat acquisition, targeting, and engagement. Engineer support tasks such as construction of field fortifications (hardening of command, communication and combat train locations, weapon system firing positions, and infantry fighting positions) are critical to this effort.

### **Field Fortifications**

(DOD, NATO) "An emplacement or shelter of a temporary nature which can be constructed with reasonable facility, by units requiring no more than minor engineer supervisory and equipment participation." (JP 1-02) Engineers construct fighting positions for combat vehicles, direct fire weapons systems, artillery, and air defense. Field fortifications provide a degree of protection from the effects of enemy weapons systems and a more stable weapons platform from which to sustain accurate volumes of fire. They sustain confidence in a Marine's ability to fight effectively where they otherwise could not survive.

### **Strong Point**

(DOD, NATO) "A key point in a defensive position, usually strongly fortified and heavily armed with automatic weapons, around which other positions are grouped for its protection." (JP 1-02) Strong points are heavily fortified battle positions that cannot be overrun quickly or bypassed easily by enemy forces. They consist of an integrated series of well-protected fighting positions connected by covered routes and reinforced with extensive protective obstacles. They are designed to withstand artillery fire, air strikes, and both mounted and dismounted assaults. The

enemy can reduce them only by expending significant time, personnel, and equipment assets in the application of overwhelming force.

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## SPECIALIZED DEMOLITION

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Combat engineers and EOD Marines are capable of executing demolition work of a constructive and destructive nature. Demolition missions requiring the use of formulas or calculated quantities of explosives with specific placement to produce the desired effect are normally performed by engineers. These tasks include placing hand explosives near heavy weapons, destroying cave systems; facilities; and equipment, and improving mobility in urban terrain and designated or reserve targets. Engineers are assigned those tasks that require greater control in execution, more precision in effect, and are generally larger in scale and more technical in scope.

The MAGTF's EOD team(s) have specialized demolition skills. They are specifically trained to use explosives and do so more often than combat engineers. The EOD team can help economize demolition materials and assist in the explosives training of combat engineers. Engineers should use the EOD team's practical knowledge for ideas and solutions regarding the commander's mission.

### Explosives

**Standard Military Explosives.** Military explosives procured through the supply system meet certain military specifications that make them less sensitive to the effects of a combat environment than their commercial (nonstandard) equivalents. They are safer to handle and are designed for the common tasks encountered in combat.

**Commercial (Nonstandard) Explosives.** Commercially available explosives and combustibles are available worldwide and may be encountered and employed by the MAGTF. The greatest deficiency in the use of commercial or expedient explosives is their unknown explosive power. Accurately evaluating their explosive power is difficult thus making their effect unpredictable. Whenever possible, standard military explosives should be employed to support MAGTF demolition requirements. Reserved targets should only use standard military explosives.

### Explosive Configurations and Techniques

**Economy of Effort.** Economy of effort is extremely important to the employment of explosives. By modifying the size and/or shape of explosives, a variety of special effects can be produced that have military significance. The diamond charge and the shape charge are examples of militarily effective demolition using the minimum of explosives, accomplished by modifying the configuration of the charge.

**Explosive Effect.** Evaluating explosive power and effect against a given material allows the engineer to use the correct type and quantity of explosive at the critical points necessary to produce the desired effect. The result is that only the minimum required explosive is used to complete the task. Additional information on calculating explosives in a field environment can be found in MCRP 3-17A/FM 5-34, *Engineer Field Data*.

**Demolition Reinforcing Obstacles.** These obstacles are created by the detonation of explosives. Demolition obstacles include structures like road and rail bridges, airfields, and the denial of structures such as seaports, offshore oil rigs, and other facilities and material. There are two types of demolition reinforcing obstacles:

**Designated Targets.** Maneuver force commanders designate targets for demolition to support their scheme of maneuver or fire support plans. Designated targets are identified and destroyed through hasty or deliberate planning. Although not critical to the commander's mission, designated targets can be destroyed more efficiently through selection of the appropriate demolition, accurate calculation of explosives, and positive charge placement to obtain the desired effect. Infantry personnel create or remove individual obstacles, and engineers create or remove obstacle systems. The difference is the degree of complexity in planning and execution required.

**Reserved Targets.** Reserved targets are critical to the commander's tactical plan and are specifically controlled at a command level (MAGTF CE/GCE) appropriate to the commanders concept of operations. They are normally astride high-speed avenues of approach or control-significant static energy sources (dams, reservoirs, and earthen overhangs over mountain passes). Reserved targets are usually constructed by engineers in safe

conditions (charges calculated and placed waiting to be armed). To ensure proper execution, a target folder (obstacle folder) is prepared. Personnel remain at the target site to guard, arm, and execute the target on order.

Supported units guard and execute most reserved targets within their zone of action or sector of defense. Securing the target site and executing the target do not normally require engineer skills. Depleting engineer resources through security and firing responsibilities at every obstacle location is usually counterproductive to the MAGTF engineer effort. An engineer firing party will remain with certain key targets as designated by the authorizing commander. Engineer firing parties should be used for targets that—

- 1 Represent an advance force objective for enemy forces.
- 1 Are exposed to enemy fires before detonation, thus possibly requiring repair or replacement of demolition or firing circuits.
- 1 Use special demolition (atomic demolition munitions, gas enhanced explosives, etc.) and complex firing systems.

## Obstacle Folders

The obstacle folder is normally only employed when time permits the consolidation of all pertinent information required to destroy a target. As a minimum, it will contain the following four parts:

- 1 Detailed target location.
- 1 Explosives and supporting equipment location.
- 1 Preparing and firing orders.
- 1 Demolition report.

Appropriate standardization agreements may govern the control of reserved targets and require additional information with the obstacle folders.

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## ENGINEERS AS INFANTRY

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Engineer organizations have, throughout history, been required to fill the role of infantry as a secondary mission. The CEB is a well-armed and well-equipped organization capable of executing light infantry tasks in conjunction with other combat units. The only significant organizational deficiency is the lack of organic fire control personnel and communications equipment. Augmentation in this area would produce a credible and flexible light infantry organization.

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## Chapter 5

# General Engineering Operations

General engineering involves activities that identify, design, construct, lease, and provide facilities. Characterized by high standards of design, planning, and construction, general engineering is the primary CSS function performed by engineers. General engineering normally serves the MAGTF at the operational level of warfare, contributing to force sustainment by enhancing the environment to improve operational tempo in the area. It includes horizontal and vertical construction, facilities, environmental impact considerations, provision of utilities, bulk liquids (e.g., water and fuel) support, and EOD.

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### CONSTRUCTION TYPES

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The MAGTF may have extensive requirements for expeditionary horizontal and vertical construction in support of sustained operations ashore. Construction is normally of an initial or temporary standard but can develop into complex construction projects, i.e., the construction of multistory structures or develop paved road networks when assisted by the NCF.

#### Vertical

Vertical is the improvement or construction of facilities for use by the MAGTF. These facilities can be used in base camps, command posts, and maintenance facilities. Pre-engineered structures should be considered in the planning of any vertical construction project. These structures provide significant savings to the MAGTF in embarkation space and ease of construction and should be used at every opportunity. Types of vertical construction are—

- | Wood and masonry.
- | Existing facilities rehabilitation.
- | Structural reinforcement.

Planning considerations for vertical construction include (total requirement for each type of facility)—

- | Beddown.
- | Maintenance.
- | Command centers.
- | Hospitals.

- | Bunkers.
- | Enemy prisoner of war (EPW) compounds.
- | Quantity and quality of existing structures and facilities.
- | Amount of new construction required.
- | Host nation Class IV availability.
- | Unit Class IV stocks.
- | Number of engineer units available.

#### Horizontal

Horizontal construction is the construction required to shape the terrain to meet the operational requirements of the MAGTF. Horizontal construction is—

- | MSR construction and/or maintenance.
- | Expeditionary airfields.
- | Site preparation for beddown facilities.
- | Ordnance storage facilities.

The planning considerations for horizontal construction include (total requirement for each type of facility)—

- | Tactical situation.
- | Soil type.
- | Soil stabilization.
- | Construction material availability.
- | Drainage characteristics.
- | Class of road required.
- | Location.
- | Engineer equipment availability.

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### NEW AIRFIELD CONSTRUCTION

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Construction of an airbase is a complex general engineering construction project performed by a combination of MWSS, ESB, and NCF engineers. However, careful planning and a strict focus on essentials can result in a facility that will support air operations soon after construction begins. Subsequent improvements can be made during use. If construction is guided by an ultimate plan, phased completion of each structure can be designed to serve both expedient operation and the final design of the facility.



The construction schedule in any single construction program is generally established by the theater commander. It is best to complete an air base to its ultimate design in a single construction program. Often, however, it is necessary to design a lower construction standard to get the base into operation within available time and construction support. In such cases, every effort must be made to proceed to the optimum design of the airfield. Repeated modification of a facility plan is to be avoided.

### Airfield Facilities

A fully completed airfield includes—

- 1 Airfield runways including taxi ways, hardstands, aprons, and other pavements, shoulders, overrun, approach zones, navigation aids (NAVAIDs), airfield marking, and lighting.
- 1 Personnel facilities including kitchens, dining areas, showers, latrines, general housing, and troop quarters.
- 1 Operational support facilities including ammunition storage, fuel and lubricant storage, and distribution areas.
- 1 Aircraft maintenance, operations, and supply facilities including maintenance bays, base shops, photo labs, operations buildings, base communications, fire stations, weather facilities, general storage, and medical facilities.
- 1 Indirect operational support facilities including roads and exterior utilities, such as water supply and electric power.
- 1 Administration including recreation, welfare facilities, headquarters, and personnel services.

### Reconnaissance

Airfield reconnaissance differs from road location reconnaissance in that more comprehensive information is needed. An airfield project involves more man-hours, machine-hours, and material than most road projects. Air traffic also imposes stricter requirements on traffic facilities than vehicular traffic. Consequently, the site selected has to be the best available.

When new construction is undertaken, the planner and the reconnaissance team must choose a site with soil characteristics that meet strength and stability requirements, or a site that requires minimum construction effort to attain those standards.

Airfields present more drainage problems than roads. Their wide, paved areas demand that water diverts completely around the field, or that long drainage structures are built. A desirable airfield site lies across a long, gentle slope because it is relatively easy to divert water around the finished installation.

### Support Facilities

Maximum use must be made of existing facilities. However, airfields and heliports may need extensive support facility construction. The advanced base functional components system (ABFC) provides estimates of material, man-hours of construction effort, and material estimates for standard types of facilities.

### Expansion and Rehabilitation

Whenever possible, existing facilities must be used. The missions of engineers are so extensive, and the demand for their services is so great that new construction should be avoided. Facility use must be coordinated with host nation authorities because existing airfields, particularly in the rear area, are usually needed by host nation air forces and for commercial purposes. Military operations may require that friendly or captured enemy airfields be modified, expanded, or rehabilitated. When the decision to use an existing facility has been made, a reconnaissance is conducted by the anticipated users and engineers. Support facilities are converted to standards dictated by construction policy. Imaginative use of existing facilities is preferable to new construction. Ground reconnaissance of an airfield previously occupied by enemy forces must be performed cautiously, since facilities may be booby trapped or harbor unexploded explosive ordnance (UXO). Priorities for expanding and/or rehabilitating an existing airfield generally parallel those for new airfield or heliport construction. Procedures, personnel, and construction material requirements for expanding or rehabilitating airfields are usually similar to requirements for new construction and airfield damage repair.

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## RAPID RUNWAY REPAIR

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RRR is one task of the base recovery after attack team (BRAAT). Materials, procedures, and techniques for rapid repair of bomb-damaged airfield runways and taxi ways have been under development for several years. The need for such developments has grown because of the substantial increase in the

diversity and lethality of both air-launched and surface-launched weapons capable of inflicting damage on airfield runways and taxi ways.

Since substantial runway and taxi way damage following an attack is expected, quick recovery and support for tactical aircraft launch and recovery operations are paramount. To ensure task accomplishment, the RRR process has been broken down into the following nine elements.

- 1 Base recovery operations command and control.
- 1 RRR planning.
- 1 Airfield damage assessment.
- 1 Unexploded ordnance recognition.
- 1 Minimum operating strip (MOS) selection and/or layout.
- 1 RRR methods.
- 1 Aircraft arresting system.
- 1 Minimum operating strip marking and lighting.
- 1 Airfield lighting.

### Rapid Runway Officer in Charge

The RRR officer in charge (OIC) receives the airfield recovery plan from the combat operations center showing the MOS selected requiring immediate repair. The RRR OIC receives problem area information from the roving controller while directing the airfield recovery process.

### Rapid Runway Repair Planning

RRR is a type of large-scale horizontal construction operation that requires immediate results. RRRs are usually spontaneous, and they are performed without the benefit of construction drawings or standardized plans. RRR planning should predicate on the worst-case possible and on historical-based data that aid in determining the needs for a particular airbase. RRR planning considerations include—

- 1 Personnel available to work repair crews.
- 1 Equipment availability and requirements.
- 1 Material requirements.
- 1 Number of craters and spalls that would need to be repaired to achieve an MOS.
- 1 Pre-stage RRR kits and aggregate materials along length of airstrips, and/or fields and/or parking aprons.

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## BRIDGING SUPPORT

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The bridging support for gap-crossing operations is critical to the mobility of the MAGTF. The following include types of gap crossings:

- 1 River-crossing operations. River crossing operations are a type of complex obstacle breach. The equipment necessary to conduct the breach, in this case a bridge and associated resources, is placed under the operational control of the CEB until follow-on engineer forces are in place to assume responsibility for the site.
- 1 Dry-gap crossing. These gaps can range from tank ditches to deep canyons. A key factor in the execution of this operation is the limitation of organic standard bridging assets to span large gaps.
- 1 Overbridging operations. These operations place standard bridging assets over existing bridges to decrease the load on the existing structure.
- 1 Nonstandard bridging operations. Nonstandard bridging operations involve the construction of a bridge using normal construction materials (e.g., wood, concrete, stones) vice standard bridging assets. Due to material and time requirements and intense allocation of personnel, equipment, and materials, this is rarely effective for front-line maneuver elements in the battle zone. This would be more appropriately used in the rear areas in lieu of standard bridging or to replace standard bridging for reuse by the maneuver forces. This function would best be supported by ESB or NCF.

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## FOLLOW-ON BREACHING AND/OR AREA CLEARANCE

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At the FEBA, there are normally two priority tasks for support engineers to perform in maintaining speed and momentum: follow-on breaching (clearing additional lanes through obstacle or mine fields) and area clearance (final reduction) of obstacles or mines. It is imperative that combat forces following the assault force and all necessary support units and supplies pass through the breach as quickly as possible. As there will usually be far more elements and supplies in trace of the assault force than the

assault force itself, the initial breaching effort may be insufficient to support the heavy track flow.

### Follow-on Breaching

The additional flow of personnel, equipment, and materials will normally require widening existing lanes and breaching and proofing additional lanes. The support engineers will need to plan additional lanes or widening operations that do not endanger elements passing through the obstacle field or cut off usage of the existing lanes.

### Area Clearance

A significant cleanup, repair, and maintenance effort is usually required to convert the enemy infrastructure to friendly use. The demolition of damaged facilities, clearance of minefields, unexploded ordnance, battle debris from MSRs, and CSS areas constitute a major part of follow-on operations. As the combat engineer elements will advance with the maneuver forces, the area clearance requirement falls to support engineers and other engineering assets.

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## ELECTRICAL SUPPORT

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Mobile electric power (MEP) support, especially to the MAGTF command element and the command elements of subordinate units, becomes increasingly more important when the MAGTF is unable to rely on local electrical utilities for its power needs. Planning considerations include—

- | Commander's priorities.
- | Support sources.
- | Environmental considerations.
- | Power requirements.

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## BULK LIQUID SUPPORT

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All operations rely heavily on the supply of fuel and water. Bulk-fuel Marines and utility Marines in the ESB are responsible for planning and executing bulk liquid operations for the MAGTF beyond the elements organic capabilities. The ESB is responsible for the transfer of Class III (bulk fuel) from amphibious and/or commercial sources, and acts as the main source of fuel storage for the MAGTF. The ESB provides fuel to the ACE, GCE, and CSSE. The ESB also provides the MAGTF with potable water production and storage as well as

laundry and shower support when the requirement exceeds the organic capabilities of the elements of the MAGTF. Planning considerations include—

- | Commander's priorities.
- | Supply sources.
- | Environmental considerations.
- | Space, terrain, and weather conditions.
- | Storage and distribution requirements.
- | Support requirements.

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## EXPLOSIVE ORDNANCE DISPOSAL

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EOD assets to support operations in the MAGTF AO are normally found with the support engineer and wing engineer units, i.e., MSSG, ESB (in the FSSG), and MWSS (in the MAW). The operations typically supported by EOD units include—

- | Clearing ordnance.
- | Rendering ordnance safe.
- | Identifying, collecting, evaluating, and exploiting foreign ordnance.

These operations play a vital role in the conduct of operations in the battlespace. The following paragraphs are some examples of when this can occur.

Large, existing minefields (enemy or friendly), ammunition supply points, unexploded ordnance, or the existence of chemical or biological weapons systems can impact the commander's use of the battlespace. Disposition of units, equipment, or supplies in an operation may prevent conventional clearing operations, or operational tempo may not allow time for combat engineers to remain in rear areas to clear these hazards. These situations may require the use of EOD teams to disarm or destroy ordnance without endangering friendly unit.

EOD unit's knowledge of foreign ordnance can aid the commander's planning to avoid situations such as having units remain in the vicinity of an enemy's self-destructing mines. Even after breaching such a field, it would be imperative to keep units away from the field until the self-destruct cycle has completed. Inspecting foreign ordnance to ascertain the existence of chemical or biological delivery systems would be necessary to prevent contamination of units when these items are destroyed.

EOD brings a vast array of skills and knowledge to the engineer commander and the commander's staff

that should be incorporated into the MAGTF commander's planning and execution of an operation. EOD operations require early and continuous involvement of EOD personnel in operational planning. Given the complexity and

number of U.S. domestic and foreign ordnance, EOD personnel must coordinate with intelligence, logistics, and aviation staffs to ensure they have a complete understanding of possible ordnance types in the battlespace.

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## Chapter 6

# Engineer Planning for Operations

Engineer planning can be a challenging endeavor. Understanding how the engineers affect operations equips the planner with the background to form a plan of engineer actions. The participation of engineers in the planning process is crucial to the success of military operations. The omission of engineer considerations in any operation may have a negative impact on the entire campaign. Consequently, engineer planning must be thorough, concurrent, and coordinated at all levels of command and reflect both the tactical and operational engineer requirements of the MAGTF. Engineer planning is based on the commander's concept of operation, engineer missions, priority of effort, engineer estimate of the situation, accessible construction resources, and the engineer forces available.

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### SCOPE OF ENGINEER OPERATIONS

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The engineer's role in any operation will normally fall under one or more of the following categories:

- 1 Supporting the MAGTF scheme of maneuver.
- 1 Supporting joint operations.
- 1 Supporting the MAGTF in civil engineering.

The MAGTF engineer staff must be prepared to plan and execute any of these operations concurrently or sequentially. Although the initial mission and planning for an operation may not appear to require one or more of these operations, the engineer staff must be prepared to handle any additional operational requirements. The phenomenon known as "mission creep" often introduces one or more new requirements. Because engineering is largely driven by logistics and time constraints, a good engineer staff should have the foresight to collect data and formulate plans for all foreseeable contingencies and be prepared to implement them as needed.

### Supporting the MAGTF Scheme of Maneuver

Engineer missions enhance the MAGTF scheme of maneuver. Engineer efforts take on many forms during the phases of an operation, but are always focused on increasing the tempo of operations by

physically shaping the battlespace. The engineer effort in support of the MAGTF is expeditionary in nature. Missions and tasks are based on standards that account for the speed and austerity of expeditionary operations. Marine Corps engineers do not have the organic capabilities necessary to support a large MAGTF indefinitely. During sustained operations ashore (SOA), large infrastructure requirements and needs for more refined construction will develop. As this occurs, the MAGTF commander will need to acquire additional engineer resources from both military and civilian sources to develop a comprehensive support plan.

### Supporting Joint Operations

Marine Corps engineers are organized to provide an organic engineer capability to each MAGTF major subordinate element. As such, during joint operations, Marine Corps engineer assets normally do not support general support requirements for the overall joint force.

### Supporting the MAGTF in Civil Engineering

JP 4-04 provides detailed discussion for planning and executing civil engineering support for operations. Marine Corps engineers do not have a civil engineering capability. A significant civil engineering capability exists in the Army, Navy, and Air Force to support the MAGTF as part of a joint force operation. The engineer staff is responsible for developing requirements and coordinating this support.

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### PREPARING FOR ENGINEER OPERATIONS

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When preparing for and participating in the planning process, the MAGTF engineers must consider the following functions:

#### Intelligence

The rapid introduction of U.S. forces requires detailed, continuous, and timely intelligence. Engineers assess available infrastructure for possible general engineering requirements including airfields,

MSRs, ports, utilities, and logistics facilities. They determine threat engineer capabilities in likely lodgment areas including requirements for countermine and counterobstacle capabilities needed with the early-entry force. Engineers assist in the analysis of topographic features, the nature and characteristics of the AO, and the creation of special products allowing planners to—

- | Develop maneuver operations.
- | Select high-payoff targets.
- | Acquire precise deep-target information.

### Reconnaissance

The key to effectively using combat power is gathering information about the enemy and the AO through reconnaissance. Reconnaissance provides current battlefield information helping the commander plan and conduct tactical operations. When properly planned and executed, reconnaissance greatly enhances maneuver, firepower, and force protection. The types of reconnaissance missions the engineers conduct are—

- | Tactical (route, zone, and area).
- | Obstacle.
- | Route classification.

### Combat Engineering

**Mobility.** Mobility enables the force commander to maneuver units into advantageous positions. At the operational level, the commander relies on mobility to achieve surprise, mass at the critical time, and maintain momentum.

**Countermobility.** Countermobility augments natural terrain with obstacle systems according to the commander's concept of operations and attacks the enemy's ability to maneuver its forces. With its movement disrupted, turned, fixed, or blocked, the enemy is vulnerable to our forces. Engineers ensure obstacle integration through the proper exercise of command and control focused on obstacle emplacement and obstacle control.

**Survivability.** Force protection is a principal concern of leadership at all command levels. Marines in Haiti, Somalia, and Northern Iraq faced a threat from armed and organized opposition groups. The rise in terrorist activities, such as the bombing of Khobar Towers in Saudi Arabia, is of increasing concern. This threat is not limited to operations involving a declaration of war. At a minimum, in any operation, forces will need protection from the natural elements

(e.g., heavy winds, freezing temperatures, fires, or floodwaters) and disorganized bands of looters or rioters.

Engineers, in concert with maneuver forces, build such items as protective bunkers, wire structures to control personnel, protective berms, and overhead cover to protect the force.

### General Engineering

#### Lines of Communications (air, sea, land).

Engineers assist in establishing and maintaining the infrastructure necessary for sustaining military operations. Sustainment tasks include new construction and repair of existing construction; logistics support facilities, supply routes, airfields, railroads, ports, water wells, power plants, electrical distribution expertise, and pipelines. Force projection forces (for receiving equipment and Marines) are maintained to develop the infrastructure to sustain the MAGTF. The task is complete when the support structure is in place to redeploy the MAGTF.

**Beddown Facilities.** Providing facilities for the force is an engineer function, whether it is building base camps or leasing facilities. The billeting requirements go beyond tent floors or strong-backed tents and include developing facilities for—

- | Personal hygiene.
- | Messing.
- | Sanitation.
- | Administrative functions.
- | Morale, welfare, and recreation (MWR).
- | Logistics.
- | Landfill operations and environmental support are also among force beddown requirements.

**Utilities.** Utility operations are electrical, hygiene equipment (water purification, plumbing, and laundry), and refrigeration support for the MAGTF. The NCF and Army support the MAGTF's additional utility requirements.

**Water-Well Drilling.** Water well drilling is essential, especially when operating in austere environments. NCF well-drilling units provide personnel and equipment capable of drilling and developing water wells in virtually any area with an underground water source.

**Bridging.** Military traffic engaged in rapid movement on the battlefield must be able to cross wet or dry gaps in existing road networks or natural high-speed avenues. Maneuver forces and logistical

forces depend on permanent, expedient, or tactical bridges to sustain mobility.

**Explosive Ordnance Disposal.** Destruction of ordnance materials is a unit commander's decision. The purpose of this intentional destruction is to prevent the enemy from capturing stockpiles of ordnance. Whenever the commander orders destruction, two primary considerations are site selection and safety. EOD units are responsible for destroying damaged or unserviceable ordnance materials in a combat zone. Essential components of sets and kits must be sufficiently damaged to prevent complete reassembly by cannibalizing from undamaged components. Such destruction is a command decision-based on the tactical situation, security classification of the ordnance materials, their quantity and location, facilities for accomplishing destruction, and time available. Usually, burning and detonating or a combination of both is the most effective means of destruction. Commanders must ensure they know the exact materials contained in any ordnance they plan to destroy, especially if the ordnance is captured enemy stockpiles.

**Vertical and/or Horizontal Construction.** JP 3-07 and JP 4-04 establish construction standards for facilities. In planning, estimating, and scheduling projects, the engineer staff should rely on the navy engineering field division for support. MAGTF engineers concentrate on construction of initial and temporary standard facilities.

**Initial Standard.** The initial standard is for immediate operational support of units upon arrival in theater. The initial standard has austere facilities that minimize construction effort where usage is from 1 to 6 months (depending on the specific facility).

**Temporary Standard.** The temporary standard provides for sustained operations. The facilities provided are the minimum required to increase efficiency of operations for periods of time extending to 24 months. In some cases, it replaces initial standard.

**Permanent Construction.** Permanent construction is for personnel or resource protection. This includes, but is not limited to, revetments, shelters, and concrete barriers. Permanent construction is used only where it is cost or mission effective to use permanent facilities in place of, or to replace, initial or temporary standards.

**Real Estate.** The Marine Corps forces (MARFOR) component commander is responsible for coordinating real estate requirements within the command and with the geographic commander. In time of war, it is quicker and cheaper to lease facilities than it is to use combat engineer resources or contract construction. The use of combat engineers in this role detracts from their ability to provide mobility, countermobility, and survivability support to the forces. Contract construction requires funding, long lead times, construction time, and additional manpower to manage. In addition, it is not desirable to build permanent or semipermanent facilities in areas that U.S. forces will eventually abandon or not use for long periods of time. JP 4-04 provides details on real estate planning and operations.

The Navy Facilities Engineering Command (NAVFACENGCOM) provides the MAGTF real estate support for most contingency operations. NAVFACENGCOM real estate teams are the early deploying real estate experts. The mission is to provide real estate services to forces and agencies requiring or using real estate in the AO. They are generally self-sufficient in the area of operations.

## Preparation and Planning

Engineers consider all of these things and introduces them into the planning process. Engineers use their expertise and unique capabilities to help the commander shape the battlespace. The goal is to make the enemy vulnerable to the commander's will.

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## THE ENGINEER'S ROLE IN THE PLANNING PROCESS

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The planning process, as defined in MCDP 5, *Planning*, is a continuous cyclic mechanism that assists the commander in envisioning and refining a desired future, and the effective ways of bringing it about. The engineer commander and staff provides the MAGTF commander information throughout the planning process. Some information will be a brief "point of view," while other information will require detailed engineering studies with extensive supporting documentation. Given the wide range of engineer operations in support of the MAGTF, early and continuous involvement in the planning process is critical.

## Assessing the Situation

The first step of the planning process is assessing the situation. The engineer staff will present the commander with friendly and enemy engineer relevant facts and assumptions. The engineer staff officer assists the commander in developing facts and assumptions by participating in the IPB and conducting the engineer assessment. The engineer develops facts and assumptions and supports the IPB process through the EBA. The engineer then analyzes the terrain and weather, using the five military aspects of terrain, and assesses their impact on operations. The function of the terrain analysis is to reduce the uncertainties regarding the effects of natural and manmade terrain on friendly and enemy operations. The process of preparing the MCOO assists the engineer in analyzing the military aspects of the terrain. The engineer will assist the G/S-2 in developing the MCOO.

The second step of the EBA is to analyze the threat engineer mission and capabilities and the enemy's doctrinal use of engineers. To do this, the engineer and G/S-2 will use the guidance and templates described in chapter 2.

The third step of the EBA is to evaluate friendly engineer capabilities and their impact on mission accomplishment. The engineer officer evaluates the task organization to determine the engineer organization and assets available and considers the possibility of additional support from maneuver forces and other engineer forces.

## Establishing Goals and Objectives

The commander's intent, goals, and objectives are important elements of the estimate process. The desired outcome of the mission will provide the staff with a defined focus required to develop and analyze a COA. The engineer staff will focus primarily on identifying, integrating, and coordinating engineer tasks in support of the mission.

## Conceptualizing the Course of Action

The COA is actions envisioned to achieve the desired outcome. The EBA provides a reference for the engineer participation in the COA development. At a minimum, the engineer ensures that the G/S-3 understands the engineer task organization and available combat power. The engineer begins to develop a scheme of engineer operations to support the COA. The engineer's initial scheme is a rough draft and is refined during the wargaming process.

## Detail the Course of Action

This phase includes *execution* planning—developing practical measures for carrying out the COA—and the engineer must be an active participant. For example, the engineer must wargame the timing aspects of situational obstacles, obscuring and suppressing for obstacle breaching, and the positioning of forces and material for current and future operations. The engineer must be ready to interject thoughts and identify critical events and tasks. The engineer identifies engineer tasks and determines if a task is feasible based on the assets available. Also, the engineer must articulate the actions of threat engineers during course of action development.

## Evaluate the Course of Action

Based on the staff recommendation, the commander announces a decision and COA or intent. The type and amount of detail that the engineer provides depends on the needs and preferences of the commander, but generally include—

- | Concept of engineer support.
- | Engineer mission priorities.
- | Critical engineer events and/or actions.
- | Task organization and command and support relationships.
- | Obstacle overlay (including SCATMINE employment authority and concept for use by system type).
- | Survivability estimate and priority.
- | Critical tasks directed to subordinate units.
- | Engineer's work time line.

## Issue the Order

Once the commander makes a decision, the estimate provides the bulk of the information needed to prepare the force's OPLAN or OPORD.

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## PLANNING DOCUMENTS

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Blank forms of engineer documents are found in MCRP 3-17B. The basic forms and reports are—

- | Engineer Breaching Plan. A plan in five-paragraph order format that directs task organization, states mission, articulates execution, coordinating instructions; and administrative and logistic requirements, and details the command and control of a specific breaching evolution. It is the commander's



breaching directive to subordinate organizations. The GCE engineer staff prepares the breaching plan in coordination with detailed and specific information provided by subordinate engineer commanders.

- I Barrier Plan. The engineer staff prepares the barrier plan. The barrier plan is a series of obstacle zones designed to shape the movement of the enemy at the operational and strategic levels of war. Normally in five-paragraph order format, barrier plans identify supporting organizations, state the mission, articulate execution; coordinating instructions; and administrative and logistic requirements, and detail command and control procedures.
- I Engineer Obstacle Plan. An obstacle plan is prepared when the use of obstacle groups is essential to MAGTF operations. Primarily implemented by the GCE commander, this plan must fall within the constraints of the MAGTF barrier plan. The obstacle plan is an annex to the operations appendix to the

OPLAN. It details the information required to emplace and/or activate friendly obstacles. It should specifically address obstacle requirements in support of the withdrawal plan required when executing amphibious operations.

- I Engineer Appendix to the Operations Annex to the OPLAN. The engineer appendix to the operations annex of the OPLAN is a supporting document covering the engineer organization, mission, concept of operations, administrative, logistic, and command and control information.
- I Engineer Estimate. The engineer estimate is a planning document that serves as a basis for the submission of conclusions to the commander. It presents the specialized viewpoints of the staff engineer officer. The engineer staff provides analysis to the commander of the principal engineer factors governing the operation and the comparative courses of action identified.

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## Chapter 7

# Operational Situations and Environments

Engineers advise commanders of the effects of natural and artificial restrictions to movement and present methods of counteracting these restrictions. Engineer support is necessary when the nature of the obstacle, terrain, or operation exceeds the maneuver units' surmounting capability. When evaluating tactical situations, Marine engineers must consider mission assignments, operational environments, engineering capabilities, and available equipment. These varying operations and environments have a great impact on engineer tactics, required equipment, and speed of mission accomplishment.

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### JOINT OPERATIONS

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Future operations involving MAGTF forces will be joint operations with other Service engineers working concurrently within the area of operation. While each Service organizes and trains for specific missions, MAGTF engineers must understand other Services engineer capabilities and how MAGTF engineer operations fit into the joint environment. There are several command and control relationships used during joint operations to facilitate general engineering support to the Joint Force. These relationships usually do not involve Marine and Navy engineers in the MAGTF but will affect MAGTF's external sourcing for support.

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### MARITIME PREPOSITIONING FORCES OPERATIONS

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Maritime pre-positioning force (MPF) operations are a strategic deployment option. These operations join a MAGTF with prepositioned equipment and supplies aboard a forward deployed maritime prepositioned ship. A Navy support element (NSE) is normally required for MPF offload and throughput. The MPF's goal is the rapid establishment of a combat ready MAGTF ashore. Airlifted by the Air Mobility Command (AMC), MAGTF and NSE personnel secure an area in or adjacent to an objective area to assemble with their equipment in preparation for operations ashore. This capability is

global in nature, naval in character, and suitable for employment in a variety of circumstances.

The foremost engineer requirement for this type of operation is developing the infrastructure to support the influx of personnel and equipment. Along with developing beddown sites and staging areas, existing ports, beaches, and road networks can require improvements or development.

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### JUNGLE OPERATIONS

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Engineer operations in the jungle include road construction, stream crossing, expeditionary airfield construction, water treatment, mine warfare, and mapping. For detailed information on jungle operations see FMFM 7-28, *Jungle Operations*.

#### Road Construction

In normal operations, enemy resistance usually determines the rate of advance. In jungle operations, the ability of engineers to construct and maintain roads and trails may determine the rate of advance. In most jungle areas, roads are relatively undeveloped or nonexistent. Those that exist are generally narrow, winding, and not capable of supporting landing force vehicles. Heavy rainfall and lack of drainage make construction difficult, placing the majority of the engineer effort on constructing and maintaining essential roads and trails.

#### Wet-Gap Crossing

Selection of crossing sites must reflect the impact of heavy rainfall and flooding conditions. Flash flooding is characteristic of most jungle areas. To expedite operations, the MAGTF should employ standard bridging where possible.

#### Forward Operating Bases

The clearing and drainage problems encountered in road construction magnify during the construction of forward operating bases. This type of jungle construction consists of rehabilitating old abandoned airfields, small liaison type strips, helicopter and vertical/short takeoff and landing sites, and new

construction near beaches or other naturally open terrain.

### **Potable Water**

Water sources are abnormally abundant; however, water treatment is essential due to the presence of harmful organisms.

### **Mine Warfare**

The jungle forms a very effective obstacle against all vehicles. Mines and other manmade obstacles exist mostly on roads, trails, and patches of cleared ground.

### **Mapping**

Because of the inaccessibility and rapidly changing features in the jungle, maps reflect only locations of major terrain features. Swamps, streams, inlets, and lagoons seldom appear and any contours shown are rarely accurate. Engineer reconnaissance to supplement existing data is of prime importance.

### **Construction Material**

The jungle provides an abundant supply of timber; however, there will usually be a requirement for the Seabees to establish or use captured sawmills to provide lumber. Sandbags disintegrate rapidly and require periodic replacement.

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## **MOUNTAIN OPERATIONS**

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Mountainous terrain characterized by exaggerated terrain features, heavy woods, rocky crags, glacial peaks, extreme weather, high altitudes, and limited routes of communication require the dedication of a large segment of the engineer force for lines of communications, construction, and maintenance. Roads and trails in the mountains usually require extensive construction, improvement, maintenance, and repair to withstand traffic and severe weather. Construction operations are extremely slow, time-consuming, and complicated by lack of local material, heavy equipment operating difficulties, and enemy defensive activities. Employment of demolition and use of mines are particularly effective. To accomplish essential tasks, engineers must use mechanical assistance such as air compressors, power saws, heavy construction equipment, large quantities of explosives, and sufficient transportation. Helicopters can be an invaluable transportation asset. To support mountain

operations, engineer training should include cable and rope rigging, demolition of rock formations, mountain climbing, mountain road clearing and construction, employment of helicopters, expedient stream crossing, and bridge construction. FM 90-6, *Mountain Operations*, provides additional information.

### **Road Construction**

The construction of roads and trails in mountainous areas is one of the most important engineering tasks. Development of an extensive road network involves the intensive use of personnel, material, and time. Initial work improves existing roads and trails using the advantage of natural routes. The extensive road network normally found near beaches are seldom available in mountain operations. FM 5-430-00-1, *Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations—Road Design*, provides additional information.

### **Stream Crossing**

Engineers employ standard bridging to the greatest extent possible. Expedients such as rope crossings and cableways are useful in mountain operations.

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## **COLD WEATHER OPERATIONS**

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Arctic operations may occur in arctic regions and areas of North America and Eurasia. For military purposes, the arctic is that portion of the northern hemisphere lying north of the tree line. The arctic consists of polar sea, polar land, and ice pack areas. The subarctic is an area of extremes with hot summers and extremely cold winters. In the arctic, vegetation is dwarfed and scrubby, and lines of communications consist of roads, trails, and limited water travel. The arctic is a cold, snow-covered desert with an average annual rainfall of about 8 inches.

### **Road Construction**

Rivers used as water highways in the summer and ice roads in the winter significantly enhance movement. Some roads and trails exist but are undeveloped and limited in trafficability. Road networks and railroads are practically nonexistent making road construction a major operation. Operators exposed to the elements rapidly become fatigued and require regular relief after short periods. Continuous operations, except for short periodic stops for operator checks and

minimum equipment maintenance, prevent equipment from freezing. Cross-country movement of units without engineer support is extremely difficult.

## Stream Crossing

The numerous lakes, swamps, and streams require increased quantities of stream-crossing equipment including ferries and fixed and floating bridges. Because of the temperature, deep fording is not a recommended option regardless of the time of year. As a result, there is an increased requirement for manpower, crossing equipment installation, and maintenance. Drainage throughout the subarctic complicates efficiency because rivers flow north and ice starts to melt in the south. This causes flooding until the river mouths thaw.

## Construction

Field construction time and difficulty of conventional engineer work are magnified in cold weather operations. Environmental characteristics that complicate engineer tasks are permafrost, extreme and rapid changes in temperature, wind, snow, ice storms, and flooding.

## Potable Water

Major sources of water supply, in order of efficiency and economy, are drawing water from under rivers or lakes, melting ice or snow, and drilling wells. The collection of melting ice and snow in quantities required for unit requirements is impractical and only done in an emergency. Heated shelters are often necessary for operation of water purification equipment. If water is not available under rivers or lakes, special or improvised ice-melting equipment must melt ice in place. Shaped charges are far superior to hand tools for cutting holes through thick ice to prepare a water hole. See FM 31-71, *Northern Operations*, and FM 10-52, *Water Supplies in Theaters of Operations*, for additional information on obtaining water.

## Fuel

Cold weather operations require increased testing, re-circulation, equipment maintenance, and fuel usage due to extended equipment operation requirements.

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## DESERT OPERATIONS

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Although desert areas are not usually uniform, they contain common physical characteristics such as a lack of water and vegetation, extreme temperatures, bright sunshine and moonlight, dust storms, mirages, and dry river channels. Operations in the desert, complicated by supplying water, increased requirements for camouflage assistance and deception, and special problems in field fortifications, significantly task engineer resources. There is generally a reduced requirement for road, airfield, and bridge construction than in other conditions. Engineer reconnaissance and terrain analysis are crucial operations because desert terrain is rugged. FM 90-3, *Desert Operations*, provides details on desert operations.

## Potable Water

Water supply is the most important engineer operation and presents the most difficult problems for engineers involved in desert warfare. Control of water sources is critical. Water reconnaissance is intensive and continuous. Water supply points require adequate defenses from air raids. The general lack of concealment and the required dispersion of troops compound the problem of water distribution and increase the required number of water supply points. Special well-drilling and pumping equipment is required to supplement normal water purification and storage capabilities because Marine Corps organizations do not possess an organic capability to drill and pump water from wells.

## Camouflage

Engineers and their equipment provide assistance to individual unit camouflage activities. Lack of vegetation presents a considerable problem in desert camouflage. Desert camouflage measures consist primarily of deception of the nature of objects rather than concealment. Deception plans are elaborate, carefully planned, and coordinated with all components of the landing force.

## Field Fortifications

The desert normally lacks materials for construction purposes. Even under ideal conditions, moving and employing fortification materials involves tremendous volume and weight. For this reason, desert operations discourage the use of permanent structures.

## Mines and Obstacles

Due to the speed with which mounted operations progress in desert terrain, the use of mines to prevent surprise assumes considerable importance. Minefields are often the only obstacle placed in the path of the enemy due to the manpower and equipment demands of other obstacle options. Desert minefield emplacement involves large quantities of mines emplaced over vast areas. The lack of landmarks complicates recording the location and layout of minefields. The effect of wind on desert sand may result in either exposing or burying emplaced mines, rendering them ineffective. Track patterns, unless carefully camouflaged, make minefield gaps and lanes easily detectable.

## Vehicles and Equipment

Heat, dust, and cross-country movement pose special maintenance problems for all types of vehicles and equipment. Sand and dust are particularly hard on fuel and lubricating systems. Tire, spring, axle, filters, and engine life shorten because of heat and operation over rough, stony, and sandy terrain. Extreme heat burdens engineer equipment, particularly cooling systems. Heat and dust affect the efficiency of equipment operators and mechanics.

## Construction

Road construction in desert warfare is less extensive. The relatively unrestricted mobility of vehicles (especially tracked vehicles) makes extensive road networks unnecessary. Tractor drawn drags usually suffice except in loose sand or stony ground, and matting usually proves satisfactory for short distances over loose sand. Mud is a special problem during the rainy season. Gully crossing and rainy season operations require the use of bridging. Forward operating base construction considerations include surfacing and dust reduction.

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## RIVER-CROSSING OPERATIONS

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River-crossings are second only to amphibious operations in complexity and vulnerability. A river-crossing operation is not specifically the same as a bridging operation, though there are many similarities. These similarities may vary only by the degree of the operational situation. Whether the crossing operation is hasty, deliberate, or retrograde, it requires advanced planning, training, coordination, and considerable equipment. Command and control,

planning, unit relationships and responsibilities, and participation by various units are different with each type and size of crossing operation. MCWP 3-17.1/FM 27-10, *River-Crossing Operations*, gives detailed instructions on the conduct of this type of operation.

## Hasty River Crossing

A hasty river crossing is a decentralized operation using organic, existing, or expedient crossing means. A hasty river crossing is conducted by elements that have been suitably augmented with crossing equipment and personnel well before anticipated crossing operations. It includes the rapid decentralized seizure of existing crossing sites and requires minimal concentration of forces with no loss of momentum.

## Deliberate River Crossing

A deliberate river crossing is conducted when a hasty crossing is not feasible, when offensive operations begin at a river line, or when forced by a significant river obstacle. It requires detailed planning and centralized control, with heavy reliance on crossing assets and personnel from CSSE engineer assets. Normally a deliberate pause allows the concentration of combat power and additional bridging or rafting assets. It normally requires the clearance of the enemy from the entry side of the river and suppression of enemy forces on the exit shore.

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## MILITARY OPERATIONS ON URBANIZED TERRAIN

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Urbanized terrain is a complex and challenging environment. It possesses all of the characteristics of the natural landscape, coupled with manmade construction, resulting in an incredibly complicated and fluid environment that influences the conduct of military operations in unique ways.

Military operations on urbanized terrain (MOUT) is defined as “all military actions planned and conducted on a topographical complex and its adjacent natural terrain where manmade construction is the dominant feature. It includes combat-in-cities, which is that portion of MOUT involving house-to-house and street-by-street fighting in towns and cities.” (MCRP 5-2A, *Operational Terms and Graphics*) MOUT affects the tactical options available to a commander. A built-up area is “a concentration of structures, facilities, and population, such as villages, cities, and towns,” that form the

economic and cultural focus for the surrounding area. (MCRP 5-2A)

Buildings are readily made into fortresses by reinforcing structures with material available locally. Cellars, sewers, subway tunnels, thick masonry walls, reinforced concrete floors, and roofs provide excellent cover and concealment. Obstacles created using craters, demolished walls, overturned or derailed railroad cars, steel rails, autos, and rubble are excellent for canalizing movement that is easily covered with fires. Time, equipment, and ingenuity are the only limits to the creation of complex obstacles systems. FM 31-50, *Combat in Fortified Areas and Towns*, and MCWP 3-35.3, *Military Operations on Urbanized Terrain (MOUT)*, provide additional information.

Major engineer tasks during combat in urban areas are—

- 1 Clearing mines and booby traps from avenues of approach and other areas.
- 1 Clearing obstacles.
- 1 Performing specialized demolition missions that are beyond the capability of the combat units.
- 1 Securing subterranean avenues of approach to include sewers, subway systems, and cellars.
- 1 Providing advanced mine warfare training and recommending additional unit demolition allowances to all combat units. Reaching specific understandings on which unit will provide additional demolition allowances is a critical planning step.
- 1 Assessing the need for unique items such as rope ladders, grappling hooks, water production and/or purification, bridging across buildings.

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## ASSAULT ON A FORTIFIED POSITION

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Assault on a fortified position involves the following four phases:

- 1 Reducing outposts and developing the attack.
- 1 Breaking through.
- 1 Extending the gap by isolating and reducing emplacements on the flanks.
- 1 Moving reserves through the gap to encircle and isolate the remaining fortification while the attack continues.

The entire action requires precise coordination with supporting arms such as artillery, air power, and other available crew-served weapons. During the attack, infantry and engineers breach large obstacles protecting the fortification. Clearing minor obstacles is the mission of specially organized and equipped infantry teams. After the breach, engineers create and maintain routes through the gap and assist in making the captured emplacement unsuitable for reoccupation or suitable for use by friendly forces. Also, the engineers' organic weapons systems (e.g., shoulder-launched multipurpose assault weapon [SMAW], 240G, and demolition) can augment the assault force in reducing enemy forces near the breach or in controlling the breach as the assault forces continue their mission deeper into the enemy's rear area.

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## HELICOPTERBORNE OPERATIONS

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Marine engineers support fixed-wing, air-landed, and helicopterborne operations. Cargo aircraft lift capability and availability will normally control the employment of heavy weapons and vehicles such as tanks and amphibious tractors, as well as heavy engineer equipment. Helicopterborne operations normally result in a reduction of equipment engineers can bring. This causes an increased emphasis on field expedients using local material which greatly limits the engineer support available to helicopterborne units. However, given adequate transportation assets, the standard items of engineer equipment organic to all engineer units are generally adequate to support these operations. Heavy engineer equipment required later in the operation requires transportation to the objective area by surface means or heavy cargo aircraft.

The employment of the helicopterborne assault, as a part of the amphibious assault, has changed engineer operations and the echelon at which such operations occur. While engineer missions and functions have remained, lightly equipped units require engineer support to be highly mobile and flexible. The use of helicopter transportable engineer equipment enhances the support capability of landing sites and zones. Tasks focus on improving mobility of the supported unit. When the assault unit reverts to parent unit control, the engineer platoon supporting that assault unit reverts to control of the engineer company commander. Engineer platoons are normally equipped with demolition, hand tools, chain

saws, and other hand-carried equipment. Engineer units supporting helicopterborne assault operations limit their tasks to the performance of hasty, field expedient tasks using hand tools, small powered tools, small dozers, and demolition. Limited items of heavy equipment are often air transported to the landing site to accomplish critical engineer requirements. Normally, mechanical equipment which exceeds the helicopter lift capability is not available. Labor-intensive engineer tasks require augmentation from supported unit troops.

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## AMPHIBIOUS OPERATIONS

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Amphibious operations normally require the landing force to make a waterborne assault within the objective area. This is the most critical phase of the landing operation. Engineers assist assault units by accomplishing priority beach area combat support engineer tasks. Priority engineer tasks requiring rapid accomplishment include beach reconnaissance to determine beach exits, breaching of vehicle lanes through all types of existing and reinforcing obstacles from the high water mark inland, and clearing obstacles from the beach to facilitate the landing and rapid movement inland of maneuver units. An engineer's first priority is breaching lanes for the passage of assault troops and vehicles. This involves integrating combat engineer teams into the first units ashore. Breaching, accomplished by both explosive and nonexplosive means, is the priority of effort for these teams who may require supporting arms reinforcement. When essential for beach support operations, engineer troops initiate beach obstacle clearance beyond the capability of the landing force support party.

### Engineer Considerations in Amphibious Operations

Considerations affecting engineer operations include type of terrain, coastline configurations, suitability of routes of communication, availability of airfields, extent of existing infrastructure, use of existing infrastructure by the landing force, climate, weather, and available engineer resources. Decisions affecting engineer operations include—

- | Commander's concept of operations ashore.
- | Landing beaches, landing zones, and drop zones selection. Engineers may need to coordinate breaching operations (if required) with the Navy concerning the impact of the

presence of mines, i.e., deep, shallow, or very shallow waters on the MAGTF commander's planning and scheme-of-maneuver;

- | Proposed limits to the area of operations.
- | Tentative date and hour of landing selection.
- | Amount and type of military construction anticipated at the theater level. Special interest and planning should be given to maintaining trafficability in transition zones between bodies of water and dry land. These areas, if not carefully planned and constructed, will deteriorate rapidly under heavy usage.

### Engineer Shipping and/or Transportation Requirements

The landing force mission dictates equipment and material items essential for engineer support in the objective area. The size and weight of engineer equipment require special consideration in planning, conducting, and sustaining engineer support operations ashore. Close coordination with the G/S-3, G/S-4, and embarkation officer is essential.

**Transportation.** Transportation availability places certain limitations on the types and quantities of equipment and material transported to support the landing force. Inadequate transportation can significantly reduce engineering capabilities. Supporting commands and agencies must be aware of special transportation requirements. Supported commanders and their staffs must be aware of the anticipated level of engineer support throughout the planning phase.

**Ship to Shore.** The limited ability to land engineer equipment during the early phases of the amphibious assault constrains engineer support ashore. Using landing craft as the sole method of ship to shore movement causes many engineer assets to remain embarked aboard assault shipping until causeways or other means of debark develop.

**Supply and/or Resupply.** Transportation limitations and distances from supply resources dictate time-phased projections of material requirements. These requirements should be anticipated and planned for before the commencement of the operation.

### Control

During the initial stages of the assault, decentralized engineer operations allow task-organized combat engineer units to provide direct support to the initial

assault forces. Although this configuration may be necessary for landing, it limits the commander's ability to reinforce or realign engineer support during the early, critical stages of the landing. Once ashore, the engineer commander regains control of all of the engineer units.

## Embarkation and Rehearsal

**Embarkation.** Engineers should be aware of their impact on the landing plan and equipment preparation as part of the pre-embarkation; once embarked, changes to the landing plan are difficult.

**Rehearsal.** Engineer elements participate in the amphibious assault rehearsal to ensure proper timing, teamwork, communications, and verification of any special techniques. For example, it is essential that engineer elements scheduled to take part in the initial beach obstacle breaching effort participate in all rehearsals. Other engineer units should participate, provided undue hazard to equipment does not exist.

**Engineer Impact on the Landing Plan.** The landing of engineer equipment, unarmored and vulnerable to all weapon systems, must be weighed against the operational situation and the requirements for obstacle breaching equipment before assets move ashore.

**Preparation of Equipment.** The landing plan, landing craft being employed, and hydrographic conditions in the objective area determine the need to prepare equipment for deep water fording. Certain critical items such as mines, handtools, fortification materials, and explosives require mobile loading to aid rapid movement ashore. Limitations of available

transportation require considerable care in determining priority of critical items.

**Pre-embarkation Responsibilities.** During the pre-embarkation phase, engineer units provide assistance to the MAGTF as required. Possible tasks include the preparation of staging areas, loading areas, and related facilities; assistance in palletizing and crating heavy material for other units; improvement of access routes at the loading areas; and, under some circumstances, the operation of loading equipment during the loading phase. These activities may carry over to the actual embarkation phase.

Engineer units normally embark as combat engineer platoons and companies attached to the infantry battalions and regiments they will support upon landing. Headquarters and service company and support company of CEB embark with the division headquarters and other division troops. MWSS and ESB engineers embark with the groups they will support on the landing.

These suggested movement relationships occur at the engineer company level or lower. A reinforced, task-organized engineer platoon of the ESB normally supports a Marine expeditionary unit and a reinforced engineer company normally supports a regimental landing team. Early phases of the assault will include elements of the ESB when required. ESB assets usually embark and remain under the control of their headquarters for centralized employment. However, the wide range of missions assigned in support of both ground and air operations may render initial centralized control impractical.

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## Chapter 8

# Engineer Implications in Emerging Concepts

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### OPERATIONAL MANEUVER FROM THE SEA

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Operational maneuver from the sea (OMFTS) is the maneuver of naval forces at the operational level that aims at exploiting a significant enemy weakness to achieve victory. Operational maneuver aims for the enemy's center of gravity; which is essential to the enemy's ability to continue the struggle.

The implementation of OMFTS will require significant changes to engineer organizations, movement between the sea base and the objective, equipment, and the way engineers handle the wide variety of missions they support. Traditional responsibilities, as well as tactics and techniques, may be changed to overcome the challenges of this dynamic operational concept.

#### Organization

OMFTS treats the littoral as a single environment wherein the cooperation of units on land, at sea, and in the air is based on a shared vision of what must be done, intimate knowledge of the capabilities and weaknesses of each type of unit, and an *esprit de corps* that transcends service identity or occupational specialty. This can only be achieved by a fully integrated naval expeditionary engineer team of Marine and Navy combat and general engineers that can handle the full range of engineer needs. Engineering forces will need to be light, responsive, and adaptive. This may require small Marine and Navy engineer teams working side by side to provide a wide range of engineer support.

#### Movement Between Land and Sea

OMFTS requires rapid movement, not merely from ship to shore, but from ship to objectives that may be miles away from blue water and from inland positions back to offshore vessels. While some operations may require the establishment of bases ashore, the practice of separating ship-to-shore movement from the tactical and operational maneuver of units ashore will be replaced by

maneuvers in which units move, without interruption, from ships at sea to their inland objectives.

#### Mobility

The capability to cross great distances, reduce the limitations imposed by terrain and weather, and seamlessly maneuver between sea and ashore are required. These capabilities are used to move units from ships lying over the horizon to objectives lying far from the shore. Engineers will need the capability to create a visual picture of the battlespace, from the ship to the objective, and to rapidly breach any barrier and obstacle in the path of the force.

#### Mine Countermeasures

Because of their relative low cost and pervasiveness, mines have become an inexpensive way to limit the mobility of ships, landing craft, and vehicles in the contested littoral regions. For that reason, we must develop and enhance our countermine and obstacle reconnaissance, mine-marking and clearing capabilities, precision navigation, and breaching to support maneuver at sea, ashore, and during the transition from sea to land. This effort again will require the full efforts of a Navy and Marine team. Marine engineers must fully understand seaward mine countermeasure activities and be able to plan and integrate those efforts into rapid movement to the objective.

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### GENERAL ENGINEERING

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The requirement to sustain fast-moving, powerful, combined arms forces conducting ship-to-objective maneuver will strain the best logistics system. Speed and mobility comparable to the assault forces will be necessary for general engineering elements to respond to the dynamic demands of OMFTS. General engineering support has traditionally been slow moving and logistically intensive; that must change. The sea based Marine and Navy general engineering force of tomorrow must get to the fight fast, yet be strong enough to adapt to the ever-changing requirements.

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## SHIP-TO-OBJECTIVE MANEUVER

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Ship-to-objective maneuver (STOM) employs the concepts of maneuver warfare to project a combined arms force by air and surface means against inland objectives. STOM takes advantage of emerging mobility and command and control systems to maneuver landing forces in their tactical array from the moment they depart the ships, replacing the ponderous ship-to-shore movement of current amphibious warfare with true amphibious maneuver.

Historically, reliance on Navy command and control during ship-to-shore movement and the requirement to establish a lodgment ashore worked counter to the principles of maneuver warfare. By executing STOM, landing forces will exploit advanced technologies that will permit combined arms maneuver from over-the-horizon attack positions through and across the water, air, and land of the littoral battlespace directly to inland objectives.

Traditionally, the engineers' role in maneuver warfare has been to provide unencumbered maneuver

to the MAGTF commander, while simultaneously preventing unencumbered movement for the enemy. In STOM, engineers will continue to perform a key role in the mobility of the GCE. However, without the massive build-up ashore normally seen in current amphibious operations, engineers will have to perform their mobility mission using smaller, lighter, and more efficient means. This dictates the development of new breaching equipment and perhaps new TTP.

The CSS functions currently performed by engineers will be minimized in STOM. Although the need for fuel and water to be sent forward will continue, the massive fuel and water farms used today will cease to exist. Fuel, water, ammunition, and food will be delivered by air using forward refueling and resupply points. Vertical construction for Marine engineers will be virtually nonexistent in STOM since there will be limited build-up ashore. Horizontal construction will mostly be limited to improving the trafficability of roads needed by the maneuver force until there is a transition to SOA.

## Appendix A

# FASCAM Characteristics

**ADAMS**—Artillery delivered anti-personnel (ADAMS) mine system

U.S. Army  
U.S. Marine Corps

Round M692/M731 contains 36 trip-wire activated, blast-type mines with antihandling devices. Two self-destruct settings OR 24 hours. Mine fields usually laid in 400m X 400m blocks. Emplacement time is in 5 minutes.

**RAAM**—Remote anti-armor mine system (RAAMS) (artillery delivered)

U.S. Army  
U.S. Marine Corps

Round M718/M741 contains nine magnetic-fused, self-forging, fragmentary type mines with anti-handling devices. Two self-destruct setting OR 24 hours. Mine fields usually laid in 400m X 400m blocks. Emplacement time is in 5 minutes.

**Gator**—(AT/AP) (Delivered by fixed-wing, high performance aircraft)

U.S. Air Force  
U.S. Army  
U.S. Marine Corps

USAF dispenser (CBU-89/B)—72AT/22AP  
USN/USMC dispenser (CBU-78/B)—45AT/15AP  
Contains self-forging, fragmentary type AT mines and trip-wire-activated, blast type AP mines. One short and two long self-destruct settings. Emplacement time subject to aircraft delivering to target area.

**Characteristics.** FASCAM mine systems have similar characteristics in that they are sown on the surface of the ground. They have preset SELF-DESTRUCT times and may have an anti-disturbance actuator as well as seismic and/or magnetic triggering devices.

**Self-Destruct Times.** These are the times beyond which *no* mines will remain active. The individual mine self-destruct times actually occur *before* the times detailed in Table A-1. There is very little probability of a live mine existing past its stated self-destruct time. Ninety-nine percent of all FASCAM mines will self-destruct in an interval between .89 to .91 of the stated self-destruct time.

**Table A-1. Self-Destruct Times.**

	4 Hours	48 Hours	5 Days	15 Days
ADAM/RAAM (M731/M741)	X			
ADAM/RAAM (M692/M714)		X		
GEMSS (M74/M75)			X	X
MOPMS (M76/M77)	X			
Gator/Volcano (M89/M90)		X	X	X

**SAFE SEPARATION Arming Time.** Immediately after receiving an arming signal, the mine batteries activate. Upon reaching their designated SAFE SEPARATION (arming) time, they arm themselves. The first step in arming is to perform a self-test. All mines that fail the self-test SELF-DESTRUCT IMMEDIATELY! SAFE SEPARATION (arming) times for U.S. Armed Forces FASCAM type mines are listed in Table A-2.

**FASCAM Employment Information.** Occasionally, FASCAM systems will not perform as advertised. This is the case with most complex, microchip operated technology. The following information will assist in understanding these functional anomalies.

Sometimes the mines detonate for no apparent reason. Between arming and reaching 80 percent of their self-destruct times, 15 mines per 1,000 will self-destruct.

Sometimes the mines are duds. This is the most frequent failure and occurs to 52 mines per 1,000. Mines remaining after their programmed self-

destruct time should not be considered duds but considered dangerous unexploded ordnance and dealt with appropriately.

All munitions must pass a bullet impact test which involves firing a .50 caliber projectile into the mine from each of three axes. If the ordnance explodes, it fails the test. All U.S. FASCAM mines pass this test.

The modular packed mine system (MOPMS) system begins arming when directed. It completes arming at 90 seconds. The mines will discharge from their dispensing case 50 seconds after arming has been directed. They do not come out armed. They do not come out immediately upon receiving the signal to initiate arming. The delay is due to the time required for the 333 mines to receive coded identification and activation.

**FASCAM Release Authority.** FASCAM release authority is maintained at the lieutenant general-level and released to subordinate commanders only with good reason (exception is 4 hour self-destruct time which is usually given to colonel-level commanders).

**Table A-2. Arming Times.**

<b>FASCAM System</b>	<b>SAFE SEPARATION (Arming) Time</b>
GEMSS	45 seconds
MOPMS	90 seconds
RAAM (Improved)	45 seconds
RAAM	2 minutes
ADAM	2 minutes
Gator	2 minutes

## Appendix B

# Glossary

AA	avenue of approach
AAV	assault amphibious vehicle
ABFC	advanced base functional components
ACE	aviation combat element
ADAM	area denial anti-tank munition
ADAMS	artillery delivered anti-personnel mine system
AGS	aviation ground support
AHM	anti-helicopter mines
AMC	Air Mobility Command
AO	area of operations
ARFF	aircraft rescue and fire fighting
ASP	ammunition supply point
BLT	battalion landing team
BRAAT	base recovery after attack team
C2	command and control
CATF	commander, amphibious task force
CBR	chemical, biological, and radiological
CE	command element (MAGTF)
CEB	combat engineer battalion
CESP	Civil Engineering Support Plan
CINC	commander in chief
CLF	commander, landing force
COA	course of action
COC	combat operations center
COMSECONDCB	Commander, Second Naval Construction Battalion
COMTHIRDCB	Commander, Third Naval Construction Battalion
CSS	combat service support
CSSE	combat service support element (MAGTF)
DA	direct action
DART	disaster assistance response team
DAT	damage assessment team
DOD	Department of Defense
DP	decision point
DST	decision support template
EAF	expeditionary airfield
EBA	engineer battlespace assessment
EOD	explosive ordnance disposal
EPW	enemy prisoner of war
ERS	expeditionary refueling system
ESB	engineer support battalion
FACE	forward aviation combat engineering
FARP	forward arming and refueling point
FASCAM	family of scatterable mines

FEBA .....forward edge of the battle area  
FLOT ..... forward line of own troops  
FM .....field manual  
FMFM.....Fleet Marine Force Manual  
FMFRP .....Fleet Marine Force Reference Publication  
FOB ..... forward operations base; forward operating base (USMC)  
FOD ..... foreign object damage  
FSC .....fire support coordinator  
FSSG.....force service support group (USMC)

G-1/S-1 ..... manpower or personnel staff officer  
G-2/S-2 ..... intelligence staff officer  
G-3/S-3 ..... operations staff officer  
G-4/S-4 .....logistics staff officer  
G-6/S-6 ..... communications and information systems officer  
GCE ..... ground combat element (MAGTF)  
GEMSS ..... ground emplaced mine scattering system

H&S ..... headquarters and service  
H&HS ..... headquarters and headquarters squadron  
HQ ..... headquarters  
HVT..... high-value target

IPB .....intelligence preparation of the battlespace  
IR .....intelligence requirement

JF ..... joint force  
JP ..... joint publication

LANTFLT ..... United States Atlantic Fleet  
LAV ..... light armored vehicle  
LF..... landing force  
LFSP ..... landing force support party

MAG.....Marine Air Group  
MAGTF .....Marine air-ground task force  
MARFOR ..... Marine Corps forces  
MAW .....Marine aircraft wing  
MCAS .....Marine Corps Air Station  
MCDP ..... Marine Corps doctrinal publication  
MCOO ..... modified combined obstacle overlay  
MCRP .....Marine Corps reference publication  
MCWP .....Marine Corps warfighting publication  
MEF .....Marine expeditionary force  
MEP .....mobile electric power  
METT-T..... mission, enemy, terrain and weather, troops and support  
available-time available

MEU ..... Marine expeditionary unit  
MGB .....medium girder bridge  
MOOTW ..... military operations other than war  
MOPMS..... modular packed mine system  
MOS..... minimum operating strip  
MOUT ..... military operations on urbanized terrain  
MPF .....maritime pre-positioning force

MSC .....	major subordinate command
MSR .....	main supply route
MWR .....	morale, welfare, and recreation
MWSG .....	Marine wing support group
MWSS .....	Marine wing support squadron
NAI .....	named area of interest
NATO .....	North Atlantic Treaty Organization
NAVAID .....	navigation aid
NAVFACENGCOM .....	Naval Facilities Engineering Command
NBC .....	nuclear, biological, and chemical
NCF .....	Naval Construction Force
NCFSU .....	naval construction force support unit
NCR .....	naval construction regiment
NMCB .....	naval mobile construction battalion
NSDAPL .....	non-self destructing antipersonnel land mines
NSE .....	Navy support element
NWP .....	naval warfare publication
O&M .....	operation and maintenance
OIC .....	officer in charge
OMFTS .....	operational maneuver from the sea
OODA .....	observe, orient, decide, act; observation, orientation, decision, action
OPCON .....	operational control
OPLAN .....	operation plan
OPORD .....	operation order
PACFLT .....	United States Pacific Fleet
PIR .....	priority intelligence requirement
POL .....	petroleum, oils, and lubricants
PSD .....	Personnel Support Detachment
RAAMS .....	remote anti-armor mine system
RLT .....	regimental landing team
ROE .....	rules of engagement
RPMA .....	real property maintenance activities
RRR .....	rapid runway repair
SCATMINE .....	scatterable mine
SCATMINWARN .....	scatterable minefield warning
SMAW .....	shoulder-launched multipurpose assault weapon
SOA .....	sustained operations ashore
SOC .....	special operations capable
STANAG .....	standardization agreement (NATO)
STOM .....	ship-to-objective maneuver
TAI .....	target areas of interest
TM .....	technical manual
T/O .....	table of organization
TOA .....	table of allowance
TOR .....	terms of reference
TTP .....	tactics, techniques, and procedure

UXO..... unexploded explosive ordnance

V/STOL ..... vertical/short takeoff and landing aircraft

WDR..... war damage repair



## Appendix C

# References and Related Publications

### NATO Standardization Agreements (STANAGs)

2010, *Military Load Classification Markings*, provides standardized system of marking the military load classification of bridges, rafts, and vehicles; July 1994.

2017, *Orders to the Demolition Guard Commander and Demolition Firing Party Commander (Non-Nuclear)*, provides standardized procedures to the Demolition Guard Commander and to the Demolition Firing Party Commander in connection with the preparation, charging, and firing of non-nuclear demolition in operations on land; April 1988.

2021, *Military Computation of Bridge, Ferry, Raft, and Vehicle Classifications*, provides instructions, charts, and graphs for calculating the load carrying capacity of bridges, ferries, and rafts and load effects of vehicles; September 1990.

2036, *Land Mine Laying, Marking, Recording and Reporting Procedures*, standardizes the policies, procedures, and techniques of land minefield laying, marking, recording and reporting for use by NATO forces, excluding policies, procedures, and techniques concerning employment of scatterable mines with a limited laid life; April 1988.

2123, *Obstacle Folder*, provides standardized procedures to be used by the NATO nations in connection with the preparation in peacetime of preplanned, preconstructed and/or field-type obstacle; May 1988.

2136, *Minimum Standards of Water Potability in Emergency Situations*, provides criteria to standardize water potability between military organizations. It also provides a list of water treatment equipment used by 14 NATO nations; September 1995.

2394, *Land Force Combat Engineer Doctrine*, contains only the agreement to utilize the basic document ATP-52(A), *Land Force Combat Engineer Doctrine*; February 1998.

2395, *Water Crossing Procedures*, Standardizes procedures for conducting an opposed water crossing in a forward combat area. It covers the following information: stages/phases, forces, critical functions, movement control responsibilities, engineer tasks, responsibilities of the crossing unit, communications and combat service support responsibilities, the crossing plan, terms and definitions, and charts showing the sequence of crossing events; March 1997.

2818, *Characteristics of Demolition Accessories to Determine Their Operational Interchangeability*, provides characteristics of demolition materials used by various NATO members, as well as a general discussion of demolition principles. It also provides instructions for conducting comparison tests to evaluate the compatibility of foreign demolition materials; December 1979.

2885, *Emergency Supply of Water in War*, provides procedures to standardize the emergency supply of water to NATO forces if the public water supply breaks down. It contains information pertaining to: definitions, requirements, quality and

quantity, impurities, responsibilities, water sources, storage, distribution, and treatment methods; October 1997.

2889, *Marking of Hazardous Areas and Routes Through Them*, provides instructions to standardize procedures to mark hazardous areas on land and those routes through or between them. It discusses requirements, types of marking, definitions, and methods and procedures for marking various types of areas; December 1994.

2933, *Land Forces Explosives and Demolition Accessories Interchangeability Catalogue in Wartime*, contains only the agreement to use the basic document AOP-19(B), *Land Forces Explosives and Demolition Accessories Interchangeability Catalogue in Wartime*; December 1997.

2989, *Transfer of Barriers*, outlines the procedures to be used by the NATO forces for the transfer of barriers between military forces of different nationalities. It contains the major considerations of barriers and detailed procedures to successfully transfer the barrier; January 1990.

2990, *Principles and Procedures for the Employment in Land Warfare of Scatterable Mines with a Limited Laid Life*, contains only the agreement to use basic document ATP-50, *Principles and Procedures for the Employment in Land Warfare of Scatterable Mines with a Limited Laid Life*, October 1997.

2991, *NATO Combat Engineer Glossary*, contains only the agreement to use the basic document AAP-19(C), *NATO Combat Engineer Glossary*; June 1998.

### **Allied Technical Publications (ATPs)**

50, *Principles and Procedures for the Employment in Land Warfare of Scatterable Mines with a Limited Laid Life*, provides standardized principles and procedures to be used by NATO forces when employing scatterable mines with a limited laid life in land warfare; March 1988.

52(A), *Land Force Combat Engineer Doctrine*, provides NATO combat engineer doctrine in the following areas: the role of combat engineers, principles of employment, tasks in battle, defensive operations, delaying operations, offensive operations, transitional phases, and special operations; January 1997.

### **Allied Ordnance Publication (AOP)**

19(B), *Land Forces Explosives and Demolition Accessories Interchangeability Catalog in Wartime*, provides a catalog of explosives and demolition items used by NATO forces, and shows which can be interchanged and used by each nation during wartime. It is not intended for use in training or peacetime operations. It provides, where necessary, additional data, limitations, and/or clarifying information required for use of such materials. The following information is provided for each item: NATO ammunition demand/reporting code, generic description, NATO stock number, national abbreviation and short code, quantity of issue, particular characteristics, and remarks; October 1997.

### **Allied Administrative Publication (AAP)**

19(C), *NATO Combat Engineer Glossary*, provides a glossary of terms and definitions of engineer significance in both English and French languages; April 1997.

### **Joint Publications (JPs)**

1-02	DOD Dictionary of Military and Associated Terms
3-07	Joint Doctrine for Military Operations Other Than War
3-15	Joint Doctrine for Barriers, Obstacles, and Mine Warfare
4-04	Joint Doctrine for Civil Engineering Support

### **Marine Corps Warfighting Publications (MCWPs)**

3-1	Ground Combat Operations
3-17.1/FM 27-10	River-Crossing Operations
3-35.3	Military Operations on Urbanized Terrain (MOUT)
4-11.5/NWP 4-04.1	Seabee Operations in the MAGTF

### **Marine Corps Doctrinal Publication (MCDP)**

5	Planning
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### **Marine Corps Reference Publications (MCRPs)**

3-17A/FM 5-34	Engineer Field Data
3-17B	Engineer Forms and Reports
5-2A	Operational Terms and Graphics
5-12.1A/FM 27-10	The Law of Land Warfare

### **Fleet Marine Force Manual (FMFM)**

7-28	Jungle Operations
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### **U.S. Army Field Manuals (FMs)**

5-430-00-1	Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations—Road Design
10-52	Water Supplies in Theaters of Operations
20-32	Mine/Countermine Operations
31-50	Combat in Fortified Areas and Towns
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