FM 3-90.12/MCWP 3-17.1 (FM 90-13)

COMBINED ARMS GAP-CROSSING OPERATIONS

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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COMBINED ARMS GAP-CROSSING OPERATIONS

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***This publication supersedes FM 90-13/MCWP 3-17.1, dated 26 January 1998.**

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Preface

This publication applies to the Active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the United States Army Reserve (USAR) unless otherwise stated.

The doctrine of gap-crossing operations focuses on the support provided by engineer and other capabilities to the combined arms team that enhances mobility of the force by projecting elements across an obstacle, wet or dry, in support of assured mobility. It is also applicable to joint, interagency, or multinational forces and is specifically written as a dual manual between the United States (U.S.) Army and the U.S. Marine Corps (USMC). Although other branches contribute to gap-crossing operations and are included in the discussions, this manual focuses on the engineer contribution to gap-crossing operations, while acknowledging the significant role of other branches and capabilities. This manual follows the principles and tenets found in Field Manual (FM) 3-90, FM 3-34, and FM 3-34.2 that continues the discussion of mobility and gap-crossing operations. It recognizes the contribution of the entire combined arms team to gap-crossing operations and the multi-Service capabilities that exist to support gap-crossing operations at both the tactical and operational levels. Finally, it addresses the specifics associated with gap crossing in support of combat maneuver and line of communications (LOC) gap crossing, integrating the considerations created by the significant changes to doctrine and force structure that have occurred since FM 90-13 was published in 1998.

This FM is the tactical commander's and engineer staff planner's manual and primary resource for understanding gap-crossing operations. This manual follows the mobility concepts and fundamentals outlined in FM 3-34.2 and is intended for use by commanders and their staff at both the operational and tactical levels. It relates the engineer-focused aspects of gap crossing to the functional area of combined arms mobility operations, incorporating new concepts associated with the expansion of the existing Army task (ART) Conduct Gap-Crossing Operations and the advent of the modular force structure.

FM 3-90.12 provides detailed guidance on integrating gap crossing into mobility operations. As a functional area of mobility operations, it describes the fundamentals and considerations necessary for the proper planning and execution of the two major types of gap-crossing support (combat maneuver and LOCs). This manual discusses the following:

- Chapter 1 defines gap crossing and how it supports mobility operations within the framework of assured mobility.
- Chapter 2 provides an overview of gap-crossing operations by providing the definitions, fundamentals, and considerations necessary to understand the concept of gap crossing.
- Chapter 3 focuses on planning considerations that should be considered during tactical and operational level planning.
- Chapter 4 goes into depth on how gap crossing supports combat maneuver at the division, brigade combat team (BCT), and lower levels.
- Chapter 5 provides an insight on how gap crossing supports the establishment or maintenance of LOCs.
- Chapter 6 provides selected special planning and when conducting gap-crossing operations in special environments and situations.

- Appendix A describes crossing means that are most commonly used by Army and Marine forces.
- Appendix B provides the planner with some considerations to assist in evaluating potential crossing sites for gap-crossing operations.
- Appendix C provides information about specific procedures, conditions, and factors that can impact a gap-crossing operation.
- Appendix D addresses detailed engineer planning necessary for a wet-gap-crossing operation.
- Appendix E discusses the specialized tasks that divers perform in support of wet-gap crossing.
- Appendix F describes the tactics and techniques used by a division or BCT in a retrograde gap-crossing operation that differ from those used in an offensive crossing.
- Appendix G discusses gap-crossing security considerations.
- Appendix H provides descriptions of some common foreign bridging resources.

The primary audience for FM 3-90.12 is the task force (TF) and above maneuver commander and supporting staff. This also includes nonorganic unit commanders and staffs that will support brigade and above maneuver organizations. This doctrine will assist Army branch schools in teaching the integration of engineer capabilities into Army operations as well as the combined arms roles and responsibilities in regards to gap-crossing operations.

Engineer involvement is critical to most gap-crossing operations. The degree of involvement will include all of the essential tasks for mobility, countermobility, and survivability (M/CM/S) performed by engineers and others with focus on mobility operations. FM 3-90.12 is intended to inform all Service components of the types and complexity of gap-crossing operations and the capabilities of Army and Marine engineers to do them. This doctrine applies to all Army, USMC, Navy, and Air Force commanders and staffs (and other Department of Defense [DOD] units and/or staffs and other elements operating under their command authority) responsible for gap-crossing operations in support of combat operations at the tactical and selected operational levels.

FM 3-90.12 is linked to the doctrine articulated in FM 3-0, FM 5-0, FM Interim (FMI) 5-0.1, FM 3-90.6, FM 3-90.2, FM 3-34, and FM 3-34.2. Given the magnitude of recent doctrinal changes and the fact that river crossing operations are now a subordinate operation within gap-crossing operations, it is important to understand the changes occurring in Army doctrine and organization to effectively use FM 3-90.12. The doctrine in FM 3-90.12 applies to all types of operations (offense, defense, stability, and civil support) and is focused at the tactical level of war in support of the tactical commander's mobility needs.

Terms that have joint or Army definitions are identified in both the glossary and the text. Glossary references: The glossary lists most terms used in FM 3-90.12 that have joint or Army definitions. Terms for which FM 3-90.12 is the proponent FM (the authority) are indicated with an asterisk in the glossary. Text references: Definitions for which FM 3-90.12 is the proponent FM are printed in boldface in the text. These terms and their definitions will be incorporated into the next revision of FM 1-02/Marine Corps reference publication (MCRP) 5-12A. For other definitions in the text, the term is italicized, and the number of the proponent FM follows the definition.

The proponent for this publication is the United States Army Training and Doctrine Command (TRADOC). Send comments and recommendations on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commandant, United States Army Engineer School, ATTN: ATZT-TDD-E, 320 MANSCEN Loop, Suite 220, Fort Leonard Wood, Missouri 65473-8929. Submit an electronic DA Form 2028 or comments and recommendations in the DA Form 2028 format by e-mail to <leon.mdottddengdoc@conus.army.mil>.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

Some common abbreviations and acronyms—for example, the abbreviations for military ranks—are not spelled out; refer to the glossary. As a dual service manual, references made to the U.S. Army, Soldiers, division, and BCT are interchangeable with and/or include the USMC, Marines, and regimental combat team (RCT) unless stated otherwise in the text. References made to mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC) is the way the Army uses this acronym by adding "civil considerations." The Marine Corps and joint doctrine use it without "civil considerations."

ACKNOWLEDGMENT

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Introduction

MOBILITY DOCTRINE

Gap-crossing operations are functional areas of combined arms mobility operations and are applied across the spectrum of conflict. Each of the warfighting functions have the potential to contribute to a gap crossing. This manual focuses on the engineer roles and responsibilities for gap-crossing support to tactical commanders at the BCT level and above. It also discusses the general engineering aspects related to the establishment and maintenance of LOCs and other crossing operations. Finally, geospatial engineering is used to enable gap-crossing operations and the other functional areas of mobility. It is an important contributor to the planning process.

FM 3-90.12 also discusses how commanders can best plan and execute gap crossing as a part of all operations with the support of their engineer and other key staff members. The planning of gap crossings is linked to the fundamentals of operations and planning contained in FM 3-0 and FM 5-0. Because gap-crossing operations are focused on support of maneuver forces at the BCT level, the primary combined arms manual for this manual is FM 3-90.6. For the same reason, this manual complements FM 3-34 and FM 3-34.2. Additionally, since many gap crossings involve or require a subsequent general engineering effort, FM 5-104 has applicability.

The degree of a land component force's success can depend on their ability to move freely and quickly across terrain to achieve critical tactical and operational aims. As such, it is imperative that effective and efficient crossing means are available throughout the area of operations (AO). Additionally, in today's operational environment (OE), land forces must coordinate and synchronize their efforts so that they are able to fully support joint, interagency, and multinational forces that may require movement throughout the AO. As dominant land forces, it is incumbent on the Army and Marine Corps to support these diverse forces and agencies with gap-crossing solutions to facilitate the successful conduct of all types of military operations. In the past, various gap-crossing operations were identified in FM 90-13. River crossing is defined as a combined arms operation to project combat power across a terrain feature, wet or dry, that is too wide to overcome by self-bridging. Therefore, by definition it is a type of gap crossing. With transformation and today's OE, the focus of gap crossing is normal maneuver, thus obstacles as significant as river crossings are but one type of gap that must be fully considered. As such, it has become necessary to expand the concepts associated with gap crossing with the emphasis on combined arms maneuver and force movement within the AO.

EMERGING DOCTRINAL REQUIREMENTS

FM 3-90.12 is a significant revision of FM 90-13. While the principles of river crossing have not changed, it is but one of the gap crossings that must be considered to facilitate the movement and maneuver of the force within the AO. Another fundamental change to this manual is the adjustment to current doctrine and the alignment and titling of the ART Conduct Gap-Crossing Operations. This ART has two subordinate ARTs: Conduct Gap Crossing in Support of Combat Maneuver and Conduct Line of Communications Gap-Crossing Support. These tasks essentially divide gap crossings into those that have a tactical focus and directly impact normal combat maneuver, and those that facilitate movement as part of force sustainment or have unique or special considerations in their application. Finally, the Army's reorganization and restructuring to a modular force has impacted both the doctrinal and operational approach to gap-crossing operations.

Changes that directly affect this manual include the following:

- The expansion of the ART of river crossing to include all gap-crossing operations. With that, the addition of the two subordinate ARTs.
- The advent of the construct and term of assured mobility and its relationship to other doctrine (see FM 3-34).
- An acknowledgement of the importance of joint interdependence among the Services.
- The formalization of a planning tool that supports the engineer staff running estimate known as essential tasks for M/CM/S (see FM 3-34).
- The OE and specifically how the contemporary operational environment (COE) can be expected to challenge maneuver (see FM 1 and FM 3-0).
- The likelihood that operations will be conducted in a joint, interagency, and multinational environment with a reliance on joint interdependence (see FM 1 and FM 3-07) to maximize their total complementary and reinforcing effects while minimizing vulnerabilities.
- The frequency of contractors on the battlefield and their support for selected LOC bridging and similar tasks associated with general engineering missions. (See Army Regulation (AR) 715-9, FM 100-10-2 and FM 3-100.21).
- Changes in the design and organizational structures and equipment of engineer organizations to support the Army's ongoing transformation.
- The deletion of the term shallow fording. This term is no longer necessary.

The engineer role in combined arms gap-crossing operations is to facilitate mobility by providing the expertise, equipment, and/or materials necessary to move units across a terrain feature or linear obstacle, wet or dry, in a manner which is unimpeded by the obstacle. The resources that support this task are limited and normally require a significant effort to be effective. Due to the lack of organic gap-crossing equipment in the heavy brigade combat team (HBCT) and the infantry brigade combat team (IBCT) and limited assets in the Stryker brigade combat team (SBCT), the task organization of nonorganic gap-crossing assets is one that requires careful planning and consideration by operational staffs and commanders. Tactical gap-crossing capability should always augment BCTs whenever they are engaged in offensive or defensive operations.

SUMMARY OF CHANGES OR EVOLVING ISSUES

The following material highlights some of the changes or evolving issues that are present in this manual. This manual has attempted to capture the most critical changes highlighted within FMI 5-0.1, FM 3-0 Content Summary, and other ongoing and evolving issues and doctrinal guidance.

NEW TERMS AND CONCEPTS

This manual has captured or attempted to highlight and integrate many of the following terms or concepts that have been (or are being) discussed for addition to Army doctrine:

- Warfighting function.
- Assured mobility.
- Engineer reconnaissance team (ERT).
- Deputy commanding general (DCG) as a replacement for the assistant division commander (ADC).
- Essential tasks for M/CM/S.
- Gap crossing and gap-crossing operations.
- Gap-crossing considerations in special environments or circumstances (such as overbridging).
- Revision of bridging terms and definitions.
- Tactical bridging and support bridging (to include line of communication bridges).
- Standard and nonstandard bridging.
- Spectrum of conflict.

- Stability operations.
- Infrastructure reconnaissance.
- Covert gap crossing (the third type of gap crossing).
- The highlighting of the supporting roles of geospatial engineering.
- New division structure and two tactical command posts (TAC CPs).
- The changing BCT structures.
- The realities of modularity.

Chapter 1

Operations in Support of Gap Crossing

"Throughout history, wars had been lost by not crossing rivers."

General George S. Patton

Freedom of movement and maneuver within the AO is critical to achieve decisive results across the full spectrum of conflict. Mobility operations are designed to facilitate moving forces to achieve a position of advantage in relation to the enemy. One of the major challenges to movement and maneuver are linear obstacles or gaps. These obstacles are natural and man-made, wet or dry, and vary in size. From simply fording a shallow creek to continuing movement, to synchronizing assets and activities at multiple crossing sites across a major water obstacle in an opposed crossing operation, gap-crossing operations can range in complexity from very simple to extremely difficult. The simplest operation may be done by using organic assets, while the most difficult will require extensive augmentation and support from higher-level headquarters (HQ) to resource and for C2 of the operation.

Gap crossings and gap-crossing operations are essential to enable combat and supporting forces to do their mission. They will occur in support of decisive and shaping operations. Because of the importance of these operations, as well as the amount of resources that may have to be committed, gap crossings are often controlled by division/Marine expeditionary force (MEF) or BCT/RCT HQ. Future operations will be characterized by a high degree of mobility, firepower, and situational understanding (SU) resulting in an increase of the operating tempo and the synchronization of battlefield effects. Engineers (and others) must understand the gap-crossing fundamentals of surprise, extensive preparation, flexible plan, traffic control, organization, and speed to properly plan, resource, and facilitate the execution of a successful gap crossing. Simultaneously, they must be able to plan longer term gap-crossing operations and upgrade bridging over gaps through support and LOC bridging to ensure freedom of movement for the supported force. Tactical bridging should primarily serve in close support of combat maneuver forces. It is replaced by support bridging, when necessary, to allow continued support of combat maneuver. Support bridging should be replaced by LOC bridging when that is the proper solution for long-term, gap-crossing support.

CHALLENGE TO MANEUVER

1-1. Maneuver warfare depends on freedom of movement and seeks to capitalize on enemy weaknesses whenever possible. The enemy will use firepower, terrain, and natural and man-made obstacles to deny freedom of maneuver. Friendly forces will first attempt to bypass such obstacles; however, this may not always be an option. Challenges which limit maneuver must be overcome. ***Gap crossing*** **is defined as projecting combat power across a linear obstacle (wet or dry gap).** Combined arms ***gap-crossing operations*** **[is] defined as a mobility operation consisting of river crossing, brigade-level crossing, and special gap-crossing operations conducted to project combat power across a linear obstacle (wet or dry gap)**. These are employed to restore the ability to wage maneuver warfare in spite of the reality of natural and man-made obstacles. Gap crossing, which involves projecting combat power across a linear obstacle (wet or dry gap), is also a necessary operation to facilitate the freedom of movement for support forces in and around the AO. Gaps present a significant challenge and are found in almost every environment and throughout the full spectrum of operations.

1-2. In the past, gap-crossing operations were described only in the context of "river crossing." ***River crossing*** **is a type of gap-crossing operation required before ground combat power can be projected and sustained across a water obstacle. It is a centrally planned and controlled offensive operation that requires the allocation of external crossing means and a force dedicated to the security of the bridgehead.** While a river crossing is still considered one of the most challenging of gap crossings, it is but one type of gap that can obstruct freedom of movement. **A *gap* is a ravine, mountain pass, river, or other terrain feature that presents an obstacle that may be bridged.** The fundamentals of crossing any type of gap are essentially the same as those fundamentals that have been associated with river crossing. The acknowledgment is that river crossings are simply one focused set of challenges among all of the possible gap-crossing operations. Gap crossing encompasses all types of gaps (wet or dry); in any type of environment using organic and augmenting modularized engineer (and other) elements best suited to do the mission.

1-3. The organic structure of the BCT does not include the engineer and other support elements needed to conduct all combined arms gap-crossing operations. In fact, BCTs will require additional gap-crossing capabilities as augmentation in most cases and only the SBCT has limited organic gap-crossing equipment/bridging in the form of the rapidly emplaced bridge system (REBS). Depending on mission requirements and the type of crossing or crossings, the BCT may require augmentation of at least one engineer battalion HQ with subordinate engineer capabilities and other specialized assets. The engineer battalion will assist the BCT in planning and serve as a C2 element for the subordinate mix of mobility augmentation companies (MACs), multirole bridge companies (MRBCs), and any other necessary units/capabilities. Mission analysis may identify other shortfalls such as military police; chemical, biological, radiological, and nuclear (CBRN) ; aviation; or other capabilities required to support the BCT in a gap-crossing operation. It is imperative that the BCT commander and staff identify and correct any required capability shortfalls through augmentation early in the planning process.

1-4. Early identification of gaps within the maneuver area and applying the appropriate forces and resources early in the planning process can mean the difference between success and failure for maneuver units. Assuring mobility requires proactive assessment as a part of intelligence preparation of the battlefield (IPB) as well as integrating the proper support elements into the combat maneuver force to deal with planned or unplanned obstacles (to include gaps) that will affect the mobility of the force. While gap crossing is only one of the five mobility functions (FM 3-34.2), it has an important role in enabling the tactical commanders' freedom of movement so he can maintain or dictate the momentum on the battlefield.

INTEGRATING ASSURED MOBILITY

1-5. Assured mobility provides a planning framework to guide the commander and staff in the proactive application of engineer and other combat power to assure the freedom of movement and maneuver. As an integrating process, assured mobility provides linkage between the tasks associated with mobility, countermobility, and survivability and their roles across the six warfighting functions. It applies in all operations and across the complete spectrum of conflict. Assured mobility is the framework of processes, actions, and capabilities that assure the ability of the joint force to deploy and maneuver where and when desired, without interruption or delay, to achieve the mission. It strives to ensure freedom of maneuver and preserve combat power throughout the AO as it seeks to exploit superior SU. This construct is one means of enabling a joint force to achieve the commander's intent. Assured mobility emphasizes proactive mobility and countermobility (and supporting survivability) and integrates all of the engineer functions in accomplishing this. Assured mobility is broader than the term mobility and should not be confused with the limited application of the mobility operations as described in FM 3-34.2. Its focus is on supporting the maneuver commander's ability to gain a position of advantage in relation to the enemy; by conducting mobility operations to negate the impact of enemy obstacles, conducting countermobility to impact and shape enemy maneuver, or a combination of both.

Note. *Assured mobility* is defined as actions that give the force commander the ability to maneuver where and when he desires without interruption or delay to achieve the mission. (FM 3-34)

1-6. While focused primarily on the warfighting function of movement and maneuver, intelligence, and protection, it has linkages to each of the warfighting function and both enables and is enabled by those functions. While the engineer has a primary staff role in assured mobility, other staff members support its integration and have critical roles to play. The engineer plays an integrating role in assured mobility that is similar to the role played by the intelligence officer in the IPB integrating process. Ultimately, assured mobility is the commander's responsibility. Other staff members also integrate essential tasks for M/CM/S as part of assured mobility. For example, the regulation of traffic in the maneuver space; the handling of displaced persons; and other essential tasks for M/CM/S to support the maneuver plan. Assured mobility is the integrating planning process where consideration of engineer, CBRN, and other reconnaissance capabilities also occur.

1-7. The framework of assured mobility follows the continuous cycle of the operations process. Achieving assured mobility rests on applying six fundamentals that both sustain friendly maneuver, preclude the enemy's ability to maneuver, and assist the protection of the force. The fundamentals of assured mobility are:

- **Predict.** Engineers and other planners must accurately predict potential enemy impediments to joint force mobility by analyzing the enemy's tactics, techniques, procedures, capabilities, and evolution. Prediction requires a constantly updated understanding of the OE.
- **Detect.** Using intelligence, surveillance, and reconnaissance (ISR) assets, engineers and other planners identify early indicators for the location of natural and man-made obstacles, preparations to create and/or emplace obstacles, and potential means for obstacle creation. They identify both actual and potential obstacles and propose solutions and alternate COA to minimize or eliminate their potential effects.
- **Prevent.** Engineers and other planners apply this fundamental by denying the enemy's ability to influence mobility. This is done by forces acting proactively before the obstacles are emplaced or activated. This may include aggressive action to destroy enemy assets and/or capabilities before they can be used to create obstacles. Political considerations and rules of engagement (ROE) may hinder the ability to apply the fundamental early in a contingency.
- **Avoid.** If prevention fails, the commander will maneuver forces to avoid impediments to mobility if this is viable within the scheme of maneuver.
- **Neutralize.** Engineers and other planners plan to neutralize, reduce, or overcome obstacles/impediments as soon as possible to allow unrestricted movement of forces. The breaching tenets and fundamentals apply to the fundamental of "neutralize."
- **Protect.** Engineers and other elements plan and implement survivability and other protection measures that will deny the enemy the ability to inflict damage as joint forces maneuver. This may include countermobility missions to deny the enemy maneuver and provide protection to friendly maneuvering forces.

1-8. Assured mobility provides the broad framework of fundamentals that serve to retain the focus and integrate mobility, countermobility, and survivability within the combined arms team. Planners at all levels of the combined arms team rely on this framework to ensure that adequate support is provided to the commander's scheme of maneuver and intent. Within the combined arms team planning staff, it is the assured mobility section at the BCT level (and those same staff members at echelons above the BCT) that provide the input for engineer, CBRN, and similar specialized reconnaissance. The engineer coordinator (ENCOORD) plans for the application of and coordinates the integration of engineer reconnaissance across the engineer functions and spanning the range from tactical to technical capabilities.

1-9. Many gap-crossing options exist to overcome gaps that may be encountered. While there are many options, standard gap-crossing systems are a valuable and limited asset. Where and how they are used, their emplacement duration, and recovery or replacement by other systems are important considerations. Staffs apply the fundamentals of assured mobility to assist in resolving the challenges of what, where, when, and how gap-crossing operations are to be resourced and performed on the battlefield.

GAP-CROSSING OPERATIONS

1-10. *Mobility* is a quality or capability of military forces which permits them to move from place to place while retaining the ability to fulfill their primary mission (Joint Publication [JP] 1-02). Gap crossing is but one of the five mobility areas intended to meet the challenges of maintaining freedom of tactical and operational movement (Figure 1-1). The Conduct Mobility Operations ART has the following two primary subordinate ARTs related to gap crossing:

- **Conduct Gap Crossing in Support of Combat Maneuver.** This task includes deliberate, hasty and covert gap crossings. **A *deliberate crossing* involves the crossing of an inland water obstacle or other gap that requires extensive planning and detailed preparations (JP 1-02). A *hasty crossing* is the crossing of an inland water obstacle or other gap using the crossing means at hand or those readily available, and made without pausing for elaborate preparations (JP 1-02). A *covert crossing* is a gap-crossing operation that is planned and executed without detection by opposing forces. Its primary purpose is to facilitate undetected infiltration of the far side of a gap and is normally conducted by battalion and smaller forces.** See Chapter 2 for more information about each of these. The terms of crossing force and crossing force commander may be useful in describing the force executing the crossing and their commander. **The *crossing force* is the unit that has responsibility to establish the bridgehead. The *crossing force commander* is the individual designated to control the lead brigades during the assault across the gap to secure the bridgehead line.** Gap crossing in support of combat maneuver includes those operations conducted primarily at the BCT level, as well as potentially some of those conducted by the division or corps level organization, but this task is typically conducted in a close-combat environment. The crossing means task organized to combat maneuver can provide temporary to semipermanent crossing capability; however, its primary purpose is to provide the maneuver force a means to maintain its momentum. Those gap crossings conducted as a reduction method within a combined arms breaching operation are also included in this ART, but since the primary focus of planning and preparation is on the breaching operation, they are typically discussed as a part of the breaching operation rather than as a separate gap-crossing operation in that context.
- **Conduct Line of Communications Gap-Crossing Support.** The conduct of LOC gap-crossing support is not tactically focused, although it may clearly have an effect on tactical operations. ***LOC bridging* is used to establish semipermanent or permanent support to planned road networks that anticipate high-volume traffic. These bridges are typically placed in locations free from the direct influence of force on force combat operations.** This support may provide the means for combat maneuver forces to move, but it is not directly in support of combat maneuver. This type of gap-crossing support is typically distinguished by the size or length of the bridge and the capacity for high volume and frequent crossings. The crossing means is designed to provide extended service and is normally associated with support forces. It is typically conducted in an area free of the threat of direct or indirect fire. As the title implies, the focus of this ART is on nonstandard bridging.

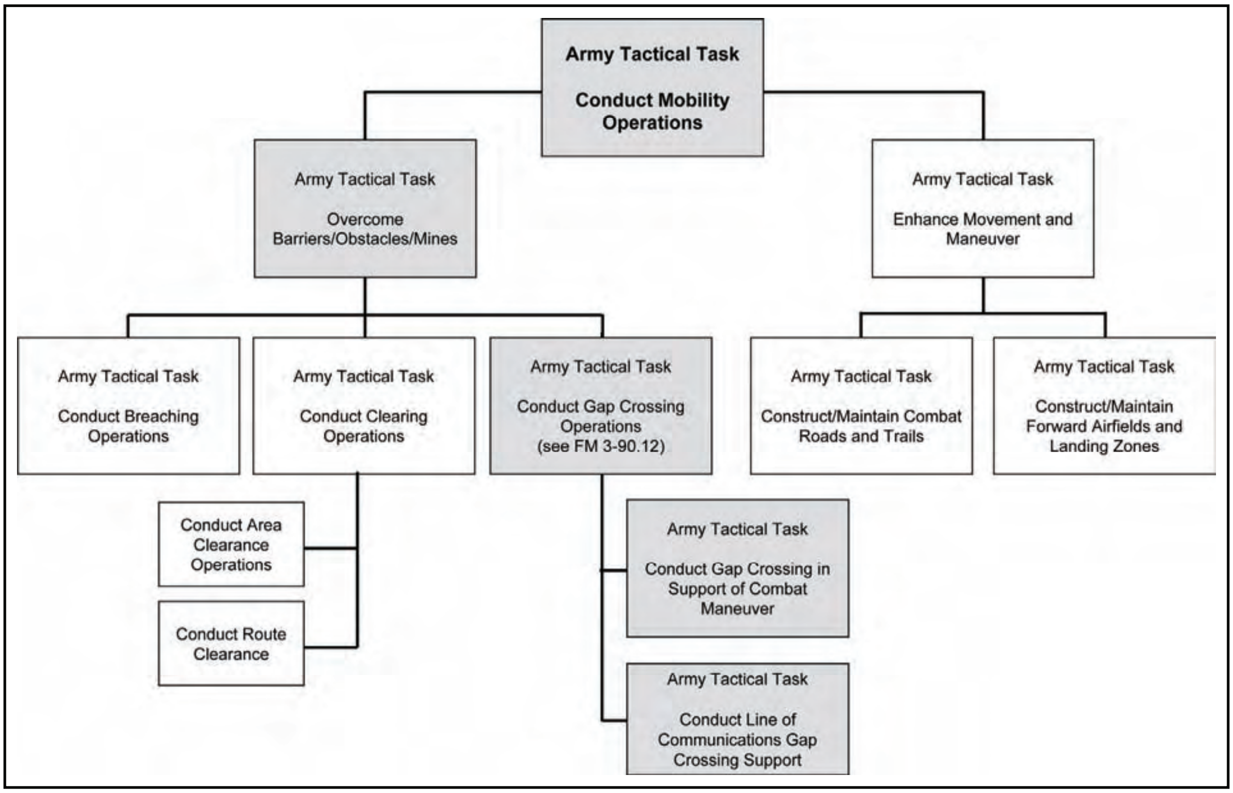

Figure 1-1. Gap-Crossing Operations in the Army Universal Task List

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Chapter 2
Overview of Gap-Crossing Operations

"The wise man bridges the gap by laying out the path by means of which he can get from where he is to where he wants to go."

John Pierpont Morgan

The purpose of any gap-crossing operation is to project combat power or operational forces across a linear obstacle in support of mobility. A gap crossing is a unique operation that often requires specific procedures for success because the obstacle, either wet or dry, can prevent or severely impede tactical maneuver or operational movement. In addition to specific procedures, a gap crossing normally requires special equipment or materials that are limited or nonexistent as organic assets in the BCT. It is incumbent on engineer planners to highlight the need for augmentation of additional assets early in the planning process. Then they should task-organize all available assets in a manner that best supports the commander's scheme of maneuver within the entire AO. Engineers face the challenge of getting the necessary assets to the right location at the right time. They should synchronize the effort so that the tactical force can maintain their movement while the supporting forces retain freedom of movement in support of the operation.

GAP CROSSING AS A FUNCTIONAL AREA OF MOBILITY OPERATIONS

2-1. The change of the ART from "Conduct River Crossing" to "Conduct Gap-Crossing Operations" is based on the realization that gap crossings are necessary for a wide variety of gaps, not just rivers. It has become clear that while river crossings are perhaps one of the most difficult gaps to cross, the fundamentals, planning, and many of the resources used in a river crossing are applicable to other types of gap crossings.

2-2. Combined arms gap-crossing operations are narrowly focused on the reduction of natural or man-made gaps utilizing mechanical equipment (normally bridging assets) or commercially procured or expedient materials to facilitate mobility. To further refine the doctrine associated with gap-crossing operations, it is necessary to divide it into two categories: combat maneuver gap-crossing support and LOC gap-crossing support (Chapter 1, Figure 1-1, page 1-5). The challenge for both is the same: to minimize a gap's impact on the commander's ability to maneuver.

2-3. Combat maneuver gap-crossing support is like a breaching operation in that the force is vulnerable while moving through a lane or across a gap. Maneuver units are forced to break movement formations, concentrate within lanes or at crossing points, and reform on the farside before continuing to maneuver. To minimize the impact on maneuver, commanders must determine if the gap crossing is to be conducted as a deliberate, hasty, or covert operation. While much of the terminology and planning associated with gap crossing is the same as that used in a breaching operation, they differ in scope and the amount and type of assets involved. Additionally, gap crossings do not ordinarily require the reduction or clearance of explosive hazards (EH) obstacles.

2-4. LOC gap-crossing support concentrates on nonstandard bridging, specialized bridging, and other LOC crossing means. They differ in that they are always well planned and conducted under relatively safe, protected conditions.

2-5. The expansion of the ART, to be more inclusive of natural and man-made gaps, has led to the need for expanding and, in some cases, redefining some of the previous terminology associated with river crossing. Listed below are many of the terms that are necessary to understand gap-crossing operations.

DELIBERATE

2-6. A deliberate gap crossing is classified as wet or dry and is usually done with one or more MRBCs in support of combat maneuver. It is normally done when a hasty crossing is not feasible or has failed. Often, these types of crossings will be river crossings. However, like any deliberate crossing, they all require detailed reconnaissance, detailed planning, coordination of fire plans, extensive preparations and rehearsals, and significant engineer assets. While a BCT can do a deliberate crossing, in most cases a division- or corps-level organization will C2 the crossing because they involve more than one BCT. Deliberate crossings can involve both general and combat engineering elements.

2-7. Some additional considerations for conducting deliberate gap crossings are as follows:

- Complexity and assets required to do the crossing.
- Opposition from a defending enemy and/or the severity of the obstacles.
- Necessity to clear entry and/or exit crossing points of enemy forces.
- Clarifying if the situation allows and time permits thorough preparations.

Deliberate Wet-Gap Crossing

2-8. The deliberate wet-gap crossing (see the example in Chapter 4) is one that requires rafting (nonbridging) and/or bridging assets. Assault craft (boats and/or helicopters), rafts and/or ferries, and the emplacement of bridging assets may occur sequentially or concurrently. The objective in deliberate wet-gap crossings is to project combat power to the exit bank of a river or other type of significant water obstacle at a faster rate than the enemy can concentrate forces for a counterattack. It is typically one of the most difficult types of gap crossings and will generally require significant augmenting with specialized assets to accomplish.

Deliberate Dry-Gap Crossing

2-9. A deliberate dry-gap crossing is usually determined by the strength of the enemy's defenses and the magnitude of the gap. Generally, the M9 armored combat earthmover (ACE), the Wolverine, the joint assault bridge (JAB), or the armored vehicle-launched bridge (AVLB) is preferred in the HBCT and the IBCT, while the REBS is organic to and may normally serve the basic immediate needs of the SBCT with augmentation of other assets as required. Neither the HBCT nor the IBCT has any organic gap-crossing capability and will need augmentation as a minimum for all offensive and defensive operations. Other bridging, to include the logistics support bridge (LSB) , the dry support bridge (DSB), the medium girder bridge (MGB), and the M2 Bailey bridge, are used to span larger dry gaps. (See Appendix A for military load classification [MLC] information.) These assets are labor-intensive and expose personnel to enemy fire during construction while providing stable gap-crossing support for continuous operations.

HASTY

2-10. A hasty gap crossing is also classified as wet or dry. A hasty gap crossing is normally preferable to a deliberate crossing because there is no intentional pause to prepare. This promotes speed, facilitates surprise, and provides a continuation of maneuver momentum. It is most often used when enemy resistance is weak and the gap is not a severe obstacle. It also features decentralized control at the BCT and below level, utilizing an augmenting MAC, organic assets, or expedient crossing means at multiple sites along a broad front. Due to the limited organic crossing assets, additional support in the form of MACs from echelons above the BCT is often necessary. That support is only available when those HQ have taken purposeful action to position the assets at the right time and place and integrate them with the maneuver force to make a hasty gap crossing feasible. Coordination for these assets must be made early in the planning process.

2-11. Some additional considerations for conducting hasty gap crossings are as follows:

- Size of the gaps in the maneuver area.
- Availability of existing bridges, fords, bypasses, or expedient crossing materials. **A *ford* is a shallow part of a body of water or wet gap that can be crossed without bridging, boats, ferries, or rafts** (the definition was shortened, and the complete definition is printed in the glossary).
- Recovery of assets.
- Aviation (helicopter) asset availability.

Hasty Wet-Gap Crossing

2-12. The depth and width of the "wet gap," bank conditions, and the current's velocity are major factors to determine the maneuver unit's ability to conduct a hasty wet-gap crossing. These factors will determine if the maneuver force can cross by fording or swimming, if expedient materials can be used, or if specific bridging assets are required. Identifying wet gaps early and deploying the required resources allow hasty crossings of known or anticipated gaps to occur.

Hasty Dry-Gap Crossing

2-13. Antitank (AT) ditches, craters, dry river beds, partially blown bridges, and similar obstacles are normally what maneuver forces encounter as a dry-gap-crossing obstacle. Maneuver forces can use the M9 ACE to push down the sides of ditches or to fill in craters. Substantial fill materials placed in the dry gaps allow the passage of combat tracked vehicles. The ***crossing site*****, defined as the location along a water obstacle or other gap where the crossing can be made using amphibious vehicles, assault boats, rafts, bridges, or fording vehicles,** can be improved and maintained for wheeled traffic use by follow-on forces. The AVLB, Wolverine, JAB, or REBS are also well suited for hasty dry-gap crossings. (See Appendix A for bridge MLC information.) As with any hasty crossing, consideration must be given to the need for replacement bridging so that the maneuver unit can maintain its assets for follow-on, gap-crossing requirements.

In-Stride Gap Crossing

2-14. An in-stride gap crossing is merely a variation of a hasty gap crossing (wet or dry) with the unique requirements for a company team (or lower) to do the gap crossing in a drill-like fashion. In-stride gap crossings can occur when a given gap is not the same as the unit planned or anticipated. To conduct an in-stride crossing, the unit must be well trained, have established standing operating procedures (SOPs), and be task-organized with the proper assets and capabilities.

COVERT

2-15. A covert gap crossing is a gap crossing used to overcome gaps (wet or dry) without being detected by the enemy. It is used when surprise is essential to infiltrate across a gap and when limited visibility and gap conditions present an opportunity to complete the crossing without being seen. The covert gap crossing is normally done by a battalion-size element or smaller (dismounted or in wheeled vehicles) as a BCT is typically too large to maintain the level of stealth necessary to conduct a successful covert gap crossing.

2-16. The primary purpose of a covert gap crossing is to move forces across a gap in an undetected fashion to infiltrate forces to the farside. It should not be confused with the assault phase of a deliberate gap-crossing operation. While a covert crossing can precede a deliberate or hasty gap crossing by a like-sized or larger element, it is planned and conducted as a separate operation. Common crossing means to facilitate a covert crossing include rope bridges, infantry foot bridges, rafts, Zodiac boats, fording and swimming, or aerial insertion. Whatever means is used, consideration must be given to the recovery of the crossing assets. Plans (contingencies) should also be made to deal with the possibility that the covert crossing may be compromised.

GAP-CROSSING MEANS

2-17. Gap-crossing means refer to the method used and include standard and nonstandard bridging assets utilized to cross a gap (Figure 2-1). Additionally, crossing means can include nonbridging methods. Some examples of nonbridging methods include rafting, ferrying, rotary-wing airlift, or fill materials (culverts, fascines, or soil). Nonbridging methods are promoted for certain types of gaps and where possible to conserve bridging resources. The expedient and rapid nature of some of these nonbridging methods aggressively supports maintaining the tempo of the tactical force they are supporting. These methods are essentially only limited to imagination, the materials available, and the commander's willingness to accept a measure of risk.

BRIDGING TYPES

2-18. There are two basic bridging types: standard and nonstandard (Figure 2-1). While the two types could be combined as a hybrid of some nature, the bridge will normally be identified by the predominant components of the bridge. ***Standard bridging*** **includes any bridging derived from manufactured bridge systems and components that are designed to be transportable, easily constructed, and reused.** Examples of standard bridging include the Wolverine, DSB, and Bailey bridges. ***Nonstandard bridging*** **is purposely designed for a particular gap and typically built utilizing commercial off-the-shelf (COTS) or locally available materials.** They are normally used when time permits and materials and construction resources are readily available; standard bridging is inadequate, unavailable, or being reserved for other crossings; and when the situation allows for unique construction. These bridges are normally left on-site, even when they are no longer necessary to support military movement. Nonstandard bridging is typically constructed by construction engineers or contractors utilizing construction materials such as steel, concrete, and/or timber.

BRIDGING CATEGORIES

2-19. There are three bridging categories (Figure 2-1), and they are broadly defined by their intended purpose(s). These categories include tactical, support, and LOC bridging. The bridging category is typically dictated by the operational environment, gap characteristics, and equipment available. They are subordinate to the bridging types and, therefore, can be standard or nonstandard. As the situation changes, crossing sites may eventually be abandoned, improved, or replaced with appropriate alternatives that befit the requirements.

Tactical Bridging

2-20. ***Tactical bridging*** **are those bridges that are used for immediate mobility support of combat maneuver forces in close combat. They are very often employed under the threat of direct or indirect fire and are intended to be used multiple times for short periods.**

Support Bridging

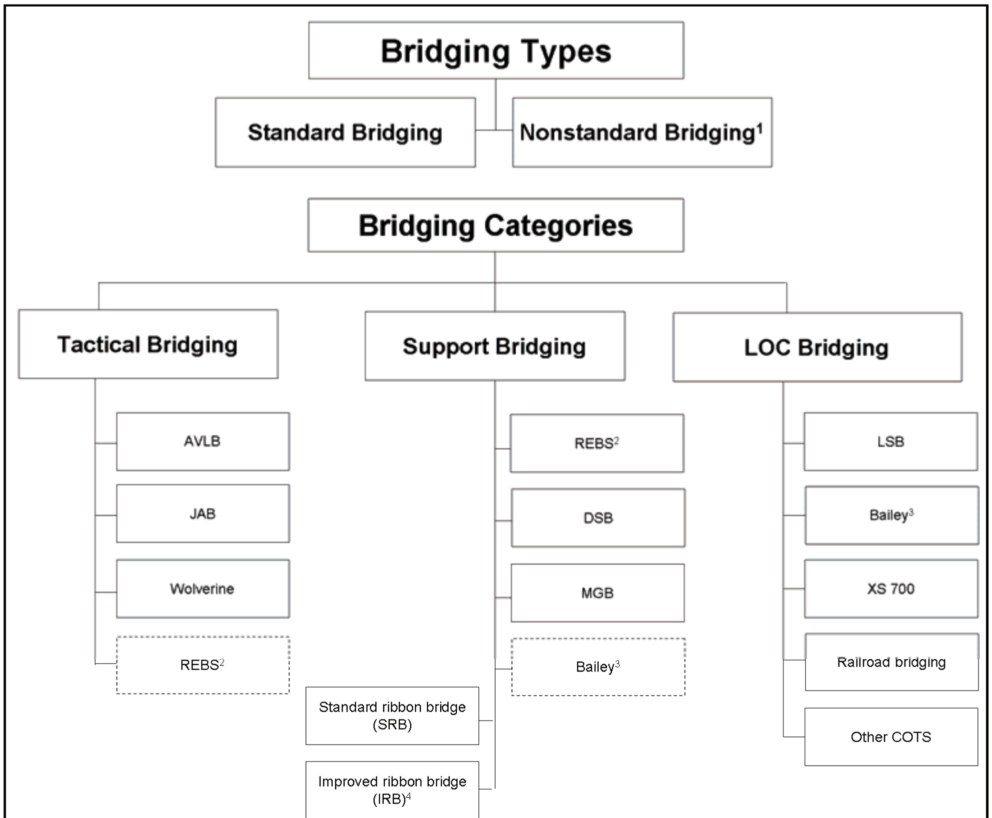
2-21. ***Support bridging*** **is used to establish semipermanent or permanent support to planned movements and road networks. They are normally used to replace tactical bridging when necessary.** These bridges are used to establish semipermanent or permanent support to planned movements and road networks. High use can be expected by both tracked and wheeled traffic. Replacement of tactical bridging by support bridging should be considered to allow the tactical bridge asset to continue in support of the combat maneuver force's mobility.

Line of Communications Bridging

2-22. The construction of a LOC bridge is generally conducted in areas free from the direct influence of enemy action. This does not mean that protection against attacks by air and ground forces are not considered. Their emplacement is not generally time-constrained in a tactical sense. Because of the load to be carried, potential length of service (relative to tactical or support bridging), and the longer spans (usually) of LOC bridges, a thorough reconnaissance, planning, and site preparation are essential.

GAP-CROSSING BRIDGES

2-23. When selecting a particular crossing means, it is important to clarify between bridging and nonbridging as the method for crossing a gap. A gap-crossing bridge is a bridge system that, when fully employed or constructed either independently or in conjunction with other or additional bridges, closes the gap. This includes standard and nonstandard bridges. It does not include partial bridges utilized as rafts or ferries.



Notes:

1. Constructed from locally available, suitable materials.

2 & 3. While most bridge systems are designed for use in a particular bridging category for various reasons, it may be appropriate to use the REBS and Bailey as shown.
REBS: Primary – Support; Secondary – Tactical
Bailey: Primary – LOC; Secondary – Support

4. Wet bridges can only be used over wet gaps. Some dry bridges can be used over wet or dry gaps.

Figure 2-1. Types and Categories of Bridging

GAP-CROSSING FUNDAMENTALS

2-24. Gap-crossing fundamentals are the same for all gap crossings, but their application varies. For example, traffic control is a key fundamental. The commander maintains it in a hasty gap crossing by using the unit's SOP and a fragmentary order (FRAGO). In a deliberate gap crossing, he uses a traffic control organization (such as a military police unit) that implements a detailed movement plan. Crossing fundamentals must be applied to ensure success when conducting any type of gap crossing.

2-25. Gap-crossing fundamentals include the following:

- Surprise.
- Extensive preparation.
- Flexible planning.
- Traffic control.
- Organization.
- Speed.

SURPRISE

2-26. The range and lethality of modern weapons allow even a small force to defeat a larger exposed force caught in the position of having to cross a gap. A gap does the following:

- Limits a force to a small number of crossing sites.
- Splits the force's combat power on both sides of the gap.
- Exposes the force to fires while crossing the gap.

2-27. Surprise minimizes these disadvantages. Forces that fail to achieve surprise may also fail in a crossing attempt. A deception plan may be a key element of surprise. It reinforces the enemy's predisposition to believe that the force will take a particular course of action (COA). The enemy usually expects a crossing; however, it does not know where or when. A deception plan that employs reconnaissance, site preparation, force buildup, and preparatory fires at a time or location other than the intended crossing area may delay an effective enemy response to the true crossing.

2-28. The usual operations security (OPSEC) measures are also important. Commanders enforce camouflage, noise, thermal, electromagnetic, and light discipline. In particular, commanders closely control movement and concealment of gap-crossing equipment and other obvious gap-crossing preparations. Though modern intelligence gathering technology is helpful, the skillful use of night, smoke, fog, and bad weather to assist obscuration can still be effective.

EXTENSIVE PREPARATION

2-29. Comprehensive intelligence of the enemy's composition, disposition, and crossing area terrain must be developed early, since planning depends on an accurate and complete intelligence picture. Supporting forces (some may not be present in a hasty gap crossing) that typically include MRBCs, MACs, air and missile defense (AMD) and artillery elements, CBRN units with obscuration capabilities, and military police companies must link up. They immediately begin crossing preparations and are available to train with the crossing force during rehearsals.

2-30. Commanders plan and initiate deceptive operations early to mask the actual preparation. These operations should conceal both the time and location of the crossing, beginning before and continuing throughout the preparation period.

2-31. Work necessary to improve routes to handle the traffic volume of the crossing operation should occur early as to not interfere with other uses of the routes. This requires a detailed traffic plan that is carefully synchronized with the deception plan. Full-scale rehearsals are essential to clarify roles and procedures, train personnel, inspect equipment, develop teamwork, and ensure the unity of effort.

Flexible Planning

2-32. Even successful crossings seldom go according to plan. A flexible plan enables the crossing force to adapt rapidly to changes in the situation during execution. It allows the force to salvage the loss of a crossing site or to exploit a sudden opportunity. A flexible plan for a gap crossing is the result of thorough staff planning, not chance. This type of plan includes the following:

- Multiple approach routes from assembly areas (AAs) to crossing sites.
- Lateral routes to redirect units to alternate crossing sites.
- Alternate crossing sites and staging areas to activate if enemy action closes the primaries.
- Alternate gap-crossing means.
- Crossing equipment held in reserve to replace losses or open alternate sites.
- Multiple crossing means and/or methods.

Traffic Control

2-33. A gap can be a significant obstacle that slows or even stops units, thus impeding their ability to maneuver. Units are restricted to moving in column formations along a few routes that come together at the crossing sites. Traffic control is essential to cross units at the locations and in the sequence desired. Traffic control also prevents the formation of targets that are susceptible to destruction by artillery or air strikes. In addition, effective traffic control contributes to the flexibility of the plan by enabling commanders to change the sequence, timing, or site of crossing units. The traffic control organization can switch units over different routes or hold them in waiting areas as directed by the tactical commander.

Organization

2-34. Commanders use the same C2 nodes for gap crossings as they do for other operations. These nodes, however, take on additional functions in deliberate gap crossings. For this reason, commanders specify which nodes and staff positions have specific planning and control duties for the crossing. This may require some temporary collocation of HQ cells (or individual augmentation) and an increase in communication means.

2-35. The tactical commander organizes his units into assault, assured mobility, and bridgehead forces. He organizes support forces consisting of engineer, military police, CBRN, and other units, as needed, into a crossing organization. This organization reports to the tactical commander’s controlling HQ. Since this is a temporary grouping, procedures that the controlling HQ establishes must be clear, simple, and rehearsed by all elements to ensure responsive support of the plan and unity of command.

2-36. Terrain management is an integral part of the crossing operation. The controlling HQ assigns space for support forces to work on and for assault forces to concentrate on before crossing. Otherwise, they interfere with each other and become lucrative targets for indirect fires and enemy air attacks.

Speed

2-37. A tactically oriented gap crossing is typically a race between the crossing force and the enemy to mass combat power on the farside. The longer the force takes to cross, the less likely it will succeed, because the enemy will defeat, in detail, the elements split by the gap. Speed is so important to crossing success that extraordinary measures may be justified to maintain it. The commander must allow no interference with the flow of vehicles and units once the crossing has started. Speed, in the context of a deliberate or a hasty crossing, is focused on the execution of the crossing itself, not necessarily on the rapidity of getting to the gap. Rather, it is focused on the speed of execution and not allowing crossing units to be defeated by the enemy.

Historical Perspective – Bridging the Rhine

There are few military operations as complex or as hazardous as an opposed gap crossing. Rivers have historically been key psychological barriers for attackers and defenders alike and can be formidable obstacles. A well-planned and well-executed crossing can achieve significant results despite a well-entrenched foe. The important role of deception in achieving surprise during gap crossings is highlighted by examining the crossing of the Rhine River in March 1945 by the U.S. Ninth Army (Operation *Flashpoint*). Deception played a key, perhaps essential, role in achieving success and minimizing friendly casualties.

The U.S. Ninth Army was positioned along the Rhine River from Dusseldorf north to Wesel. Composed of three corps (XVI, XIII, XIX), it was ordered to cross the Rhine north of the Ruhr and secure a firm bridgehead with the view to developing operations, isolating the Ruhr, and penetrating deeper into Germany.

The XVI Corps was chosen to conduct the main attack in the north of the army sector. The XIX Corps was to be prepared to follow. XVI Corps was to cross the Rhine at two places simultaneously, with the 30th Division crossing near Mehrum and the 79th Division crossing to the south near Milchplatz. In an effort to minimize casualties by achieving a measure of surprise, the Ninth Army planned a deception operation, called Operation *Exploit*. The plan proposed that XIII Corps conduct a large-scale demonstration near Dusseldorf to cause the Germans to believe that this corps was conducting the main assault.

To aid in the demonstration, many deception measures were adopted. False vehicle concentrations were displayed in the XIII Corps area. False radio nets were established and bogus traffic was sent, indicating that the 30th and 79th Divisions were subordinate to XIII Corps. Patrols were conducted at the deception sites almost twice as frequently as at the real ones. Dummy engineer parks were created. To add more realism to the deception, genuine antiaircraft barriers were placed near the fake crossing sites, dummy parks, and notional command post locations. In addition, numerous real, improved roads were built to the false crossing sites. Finally, troop and vehicle noise was amplified, inflatable dummies were used to simulate tanks, trucks, and artillery pieces, false unit patches were worn, and elements moved throughout the area simulating MPs conducting traffic control and posting false unit directional signs and command posts. An elaborate, well-thought out and believable picture was slowly built for the German intelligence gatherers.

On the flip-side of deception, cover and concealment, the true concentrations of the 30th and 79th Divisions in the XVI Corps area had to be kept secret as long as possible. Using radio security, strict camouflage measures, only conducting unit movements at night, and removing bumper numbers and distinctive patches during training and rehearsals, the XVI Corps successfully "concealed the real," while XIII Corps "displayed the false."

During the last eight days before the attack, chemical units generated smoke virtually nonstop during daylight hours along the entire riverfront. Many German POWs later reported that they had initially expected the assault when the smoke screen began, but had gotten so used to it that the actual crossings were a surprise. This is an excellent example of accustoming the enemy to a higher level of activity, so that it becomes "normal" behavior just before an attack.

Early on the morning of 24 March, the 30th Division crossed with little opposition in a well-planned and well-executed operation. The 79th Division achieved equal success. What has been called the "most elaborate assault river crossing of all time" had gone off virtually without a hitch. Operation *Exploit* had obviously helped to make Operation *Flashpoint* a success. As a post war critique of the plan stated: "nothing was overlooked" to make the operation "a model of deception as to time and place of the deliberate crossing." The Germans had been surprised by the time, place, and strength of the river crossings. German confusion was, without a doubt, important in saving hundreds of lives and was almost certainly important in assuring the speedy success of the bridgehead. The combination of planning for deception, camouflage, and smoke operations, had achieved operational and tactical surprise even in the face of a prepared, entrenched enemy. For more information, see *Conquer: The Story of Ninth Army*.

NOTE. Excerpt taken from Military Review 69. See the Source Notes.

GAP-CROSSING CONSIDERATIONS

2-38. Gap-crossing considerations are those things that the commander should, as a minimum, consider before making a crossing that involves crossing equipment or procured materials. While these considerations have applicability to both crossings in support of combat maneuver and LOC support, some of them require more consideration depending on the location and purpose of the crossing within the AO.

2-39. These considerations include the following:

- Size of gap(s).
- Location and purpose.
- Avenues of approach.
- Size/type of crossing unit(s).
- Deliberate or hasty versus covert.
- Engineer (and other) assets required or available.
- Duration of emplacement.
- Sustainment of crossing equipment.
- Recovery procedures.
- Retrograde operations.

SIZE OF GAP(S)

2-40. The size of the gap(s) that the maneuver element must cross during an operation directly impacts the units and assets required to support the mission. To effectively anticipate, plan, and allocate resources for gap crossings, it is imperative that the maneuver force define the size of the gap(s) in their respective mobility corridors.

LOCATION AND PURPOSE

2-41. Identifying the location of gaps and the purpose of the crossings assists the commander in determining potential crossing sites. For example, if it is possible to bypass a site, the commander may choose to vary the movement route to prevent the need for a crossing. Likewise, if it is proven that the gap must be crossed, it will provide clarity to the type of crossing, such as deliberate, hasty, or covert; wet or dry gap; and the assets required. Reconnaissance is critical in supporting the commander's decision making.

AVENUES OF APPROACH

2-42. The movement routes from the avenues of approach to the crossing site should be capable of handling a large volume of traffic without requiring excessive maintenance during the gap-crossing operation. The routes must also provide for lateral movement between the primary routes in the event that traffic should need to be diverted to an alternate crossing site. Sharp or constricted turns, narrow roadway width, and overhead obstructions are other considerations that impact the selection of routes because they can frustrate or prevent passage by larger vehicles. These considerations, in turn, delay movement and potentially impact the movement timetable. Finally, the routes should have areas that support easy access in and out of staging or waiting areas. These areas are typically close to the primary routes; however, they should provide concealment and be free of enemy activity. Portions of the routes may, ideally, also be partially covered or concealed.

SIZE AND TYPE OF CROSSING UNIT(S)

2-43. The size and type of the unit conducting the crossing impacts the number of crossing sites and the type and amount of assets required. Additionally, the number and type of vehicles (tracked or wheeled) making the crossing can impact the type of crossing equipment involved and/or their emplacement duration. The ability to swim or ford certain vehicles may provide a reduction of other gap-crossing means.

Deliberate or Hasty versus Covert

2-44. Making the determination to conduct a deliberate, hasty, or covert crossing is based on the mission, the enemy, the significance of the crossing, the troops and assets available, the need for additional C2, and the time available. While a hasty crossing is normally preferable, it is not always the most reasonable.

Engineer (and Other) Assets Required or Available

2-45. Under the current force structure, the HBCT and IBCT have no organic tactical bridges to facilitate gap crossing. The SBCT does have the organic REBS, however, its primary bridging category is support bridging. It is not designed to be employed in support of close combat.

2-46. If considering a hasty gap crossing, a BCT would require at least one (and more likely two) MAC(s) with their organic tactical bridges. Generally a HBCT would receive two while the IBCT and SBCT may only receive one. Additionally, if the maneuver force is to cross gaps greater than 18 meters, a MRBC would become necessary. It is imperative that the engineer terrain team identify each gap along the maneuver routes to allow the BCT staff to ensure that the BCT is resourced, organized, and prepared to properly conduct all necessary gap crossings. Other support assets may also be required.

Duration of Emplacement

2-47. There are no absolute set rules concerning bridge emplacement duration, however, each bridge has a primary purpose and a finite number of tracked and wheeled crossings that it can safely support. Tactical bridging is designed to support combat maneuver. It is designed to support a high emplacement frequency, although the duration of the emplacement is normally intended to be very brief. Tactical bridging is usually replaced by support bridging if the crossing is to be maintained for a period after the maneuver elements are across the gap. Support bridging generally remains in place until it is determined that the bridge is required to support other combat maneuver; it is no longer needed; or it becomes clear that the bridging is located on a LOC route. If it is determined that the bridge is located on a primary movement route, supports a considerable amount of traffic, and/or is intended to serve for an extended period, LOC bridging should be considered as a replacement.

Sustainment of Crossing Equipment

2-48. Sustaining crossing equipment varies with the type of crossing means. Besides normal maintenance and inspections of the crossing equipment, the bridge transport vehicle(s) must also be serviced. While each type of bridge has its own set of criteria to ensure that it operates effectively and in a safe manner, there are other considerations to ensure that the crossing equipment does not get damaged while in service. Maintaining access roads, abutments, shorelines, piers, anchorage systems, and bridge roadway surfaces will assist in minimizing stress on the bridge, lengthening the overall lifespan, and ensuring military load capacity is not compromised.

Recovery Procedures

2-49. The recovery of tactical crossing assets after the crossing is especially important to the BCT to enable the continuation of movement. Typically, BCTs will expect that their task organized tactical crossing assets are recovered and rejoin the maneuver force on the far side of the gap to continue the mission (see Chapter 4). If this is not the case, they need to be adequately resourced with additional tactical bridging to allow them to continue the momentum of their movement and maneuver.

2-50. The recovery of support and LOC bridging assets is more complicated than tactical bridging, because it requires Soldiers and Marines to be exposed to recover the bridge. Additionally, the equipment involved in the recovery requires a large, relatively open area to stage and maneuver the equipment. Most support and LOC bridging requires significant time to lay as well as recover, and it is typically not recovered once it is laid until after the tactical operation is complete.

Chapter 3
Planning Considerations

"No enterprise is more likely to succeed than one concealed from the enemy until it is ripe for execution."

Niccolo Machiavelli

The military decision-making process (MDMP) (and associated troop-leading procedures [TLP]) is the doctrinal planning model that establishes procedures for analyzing a mission; developing, analyzing, and comparing COAs against criteria of success and each other; selecting the optimum COA; and producing a plan or order (FM 5-0). Commanders must utilize the operations process to ensure that they synchronize the many integrating processes (such as the MDMP, the IPB, and targeting) to do the mission. This occurs during the planning, preparation, and execution and provides for continuous assessment throughout the operation. This chapter provides specific planning considerations associated with the MDMP that are applicable to a deliberate wet-gap crossing (formerly known as a deliberate river-crossing operation). An example of a deliberate wet-gap crossing is used in this chapter to describe the planning process, because it will generally require the most extensive planning. It is written as if a division were planning the operation, although the fundamentals are also applicable to the BCT when conducting the same type of operation at the BCT level. When conducting this type of operation at the division level, it is necessary for a brigade or battalion engineer HQ to augment the division or brigade, respectively, to assist in the planning and overall execution of the crossing. When referring to the division or brigade engineer in this chapter, it is typically the augmenting engineer HQ commander in conjunction with the staff engineer that is organic to these organizations.

GENERAL

3-1. Units plan deliberate gap crossings in the same fashion as any tactical operation, with one major difference. Force allocation against enemy units has an added dimension of time as affected by rate. Friendly forces can only arrive on the battlefield at the rate at which they can be brought across the gap. This rate will change at various times throughout the operation. This chapter outlines the detailed planning necessary to support this significant difference. The rate at which combat forces need to cross will directly affect the number of crossing sites. See Appendix B for more information concerning crossing site selection.

3-2. The corps (if present in the AO) allocates support elements to the division and provides terrain and enemy analysis. It assigns mission objectives to the division. For operations where the corps is crossing the gap, it may assign the bridgehead line.

3-3. The division assigns mission objectives to the brigades and specifies the bridgehead line. It may assign bridgehead objectives to the brigades. The division allocates maneuver and assured mobility forces to the brigades and develops coordination measures, such as movement schedules, that apply to more than one brigade. The division also provides terrain and enemy analysis to the brigades.

3-4. The senior engineer HQ, allocated to the division for the crossing, assists the division engineer section with detailed crossing plans. The lead brigade develops the tactical portion of the crossing plans that it will execute. It develops subordinate crossing objectives that will attain its mission objective from the division.

3-5. An engineer battalion HQ will typically be assigned to support each brigade crossing and assist with the development of the detailed crossing plan (see Appendix C). Subordinate battalions within the BCT will further develop the tactical plans necessary to seize their respective assigned objectives. The USMC engineer battalion HQ will task-organize to support the Marine air-ground task force (MAGTF) as required.

3-6. The actual planning process for a deliberate wet-gap crossing is the same as for any other tactical operation. Differences occur primarily because of the complexity of crossing a "wet gap" (which makes extensive calculation necessary) and the need to balance tactics with crossing rates.

3-7. Planners perform crossing calculations at least twice. Once for initial planning, where simple calculations and standards are typically used to produce quick but useful force buildup information. The second time is after the commander selects a specific COA and planners proceed with the detailed crossing calculations necessary to produce the crossing plan. Crossing calculations are critical to COA evaluations and are required to ensure that force buildup supports the COA.

PLANNING PROCESS

3-8. The staff planning process produces a best possible solution to accomplish the unit's mission. This chapter discusses those parts of planning that are necessary for a deliberate wet-gap crossing. It does not attempt to discuss the larger planning process necessary for full-mission accomplishment.

3-9. In the following paragraphs, the planning process is described in steps and by echelons. The shadowed text in the tables that follows shows the step in the planning process being discussed, with the engineer and other respective staff section planning requirements. During the MDMP, the engineer must simultaneously develop the engineer staff running estimate (see Table 3-1, the discussion later in this chapter, and the discussion in FM 3-34.2, as necessary) with the MDMP development. The estimate allows for early integration and synchronization of essential tasks for M/CM/S into the combined arms planning process. The remainder of the chapter is focused on those considerations that are specific to a deliberate wet-gap crossing that must be considered during the MDMP. In general, the corps identifies the crossing requirement and provides assets; the division conducts a detailed terrain analysis and develops rough crossing plans; and the brigade develops the detailed crossing plans.

Table 3-1. The Military Decision-Making Process and its Relationship to the Engineer Estimate

Military Decision-Making Process Mission Analysis	***Engineer Staff Running Estimate***
Analyze higher HQ order. Conduct IPB. Determine specified, implied, and essential tasks. Review available assets. Determine constraints. Identify critical facts and assumptions. Conduct risk assessment. Determine commander's critical information requirements (CCIR). Develop ISR plan. Plan use of available time. Write restated mission. Conduct mission-analysis briefing. Approve restated mission. Develop commander's intent. Issue commander's guidance. Issue warning order (WARNORD). Review facts and assumptions.	Analyze higher HQ orders. • Commander's intent. • Mission. • Concept of operation. • Timeline. • AO. Conduct IPB/develop engineer staff running estimate. • Terrain and weather analysis. • Enemy mission and essential tasks for M/CM/S capabilities. • Friendly mission and essential tasks for M/CM/S capabilities. Analyze the engineer mission. • Specified essential tasks for M/CM/S. • Implied essential tasks for M/CM/S. • Assets available. • Limitations. • Risk as applied to engineer capabilities. • Time analysis. • Identify essential tasks for M/CM/S. • Restated mission. Conduct risk assessment. • Safety. • Environment. • Determine CCIR (terrain and mobility restraints, obstacle intelligence, threat engineer capabilities). Integrate reconnaissance effort.
COA development.	Develop scheme of engineer operations. • Analyze relative combat power. • Refine essential tasks for M/CM/S. • Identify engineer missions and allocation of forces and assets. • Determine engineer priority of effort/support. • Refine the commander's intent for essential tasks for M/CM/S operations. • Apply engineer employment considerations. • Integrate engineer operations into maneuver COA.
COA analysis.	War-game and refine engineer plan.
COA comparison.	Recommend COA.
COA approval.	Finalize engineer plan.
Order production.	Input to basic operation order (OPORD). • Scheme of engineer operations. • Essential tasks for M/CM/S. • Subunit instructions. • Coordinating instructions. • Engineer annex/appendixes.

RECEIPT OF MISSION

3-10. The first step of the MDMP is the receipt of mission. The second step is the recognition that a deliberate gap crossing is necessary.

MISSION ANALYSIS

3-11. Upon receipt of the mission, the staff develops and conducts a mission analysis (Table 3-2). This is done to—

- Understand the purpose of the mission and the intent of the commander and the commander two levels up.
- Review the conditions of the AO.
- Identify the tasks (both specified and implied), assets available, constraints, restraints, and an acceptable level of risk (to include risk associated with environmental considerations in conjunction with FM 3-100.4/MCRP 4-11B).
- Begin the development of essential tasks for M/CM/S in conjunction with the task identification and the maneuver commander's guidance.

Table 3-2. Step Two: Mission Analysis

Military Decision-Making Process	*Actions to be Taken*
Receipt of Mission **Mission Analysis** **COA Development** **COA Analysis (War Game)** **COA Comparison** **COA Approval** **Orders Production**	The battle staff— • Identifies critical facts and assumptions. • Conducts an initial IPB by— - Identifying key terrain affecting the crossing. - Templating enemy gap (river) defenses. - Estimating the crossing capability of the area to be crossed using terrain data and available crossing means. - Calculating force crossing rates for each crossing area using the troop list. - Reviewing available bridging assets. • Determines specified, implied, and essential tasks. • Recognizes that a river crossing operation is necessary. • Issues a WARNORD. • Determines the CCIR as they pertain to the gap (river) crossing.

3-12. A mission analysis is conducted in the manner identified in FM 5-0. Corps planners normally identify gap-crossing requirements when assigning missions to the division. The corps plan will then provide gap-crossing assets to the division, and may specify crossing the gap as one of the tasks assigned to the division. If the corps does not see the need for a division-level gap crossing, it may not specify a crossing. Gap crossings requiring bridging assets may still be required, and either the BCT or the division must then request these assets in a timely fashion as soon as they understand the requirements of their mission. Necessary crossing assets should be listed in the corps and division orders.

3-13. Normally, if the corps identifies the requirement for a deliberate gap crossing, its WARNORD includes it. The topographic element supporting the corps provides detailed gap data and crossing area overlays to support the planning of the operation. This topographic element automatically provides necessary geospatial data to the division and BCT terrain teams. See FM 100-15 for more details on planning at the corps level.

3-14. The division discovers that it must cross a gap by receiving a specified task in the corps order or by developing an implied task during mission analysis. The engineer section assigned to the division should always examine every potential gap in the division AO during the mission analysis process as a standard piece of the engineer estimate. The division terrain team maintains a terrain database that includes gap data and potential crossing sites for the division AO. The terrain team in the BCT should also maintain similar data for the AO of the BCT. Together, the engineer HQ assigned to the division and the division organic terrain team immediately determine the potential crossing sites to do the mission.

Intelligence Preparation of the Battlefield

3-15. All staff sections, to include the engineers, help analyze the existing situation. This analysis includes the METT-TC for the mission. This step is primarily designed to acquire the data necessary for the following planning steps, but some early analysis is necessary to generate critical information. The engineer staff officer must very quickly convert raw terrain data and friendly information into crossing rates. This allows the planners to make intelligent decisions about supportable schemes of maneuver. For more information on the IPB process and its integration into the MDMP, see FM 34-130 and FM 5-0.

3-16. As a part of the IPB process, the Assistant Chief of Staff, Intelligence (G-2) leads the staff development of a defensive situational template along the entire gap that the division must cross. The template focuses attention on possible areas of weakness, enemy counterattack forces, artillery, and potential close air support as a minimum.

3-17. The G-2, with the engineer's help, develops obstacle templates from the line of contact through to division objectives. He provides the templates to the brigade intelligence sections for their planning and analysis. The division engineer provides enemy obstacle information (particularly along the gap) to the engineer HQ supporting each of the brigades. This information is continuously updated based on intelligence updates focused on obstacle intelligence (OBSTINTEL).

3-18. The division provides the brigade staff with templates that it continues to refine and further develop focused on the enemy forces in its AO. The intelligence staff officer (S-2) develops intelligence requirements and a detailed intelligence collection plan with specific emphasis on the far side of the gap.

3-19. Reconnaissance teams seek information to fill those requirements. Obstacle templates are verified by active air and ground reconnaissance. Continuous reconnaissance is performed to update all aspects of this information as required.

Troops and Support Available

3-20. The division engineer coordinates for engineer units to cross the force using the simple standard that every forward brigade requires a minimum of two bridges or crossing sites. Not having enough bridging assets will limit possible COAs. Other required specialized units and capabilities are also identified.

3-21. The brigade engineer identifies the crossing sites required for the brigade and for each battalion based primarily on the number and type of vehicles. This calculation is based on simple assumptions of vehicle densities within the task organization of the battalions/TFs at full strength. From it, the brigade engineer determines the approximate time necessary to cross the entire brigade (see Appendix D). The number of crossings required is a critical element for consideration during COA development. The brigade engineer also determines the amount of bridging available, the number of possible heavy rafts, and the number of likely assault boats. This information is forwarded to the crossing area engineer (CAE), who handles the control of all crossing means. Other crossing means such as helicopters (if available) should also be added into the calculations.

Terrain and Weather

3-22. The division engineer ensures that adequate information is compiled in the crossing site database to support planning at brigade level. The division and brigade terrain teams generate crossing site overlays, site data files, and road and cross-country movement overlays for the crossing areas.

3-23. The division engineer ensures that enough vehicle swimming, assault boat, raft, and bridge sites are available within each assault brigade area. Generally, a main attack brigade requires two vehicle swim or assault boat (for dismounted battalions) sites and at least two raft or bridge sites.

3-24. The brigade engineer, coordinating with the CAE, evaluates all potential crossing sites from both technical and tactical considerations, including the following:

- Entry and exit road networks.
- Cross-country movement.
- The width, velocity, and depth of the gap (river).
- The conditions of the bank (as they support each of the four types of sites).
- The vegetation along the shore.
- The obstacles in or along the gap.
- The obstacles immediately affecting the approaches to or from potential crossing sites.
- Possible attack positions and routes to the gap.
- Possible ***call forward areas*****, which are defined as waiting areas within the crossing area where final preparations are made** (the definition was shortened, and the complete definition is printed in the glossary).
- Projected weather conditions and the potential impacts.
- Environmental considerations as appropriate.

3-25. The brigade engineer, coordinating with the CAE, then analyzes each site to arrive at a rough crossing rate capability and the effort necessary to open the site. Operational planners use this information to develop possible COAs.

3-26. The division engineer, coordinating with the crossing area commander (CAC), ensures that crossing requirements of the lead brigades and breakout force are adequately resourced to satisfy each COA.

3-27. The BCT main command post (CP) evaluates the terrain along the gap in terms of observation and fields of fire, avenues of approach, key terrain, obstacles, and cover and concealment (OAKOC). The intent is to understand the terrain along the gap (and along selected approaches) so that potential COAs can be devised with crossing objectives. The operations planners combine this knowledge with the crossing site comparisons and enemy templates to develop possible COAs.

COURSE OF ACTION DEVELOPMENT

3-28. The Assistant Chief of Staff, Operations (G-3), along with key members of the staff, sketches out possible COAs to do the mission of the division as they accomplish COA development (Table 3-3). COAs must include the following:

- Assigned crossing areas for each brigade.
- A crossing timeline for each COA.
- Brigade boundaries that include terrain, which is necessary to defend the bridgehead against enemy counterattacks.

Table 3-3. Step Three: Course of Action Development

Military Decision-Making Process	*Actions to be Taken*
Receipt of Mission	The battle staff— • Uses the commander's guidance to sketch out several COAs. • Develops the scheme of maneuver, fire plan, and support plan for each COA considering crossing capabilities and the order of crossing. The engineer selects sites; determines vehicle swimming and assault boat, rafting, and bridging configurations and bank preparation requirements; and task-organizes the engineers for each COA.
Mission Analysis	
COA Development	
COA Analysis (War Game)	
COA Comparison	
COA Approval	
Orders Production	

3-29. Looking two levels down, the division staff plans an assault crossing site (vehicle fording or assault boat) for each anticipated assault battalion in a brigade area. A brigade should also have two bridging or rafting sites within its boundaries as a norm. The discussion proceeds to the BCT gap crossing for this crossing. Multiple brigade packages may be necessary for a division crossing.

3-30. The brigade operations staff officer (S-3) looks closely at the avenues leading to brigade mission objectives, particularly at crossing sites feeding the avenues. Developing practicable COAs is normally an iterative process. The division staff first develops a scheme of maneuver to take the final objective, and then verifies that the force buildup rate across the river is adequate for the scheme of maneuver. If so, the S-3 expands the COAs to include the tactics required for the crossing.

3-31. The tactics required for the crossing are based on enemy defenses near the crossing sites, enemy reaction forces and earliest employment times, and crossing rates at each site. The COAs must include exit bank, intermediate, and bridgehead objectives.

3-32. The S-3, working with the brigade engineer and CAE, develops the control mechanisms, crossing graphics, crossing timeline, and crossing area overlay for each COA (Figure 3-1 and Figure 3-2, page 3-8). This planning assists the division in their overall plan by providing the specifics necessary for their portion of the crossing. See Appendix D, Figure D-2, page D-5.

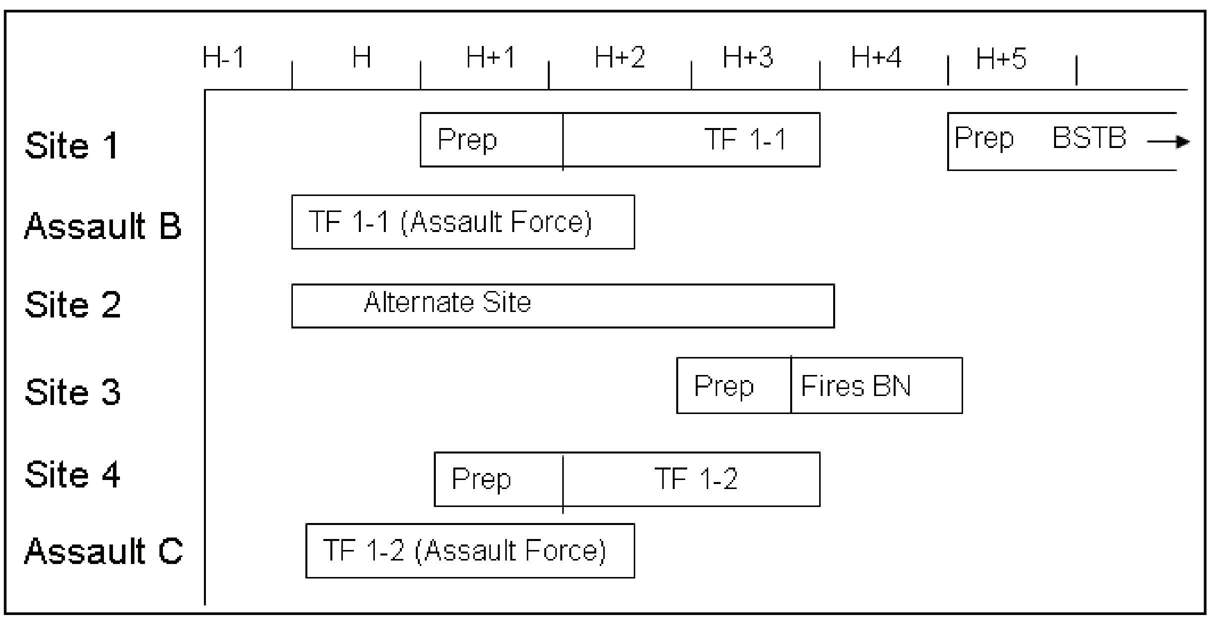


Figure 3-1. Brigade Combat Team Crossing Timeline for a Course of Action

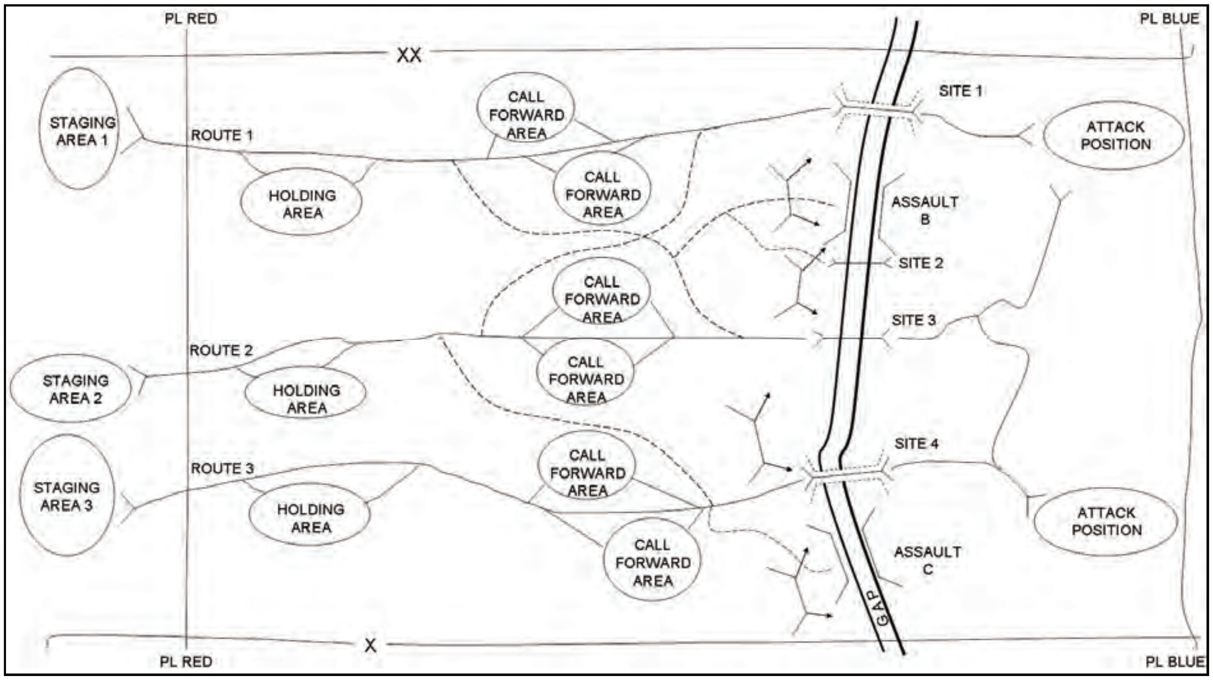


Figure 3-2. Brigade Combat Team Crossing Area Overlay for a Course of Action

COURSE OF ACTION ANALYSIS

3-33. The staff at both the division and brigade levels war-game each COA against likely enemy reactions (Table 3-4). They then attempt to counter each enemy response.

3-34. The engineer does the following:

- War-games against other variables outside his control, such as terrain difficulties, potential weather impact, and crossing equipment losses.
- Considers what will happen—
  - If it takes longer to open a crossing site.
  - If damage slows progress over entrance and exit routes.
  - If the conditions of the gap change.
- Considers what will happen if enemy action shuts down a crossing site or forces its relocation.
- Considers the consequences of equipment failure or loss to enemy action.
- Evaluates the most likely of these against all COAs and develops, within his means, necessary counters to include alternate sites, routes, and crossing means.

Table 3-4. Step Four: Course of Action Analysis (War Game)

Military Decision-Making Process	*Actions to be Taken*
Receipt of Mission	The battle staff war-games each COA against possible enemy responses. The engineer war-games each COA against potential changes to the terrain and likely equipment losses.
Mission Analysis	
COA Development	
COA Analysis (War Game)	
COA Comparison	
COA Approval	
Orders Production	

COURSE OF ACTION COMPARISON

3-35. The division staff examines each COA against both the immediate and follow-on missions (Table 3-5). The division is particularly concerned with the movement of reserve and support forces and compares COAs against these requirements.

3-36. The brigade staff considers the ability of each COA to handle enemy responses, support follow-on missions, provide flexibility for the brigade, and allow for crossing redundancy.

Table 3-5. Step Five: Course of Action Comparison

Military Decision-Making Process	*Actions to be Taken*
Receipt of Mission	The battle staff— • Compares and evaluates the advantages and disadvantages of the COAs. • Recommends one COA to the commander. The commander selects a COA and issues a FRAGO.
Mission Analysis	
COA Development	
COA Analysis (War Game)	
COA Comparison	
COA Approval	
Orders Production	

COURSE OF ACTION APPROVAL AND ORDERS PRODUCTION

3-37. COA approval and orders production are the final two steps of the MDMP. Once the commander has selected and approved a COA, the staff engineer immediately issues a verbal FRAGO or written WARNORD to the engineer HQ executing the crossing. Simultaneously, the staff converts the selected COA into a plan with enough detail for synchronized execution (Table 3-6). The staff engineer conducts an extensive analysis to develop a unit-by-unit crossing plan and movement schedule in conjunction with the G-3, the Assistant Chief of Staff, Logistics (G-4), and the division transportation officer (DTO).

Table 3-6. Steps Six and Seven: Course of Action Approval and Orders Production

Military Decision-Making Process	*Actions to be Taken*
Receipt of Mission	The battle staff— • Adjusts the COA to reflect commander guidance. • Issues a WARNORD to units involved in the operation. • Converts the selected COA chosen by the commander into an executable plan. The engineer develops a detailed crossing plan to support the operation.
Mission Analysis	
COA Development	
COA Analysis (War Game)	
COA Comparison	
COA Approval and Orders Production	

3-38. As a result of this process, the engineer now refines and fully develops the crossing capability chart, the crossing timeline, the crossing site overlay, and the crossing synchronization matrix. These documents serve as primary C2 tools for the CAC and execution tools for the BCT/RCT/TF S-3 (see Appendix D for examples of those graphics not shown in this chapter). Support is provided to the traffic control cell as they work out the traffic circulation plan to support the operation.

3-39. While detailed planning is underway, the CAE initiates farside and nearside reconnaissance to develop enough detail for battalion-level planning. He converts this planning into a detailed engineer task list, and develops the engineer execution matrix to synchronize it (see Appendix D for an example of an execution matrix).

ENGINEER PLANNING CONSIDERATIONS

3-40. Commanders maneuver their forces into positions of advantage over the enemy. Engineers analyze the terrain to determine the maneuver potential, ways to reduce natural and enemy obstacles, and how they can deny freedom of maneuver to the enemy by enhancing the inherent obstacle value of the terrain (see FM-3-34.2 for more information).

ENGINEER ESTIMATE

3-41. Commanders and staffs develop running estimates before and during the MDMP. These estimates are updated throughout the operation as well. Terrain, enemy aspects, and water characteristics are key components of the estimate for gap-crossing operations and are applied during the planning process. Much of this information directly applies to and must be included as a part of the IPB (Table 3-1, page 3-3).

TACTICAL REQUIREMENTS

3-42. Although terrain characteristics have a strong influence, tactical requirements ultimately determine the location of the crossing site(s). During a wet-gap crossing, water conditions must allow the proper employment of available crossing means and the tactics required for their operation.

3-43. The farside terrain must support mission accomplishment; otherwise, crossing the gap in that location serves little purpose. Crossing sites must also support the rapid movement of units to the farside, or the enemy can win the force buildup race. Commanders balance the tactical use of the farside terrain against technical crossing requirements at the gap to determine suitable crossing locations.

3-44. Nearside terrain must support initial assault sites, rafting and bridging sites, and the assembly and staging areas used by the force. Routes to and from the gap must support the quantity of traffic that is necessary for the operation and for the sustainment of the force in subsequent operations.

3-45. The enemy's disposition of forces may limit options for the commander. Because the gap physically splits his force, he should execute his crossing operation where the enemy is most vulnerable or least able to react. This gives the commander time to mass his force on the farside before the enemy can concentrate against it.

TERRAIN ANALYSIS

3-46. The engineer is the terrain expert. He must work closely with the S-2 during the planning process to identify the advantages and disadvantages presented by the terrain for both friendly and enemy forces. Engineers have the primary responsibility of collecting the terrain information needed for wet-gap crossings. This is easiest if the nearside is under friendly control in adequate time to collect necessary information about the gap. Engineers collect water, bank, and route information through the integration of geospatial means, engineer reconnaissance (see FM 3-34.170), and other reconnaissance means and methods. Engineer diving teams may be available to provide farside, nearside, water bottom, and underwater-obstacle information (see Appendix E and FM 3-34.280). Local inhabitants can provide additional information about bridges, flow, bank stability, road networks, ford sites, and other gap conditions. Aviation assets can provide aerial and video reconnaissance to greatly enhance the IPB for gap-crossing operations. Normal intelligence collection assets develop the picture of the enemy's defense that is necessary to build a template of those forces affecting the gap.

CHARACTERISTICS

3-47. Wet gaps requiring a deliberate crossing that confront a division or BCT are usually rivers. Rivers form unique obstacles. They are generally linear and extensive and normally cannot be bypassed. Meandering bends in rivers provide farside defenders with opportunities for flanking fires and observation of multiple crossing sites. The combined arms team, as normally configured for combat, needs special preparation and equipment to carry it across river obstacles. After the attacking force crosses the river, it remains an obstacle for all follow-on forces unless a permanent bridge has been emplaced or rafting and/or ferry assets are in place to provide a crossing means.

3-48. A formation cannot typically cross a river (wet gap) wherever desired as compared to the options available when crossing most dry gaps or breaching most field obstacles. Potential crossing sites may be few, and they will be equally obvious to both the attacker and defender.

3-49. A gap (river) provides excellent observation and fields of fire to both the attacker and defender. It exposes the force on the water and makes it vulnerable while entering and leaving the water. It is also an aerial avenue of approach, allowing enemy aircraft low-level access to crossing operations.

3-50. Force buildup on the farside is a race between the defender and the attacker. The gap (river) can be an obstacle behind the initial assault force allowing the enemy to pin and defeat it in detail while preventing rapid reinforcement.

MILITARY ASPECTS

3-51. Terrain analysis for a wet-gap crossing includes the OAKOC aspects of terrain; however, many details are peculiar to river crossings. These details include the specific technical characteristics of the gap as an obstacle.

WATER CURRENT

3-52. Water current is a major limiting factor for wet-gap crossings. It imposes limits on all floating equipment whether rubber assault boats, swimming armored vehicles, rafts, or bridges (the current's velocity determines the amount of personnel and equipment each type of floating equipment can carry or if it can operate at all). Current affects the distance that the floating equipment will drift downstream. Commanders must either select an offset starting point upstream to reach a desired point on the farside or take additional time to fight the current. High current velocities make control of a heavy raft difficult; therefore, landings require skilled boat operators and raft commanders and more time.

3-53. Current causes water pressure against floating bridges. MRBCs use boats or an anchorage system to resist this pressure. The higher the current, the more extensive the anchorage system must be. Higher currents provide velocity to floating objects, which can damage or swamp floating equipment.

3-54. Current can be measured easily (for example, by timing a floating stick) but is normally not constant across the width of the river. Generally, it is faster in the center than along the shore. It is also faster on the outside of a curve than on the inside. A factor of 1.5 times the measured current should be used for planning purposes.

WATER MEASUREMENTS

3-55. The depth of the water influences all phases of a wet-gap crossing. If the water is shallow enough and the riverbed will support traffic, fording is possible. If the force uses assault boats and the water becomes shallow in the assault area, the force will have to wade and carry their equipment. Shallow water may also cause difficulty for swimming vehicles, because the rapidly moving tracks can dig into a shallow bottom and ground the vehicle. The water must be deep enough to float bridge boats and loaded rafts on their crossing centerlines and deep enough in launch areas to launch boats and bridge bays. The depth of the water is not normally constant across a wet gap. It is generally deeper in the center and in high velocity areas. Either a bottom reconnaissance with divers or sounding from a reconnaissance boat is necessary to verify the depth.

3-56. The width of a wet gap is a critical dimension for bridges (especially when it determines how much equipment is necessary) and rafts. The distance a raft or assault boat must travel determines its round-trip crossing time, which in turn determines the force buildup rate on the farside.

WATER CHANGES

3-57. A swell is the wave motion found in large bodies of water and near the mouths of rivers. It is caused by normal wave action in a larger body, from tidal action, or from wind forces across the water. A swell is a serious consideration for swimming armored vehicles, although it is of lesser importance for assault boats, heavy rafts, and bridges. Hydrographic data and local residents are sources of information on swells. Direct observation has limited use, because a swell changes over time with changing tide and weather conditions.

3-58. Tidal variation can cause significant problems. The water's depth and current changes with the tide and may allow operations only during certain times. Tidal variation is not the same every day. It depends on lunar and solar positions and on the current's velocity. Planners need tide tables to determine the actual variation, but they are not always available for rivers. Another tidal phenomenon found in some estuaries is the tidal bore, which is a dangerous wave that surges up the river as the tide enters. It seriously affects water operations. This reverse flow may require that float bridges be anchored on both sides.

3-59. Wet gaps may be subject to sudden floods due to heavy rain or thawing upstream. This will cause bank overflow, higher currents, deeper water, and significant floating debris. If the enemy possesses upstream flood control structures or dams, it can cause these conditions also. Dry gaps may also become wet gaps given certain weather conditions or as a result of the breaching of flood control devices or similar structures.

OBSTRUCTIONS

3-60. The following obstructions may impede gap-crossing operations:

- **Sand or mud.** Most wet gaps contain sand or mud banks. They are characteristic of low current areas along the shore and on the inside of the curves of a river, but they can be anywhere. Since they cause problems for swimming vehicles, assault boats, outboard motors, bridge boats, and rafts, troops must find them through underwater reconnaissance or sounding.
- **Rocks.** Rocks damage propellers, boats, floating bridges, and ground rafts. They cause swimming armored vehicles to swamp if the vehicle body or a track rides up on them high enough to cant the vehicle and allow water into a hatch or engine intake. They can also cause a fording vehicle to throw a track. Rocks are found by underwater reconnaissance or sounding.
- **Natural obstructions and floating debris.** These can range from sunken ships to wreckage and snags. The current in large waterways can carry significant floating debris, which can seriously damage boats and floating equipment. Usually, debris can be observed after flooding or rapidly rising waters. Performing underwater reconnaissance or using bottom-charting sonar is the only way to locate these obstructions.
- **Man-made.** Man-made underwater obstacles can be steel or concrete tetrahedrons or dragon's teeth, wood piles, or mines. The enemy places them to deny a crossing area and designs them to block or destroy boats and rafts. Performing underwater reconnaissance or using bottom-charting sonar can locate these obstacles.
- **Vegetation.** Vegetation in the water can snag or choke propellers and ducted impellers on outboard motors and bridge boats. Normally, floating vegetation is not a significant problem. Thick vegetation beds that can cause equipment problems are found in shallow water and normally along the shore. Thick vegetation must extend to within 30 to 60 centimeters of the surface to hinder equipment, so it can normally be seen from the surface.
- **Animals.** Some water creatures may also conceivably become obstructions to crossing operations.

FRIENDLY SHORE (NEARSIDE)

3-61. Concealment is critical to the initial assault across the gap. The assault force must have concealed access to the gap. It must also have concealed attack positions close to the gap from which to prepare assault boats. The overwatching unit prepares concealed positions along the friendly shore, taking full advantage of vegetation and surface contours. Overwatching units must be in position to engage the most likely enemy position(s) on the enemy shore.

3-62. Dominant terrain formed by hill masses or bluffs provides direct-fire overwatch positions. If the dominant terrain is along the shore, it also covers attack positions, AAs, and staging areas. AMD sites should be located on terrain that dominates aerial AAs (one of which is located along the gap). When selecting a crossing site, consider the following:

- Dismounted AAs that allow silent and concealed movement of assault battalions to the gap.
- Concealed attack positions that are very close to the gap along the dismounted avenue.
- Approaches from the attack positions to the wet gap that have gradual slopes and limited vegetation to allow the assault force to carry inflated assault boats.
- Bank conditions that are favorable. Dismounted forces must be able to carry assault boats to the water, and engineer troops must be able to construct and operate rafts with little bank preparation.
- Road networks that feed the crossing sites and support the lateral movement of vehicles between sites. These road networks must be well constructed to carry large amounts of heavy vehicle traffic.
- Potential staging areas that can support large numbers of tracked and wheeled vehicles without continual maintenance.
- Helicopter landing zones (LZs) for embarkation of the assault force.

ENEMY SHORE (FARSIDE)

3-63. A river meanders and forms salients and reentrant angles along the shore. A salient on the enemy shore is desirable for the crossing area, because it allows friendly fires from a wide stretch of the nearside to concentrate against a small area on the farside and limits the length of enemy shore that must be cleared to eliminate direct fire and observation (Figure 3-3).

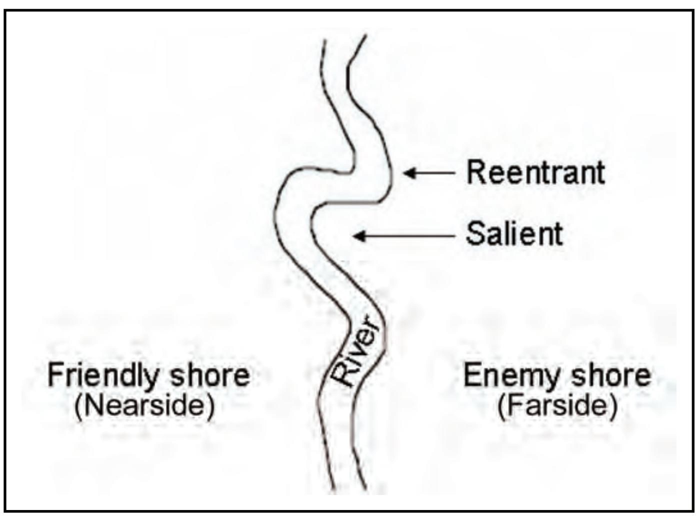


Figure 3-3. Salients and Reentrants on the Enemy Shore

3-64. Having dominant terrain on the enemy side of the gap is undesirable. Any terrain that permits direct fires or observed indirect fires onto crossing sites is key terrain. Friendly forces must control it before beginning the rafting or bridging phases. Merely attempting to suppress this key terrain will probably not be effective.

3-65. Natural obstacles must be minimal between the river and the bridgehead objectives. River valleys often have parallel canals, railroad embankments, flood control structures, swamps, and ridges that can impede more than the river itself. Obstacles perpendicular to the river can help isolate the bridgehead.

3-66. Exits from the river must be reasonably good without preparation. Initially, the bank should allow the assault force to land and dismount from the assault boats. This requires shallow banks with limited vegetation. The assault force also requires concealed dismounted avenues up from the river. Bank conditions must allow vehicles to debark from rafts and move up from the river. If banks require earthwork, at least one unimproved crossing site must allow the landing of earthmoving equipment. The most important far shore requirement is a road network to carry high volumes of heavy vehicle traffic.

INTELLIGENCE INTEGRATION

3-67. Detailed knowledge of the gap and adjacent terrain is critical to both tactical planning and to engineer technical planning. The keys are early identification of intelligence requirements and an effective collection plan. Space- and aircraft-based imaging and weather systems can provide invaluable information to the terrain database. Multispectral imagery (MSI) from satellites and aircraft can give the engineer terrain teams a bird's-eye view of the AO. Satellite images can be used to identify key terrain and provide crossing locations. These images can provide information concerning the depth and turbidity of the water and can be used to identify the line of site for weapons and communications systems. With MSI products, prospective construction materials, the locations of existing crossing sites, and nearside and farside road networks can be identified and exploited.

3-68. When the MSI is combined with satellite weather receivers, data processors, and the terrain database, it can be used to identify mobility corridors and establish floodplain trafficability. When these space systems are used together, the effects of the weather on terrain can be analyzed and used to develop decision support products for the commander.

3-69. The terrain database is the starting point for obtaining terrain information. Hydrographic studies exist for most bodies of water and/or rivers in potential theaters of operation around the world. Many of these studies have enough detail for identifying feasible crossing sites. Modern information collection and storage technology permits frequent revision of existing data.

3-70. Engineer terrain teams maintain a terrain database and provide information in the form of topographic and other geospatial products. These products are used with other tools, such as computers and photography, to develop terrain intelligence for staff planners. The planners, in turn, determine initial crossing requirements and estimated crossing rates from their terrain analyses.

3-71. Early in the mission analysis, planners identify further terrain intelligence needs for the crossing. They provide this information to the G-2 for inclusion in the intelligence collection plan. The plan specifies that intelligence systems are used to gather essential terrain information for a more detailed analysis. Information on specific gap segments and the surrounding terrain is obtained and verified by aerial and ground reconnaissance.

PRIORITY INTELLIGENCE REQUIREMENTS

3-72. The following tactical and technical information is often characterized as priority intelligence requirements (PIR) used in the decision making process:

- Enemy positions that can place direct or observed indirect fires on crossing sites and approaches.
- The location and type of enemy obstacles, particularly mines, in the water and on exit banks.
- The location of enemy reserves that can counterattack assault units.
- The location of enemy artillery that can range crossing sites, staging areas, and approaches.
- The location and condition of existing crossing sites.
- The width, depth, and water velocity of the wet gap.
- The condition and profile of the gap (river) bottom.
- The height, slope, and stability of the bank.
- The condition of nearside and farside road networks.

Chapter 4

Gap Crossing in Support of Combat Maneuver

"The passage of great rivers in the presence of the enemy is one of the most delicate operations in war."

Frederick the Great

Conducting gap crossings in support of combat maneuver includes deliberate, hasty and covert gap crossings and will include the majority of river-crossing operations. It includes both those operations conducted primarily at the BCT level and those conducted by the division or corps level organization. Those gap crossings conducted as a reduction method within a combined arms breaching operation are also included in this, but since the primary focus of planning and preparation is on the breaching operation, they are typically discussed as a part of the breaching operation rather than as a separate gap-crossing operation in that context. While the fundamentals and requirements associated with gap crossings have not changed too much over the years, Army transformation has now provided more flexibility in terms of C2 elements within both the division and the brigade and structured forces so that a BCT may be able to execute hasty, deliberate, and covert crossings when provided with the necessary resources. In most cases this begins with a task-organized engineer battalion HQ that includes subordinate engineer units and associated engineer gap-crossing means. The examples presented in this chapter will typically focus on a wet-gap crossing since these tend to be more complex and demanding than dry-gap crossings.

TYPES OF GAP CROSSINGS

4-1. There are three types of gap crossings: deliberate, hasty, and covert. Each of these has a general list of conditions that help define their category. As with the categories of breaching operations, all other labels placed upon a crossing are a variation of a deliberate, hasty, or covert gap crossing. The planning requirements for each type of gap crossing are similar. However, the required degree of detail and necessary conditions for a high degree of success will vary based on the type and the unique features associated with a given crossing operation.

DELIBERATE GAP CROSSING

4-2. Deliberate gap crossings are conducted as part of an offensive operation when a hasty crossing is not feasible or has failed. The phases, echelons, organizations, and C2 of a division or BCT deliberate gap crossing are discussed in detail in this chapter. This type of crossing normally requires additional augmentation that is focused exclusively on facilitating the crossing. While a BCT is capable of making a deliberate crossing, this type of crossing normally requires a higher HQ to assist in the planning and C2 as it requires meticulous planning, preparation, and coordination; centralized control; and extensive rehearsals. Additionally, deliberate crossings usually involve more than one BCT and/or the crossing of gaps greater than 20 meters. A gap of this length limits the effectiveness of tactical bridging assets and will typically require other bridging assets. To cross gaps of this magnitude, support bridging is normally required in the form of float bridging (wet gap) or other types of standard bridging.

4-3. A deliberate gap crossing is generally more costly than a hasty crossing in terms of manpower, equipment, and time. It requires the concentration of combat power on a narrow front, capitalizing on the element of surprise whenever possible. Deliberate gap crossings are generally conducted in the same manner as hasty gap crossings and utilize the same basic terminology. Deliberate wet-gap crossing are usually more difficult in terms of complexity and amount and type(s) of specialized resources required.

4-4. While they may be conducted by a BCT, deliberate gap crossings are normally conducted by a division. Division and brigade commanders organize their forces into assault, assured mobility, ***bridgehead*** **(defined as an area of ground held or to be gained on the enemy's side of an obstacle** [the definition was shortened, and the complete definition is printed in the glossary]**),** and breakout forces for deliberate gap-crossing operations. Assault forces seize the farside objective to eliminate direct fire on the crossing sites. Assured mobility forces may consist of sapper companies, MACs, MRBCs, military police, and CBRN units that provide crossing means, traffic control, and obscuration. Further augmentation requirements may be necessary and are based on METT-TC conditions that affect the operation. ***Bridgehead forces*** **assault across a gap to secure the enemy side (the bridgehead) to allow the buildup and passage of a breakout force during river crossing operations.**

4-5. A retrograde gap crossing is not a fourth type of gap crossing. In reality it is merely a variation of a deliberate or hasty gap crossing and is typically performed as a deliberate gap crossing. It may be performed with or without enemy pressure on the maneuver force. Clearly it is more difficult when performed under enemy pressure. For more information see Appendix F.

HASTY GAP CROSSING

4-6. Hasty gap crossings tend to be focused on a combined arms operation to project combat power across a terrain feature (wet or dry) that can be overcome by self-bridging assets within the BCT. These assets may be organic, provided to the BCT as augmentation, or found as expedient crossing materials within the AO. They typically are, but are not limited to, gaps that are 20 meters or less in width. They are normally done through tactical bridging, such as the AVLB, JAB, Wolverine, or REBS. Most hasty gap crossings will be conducted using tactical bridging. They may also include support bridging and expedient bridging or gap crossing by other means.

4-7. The gap-crossing fundamentals for a hasty crossing are the same as those discussed previously; however, there must be a particular emphasis on early task organization of bridging or other gap-crossing assets for it to be successful. A hasty crossing is conducted to maintain the momentum of the maneuver force by quickly massing combat power on the far side of the gap with no intentional pause. To do this, it is critical in the planning process to identify gap locations and their dimensions, and then request and/or allocate the necessary assets to ensure unimpeded movement. Planned, organized, and executed much like a hasty breaching operation, the unit must consider the integration of the crossing assets in their movement formation; redundancy in crossing means; traffic flow across the gap; and the recovery of the crossing assets (see FM 3-34.2). Because a gap crossing constricts and splits the maneuver force at the crossing site, the plan must be flexible enough for the commander or his designated representative to be able to make execution decisions based on acceptable opportunity and threat variances. The BCT TAC CP can assist the command group by controlling the execution of the crossing and maintaining a status of the location and operational readiness of the crossing assets.

4-8. The BCT task-organizes in a manner that supports the overall mission and facilitates a successful gap crossing followed by a quick recovery. To do gap crossing efficiently, bridging assets should be located in a position within the maneuver formation where positive control can be maintained. This is an important consideration since all gap-crossing equipment does not have the necessary communications equipment to maneuver effectively as part of a BCT or combat maneuver battalion formation. Additionally, some of the gap-crossing equipment is less maneuverable and slower than the other combat maneuver systems it supports and is also less survivable in some cases. This may slow down the speed of movement for the maneuver elements. In spite of these challenges, proper planning and C2 can minimize these negative impacts.

4-9. Two other considerations are the desirability for redundancy of crossing equipment and the capability to rapidly recover the crossing means. Tactical bridging is designed with these considerations in mind. Commanders should plan on using multiple crossing means, depending on the criticality of the crossing and the time available. While the Wolverine can be launched in less than 5 minutes and recovered in less than 10 minutes, there are sometimes extenuating circumstances that will dramatically increase the launch and recovery times. The JAB and the AVLB have comparable launch and recovery times but are not as fully capable as the Wolverine. Terrain, transporter and bridge maintenance, and crew experience can all impact bridge launch and recovery.

4-10. As one of the most important considerations, the recovery of crossing assets and transition after the crossing is important to the BCT to sustain its momentum. Typically, BCTs will expect crossing assets to recover and join the maneuver force on the far side of the gap. For this to be successful, the BCT has at least two options. First, the BCT can halt movement on the far side of the gap and wait for the crossing asset to recover the bridge. Another option is for the BCT to continue movement and leave an adequate security force during the recovery, which can also assist the crossing asset in rejoining the maneuver force. Whatever option is used, if the assets are intended to stay with the BCT, consideration must be given to follow-on support or LOC bridging assets to ensure support or follow-on forces can adequately continue to follow the maneuver force. The BCT may also be directed by division to keep its crossing assets in place for follow-on forces to use, but this will degrade or eliminate the ability of the BCT to cross any additional gaps unless they have been resourced by the division with enough tactical bridging to do this. If division intends for tactical bridging to remain in place, then the BCT must be augmented with enough assets to do this task while retaining enough tactical gap-crossing capability to facilitate continued movement and maneuver.

4-11. An in-stride gap crossing is a variant of the hasty gap crossing that consists of a rapid gap-crossing adaptation conducted by forces organic to (or task-organized with) the attacking force. It consists of preplanned, well-trained, and well-rehearsed gap-crossing battle drills and the unit's SOP. An in-stride gap crossing takes advantage of surprise and momentum to bridge or defeat gaps and relies on good and timely reconnaissance for its success. The force uses in-stride gap crossings against either weak defenders or very simple gaps and executes the battle drill(s) on the move. Attacking maneuver forces generally move configured to be able to execute an in-stride gap crossing except when a deliberate gap crossing is planned. In-stride gap crossings may occur when a given gap is not the same as the unit planned to cross, or in some cases, where the unit is surprised by the gap (obstacle). To conduct in-stride crossings, the unit must be task-organized with the necessary tactical bridging assets or capabilities and trained to perform such an operation. There are many similarities between an in-stride breach and an in-stride gap crossing. The primary difference between an in-stride breach and an in-stride gap crossing is the nature of the obstacle or obstacles. See FM 3-34.2 for more information on in-stride breaches.

4-12. The battalion is the principal unit to plan, coordinate, and control an in-stride gap crossing; but a company will normally conduct the actual crossing. The battalion normally designates specific support forces and handles the synchronizing of the breaching fundamentals (suppress, obscure, secure, reduce, and assault [SOSRA]) as they apply to a gap crossing through detailed planning and/or well-rehearsed, immediate action drills. The commander planning for an in-stride gap crossing must also plan for a transition to a deliberate gap crossing should an in-stride gap crossing be unsuccessful. An unclear situation (both enemy and exact gap dimensions and conditions) will make it necessary for several lead company-sized units to be capable of conducting independent gap-crossing operations. Accurate and timely reconnaissance of the gap (obstacle) and enemy force defending it sets the condition for properly focusing the location of the in-stride gap crossing.

COVERT GAP CROSSING

4-13. The third type of gap crossing is the covert gap crossing. The covert gap crossing is an operation used to overcome obstacles (gaps) without being detected by the enemy. It is used when surprise is essential to infiltrate over a gap, and when limited visibility and terrain present the opportunity to reduce or defeat the enemy obstacle (gap) without being seen. Through surprise, the commander conceals his capabilities and intentions and creates the opportunity to position support and assault forces to strike the enemy unaware or unprepared. Like the covert breach, it is normally conducted by a battalion or smaller-sized unit. A *covert breach* is defined as a breaching operation that is planned and intended to be executed without detection by opposing forces. Its primary purpose is to reduce obstacles undetected to facilitate the passage of maneuver forces (FM 3-34.2). The forces executing a covert gap crossing can mark nearside and farside entry and exit points and secure and/or guard the crossing site if the covert gap crossing is a precursor to a larger, deliberate gap-crossing operation. The primary difference between the covert breach and the gap crossing is the nature of the obstacle or obstacles. See FM 3-34.2 for more information on covert breaches.

4-14. The covert gap crossing applies the same gap-crossing fundamentals as the other gap-crossing types; however, it is focused on the crossing fundamental of surprise. Surprise is the primary element of the covert crossing. The requirement to execute the crossing without enemy detection is the element that distinguishes it from the other types of crossings. It can be used in a variety of situations to support various operations, but should be considered (as opposed to deliberate or hasty) only when there is a need or opportunity to cross a gap without being discovered.

4-15. The battalion is usually the principal unit to conduct a covert breach. A covert breach requires a level of detailed planning, intelligence collection, and C2 that is normally beyond the capability of a company. A BCT is usually too large to maintain the level of stealth necessary to conduct a covert breach. A covert gap crossing is ideally suited for foot-mobile forces that are battalion-sized or smaller. A covert crossing can be used to cross forces that will support a follow-on crossing of a larger or similar-sized element; however, it is a separate operation and should be planned. If conducted as an operation that does not involve crossing additional elements, planning and consideration should be given to the recovery of the crossing assets. If the crossing is a precursor to a larger, follow-on crossing, it may be considered that recovery of the crossing assets should be done as part of that follow-on operation.

4-16. If a covert gap crossing is being used as a precursor to a deliberate crossing and is compromised, higher HQ may need to re-evaluate other potential crossing sites before conducting the deliberate crossing. A contingency plan must always be included in the planning of a covert operation in the event that the operation is compromised.

CONTROL MECHANISMS

4-17. A major control mechanism category is graphic control measures. The commander uses graphic control measures to delineate areas of responsibility for subordinates and to ease traffic control. Figure 4-1 provides a simplistic illustration of the graphic control measures described in the following paragraphs.

RELEASE LINE

4-18. As used in gap-crossing operations, a release line (RL) is used to delineate the crossing area. RLs are located on both the farside and nearside and indicate a change in the HQ that is controlling movement. RLs are normally located within 3 to 4 kilometers of the gap and on easily identifiable terrain features, if possible. Typically, they are graphically identified as phase lines (PLs).

CROSSING AREA

4-19. **A *crossing area* is a controlled access area for a gap-crossing operation used to decrease traffic congestion at the river (JP 1-02) (the definition was shortened, and the complete definition is printed in the glossary).** This permits swift movement of forces. Each lead brigade has a crossing area on both sides of the gap that is defined by brigade boundaries and RLs. Crossing areas normally extend 3 to 4 kilometers on each side of the gap, depending on the terrain and the anticipated battle.

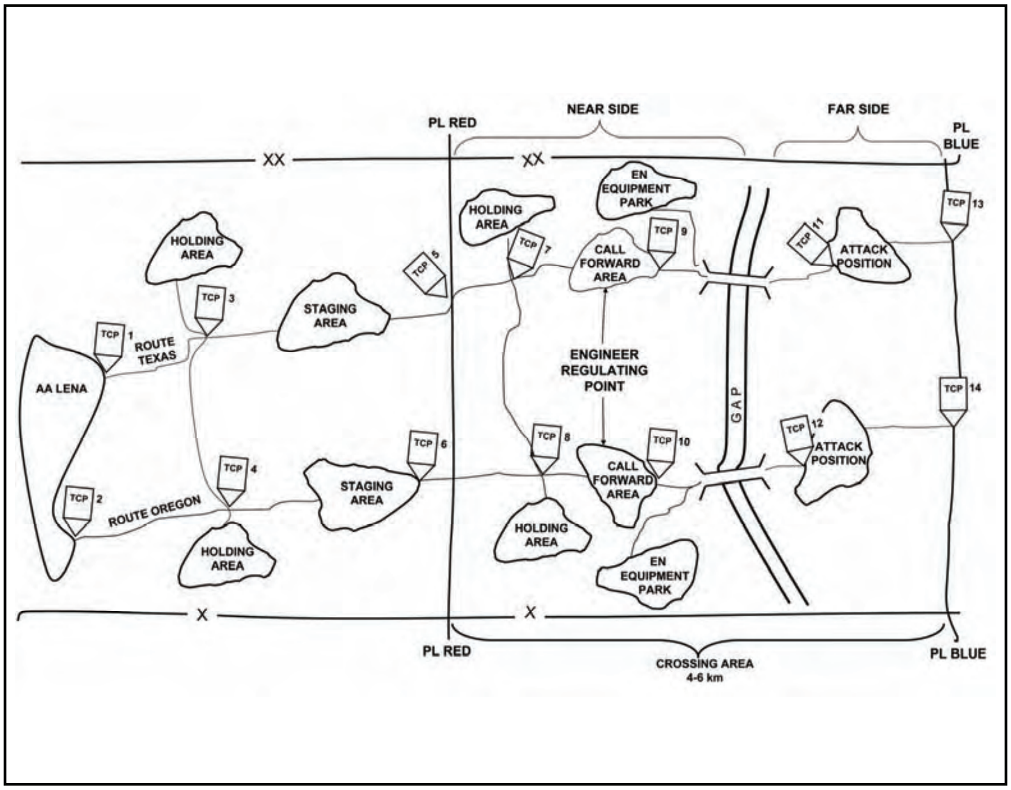


Figure 4-1. Graphic Control Measures

WAITING AREA

4-20. A ***waiting area*** **is a location adjacent to the route or axis that may be used for the concealment of vehicles, troops, and equipment while an element is waiting to resume movement. Waiting areas are normally located on both banks (or sides) close to crossing areas.** Commanders use the following waiting areas to conceal vehicles, troops, and equipment while waiting to resume movement or to make final crossing preparations:

- Staging area.
- Call forward area.
- Holding area.
- Attack position.
- Assault position.
- AA.

Staging Area

4-21. A staging area is a battalion TF size waiting area outside the crossing area where forces wait to enter the crossing area. The BCT traffic control cell handles units' movement into staging areas. The ***crossing area commander*** **(CAC) is the officer responsible for the control of all crossing units, assault units, and support forces while they are in the crossing area.** The CAC controls movement from the staging areas into the crossing areas. Military police operate traffic control posts (TCPs) at staging areas according to the crossing and traffic circulation plans. They emplace temporary signs along the route from the staging area through the crossing area to guide convoys. Units make crossing preparations and receive briefings on vehicle speed and spacing in the staging areas. Staging areas—

- Are located to support the crossing concept.

- Are far enough back to permit the rerouting of the battalion along other roads or to alternate crossing sites.
- Are easily accessible from major routes.
- Have enough area for dispersing a battalion-sized unit.
- Provide concealment.

Holding Area

4-22. A holding area is a waiting area that forces use during traffic interruptions. Units move into these areas when directed by TCP personnel and disperse rather than stay on the roads. Holding areas are battalion TF size outside of the crossing area and company size within it. Nearside holding areas are used to organize return traffic. Military police and engineers, if available, operate holding areas according to the crossing and traffic circulation plans. Established as needed on both sides of the gap, holding areas—

- Are used as call forward areas for return traffic from the farside.
- Are located where they support the crossing plan.
- Are easily accessible from routes.
- Have enough area for dispersion.
- Provide cover and concealment.
- Are defensible.
- Maximize traffic flow with minimum control.

Call Forward Area

4-23. A call forward area is a company-sized waiting area located within the crossing area. Engineers use them to organize units into raft loads, or crews use them to make final vehicle swimming or other crossing preparations, depending on whether the crossing is a wet or dry gap. The CAC controls movement from the staging area to the call area. The ***crossing site commander*** **(CSC) is the individual, normally an engineer company commander or a platoon leader, responsible for the crossing means and the crossing site. He commands the engineers operating the crossing means and the engineer regulating points at the call forward areas and the staging areas for that site.** As a minimum, each CSC operates his own call area. Call areas—

- Are located where they support the crossing plan.
- Are company-sized within the crossing area.
- Are easily accessible from designated routes.
- Are planned with a minimum of one per crossing site.
- Have engineer regulating points (ERPs) collocated with them.
- Are used to organize units into crossing means (rafts in a wet-gap crossing) loads.
- Are the final preparation areas before going to the crossing site.
- Are normally operated by engineers.

Attack Position

4-24. An *attack position* is the last position occupied by the assault echelon before crossing the line of departure (FM 1-02). Within the bridgehead, the attack position is the last position before leaving the crossing area.

Assault Position

4-25. An *assault position* is a covered and concealed position short of the objective, from which final preparations are made to assault the objective (FM 3-90). The USMC definition adds: That position between the line of departure and the objective in an attack from which forces assault the objective. Ideally, it is the last covered and concealed position before reaching the objective (primarily used by dismounted infantry).

Assembly Area

4-26. An *assembly area* is the area a unit occupies to prepare for an operation (FM 3-90). As such, it should have good road access, offer cover and concealment, and be positioned so that it supports follow-on tactical maneuver.

ENGINEER EQUIPMENT PARK

4-27. An engineer equipment park (EEP) is an area located a convenient distance from crossing sites for assembling, preparing, and storing bridge or other crossing equipment and material. It is at least 1 kilometer from the gap and holds spare equipment and empty trucks that are not required at the crossing sites. An EEP should be located where it does not interfere with the traffic to the crossing sites and where equipment can be concealed and dispersed. Ideally, routes leading from EEPs to the crossing sites are not the same routes used by units crossing the gap.

TRAFFIC CONTROL POST

4-28. A *traffic control post* is a manned post used to preclude interruption of traffic flow or movement along designated routes. They are used to support maneuver and mobility support operations only when needed (FM 3-19.4). In deliberate gap crossings, TCP personnel assist the crossing area HQ in traffic control by reporting and regulating the movement of units and convoys. TCP personnel relay messages between the crossing area HQ and moving units. The provost marshal (PM) identifies locations that need or require TCPs. Military police or engineers, as available, operate TCPs on both sides of the gap to control traffic moving toward or away from it. TCPs are additionally operated at major or critical crossroads and road junctions, staging areas, holding areas, and ERPs. If necessary, military police may also establish a detainee collection point to prevent traffic interruption. Additional military police augmentation may be needed from a higher military police command, depending on the amount of traffic and number of detainees in the area.

ENGINEER REGULATING POINT

4-29. **An *engineer regulating point* (ERP) is a checkpoint to ensure that vehicles do not exceed the capacity of the crossing means and to give drivers final instructions on site-specific procedures and information, such as speed and vehicle intervals.** See Figure 4-2, page 4-8. They help maintain traffic flow. Vehicles that will not be allowed to cross are removed so that they do not cause a traffic backup at the actual crossing site. Engineers man the ERPs and report to the CSC. TCPs are collocated with the ERPs to ensure that all vehicles clear the call forward areas. Additionally, ERP personnel give the drivers final instructions on site-specific procedures and other information such as speed and vehicle intervals. As a minimum, each crossing site requires an ERP at its own call forward area. If enough engineer assets are available, ERPs may be established at farside holding areas to regulate rearward traffic. Finally, the ERP may be used to issue crossing specific safety equipment and information. Safety equipment may need to be recovered on the farside to sustain the operation.

CROSSING PLAN

4-30. The crossing plan is integrated throughout the division's and brigade's OPORD and is as detailed as time permits. The crossing annex to the OPORD contains much, but not all, of the plan. It has the crossing overlay and the crossing synchronization matrix.

4-31. The crossing overlay (Chapter 3) shows the crossing areas, the crossing sites, the routes leading up to them from the waiting areas, and all the control measures necessary for the crossing. The crossing synchronization matrix (Appendix D, Figure D-6, page D-8) is a tool to adjust the crossing plan as the battle develops. It shows crossing units in relation to their planned crossing times and locations. The crossing overlay, in conjunction with the crossing synchronization matrix, provides critical information to the CAC as they depict the locations of critical C2 nodes and detail unit crossing schedules and locations while they are within the crossing area.

4-32. The task organization paragraph and paragraph 5 of the OPORD contain the organization and command portions of the crossing plan. For more information on the development of the crossing plan, refer to Chapter 3.

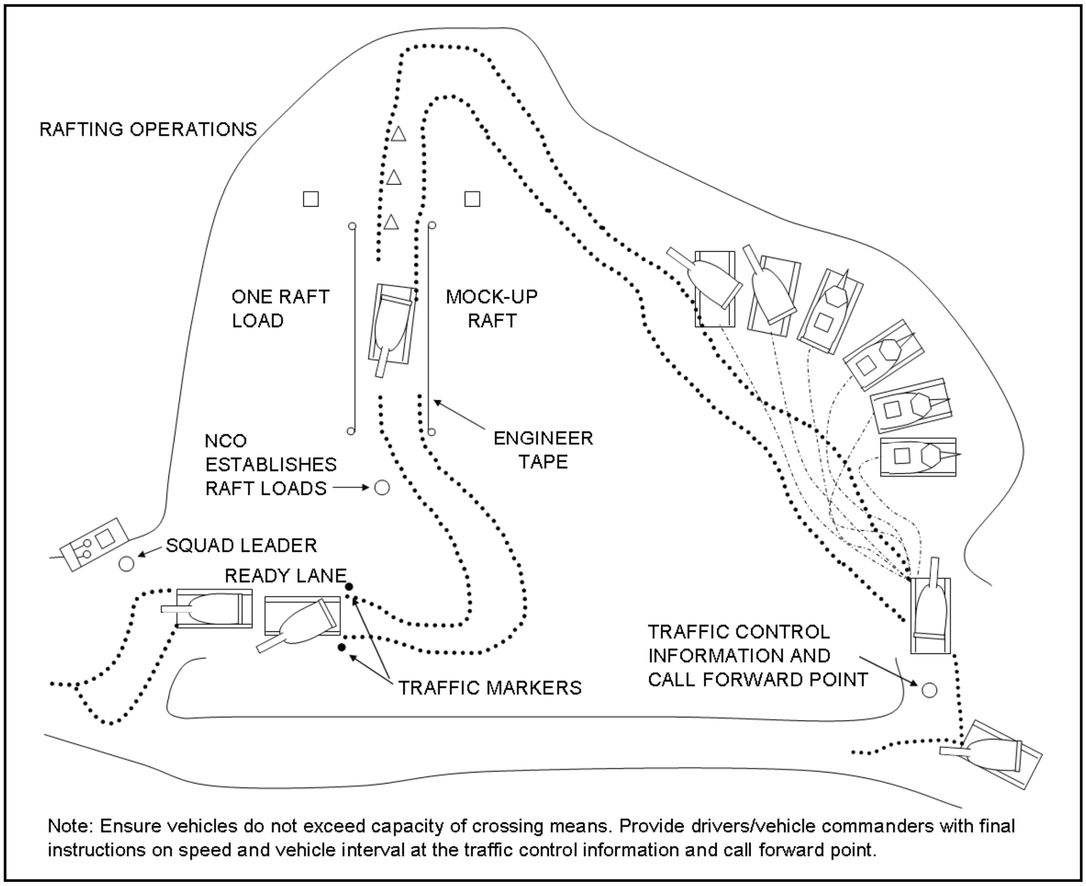


Figure 4-2. Engineer Regulating Point Layout

COMMUNICATIONS

4-33. The communications network that supports a deliberate crossing is critical to the success of a gap crossing. It should be planned and support the five phases of the deliberate gap-crossing operation (Table 4-1, page 4-11). The operation is divided into phases for planning purposes only, with no intentional pauses during execution. This will require early planning and a redundancy of communications. It may even be desirable to include wire as one of the redundant means of communication. The selected mode(s) of communications are dependent on what is available; however, all sites involved in the C2 and execution (all CPs, waiting areas, EEPs, TCPs, and ERPs) should have communications capable of monitoring and sending information to every other element that has a role in the crossing operation. This is an important consideration to ensure efficient vehicle positioning, traffic flow, and proper crossing order. Figure 4-3 provides a graphic depiction of the minimum communications linkages to support a deliberate crossing during Phase 3 of the operation. Regardless of the phase, it should be understood that each node must have a similar communications structure for proper C2.

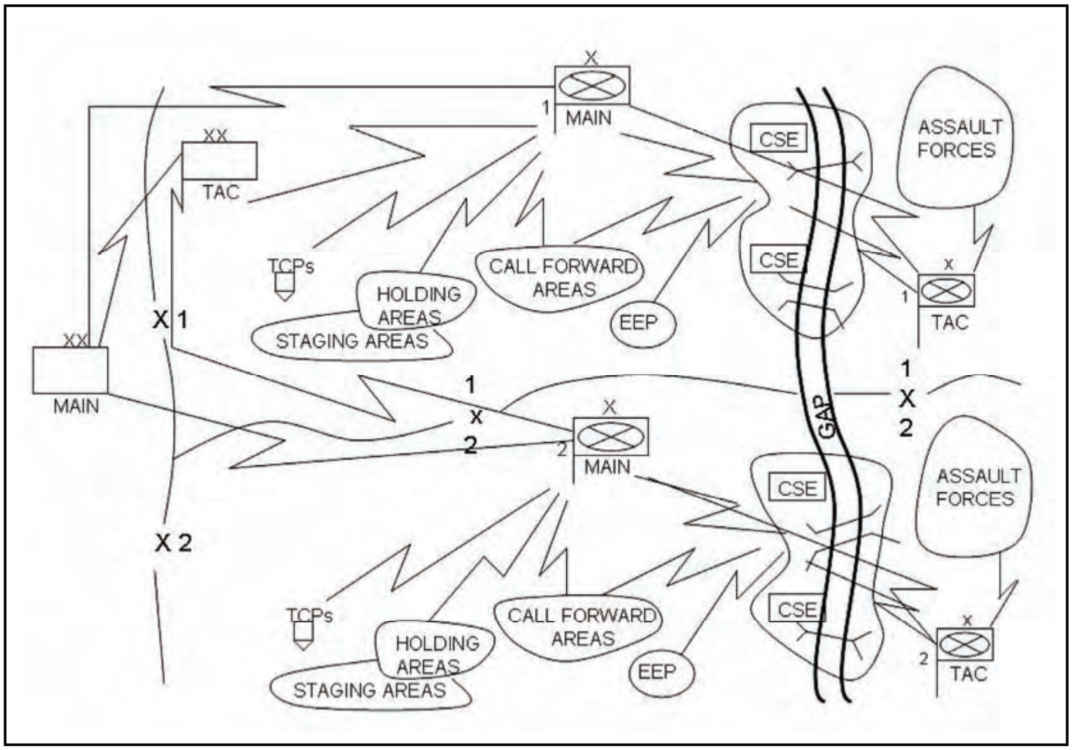


Figure 4-3. Communication Linkages

MOVEMENT CONTROL

4-34. Movement control is vital to efficiently move units and material up to the crossing area in the sequence needed by the commander. The traffic control cells at the division and brigade HQ exercise movement control through TCPs outside the crossing area. The division main CP controls movement from its rear boundary up to the nearside RL. In this example, the division main CP (assisted by the focused efforts of the crossing area HQ) synchronizes movement through the crossing area to the attack positions on the farside. The division TAC coordinates and synchronizes movement from the attack positions to the bridgehead line and beyond, as required. **The *bridgehead line* is the limit of the objective area in the development of the bridgehead (JP 1-02).** The brigade main CP controls battalion TF movement from the rear boundary up to the bridgehead line.

4-35. The DTO develops the division movement plan according to the movement priorities that the Assistant Chief of Staff, Plans (G-5), G-3, and G-4 establish. The logistics staff officer (S-4) prepares the brigade movement plan according to the priorities that the S-3 establishes. Each unit movement officer, normally the battalion S-4, provides the unit's vehicle information to the planning HQ.

4-36. The movement plan normally consists of a traffic circulation overlay and a road movement table found in the movement annex to the division or BCT order. Military police provide the support to implement the circulation control plan. Military police establish and operate TCPs, and provide temporary route signing. These measures are implemented at major crossroads on the MSR leading to and inside the crossing area. Military police also provide mobile patrols to operate along primary routes to control traffic, spot problems, guide and escort vehicles, and reroute traffic when necessary. Military police also establish detainee collection points (DCPs), if they become necessary, or evacuate detainees to ensure they do not impede the gap-crossing operation.

SUSTAINMENT OPERATIONS

4-37. While units are in waiting areas, the unit leadership should take advantage of the time available to make necessary preparations for the crossing and the mission. Additionally, activities may include anything extending from the TLPs inherent with the particular mission. For example, if the situation is defensive in nature, the leadership may review priorities of work. Conversely, if the situation is offensive, the leadership may focus on rehearsals. Finally, depending on the time and space available, leaders may want to conduct some final maintenance checks on vehicles, ensure items are loaded and secured properly, and/or conduct refueling operations.

CONTROL ELEMENTS

4-38. Division and brigade commanders are responsible for crossing their formations. They organize their staffs and subordinate commanders to help them control the crossing. Division and brigade HQ operate from a command group, main CP, and TAC CP. At the division level, an engineer brigade or an additional maneuver enhancement brigade (MEB) maneuver enhancement (ME) is normally designated as the crossing area HQ for the execution of a deliberate gap crossing. In a deliberate gap-crossing operation, it may be necessary to collocate a center for movement control to assist the crossing area HQ in monitoring traffic and routes between RLs. Some hasty dry-gap crossings may not require all of the control elements discussed. See Table 4-1.

Table 4-1. Command Post Tasks

Phases / CPs	*Advance to the River*	*Assault across the River*	*Advance from the Farside*	*Secure the Bridgehead Line*	*Continue the Attack*
Division Main CP	Coordinates deep operations to isolate the division's advance to the gap (river). Sustains the fight.	Coordinates deep operations to isolate the crossing area and the farside objectives. Sustains the fight.	Coordinates deep operations to isolate the exit bank and intermediate objectives. Sustains the fight.	Coordinates deep operations to isolate the bridgehead. Sustains the fight.	Coordinates deep operations to isolate the enemy's attack against corps objective. Sustains the fight.
Division TAC CP	Coordinates the division's seizure of nearside objectives.	Coordinates the division's dismounted assault of the gap to attack positions on the farside.	Assists the BCTs in the transition to seize and secure the exit bank and the intermediate and bridgehead objectives.	Coordinates the lead brigades seizing of and securing of bridgehead objectives.	Directs the attack and integrates follow-on BCTs into the attack.
Engineer Brigade or MEB, or different BCT (Division Crossing Area HQ)	Coordinates marking, control, and improvement of routes from the staging areas to the crossing sites; lays out staging, holding, and call forward areas; and the establishment of ERPs and TCPs.	Facilitates BCT assault crossings. Coordinates the preparation of farside exit sites. Begins rafting and/or bridging operations.	Coordinates marking, control, and improvement of routes and the establishment of holding areas in the farside crossing area. Continues crossing operations.	Continues crossing operations.	Continues crossing operations.
BCT TAC	Coordinates the lead TFs seizing of and securing of nearside objectives.	Coordinates the dismounted assault crossing of the gap (river) to secure the farside objectives.	Coordinates the TFs attack to seize and secure exit bank and intermediate objectives.	Coordinates the TFs seizing of and securing of bridgehead objectives.	Prepares to reorganize and follow the breakout forces attack out of the bridgehead toward the division's deep objectives.
BCT Main CP (Brigade Crossing Area HQ)	Moves into the crossing area to provide traffic control, crossing means, and obscuration.	Coordinates assault crossing means for TFs dismounted and controls obscuration of the crossing sites.	Controls follow-on TFs passing through the crossing area into attack positions.	Controls the passage of the brigade units through the crossing area and prepares to cross breakout forces.	Passes crossing area control to division TAC CP.

DIVISION HEADQUARTERS

4-39. One of the DCGs is typically designated to C2 the division's deliberate gap crossing as the CAC. His primary function is to serve as the division's CAC, controlling the gap-crossing operation, to include synchronizing forces and integrating the elements of combat power as they pertain to the crossing operation. As the CAC he may reallocate crossing means or movement routes to the gap between different brigades as the crossing develops. As the division CAC, he will typically remain at the crossing area HQ until the division has completed the crossing or is relieved by a corps element. The division TAC CP is normally established to C2 the lead brigades attack across the gap and to subsequent objectives.

4-40. The division main CP prepares the gap-crossing plan. It also directs the division's deep operations to isolate the bridgehead from enemy reinforcements and counterattacking formations. As a guide, the main CP typically waits to displace across the gap until after the division reserve has crossed.

4-41. The division crossing area engineer is typically the engineer brigade or MEB commander that supports the division deliberate gap crossing. His HQs usually serves as the division's crossing area headquarters. Under the direction of the division CAC, he coordinates the division's gap crossing activities within the crossing area.

BRIGADE HEADQUARTERS

4-42. Each brigade HQ operates with a command group, main CP, and TAC CP. The BCT TAC CP controls the advance to and the attack across the gap. It displaces across the gap as soon as practical after the assault to control the fight for the exit side and both the intermediate and bridgehead objectives.

4-43. The BCT main CP controls the crossing of the rest of the brigade. It prepares the brigade crossing plan and provides the staff nucleus to coordinate it. For brigade crossings, the S-4 assisted by the supporting military police platoon leader, the company commander, or the BCT PM (and the engineers, if available) organizes a small, temporary traffic control cell collocated with the BCT main CP. This cell conducts coordination with the division movement center for movement control.

4-44. Once the lead battalions assault across the gap and secure the farside objective, the crossing area is activated. The brigade CAC, normally the brigade's deputy commanding officer (DCO), controls the movement of forces inside the crossing area. The BCT main controls the assured mobility force that should normally consist of an engineer battalion HQ with bridge companies and other engineer capabilities, military police, and perhaps CBRN units that have obscuration capabilities. This leaves the BCT commander free to direct key activities while the DCO runs the crossing. The CAC controls—

- The movement and positioning of all elements transiting or occupying positions within the crossing area.
- Security elements at crossing sites.
- Assured mobility forces such as engineer, military police, and CBRN units within the crossing area.

4-45. Each forward brigade will normally be task-organized for the crossing operation with an engineer battalion HQ and subordinate elements. The engineer battalion commander is responsible to the brigade CAC for the engineer crossing means and sites and will generally function as the brigade's CAE. While unlikely, if multiple engineer battalions are required to carry out a BCT deliberate crossing, an engineer brigade would typically provide C2 and the engineer brigade commander would serve as the brigade's CAE. The CAE informs the CAC of changes, due to equipment or operator difficulties or threat variances that render a crossing means inoperable or reduce its capacity. He commands those engineers tasked to move the brigade forces across the gap; they remain there as the attack proceeds beyond the exit side objectives. Organic or augmenting combat engineers within the combined arms battalions (CABs) or other maneuver battalions remain under the C2 of those organizations to support their movement and maneuver after the gap crossing.

Crossing Site Commander

4-46. Each crossing site has an engineer, typically either a company commander or a platoon leader, who handles the crossing of the units sent to the site. Normally, the CSC is the company commander for the bridge unit operating the site. He commands the engineers operating the crossing means and the ERPs at the call forward areas for that site. He maintains the site and decides on the immediate action needed to remove broken down or damaged vehicles that interfere with activities at the site. He is responsible to the CAE and keeps him informed on the status of the site.

Unit Movement Control Officer

4-47. Each battalion and separate unit commander designates a movement control officer, who coordinates the unit's movement according to the movement control plan. He provides staff planners with detailed information about the unit's vehicle types and numbers and any other pertinent information.

MARINE CORPS

4-48. When conducting independent operations or providing C2 of a gap-crossing operation, Marine engineer units assigned to support MAGTFs will task-organize their HQ assets to establish the C2 nodes. The core of this task organization will most likely come from the engineer support battalion (ESB) providing the bridging assets but could include engineers from the combat engineer battalion (CEB) and division staff. The basic organization will include a CAE cell that can be formed as an independent CP from the ESB HQ or integrated into the division CP by the division engineer staff, depending on the situation. Each maneuver unit requiring gap-crossing capability will have a CAE formed from the ESB HQ. This is usually done at the RCT level and requires significant communications capability augmentation from outside of the ESB.

A DELIBERATE WET-GAP CROSSING

4-49. The following section describes an example of a deliberate wet-gap (river) crossing operation from the divisions' and brigades' perspectives. It details the actions that are required by the phase of the operation.

4-50. A division is normally the smallest organization that can conduct a deliberate wet-gap (river) crossing operation. It is usually an implied task in a larger mission given by the corps. The gap crossing is not the objective but is part of the scheme of maneuver and overall offensive action against the enemy. The enemy will normally use the gap as a tactical obstacle system to slow and gain positional advantage against the division's advance. The intent of the division is to maintain its momentum through the crossing.

4-51. METT-TC will dictate the force allocation required during each phase of the operation. Aside from the normal planning, detailed march tables are required for the rapid passage of units through the crossing area into the bridgehead. Detailed plans are disseminated before the execution to ensure an uninterrupted operation. Deliberate wet-gap (river) crossing operations normally restrict movement to four to six routes. This requires disciplined and controlled movement to ensure that combat power builds in the bridgehead faster than the enemy's ability to react.

4-52. An integral part of the wet-gap (river) crossing operation is the deception plan. The corps will plan, resource, and control all of the requirements to execute a believable deception so that the enemy does not know where the division will conduct the deliberate gap-crossing operation.

4-53. To conduct the deliberate wet-gap (river) crossing, the division requires an appropriate engineer HQ specifically for C2 of the gap crossing that includes bridging augmentation in the form of MRBCs. Also, the division may require augmentation from other combat engineers, MACs, and dive teams to assist in the overall operation.

4-54. Additionally, military police from echelons above BCT should augment the division to assist in regulating the traffic and conducting route security in the crossing area. The corps also allocates CBRN units with obscuration capabilities to assist in gap-crossing operations. Finally, the corps will provide AMD support to protect the bridgehead from air interdiction.

PHASES OF A DELIBERATE WET-GAP CROSSING

4-55. An offensive deliberate wet-gap-crossing operation has five phases. They are distinct phases for planning, but there is no pause between them in execution. The phases are as follows:

- **Advance to the gap (Phase I).** The first phase is the attack to seize the nearside objective.
- **Assault across the gap (Phase II).** The second phase involves units assaulting across the gap to seize the farside objective, eliminating direct fire into the crossing sites.
- **Advance from the farside (Phase III).** The third phase is the attack to secure the exit bank and intermediate objectives that eliminate direct and observed indirect fires, into the crossing area.
- **Secure the bridgehead line (Phase IV).** The fourth phase involves units that secure bridgehead objectives to protect the bridgehead against a counterattack. This gains additional time and space for force buildup for the attack out of the bridgehead.
- **Continue the attack (Phase V).** The fifth phase is the attack out of the bridgehead to defeat the enemy at a subsequent or final objective. It is considered as a phase of the gap-crossing operation because the timing and initiation of this phase is typically dependent on the success of the other four phases of gap crossing.

4-56. Figure 4-4 provides an overview of a deliberate gap crossing, showing the five phases and their relationship to the crossing area.

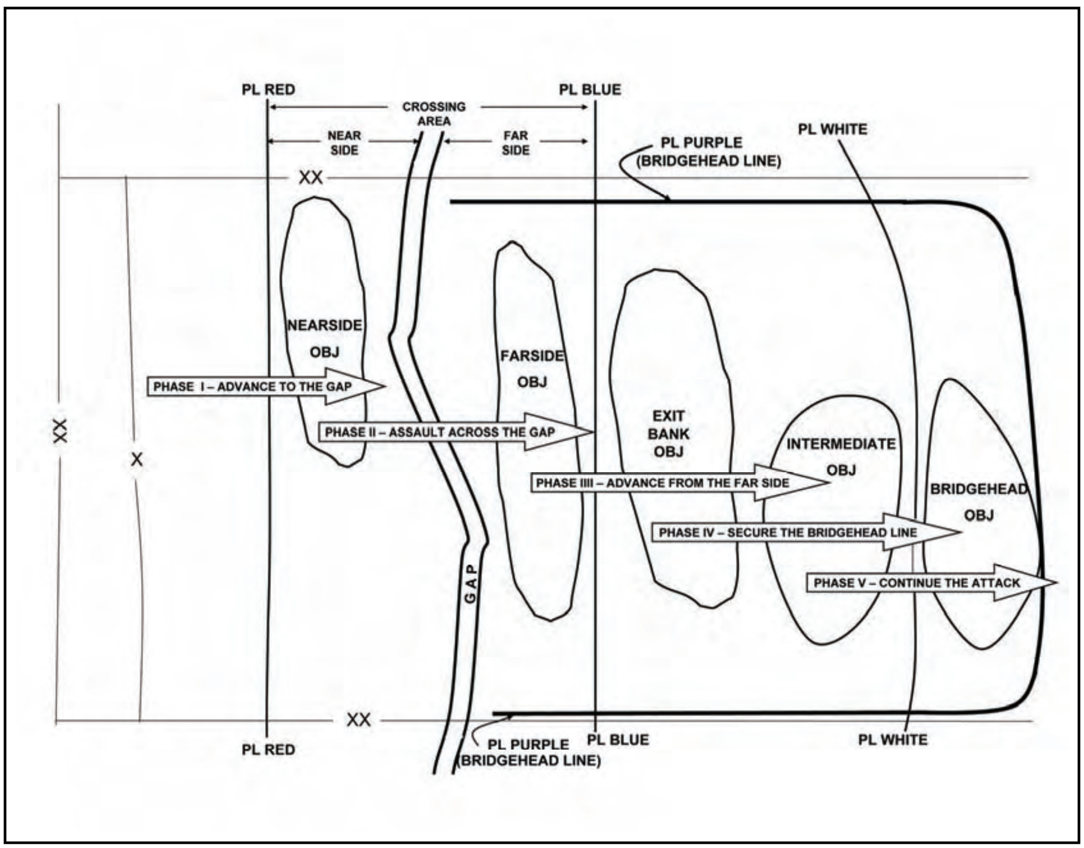


Figure 4-4. Overview of a Deliberate Gap Crossing

ADVANCE TO THE GAP (PHASE I)

4-57. Once the division has planned the operation, the first phase is initiated. The division, typically using the C2 of division TAC CP, will attack to seize nearside terrain that includes favorable crossing sites and road networks. Normally, the division advances with two brigades abreast and a reserve brigade trailing. The division TAC CP controls the efforts of the lead brigades. Figure 4-5 depicts the advance to the gap from a division perspective.

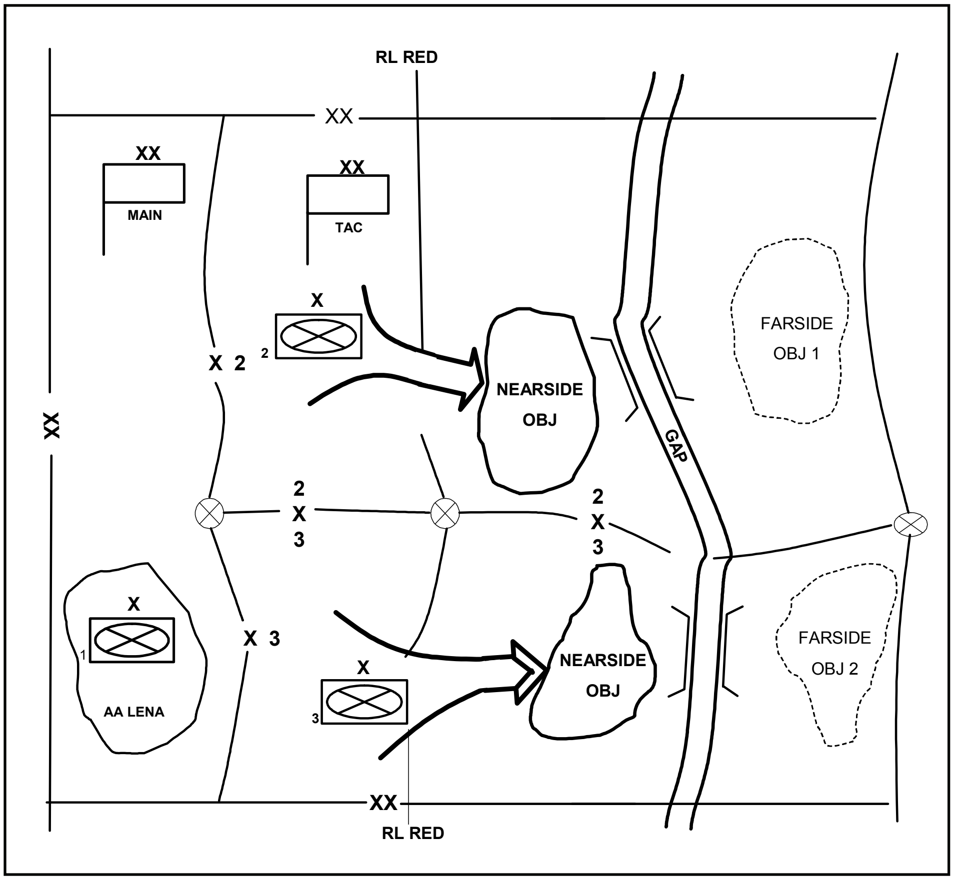


Figure 4-5. Advance to the Gap

4-58. Well before the division reaches the river, a reconnaissance element moves ahead of the main body to conduct a reconnaissance of the nearside and predetermined crossing sites. ERTs may need to be allocated to the reconnaissance element to assist in the reconnaissance of crossing sites. If the tactical situation prohibits reconnaissance of the crossing sites, one or both of the lead brigades must conduct the reconnaissance. As the division arrives at the gap, the lead brigades establish security on the nearside. The lead brigades develop hasty defensive positions to protect the crossing area and cover the crossing sites with direct and indirect fires.

4-59. During the advance to the river, the division main CP coordinates counterfire, close air support (CAS), and support of the division aviation brigade against deep targets. By effectively using these assets, the division main CP fights the deep battle and isolates the bridgehead.

4-60. As METT-TC allows, the crossing area HQ (an engineer brigade or additional MEB coordinates the improvement, control, and marking of routes within the nearside crossing area to the crossing sites; lays out staging, holding, and other areas and establishes TCPs and ERPs. The crossing area HQ ensures that key classes of supplies are pre-positioned forward.

4-61. The BCT TAC controls the fight of the TFs within its brigade. The brigade travels in a formation that is METT-TC driven. The brigade seizes objectives that secure the nearside.

4-62. Each BCT main CP functions as the crossing area HQ. The crossing area is bound by RLs on the friendly and enemy sides of the gap. The RL on the friendly side is usually set 2 to 3 kilometers from the exit bank, out of the range of enemy direct-fire weapons. The RL on the enemy side delineates an area large enough for forces to occupy battalion-sized attack positions. The BCT main CP is responsible for controlling units that provide the crossing means, traffic management, and obscuration. Once the brigade has secured the nearside, military police and engineers mark routes from the staging area to the crossing sites; lay out staging, holding, and call forward areas; and set up ERPs and TCPs. Additionally, the BCT commander, in coordination with the CFC, normally designates an appropriate area around the crossing sites as critical friendly zones (CFZ) to ensure priority is given to the protection of the crossing site(s).

4-63. The farside must provide enough space and time for the initial buildup of combat power to continue offensive combat operations to establish the bridgehead. The crossing area is the area, bound on either side of the gap by RLs, in which units move on predetermined routes and use the time tables that are specified in the division operation plan (OPLAN).

ASSAULT ACROSS THE GAP (PHASE II)

4-64. The division main CP continues to control deep fire assets to isolate the bridgehead. As units advance, deep fires shift to subsequent targets.

4-65. The division coordinates with the corps for AMD coverage to protect the bridgehead from enemy air interdiction. The gap creates lucrative targets at relatively fixed locations that are easily targeted by enemy air. Therefore, approaches; holding, staging, and call forward areas; and crossing sites along the gap are the highest priority for AMD during the crossing. AMD units occupy positions to engage aircraft with massed fires before the aircraft can reach weapons release points (RPs).

4-66. The division TAC CP (in conjunction with the crossing area HQ) coordinates the actions of the brigades conducting the assault across the gap (Figure 4-6). The crossing sites are chosen because of available concealment, good route systems, and enough space for AAs on the nearside. These sites also have defensible terrain on the far side of the gap to provide a secure base for continuing the operation.

4-67. Each BCT TAC controls their own respective assault crossing elements, which normally consist of dismounted infantry. Combat maneuver battalions conducting the assault across the gap move to it under the direct control of their BCT commander. The BCT commander keeps the remainder of the BCT back from the gap to avoid congestion. Elements not engaged in security or supporting the crossing occupy AAs and prepare for movement across the gap.

4-68. An engineer company, operating assault boats, transports the dismounted Soldiers and Marines of the assault force to the farside. The dismounted element crosses the gap and secures terrain for the reinforcing armored vehicles. The assault across the gap may also be an air assault operation, or the two types may both be conducted. The dismounted assault forces are supported by the tanks and infantry fighting vehicles from their TF and by other combat units in support from fire positions. Heavy rafts are prepared to transport tanks and infantry fighting vehicles to the farside for reinforcing the dismounted infantry. M9 ACEs and/or dozers are transported to prepare the farside exit sites. Rapid reinforcement of dismounted assault forces with armored vehicles may be so critical, based on the METT-TC, that it justifies using any expedient method to get the first few armored vehicles across. This includes winching, towing, or pushing the first ones across normally unsuitable places while engineers improve entry and exit points for the rest. In certain situations, tanks may be able to cross using fording equipment.

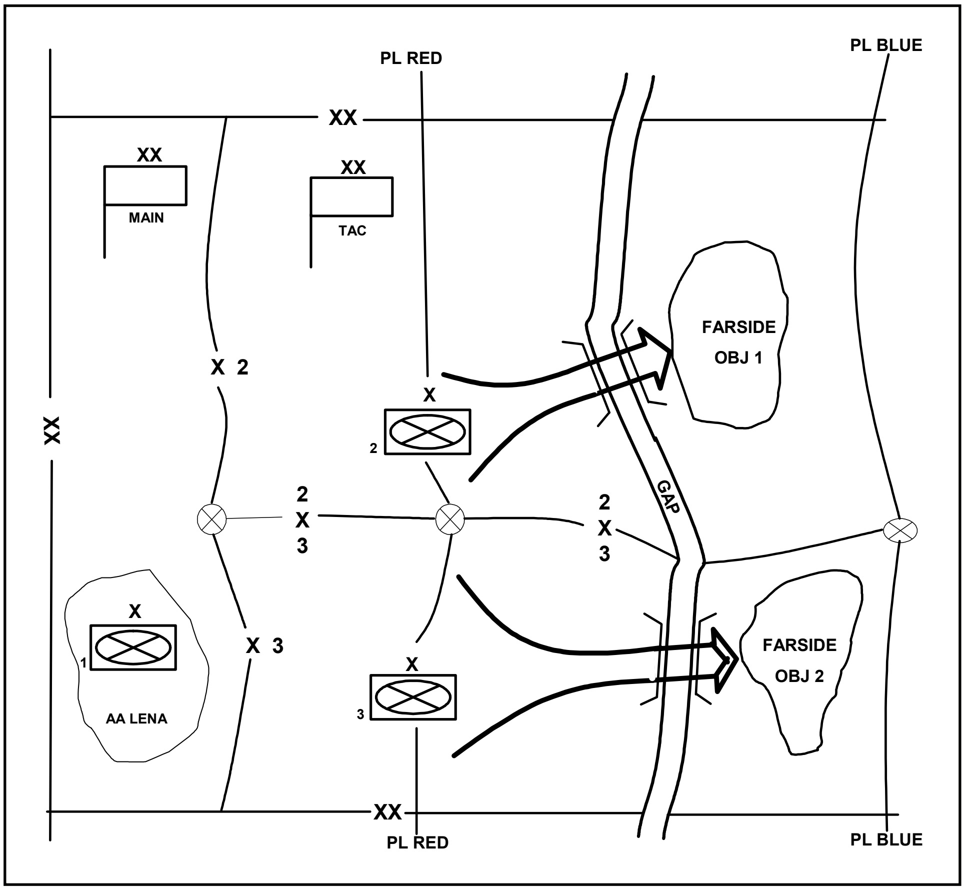


Figure 4-6. Assault Across the Gap

4-69. Each BCT main CP controls smoke to obscure the crossing sites of the gap in conjunction with the division OPORD. When employed, the smoke blanket covers several kilometers of the gap and gap approaches to conceal the actual crossing locations, but not as to obscure the bridge crewmen's vision. The crossing area HQ uses smoke generators, smoke pots, and smoke munitions from the division. Each BCT main CP controls military police and engineer units to establish nearside waiting areas, mark routes to the crossing sites, and begin constructing heavy rafts and/or bridges in conjunction with the division OPORD.

4-70. The intent of this phase is to rapidly place combat power on the farside to eliminate the enemy's direct fire onto the crossing sites and secure terrain for attack positions. Brigades normally establish limits of advance (LOAs) and fire-support coordination lines (FSCLs) for the dismounted TFs conducting the assault in conjunction with the division OPORD. These lines establish an LOA that encompasses the farside objective. Enemy indirect fire into the crossing area will probably continue; however, each crossing site within the crossing area must be isolated from direct fire to enable the construction and operation of rafts. These rafts will then be used to transport armored vehicles for rapid reinforcement of the dismounted infantry TF. Within the crossing area, secured attack positions allow units to form into combat formations before continuing the attack.

4-71. The CAC may consider immediate construction of a bridge during this phase without ever conducting rafting operations, if this is viable. The advantage to this is that it may allow for combat power to be massed on the farside at a much faster rate. The risk that the commander takes in making this decision is that a large amount of bridging assets are potentially exposed to enemy fire before the elimination of enemy indirect fires on the crossing area. This phase is completed once the farside objectives are secure.

ADVANCE FROM THE FARSIDE (PHASE III)

4-72. The division TAC CP continues to secure the farside until the BCTs are set in attack positions. The intent is to eliminate direct fires and observed indirect fires from the crossing area (Figure 4-7). Once set in attack positions, the division TAC CP coordinates the attack of the lead brigades from the farside attack positions to the bridgehead.

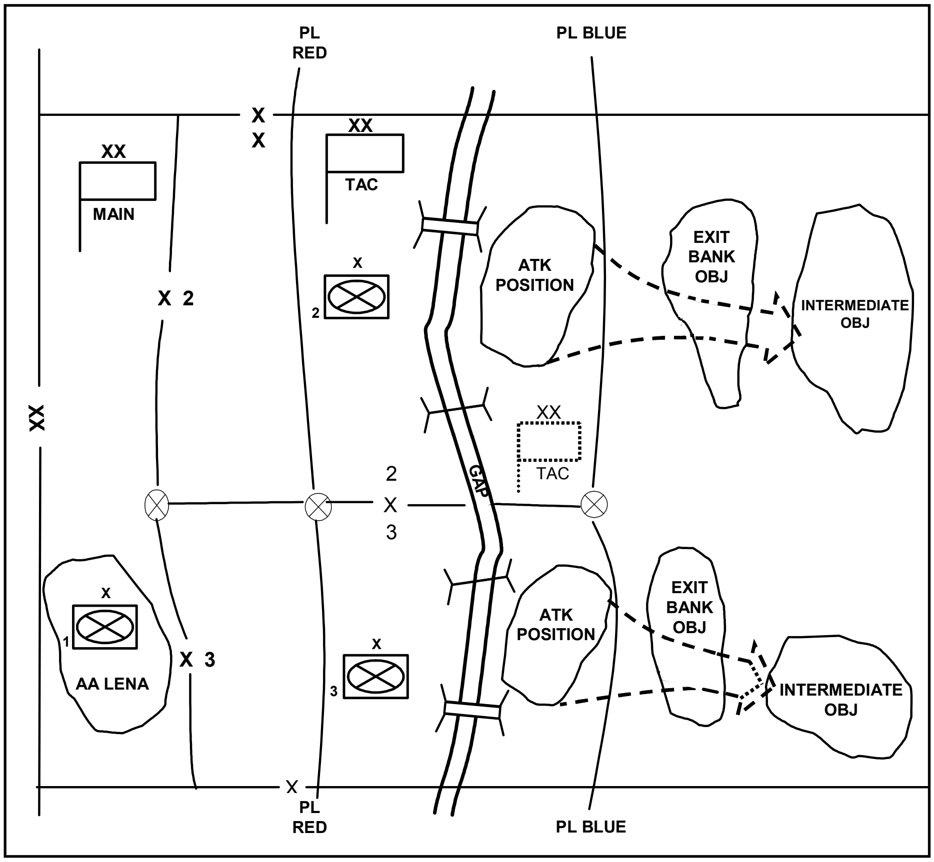


Figure 4-7. Advance From the Farside

4-73. The division commander selects exit banks and intermediate objectives based on METT-TC. The gap splits the attacking force, limiting massed direct fires beyond the exit bank. Therefore, these objectives are usually smaller and not as far from the attack positions as the objectives used in other offensive operations.

4-74. The BCT main CP prepares push packages of Class III and V supplies that will support the attack out of the bridgehead. They also begin to push Class IV and V supplies for the hasty defense during the last phase of the gap-crossing operation.

4-75. Each respective BCT main CP controls the movement of their follow-on TFs from the staging areas across the gap to their attack positions on the farside. They control the upgrade of crossing sites from assaults boats to heavy rafts and/or bridging in conjunction with the division OPORD to ensure that the force buildup can support the advance from the exit bank to the intermediate objectives. Military police and, if available, engineers assist in movement control through the crossing area.

4-76. During this phase, limited two-way traffic begins to allow for the return of disabled equipment and casualties by ground transportation. Each respective BCT TAC, in conjunction with division TAC CP, controls the movement out of the attack positions to the exit bank, intermediate objectives, and a subsequent bridgehead. Exit bank objectives are those positions that, when seized, eliminate the enemy's ability to use direct-fire weapons on the crossing area. Intermediate objectives are those positions from which the enemy can provide observation for indirect-fire weapons. This enables the expansion of AMD coverage, allowing more time to engage aircraft in air avenues of approach on the far side of the gap.

4-77. The TF that conducted the dismounted assault across the gap continues to cross armored and/or wheeled vehicles and remount their dismounted Soldiers and Marines in preparation for continued offensive operations. The BCT commander (with staff support) establishes the order of raft loads based on the division's crossing priorities. Bridge companies run heavy raft sites and begin to construct ribbon bridges. Military police mark routes and control holding areas on the farside to ensure rapid transit within the crossing area.

SECURE THE BRIDGEHEAD LINE (PHASE IV)

4-78. The bridgehead must be defendable and large enough to accommodate forces that will break out to continue offensive combat operations. The lead brigades attack to secure the final objectives within the bridgehead to prevent the enemy from successfully counterattacking against forces within the bridgehead line by rapidly building enough combat power to establish a hasty defense in the sector. The lead brigades maintain continuous farside security to prevent bypassed enemy elements from infiltrating back to the gap and disrupting activities at the crossing sites. See Figure 4-8.

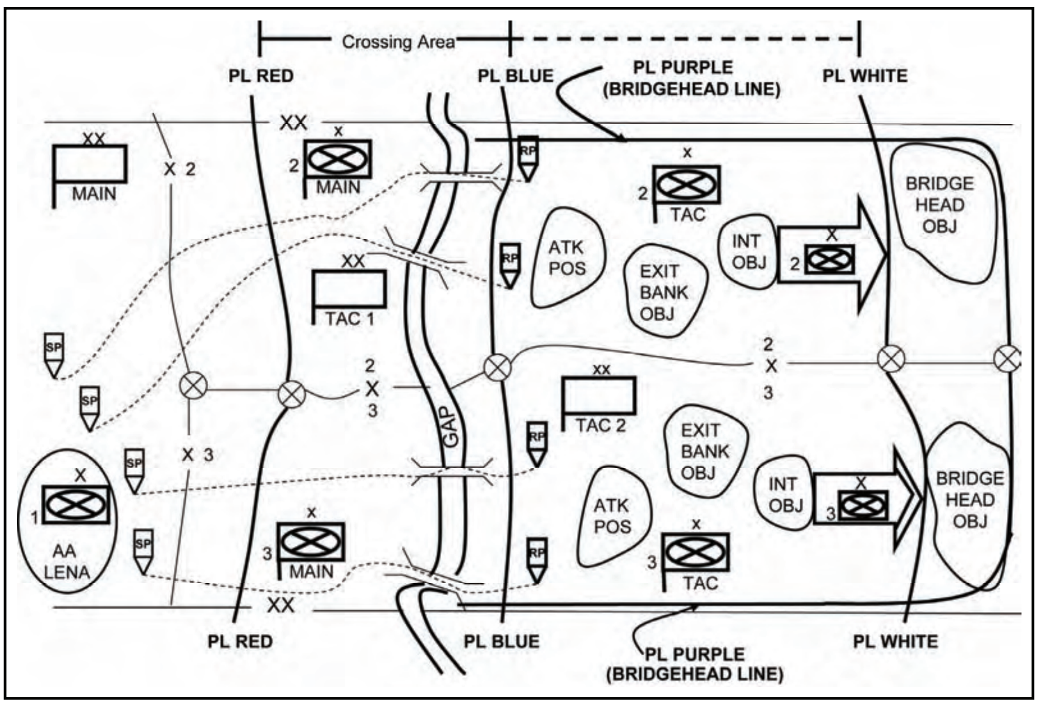


Figure 4-8. Secure the Bridgehead Line

4-79. The division TAC CP controls the lead brigades as they secure the bridgehead objectives and preparation is made to move the reserve brigade or other forces (breakout forces) into attack positions within the bridgehead. Once the bridgehead objectives are secured, the lead brigades establish a hasty defense in sector.

4-80. The BCT main CP continues to upgrade and monitor the crossing sites and control the movement of forces through the crossing area. The farside RL, defining the crossing area, is moved just past the intermediate objectives to provide space for the breakout forces. The division TAC CP controls the movement of the breakout forces through the crossing area to attack positions within the bridgehead. During this phase, specific bridges and/or rafts are designed for full time return traffic. This ensures that ground resupply and the evacuation of wounded Soldiers and Marines and disabled equipment can occur.

4-81. The division main CP controls the aviation, artillery, and available CAS sorties to screen the flanks and interdict enemy counterattacks. Deep operations play a key role in the bridgehead defense by targeting enemy formations as they move to counterattack. They also eliminate effective artillery fire within range of the bridgehead and destroy other enemy artillery forces moving up to the fight.

4-82. The lead BCT elements that secure the bridgehead line must control the avenues of approach into the bridgehead and be large enough to defeat counterattacks. After the bridgehead is secure, the division commander commits the breakout force to an attack position within the bridgehead. The bridgehead needs enough space (20 to 30 kilometers deep) to accommodate both the lead brigades and the breakout force with their sustainment. The bridgehead line must also be deep enough to employ AMD systems against hostile aircraft before they can engage crossing sites.

CONTINUE THE ATTACK (PHASE V)

4-83. Once the division has secured the bridgehead and the breakout forces are in attack positions, the division gap crossing is complete. Crossing area control will normally be passed to a higher HQ or follow-on HQ. The breakout force must complete its passage before continuation of offensive operations. The lead BCTs must reorganize and prepare to follow the breakout force as the division or corps reserve. Security forces from the corps must come forward to relieve the lead BCTs from their bridgehead security mission.

Chapter 5

Line of Communications Gap-Crossing Support

"The most dangerous thing in the world is to try to leap a chasm in two jumps."

William Lloyd George

Conducting LOC gap crossing support is not tactically focused, although it may clearly have an effect on tactical operations. It may however employ what has been categorized as support bridging (see Chapter 2, Figure 2-1, page 2-5). This support may provide the means for combat maneuver forces to move, but it is not directly in support of combat maneuver. As the title implies, LOC gap crossing is focused on sustainment of the force. The focused logistics joint functional concept seeks the ability to sustain widely dispersed forces over a large AO. As such, it is imperative that LOC gap crossing be included in the overall theater sustainment plan. These crossings must be capable of effectively and efficiently supporting the uninterrupted flow of forces, equipment, personnel, supplies, and support for sustained ground operations for not only U.S. forces, but also allied, coalition, and host nation (HN) forces, and displaced civilians.

OVERVIEW OF LINE OF COMMUNICATIONS GAP CROSSING

5-1. While LOC gap crossings vary in size, scope of work, and bridge type, their purpose is primarily sustainment of the force. To ensure support forces are able to move freely and without delay throughout the theater, it is imperative that LOC crossings support the movement plan, are able to handle high volumes of various types of traffic, and don't require levels of maintenance and/or replacement that would impede traffic flow for extended periods. There are two principle methods used to do LOC gap crossings: military or contracted panel bridging and nonstandard bridging. Contingency purchases of COTS panel bridging are better maintained than the Bailey, but normally require special training to emplace and sustain them. New construction LOC nonstandard bridging involves horizontal and vertical engineer units and usually requires weeks instead of days to complete. As a general rule, they are built in areas free from the direct influence of enemy action, however, this does not mean that protection against attacks by air and ground forces are not considered. This is an important factor because they require a large organizational footprint of manpower and equipment. Additionally, they are built with the assumption that once emplaced, they will not be removed until a more permanent structure can replace them, they are no longer needed, or they are eliminated by friendly or enemy forces or natural causes.

Historical Perspective – Bridging the Sava

U.S. Army operations in Bosnia included the mission to bridge the Sava River near Zupania, Croatia, in December 1995. This mission was the largest gap-crossing operation since World War II and was conducted under extreme conditions. Seasonal weather caused the Sava River to swell from its normal width of 300 meters to more than 600 meters. Despite harsh conditions, engineers used Chinook helicopters to deploy ribbon bridge sections into the gap while other engineers rebuilt the approaches and successfully bridged the Sava River to allow elements of the 1st Armored Division to cross. As the floodwater receded, engineers built a causeway across the floodplain. As operations in the area continued, the ribbon bridge remained the only crossing means for both military and civilian traffic while preparations were made for LOC bridging. The 130th Engineer Brigade maintained the bridge and received traffic—a total of 20,000 vehicles until it was disassembled in April 1996.

GAP SIZE

5-2. The size of LOC gaps vary. Often, the size depends on one of the following situations: replacement for assault bridging emplaced by maneuver forces, repair of existing bridging, or new construction. If its purpose is to replace assault bridging emplaced by a maneuver unit, the gap size will typically be 18 meters or less. If it is a repair to existing bridging, the size fluctuates based on the amount of damage to the original structure. Finally, the gap size requiring new construction depends on current and future mission necessity, availability of alternative crossing sites and means, and cost and availability of resources.

SCOPE OF WORK

5-3. The scope of work required for LOC bridging is based on the gap size and type (wet or dry), enemy activity, terrain, site preparation requirements, entry and exit routes, bridge type to be installed, and the availability of resources. A detailed reconnaissance early in the process should identify as much of this information as possible to assist the staff engineer in planning and resourcing the bridge construction.

BRIDGING TYPES

5-4. LOC bridging is normally nonstandard fixed or commercially procured bridging. It can, however, include the Bailey bridge (standard fixed bridge), rafting, or ferrying operations for limited durations. Considerations for bridge selection include: bridge availability, time constraints, access to bridge site, amount and type of crossing vehicles, and number of crossings. Table 5-1 and Table 5-2 depict those bridges that are currently being used (or could temporarily serve) as LOC bridging by U.S. and allied forces.

Table 5-1. United States–Line of Communications Bridging

Nomenclature	*Name*	*Span*	*MLC*	*References*
M2	Bailey	24.4 meters	Triple Single 80T/85W	FM 5-34/MCRP 3-17A
	Bailey	33.5 meters	Triple Double 90T/90W	
	Bailey	51.8 meters	Triple Triple 70T/70W	
	LSB	61 meters	80T/110W	Purchased with contract

Table 5-2. Selected Allied–Line of Communications Bridging

Country	Name	Span	MLC
Canada	MGB • Single story (SS) • Double story (DS) • DS with link reinforcement set (LRS)	 9 meters 31 meters 49 meters	 70 70 70
	Acrow® 700XS	48 meters	60
Germany	Faltfestbruke (FFB)	45 meters	70
UK	BR 90	56 meters	70T/105W
	M3 Bailey	61 meters	80
	LSB	61 meters	80T/110W
	MGB • SS • DS • DS with LRS	 9 meters 31 meters 49 meters	 70 70 70

NONSTANDARD BRIDGING

5-5. Engineers design nonstandard bridges to match specific conditions of a particular site when standard bridges are not available; they are unable to handle the volume and weight of the anticipated traffic; they are needed forward of the proposed bridge site; or the bridge is expected to remain in place indefinitely. Available structural materials, site details, proposed traffic, and time will influence the design. The design of military nonstandard fixed bridges is similar to that of civilian fixed bridges. Military methods, however, include several simplifications and assumptions about the loads to be carried, the type of construction, and the materials available. For task organization (TO) nonstandard bridging, steel stringers are desired with laminated, plank, or concrete decking and plank or asphalt as a wearing surface (see FM 3-34.343).

5-6. Before considering new construction, engineers should conduct a reconnaissance to determine if there are existing bridges that are intact, if a detour or bypass is available, or if there are existing bridges that can be reinforced or repaired. If one of these options exists, it is generally more economical and less time consuming to use one of these alternatives. It is important to note that if an existing bridge is acceptable, it must be classified utilizing normal military classification procedures.

5-7. Some examples of nonstandard fixed bridges that may be encountered include: timber trestle bridge, steel stringer bridge, composite steel/concrete stringer bridge, steel girder bridge, truss bridge, reinforced concrete slab bridge, reinforced concrete T-beam bridge, reinforced concrete box girder bridge, prestressed concrete bridge, arch bridge, suspension bridge, moveable bridge, or expedient ice bridge. Detailed information concerning classification and repair is contained in FM 3-34.343.

STANDARD BRIDGING

5-8. In some cases, it may be necessary to use the Bailey bridge (see FM 5-277) or DSBs (see Technical Manual [TM] 5-5420-212-10-1) as temporary or semipermanent LOC bridging. If using one of these bridges, careful consideration must be given to MLC and the volume of traffic to ensure that the bridge can withstand the desired weight and number of crossings that would be required. Currently, the Bailey bridge is not organic to the MRBC; however, they are capable of emplacing the bridge. The DSB is organic to the MRBC. If the bridge can satisfy the weight and volume requirements, it is usually an option for temporary service.

5-9. Railroad bridging is a LOC bridge and is classified as a standard fixed or nonstandard fixed bridge. The U.S. Army does not have design criteria for nonstandard railroad bridges nor does it maintain railroad float bridge equipment. Many variables of standard railroad bridges are available through the Army Facilities Components System (AFCS). Construction details and bills of material are given in the TM 5-302 series which supports AFCS. Also see FM 5-104 for more information.

RAFTS, FERRIES, LANDING CRAFT AIR CUSHIONS, AND OTHERS

5-10. When it is necessary to cross a wet gap, rafts, ferries, landing craft air cushions (LCACs), or other equipment and assets may provide the best solution. They are normally used when time is critical; when float bridging is unavailable or impractical; when they are supporting a larger deliberate wet-gap crossing; or when they are involved in ship-to-shore operations. These types of operations (rafting, ferrying, and ship to shore) essentially have the same purpose—to cross a gap. Unlike bridging that closes the gap, these operations use floating equipment to move between two points across a wet gap. Each solution for dealing with a gap has advantages and disadvantages which typically center on the specifics of the gap; the availability of equipment or other items, supplies, or personnel; the types of equipment and other items to be crossed; and the nature of the threat.

RAFTS

5-11. Rafting is most often used as the sole crossing means. It may be used in conjunction with other crossing means when it is employed for gap crossing in support of combat operations. It can also, however, serve as an alternative or temporary solution for LOC bridging.

5-12. Units begin their preparations for rafting operations at a staging area. There, they receive briefings, conduct inspections, and rehearse the rafting operation. Personnel will be issued life jackets and given instructions on what to do upon loading onto the raft.

5-13. When ordered to begin rafting, the site commander directs personnel at the ERP in the call forward area to begin sending raft loads forward. Units proceed from a staging area to the call forward area where engineers at the ERP organize them into raft loads and send them down to the river. Any points along the route that may cause confusion, such as intersections, are either manned with a guide or are marked to ensure that the vehicles do not get lost. Once a raft load nears the river, the platoon leader directs it to the appropriate centerline. The platoon leader controls the traffic flow to the centerlines to ensure that there is a smooth traffic flow and that centerlines are neither congested nor underused. He establishes the timing required so that raft loads leave the call forward area and match up with a returning empty raft. When a raft load reaches the riverbank, it is met by an engineer centerline guide. He stops the raft load 3 meters from the edge of the water and holds it there for the raft commander. The raft commander guides the vehicles of the raft load onto the raft. The raft crew chocks the vehicles and ensures that all passengers are wearing life jackets. The passengers do not dismount from their vehicles. All hatches are opened to allow quick exit of the vehicle in case of an emergency. Upon reaching the debarkation point, the raft commander guides the vehicles off the raft. After the raft load debarks, the raft commander checks with the centerline guide for any return vehicles and returns to the embarkation point.

5-14. Once on the farside, the centerline guide directs the raft load to the farside holding area where it reforms. The passengers remove their life jackets, which are collected and returned by an engineer team to the staging area for future loads. During rafting operations, rafts require stops for refueling, preventive maintenance, and minor repairs. The efficiency of the crossing depends on all rafts having enough fuel and minimal lost time for refueling and normal maintenance. This efficiency requires the bridge company to intensely manage raft maintenance and to operate the maintenance area much like a pit crew in an automobile race. When directed, a raft pulls off the centerline and moves to the crossing site maintenance area.

5-15. With the raft secured, the crew begins refueling and performing maintenance operations. Mechanics assess and repair any minor damages to the raft and the boats. Fuel handlers run fuel lines from the fuel to both bridge boats and fuel them simultaneously. If no major deficiencies are identified, the entire process requires 20 minutes. If major deficiencies are identified on the boat, it is removed from the raft and replaced with an awaiting spare. The boat will then be removed from the water and sent back to the EEP for repair. When refueling and maintenance operations are finished, the raft returns to its centerline and another raft is directed in for maintenance and refueling.

5-16. Since the maintenance and refueling operation is continuous and requires removing a raft from the operation for up to 30 minutes, it is important to account for this reduction in capabilities when planning the operation. Generally, it is unnecessary to refuel for the first 2 hours after rafting begins. Once raft maintenance and refueling begin, one of the six rafts in each bridge company is unavailable for carrying vehicles across the river at all times.

5-17. When a raft becomes damaged and needs immediate repair, the raft commander moves it to the maintenance area. If a raft loses a boat and cannot make it to the maintenance area without assistance, the raft commander contacts the maintenance supervisor, who sends the maintenance boat out to assist. If a raft is still carrying a load, the raft commander will decide which bank he will use to disembark the load. Once in the maintenance area, mechanics determine the extent of the damage. If the damage requires significant repair, the raft will be removed and replaced with a spare. Lengthy equipment repairs are done at the EEP.

FERRIES

5-18. Ferry operations are similar to rafting operations with the primary difference being the scale of the operation and the fact that they are less likely to be involved in active support of combat maneuver. They also differ in that they are generally used in lower threat areas, are conducted for extended periods of time, and have designated crossing times that may be developed into a standard schedule. Ferries may provide the best crossing solution when bridging assets are unavailable or the gap is so large that bridging is not feasible. Often times when conducting ferrying operations, it may be necessary to do so in conjunction with riverine operations. In a riverine area, watercraft is the principal means of transport. In such areas, indigenous personnel often settle along the waterways because they are the primary means of travel between villages. Civilian traffic, ferrying operations, and settlements can conceal enemy movement (see FM 55-50 for more information concerning riverine operations). Ferries are a likely means of supporting LOC requirements in AOs that are characterized by the need for riverine operations.

LANDING CRAFT AIR CUSHIONS AND OTHER SIMILAR SYSTEMS

5-19. This section describes two primary vessels used by the USMC and Army when conducting amphibious operations (see Marine Corps Warfighting Publication [MCWP] 3-13 and JP 3-02*).* They may also have applicability in supporting other selected wet-gap-crossing operations. Typically, Navy and USMC assault units conduct amphibious operations and Army amphibians and watercraft are used as floating platforms for on-call supply movement after the beachhead has been secured. The Army can, however, be a part of the assault force in an amphibious operation.

5-20. The LCAC is a high-speed, fully amphibious craft capable of carrying a 60-ton payload (75 tons in overload), at speeds in excess of 40 knots, at a nominal range of 200 nautical miles. Its primary purpose is to move Marines and Soldiers and their equipment from the well decks of warships to the beach.

5-21. The Landing Craft, Mechanized 8 (LCM-8), Modification 2 (MOD2) is an Army vessel that is primarily used for C2, moving Soldiers and Marines, or light salvage. It is normally used in harbors, inland waterways, and as a C2 vessel for ship-to-shore operations. For other Army vessels that may support selected wet-gap-crossing operations see FM 55-50.

SUSTAINMENT, MAINTENANCE, AND REPLACEMENT OF LINE OF COMMUNICATIONS GAP-CROSSING SYSTEMS

5-22. Engineer horizontal and MRBC companies, usually under the C2 of an engineer battalion, are normally responsible for LOC bridge sustainment, maintenance, or replacement depending on the amount and type of work to be done. Organic and special engineer equipment may be augmented from depot stocks, supply points, other units, or commercially procured. Captured equipment, parts, and material should also be considered as possible resources. When speed is essential, stock items are best for efficient maintenance. The responsible commander should determine the best resources and methods for obtaining material (see FM 3-34.343 for more information).

DECKS

5-23. Decks should be free of stones, mud, ice, and debris to decrease wear on the surface. Keep flat decks clear with a patrol grader, which throws mud, ice, and debris to the curb where it can be removed by hand shoveling. A scarifier may help remove ice. If patrol grading is impractical, shoveling and hand removal of large debris is necessary.

5-24. A thin tar or asphalt coating densely covered with sand, pea gravel, or stone chips will reduce the danger of fire on wooden decks. Loose sand, chemical fire extinguishers, water pumps for river water, or barrels of water are effective resources for fighting bridge fires.

5-25. Misalignment (caused by simple shifting or structural failure) can be repaired by pulling the deck back into place with wire cable and tractors. Mechanical or hydraulic jacks may be effective. Misalignment of major superstructure members is usually caused by movement of the footings. Since this type of misalignment is difficult to repair, the bridge may have to be reconstructed.

5-26. The principles of firefighting, shifting, and stringer replacement in highway bridges also apply to railroad bridge decks. Replace burned or damaged ties promptly. Check the rail alignment and guardrails for shifting and correct any problems. The maintenance patrol or gang should also tighten all loose rail spikes, end joints, hook bolts, and tie-spacer connections and check the following:

- **Fastenings.** Wooden decks tend to shift under load. Correct this problem by adding adequate fastenings to the curb rail, tread, or stringers. If the stringers shift, draw them back into position and secure them with drift bolts (for timber stringers) or steel bolts (for steel stringers). Redrive any loose nails or add new nails to loose planks. Drift pins or lag screws might be needed in troublesome spots. Ensure that the clamps for the curbs and handrails are secure.
- **Timber treads.** All types of timber deck bridges should have timber treads. Bolt timber treads onto steel grid floors if the grids show signs of excessive wear. Replace the treads when 10 to 15 percent of the original surface has worn. A tar or asphalt coating covered with sand, fine gravel, or stone chips will prevent excessive splintering and rapid wear.
- **Wearing surfaces.** Asphalt concrete best protects wearing surfaces of concrete or masonry.
- **Stringers.** Replace bent, crooked, or rotten stringers by removing and replacing the flooring planks. Correct stringer bearing is essential for the bearing cap and the flooring. Placing metal shims between the stringer and cap is the best way to correct the bearing. Securely fasten shims in place to prevent them from dislodging. Do not use small shims between the floors and stringers.
- **Curbs and handrails.** Replace curbs and handrails only when they have been damaged by accidents.

FOUNDATIONS

5-27. Foundation settlement is usually caused by scour or structural failure. Correct minor settlement by jacking up the structure and inserting steel shims between the stringers and the cap or between the bearing plates and the pedestal. Use hardwood shims under wooden members. Correction of settlement is discussed below.

ABUTMENTS

5-28. Treat scour and settlement of abutments the same as foundation settlement. However, since an abutment also acts as a retaining wall, it is subject to horizontal earth pressures. If the abutment is unstable, shore it or hold it in place with guy lines from anchors on shore.

TIMBER

5-29. Decay, excessive loads, structural defects, fire, or explosives may cause timber members to fail. Untreated timbers that are alternately wet and dry or are only partly saturated decay quickly. Timber that is under water or otherwise continually wet does not decay, but may be attacked by marine borers. Replace all timber showing decay or structural damage (preferably with masonry or steel) especially if the timber is in contact with the ground. One method of repairing piling is to splice new members to solid members with butt joints and scabs.

5-30. To allow timber to breathe, leave at least a 1/8-inch clearance between the timbers (where possible). Keep all bridge timber clear of debris. Remove the bark from native logs if this was not done during construction. Green or wet timber shrinks considerably when seasoned. Repeated wetting and drying also cause dimension changes as great as 5 to 10 percent, parallel to the grain. Unseasoned timber may require frequent renailing and tightening of bolts.

STEEL

5-31. Intense heat that raises steel temperatures above 1,000°F is particularly serious when the members are under stress. Members under tension that are heated to this extent will permanently elongate and will buckle if under compression. Intense heat will also destroy the temper and extra strength in certain types of steel (especially cold-rolled sections and high-strength wire). Replace damaged steel or reinforce it by welding new members onto the damaged sections.

5-32. Bending (due to accidents or explosions) is not as serious in members that are under tension as it is in those that are under compression. Straighten the bent compression members to their original shape. If not possible, weld or bolt steel plates or shapes onto the bent member to increase its stiffness. When essential members are severed, other members assume added stresses. Relieve overstressing of members by adding bolted or welded plates or structural sections across the gap.

5-33. Military loads and design stresses are high, with impact adding to the severity of steel stresses. Fatigue failure is caused by repeated stressing and may result in sudden collapse. Fatigue failure is usually preceded by small hairline cracks around the rivet holes, welds, and other surface irregularities. Since these cracks usually do not get large before ultimate failure, reinforce the affected components immediately with steel plates.

5-34. Rusting on bridges seldom requires special attention unless these structures are subject to salt spray or are located in humid climates. Keep all steel clear of debris, and limit timber-steel contact to a minimum to prevent rusting due to moisture retention. Loose rust is not serious, but deep pitting should be investigated. Paint areas that are subject to severe rusting, and coat them with tar, asphalt, or thick grease. Remove all rust with a wire brush or sandblast before painting.

CONCRETE

5-35. Correct surface spalling on concrete with plaster or with a low-water content mortar applied with a pneumatic sprayer. Extensive frost damage is usually not repairable. Rust flakes on reinforcing steel can exert considerable pressure when confined and will spall concrete along bars that are too close to the surface. Although seldom serious, repair this condition by chipping away the concrete, cleaning most of the rust from the bar, and grouting the area. Fires of 1,200°F and above that last for an hour or more cause spalling and cracks and reduce the strength. Replace the concrete if the damage is serious. Patch all holes and gaps that are caused by accidents or explosions.

Tension

5-36. Concrete tensile strength is negligible since resistance to tension is furnished by the reinforcing steel. Tension cracks crossed at right angles by reinforcing steel are not serious unless they are more than 1/8 to 1/4 inch wide, depending on the structural details.

Compression

5-37. Compression creates a crushing failure that crumbles concrete, especially in columns. Connections between steel tension and compression members are usually made with splice plates that are welded, riveted, or bolted to the members.

Shear

5-38. Repair concrete shear failure in rectangular members with tight steel bands. Do this only under the supervision of a structural engineer.

APPROACHES

5-39. Correct any settlement of approaches immediately. The grade line of unpaved approaches should be 1 inch above the grade of the deck. The grade line of paved approaches should be the same grade as the deck. Patch any potholes immediately. When settlement occurs on railroad bridges, add ballast to the track (shoreward of the abutment) to keep the track from dipping.

5-40. Some waterways with flat grades and floodplains have a tendency to shift channel locations. Such shifts may deposit eroded material against the piers or erode the pier foundations or approaches. These problems can be controlled by earth or rock dikes or by piles strung with brush mats woven into wire cables.

Chapter 6

Special Environments and Situations

"It is an immense task that I have on my hands, but I believe I can accomplish it."

General George McClellan

Gap-crossing operations in austere environments can present many challenges—not only in the selection of a bridging means, but also on the personnel constructing the crossing. When planning crossings in these environments, planners must develop specific, flexible plans because the conditions often change in very short periods of time. Crossing sites must be monitored continually, with close attention paid to the condition of the bridging means and other factors that may impact the risk assessment. Additionally, it may be necessary to make or construct crossings that are affected by unique conditions or situations. Such situations include, but are not limited to, crossing a contaminated area or conducting a crossing in conjunction with crowds of dislocated civilians or refugees that compound the other challenges associated with a gap crossing. These situations require extensive specialized and focused planning as added conditions and will increase the level of difficulty and the assets necessary to successfully complete the crossing.

GENERAL

6-1. Gap-crossing operations in specific environments or under unique conditions refers to tasks undertaken in extremes of temperature, climate, topography, or combinations. It also applies to more specialized situations such as a CBRN or in a situation where the impact of large numbers of refugees add a very special twist to a gap-crossing operation. The specific environments and unique conditions considered in this chapter include the following:

- Arctic and cold weather.
- Mountainous areas.
- Desert and extremely hot conditions.
- Jungles and forests.
- When compounded by CBRN conditions.
- When compounded by significant numbers of dislocated civilians or refugees.

6-2. This chapter introduces the engineer to the climate and terrain limitations imposed on gap-crossing operations. It is not intended to study in detail the effects of these environments since they are outlined in other publications. In certain climates or situations, specific aspects of environmental considerations may require adjustments to the gap-crossing solution.

6-3. Remember that the nature of dry gaps can rapidly change to wet gaps as a result of a change in weather conditions, the destruction of dams and dikes, or as the result of other actions. Seasonal effects on the nature of a gap must also be taken into consideration when planning gap crossings.

GAP-CROSSING OPERATIONS IN ARCTIC AND COLD WEATHER

CONSIDERATIONS

6-4. Arctic and cold weather operations can be conducted in many parts of the world. The same type of temperature conditions can be found in mountainous areas. Even moderate climates can experience severe winters, producing the same constraints on operations as found in other cold weather areas. When conducting operations in this type of environment, significant changes in temperature can cause ice or snow melt or freeze. Ice or snow melt can cause significant water level and current changes in streams, rivers, and lakes—potentially causing flooding in low areas in short periods.

Terrain

6-5. The following terrain conditions may be encountered:

- **Deep snow.** In many areas there will be deep snow. This will impede mobility and make it difficult to see the true ground conditions.
- **Permafrost.** Permafrost is perennially frozen ground. The annual thaw depth, from 0.3 meters to 1.5 meters, is called the active layer. Digging, even in summer, is nearly impossible. Because permafrost restricts surface drainage, the active layer is often saturated with slow moving water. Any surface disturbance collects water if it provides a channel in the direction of the watershed. Surface water may wash away or otherwise alter the vegetation that binds the surface and insulate the permafrost. In turn, this deepens the active layer and creates the effect of a drainage ditch, which again increases the flow of water into the area of the channel. Under certain watershed conditions, this cycle may convert a single vehicle track into a destructive ditch of erosion—preventing vehicle movement.
- **Hydrology.** If the precipitation is low, streams may have relatively little volume. However, melting snow in the warm months can produce sudden variations. Also, ice expansion, continued water influx, and partial thaws can create pressure ridges in frozen bodies of water. These ridges, often 1 meter high, can be formidable obstacles to vehicles. Similarly, dependant upon the snow cover, ice can be up to and greater than 2 meters thick if the snow cover is sparse and the lake windswept, or only a fraction of a meter thick if the snow cover is extensive. In the winter, swamps, rivers, and lakes may be an asset to movement. In the summer, they may be a liability and an obstacle to overcome. Gap-crossing operations predominate during the summer but must not be discounted during the winter.
- **Vegetation.** The vegetation could range from nil on the high arctic tundra to heavy forests such as the forests of northern Canada or Norway. Forested areas may provide the engineer with an abundance of natural materials for the construction of nonstandard bridges, but restrict movement on prepared routes.

Personnel

6-6. The climate provides some particularly unique problems. In many cases of extreme cold or storms, personnel survival becomes the preoccupying activity of military forces. The most common problem areas are dehydration, exposure and frost bite, and reduced work rates. Good clothing, equipment, and training will ease the problems, but Soldiers and Marines need to have access to a warming area, hot and high calorie food, and a shelter from severe weather to maintain long-term effectiveness.

Equipment

6-7. The cold affects equipment in many ways, some considerations include the following:

- **Petroleum, oils, and lubricants.** Some types of petroleum, oil, and lubricants (POL) will gel at low temperatures. Engines could be difficult to start and fuel consumption will be high due to the need to keep engines running for warmth.
- **Vehicles.** Vehicles may have to run continuously, resulting in excessive wear on the engine. Parts may break due to increased brittleness of materials at low temperatures.

- **Mobility.** Mobility could be affected by snow, weather (whiteouts or storms), and ice.
- **Effects on metals.** Metals could become brittle at low temperatures.

GAP-CROSSING TECHNIQUES

6-8. The various gap-crossing techniques used in other environments are normally an option in cold weather. However, caution must be used due to the extreme cold temperatures and challenges associated with large formations of ice.

Standard Bridging

6-9. Regardless of whether standard (fixed) or nonstandard bridging is to be used, it is most desirable to construct the bridges in one clear span. This is to prevent damage, or in the worst case, destruction of the bridge due to a heavy water flow during runoff and the floating debris and ice associated with it.

6-10. Not usually considered as an alternative, floating bridges such as the IRB are suitable for use over large lakes and slow moving rivers, limited by freeze-up. If extreme care is not taken and bridges removed early enough, extensive damage can be expected should the bridge become frozen in the ice. Care must be exercised to ensure that the equipment does not sustain damage by an overnight freeze-up or floating ice and debris in the spring.

Nonstandard Bridging

6-11. Not usually desirable from the point of view of task duration, nonstandard bridging from local resources and prefabricated components may be an alternative. It provides the engineer with the flexibility to construct/erect each bridge to suit the particular site requirements.

6-12. Ice bridging is an effective crossing technique but time consuming to complete. As indicated by the name, it can only be constructed when conditions permit. Its purpose is to reinforce the already present ice cover on large bodies of water, streams, and rivers allowing the passage of heavier load classes that would otherwise be supported by the existing ice. Care must be taken to ensure that the initial ice span is stable and not simply a floating ice mass (see TM 5-349).

Nonbridging Techniques

6-13. Gap-crossing techniques that may be considered include the following:

- **Culverts.** Culverts may be an adequate means of crossing streams and rivers. The requirement for bridging material is minimized, but conversely it may necessitate the movement of resources and heavy equipment to the construction site.
- **Aerial ropeways/cableways.** These crossing methods can be used if movement is limited to personnel and equipment. They provide a quick and effective method of traversing a gap.
- **Fords.** Where permafrost is prevalent, the preparation of entrances and exits is extremely difficult. The fords could deteriorate rapidly under traffic.
- **Amphibious crossings.** Amphibious crossings should not be overlooked. These crossings are limited in the same manner as fords.

GAP-CROSSING OPERATIONS IN MOUNTAINOUS AREAS

6-14. The biggest factor affecting mountainous region operations is the terrain. Mountainous and hilly areas are characterized by rocks, steep slopes, and valleys. Movement is normally canalized along the valleys and lateral, cross-country movement is difficult. In the mountains, some areas can be barren of vegetation while other parts are covered by thick forests. Rivers and watercourses are often deep and fast flowing. If a river is slow moving, it is usually because it is a major river in a valley. The climate in mountainous areas can vary widely, depending on the geographical location. Mountainous areas are often subject to heavy precipitation, either in the form of rain or snow. Abrupt temperature changes or heavy precipitation, particularly during short periods, often dramatically increases water current in mountain streams and rivers. Division and BCT terrain teams can provide detailed information on the proposed AO and will be able to provide up-to-date information on routes, climate, and hydrology.

TERRAIN

6-15. The sharp relief of the mountains creates multiple dead ends, covered approaches, and extreme slopes. The major characteristics of many mountainous areas include the following:

- **Topography.** The terrain is characterized by—
  - Steep precipitous slopes and vertical crags.
  - Valleys that canalize movement and can rapidly change in size and direction.
  - An exaggerated slope that makes movement difficult.
  - Few roads that normally follow valleys.
- **Hydrology.** Deep, swift-running rivers and streams, especially after rain or during thaw, could scour abutments or piers. Special consideration may be required for drainage.
- **Vegetation.** At higher elevations, vegetation may be very scarce, affecting the availability of resources for nonstandard bridging and soil stability. However, the forested areas may provide the engineer with an abundance of natural materials for construction. These forests will also restrict movement to prepared routes.

PERSONNEL

6-16. Personnel operating in mountainous areas can be affected by the altitude, which can result in reduced work rates or altitude sickness. Dismounted personnel also have to work harder climbing up and down the slopes. Accident rates can increase due to small injuries, sprains, and broken bones when moving and working in the rough terrain. At certain times of the year, the threat from exposure (high winds, cold, and rain) is severe. These are all considerations when planning any gap-crossing operation.

EQUIPMENT

6-17. The terrain will also affect vehicles and equipment:

- Road widths and carrying capacity may limit the size and type of vehicles that can be used. This should not be overstated. Fully loaded logging trucks use narrow, rough logging roads. However, roads may have to be used as one-way routes or with traffic control to allow safe two-way traffic.
- Moving up and down steep roads will increase movement time, as well as impact the maintenance required on vehicles. Fuel consumption could increase.
- Mobility off routes may be difficult.
- Communications may be difficult due to interference by the mountains. Any gap-crossing plan must consider the communications requirements and ensure that potential problems are addressed.

GAP-CROSSING TECHNIQUES

6-18. Bridging techniques in mountainous and hilly areas are not unique. The means or construction may have to be adapted to the realities of constricted sites, terrain, hydrology and crossing sites. In some instances, it may be necessary to airlift equipment and material to the site. This would normally be done to bypass the traffic and speed up the movement of the bridging or gap-crossing material. Most available crossing sties may have already been used by the local inhabitants or are part of the existing traffic network.

Standard Bridging

6-19. Most standard bridging is laid as a single span. In some cases, MGBs can be constructed with piers. Whether single span or multispan, the potential for water damage must be considered as the water level could change radically and rapidly. Multispan bridges often use existing piers. If a pier must be constructed, it must be well-sited and protected against water and ice damage.

6-20. The SRB and the IRB have limited use in mountainous terrain, other than across rivers with slow currents. The engineer planner, in conjunction with the terrain team, should consider the potential need for these bridges early due to the significant challenges presented by the terrain.

Nonstandard Bridging

6-21. Any nonstandard bridge may prove useful in some areas, especially if locally procured materials are readily available, such as a gap crossing in a forested area. Unless standard bridging is in short supply it may not be feasible to transport nonstandard bridging material over long distances. Nonstandard bridging is relatively slow and most suitable for small gaps. It should be considered for lateral movement to free up standard bridging for time urgent gap-crossing operations.

Nonbridging Techniques

6-22. Gap-crossing techniques that can be considered include the following:

- **Culverts.** Culverts may be an adequate means of crossing streams. The requirement for bridging material is minimized, but conversely, it may necessitate the movement of resources and heavy equipment to the construction site.
- **Aerial ropeways.** These crossing methods can be used if movement is limited to personnel and equipment. They provide a quick and effective method of traversing a gap. In some mountainous areas, the local inhabitants may have sites for aerial ropeways or personnel suspension bridges.
- **Fords.** The preparation of entrances and exits may be extremely difficult if the banks are rocky or shear. Explosives and drilling may be required to make the cuts. When the bottom of the ford is hard, it can be used with consistent monitoring for changes of water level and current. The fording option should be considered, because some time and effort expended to opening a ford could result in a low-maintenance, high-volume traffic route.
- **Amphibious crossings.** Considerations for amphibious crossing in mountainous and hilly terrain include the following:
  - **Entrances and exits.** Sheer and rocky banks to the water course could prevent the vehicles from safely entering and exiting the water.
  - **Water current.** Fast currents may prevent an amphibious crossing.
- **Assault boats.** Assault boats are a potential crossing resource in mountainous and hilly terrain, but are affected by water current. Proximity of rapids or falls must be taken into account when deciding on assault boats. Current outboard motors provided with assault boats may not be strong enough to move a fully laden boat upstream in strong current.

GAP-CROSSING OPERATIONS IN DESERT AND EXTREMELY HOT CONDITIONS

6-23. All deserts are not hot, and not all extremely hot terrain is a desert. The desert can incorporate many and varied relief features from a flat, barren sand plain to irregular mountain heights exceeding 3,000 meters. While terrain and weather in desert areas, unlike the other geographical areas discussed, has the least effect upon bridging operations, it must not be overlooked. Any amount of precipitation can cause sudden and significant increases in water flow, particularly in dried-up lake beds, marshes, river channels, gullies, or wadis.

TERRAIN

6-24. Desert areas often hold vast stretches of the flattest ground on the globe and may sometimes include extensive coastal flatlands, alluvial planes, and fan-cut gorges. Within these general forms of relief occur an almost infinite number of smaller irregularities, such as thin, soil-covered hill rocks and bare rocks, eroded rock-strewn areas, shallow lakes and dried-up lake beds, salt marshes, steep-sided gullies (wadis), dry washes, and dry river channels. Some desert areas have huge tracts of moving sand dunes. The many variations in desert topography require flexibility and ingenuity of engineer commanders. Some variations and types include the following:

- **Hydrology.** Precipitation in hot climates can range from zero (deserts) to intense (rain forests). Depending on the location, dry gaps may turn into deep, fast streams and rivers, which can scour abutments or piers. Special consideration may be required for drainage.
- **Vegetation.**
  - In desert areas, vegetation may be very scarce, affecting the availability of resources for nonstandard bridging and soil stability.
  - In extremely hot areas that contain jungles or forests, there may be an abundance of natural materials for the construction of nonstandard bridging, but movement is normally restricted to prepared routes.

PERSONNEL

6-25. The main issue in deserts and extremely hot areas is water. Soldiers and Marines will require large quantities of potable water, and extra water will be required for hygiene. The heat can also be debilitating, resulting in heat casualties and reduced work rates. The environment is also prone to diseases and disease-bearing insects and animals.

EQUIPMENT

6-26. Desert climate may affect equipment in many ways. Some considerations include the following:

- Temperatures and dryness are major causes of equipment failure. Wind action lifts and spreads sand and dust, clogging and jamming anything that has moving parts. Vehicle maintenance will have to take the hot weather and dust into account. This could include more frequent filter changes and other increased maintenance.
- Soil compaction may be difficult or require additives due to the lack of moisture. If water is required, this will be an extra burden on the water supply system.
- Blade edges may wear more rapidly in dry, abrasive soil and rocks.

GAP-CROSSING TECHNIQUES

6-27. Bridging in hot weather is generally of a conventional nature; however, heavy reliance may be placed on the tactical and support bridging assets to maintain the momentum of mechanized formations.

Standard Bridging

6-28. There are no unique issues with standard bridging in this type of climate other than some problems with clearances due to metal expansion. The SRB and IRB could still be used in desert or hot weather environments and should not be automatically discounted. The division or BCT terrain teams can provide information concerning most potential water courses that may have to be crossed in a particular AO. Floating bridge assets may prove useful for lateral moves.

Nonstandard Bridging

6-29. In desert conditions there will normally be a lack of natural resources to allow the construction of nonstandard bridging. It is possible that there will be stockpiles of man-made resources that could be used, such as pipes and other construction material. Using nonstandard materials may require a review of the design if materials are not used according to the Theater Construction Management System (TCMS). Nonstandard bridging should be used whenever possible to best utilize standard bridging resources. In extremely hot areas with jungles or other forests, there may be an abundance of natural resources permitting the construction of bridges or rafts. In most cases, nonstandard bridging construction requires more time than standard bridging.

Nonbridging Techniques

6-30. Gap-crossing techniques that can be considered include the following:

- **Culverts.** Culverts may be an adequate means of crossing streams. They should be considered for dry water courses, as water may flow down the channel during use. A risk assessment may be made to fill in a dry water course as a more rapid means of crossing. The requirement for bridging material is minimized, but conversely, it may necessitate the movement of resources and heavy equipment to the construction site.
- **Aerial ropeways.** These crossing methods can be used if movement is limited to personnel and equipment. They provide a quick and effective method of traversing a gap.
- **Fords.** Fords should be used whenever feasible.
- **Amphibious crossings.** Amphibious crossing means can be employed when they are available.

GAP-CROSSING OPERATIONS IN JUNGLES AND FORESTS

6-31. Almost one third of the earth's tropical zone is an area of high temperature and humidity where the natural vegetation is largely rain forest. This area includes deciduous forests, swamps, and tropical grasslands. Gap-crossing tasks in the jungle occur more often than in other areas; however, they are less complex in terms of manpower and equipment involved. As with all environments, rainfall is a consideration for where and when bridging assets can be most effectively employed. If gap crossing is necessary during periods of extended rainfall or monsoon season, careful attention must be given to water levels. Relying on improvised bridging techniques and available natural resources will play a key role in the success of an operation.

TERRAIN

6-32. The majority of jungle covers extensive tracts of hilly country. Jungle regions sometime include rugged mountains, often with razorback ridges abruptly intersected by deep and steep-sided valleys. Some mountain chains may reach 3,000 meters or more and extend above the tree line to areas where temperatures drop at night below freezing. The jungle terrain can further be described in terms of the following:

Coastal Areas

6-33. The coastlines of jungle and forest areas include a wide variety of terrain, from open beaches to dense mangrove swamps that sometimes extend for a considerable distance inland. The coastal belt behind the beaches may vary from flat alluvial plains to narrow strips with foothills rising abruptly near the shore. In flat coastal regions and near deltas, the area is seldom well drained, resulting in many slow-moving streams many of which finally flow into swamps with tidal effects often evident well inland.

Plains

6-34. Where extensive plains are found they are usually in the form of river basins, deltas, or high plateaus. The rivers often vary widely according to the season and where monsoon conditions prevail; they may rise quickly and flood easily. Rice cultivation is a major feature of low-lying plains. It requires prolonged flooding and the construction of many dykes, which give the landscape a patterned appearance and hinder movement.

Soils

6-35. The soils of the jungle areas vary widely. They seldom provide a good surface for wheeled traffic, especially during rainy periods.

Hydrology

6-36. The large rainfall in jungle areas produces swift-flowing streams in the hills often bordered by steep rocky banks with frequent rapids. These streams drain into sluggish and meandering rivers in the plains that flood quickly and often take a long time to drain.

Vegetation

6-37. The heavy rainfall and high temperatures encourage rapid and continuous growth and a consequent profusion of vegetation. Vegetation is further explained as follows:

- **Primary jungle.** Primary jungle is the original growth of full and profusely leaved trees that occur naturally in lowland tropical areas where the annual rainfall averages 2000 millimeters or more. Movement on foot through primary jungle is generally easy because the trees are well-spaced. The worst obstacles are streams or river banks where dense undergrowth may occur. Movement of wheeled vehicles is difficult if not impossible.
- **Secondary jungle.** Whenever primary or deciduous forest is cleared and later abandoned, a secondary growth known as secondary jungle occurs. Due to exposure to sunlight, the bare areas are rapidly overgrown by weeds, grasses, ferns, canes, thorns, and shrubs that reach a height of 2 to 3 meters within a year. Movement is very slow for Soldiers on foot and, while tanks can sometimes crash their way through, the growth of woody species and the presence of old, felled logs, stumps, and protruding roots that often litter the ground create conditions virtually impossible for wheeled vehicles.
- **Deciduous forest.** Deciduous forest occurs in areas that have a dry season lasting 3 to 6 months. The trees are not as dense or as tall as in the primary jungle and some sunlight filters through the canopy, encouraging profuse undergrowth. In the wet season, movement is generally more difficult than in the primary jungle because of the amount of undergrowth. However, in the dry season it is easier because the forest floor is firmer and trees are more wildly spaced. Vehicles can seldom negotiate deciduous forest without considerable effort.
- **Swamps.** Swamps are commonplace in tropical jungles in all low-lying areas where there is water. They produce a formidable combination of terrain and vegetation through which movement is difficult except to a limited extent by foot or small boat.

PERSONNEL

6-38. The main issue for personnel operating in extremely hot or jungle areas is a supply of potable water. These areas are also high-risk areas for diseases and disease-bearing insects and animals. The heat can become debilitating, resulting in heat casualties and reduced work rates.

EQUIPMENT

6-39. Equipment is affected in many of the same ways as in a desert environment. Protection against water may be a serious problem, especially during periods of monsoon rains. The rain may cause increased problems with mobility of the vehicles and equipment.

GAP-CROSSING TECHNIQUES

Standard Bridging

6-40. The road network in some parts of this environment can be very restricted. This means that the location of standard bridging assets (whether tactical, support, or LOC bridging) must be carefully planned. Standard bridging is essential to allow the momentum of operations to be maintained, but it has to be in the right place at the right time. Using aviation to lift in bridging equipment should be considered to reduce the burden on the road network. It will not eliminate it; however, certain pieces of equipment cannot be lifted by Army aviation. Since the bridge is of little use if a road network is not connected to it, the demands for clearing dense growth and creating or improving the roads will still exist. Using aviation to lift bridge components may make it possible to construct the bridge concurrently with the preparation of the roads to get to the bridge.

6-41. Floating bridge and raft resources can be critically important in jungle operations. Most jungles are cut by large rivers draining all of the water that falls to form the jungle. Most of these waterways are too large to cross with tactical bridging, leaving SRB or IRB the only feasible way to cross. Locally available craft should be exploited whenever possible.

Nonstandard Bridging

6-42. Nonstandard bridging may be the predominant means of moving personnel and material through the jungle. The jungle should have an abundance of natural building material that can easily be incorporated into bridging tasks. Using nonstandard bridging will free up standard bridging resources to maintain freedom of maneuver.

Nonbridging Techniques

6-43. Gap-crossing techniques that can be considered are as follows:

- **Culverts.** Culverts may be an adequate means of crossing streams. The requirement for bridging material is minimized, but conversely, it may necessitate the movement of resources and heavy equipment to the construction site.
- **Aerial ropeways.** These crossing methods can be used if movement is limited to personnel and equipment. They provide a quick and effective method of traversing a gap.
- **Fords.** The preparation of entrances and exits may be extremely difficult. The fords deteriorate rapidly under traffic as well as heavy rainfall.
- **Amphibious crossings.** Amphibious crossings should not be overlooked. These crossings are limited in the same manner as fords.
- **Expedient raft.** It may be possible to construct rafts with local material or boats.

GAP CROSSING COMPOUNDED BY CHEMICAL, BIOLOGICAL, RADIOLOGICAL, OR NUCLEAR CONDITIONS

6-44. Central to the planning of a gap-crossing operation in a situation compounded by CBRN conditions is an assessment of the operational risk. The threat of having to operate in a CBRN environment can come from multiple sources. They can be unexpected and employed through a broad range of tactics from clandestine operations to large scale attacks. They may be intended to cause psychological distress or diversion, hinder operations, or cause mass casualties and force withdrawal. Because gap-crossing operations tend to canalize forces and severely restrict maneuver within the crossing area, it is critical to identify and quantify the risk of a CBRN attack on the crossing. See FM 3-11.3/MCWP 3-37.2A/Naval Tactics, Techniques, and Procedures (NTTP) 3-11.25/AFTTP(I) 3-2.56, and FM 3-11.4/MCWP 3-37.2/NTTP 3-11.27/AFTTP(I) 3-2.46.

6-45. If intelligence suggests that a significant risk of a potential CBRN attack exists for the crossing site, planners should conduct a focused risk assessment to determine the priority trade-offs, assessing the tactical requirements against the additional time and assets required to execute the crossing in anticipation (or as a result) of a contaminated area. The likely increase in the number of designated crossing locations to allow for both clean and dirty crossing lanes may cause a significant increase in the assets and time required to accomplish the crossing. Planners must weigh these realities against the trade-off of time, assets, and risk to the force as well as a successful accomplishment of the mission. It must be understood that not all CBRN agents have the same impact on operations because different agents have different degrees of lethality and persistence. If it is determined that a crossing is inevitable in a potentially contaminated area, planners should consider the following in their subsequent planning:

- Contamination avoidance.
- Protection measures.
- Decontamination.
- Additional crossing sites and/or lanes.

CONTAMINATION AVOIDANCE

6-46. Contamination avoidance includes those individuals and/or unit measures taken to avoid or minimize CBRN attacks and reduce the effects of the hazards. Contamination avoidance helps to avert the disruption to gap-crossing operations by preventing casualties, eliminating unnecessary time in protective posture, and minimizing decontamination requirements. Commanders need information about contamination hazards and locations of clean areas (gained through CBRN reconnaissance, warning, and reporting) to determine alternative COAs or other potential crossing sites. See FM 3-11.3.

PROTECTION MEASURES

6-47. CBRN protection is a command responsibility. The commander directs actions to ensure continued mission accomplishment. If or when the potential use of CBRN becomes essential to conduct a crossing in a contaminated area, it is imperative that all personnel are trained and have access to individual protective equipment (IPE). Besides IPE, collective protective shelters (CPSs) can be placed in selected areas to provide additional cover and protection to groups of Soldiers and Marines, enabling them to relax their individual protection. This requires extensive planning and logistical support to maintain these systems. It also greatly reduces work efficiency within the crossing area and at the crossing site. See FM 3-11.4.

DECONTAMINATION

6-48. Decontamination sites must be incorporated into the planning of a gap-crossing operation. The principles of speed (decontaminate as soon as possible), need (decontaminate only what is necessary), and limit (decontaminate as close to the site of contamination as possible to limit spread) should guide planning. For example, if the farside is not a contaminated area, personnel and equipment should be decontaminated before departing the nearside and if the situation permits, before entering the crossing area. If decontamination must occur within the crossing area, a water source, such as a river, will speed and improve the quality of the decontamination process. CBRN staff decontamination expertise must be included in the planning and decision making for how and when the decontamination of bridging equipment and units involved in moving through the gap crossing will occur. See FM 3-11.5/MCWP 3-37.3/NTTP 3-11.26/AFTTP(I) 3-2.60.

ADDITIONAL CROSSING SITES AND/OR LANES

6-49. This is similar to provisions that may need to be made for the operation of main supply routes (MSRs) in a CBRN environment. Selected routes (lanes) may be designed and maintained as clean while others are designated as dirty. A single lane may be maintained as dirty with alternating one-way traffic, or it may be necessary to create a dirty lane in each direction across the gap. Sustainment and maintenance of a clean lane (or series of lanes) would require similar considerations of desired traffic flow and time available. Additional crossing sites and/or lanes would require not only additional bridging or rafting assets, but CBRN personnel and military police as well.

GAP CROSSING COMPOUNDED BY SIGNIFICANT NUMBERS OF DISLOCATED CIVILIANS OR REFUGEES

6-50. The consideration of conducting a gap-crossing operation when hampered by significant numbers of dislocated civilians or refugees is an example of an added condition that can significantly increase the complexity of a gap crossing. This condition is perhaps most often encountered during stability operations;

however, it is a consideration during any operation where the population envisions a perceived or real threat (economic hardship, social injustice, ethnic differences, objections to an organization or government, political unrest, terrorist threats, or pursuing an enemy army) or simply a better opportunity in another location.

6-51. Two significant historical examples of this kind of fleeing, in conjunction with a retrograde gap crossing, are the French and their allies retreating from Moscow during the Napoleonic Wars and the German Army and its allies retreating to the west, pursued by the Armies of the Soviet Union during World War II. In both cases, there were masses of frightened fleeing civilians challenging the attempts of the military forces to withdraw across gaps (rivers) under pressure. A similar scene highlighting the affect of the crush of civilians was as U.S. forces attempted to evacuate Saigon at the end of the Vietnam War (although in that example the crush occurred as helicopters attempted the evacuation of the U.S. embassy. In that case, the crossing lanes were essentially replaced by the helicopter lifts). However, the same issues and challenges of control and capability abounded.

6-52. When these conditions exist within a crossing area, planners must ensure they include COAs to deal with the civilians. Considerations impacting the COA development could include the tactical situation, the numbers of civilians involved, the desire of U.S. and HN forces to safely support the movement of the civilians to the other side of the gap, the amount of bridging and other supporting assets available, and time constraints. As the planning process continues, at least two other considerations must be addressed. First, control of the civilians to prevent disruption of the crossing, destruction of assets, and the possibility of violence among the gathered civilians among themselves or against U.S. or allied forces. Second, if it is determined that the civilians will be allowed to cross, the crossing priority and special accommodations that will be necessary to support their crossing.

CONTROL

6-53. Any gap crossing has control issues and challenges and the addition of civilians merely heightens the requirement for control. Ideally, the movement of civilians can be included in the planning for the gap crossing with only minimal additional control assets required to support additional capacity so that all needing to cross can do so in an appropriate timeframe. When capacity cannot be increased, significant additional control may be required for crossing success. This additional control will include additional engineer, military police, and C2 assets at a minimum. If the panic among the civilians and the numbers are great enough, combat forces may also be required to ensure that the crossing is done in an orderly fashion. The crossing of civilians will compete with the necessary crossing of military forces and equipment. Large numbers of civilians and their property create a capacity as well as a control challenge.

CROSSING PRIORITY

6-54. When a gap-crossing site has additional personnel and perhaps unique sorts of equipment (such as wagons or even livestock needing to cross), the number and type of crossing lanes or the time available to complete the crossing must be increased. Developing a crossing priority in a waiting area as far back as feasible in the crossing area will assist in maintaining control and facilitate a more organized and speedy crossing.

GAP-CROSSING TECHNIQUES

6-55. Gap-crossing techniques which can be considered include the following:

- **Fords.** Fords should be used whenever feasible.
- **Focused lanes.** Keeping the civilian flow on designated crossing lanes is essential. Military bridging may not always allow for the rapid movement of civilians and their material or their various modes of transportation. Expedient or locally procured products may be necessary to augment the decking or roadway surface for one or more of the lanes.
- **Amphibious crossings.** Amphibious crossing means can be employed when they are available.
- **Rotary wing crossings.** Depending on the number of civilians, their possessions, and availability of aircraft, helicopters may provide one of the most efficient methods for crossing selected categories of civilians. Capacity itself may be one of the greatest issues to resolve when considering the use of rotary wing equipment to transport in this sort of scenario.

Appendix A

Crossing Means and Organizations

Crossing a gap can be accomplished numerous ways making use of various types of equipment and/or available resources. Any method that is used, to include standard and nonstandard bridging or nonbridging alternatives is described as the crossing means. This appendix describes those means that are most commonly used by Army and Marine forces. While not inclusive of all possible means that may be used to cross a gap, it does include discussion of both bridging and nonbridging means. For selected information on bridging assets used by other armies, see Appendix H.

GENERAL

A-1. Crossing means are the equipment or materials (nonbridging) used to allow a force to cross a gap. Gap-crossing equipment is specially designed to operate within certain limits, and commanders must understand these limits if the force is to cross safely.

A-2. A safety matter that affects operational use is the load capacity of rafts, bridges, and other equipment. The quantities shown in Table A-1, page A-2 reflect the normal capabilities for selected crossing equipment. In exceptional circumstances, certain safety factors or margins allow an increase in the load. These exceptional (risk) capacities have been deliberately omitted here because they are not intended for use in operational planning. The standard or design capabilities are provided for normal crossings. The exceptional category is intended for special situations using the terms caution or risk crossings.

A-3. Besides the command decision required to employ caution and risk-crossing loads, commanders must consider the physical status of the equipment. Thus, CACs or CFCs should obtain an assessment of the bridge condition from an engineer familiar with the equipment. The commander weighs these factors with the tactical needs before directing an increase in the load, keeping in mind that the equipment may be lost for future use. There is a significant difference between the risk involved in the crossing of a single vehicle and the crossing of multiple vehicles over a bridge. Gap crossings are categorized as one of the following:

- **Normal crossing.** The vehicle's classification number is equal to or less than the bridge's. Vehicles maintain 30-meter intervals on standard bridging, and the vehicle's speed must not exceed 24 kilometers per hour. Sudden stopping or acceleration is forbidden.
- **Caution crossing.** Vehicles with a classification exceeding the capacity of the bridge by 25 percent are allowed to cross under strict traffic control. The crossing requires that vehicles remain on the centerline and maintain 50-meter intervals. The crossing requires that vehicles do not exceed 13 kilometers per hour, stop, accelerate, or shift gears.
- **Risk crossing.** The crossing may be made only on standard bridging and in the greatest emergencies. The vehicle moves on the centerline and is the only vehicle on the bridge. The crossing requires that vehicles do not exceed 5 kilometers per hour, stop, accelerate, or shift gears. The vehicle's classification number must not exceed the published risk classification for the bridge type being crossed. After the crossing and before other traffic is permitted, a qualified engineer must reinspect the entire bridge for any damage.

Table A-1. Selected Nonvehicle Crossing Equipment Characteristics

Equipment	*Allocation*	*Transportation*	*Capabilities*	*Assembly/ Propulsion*	*Remarks/ Limitations*
Inflatable assault boat (Zodiac)	30 per MRBC 8 combat rubber reconnaissance craft (CRRC) per USMC bridge company 9 per ACR	Deflated size—70" x 36" x 26" A deflated boat weighs 196 kilograms (432 pounds)	The boat can carry a maximum of 15 Soldiers and Marines or a total load capacity of 1,714 kilograms (3,770 pounds) of equipment. Can be used with 9 paddles or an 80 horsepower (maximum) outboard motor (OBM).	Inflation time is 10 to 15 minutes with pumps. Paddle speed is 1.5 meters per second (5 feet per second). Speed with an OBM is 4.5 meters per second (15 feet per second).	2 pumps and 9 paddles are included with each boat. OBM must be requested separately (10 per MRBC)
Pneumatic, 3-man reconnaissance boat	2 per engineer company IBCT 3 per engineer company SBCT 2 per combat engineer company HBCT 6 per MRBC	The boat is carried by backpack (1-man carry). The boat and backpack weigh 26 kilograms.	The boat can carry 3 Soldiers and Marines with equipment or 306 kilograms of equipment.	Inflation time is 5 minutes with a pump. Paddle speed is 1.0 meters per second (3 feet per second).	The maximum current velocity is 1.5 meters per second (5 feet per second). 1 pump and 3 paddles are required per boat. The boat cannot be used with an OBM.
Bridge erection boat (BEB)	14 per MRBC 21 per USMC bridge company	The boat is carried by 1 common bridge transporter (CBT) with an improved boat cradle (Army). Weight is 4,445 kilograms or MK 48/18 or a bridge trailer (USMC) or 1 medium-lift helicopter. The boat weighs 3,992 kilograms.	The boat can carry a 3-man crew and 12 Soldiers and Marines with equipment or 1,814 kilograms of equipment. Tow hook provides safe towing capacity of 2,000 kilograms. Can be deployed with a CH-47 helicopter.	Launch time from the cradle is 5 minutes.	The draft is— • 56 centimeters for normal operations. • 66 centimeters when fully loaded. • 122 centimeters for a launch from the cradle.

DESCRIPTIONS OF CROSSING MEANS

A-4. This appendix supplements a general description of the crossing means discussed in Chapter 2. It provides a graphic of the equipment as well as equipment capability tables that should be useful in selecting crossing means and planning crossing operations. The tables located in this appendix provide unit allocations based on authorizations and emplacement times that only consider the estimated construction times in a best case scenario. The emplacement planning times in the tables were derived using well-trained crews in sterile OEs with times starting with the first transporter in place at the crossing site and end when the bridge is open for traffic. Planners must consider that there are many variables that can impact the actual amount of bridging available and the emplacement times when determining the resources necessary and the time required. Challenges such as unit training, experience, and the tactical situation in conjunction with the results of the gap reconnaissance (gap width, gap bank conditions and slope, stream velocity, visibility, terrain, weather conditions, and accessibility) must all be considered during the mission analysis to assist in developing an accurate timeline and execution matrix to support the gap-crossing operation.

A-5. Available crossing means dictate both the manner of crossing operations and the force buildup rate on the farside. Before the commander develops his tactics, he must understand how the available crossing means may impact his ability to mass forces on the farside. The following are some of the crossing means that the military uses to cross a gap:

- Fording.
- Swimming.
- Amphibious vehicles.
- Helicopters.
- Boats.
- Rafts.
- Bridges.
- Other nonbridging means.

FORDING

A-6. Combat vehicles can ford shallow wet gaps that have a limited current velocity and stable beds. Some vehicles have kits to increase the fording depth, to include the USMC, which has the deepwater fording kit (DWFK) for the M1A1 tank. Fording is possible for current velocities that are less than 1.5 miles per second. If fording a riverbed, the site must be firm and free of large rocks and other obstructions. Vehicle-operator manuals contain specific depth capabilities and required adaptations. The AVLB, JAB, and Wolverine can be used to assist fording vehicles in deep water. See Table A-2, page A-4.

Table A-2. Fording and Swimming Capability of Selected Combat Vehicles

Equipment	*Fording Depth*	*Ford Depth With Preparation*	*Ford Depth With Kit*	*Swimming Data*
M113 series	1.02 meters			Nonswimmer
M2/M3 series	1.10 meters			Nonswimmer
M1 series[2]	1.20 meters		Note 2	Nonswimmer
Stryker infantry carrier vehicle (ICV) series	1.00 meters			Nonswimmer
Light assault vehicle (LAV) series[3]				Fully amphibious with 3 minutes of preparation Swim speed–6 miles per hour in current up to 2.5 meters per second
Amphibious assault vehicle (AAV) 7A1 series[3]				Fully amphibious Swim speed–6 to 8 miles per hour in current up to 2.5 meters per second
Expeditionary fighting vehicle (EFV) series[3]				Fully amphibious Swim speed–23 to 28 miles per hour in sea state 3[4]
JAB[5]	1.20 meters		Note 5	Nonswimmer

Notes.

[1] Fording capability can vary based on various factors including current, bottom structure, and bank slope.

[2] M1 series (USMC) is capable of fording up to 2.37 meters with a DWFK.

[3] Reflects vehicles that are also capable of swimming as well as fording. Only the USMC is equipped with this variant.

[4] Wind: 7 to 10 knots, gentle breeze, large wavelets, crests beginning to break, scattered whitecaps, and light flags extended.

[5] Fording kit for the JAB is under development.

SWIMMING

A-7. Some combat vehicles can swim (Table A-2). Entry and exit points must be clear of obstructions and have slopes consistent with the vehicle's capabilities. The current's velocity sets limits. Crews of amphibious vehicles prepare and inspect each vehicle before entering the water. Engineer assistance, including recovery vehicles and standing cables, maximizes swimming opportunities.

AMPHIBIOUS VEHICLES

A-8. The LCAC is the primary vehicle used by the USMC to move tactical equipment and Marines from ship to shore. It is a high-speed, fully amphibious craft capable of carrying a 60-ton payload at speeds in excess of 40 knots, at a nominal range of 200 nautical miles. Its ability to ride on a cushion of air allows it to operate directly from the well decks of amphibious warships and to access more than 70 percent of the world’s beaches. See Figure A-1.

Figure A-1. Landing Craft Air Cushion

A-9. The AAV P7A1 (Figure A-2) is an armored assault amphibious full-tracked landing vehicle. The vehicle carries troops in water operations from ship to shore, through rough water and surf zone. It also carries troops to inland objectives after ashore. The amphibious capability of the AAV makes it unique among all the military's land combat systems. The primary responsibility of AAVs during an amphibious operation is to spearhead a beach assault. They disembark from the ship and come ashore, carrying infantry and supplies to the area to provide a forced entry into the amphibious assault area for the surface assault element. Once the AAVs have landed, they can take on several different tasks. The standard AAV comes equipped with an MK-19 grenade launcher and an M2 .50-caliber machine gun. With a 10,000-pound capacity, the AAV can also be used as a bulk refueler or a field-expedient ambulance. The vehicle has a water speed of 6 to 8 miles per hour and can travel up to 45 miles in the water. On land, it can travel 15 to 20 miles per hour with a range of 300 miles.

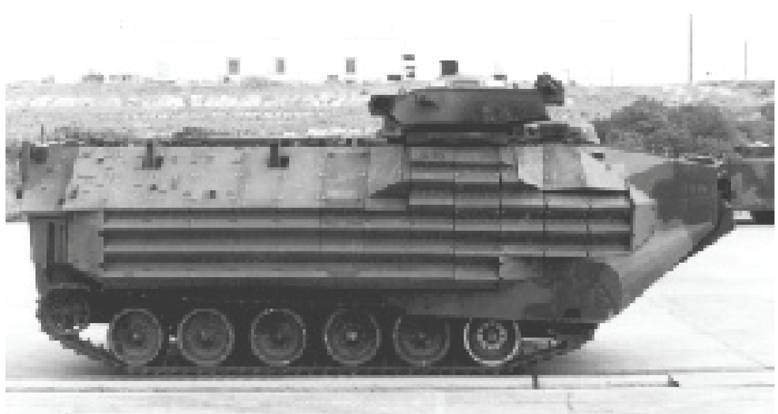


Figure A-2. Amphibious Assault Vehicle P7A1

A-10. The EFV (Figure A-3, page A-6) is a keystone vehicle for both the Marine Corps expeditionary maneuver warfare (EMW) and ship-to-objective maneuver (STOM) warfighting concepts. It will replace the AAV P7A1 and represent the Marine Corps as its primary means of tactical mobility for the Marine rifle squad during the conduct of amphibious operations and subsequent ground combat operations ashore. The EFV is an armored amphibious vehicle capable of seamlessly transporting Marines from Naval ships located beyond the visual horizon to inland objectives. While providing the speed and maneuvering capabilities to operate with the main battle tank (MBT) on land, it can also cross gaps such as lakes and rivers. The EFV has two variants; the EFVP1 and the EFVC1. The EFVP1 has a 3-man crew and is capable of initiating amphibious operations from 20-25 miles over the horizon (OTH) and transporting 17 combat equipped Marines to inland objectives. It is a fully-armored, tracked combat vehicle equipped with an MK46 30-millimeter weapon station and 7.62-millimeter coax machine gun. The EFVC1 provides the same armor as the EFVP1, but is employed as a tactical command post for maneuver unit commanders at the battalion and regimental level. It is equipped with a 7.62-millimeter machine gun. Both of the EFV variants have a water speed of 23 to 29 miles per hour on water and about 30 miles per hour on land. They have a range of 65 miles in the water and 300 miles on land.

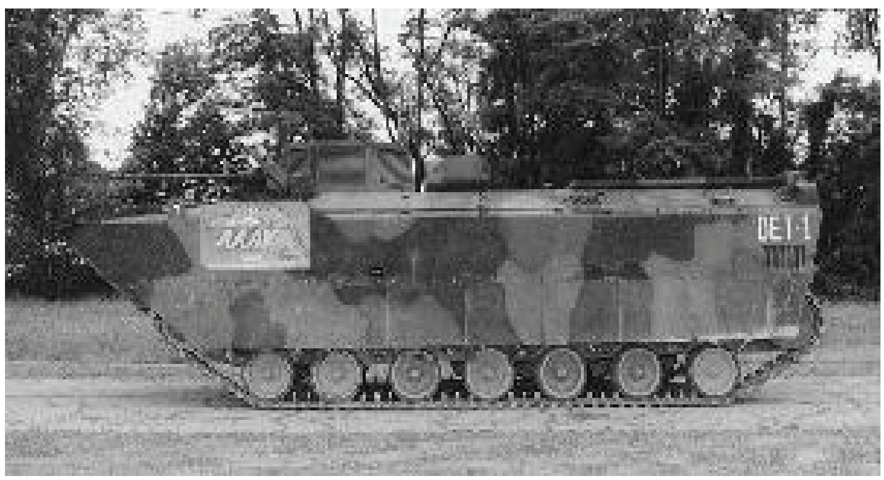


Figure A-3. Expeditionary Fighting Vehicle

A-11. The family of light armored vehicles (FOLAV) includes 8 x 8 wheeled light armored combat, combat support, and combat service support vehicles. The light armored vehicle family of vehicles (LAVFOV) consists of seven fielded LAV configurations, and one communication/intelligence-configured asset on an LAV chassis. The LAV-25 is the baseline vehicle chassis and is primarily used for the combat and combat support roles. It is based on the Mowag Piranha family of armored fighting vehicles used by the USMC. Powered by Detroit diesel turbo-charged engines, they are 4-wheel drive (rear wheels) transferable to 8-wheel drive. These vehicles are also amphibious, meaning they have the ability to "swim," but are limited to nonsurf bodies of water (no oceans). While engaged in amphibious operations, the maximum speed is approximately 6 miles per hour. Typical land speeds are approximately 62 miles per hour in either 4- or 8-wheel drive; however, fuel economy decreases in 8-wheel drive. The vehicles operate on diesel fuel, and require 3 weights of lubricants to remain in running condition. They are equipped with a M242 25-millimeter cannon, two M240 7.62-millimeter machine guns, and two 4-barrel launchers usually loaded with smoke canisters. The crew is three and four passengers with combat gear. See Figure A-4.

Figure A-4. Light Armored Vehicle

HELICOPTERS

A-12. A primary crossing means for carrying dismounted infantry across a gap may be helicopters. Selected types of helicopters may also be used to lift other crossing assets to the gap and carry essential combat support and critical resupply across it. See Table A-3 for characteristics of external loads for aircraft.

Table A-3. Typical External Loads for Helicopters

Equipment	*Weight in Kilograms (pounds)*	*Remarks*
BEB MK II-S	4,445 (9,800)	The boats are lifted in the bow-and-stem configuration without the cab and placed directly on water surfaces.
Ribbon bridge bays		The bays are placed directly on water surfaces.
SRB		
Interior bays	5,443 (12,000)	
Ramp bays	5,307 (11,700)	
IRB		
Interior and ramp bays	6,350 (14,000)	
REBS bridge	4,800 (10,582)	The bridge can be emplaced directly over the gap.*
DSB pallets	Maximum weight of a single pallet load of DSB: 10,473 (23,040)	Transported to the bridge site in a palletized load configuration. The DSB launcher (M1975 launch vehicle [LV]) is not helicopter transportable.*
Note. * If using a helicopter lift, refer to TM 5-5420-280-10 for the REBS or TM 5-5420-279-10 for the DSB.		

BOATS

A-13. Pneumatic assault boats are another crossing means for dismounted infantry and accompanying elements. For light infantry, assault boats may be the only means required if air resupply is available. They carry 12 assault troops and a 2-man engineer crew in a silent or powered crossing OBM.

RAFTS

A-14. Heavy rafts are often the initial crossing means for tanks and other fighting vehicles. They are faster to assemble than bridges and can operate from multiple sites to reduce their vulnerability. The MRBC can provide heavy rafting utilizing the IRB (Figure A-5 and Tables A-4 through A-8, pages A-8 through A-10).

Figure A-5. Ribbon Raft

Table A-4. Launch Restrictions

Characteristics	*Free Launch*	*Controlled Launch*	*High-Bank Launch*
Minimum depth of water required in centimeters (inches)	Ramp bay 112 (44) Interior bay 92 (36)**	76 (30)*	76 (30)**
Bank height restrictions in meters (feet)	0-1.5 (0-5)	0	1.5-8.5 (5-28)
Bank slope restrictions	0-30 percent	0-20 percent	Level the ground unless the front of the truck is restrained.
Notes. * This is the recommended water depth. The launch could technically be conducted in 43 centimeters (17 inches) of water. ** The launch is based on a 10 percent slope with the transporter backed into the water. The required water depth for a 30 percent slope with a 1.5-meter (5 feet) bank height is 183 centimeters (72 inches). Interpolate between these values when needed.			

Table A-5. Allocation of Ribbon Bridge

Components	*Per Multirole Bridge Company*	*USMC Bridge Company*
Bridge platoons	2	1
Interior bays	30	12
Ramp bays	12	5
BEBs	14	21
Note. The longest ribbon bridge that can be constructed is 215 meters.		

Table A-6. Ribbon Raft Design (Standard Ribbon Bridge)

Raft Types	*Assembly Time in Minutes*	*Load Space in Meters (feet)*	*Rafting Method Longitudinal (L) Conventional (C)*	*Current Velocity in mps (fps) and MLC*							
				0-0.9 (0-3)	*1.2 (4)*	*1.5 (5)*	*1.75 (6)*	*2 (7)*	*2.5 (8)*	*2.7 (9)*	*3 (10)*
3 bays (2 ramps/ 1 interior)	8	6.7 (22)	L C	45 45	45 45	45 35	40 25	40 15	35 10	30 0	25 0
4 bays (2 ramps/ 2 interiors)	12	13 (44)	L C	70 60	70 60	70 60	60 55[1]	60 40[1]	60 30[1]	55 15[1]	45 0[1]
5 bays (2 ramps/ 3 interiors)	15	20.1 (66)	L C	75 75	75 70	75 70	70 70[1]	70 60[1]	70 50[1]	60 25[1]	60 0[1]
6 bays (2 ramps/ 4 interiors)	20	26.8 (88)	L (W/T) C (W/T)	96/80 96/70	96/80 96/70	96/80 96/70	96/70 70/70[1]	96/70 70/70[1]	96/70 55/55[1]	70/70 30/30[1]	70/70 0[1]

Notes:
If the current's velocity in the loading/unloading area is greater than 1.5 mps (5 fps), then conventional rafting must be used.
Roadway width of a standard ribbon raft is 4.1m (13 ft 5 in) and the draft of a fully loaded ribbon raft is 61 cm (24 in).
Vehicles should only be loaded on the interior bays.
Each raft requires a minimum of two BEBs for propulsion.
The assembly time for a raft increases by 50 percent at night.
Do not mix SRB and IRB bays for rafting operations.
[1] Three BEBs are required for conventional rafting of 4, 5, or 6 bay rafts in current velocities greater than 1.5 mps (5 fps).

Table A-7. Ribbon Raft Design (Improved Ribbon Bridge)

Raft Types	*Assembly Time in Minutes*	*Load Space in Meters (feet)*	*Rafting Method Longitudinal (L) Conventional (C)*	*Current Velocity in mps (fps) and MLC*					
				0.0	*0.3-0.6 (1-2)*	*0.9-1.2 (3-4)*	*1.5-1.8 (5-6)*	*2.1-2.4 (7-8)*	*2.7-3.0 (9-10)*
4 bays (2 ramps/ 2 interior)	12	13 (44)	L C	70 70	70 70	70 70	70 70	65 60	60 30
5 bays (2 ramps/ 3 interiors)	15	20.1 (66)	L C	90 90	90 90	90 90	90 90	85 75	80 40
6 bays (2 ramps/ 4 interiors)	20	26.8 (88)	L C	105 105	105 105	105 105	105 105	100 100	95 60
7 bays Single (2 ramps/ 5 interiors)	24	33.5 (110)	L (W/T) C (W/T)	115 115	115 115	115 115	115 115	110 105	105 65
7 bays Multiple (2 ramps/ 5 interiors)	24	33.5 (110)	L (W/T) C (W/T)	140 140	140 140	140 140	140 140	135 125	130 80

Notes:
Assembly times do not include site preparation, travel times to/from the EEP, or other mitigating factors. Planners must consider operational conditions and factors to develop actual emplacement timelines.
If the current's velocity in the loading/unloading area is greater than 1.5 mps (5 fps), then conventional rafting must be used.
The roadway width of an improved ribbon raft is 4.5 m (14 ft 9 in).
Water depth of less than 2 m (6' 7") in combination with current speeds in excess of 1.2 m/s (4f/s) will reduce MLC rating on above chart.
Each raft requires a minimum of two BEBs for propulsion.
The assembly time for a raft increases by 50 percent at night.
4-6 bay rafts, MLC ratings are for single or multiple vehicles, 7 bay rafts have separate ratings for single and multiple vehicles.
Refer to TM 5-5420-278-10
Three BEBs are required for conventional rafting of 4, 5, 6 or 7 bay rafts in current velocities greater than 1.5 mps (5 fps).

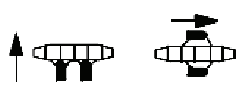


Table A-8. Raft Crossing Capabilities

River Width		*Minutes per Round Trip*	*Round Trips per Hour*	*Number of Rafts per Centerline*
Feet	*Meters*			
246	75	7	8	1
328	100	8	7	1
410	125	9	6	1
492	150	10	6	2
610	188	11	5	2
738	225	12	5	2
861	263	14	4	3
964	300	16	3	3
1,148	350	18	3	4
1,312	400	20	3	5
1,476	450	22	2	5
1,640	500	24	2	5
1,968	600	26	2	6
2,296	700	29	2	6
2,824	800	32	1	6
2,952	900	35	1	6
3,280	1,000	38	1	6
3,808	1,100	41	1	6
3,936	1,200	45	1	6

Notes.
1. This table is valid for ribbon rafts in current velocities up to and including 1.5 meters per second (5 feet per second).
2. This data is based on using crews under ideal conditions.
3. Round-trip times include the times required to load and unload the raft.
4. Crossing times will take 50 percent longer at night.
5. If the river width falls between 2 columns, use the value found in the next highest column.

BRIDGES

A-15. The following sections describe standard bridging assets for the three bridging categories: tactical, support, and LOC. These listed bridges are currently in the Army and/or USMC inventory, are in the procurement, testing, and fielding process, or are the most common bridges currently being purchased as COTS bridging.

Tactical Bridging

A-16. The AVLB is an organic engineer asset based on the M60 (or M48 for some nations) that can travel with maneuvering tactical formations and can quickly gap up to 18 meters for MLC 70 vehicles. It is unable to effectively maintain the tempo of M1 or M2 equipped units. The launcher can launch the bridge without exposing bridge personnel to enemy fire and can retrieve the bridge from either end (Figure A-6 and Table A-9).

A-17. The JAB (Figure A-7, page A-12 and Table A-10, page A-12) and the Wolverine (Figure A-8, page A-13 and Table A-11, page A-13) will eventually replace the AVLB. The Wolverine and the JAB are each based on the M1-series Abrams tank chassis and modified to transport, launch, and retrieve an MLC 70 bridge. Because they are both mounted on the M1 chassis, they are able to maintain the tempo of all combat maneuver organizations. The Marine Corps uses the AVLB and the JAB and they are organic to the Marine Corps armor battalions. They are organic to the MAC for Army organizations. Only selected Army MACs are equipped with the Wolverine.

A-18. The JAB will support the assault force with the capability of spanning obstacles up to 60 feet (18.3 meters) from the high watermark inland. The JAB provides a rapidly employable, short-gap, assault crossing bridge capable of spanning road craters, antitank ditches, partially blown bridges, railroad cuts, canals, rivers, and ravines.

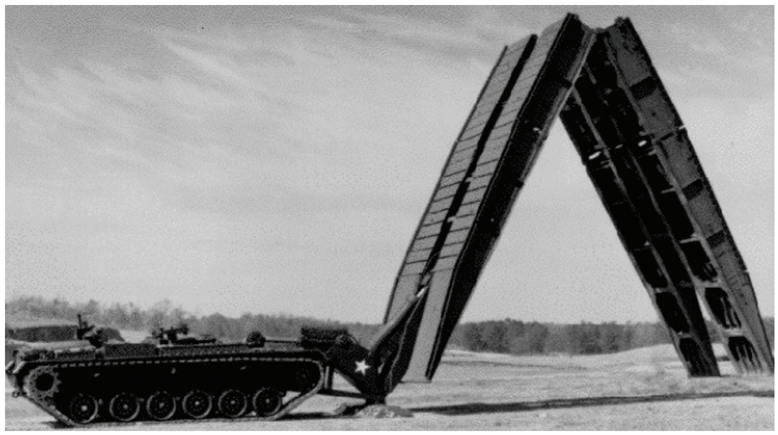


Figure A-6. Armored Vehicle-Launched Bridge

Table A-9. Characteristics of the Armored Vehicle-Launched Bridge

Allocation	***Transportation***	***Emplacement***	***Capacity Classification***	***Limitations/ Remarks***
6 per MAC	The AVLB— • Is carried on a launcher (a modified M48A5 or an M60A1 chassis). • Weighs 15,000 kilograms (15 tons) (bridge only). • The spare bridge is folded on a 25-ton low bed trailer with a 10-ton tractor (usually consolidated at corps or theater level).	The AVLB— • Can be launched in 2 to 5 minutes by a buttoned up 2-man crew. • Can be retrieved from either end. • Requires that 1 man be exposed to guide and connect while retrieving.	The total length of the AVLB is 19.2 meters (63 feet).* The AVLB is capable of holding an MLC 60 vehicle across— • A 17.4 meters (57 feet) gap with unprepared abutments. • An 18.3 meters (60-feet) gap with prepared abutments.	

Notes.
For crossings on the AVLB that exceed MLC 60:

(1) Vehicles must not stop on the bridge.

(2) Vehicles must not turn or adjust their alignment on the bridge.

(3) The ground guide must have the vehicle lined up properly before it drives onto the bridge.

(4) All four center pins of the bridge must be in place to provide additional stability.

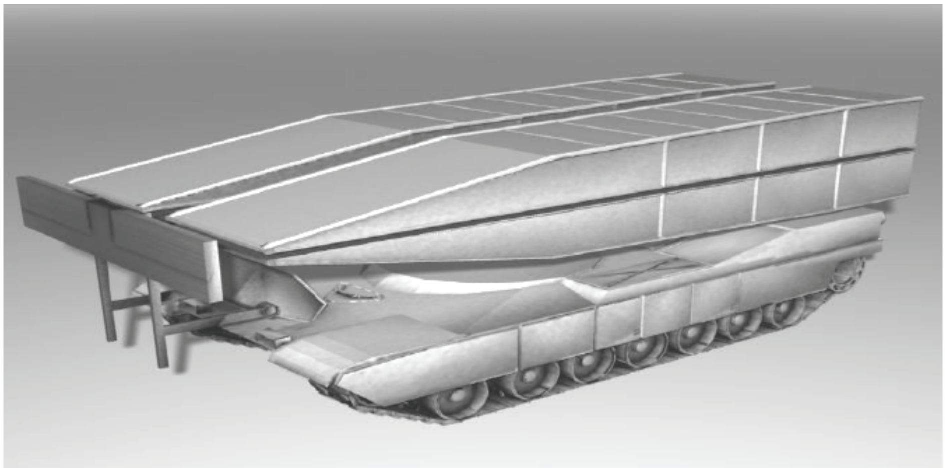


Figure A-7. Joint Assault Bridge

Table A-10. Characteristics of the Joint Assault Bridge

Allocation	*Transportation*	*Emplacement*	*Capacity Classification*	*Limitations/ Remarks*
6 Per MAC (will replace the AVLB)	The JAB— • Is carried on a launcher (a modified M1-series Abrams tank chassis). • The spare bridge is folded on a 25-ton low bed trailer with a 10-ton tractor (usually consolidated at corps or theater level).	The JAB— • Can be retrieved from either end. • Requires that 1 man be exposed to guide and connect while retrieving.	The total height of the JAB is 13.1 feet. The JAB is capable of holding an MLC 70 vehicle across an 18.3 meters (60 feet) gap.	The JAB is currently being tested. Only good when spanning obstacles/gaps of 60 feet (18.3 meters).

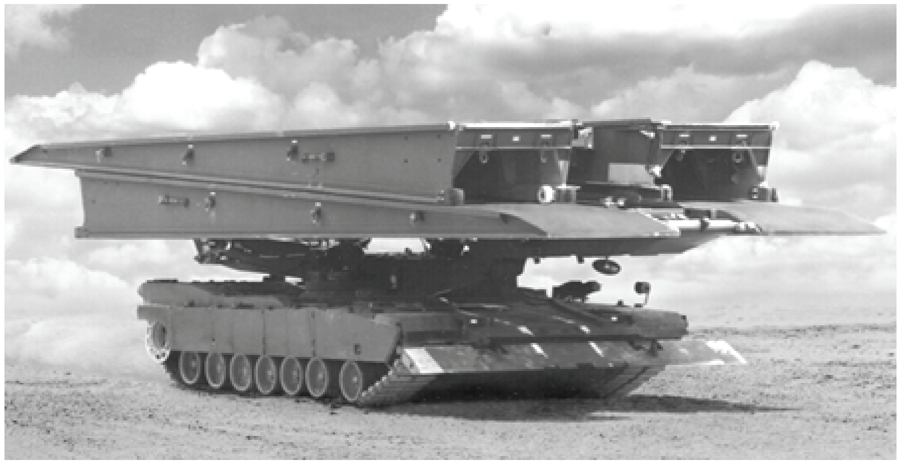


Figure A-8. Wolverine

Table A-11. Characteristics of the Wolverine

Allocation	*Transportation*	*Emplacement*	*Capacity Classification*	*Limitations/ Remarks*
6 per MAC (Only 6 selected MACs are equipped with Wolverines)	The Wolverine— • Is carried on a launcher (a modified M1-series Abrams tank chassis). • Weighs 12,500 kilograms (12.5 tons) (bridge only).	The Wolverine— • Can be launched in less than 5 minutes by a buttoned up 2-man crew. • Can be retrieved from either end. • Can be recovered in less than 10 minutes.	The Wolverine— • Can hold an MLC 70 vehicle. • Expands to a total length of 24 meters.	The launcher and bridge has a maximum speed of 83 kilometers per hour. The Wolverine can ford up to a depth of 122 centimeters (without a kit).

Support Bridging

A-19. Support bridges (excluding float bridges) rest on the gap sides or riverbanks. They span dry gaps as well as wet gaps. They have limited use for the initial assault because they are slower to emplace and vulnerable to enemy action. Where appropriate, other standard or nonstandard bridging supplements or replaces float bridges.

A-20. The REBS (Figure A-9, page A-14, and Table A-12, page A-14) is a deployable and retrievable bridge that provides the SBCT with a gap-crossing capability. The REBS can be employed by two Soldiers within 10 minutes and is air-transportable by the C-130. The REBS has an MLC 30 and is capable of crossing gaps up to 13 meters wide. It is also capable of an MLC 40 caution crossing. The REBS is designed to serve as a support bridge, however, it may be used as a tactical bridge as the situation and time permits.

Figure A-9. Rapidly Emplaced Bridge System

Table A-12. Characteristics of the Rapidly Emplaced Bridge System

Allocation	*Transportation*	*Emplacement*	*Capacity Classification*	*Limitations/ Remarks*
4 per EN CO SBCT	REBS— • The bridge is carried on an integrated pallet/launch platform. • The bridge and pallet are carried together on the CBT. • Weighs 10,582 pounds, 4800 kilograms (bridge only). • Weighs 20,856 pounds, 9460 kilograms (bridge and pallet).	REBS— • Can launch in less than 10 minutes with a 2-man crew. • Can be retrieved from either end. • Can be recovered in less than 10 minutes with a 2-man crew.	REBS— • Can hold an MLC 40 vehicle • Can be used to bridge a maximum of 13 meters of an unprepared gap.	The bridge is capable of being lifted/ emplaced by helicopter. The pallet with the bridge is C-130 transportable.*

Notes.
Emplacement times vary based on many factors (such as unit training, experience, and site preparation). Planners must consider these and other operational conditions and factors to develop actual emplacement timelines.
* To transport by C-130, the REBS must be placed on 463 L pallets.

A-21. The MGB (Figure A-10 and Tables A-13 through A-16, pages A-15 through A-17) is lightweight, hand-built bridging equipment that can be built in various configurations serving as a support bridge. Its parts are fabricated from a specially developed zinc, magnesium, and aluminum alloy that enables a lightweight, high-strength bridge to be built. All except three parts weigh less than 200 kilograms. Most parts can be handled easily by four Soldiers and Marines. The three heavier parts, used in limited quantities, are six-man loads.

A-22. The MGB is a two-girder, deck bridge. The two longitudinal girders with deck units between provide a 4-meter-wide roadway. Girders of top panels can form a shallow, SS configuration. This type of bridge is used for short spans that will carry light loads. A heavier DS configuration using top panels and triangular bottom panels is used for heavy loads or longer spans. SS bridges can be constructed by 9 to 17 Soldiers and Marines. The normal building party for DS bridges is 25 Soldiers and Marines.

A-23. The bridge can be supported on unprepared and uneven ground without grillages. It is constructed on one roller beam for SS construction; on two roller beams, 4.6 meters apart for DS construction; and on three roller beams when constructing a DS bridge over 12 bays long. The ends of the roller beams are supported on base plates and each can be adjusted in height. No leveling or other preparation of the ground is required. Single-span bridges are launched using a centrally mounted launching nose.

A-24. A third configuration using the LRS is constructed when a long, high-class type of bridge is required. The LRS deepens the girder and transfers the load throughout the length of the bridge. This type of construction requires a building party of 34 Soldiers and Marines, and is built on three roller beams.

Figure A-10. Medium Girder Bridge

Table A-13. Work Parties and Construction Times for the Medium Girder Bridge (Army)

Bridging Activity	*Work Party*	*Construction Time (Hours)*	
		Day	*Night*
4 and 5 bay SS (7.9 to 9.8 meters or 26 to 32 feet)	1 noncommissioned officer (NCO) and 8 personnel	1/2	3/4
6 through 12 bay SS (11.6 to 15.2 meters or 38 to 50 feet)	1 NCO and 16 personnel	3/4	1
9 through 12 bay SS		1	1 1/4
1 through 4 bay DS	1 NCO and 24 personnel	3/4	1 1/4
5 through 8 bay DS		1	1 1/2
9 through 12 bay DS		1 1/2	2
13 bay DS without LRS		1 1/2	2
14 through 18 bay DS without LRS		1 3/4	2 3/4
19 through 22 bay DS without LRS		2	3
13 bay DS with LRS	2 NCO and 32 personnel	2	3
14 through 18 bay DS with LRS		2 3/4	4
16 through 22 bay DS with LRS		3	4 1/2
Note. Construction times vary based on many factors (such as unit training, experience, and site preparation). Planners must consider these and other operational conditions to develop actual emplacement timelines.			

Table A-14. Work Parties and Construction Times for the Medium Girder Bridge (USMC)

Configuration	*Gap Length*	*Transport Required**	*Personnel*		*Construction Time (Hours)*	
SS	Up to 9 meters	7	***NCO***	***Workforce***	***Day***	***Night***
			1	8	1 hr	1 1/4 hr
DS	Up to 29 meters	11	***NCO***	***Workforce***	***Day***	***Night***
			1	16	1 1/2 hr	2 hr
DS with LRS	Up to 40 meters	15	***NCO***	***Workforce***	***Day***	***Night***
			1	24	3 hr	4 1/2 hr

Notes.
1. Emplacement times vary based on many factors (such as unit training, experience, and site preparation). Planners must consider these and other operational conditions to develop actual emplacement timelines.
2. Six sets per USMC bridge company. Each set is equipped with enough components to build one of the configurations shown above.
3. Maximum approach ramp slope not to exceed 1:10 for SS, DS, and XX.
4. Maximum approach ramp slope not to exceed 1:20 for DS with LRS.
5. Maximum size for each configuration is depicted in this table.
6. Actual requirements will vary based on actual bridge configuration and proficiency of personnel.

*Value is expressed in quantity of 7-ton trucks. Includes vehicles for transportation of personnel.

Table A-15. Single-Story Bridge Length and Classification for the Medium Girder Bridge

Bridge Length		*Number of Bays*	*MLC*
Feet	***Meters***		
26	7.9	4	70
32	9.8	5	70
38	11.6	6	40
44	13.4	7	30
50	15.2	8	30
56	17.1	9	24
62	18.9	10	20
68	20.7	11	16
74	22.6	12	16

Table A-16. Classification for the Medium Girder Bridge Double Story, Double Story Without Link Reinforcement Set, and Double Story With Link Reinforcement Set

Bridge Length		***2E + Number of Bays***	***MLC***	
Feet	***Meters***		***Without Link Reinforcement***	***With Link Reinforcement***
37	11.0	1	70	–
43	12.8	2	70	–
49	14.6	3	70	–
55	16.5	4	70	–
61	18.3	5	70	–
67	20.1	6	70	–
73	21.9	7	70	–
79	23.8	8	70	–
85	25.6	9	70	–
91	27.4	10	70	–
97	29.3	11	70	–
103	31.1	12	70	–
109	32.9	13	60	70
115	34.8	14	50	70
121	36.6	15	40	70
127	38.4	16	40	70
133	40.2	17	30	70
139	42.1	18	30	70
145	43.9	19	24	70
151	45.7	20	24	70
157	47.6	21	20	70
163	49.4	22	16	70
Note. Emplacement times vary based on many factors (such as unit training, experience, and site preparation). Planners must consider these and other operational conditions to develop actual emplacement timelines.				

A-25. Now being fielded as a replacement for the MGB in the MRBCs is the M18 DSB. It is a mobile, rapidly erected, modular component bridge that provides a 40-meter gap-crossing capability with an MLC of 70T/96W. It has advantages over the MGB in that it can be erected in much less time with fewer personnel and equipment. Each MRBC is capable of emplacing up to four 40-meter bridges or eight 20-meter bridges with organic equipment (Figure A-11, page A-18, and Table A-17, page A-18).

Figure A-11. M18 Dry Support Bridge

Table A-17. Characteristics of the M18 Dry Support Bridge

Allocation	*Transportation*	*Emplacement*	*Capacity Classification*	*Limitations/ Remarks*
4 per MRBC	The DSB— • Launcher is a separate vehicle (M1975 LV). • One 40-meter bridge is transported on seven PLS pallets. • Complete system is transportable and requires one M1975 LV with trailer and three M1977 CBT with trailers.	The DSB— • 40-meter bridge can be launched in 90 minutes with an 8-man crew. • 40-meter bridge can be retrieved in less than 150 minutes with an 8-man crew. • Can be retrieved from either end.	The DSB— • MLC for all bridge configurations (70T/96W). • Can provide one 40-meter bridge or two 20-meter bridge configurations.	The DSB— • Maximum approach ramp angle (1:9). • All components are landing craft, utility (LCU) 2000 or larger (transportable). • Approved for C17 and C5 transport. • Zero gap capable bridge.
Note. Emplacement times vary based on many factors (such as unit training, experience, and site preparation). Planners must consider these and other operational conditions to develop actual emplacement timelines.				

Support Bridging - Float Bridges

A-26. If there is a need for a wet-gap-crossing means beyond the capability of tactical bridging, it should be understood that, in most cases, rafts alone will not handle the total volume of traffic in the needed time. Floating bridges are the primary means to cross the force and its supplies rapidly. The same units that provide heavy rafts also provide float bridges. They often assemble bridges from the rafts used earlier.

A-27. The SRB and IRB (Figures A-12 and A-13 and Table A-18, pages A-20 and A-21) are modular, aluminum-alloy, and continuous floating bridge systems consisting of interior and ramp bays that are transported, launched, and retrieved by a transporter/launcher vehicle. Bridge bays, which are carried in a folded position, automatically open upon entering the water to form a 22-foot section of bridge.

A-28. Ribbon equipment is designed for use primarily during the rafting and bridging phases of the deliberate wet-gap crossing. Because ribbon bridges and rafts are significantly faster to construct with fewer personnel than other floating bridges, they are heavily relied upon in this capacity. Site considerations are of primary importance when ribbon equipment is to be used for rafting or bridging operations. Both the launch sites and actual bridge or raft sites should be considered.

A-29. Ribbon bridges can be emplaced during daylight hours at the rate of 200 meters per hour or 600 feet per hour. Assembly times should be increased by 50 percent when construction is at night. These times are also based upon an experienced bridge crew for bridge construction under ideal conditions. Like the other bridging emplacement times provided in this manual, planners must consider challenges such as unit training and experience and the tactical situation in conjunction with the results of the gap reconnaissance (such as gap width, gap bank, conditions of the slope, stream velocity, visibility, terrain, weather conditions, and accessibility). Other unique planning considerations for float bridging impacting emplacement times are simultaneous bay launch, distance to the EEP, and the number of BEBs supporting construction. All of these factors must be incorporated into the mission analysis to make an actual determination of emplacement times.

A-30. The river's current velocity can impact significantly upon all float bridging operations. Ribbon equipment can be used in currents of 0 to 10 feet per second. Rafting and bridging operations can become quite difficult in currents greater than 5 feet per second unless the boat operators and bridge crewmen have experience working in swift currents. For raft sites on rivers with currents greater than 5 feet per second, the unloading site on the farside should be located downstream of the loading site on the nearside to allow for a downstream drift.

A-31. The IRB is a modular floating bridge with integral superstructure and floating supports. A complete IRB consists of a ramp bay at each bank and the required number of interior bays to complete the bridge. Individual bays may be joined to form a raft for rafting or ferrying operations. The IRB mission is to provide a continuous roadway or raft capable of crossing assault or tactical vehicles over nonfordable wet gaps. IRBs have an MLC of 70T/96W.

A-32. The IRB is employed in the same general manner as the SRB. However, it will be able to cross faster water with higher MLCs and with banks that are up to 2 meters high. The IRB bays are modified ribbon bays. They possess better hydrodynamics, providing the capability of rafting or bridging MLC 70T traffic in currents up to 8 feet per second. The bays can be connected in 1 minute and can be connected to the standard ribbon bays. The bays include positive flotation to increase the survivability of the system. The ramp bays can be hydraulically articulated to 2 meters.

Figure A-12. Ribbon Bridge

The number of interior bays =

$$\frac{\text{Gap (meters)} - 14}{6.7}$$

or

$$\frac{\text{Gap (feet)} - 45}{22}$$

Notes:

1. Two ramp bays are required for all ribbon bridges.
2. During daylight hours, a ribbon bridge can be constructed at the rate of 200 meters (600 feet) per hour and during nighttime hours, at the rate of 133 meters (437 feet) per hour.
3. Two hundred vehicles per hour, with 30-meter spacing at 16 kilometers per hour, can cross the bridge.

Figure A-13. Ribbon Bridge Design

Table A-18. Boat Requirements for Ribbon Bridge Anchorage

Current Velocity in mps (fps)	*Number of Boats: Number of Bridge Bays*
0 to 1.5 (0 to 5)	1:4
1.5 to 2.4 (5 to 8)	1:3
2.4 to 2.6 (8 to 9)	1:2
2.7 to 3.0 (9 to 10)	Anchorage system is necessary
Note. (1)Temporary anchorage of ribbon bridges is normally done by tying BEBs to the downstream side of the bridge. (2) The number of boats required is shown in the table. (3) For long-term anchorage or if the water current dictates, additional anchorage systems will be necessary.	

Line of Communications Bridging

A-33. LOC bridging is generally conducted in areas free from the direct influence of enemy action. This does not mean that protection against attacks by air and ground forces are not considered. Their emplacement is not generally time-constrained in a tactical sense. Because of the load to be carried, potential length of service, and the longer spans (usually) of LOC bridges, a thorough reconnaissance, planning, and site preparation are essential. While there are several standard bridging options for LOC bridges, consideration should be given to nonstandard construction if time permits and resources are available; due to the length of anticipated service and to conserve standard bridging assets.

A-34. The LSB (Figure A-14 and Table A-19, page A-22) uses equipment from the COTS Compact 200® panel bridge system together with special features to make it suitable for military applications. The system is composed of a small range of standard parts: panels, chord reinforcements, transoms, decks, bracing members, ramps, grillages, and ground beams. The modular design of the equipment means it can be constructed in a large number of different configurations, allowing the system to be used for a wide range of load and spans. The LSB is a LOC bridge that can serve as a new bridge, replace a damaged bridge, or replace a support bridge to upgrade routes for heavier traffic.

A-35. The system is capable of routinely carrying loads to MLC 80 tracked and MLC 110 wheeled (MLC 80T/110W), and is designed to be left as a semipermanent bridge. To fulfill this requirement, the LSB requires only minimal maintenance. The LSB overcomes limitations in width, span, capacity and fatigue life associated with many other systems. The LSB can be built by hand, but where cranes and other mechanical handling equipment are available, the total number of man-hours to build the bridge is substantially reduced. Bridge components can be transported using a demountable rack offload and pickup system (DROPS), palletized load system (PLS) flat racks, and International Organization for Standardization (ISO) containers.

Figure A-14. Logistics Support Bridge

Table A-19. Characteristics of the Logistics Support Bridge

Allocation	*Transportation*	*Emplacement*	*Capacity Classification*	*Limitations/ Remarks*
Purchased only when needed.	LSB can be transported by numerous means: • 40-foot flat bed trailer. • PLS flat racks. • ISO containers. • 20-foot rigid trucks.	LSB— • Can be emplaced by hand or by mechanical means (crane).	LSB— • MLC 80T/110W; 48.77-meter span; normal crossing. • Single or multiple span bridges. • Roadway width of 4.2 meters; 4.72 meters between trusses.	Site preparation must be taken into account for planning. Large amount of time or personnel plus equipment must be dedicated to complete the bridge.
Note. Additional and contact information: <www.mabey.com>; email: <info@mabey.com>.				

A-36. The Acrow 700XS® (Figure A-15 and Table A-20) is a COTS system based upon a panel-type bridge design. The system is composed of a small range of standard parts: truss panels, chord reinforcements, transoms, steel decks, bracing members, bridge ramps and foot walk ramps, support piers, grillages and ground beams. The modular design of the equipment means it can be constructed in a large number of different configurations, allowing the system to be used for a wide range of load and spans. The 700XS is a LOC bridge that can serve as a new bridge, replace a damaged bridge, or replace a support bridge to upgrade routes for heavier traffic.

A-37. The system is capable of routinely carrying loads to MLC 110 tracked and wheeled (MLC 110T/110W) up to spans of 76 meters, and is designed to be left as a permanent or semipermanent bridge. To fulfill this requirement, the 700XS requires only minimal maintenance. It is available in 4.2-meter and 5.5-meter, one-lane widths. It is also available on a COTS basis in 2- and 3-lane widths. The 700XS can be built by hand, but where cranes and other mechanical handling equipment are available, the total number of man-hours to build the bridge is substantially reduced. Bridge components can be transported using DROPS, PLS flat racks, and ISO containers (ISO containers being the most common).

Figure A-15. Acrow 700XS

Table A-20. Characteristics of the Acrow 700XS

Allocation	***Transportation***	***Emplacement***	***Capacity Classification***	***Limitations/ Remarks***
Purchased only when needed.	700XS can be transported by numerous means. • 40-foot flat bed trailer. • PLS flat racks. • ISO containers. • 20-ton trucks.	The 700XS can be emplaced by hand or by mechanical means (crane, forklift, or other lift assets).	700XS— • MLC 120T/120W; 51.81-meter span; normal crossing. • Single or multiple span bridges. • Roadway width is 4.2 meters or 5.5 meters.	Site preparation must be taken into account for planning. Large amount of time or personnel plus equipment must be dedicated to complete the bridge.
Note. Additional and contact information: <www.acrowusa.com>.				

A-38. The M2 Bailey bridge is a truss bridge manually assembled by connecting panels end to end. It is used to replace support bridging, usually the MGB or DSB, but its primary purpose is to serve as a LOC bridge. The Bailey bridge system is highly labor intense but also highly versatile. In some cases, the Bailey bridge is the only support bridge suitable for long spans and heavy loads, because it can be assembled in multiple heights and widths. The Bailey bridge is maintained in war stocks both in the United States and outside the continental United States (OCONUS). The bridge system can also be assembled as a railway bridge, providing a relatively rapid repair capability (Figure A-16 and Table A-21).

Figure A-16. M2 Bailey Bridge

Table A-21. Load Classification for M2 Bailey Bridge

Type of Construction	Rafting	Span in Feet																		
		30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
SS	N	30 30	24	24	20	20	16	12	8											
	C	42 37	36 34	33 31	30 29	24	20	16	12											
	R	47 42	40 38	36 35	33 32	30 30	24	19	14											
DS	N			75 70	75 65	60 60	50 55	40 45	30 30	20	16	12	8							
	C			83 76	77 73	68 69	60 60	50 50	37 39	30 32	23	18	14							
	R			88 84	85 79	78 75	64 64	55 55	42 44	34 36	27 30	21	17							
TS	N						85 80	65 65	50 55	35 40	30 35	20	16	12	8	4				
	C						95 90	74 75	57 60	47 49	38 41	31 33	24	18	15	10				
	R						100[2] 90[2]	82 82	64 66	52 54	43 45	35 38	29 31	22	17	13				
DD	N								80 80	65 70	45 55	35 45	30 35	24	16	12	8			
	C								86 90	72 76	57 61	47 50	39 42	32 35	25	19	15			
	R								96 90	80 83	64 68	53 56	44 48	36 40	30 33	24	18			
TD	N									90 90[2]	75 80	55 60	45 55	35 45	30 35	20	16	12		
	C									100[2] 90[2]	83 90[2]	65 72	57 62	47 51	37 41	31 34	24	18		
	R									100[2] 90[2]	91 90[2]	74 80	64 70	54 58	45 48	37 40	29 32	22		
TT	N														80 75	70 70	55 60	45 55	35 40	24
	C														100 90[2]	80 90[2]	66 75	59 66	48 52	38 43
	R														100 90[2]	90 90[2]	77 87	68 77	55 62	46 51

Notes:
N = Normal, C = Caution, R = Risk
In all boxes, the upper figure represents wheeled load class; the lower figure represents tracked load class.
Limited by roadway width.

A-39. In arctic regions and areas that experience seasonal winter weather, a consideration that cannot be overlooked is "ice bridging." Ice bridging is using a thick layer of ice over a wet gap, such as a lake or river that forms a bridge. For more information on how to design and construct an ice bridge, see FM 3-34.343. Figures A-17 through A-19 and Tables A-22 through A-25, pages A-26 through A-28, provide the basic planning factors and tools when considering this type of bridge.

$$\text{MLC (WHEELED)} = \frac{T^2 \times C \times S}{25}$$

$$\text{MLC (TRACKED)} = \frac{T^2 \times C \times S}{20}$$

LEGEND:
T = Ice thickness in inches (see Figures F-18 and F-19)
C = Color factor (see Table F-22)
S = Strength factor (see Table F-23)

Figure A-17. Determining Load Classes for Ice

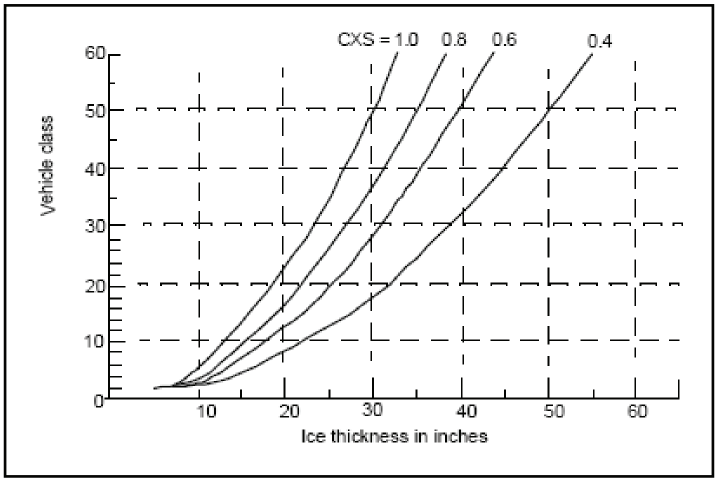


Figure A-18. Required Ice Thickness for Wheeled Vehicles

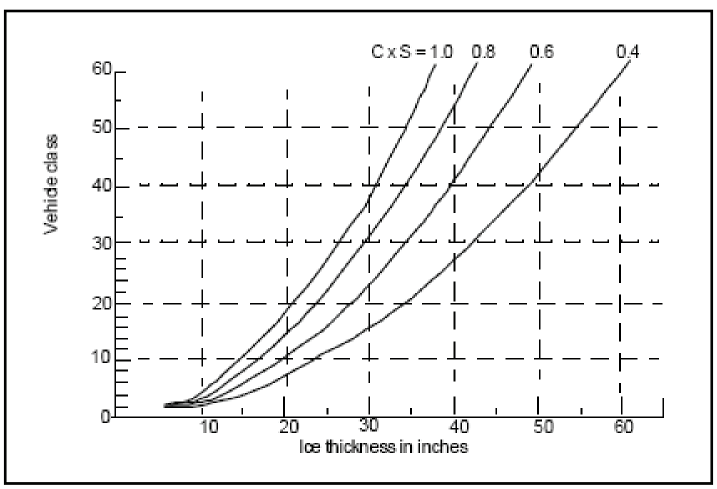


Figure A-19. Required Ice Thickness for Tracked Vehicles

Table A-22. Ice Depth Requirements

Personnel	*Ice Thickness Requirements in Inches*		
	Strong ***C = 1, S = 1***	***Medium*** ***C = 0.8, S = 0.8***	***Weak*** ***C = 0.7, S = 0.6***
On skis	1.5	2	3
In a file formation with 2-meter intervals	3	4	5
On snowmobiles	3	4	5

Table A-23. Ice Color Factors

Factor	*Characteristics*
C = 1	Ice is clear (transparent)
C = 0.9	Ice is semiclear
C = 0.8	Ice is white
C = 0.7	Ice is discolored (stained brown or yellow)

Table A-24. Ice Strength Factors

Factor	*Characteristics*
S = 1	Ice is solid, and temperatures have remained at or below freezing for the previous week.
S = 0.9	Ice is solid, and temperatures have been above freezing during the day but drop below freezing during the night.
S = 0.8	Ice is solid, and water is running on the surface from runoff or overflow.
S = 0.7	Ice is not solid, and water or air pockets are found in between layers of ice.
S = 0.6	An air pocket is under the ice, so the ice is not floating on the water underneath.

Table A-25. Ice Thickness Versus Vehicle Distance Determination

Vehicle Class (wheeled or tracked)	*Required Ice Thickness in Centimeters*	*Distance Between Vehicles in Meters (about 100 x ice thickness [in centimeters])*
1	11	11
2	15	15
3	18	18
4	21	21
5	23	23
10	33	33
15	40	40
20	48	46
25	51	51
30	58	55
35	61	61
40	65	65
50	72	72
60	79	79
70	85	85
80	91	91

Notes.
1. If the air temperature has been above freezing for more than 6 of the past 24 hours, multiply the vehicle class by 1.3 to obtain the required ice thickness. If the air temperature stays above freezing for 2 hours or more, the ice starts to lose strength, and the table no longer represents safe conditions. A rapid and unusually large temperature drop causes the ice to become brittle, and travel may not be safe for 24 hours.
2. For the distance required between two vehicles of different classes, use the distance required for the higher class.
3. If you plan to park for extended periods, multiply the vehicle class by 2 to obtain the required ice thickness and maintain at least the original distance requirements. Drill a hole through the ice near the vehicle, and move if the ice begins to flood.
4. The ice must have water support. Be very careful close to the shore. Often, the water level will drop after freeze-up. When this happens, the ice close to the shore may no longer have water support.
5. Cracks are either dry or wet. If dry, they do not penetrate the ice cover and can be ignored. If wet, multiply the vehicle class by 2 to obtain the required ice thickness, and try to drive straight across the cracks (avoid going parallel to wet cracks).

OTHER NONBRIDGING MEANS

A-40. The most common gap-crossing means not mentioned earlier include fascines, culverts, and soil. These materials can be used separately, together, or in conjunction with other crossing means. Fascines can be made out of pipe, logs, or other locally procured materials and, when tied together and placed across a gap, will reinforce the gap bottom. Not only are the materials readily available, but they are easy to assemble and, if used across a wet gap, are less likely to cause localized flooding.

A-41. Typically, culverts are used in conjunction with soil when crossing a wet gap. Like the fascine, the culvert will allow the water to continue to flow underneath the crossing surface. Culverts come in various sizes and are made of different materials. When using culverts, consideration must be given to the amount of water flow and the carrying capacity of the culvert.

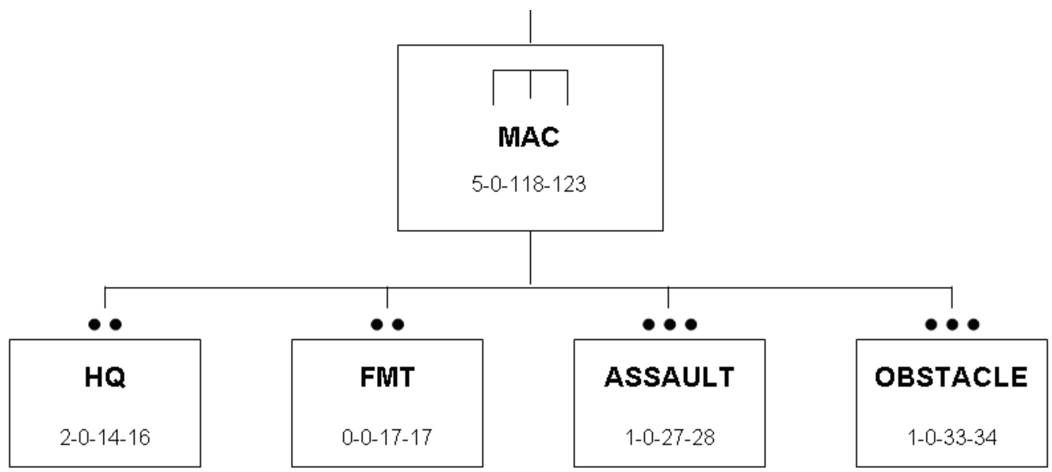
A-42. Using soil alone to fill dry gaps when the situation permits and equipment is available is perhaps one of the most rapid and perhaps one of the most effective methods. When using soil, compaction is a primary concern. Heavy vehicles or volumes of traffic will eventually displace the soil causing deep ruts resulting in a delayed crossing. Another consideration is the slope from the gap edge to the fill material. Gentle slopes at the entry and exit points will also avoid ruts and facilitate continuous traffic flow. Finally, filling the gap without leaving a culvert or other drainage method along the water flow may cause problems over time.

ARMY AND MARINE CORPS BRIDGING UNITS

A-43. While there are only a couple of U.S. units designated as bridging units, the list below will not only address those units but also those units in which bridging systems are organically found. This includes both tactical and support bridging.

MOBILITY AUGMENTATION COMPANY

A-44. The MAC is the primary engineer unit that will support BCTs in tactical gap crossing. The company has two assault platoons. Each platoon has a tactical bridge squad with three AVLBs, and the platoon is capable of providing two tactical bridges with 50 percent redundancy. Each of the tactical bridging squads three MLC 70 AVLBs are equipped with the appropriate personnel and communications equipment. Besides its tactical gap-crossing capability, the MAC is also capable of conducting breaches (mounted and dismounted) and hasty route clearance and emplacing obstacles in support of the maneuver BCT. See Figure A-20.



EQUIPMENT RECAPITULATION

B31098- (6) BRIDGE, AVLB, MLC 70
C41314- (1) STRYKER CV
D03932- (12) AN/PSS-14 MINE DETECTOR
F64544- (1) TRK CGO PLS/FRS
J97621- (13) EMGR SQD VEH (ICV)
L67342- (3) MICLIC
R50885- (1) REC VEH M88A2
T61494- (3) HMMWV CGO
T60081- (1) TRK CGO MTV
T61360- (1) M1113 HMMWV
T61908- (2) TRK M1038 MTV
T39586- (6) HEMTT W/CRANE
W76473- (4) M9 ACE

Figure A-20. Organization Chart–Mobility Augmentation Company

MULTIROLE BRIDGE COMPANY

A-45. The MRBC is organized with a company HQ, two bridge platoons, and a support platoon. Each bridge platoon has two bridge sections and a support section. The bridge sections contain the primary equipment for float bridging operations utilizing the IRB. The support section contains the primary equipment to provide support bridging to the force. The bridge sections can provide four 40-meter spans of MLC 70T/96W bridge, about 215 meters of MLC 70/96W (with SRB at 5 to 6 feet per second) float bridge, or six rafts of MLC 70. The support section will have either four DSBs or two MGBs (two bridge sets, one link reinforcement set, one erection set, and two ramp sets). The company has a maintenance section, equipment section, park section, and mess section. This allows the company to function as a single entity during gap-crossing operations. Additionally, the company can be task-organized into several sections and spread across the BCT area. See Figure A-21.

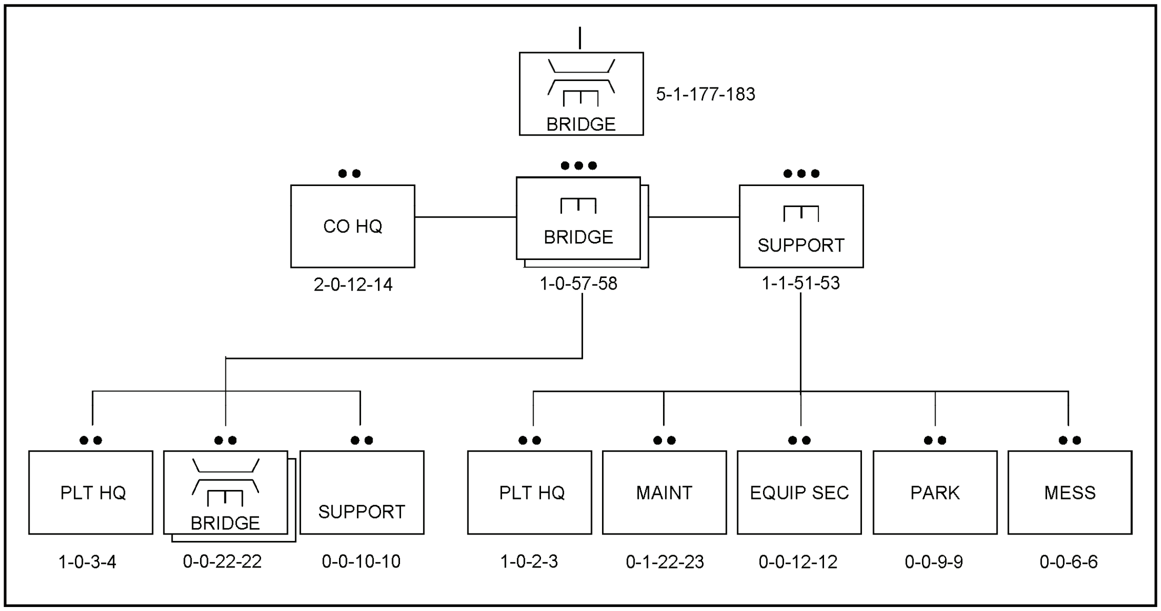


Figure A-21. Organization Chart – Multirole Bridge Company

MARINE CORPS BRIDGING

A-46. The USMC currently has one active and two Reserve Component bridge companies. The Active Component company resides in the 8th ESB. The bridge company has three MGB systems with each system containing two MGB sets, one link set, and one erection set. Those sets together give the unit the ability to construct a 22-bay, link-reinforced bridge, which spans gap lengths of 44.8 to 46.2 meters. Additionally, they have three IRB bridge sets with each set containing 12 interior bays and five ramp bays. The unit is equipped with 21 MKII BEB to support their gap-crossing operations. See Figure A-22.

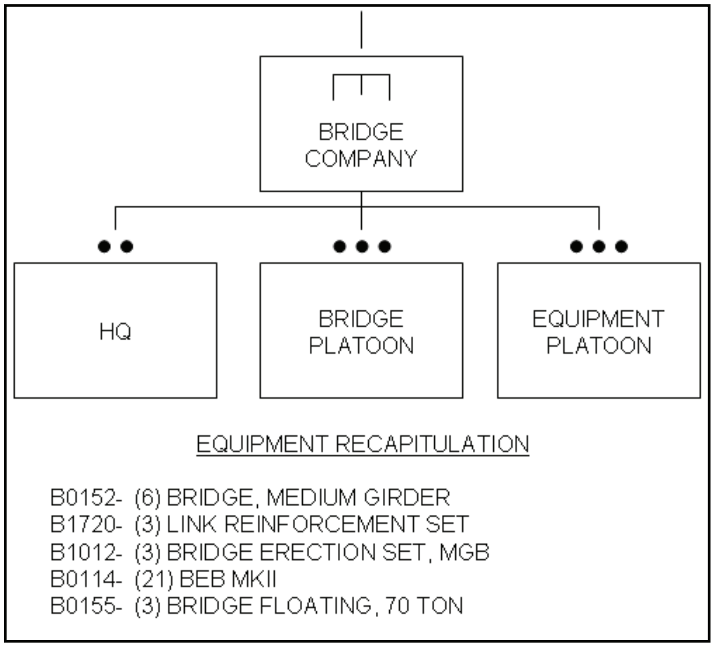


Figure A-22. Organization Chart–U.S. Marine Corps Bridge Company

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Appendix B
Crossing Site Selection

Crossing site selection is one of the most important planning considerations for a successful gap crossing. The crossing site must support the desired scheme of maneuver and available crossing means. In some cases, the preferred crossing site in terms of the gap-crossing operation is not located in an area that best supports the larger tactical operation. Other times, the preferred crossing site does not support the available crossing means. To resolve these challenges, planners must understand the complexities associated with selecting a crossing site. Reconnaissance and specifically, engineer reconnaissance is critical to the success of crossing site selection. This appendix provides the planner with some considerations to assist in evaluating a potential crossing site for a gap-crossing operation.

GENERAL

B-1. The following paragraphs supplement the general descriptions of acceptable crossing sites in Chapter 3. Selection of crossing sites is primarily based on the—

- Existing situation and anticipated scheme of maneuver.
- Physical characteristics of the available sites, road networks, and surrounding terrain.
- Availability and capabilities of gap-crossing means.
- Availability of engineer support.

B-2. Conflicts between tactical and technical requirements often occur. Commanders evaluate the factors bearing on the problem to determine the best overall solution.

CROSSING SITE SELECTION

B-3. Each gap-crossing means, except air lift (rotary wing aircraft), requires a type of crossing site. They can be identified as fording, assault boat, swimming, rafting, or bridging sites. Assault battalions use either a fording or an assault boat site (or sometimes a swimming site) as an assault site.

B-4. Both the desired scheme of maneuver and available gap-crossing means influence crossing site selection. The division assigns a crossing area to each lead brigade. The brigade chooses which crossing sites to use within its area. When a particular site is important to the division's tactical concept, such as for the movement of breakout forces, the division either coordinates with the affected brigade to open that bridge site or moves a bridge to that site once the brigade hands over the crossing area to the division.

B-5. Brigade commanders select final crossing sites based on tactical intelligence and their desired schemes of maneuver. Each site's physical characteristics, required engineer support, and available crossing means influence the decision, but tactical requirements are the most important.

B-6. The goal when selecting assault sites is to pick those that allow the lead battalions to cross unopposed and seize farside objectives rapidly. If unsuccessful at finding undefended crossing sites, the lead battalions must typically cross under enemy fire while overwatch units provide direct and indirect suppressive fires. Assault sites may or may not coincide with rafting or bridging sites.

B-7. When selecting swimming sites, the goal is to pick those that permit fighting vehicles to rapidly enter, swim across, and exit the water with minimum assistance.

B-8. The goal when selecting rafting and bridging sites is to pick those that support the greatest volume of vehicle traffic consistent with the scheme of maneuver. Rafting and bridging sites are usually on or near major roads to minimize route preparation and maintenance. When the sites are located close together, the bridging site should be upstream of the rafting site. This will avoid potential damage that may be caused by disabled rafts drifting into the bridge.

B-9. Regardless of the crossing means, each site may need engineer reconnaissance swimmers or an engineer diving team to cross early to reduce obstacles and develop exit points on the farside. Gap sides or riverbanks at otherwise suitable crossing sites often need work for access to the gap (river). Most natural soil becomes unstable under heavy traffic. This condition worsens as fording, swimming, and rafting activities carry water onto it. The required engineer effort varies with soil type, crossing means, and vehicle density. An engineer vehicle that is capable of maintaining the farside bank should be one of the first vehicles across.

B-10. Natural conditions vary widely. Banks may require little preparation, or they may be so restrictive that they limit feasible sites. Desirable site characteristics include—

- Minimum exposure to enemy direct-fire weapons.
- Covered and concealed access to the gap (river) edge.
- Firm and gently sloping banks that allow rapid entry and exit at multiple points.

B-11. Initial and subsequent entry points can vary. Available locations seldom have all the desired tactical and technical characteristics. The best routes through the crossing area normally cross the gap at the best technical crossing sites. The best technical sites may not be the best tactical sites, because they are well known and heavily defended by the enemy. Forces initially crossing at less desirable locations are more likely to avoid detection and gain surprise. Moving laterally along the farside, forces attack the flank or rear of enemy units to seize the best crossing locations. Use of these sites allows rapid buildup of combat power.

PLANNING

B-12. Planners need information about potential crossing sites to evaluate their compatibility with proposed crossing plans. Generally, planners need to know—

- Friendly and enemy capabilities and probable COAs.
- Site capacity for the crossing of troops, equipment, and supplies using various crossing means.
- Engineer support that is required to develop, improve, and maintain each site.

B-13. More specifically, planners need to know the—

- Condition of the bottom, banks, and water of the gap (river).
- Impact of forecasted and/or past seasonal weather conditions.
- Location of defensible terrain, covered and concealed areas, and natural or enemy-emplaced obstacles on both sides of the gap.
- Amount of time and effort that is required to develop sites, assemble rafts, if necessary, and construct bridges.
- Entry and exit routes and off-road trafficability.
- Road networks.
- Capabilities of friendly forces to deny observation, suppress fires, and provide site protection.

REQUIREMENTS

B-14. Specific requirements are necessary for crossing sites. These requirements are discussed in the following paragraphs.

Entry and Exit Routes or Paths

B-15. A desired feature of all sites is readily accessible entry and exit routes or paths on either side of the gap. The approaches to the banks are checked for their ability to support the requirements (width, slope, and trafficability) of the wheeled and tracked vehicles of the crossing element. Covered and concealed approaches enhance surprise and survivability; however, multiple routes (free from obstruction) will increase crossing speed and flexibility. Exit bank conditions often take precedence over entry bank conditions until equipment and troops can be crossed to develop and improve the site.

Routes and Approaches

B-16. Depending on the crossing operation that is used, the following considerations must be given to routes and approaches:

- **Fording.** Dismounted forces may use approaches with steep slopes and heavy vegetation, while vehicle fording requires paths or roads to approach fording sites.
- **Assaulting or swimming.** Assault boat crossings may use more rugged approaches than amphibious vehicles.
- **Rafting.** Multiple approach routes to rafting sites permit the relocation of rafting upstream or downstream.
- **Bridging.** Bridging sites require developed road networks to sustain the crossing capacity.

B-17. Depending on the vehicle that is used, the following considerations must be given to routes and approaches:

- **Wheeled vehicles.** In general, wheeled vehicles require 3.5-meter path widths and 3.5 meters of overhead clearance. Dry, hard slopes of 33 percent can be negotiated; however, slopes less than 25 percent are desired.
- **Tracked vehicles.** Tracked vehicles require up to 4-meter path widths and 3.5 meters of overhead clearance. Tanks can climb 60-percent (31-degree) slopes on dry, hard surfaces; however, slopes less than 50 percent are desired.

Waiting Areas

B-18. Many waiting areas are required for equipment, troops preparing and protecting sites, and troops and vehicles preparing and/or waiting to cross. These areas should be dispersed, should provide cover and concealment, and should be accessible to a road network near the sites.

River Conditions

B-19. In general, currents less than 1.5 meters per second are desired. While narrow segments of the river decrease equipment requirements, crossing time, and exposure time, the resulting increased current velocities may offset any advantage gained. As the current's velocity increases, it decreases the ribbon bridge's ability to handle heavy MLC vehicles. More boats will then be required to keep the bridge in place and allow for heavy MLC vehicles to cross.

Gap Sides/Banks

B-20. Ford banks may be steep and rugged for dismounted troops; however, vehicles require slopes less than 33 percent and firm soil conditions. Assault or swim banks may be steep when using assault boats for dismounted troops. Amphibious vehicles may be able to enter over low, 1-meter vertical banks, but they require sloped exits. Vertical banks of about 1.7 meters may be accommodated by ribbon raft ramps.

Gap Bottoms

B-21. When fording, bottoms must be firm, uniform, and free from obstacles. Gap bottoms or riverbeds can be improved with rock fill or grading equipment. Guide stakes make the crossing of a gap easier for boat drivers. Assault or swim site bottoms must be free from obstructions that interfere with boats or the tracks of amphibious vehicles. Rafting sites must be free from obstructions that could interfere with boat operations. Bridges emplaced for lengthy periods (4 hours or more) or in strong currents require suitable riverbeds for anchorage. Engineer diving teams (see Appendix E) may be used to—

- Conduct river bottom reconnaissance.
- Emplace shore and midstream anchorage for debris and antimine and antidiver nets to ensure the success of the operation.

Enemy Situation

B-22. Typically, the enemy will defend potential crossing sites either forward, along, or to the rear of the gap. If located forward of the crossing site, the enemy most likely intends to defeat the crossing force before it reaches the gap. When enemy forces are positioned along the gap, it may be an attempt to protect the crossing sites and defeat the crossing force while it is divided in the gap. Finally, the enemy usually defends from the rear of the gap if time or terrain prohibits a forward defense. A security element may be positioned on the farside to disrupt the crossing force. In this situation, the enemy force could be attempting to delay the crossing force to provide time to establish a defense.

B-23. Sites masked from enemy observation enhance surprise and survivability by degrading the enemy's ability to see. While using existing sites reduces preparation time, they require caution because the enemy may have emplaced obstacles and registered artillery on the site.

SITE ANALYSIS

B-24. A ground reconnaissance refines and confirms information gathered from other sources. Training Circular (TC) 5-210 and FM 3-34.170 contain details for conducting and reporting site reconnaissance. From this and other detailed reports, planners may develop charts or overlays to compare alternate sites. Unit SOPs may prescribe specific comparative methods. See Figure B-1 for an example.

Bank Preparation Time

- Describe the height, slope, and stability of the bank.
- List the amount of time and effort required to overcome significant natural and enemy-emplaced obstacles.
- Include day, night, or other reduced-visibility constraints.

River Conditions

- Specify the width, depth, velocity, and bottom conditions of the river, as appropriate.
- Include variations or unique factors (such as sandbars, turbulence, or water depth at the bank).

Vegetation

- List areas suitable for work sites and AAs and available cover and concealment.

Full Crossing Rate

- Describe foot-, wheeled-, and tracked-movement capabilities on roads, trails, and cross-country.
- Describe the maximum crossing rate for fording, swimming, or rafting.
- Include the overall assessment of the crossing site's potential.

Figure B-1. Crossing Site Requirements

FIELD CALCULATIONS

B-25. Some common relationships and field-expedient calculations that are useful during a ground reconnaissance include—

- Measuring the current's velocity.
- Determining the slopes and degrees.
- Measuring the gap width.
- Calculating the downstream drift.

MEASURING THE CURRENT'S VELOCITY

B-26. Correlating the desired maximum current velocity of 1.5 meters per second with a familiar comparative unit of measure may help in estimating the current's velocity. The quick-time march rate of 120 steps per minute, with a 76-centimeter (or 30-inch) step, equates to 1.5 meters per second. Other approximate correlations of 1.5 meters per second include—

- 5 feet per second.
- 3.5 miles per hour.
- 5.5 kilometers per hour.

B-27. Determining the current's velocity is critical to effective and safe crossing operations. When it is high, more boats are required to stabilize the bridge, particularly when anchorage is not used. A reasonable estimation involves measuring a distance along the riverbank and noting the time a floating object takes to travel the same distance. Dividing the distance by the time provides the current's velocity (Figure B-2, page B-6).

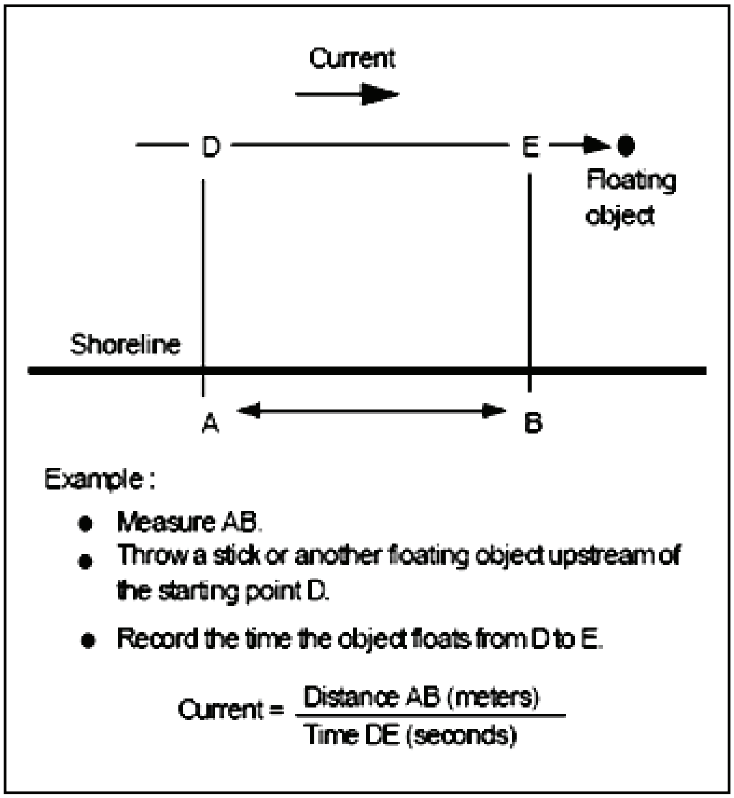

Figure B-2. Measuring the Current's Velocity

DETERMINING THE SLOPES AND DEGREES

B-28. The slope of the terrain is significant (for example, slopes of 7 percent or more slow movement and may require vehicles to operate in a lower gear). Slope, usually expressed as a percentage, is the amount of change in elevation (rise or fall) over a ground (horizontal) distance (Figure B-3). The means to determine the percent of the slope include—

- **Clinometers.** These instruments measure the percent of the slope and are organic to most engineer units down to the platoon level.
- **Maps.** In this method, first measure the horizontal distance along the desired path, then determine the difference in elevation between the starting and ending points of the path. The next step is to ensure that both figures are the same unit of measure (such as meters or feet). The final step is to divide the elevation (rise) by the distance (run) and multiply the result by 100 to get the percent of the slope (Figure B-4).
- **Line of sight and pace.** This method uses the eye-level height above ground (usually from 1.5 to 1.75 meters) and the length of standard pace (usually 0.75 meter). While standing at the bottom of the slope, the individual picks a spot on the slope while keeping his eyes level. He paces the distance and repeats the procedure at each spot. Adding the vertical and horizontal distances separately provides the total rise and run.

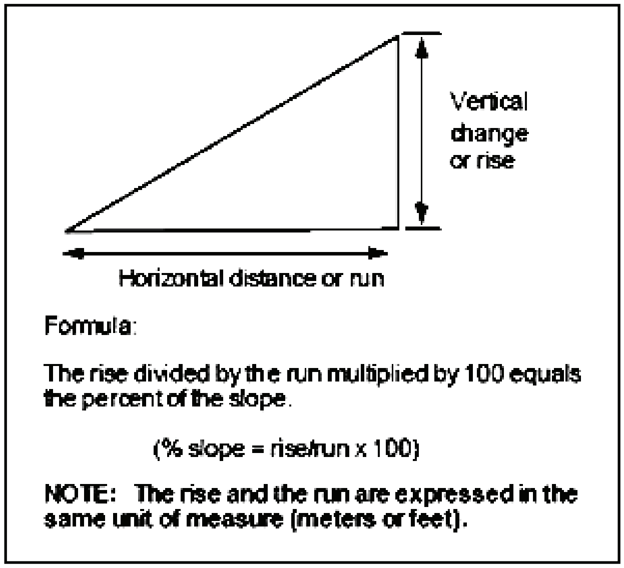

Figure B-3. Slope Calculation

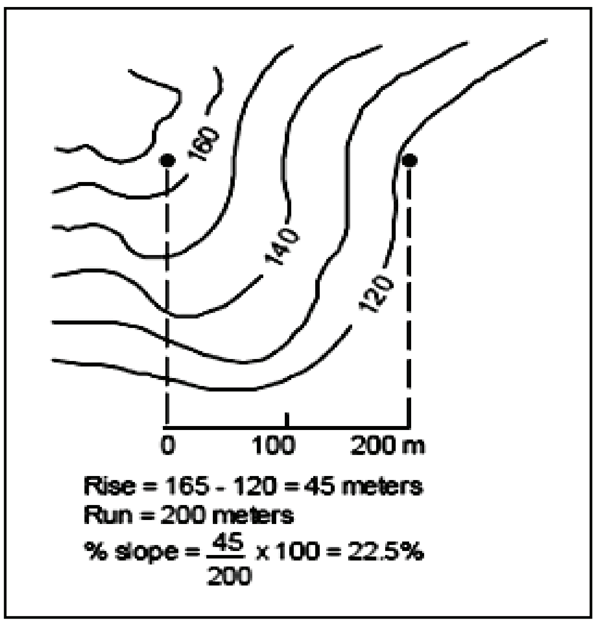

Figure B-4. Terrain Slope

B-29. Slope may also be expressed in degrees; however, this provides angular measurements. The method is not commonly used because the relationships are more complex than desired for field use. Table B-1, page B-8 lists some relationships of the percent of the slope to the degree of the slope.

Table B-1. Relationship of Slope to Degrees

Slope	*Degrees*
100 percent	45
60 percent	31
40 percent	22
20 percent	11

MEASURING THE GAP WIDTH

B-30. A field-expedient means of measuring gap width is with a compass. While standing at the gap edge, note the magnetic azimuth by citing a point on the opposite side. Move laterally, up or down the edge of the gap (upstream or downstream) until the azimuth reading to the fixed point on the opposite side is 45 degrees different than the original reading. The distance from the original point to the final point of observation is equal to the gap width (Figure B-5).

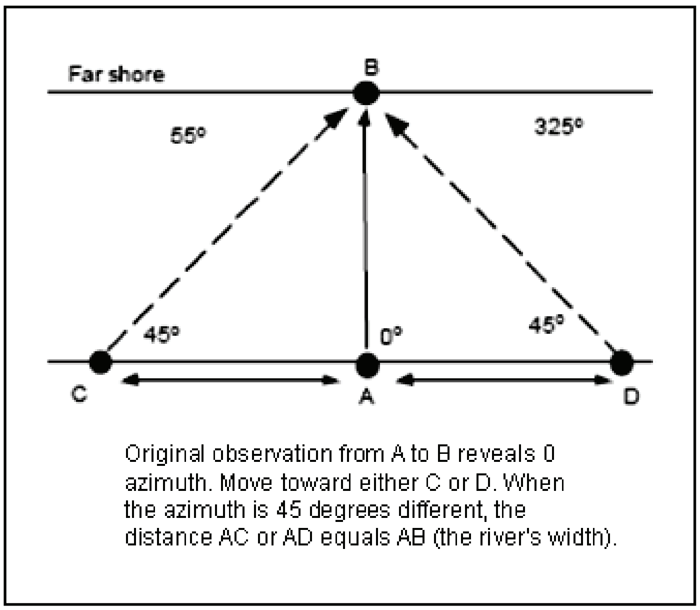

Figure B-5. Gap Width

CALCULATING THE DOWNSTREAM DRIFT

B-31. Current causes all surface craft to drift downstream. Each vehicle has a different formula for calculating downstream drift. Amphibious vehicles and assault boats drift more than powered boats and rafts; the latter has a greater capability to negate the effect of the current's velocity by applying more power.

B-32. Amphibious vehicles and nonpowered assault boats are generally limited to current velocities of 12.5 to 2 meters per second and 1 meters per second respectively (Figure B-6).

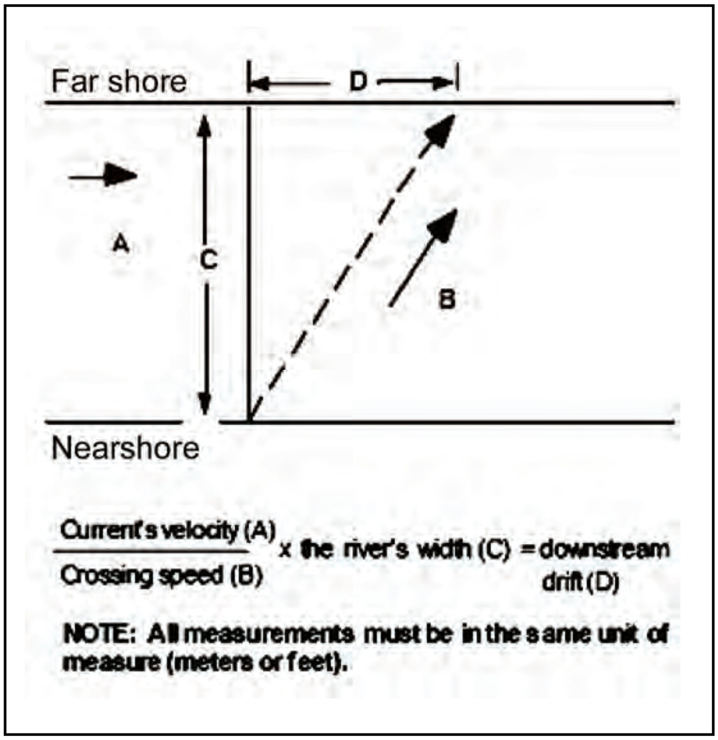

Figure B-6. Amphibious Drift

B-33. When crossing with amphibious vehicles and pneumatic boats, compensate for the effect of the current. Several examples follow.

Example 1

B-34. Entry is usually made upstream of the desired exit point. The vehicle or boat is aligned, or aimed, straight across the river, creating a head-on orientation that is perpendicular to the exit bank. However, the current produces a sideslip, downstream forward movement (Figure B-7, page B-10). This technique requires operator training in continual adjustment to reach the objective point on the exit bank. This technique results in a uniform crossing rate in the least amount of time and is usually the desired technique.

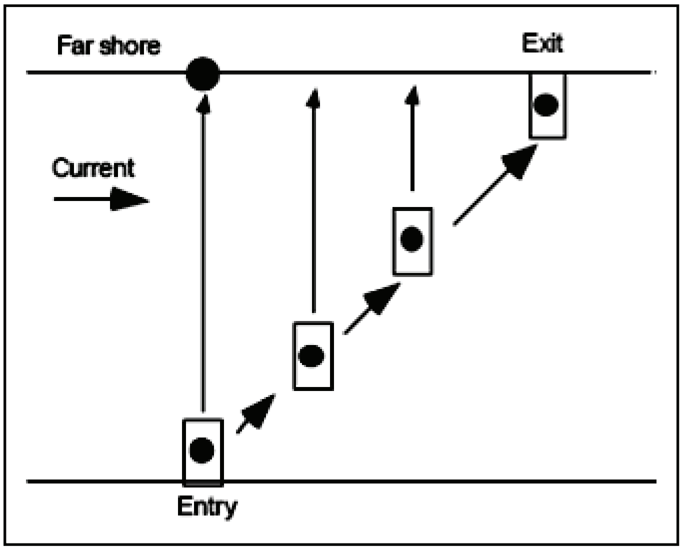

Figure B-7. Downstream Sideslip

Example 2

B-35. If the operator continues to aim the vehicle at the desired exit point, the orientation of the craft at the exit point will approximate an upstream heading. The craft's path is an arc in proportion to the current's velocity (Figure B-8).

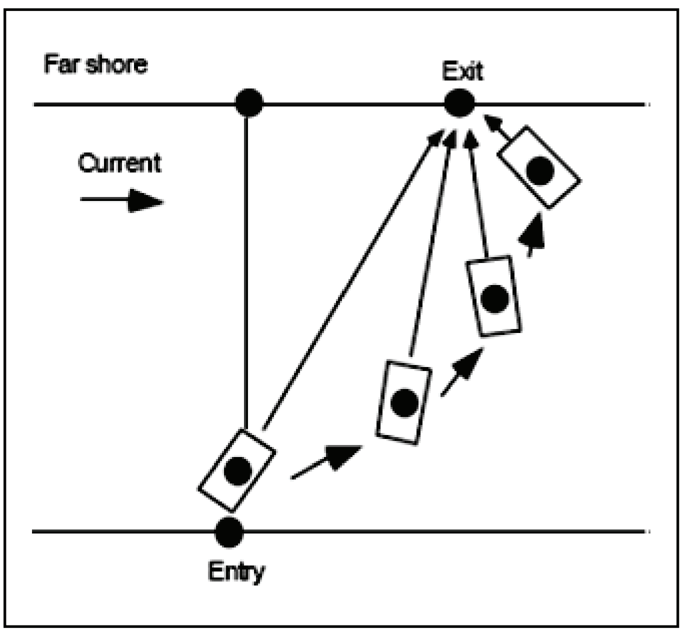

Figure B-8. Constant Aim Point

Example 3

B-36. To exit at a point directly across from the entry point requires an upstream heading to compensate for the current's velocity (Figure B-9). In all three examples, the craft's speed on the current's velocity is constant; assuming the engine revolutions per minute or paddling rate remains constant. Terrain conditions may restrict the location of entry and/or exit locations. Enemy situations may require alternate techniques. For example, when aiming at the downstream exit point, the craft moves at a greater speed relative to the banks after entry than it does as it nears the exit due to the current's velocity. Use of this technique may be favored when the enemy has a better observation of the entry bank rather than the exit bank. Watercraft moving fast and at a changing rate is more difficult to engage effectively.

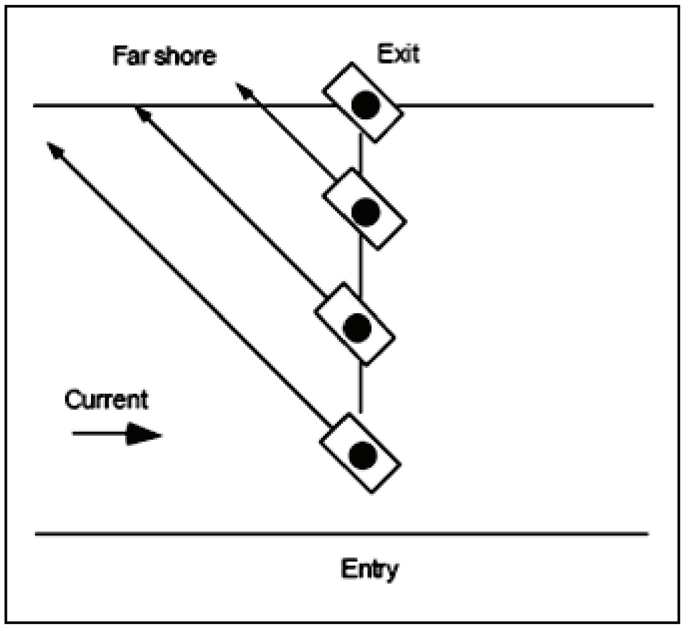

Figure B-9. Constant Heading

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Appendix C
Engineer Crossing Factors

This appendix provides information about specific procedures, conditions, and factors that can impact a gap-crossing operation. Although focused on the extreme of considerations often encountered in a wet-gap crossing, many of these are applicable to any type of gap crossing or classification.

GENERAL

C-1. A gap crossing requires specific procedures for success because the gap inhibits what would otherwise be normal ground maneuver. It demands detailed planning and different and (in some cases) unique technical support than other tactical operations. Extensive use of engineer assets is required. It is critical for the supporting engineers to be totally involved in all facets of the gap-crossing operation from initial planning through the preparation and execution. For this reason, an engineer HQ that will support the crossing must be designated as soon as a potential crossing is identified. For a BCT this may be an engineer battalion, while for a division this will generally be an engineer brigade or a MEB that is specifically focused on support of the river crossing. This will generally require a second MEB in support of the division.

C-2. Traffic control may be one of the most vital components of a gap-crossing operation. ERPs are used to control traffic flow and optimize the ordered movement across the gap in an unhindered manner. Engineer units, with the assistance of military police, provide positive control and the necessary equipment to ensure maneuver forces successfully and safely cross the gap in a timely and synchronized manner, unhindered by obstacles.

C-3. Contingency operations may require that tactical crossing assets be used for longer periods of time because support bridging is not feasible or readily available. Engineer units must implement techniques that allow the long-term use of tactical bridging assets without heavily affecting operations or damaging equipment. These topics will be discussed in detail in this appendix.

ENGINEER REGULATING POINT OPERATIONS

C-4. ERPs ensure the effective use of the crossing means. ERPs and TCPs may be collocated to provide control for the gap crossing. The CSC uses TCPs to facilitate moving units through the crossing area.

C-5. The CSC establishes ERPs at the call forward area and, if enough engineer assets are available, at the staging area and the farside holding area. He uses additional ERPs only when specific site conditions make it necessary for crossing area control. If conducting a wet-gap crossing, ERP personnel will need enough space to mark an area the size of a raft (mock-up raft), brief crossing procedures, and conduct necessary inspections and rehearsals. A hardstand, such as a rest stop or parking lot, is ideal for this purpose but lacks the overhead concealment usually desired. Some ERP functions may be done at separate ERPs to ensure a smooth and rapid flow of vehicles to and across the gap. In this case, communications between ERPs must be maintained.

C-6. Typically, an engineer squad mans an ERP. This maintains unit integrity and provides enough personnel and equipment for continuous operations. The crossing site HQ establishes direct communication with ERP personnel to control raft load or individual vehicle movement. Depending on the location and purpose of the ERP, it can be used for the following functions:

- Briefing crossing unit personnel on crossing procedures, including safety.
- Demonstrating ground guide signals.
- Inspecting equipment to ensure that it meets the load class capability of the crossing means.
- Organizing vehicles into raft loads or serials.
- Conducting rehearsals.
- Controlling vehicle movement.

RAFTING OPERATIONS

C-7. ERP personnel configure vehicles into raft loads and send them to the gap to coincide with the arrival of an empty raft. Engineers brief crossing units before their arrival in the call forward area to make this happen as rapidly as possible. The briefing covers the—

- Route and its markings through the crossing site.
- Road speeds and vehicles intervals.
- Loading and unloading of rafts.
- Location of passengers while rafting across the gap.
- Configuration of the vehicles for the crossing.
- Actions to take for disabled vehicles and the location of the maintenance collection point.
- Hand-and-arm signals and signaling devices.
- Arm bands or other identification of guides and traffic controllers.
- Issuing, wearing, and returning of life jackets and/or other safety equipment.
- Location of holding areas and alternate routes.
- Location of a casualty collection point.
- Actions to take in the call forward area.
- Actions to take in case of enemy fire.
- Regrouping of the company in the farside holding area.

C-8. An engineer from the squad running the ERP can brief vehicle crews and rehearse the movement signals with them. The staging area is an ideal place to do this, minimizing the time and effort spent organizing a crossing unit in the call forward area. Otherwise, a separate ERP should handle this task.

C-9. Chapter 4, Figure 4-2, page 4-8 is an example of an ERP at the call forward area. The engineer squad leader positions to best control vehicle movement from the call forward area to the gap entry point. Communications are established with the crossing site HQ. As a crossing unit arrives, the assistant squad leader contacts the unit's commander, who determines the order in which his vehicles will cross. The assistant squad leader then configures individual vehicles into raft loads, while ensuring that the vehicles do not exceed either the weight limit or the maximum dimensions of the raft. A space should be marked on the ground in the exact dimensions of a raft (mock-up raft) for this purpose. An engineer squad member guides the vehicles onto this mock-up raft, using the same procedure to be used at the raft's embarking point at the gap. At the same time, another engineer inspects the vehicles for the proper load classification and dimensional clearances and chalks the raft load number on the vehicles. Once cleared through the mock-up, an engineer squad leader releases individual raft loads to the gap as directed by the crossing site HQ.

C-10. Items useful for running an ERP include the following:

- Communication equipment.
- Engineer tape and stakes.
- Traffic markers.
- Flashlights with colored filters.
- Chemical lights.
- Signal flags.
- Chalk.
- Camouflage nets and poles.
- Night vision goggles.
- Sandbags.

BRIDGE OPERATIONS

C-11. A bridge operation requires a continuous traffic flow to the gap. Units must be briefed and quickly sent to the crossing site. To do this, engineers brief at staging areas and check vehicle load classifications and dimensional clearances. The briefings include the following rules:

- Vehicles will maintain a maximum speed of 9 kilometers per hour while crossing the bridge.
- Vehicles must not stop on the bridge.
- Operators must not shift or make abrupt changes in speed while on the bridge.
- Vehicles will maintain the interval indicated by signs on the side of the road.
- Operators will follow the signals of engineers at ramps and intervals along the bridge.

C-12. ERPs may be established along the routes to the crossing site to regulate traffic. A mock-up bridge is not necessary at the ERP.

FORDING AND SWIMMING OPERATIONS

C-13. For fording and swimming operations, ERP personnel provide the necessary briefings and vehicle inspections. Units must consider vehicle capabilities and mitigating factors such as reactive armor, payload, water current, and exit side slope before attempting to swim. Crossing units are responsible for most preparations, but ERP personnel can assist with operations at the pre-dip site (for swimming operations) that is established nearby and provide recovery assets. A briefing on fording and swimming operations should include the following:

- The layout of entrance and exit markers.
- Swamping drills.
- A review of safety procedures.
- Rescue procedures.
- The actions to take in case of enemy fire.

ENGINEER CONTINGENCY BRIDGING OPERATIONS

C-14. Versatile engineers provide unique personnel and equipment capabilities that can effectively support complex and sensitive situations in any contingency operation. Therefore, engineer force projection planning should include the possibility that forces committed to contingency operations may become involved with combat operations. The engineer commander tailors engineer support based on contingency operation requirements, which may be radically different from supporting combat operations. In many cases, the only difference between wartime and an engineer contingency bridging operation during stability or civil support is the threat level.

C-15. Contingency operations may require the same or greater level of logistics support to engineers as wartime operations. Combatant commanders (CCDRs) tailor logistics support to engineers based on theater needs. Logistics efforts are integrated with HN or local resources and activities. Engineers invariably get involved with a wide variety of gap-crossing operations that may need flexible logistics support. Critical engineer logistics considerations during contingency operations include the following:

- The availability of construction equipment.
- A direct-support maintenance capability.
- Repair parts supply.
- Class IV construction materials.
- Bridging equipment and materials.

SUPPORT BRIDGING, LONG-TERM USE

C-16. Ribbon bridge operations are normally intended to last no longer than 72 hours. Having the ribbon bridge remain in operation beyond that time frame may present problems. Equipment maintenance, anchorage systems, constant changes in the water level, and the repair of approaches require an increased level of consideration for long-term use of support bridging. Divers may also become necessary to support long-term bridge use.

MAINTENANCE

C-17. As equipment remains in use during crossing operations, maintenance services become more difficult to manage. Time must be made to allow boats and bays to be recovered from the water and completely serviced and checked for unusual wear. The techniques discussed in Chapter 5 are applicable, but they must include complete recovery of the equipment and movement back to the EEP where the services can be done. To do maintenance services without jeopardizing bridging operations, boats and their replacements must be carefully managed. This may require procuring more boats than authorized by the table(s) of organization and equipment (TOE) to permit continued crossing operations without disruption for maintenance. These and other considerations must be addressed early in the planning process.

C-18. To check and service interior and end bays of the ribbon bridge, it must be broken apart and replacement interior and end bays emplaced. Time for such actions should be incorporated into the bridge crossing timeline and maneuver units notified when the crossing site will be shut down temporarily. Synchronization of alternating times for crossing sites to be closed for maintenance can proactively reroute traffic flow and prevent major disturbances in movement across the gap. To expedite the time required to replace bays needing maintenance and quickly allow traffic to resume crossing operations, engineers prepare replacement bays and boats and stage them before closing the crossing site. Daily checking of the bridge throughout the operation, considering the current's velocity and the amount of debris that may affect the bridge's operation, and maintaining vehicle speeds as they cross the bridge are critical to prevent damage to the bay's lower lock devices and roadway-to-bow portion latches.

ANCHORAGE

C-19. All military bridges must be held in position by some anchorage system. Short-term anchorage is normally used for support bridges but, if the bridge is required to remain operational for a longer period, the anchorage must be upgraded to provide long-term support. See FM 3-34.343 and FM 5-125 for more detailed information about anchorage.

C-20. The design of any anchorage system is influenced by several factors, including the—

- Width of the gap.
- Water velocity or currents.
- Depth and bottom conditions of the gap.
- Height and slope of the gap banks.
- Conditions of the soil.
- Depth of the groundwater table.
- Availability of equipment.
- Potential enemy threats.

C-21. The ribbon bridge must be anchored if the bridge is used for long-term operation. During short-term crossings, boats maintain the bridge's stability against the current and keep the bridge from being damaged. However, as time permits, an anchorage system must be emplaced to provide continuous stability and provide relief for the number of boats required. Initially, the anchorage may consist of a combination of shore guys and boats. This method can still allow the bridge to be broken and permit barge or river traffic access. Eventually, a semipermanent anchorage system, such as an overhead cable system, should be emplaced to keep the bridge secure.

C-22. The three basic components of all long-term anchorage systems include approach guys, an upstream anchorage system, and a downstream anchorage system. Approach guys are cables that prevent the bridge from being pushed away from the shore as a result of the impact of vehicles driving onto the ramps of the bridge. The upstream anchorage system holds the bridge in position against the force of the current. The downstream anchorage system protects the floating bridge against reverse currents, tidal conditions, eddies, high winds, or storms that might temporarily alter or reverse the natural flow of the water. The following types of anchorage systems can be used for stabilizing a bridge.

Kedge Anchors

C-23. Kedge anchors lie in the streambed and are secured to the bridge bays with anchor lines. They are designed to sink with the stock lying flat and the fluke positioned to dig into the bottom. On hard bottoms, the kedge anchor is useless.

Shore Guys

C-24. Shore guys are cables attached from the bridges to a deadman or similar holdfasts on the shore. Shore guys can be upstream or downstream if the maximum anticipated current (or reverse current for downstream systems) does not exceed 0.9 meter per section. Shore guys can be used for any length of floating bridge if a 45-degree angle is maintained between the shore guy and the bridge centerline.

Combination of Kedge Anchors and Shore Guys

C-25. A combination system may be used for upstream or downstream anchorage systems in currents less than or equal to 1.5 meters per second. When constructing a combination system, attach kedge anchors to every float and a shore guy to every sixth float.

Overhead Cable

C-26. An overhead cable system consists of one or more tower supported cables spanning the gap parallel to the bridge. Each end of the overhead cable is secured to the bank, preferably by using a deadman. Bridle lines are used to connect each bay of the bridge to the overhead cable. The cable functions like a cable used in a suspension bridge, except that its final working position is inclined toward the bridge because of the force of the current on the bridge. TC 5-210 provides the specific criteria for the design of an overhead cable anchorage system, to include the cable design, tower design and placement, and deadman design.

PROTECTIVE SYSTEMS

C-27. Floating bridges, particularly those that will remain in place for long periods of time, must be protected against severe weather conditions and enemy destruction. If flood conditions or heavy debris hamper bridging operations, removal of interior bays will reduce the lateral pressure on the bridge and allow the debris to pass downstream. If losing the bridge is imminent, release an end section and securely anchor the bridge parallel to the shore until conditions permit resuming bridging operations. As the gap's width increases, add more interior bays to the bridge to compensate.

C-28. The enemy may attempt to destroy floating bridges in a variety of ways, including air attacks, land attacks, underwater demolition teams, floating mines, or assault boats (see Appendixes E and G). It is necessary to construct floating protective devices to prevent waterborne forces from damaging or destroying the bridge. The three types of floating protective systems are as follows.

Antimine Boom

C-29. This device is designed to stop any mines that are sent downstream toward the bridge. The antimine boom is placed far upstream to protect the other protective devices as well as the bridge. It consists of some logs or other large floating structures attached to a cable running across the gap. Concertina is normally placed along the length of the boom.

> ***Note.*** Before using timber logs or railroad ties, ensure that they are not waterlogged and that they will float.

Impact Boom

C-30. The impact boom is designed to withstand the impact of large natural or man-made debris and stop the enemy from attacking the bridge by boat. It is constructed by placing a series of floats and cables across the gap. The cables absorb the impact of the debris or boat and restrain it until it can be removed or destroyed.

Antiswimmer Net

C-31. This net is used to stop swimmers or underwater demolition teams from reaching the bridge. The net can be constructed by suspending a mesh or net barrier from an anchorage cable to the gap’s bottom. Concertina may also be connected to the cable and net to prevent swimmers from climbing over the net. The net must be firmly affixed to the bottom or enemy divers can easily go under the net. The antiswimmer net should also be placed on the downstream side of the bridge to prevent enemy divers from reaching the bridge from downstream.

C-32. Army diver teams can assist in emplacing the protective devices and can test them to ensure they are able to prevent penetration of the bridge.

APPROACHES

C-33. Over a period of time, traffic flow at the same location will eventually wear the approaches down and make them unusable. Engineers incorporate repair of the entry and exit banks and the approaches leading to the crossing site into the crossing operation plan. Initially, the approaches may be suitable to receive heavy traffic with little effect, but reinforcing the approaches must be done for long-term traffic. When inspecting approaches, consider the following:

- The steepness of the approaches.
- The ruts or gullies along the approaches, particularly in a floodplain area.
- Water level conditions and expected changes due to weather or seasonal conditions.
- The location of alternate approaches (alternate crossing sites) to allow for the repair of existing approaches.

C-34. Matting and rock or gravel are the most suitable materials to use to support the approaches. Maneuver units that will have to conduct long-term crossing operations should develop procedures to requisition and deliver these materials to identified crossing site locations. Reconnaissance teams can locate local quarries where rock and gravel can be obtained through coordination with the host country.

C-35. New techniques for constructing bridge approach roads include using fabric as reinforcement across soft soil (see FM 3-34.400). An impervious, neoprene-coated, nylon-woven membrane can be placed between stone aggregate and soft surface soil to allow the ground to withstand heavy traffic. The most important feature that a reinforcing fabric membrane can offer is improving soil stability and strength, which creates smaller deformations from vehicle traffic than soils acting alone.

LONG-TERM, GAP-CROSSING COMMAND AND CONTROL

C-36. More than any other mobility task, gap crossing involves managing combat power, space, time, and terrain. The controlling HQ must be flexible enough to react to any changes in the tactical situation and scheme of crossing. This is particularly difficult when involved with long-term operations in the same area of operations. Management of the crossing site, enemy considerations, traffic-control measures, and sustainment must be synchronized for long term activities and must not be based on less than a 72-hour period.

Management

C-37. Traffic and movement control remain the responsibility of the C2 HQ. Activities may direct that another unit take over the crossing operation and equipment as a whole or bring their own crossing equipment and personnel to relieve the existing units and permit them to move forward with the maneuver force. All aspects of the operation must be covered when handing over the crossing site to the gaining unit just as though they were conducting the crossing for the first time.

Enemy Considerations

C-38. Operation of a single crossing site over an extended period of time increases the possibility of enemy interdiction. The possible use of CBRN weapons against friendly crossing activities impacts on control measures. To prevent the friendly elements from becoming targets, forces must cross the gap as swiftly as possible to minimize the concentration of forces on either side of the gap. The controlling HQ may also vary the crossing site location to reduce the likelihood of successful enemy interdiction.

Traffic Control Measures

C-39. Military police traffic control is essential to help reduce exposure time and speed units across the gap. Additionally, effective traffic control contributes to the flexibility of the crossing plan by enabling commanders to change the sequence or timing or redirect units to other crossing sites. Military police can switch units to different routes or hold them in waiting areas as the mission dictates. This is done using mobile patrols along primary routes, stationary vehicles at key points, or appropriate signage along the route. This support assists in reducing congestion and speeding the crossing, thus enabling the maneuver forces to maintain momentum. Finally, military police can establish temporary detainee collection points to facilitate the collection, evacuation, and/or movement of the local population so that it does not interfere with the movement of friendly forces.

C-40. Staging and holding area control must be maintained. These areas must be located far enough away from the gap to facilitate rerouting and using alternate roads to crossing sites. Staging and holding areas on the farside must be developed to handle the traffic as vehicles travel back across. New routes may be constructed and existing routes upgraded to improve traffic flow. Staging areas should be able to provide the following:

- Cover and concealment.
- A sufficient area for vehicle and equipment dispersion.
- Easy accessibility.
- Enough trafficability to prevent delays caused by increased traffic flow within the area of operation.

Sustainment

C-41. In a normal gap-crossing situation, the committed combat forces will be temporarily separated from their support force(s). For long-term, gap-crossing operations, increased traffic flow for the support vehicles must be considered and controlled. Enough crossing sites and designated crossing times can ensure that priority is given to field trains and that timely resupply operations are not hindered. Recovery of nonmission-capable equipment presents an additional problem for recovery teams transporting the equipment back to the nearside for direct-support maintenance. Additionally, recovery resources should continue to be provided at both sides of the crossing sites so they can quickly recover a vehicle that is unable to cross and prevent delays.

OVERBRIDGING

C-42. **Overbridging is a method used to reinforce, provide emergency repair, or augment existing bridges or bridge spans utilizing standard bridging** (the definition was shortened, and the complete definition is printed in the glossary)**.** Overbridging may be used to reinforce existing bridges that are not strong enough to carry the expected traffic weight or to make damaged bridges functional. An overbridge typically uses the existing bridges abutments or the piers as bearing points.

Note. It is important to ensure that the existing span is capable of supporting any load which may be applied to it during construction of the overbridge.

C-43. In close combat, this is typically provided through the employment of tactical bridging. It can be used in a variety of gap-crossing situations, but is typically used when time is critical and/or construction assets and resources are not readily available to make the existing bridge reliable. See Figure C-1 for an example of using two tactical AVLB bridges over an existing timber trestle bridge whose abutments were severely compromised during a flood (though both piers were intact). When used to support combat maneuver, the AVLB, the JAB, the Wolverine, and other tactical bridging are often the augmenting bridge assets made available to the maneuver commander. The inherent characteristics of each of these tactical bridges, including the fact that they do not require a gap for emplacement (zero gap bridge), make them an extremely viable option for placement as an overbridge in support of close combat and other operations. However, when using these bridges to repair or replace damaged spans, risk should be calculated if the bridge will not be supported by a pier or a prepared abutment.

Launching

Completed

Figure C-1. AVLB Overbridge (Camp Demi, Bosnia–Herzegovina)

C-44. In other situations when time is not as critical, enemy contact is less likely, support/LOC bridging is readily available, and/or the gap is beyond the span length of tactical bridging, the MGB, LSB, Bailey, Mabey & Johnson®, Acrow, or similar systems may provide an appropriate alternative. See Figure C-2 for an example of a Mabey & Johnson Compact 200 used as overbridging of the same timber trestle bridge in Figure C-1. Figures C-3, C-4, C-5, and C-6 (pages C-10 through C-11) show examples of other Mabey & Johnson overbridges in use. Figure C-7, page C-11, was built in October 1995 by British Royal Engineers in 1 day. It is a 24-meter bridge (excluding the ramps).

Launching

Completed

Figure C-2. Mabey & Johnson Overbridge (Camp Demi, Bosnia–Herzegovina)

Figure C-3. Mabey & Johnson Overbridge (Aleksin, Bosnia)

Figure C-4. Mabey & Johnson Overbridge With a Temporary Pier Added (Bos Gradiska, Bosnia)

Figure C-5. Mabey & Johnson Midspan Overbridge Erected Over a Damaged Pier (Sweden)

Figure C-6. Mabey & Johnson Overbridge (Brcko, Bosnia)

Figure C-7. Mabey & Johnson Overbridge (Komar, Bosnia, near Travnik)

C-45. Refer to the historical perspective (page C-12) for the history of the construction and launch of the bridge over the Spreca river. Figure C-8, page C-13 shows photographic views of the war-damaged bridge over the Spreca river vicinity of Karanovac before reconstruction. Figure C-9, page C-14, is a sketch of the proposed Mabey & Johnson overbridge. Figure C-10, page C-14, shows a view of the existing site (completed MGB) after the reconstruction. Figure C-11, pages C-15 through C-17, is an extract of the OPORD to conduct the operation referred to in the last paragraph of the perspective.

Historical Perspective – Bridging the Spreca

To support local economic regeneration, displaced persons, refugees, and evacuees (DPRE) returns, and freedom of movement across the inter-entity boundary line (IEBL) in the fall of 1998, multinational division (MND) north (N) requested the use of available excess stabilization force (SFOR) bridge stocks for the reconstruction of a war-damaged bridge over the Spreca River vicinity of Karanovac, Bosnia–Herzegovina. The Karanovac bridge was on a list of priorities for reconstruction by the U.S. Agency for International Development (USAID) but was not scheduled for construction in the next two years. MND (N) engineers would then construct and launch the bridge.

This bridge would provide direct access to Route New Jersey by those south of the Spreca River. At that time the Petrovo/Doboj road could not support heavy cargo traffic and was in very bad condition. The installation of this bridge would provide a much needed alternate route and access to a better road. The project would provide an essential cargo route for a local brick factory and saw mill.

SFOR denied use of its strategic bridge stocks.

Sweden had purchased two MGB bridges for evaluation and had them on hand at their engineer school. Sweden decided to donate one of its bridges for emplacement over the Spreca River.

A legal consideration was then for MND (N) SJA to determine that receipt of this "gift" by MND (N) was acceptable and to draft a memorandum of understanding (MOU) with Sweden for the "gift" of bridge to MND (N), U.S. Forces, or SFOR as appropriate. Another key consideration to take into account was who would conduct routine bridge inspections and who had the maintenance responsibilities and oversight of the bridge once in place.

Once those issues were worked out and the bridge stocks delivered, the old war damaged bridge was removed and the MGB was erected over the existing abutments. While the end result of constructing an MGB vice the Mabey & Johnson bridge was not a full overbridging operation (as the majority of the original bridge had to be removed to accommodate the MGB with its reinforcing link system in place), the planning process and execution of the operation was extremely similar in nature.

Figure C-8. Photographic Views of the Damaged Bridge (Karanovac, Bosnia–Herzegovina)

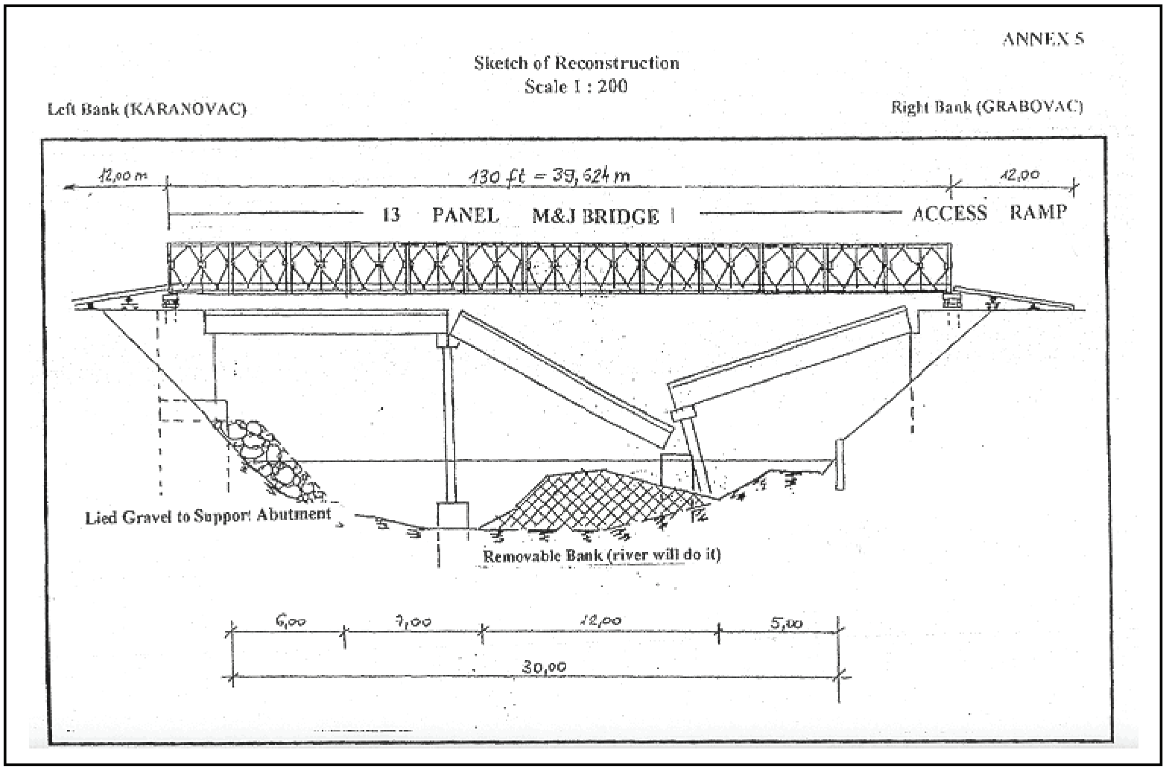


Figure C-9. Sketch of Proposed Mabey & Johnson Overbridge

Figure C-10. Completed MGB (Karanovac, Bosnia–Herzegovina)

OPERATION ORDER

(classification)
FOR TRAINING PURPOSES ONLY

Operation Order ______________ 20_____ Copy __ of __ copies

Task Organization:

1. SITUATION. This order describes the removal of the war damaged bridge at Karanovac, Bosnia–Herzegovina (BQ 840 528) to allow for future emplacement of a temporary military MGB donated by the country of Sweden.

2. MISSION. MND (N) removes the destroyed civilian bridge pieces remaining at the Karanovac site (BQ 840 528) between __ - __ and emplaces a donated MGB from Sweden upon arrival in the area of responsibility (AOR) at the site to allow for further DPRE returns and economic development.

3. EXECUTION.

a. Commander's Intent. This mission quickly and safely removes the destroyed civilian bridge spans at Karanovac. First, we will demine the work site using the mine-clearing armor-protected (MCAP) dozer or the Miniflail to ensure safety of the site. Then, we will remove all debris at the destroyed bridge site that will interfere with the removal of the spans. By using a combination of cranes, tie-downs, and heavy vehicles, we will remove each piece of the destroyed bridge to clear the site to allow the future emplacement of an MGB bridge. Upon arrival from Sweden, we will emplace the donated MGB bridge to replace the destroyed bridge. The end state for this mission is the removal of the destroyed civilian bridge spans at Karanovac and replaced by the donated temporary MGB bridge from Sweden.

b. Concept of Operation. Refer to ANNEX __ (KARANOVAC SITE) of this order for a picture and site plan of the bridge site. First, Nordic-Polish (NORDPOL) Brigade removes the debris surrounding the bridge that will interfere with the removal of the spans. 2BCT demines the Karanovac work site using the Mini-flail to ensure safety for all MND (N) soldiers. Once the debris is removed, then 2BCT and NORDPOL will extract the three spans of the destroyed bridge using a combination of cranes, tie-downs, and heavy vehicles. 2BCT and NORDPOL Brigade will break up the bridge spans to allow for easy transportation from the bridge site. NORDPOL Brigade will use these broken up spans for erosion control around their AOR. NORDPOL Brigade will also establish a laydown yard for the MGB bridge from Sweden. NORDPOL Brigade, with augmentation from 2BCT, will construct the MGB bridge at the Karanovac site.

c. Tasks to Maneuver Units.

(1) 2 BCT.

(a) O/O provide a platoon-sized element of combat engineers to assist the NORDPOL Brigade in the removal of the Karanovac Bridge (BQ 840 528). Refer to ANNEX C (KARANOVAC SITE) of this implementing instructions (IMPIN) for a picture and plan of the bridge site.

(b) Submit a transportation movement request (TMR) for one (1) Brown & Root Services Corporation™ (BRSC) 40-ton crane to assist in bridge span removal at the Karanovac Bridge site for the duration of the mission. Direct coordination with MND (N) DTO for synchronization of the equipment and operator delivery is authorized.

Figure C-11. Sample OPORD for a Temporary LOC Bridge Replacement

(c) Receive one (1) welding trailer with acetylene torch and arc welding capabilities and operator from __ - __ to assist in the removal of the broken spans

(d) Provide MGB expertise to NORDPOL Brigade __ - __ to ensure safe launching of the MGB bridge at Karanovac. Conduct training of all soldiers using the MGB bridge training set before launching the actual bridge.

(2) NORDPOL.

(a) Remove the log jam and debris at the Karanovac Bridge no later than (NLT) ______ to assist in preparing the site to have the bridge spans removed.

(b) Ensure the immediate area surrounding the remaining parts of the civilian bridge are free from mines and booby traps.

(c) In coordination with 2BCT, remove all spans from the Karanovac Bridge NLT _____ to facilitate the replacement of the existing bridge with the donated MGB bridge from Sweden. Direct coordination with 2BCT Engineers is authorized and encouraged. Point of contact (POC) is the __ EN BN S3, MAJ ______ at _____.

(d) Establish a site laydown yard for preparation in receiving the donated MGB bridge from Sweden for construction on site NLT ________.

(e) Provide jackhammers or similar equipment with operator to break up the concrete spans at the Karanovac Bridge site for transportation once the spans have been extracted.

(f) Provide Leopard recovery vehicle and operators at the Karanovac Bridge site to assist in span removal during the operation. Direct coordination with 2BCT for synchronization of the equipment is authorized and encouraged.

(g) Construct the MGB bridge at the Karanovac site after the destroyed bridge has been removed and the site has been prepared to allow for DPRE returns across the Spreca River.

(h) Receive augmentation of up to a platoon from 2BCT to assist in the construction of the MGB bridge from __ - __.

(i) (C) Receive augmentation of bridge experts for assistance in training and construction of the MGB bridge

d. (C) Tasks to Combat Support Units.

(1) LTF ___. Provide one (1) Bolster trailer with acetylene torch and arc welding capabilities, operator, and prime mover from __ - __ to assist in the removal of the broken spans at Karanovac

(2) DIVENG.

(a) Provide one (1) explosive ordnance disposal (EOD) team to 2BCT and NORDPOL during the operation to assist in the mine proofing operation from __ - __.

(b) As required, coordinate for MGB technical assistance from SFOR headquarters MND southwest (SW) or U.S. Army, Europe (USAREUR) to assist NORDPOL in proper emplacement of the donated MGB from Sweden.

Figure C-11. Sample OPORD for a Temporary LOC Bridge Replacement (Continued)

e. Tasks to Staff.

(1) Provost Marshal's Office (PMO). Notify the International Police Task Force (IPTF) and the local police of the ongoing operation in the vicinity of Karanovac Bridge NLT ____. The operation may cause minor traffic delays along Route New Jersey in the immediate vicinity.

(2) (C) Coalition Press Information Center (CPIC). (C) Inform local media about the bridge replacement NLT ____. The main theme to stress is: SFOR engineers will remove the damaged bridge to allow for the emplacement of a temporary military bridge to aid in FOM and DPRE returns.

(3) G4. Provide one (1) 40-ton (BRSC) crane to 2BCT to assist in the removal of the destroyed bridge spans duration of the operation.

f. (C) Coordinating Instructions.

(1) (C) Timeline.

Day 1	Equipment site preparation and mine proofing
NLT Day 3	Debris removed from bridge site.
Days 4-6	Excavation and bridge reduction with jackhammer Prepare laydown yard (Rock/Geotextile) Removal of war damaged Karanovac Bridge.
Day 7	MGB bridge training from bridge master and bridge commander
Day 8	Training/rehearsal by joint construction team
Days 9-11	Emplacement of the temporary MGB bridge
TBD	Opening ceremony with MND(N) Commander as key note speaker

(2) (C) All major equipment will be stored at NORDPOL’s Sierra Base.

(3) (C) POC is MAJ _________ at ____.

4. (U) SERVICE SUPPORT. No change.

5. (C) COMMAND AND SIGNAL. No change.

NOTE: Paragraph C(1)(b) reference to BRSC is currently known as Kellogg, Brown, & Root Services, Incorporated™ (KBR).

Figure C-11. Sample OPORD for a Temporary LOC Bridge Replacement (Continued)

Appendix D

Engineer Planning and Calculations

This appendix addresses the detailed engineer planning necessary for a wet-gap-crossing operation and is designed to supplement the planning considerations described in Chapter 3. It provides some example charts, overlays, and planning criteria that will assist the planner in coordinating and synchronizing gap-crossing activities leading to a detailed crossing plan. When using these planning tools, the planner should understand that factors, such as weather, austere environments, condition of the bridging equipment, water currents, and the enemy situation must be considered as they can significantly impact the actual crossing times, required crossing sites and locations, and equipment necessary to do the crossing.

ENGINEER PLANNING

D-1. Initial engineer planning at corps and division levels focuses on providing enough engineer assets to handle crossing requirements. The terrain teams maintain the terrain database and can provide potential crossing sites and river widths. The engineer assigned or supporting the division or BCT uses this information to construct a site overlay (Figure D-1, page D-2). The engineer labels assault and rafting or bridging sites and shows the site capacity and the estimated preparation time for each site (from the terrain database).

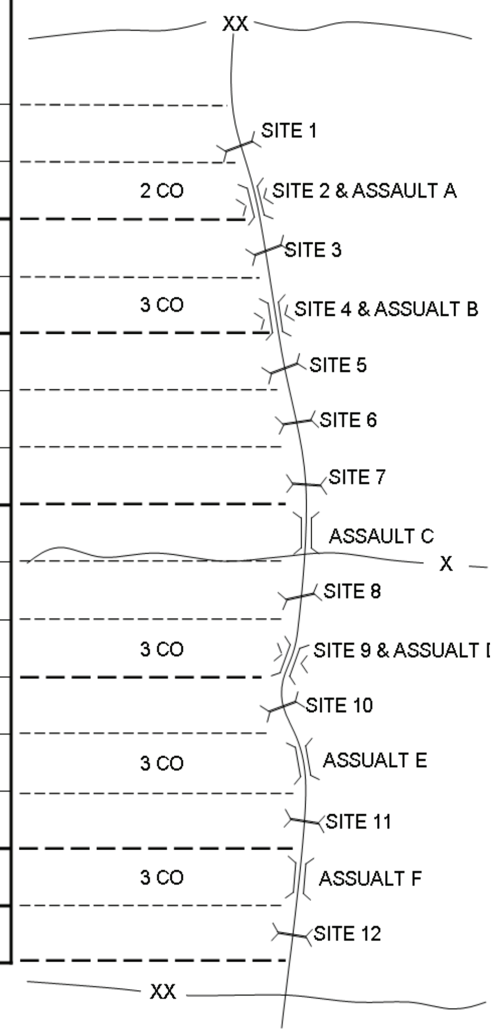
D-2. Preparation time is the time required to improve routes and wet-gap sides or river banks to support the units that will use the site. It also includes the time required to construct rafts and bridges. Rafting site capacity is the number of raft round trips per hour. The engineer calculates rafting site capacity by multiplying the number of raft trips per hour by the number of rafts and the number of centerlines at the site (Table D-1, page D-3). Centerlines must be at least 100 meters apart. Each assault company needs 200 meters of river frontage. Figure D-1 shows the determination of rafts per hour and the capacity of the assault site for the division crossing overlay. The site overlay provides additional details necessary to ensure that each brigade has enough potential crossing sites within its boundaries. Table D-2, page D-3, provides planning factors for assault boat operations.

D-3. Standards for making this determination are as follows:

- A brigade requires 31 assault boats to cross a battalion with 3 companies in the first wave. With 70 boats, it can cross 2 battalions (6 companies) at once. See Appendix A, Table A-1, page A-2.
- A brigade requires 2 bridges or the equivalent bridging configured into rafts.

D-4. The engineer planner uses the above standards to task-organize engineers that are supporting each crossing area. The division engineer then develops a rough crossing timeline using pure battalions. This provides enough information for division planning, without requiring detailed knowledge of the brigade's plan. Table D-3, page D-4, provides necessary rafting planning numbers. Figure D-2, page D-5, illustrates an initial crossing timeline using 6 float rafts. The brigade HQ does the majority of planning for detailed crossings. During the mission analysis, the brigade engineer also develops a crossing timeline to provide initial buildup rate information to the maneuver planners when they outline possible schemes of maneuver. This timeline is the same as the timeline that is developed at the division and may be provided by the division engineer.

SITE	RIVER WIDTH IN METERS	RIVER FRONTAGE	NUMBER OF RAFTS/ CENTER-LINE	NUMBER OF CENTER-LINES	RAFT ROUND TRIP/ HOUR/ CENTERLINE	TOTAL RAFT ROUND TRIP/ HOUR	PREP TIME/ TOTAL RAFT/ HOUR
1	175	300	2	3	5.4	32	1-HOUR PREP; 32 RAFTS/HOUR
ASSAULT A & 2	180	410	2	4	5.4	43	3-HOUR PREP; 43 RAFTS/HOUR
3	160	400	2	4	6	48	0.5-HOUR PREP; 48 RAFTS/HOUR
ASSAULT B & 4	140	600	1	6	6.7	40	1-HOUR PREP; 40 RAFTS/HOUR
5	150	250	2	2	6	24	1.5-HOUR PREP; 24 RAFTS/HOUR
6	150	310	2	3	6	36	2-HOUR PREP; 36 RAFTS/HOUR
7	165	300	2	3	6	36	0.5-HOUR PREP; 36 RAFTS/HOUR
ASSAULT C	150	400	NA	NA	NA	NA	2 CO
8	150	350	2	3	6	36	2-HOUR PREP; 36 RAFTS/HOUR
ASSAULT D & 9	160	610	2	6	6	72	0-HOUR PREP; 72 RAFTS/HOUR
10	170	375	2	3	6	36	0-HOUR PREP; 36 RAFTS/HOUR
ASSAULT E	175	650	NA	NA	NA	NA	
11	180	300	2	3	5.4	32	1-HOUR PREP; 32 RAFTS/HOUR
ASSAULT F	175	685	NA	NA	NA	NA	
12	170	250	2	2	6	24	1-HOUR PREP; 24 RAFTS/HOUR



Notes:
1. Obtain the river's width from the terrain database and/or reconnaissance.
2. See Table B-1 for the number of raft round trips per hour per centerline and the number of rafts per centerline.
3. Determine the amount of available river frontage from the terrain database and/or reconnaissance.

Figure D-1. Division Site Overlay (Sample)

Table D-1. Raft Centerline Data

River Width in Meters	*Round Trip in Minutes*	*Number of Raft Trips per Hour*	*Number of Rafts*
75	7	8.60	1
100	8	7.50	1
125	9	6.70	1
150	10	6.00	2
175	11	5.40	2
225	12	5.00	2
300	16	3.75	3 to 5
Note. Planning times are for current velocities up to 1.5 meters per second.			

Table D-2. Boat Planning Factors

Equipment	*Characteristic*	*River Width*		
		75 Meters	*150 Meters*	*300 Meters*
Pneumatic assault boat with an OBM	Minutes per round trip Trips per hour	3 20	4 15	5 12
Pneumatic assault boat without an OBM	Minutes per round trip Trips per hour	4 15	6 10	10 6
Notes. 1. Factors are averaged based on load/unload time and safety. 2. Planning times are for current velocities up to 1.5 meters per second. For faster current velocities, classification must be reduced to a caution or risk crossing, and an engineer analysis must be made of the actual site conditions before planning times may be assessed.				

D-5. Once the commander identifies the COAs, the staff engineer develops crossing area overlays for each (Figure D-3, page D-5). These overlays are developed using information from the site overlay, along with additional terrain data. The crossing area overlays show staging areas, holding areas, call forward areas, and routes for each crossing site included in the COA. A crossing area overlay is necessary for each COA. The overlay for the COA eventually selected is later modified by adding ERPs, TCPs, and crossing area HQ information and is used to support the operation.

D-6. When maneuver planners develop COAs, they assign crossing sites and the order of crossing to units as they have task-organized them. The staff engineer uses this information to construct a crossing timeline for each COA. He calculates the number of vehicles and raft loads for each unit using pure company figures from Table D-4, page D-6. The staff engineer then calculates the crossing time for the unit by using the crossing capacity of the site assigned to it. The crossing timeline shows these crossing periods, by site, based on the order of crossing. The staff engineer then develops a detailed crossing timeline based on the task organization (Figure D-4, page D-7).

D-7. During the comparison of the COAs, the staff engineer uses timelines, brigade site overlays, and crossing area overlays to demonstrate the differences in the crossing plans. After the commander has selected the COA for the mission, the staff converts it into a detailed plan. The staff engineer develops a vehicle-crossing capability chart.

D-8. The staff engineer starts by displaying the capabilities of each crossing site in terms of raft loads per hour (rafting operations) or vehicles per hour (bridging operations). Since the crossing rate for rafts is less during darkness, each site shows total raft trips separately (during the day and during the night). An example of the product of this first step is shown in Figure D-5, page D-7.

Table D-3. Selected Unit Rafting Requirements

Units	*Vehicles/Trailers*	*Raft Trips Required*		
		5 Bays	*6 Bays*	*7 Bays*
SBCT	**1048/410**	444	410	312
Infantry battalion	125/29 (x3 BN)	43	40	30
Reconnaissance squadron	125/26	43	40	30
Field artillery battalion	109/45	45	45	35
Brigade support battalion	281/179	174	156	118
Separate companies (headquarters company, signal corps [SC], military intelligence [MI], engineer company, and AT)	158/83	53	49	39
HBCT	**1143/430**	529	456	365
Combined arms battalion	163/24 (x2 BN)	63	61	46
Reconnaissance squadron	119/21	47	44	41
Field artillery battalion	115/29	42	39	36
Brigade support battalion	414/247	254	201	154
Brigade special troops battalion	119/66	42	35	29
IBCT	**804/443**	430	364	309
Infantry battalion	88/34 (x2 BN)	28	23	20
Reconnaissance squadron	93/32	32	27	23
Field artillery battalion	101/58	36	31	27
Brigade support battalion	384/245	239	215	182
Brigade special troops battalion	138/74	52	45	37
Armored cavalry regiment (ACR) squadron	208	110	98	82
Potential RCT units*	N/A	N/A	N/A	N/A
Infantry battalion (USMC)	90	45	40	35
Reconnaissance squadron (USMC)	30	15	10	8
Artillery battalion (USMC)	80	50	40	32
Amphibious assault battalion (USMC) LAR BN**	55	32	27	22
Tank battalion (USMC)	145	90	90	80

Notes.

1. Assume that current velocities are less than 0.9 mile per second and that battalions/squadrons are at 100 percent modified table of organization and equipment (MTOE) strength.
2. Numbers of vehicles and trailers are approximate and may vary between units.
3. Raft loads are calculated using IRB.

* RCT – Vary in organization, size, and composition; mission dependent.

** Numbers account for rolling stock minus LAVs that have swim capability.

	H	H+1	H+2	H+3	H+4	H+5	H+6	H+7	H+8
1st BRIGADE SITE 3 32 RAFTS/HOUR		PREP	CAB (xx RAFTS)	FA BN (xx RAFTS)	BSTB (xx RAFTS)				
SITE 5 48 RAFTS/HOUR	PREP	RECON SQDN (xx RAFTS)	CAB (xx RAFTS)	BSB (xx RAFTS)					
2d BRIGADE SITE 8 36 RAFTS/HOUR		PREP	INF BN (xx RAFTS)	FA BN (xx RAFTS)	BSTB (xx RAFTS)				
SITE 9 72 RAFTS/HOUR	PREP	RECON SQDN (xx RAFTS)	INF BN (xx RAFTS)	BSB (xx RAFTS)					

Figure D-2. Initial Division Crossing Timeline (Sample)

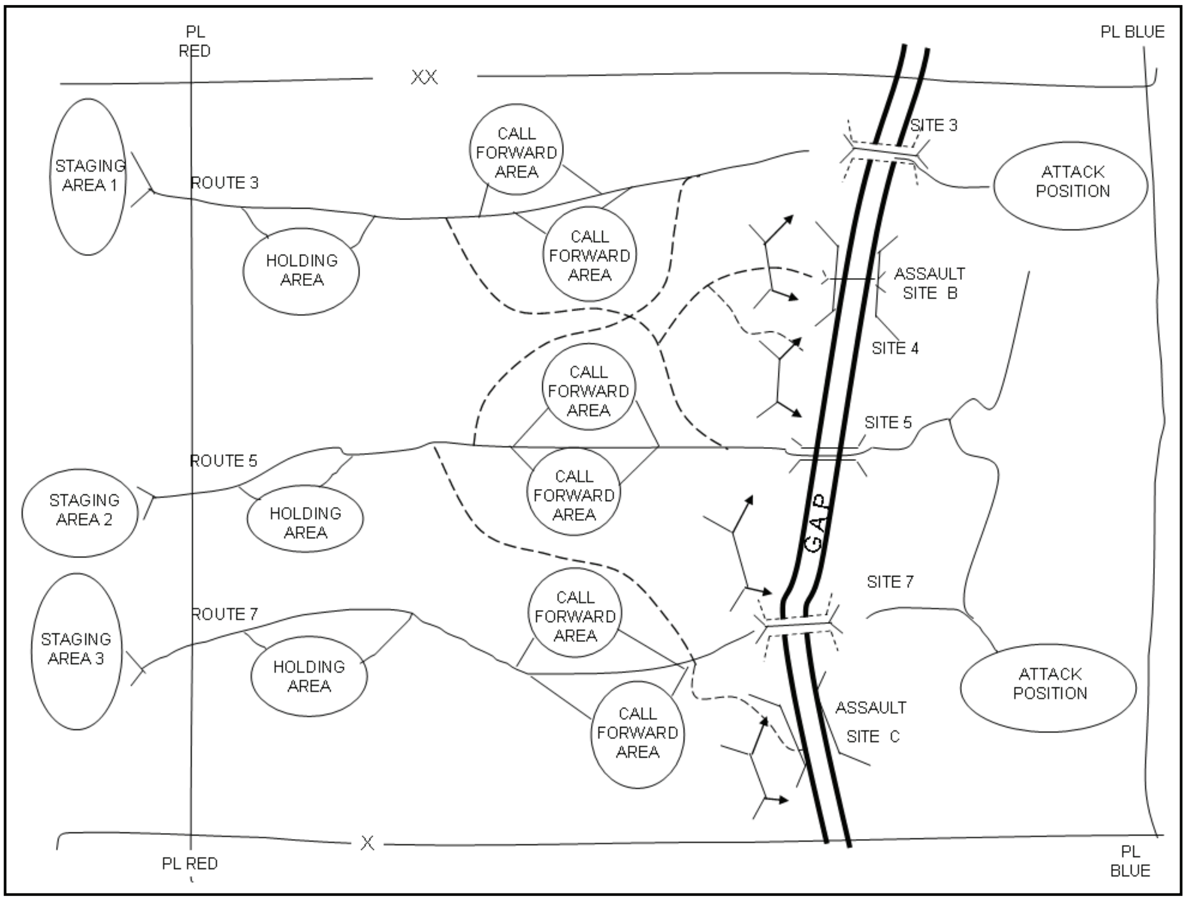


Figure D-3. Brigade Combat Team Crossing Area Overlay (Sample)

D-9. The engineer determines the crossing requirements using the factors from Table D-4, page D-6. He then blocks out the crossing periods for all units based on the site assignment, the site capability, and the crossing order in the scheme of maneuver. After adding the units' crossing periods to the chart, he coordinates the plan with the S-3 to ensure that it is synchronized and that units will arrive on the farside by the times they are needed (Figure D-6, page D-8). If not, the S-3 and engineer work together to adjust the crossing order of subordinate units. The basic technical information remains constant as different crossing sequences are checked until one meets farside requirements. The vehicle crossing capability chart is the primary tool for finalizing the crossing plan.

Table D-4. Selected Pure Company/Troop Rafting Requirements

Units	*Vehicles/Trailers*	*Raft Trips Required*		
		5 Bays	*6 Bays*	*7 Bays*
SBCT				
Infantry company	24/5	11	10	8
Reconnaissance troop	20/4	10	9	7
155 T field artillery battery	21/9	14	14	11
Engineer company	43/28	34	30	25
Antitank company	13/2	5	4	3
HBCT				
Infantry company	19/2	16	16	9
Armor company	19/1	16	16	9
Reconnaissance troop	25/2	10	10	9
155SP field artillery battery	33/5	13	13	12
Engineer company	24/9	12	11	11
IBCT				
Infantry company	2/2	1	1	1
Weapons company	23/6	8	6	5
Reconnaissance troop	25/6	9	8	7
Dismounted troop	7/5	3	2	2
105 T field artillery battery	30/19	11	10	8
Engineer company	24/14	12	11	11
ACR squadron				
ACR squadron HQ	6	3	2	2
ACR troop	27	18	17	15
ACR tank company	15	14	14	12
ACR field artillery battery	13	10	7	6
USMC units				
Tank company	20	16	16	16
Infantry company	28	15	10	10
Artillery battery	32	21	18	15
Reconnaissance company	5	2	2	1

Notes.
1. Assume that current velocities are less than 0.9 mile per second and that battalions/squadrons are at 100 percent MTOE strength.
2. Numbers of vehicles are approximate and may vary between units.
3. Numbers do not include trailers or secondary loads.

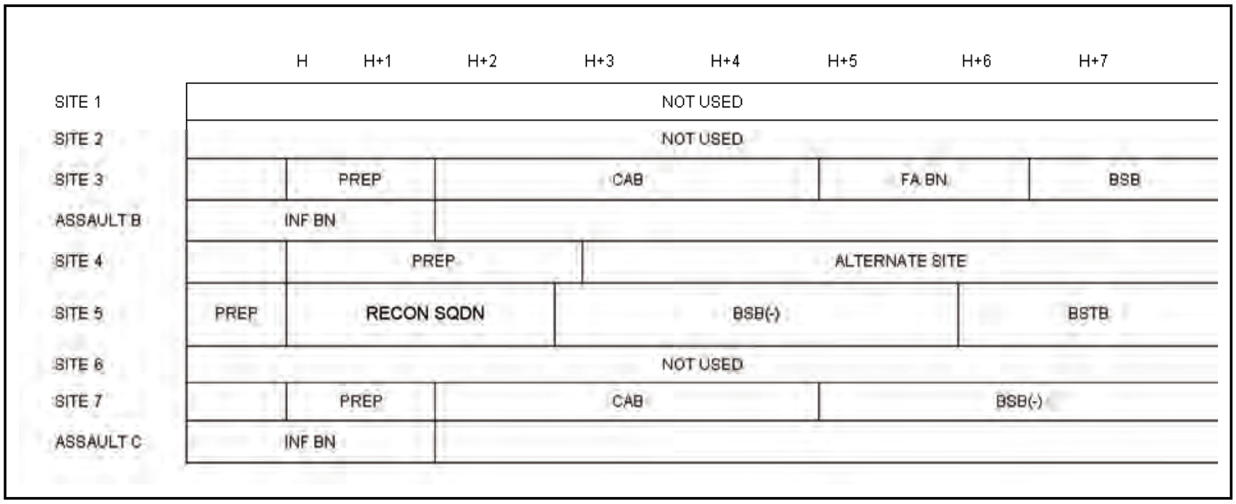


Figure D-4. Brigade Combat Team Crossing Timeline (Sample)

SITE	CROSSING MEANS	TRIPS/HOUR		BEGINNING MORNING NAUTICAL TWILIGHT						
		DAY	NIGHT	H	H+1	H+2	H+3	H+4	H+5	H+6
3	8 SIX-BAY RIBBON RAFTS; COVERT TO BRIDGE	40	25			CAB			FA BN	BSB
					PREP	xx RAFTS		CONST BRIDGE	BRIDGE	
5	BRIDGE	200 VEHICLES/HOUR	200		RECON SQDN		BSB(-)			BSTB
				SITE PREP/ CONST BRIDGE	116 VEHICLES		200 VEHICLES			
7	6 SIX-BAY RIBBON RAFTS; CONVERT TO BRIDGE	36	24			CAB				BSB(-)
					PREP	xx RAFTS		CONST BRIDGE		BRIDGE

Figure D-5. Brigade Combat Team Vehicle Crossing Capability (Sample)

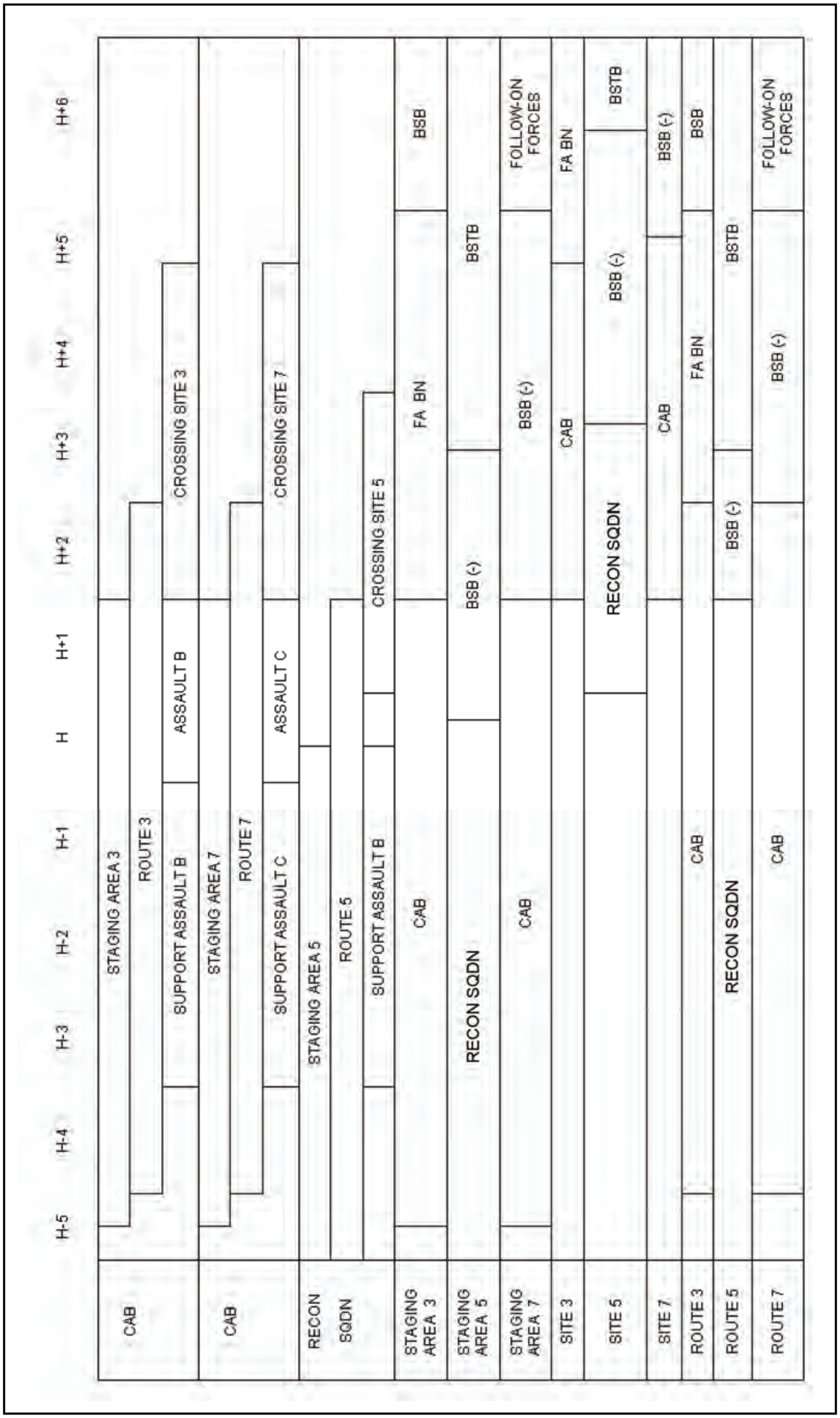


Figure D-6. Brigade Combat Team Crossing Synchronization Matrix (Sample)

ENGINEER CALCULATIONS

D-10. After the crossing order has been established, the staff engineer develops the engineer execution matrix (Figure D-7). This is the tool that the CAC and CAE will use to synchronize the execution of the crossing. It is constructed as a chart, with the unit's locations and activities displayed by time on the upper half and terrain occupation displayed by time on the lower half. The staff can follow each unit's location as the operation progresses and can easily see potential conflicts resulting from changes. The matrix also provides critical information for traffic control.

D-11. The crossing synchronization matrix is constructed backwards by first portraying the units' crossing times established from the vehicle-crossing capability chart, then by using road movement times to show route usage and staging-area times. The time required for the crossing of the assault force is also included. Once all of the units are displayed, the same information is transferred to the lower terrain portion of the matrix.

D-12. The staff immediately resolves any conflicts they discover while preparing the matrix. The final engineer planning step is developing the engineer execution matrix (Figure D-7). It displays subordinate units' task assignments by time. It is useful both for tracking unit execution and for aiding decisions if changes to the plan are required.

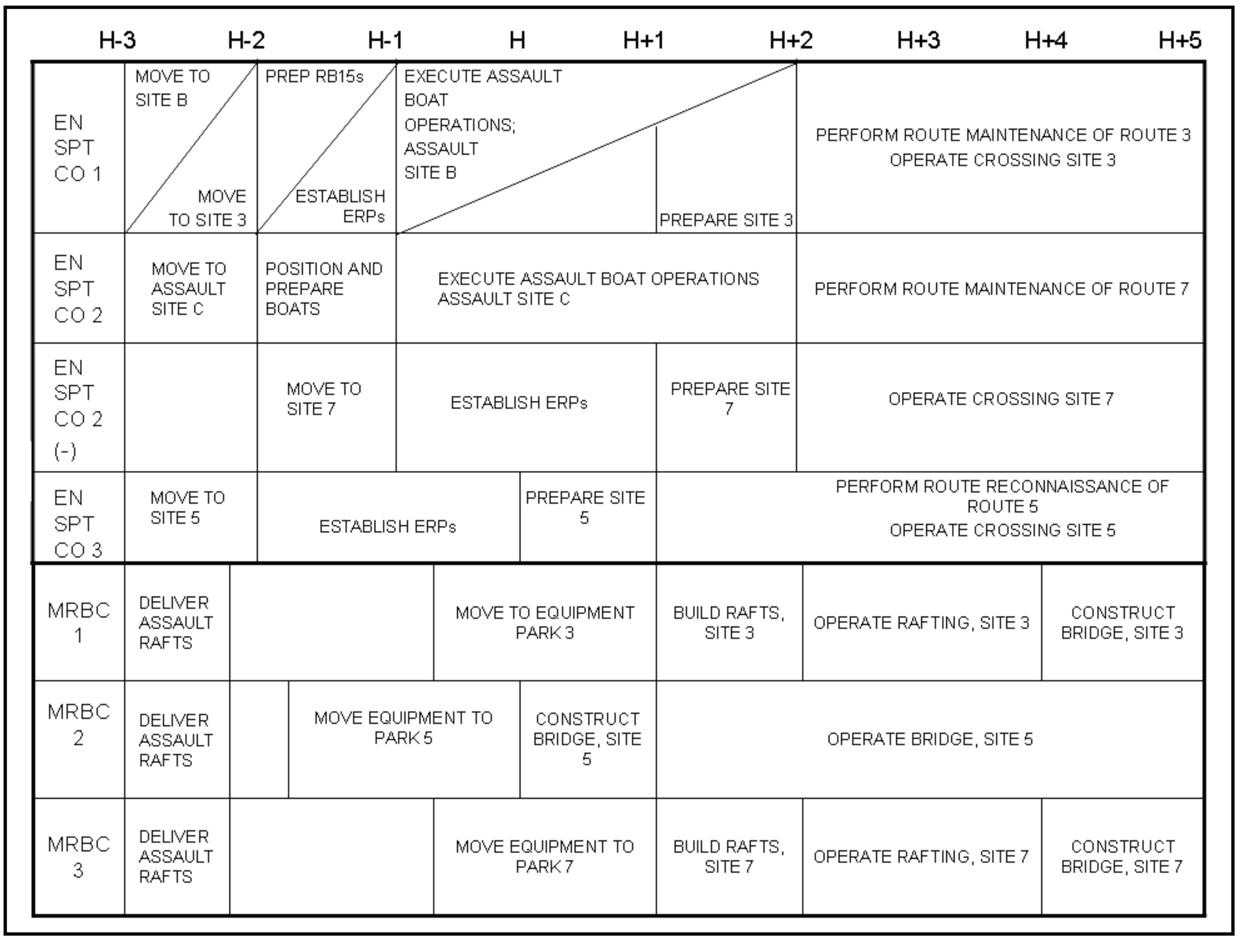


Figure D-7. Engineer Execution Matrix (Sample)

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Appendix E

Diving Support Considerations

Engineer diving teams perform a variety of tasks in support of mobility operations. Of particular importance are the specialized tasks that divers perform in support of a wet-gap crossing. Regardless of the crossing means, a reconnaissance of the crossing site by divers can provide the planner with the necessary details to confirm the conditions of a selected site. Additionally, divers can inspect and assist in the repair of nonstandard or floating bridges. They may also confirm that an existing bridge is not wired for demolition and assist with the removal of explosives if a bridge has been prepared for destruction. Since the basics of bridge design are similar to pier design, the same inspections conducted by divers on piers and pilings are conducted on bridge components. For more information, see FM 3-34.280.

WET-GAP-CROSSING SUPPORT

GENERAL

E-1. Maneuver commanders require up-to-date intelligence of crossing sites to choose the most appropriate site or sites. Divers work closely with MRBCs and reconnaissance elements to provide accurate information for the CSC. Divers conduct nearside and farside reconnaissance and perform bottom composition surveys (see FM 3-34.170). Some information divers collect may include the following:

- Gap width.
- Stream velocity.
- Nearside and farside bank composition and characteristics.
- Bottom composition.
- Obstacle type and location.
- Approach and bypass information.

E-2. The survey of a wet-gap-crossing site is similar to other hydrographic surveys conducted by divers. The degree of accuracy delivered will depend upon the commander's requirements and the threat level. In an unsecured location, engineer divers require support from security personnel.

E-3. To facilitate emplacement of bridging, divers may perform a variety of tasks to include the following:

- Neutralizing underwater obstacles.
- Constructing underwater bridge structures.
- Performing in water repair to bridging and watercraft.
- Recovering sunken equipment.
- Searching for and recovering casualties.

E-4. Once the bridging is emplaced, divers assist in installing impact booms, antimine booms, and antiswimmer nets to prevent damage caused by waterborne munitions and collision by floating debris. Antiswimmer nets are placed both upstream and downstream to protect bridges from enemy swimmers or underwater demolition teams.

E-5. Diving teams also conduct inspections and surveys of deepwater fording sites. When the divers cannot easily span the distance between banks, an inflatable boat or a BEB can be used. Helicopters may be used to drop teams in the water or place teams on the farside if the situation permits. Engineer diving teams routinely conduct reconnaissance at night to avoid detection and keep crossing site locations from being compromised.

E-6. Engineer divers also assist in wet-gap crossings by denying enemy access to bridging assets. Divers can be used to survey, emplace, prime, and detonate explosives on bridge supports to degrade or destroy bridges as the situation dictates.

BRIDGE INSPECTION AND REPAIR

E-7. Engineer divers provide critical support by providing inspection and repair of both standard and nonstandard bridging while the bridging is in place at the crossing sites. Divers conduct both underwater and surface reconnaissance of bridges to determine structural integrity and capacity. Divers may be used to repair or reinforce bridge structures and neutralize underwater obstacles in and around the bridge.

HYDROGRAPHIC SURVEYS

E-8. Hydrographic surveys provide a depiction of underwater bottom profiles of an operational shoreline or port area. Products from a survey may indicate bottom depth gradients, ship channels, and the location and type of obstructions that may impede vessel traffic.

E-9. Hydrographic surveys can be done with two levels of accuracy. A hasty survey is quicker to perform and gives the commander a general idea of the bottom profile, but the degree of detail is correspondingly less. A deliberate survey can take more time but produces more accurate results and provides a complete picture of the underwater profile, including obstacles.

OBSTACLE EMPLACEMENT AND REDUCTION

E-10. Underwater obstacles can be man-made or natural and may include mines and other explosive devices. Divers can be used to emplace or reduce these underwater obstacles by using demolitions underwater. Many of the same principles and techniques for using demolitions above water are used when employing demolitions underwater. Divers use sympathetic detonation to clear in-water munitions. This is done by emplacing demolitions on or near underwater obstacles. Demolitions are always detonated from the surface.

E-11. A diving team is fully capable of utilizing available materials to deny access to any site that has aquatic or vehicular traffic. Steel can be welded into hedgehog or tetrahedron configurations and concrete can be poured into block, cylinder, or tetrahedron molds. In the event of retrograde operations, the diving team is fully capable of rigging a bridge substructure with explosives for command detonation.

E-12. Divers can be used to emplace or breach underwater minefields. Many of the same techniques used to emplace or breach surface minefields can be adapted to underwater operations. Divers can emplace mines in water, but additional factors to consider are as follows:

- Many rivers or beaches have currents and waves that prohibit using mines with tilt rods.
- Floating debris may prematurely detonate mines.
- Soft river bottoms may prevent pressure-activated mines from detonating.

E-13. Divers can emplace mines in the water, but the mines must have additional anchors to hold them in place. One method is to use crossed pickets under the mine. This not only helps to anchor the mine but also helps to create a larger surface area in soft bottoms so that the mine can be pressure-activated.

E-14. Divers can breach underwater minefields. They use mine detectors, side-scan sonar or remotely operated underwater vehicles to locate underwater mines. The mines are then marked and, if necessary, neutralized to create a safe lane for passage. Sympathetic detonation of underwater mines is done by emplacing explosives on or near the mine, dependant on the type of fusing mechanism. Clearing an underwater minefield is a slow and deliberate process and should only be used when other alternatives for crossing have been exhausted.

ENGINEER DIVING TEAM

E-15. The mission of the engineer diving team is to provide diving support for all types of military operations. The diving team is a module that is normally attached to an engineer brigade or an engineer battalion headquarters conducting or supporting a wet-gap crossing to ensure proper C2 and logistical support. However, the module can be attached to any unit needing dive capabilities. The organization of an engineer diving team can be found in AR 611-75.

E-16. Due to mission requirements, any dive team can be reconfigured according to the manning levels outlined in AR 611-75, allowing for mission support with a much smaller footprint. Manning dive requirements for typical diving operations can be found in FM 3-34.280.

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Appendix F

Retrograde Gap Crossings

A *retrograde* is a type of defensive operation that involves organized movement away from the enemy (see FM 3-0). Gap crossings in support of a retrograde operation are most often conducted as a deliberate gap crossing. Like most deliberate gap crossings, the retrograde is normally conducted at the division level. In most situations, an engineer brigade should be part of the division and provide the division with the necessary C2 to those subordinate engineer battalions and companies supporting this sort of gap crossing. If a BCT is conducting such an operation, it will likely depend on an engineer battalion HQ to provide similar C2. This chapter describes only those tactics and techniques used by a division or BCT in a retrograde gap-crossing operation that differs from those used in an offensive crossing like the example provided in Chapter 4.

GENERAL

F-1. The goal of a retrograde gap-crossing operation is to cross a gap while preserving the integrity of the force. This involves an organized movement to the rear or away from the enemy.

F-2. A retrograde crossing features centralized control at the division or BCT level. Detailed planning and preparation of engineer assets are a critical consideration within the time available. A retrograde crossing differs from an offensive crossing in the following aspects:

- Both sides of the gap are initially under friendly control. Accordingly, detailed information concerning the gap and the area over which the retrograde is conducted should be readily available to the commander.
- All existing bridges and other crossing sites are available to the retrograde force to expedite the crossing.
- Relative combat power may favor the enemy. Units conducting retrograde operations must retain a mobility advantage over the enemy in this situation.
- Significant numbers of dislocated civilians or refugees may compound the crossing (see Chapter 6).

F-3. Deception is often planned and executed to mislead the enemy and to protect the force during a retrograde operation. As a minimum, these plans seek to conceal the extent of the operation and the actual crossing sites. Obscurants, electronic deception, and dummy sites may be used to reduce the enemy's capability to disrupt the crossing.

F-4. The same control measures are used in retrograde gap-crossing operations as in other deliberate gap-crossing operations. Figure F-1, page F-2, shows an example of some of the basic control measures used in a retrograde gap crossing.

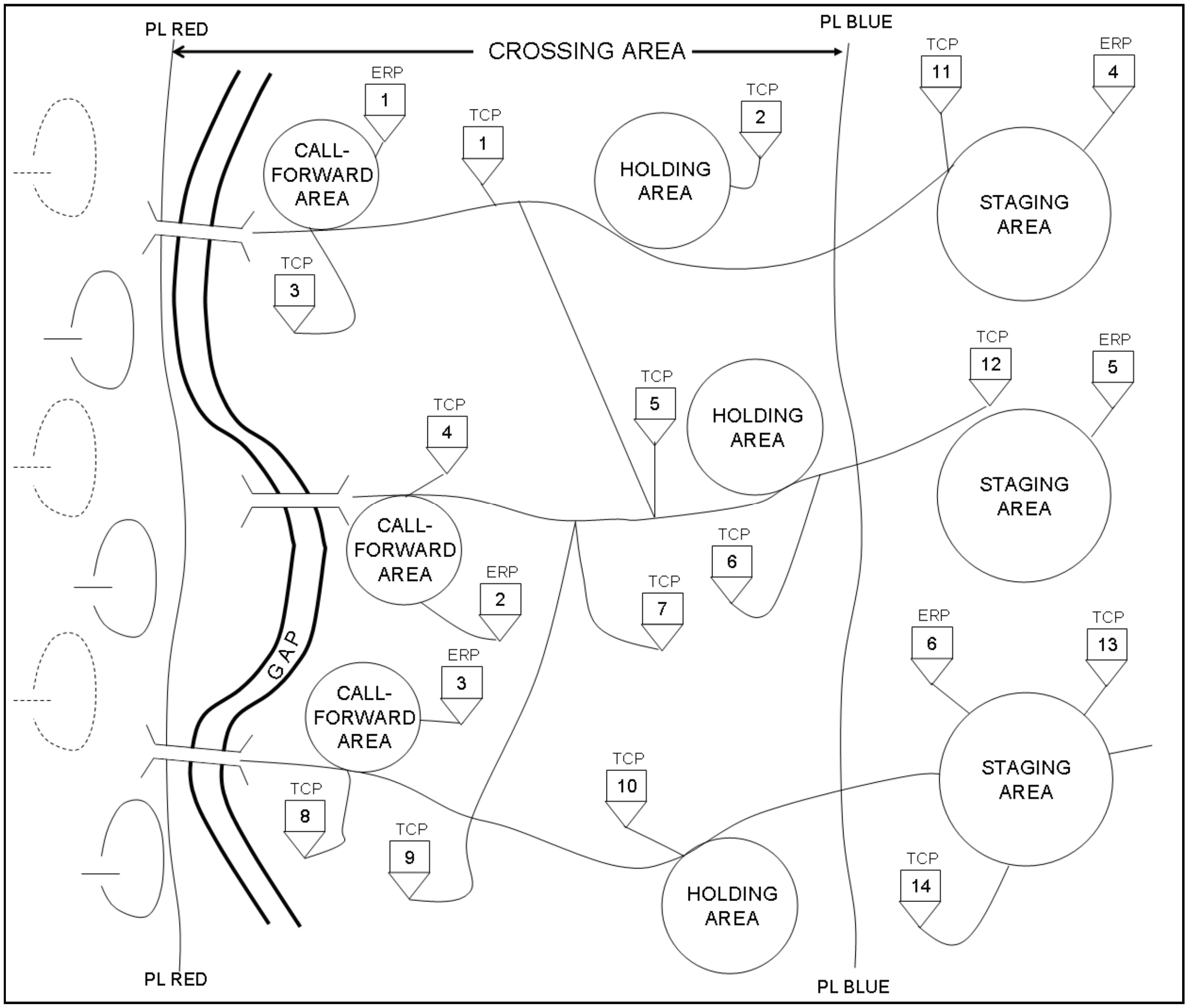

Figure F-1. Graphic Control Measures for a Retrograde Crossing

RETROGRADE TYPES

F-5. A retrograde operation may be forced by enemy action or by a higher headquarters. A well planned, well organized, and aggressively executed retrograde operation provides opportunities for the division or BCT to inflict heavy damage on enemy troops and equipment while continuing to maintain its fighting integrity. The three types of retrograde operations are delay, withdrawal, and retirement (see FM 3-90).

DELAY

F-6. Units conduct delays when they are under pressure and desire to trade space for time. Flexible planning allows the units conducting a retrograde gap crossing to adapt quickly to changes during execution. Some important features of a flexible plan include—

- Multiple approach routes from battle positions to crossing sites.
- Lateral routes between crossing sites.
- Alternate crossing sites if enemy actions close primary sites.
- Crossing equipment held in reserve to replace losses or open alternate sites.
- Multiple means or methods for crossing.
- Preplanned engagement areas (EAs) to block enemy advances.

F-7. A delay combined with a retrograde gap crossing has the following phases:

- Delay.
- Crossing.
- Defense.

F-8. Each phase is separate only in planning; they overlap during execution. Employing military crossing equipment in the retrograde is essentially the reverse of the method used in a deliberate offensive gap-crossing operation. Figure F-2 relates the retrograde sequence to the crossing stages.

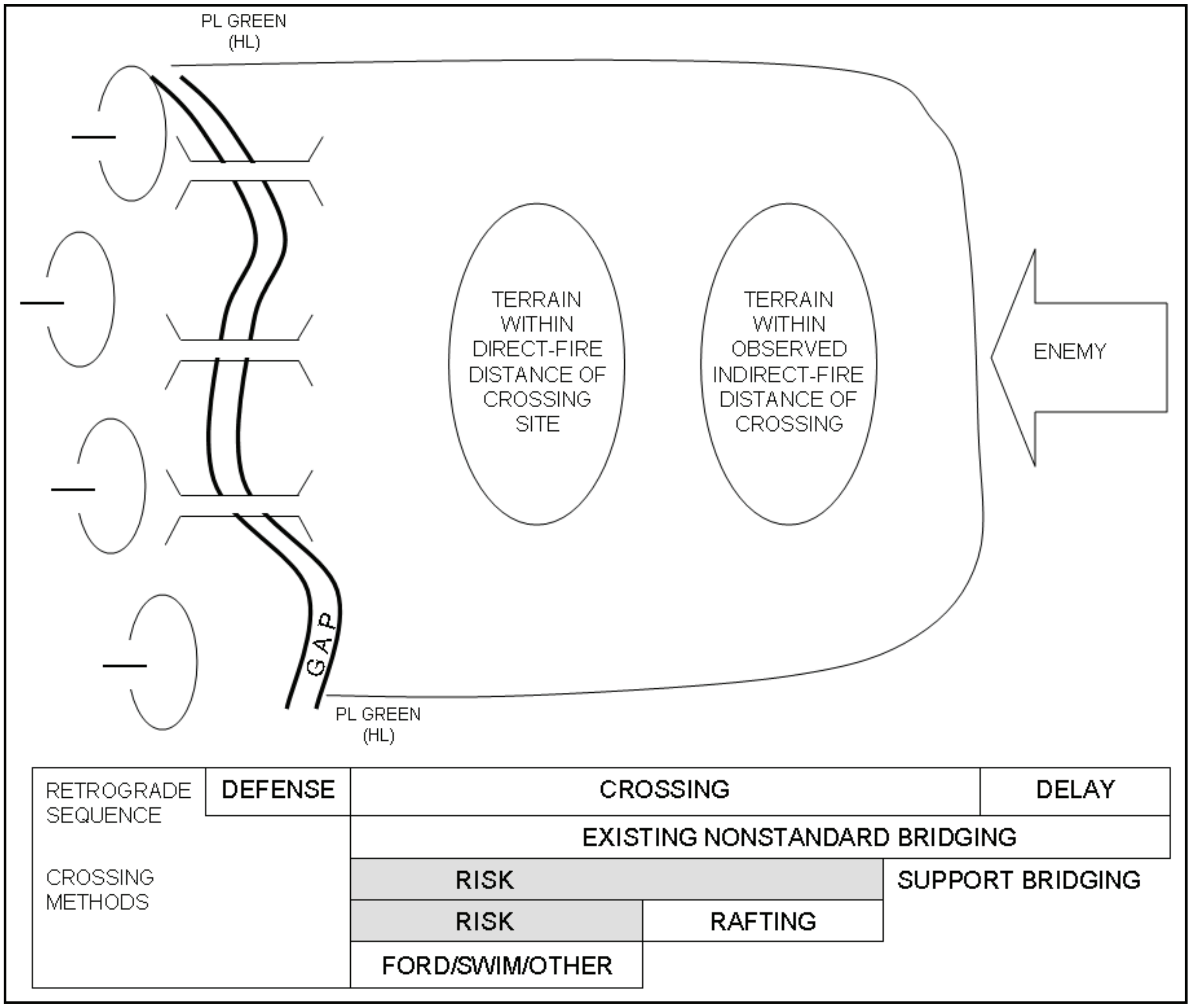

Figure F-2. Retrograde Planning

Delay Phase

F-9. The delay phase provides security for the main body and allows the delaying force to gain enough time for the main body to do its mission (cross the gap). For this reason, delaying forces take some risk to ensure the security of the rest of the division as it withdraws across the gap. The delaying force must deceive the enemy and keep it from the gap-crossing sites, allowing the main body to cross and establish the exit-side defense. While it may be impossible to deceive the enemy into believing that a retrograde crossing is occurring, it is possible to deny them the timing and specific locations and means that will allow the crossing to take place.

F-10. The division or BCT commander establishes a holding line (HL) on defensible terrain between the gap and the enemy. In retrograde gap-crossing operations, a ***holding line*** **is the outer limit of the area**

established between the enemy and the water obstacle to preclude direct and observed indirect fires into the crossings. This location is chosen to preclude direct and observed indirect fires into the crossing area.

F-11. Forces not assigned tasks in the delay, including those forces with a mission to support crossing areas or establish the defense on the exit side, execute a planned retirement or withdrawal and cross the gap as rapidly as possible. To preclude early enemy detection of the retrograde, the forces follow a movement control plan that supports the deception plan.

F-12. The delay phase continues until the battle is within communications and fire-support range of the exit side defense. The delaying force must be strong enough to hold the enemy until other forces establishes the defense. The defending force assumes responsibility for the battle as the delaying force completes a rearward passage of lines through the defending force.

F-13. Figure F-3 shows an example of a retrograde crossing. In this case, the 3d Brigade will be the delaying force. It initially occupies battle positions to the rear of the 1st and 2d Brigades along PL PLUM to facilitate their withdrawal and crossing. The 3d Brigade delays the enemy in a sector forward of PL GREEN (the HL) until the rest of the division has completed crossing the gap and the 1st and 2d Brigades reestablished their defense along the line of the gap. If available and practical, an aviation heavy delay force may afford ease in the withdrawal of the delay force due to its high relative mobility and inherent ability to cross the gap with less engineer support.

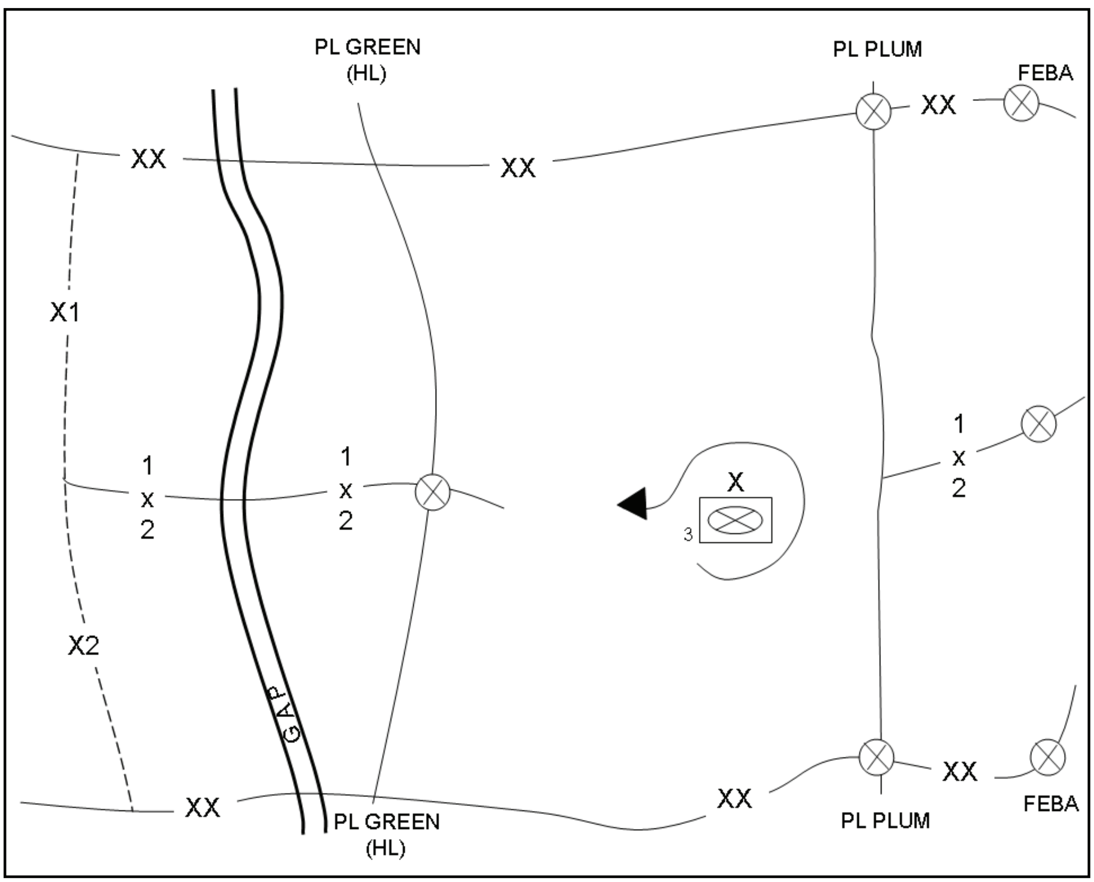

Figure F-3. Retrograde Crossing

Crossing Phase

F-14. In contrast to normal offensive crossing operations, friendly forces initially control retrograde crossing sites, although they may be insufficient in number. The enemy usually knows where the logical crossing sites are and will likely attack them early in the operation. While little can be done to prevent an attack, the enemy must not be allowed to capture them, and it may be possible to deceive the enemy about the time periods particular crossing sites are in use. Friendly forces should develop additional and multiple crossing sites, providing flexibility against potential loss of one or more crossing sites during the operation and the flexibility to vary the crossing sites that are in use.

F-15. The commander should attempt to salvage tactical bridges and rafts for future use; however, it may be necessary to use them for the final crossings and then destroy them to prevent capture. Nonstandard bridging must be prepared for destruction and also be protected against ground and air attacks. This requires close coordination with the delaying force to preclude cutting off friendly forces while at the same time denying the seizure of any intact crossing sites by the enemy.

F-16. Traffic control up to and through the crossing area is a critical challenge in this type of crossing operation. For this reason, movement plans must be detailed and synchronized with the retrograde operation. Control is exercised by the CAC with assistance from the delaying force [brigade] commander. The CAC controls all movement within the crossing area to include delaying forces that enter that area.

F-17. It is the responsibility of the CAC to ensure the continuous and orderly flow of the retrograde elements across the gap. His control includes both the ERPs, which ensure that all vehicles are of the proper class and size, and all waiting areas that feed vehicles through the crossing area. To assist the CAC, military police and, if available, engineers establish and operate TCPs. CSCs oversee the crossing means. The CAC and his staff must synchronize the crossing plan with the commander's tactical plan.

F-18. Normally, activity within the crossing area begins with two-way crossings by sustainment units evacuating nonessential supplies or restocking the delaying force. During the early stages of the retrograde, the existing crossing means may be supplemented by tactical bridging. As a minimum, additional tactical bridging assets must be planned and available. Some tactical bridging may be emplaced to deceive the enemy about the location of actual crossing sites.

F-19. Initially, the force crosses on nonstandard and/or floating bridges. It crosses on bridges as long as possible, since this is the most rapid means and allows for the greatest volume of flow. Once the bridges become vulnerable to capture, air attack, or observed indirect fires, they may need to be converted to rafts (if a wet gap) or removed. Vehicles continue to cross by using the rafts and swimming (if capable). The crossings are made under the relative protection of the suppressive fires of the defending force's direct- and indirect-fire weapons.

F-20. The forces cross the gap in an orderly flow while conserving combat power. Even when the division has to establish the crossing areas quickly, under adverse circumstances, it synchronizes crossing support activities with those of the defense force that is preparing to close the routes in the crossing areas.

F-21. Crossing sites need the highest priority for air interdiction. This is particularly critical when the enemy has air superiority or when air parity exists. The sequence for crossing AMD units should account for the need to provide continuous coverage of crossing sites.

F-22. Engineers required to support this type of operation that is not organic to the BCTs will, as a minimum, include bridge companies (MAC or MRBC depending on the gap size) and engineer support companies. They will begin preparing defensive positions on the far side of the crossing site. Essential tasks for M/CM/S support will be essential to the success of the operation on both sides of, as well as across, the gap. Engineer units performing these tasks will be organized under engineer battalions and potentially engineer brigade HQs for C2 to facilitate the operation.

Defensive Phase

F-23. The defensive phase stops the enemy by keeping it out of the direct range and observed indirect range of the crossing area, denying it crossing sites upstream or downstream, and destroying all attempts to cross the gap. In particular, the defensive phase targets potential enemy crossing assets. Whether continuing the retrograde further or defending along the gap, the division or BCT establishes a strong exit bank defense. The defending force protects the delaying force as it crosses the gap and conducts battle handover with the defending force. The rearward passage of lines by the delaying force is performed as a normal defensive operation but is complicated by the gap and the proximity of pursuing enemy forces.

F-24. Initially, the defending force may be small. It consists of combat and combat-support units not involved in the delay or actually conducting withdrawal. Due to lack of forces available to defend all points along the gap, the defense depends on rapid lateral movement to concentrate at vulnerable points. In particular, it orients on and protects the crossing sites against the enemy's forward detachments and heliborne forces. Withdrawing combat forces should rapidly move to occupy their defensive positions behind the gap.

F-25. In our example, the battle handover line (BHL) is also the HL (PL GREEN). After accepting the battle handover from the delaying force, the defending force assumes responsibility for the area between the HL (PL GREEN) and their defensive positions on the exit side of the gap. The defending force masses fires to support any of its elements in contact forward of the gap to withdraw or be supported if it is planned for them to remain forward of the gap by design.

F-26. The defending force accepts battle handover from the last of the delaying force at the BHL and HL (PL GREEN), covering its crossing over what may be one or more nonstandard or standard bridges that have normally been prepared for demolition. Friendly forces at the gap prevent the enemy from crossing at the site of a demolished bridge so that its companies securing the farside of the crossing sites can be safely withdrawn. These last elements may be formed around vehicles with swim or ford capabilities and be capable of being extracted by helicopters or other viable and rapid means of crossing the gap without any bridges being in place. If available, USMC amphibious vehicles may be very useful in this role because of their swimming capability (see Appendix A).

WITHDRAWAL

F-27. A withdrawal differs from a delay because it is an operation in which the unit in contact disengages from an enemy force. Withdrawals are executed when the commander desires to withdraw to control future tactical operations without being forced to do so by enemy pressure. A withdrawal follows the same sequence as a delay. The only difference is that the unit may or may not be in enemy contact.

F-28. During a withdrawal, the enemy may or may not pressure withdrawing units. Also, other friendly units are not always necessary to assist in withdrawals. Care must be taken to ensure that the enemy does not try to isolate and encircle units during gap-crossing operations. If a unit has difficulty breaking with the enemy in a withdrawal, it can request help from a higher level. The assisted withdrawal may take the form of another unit becoming the stationary unit and allowing the unit with difficulty to conduct a rearward passage of lines and subsequent gap crossing behind the protecting forces of the stationary unit. The exchange of information on obstacles, indirect-fire targets, and routes in the sector must be coordinated before conducting the passage of lines. The assisting unit provides mobility support along cleared routes and corridors in its sector for the passing unit.

F-29. Engineers may need to conduct clearing operations before the passage begins, as well as on a recurring basis until the crossing is completed. The assisting unit also closes the lanes once passage is complete. The passing unit must plan and organize for the possible requirement to conduct in-stride breaching or gap-crossing operations before initiating the passage of lines. This should ensure responsive mobility operations if the enemy blocks routes during the passage.

RETIREMENT

F-30. Retirements are rearward movements away from the enemy by a force not in contact. Typically, another unit's security forces cover their movement as they conduct a tactical road march. A retirement follows the same sequence as a delay. Speed is important, so engineers should focus on mobility for the retiring unit and expect to perform operations such as route clearance, route repair, and breaching of enemy countermobility efforts.

DENIAL MEASURES

F-31. Denial measures are actions taken to hinder or deny the enemy use of resources or facilities. In retrograde crossings, the commander includes bridges and crossing sites in his denial measures.

F-32. The law of war requires that denial operations, particularly against civilian resources such as existing bridges, be carefully considered and that execution authority to destroy the structure is maintained at the highest level, consistent with the ROE. A thorough understanding of the ROE and identification of the destruction authority are essential early in the planning process.

F-33. A defending force commander handles the preparation of existing bridging and other crossing means in his sector, such as ferries, for destruction to prevent their use by the enemy if they cannot be withdrawn. The CAE controls the engineers who prepare those targets. The timing of their destruction depends on their use in supporting the crossing operation. When the tactical situation dictates that crossing sites are no longer needed, or the risk of capture outweighs their usefulness, the defending force must destroy them. Authority for destruction must be clearly articulated in the OPORD.

F-34. Use of bridges in the retrograde requires a redundant means of bridge destruction and a robust demolition guard with an engineer demolition party (see FM 3-34.214). Engineer diving teams may be used to survey and emplace, prime, and detonate explosives on bridge supports to deny enemy access during retrograde operations. Because of the severe consequences of a premature decision to destroy a site, the division commander usually designates sites as reserve targets and issues specific orders stating under what conditions and by whose authority this destruction can be achieved.

F-35. Engineers destroy military bridges that they cannot recover quickly. Bridge stocks are in short supply; therefore, if existing bridges are enough to support the retrograde, the engineers recover military bridges as early as the OPORD allows. Also, the denial of major existing bridges can be so important that the commander may choose to destroy them early to ensure they are not captured by the enemy and rely on military bridges to cross the remainder of his force. In a deliberate wet-gap crossing, the IRB is preferred for this portion of the crossing because of its relative recovery speed. Engineers either recover LOC bridges well before the enemy arrives or destroy those left in place after the delay.

PLANNING

F-36. The division or BCT commander (as appropriate) as the higher HQ identifies the HL and BHL and the units required to fight the delay and defensive battles. The senior engineer HQ supporting the division (or the BCT), in conjunction with the G-3 (or the S-3), identifies crossing sites and required crossing assets. The division staff coordinates for additional assets, as needed. The staff uses the planning process identified in Chapter 3. Destruction authority is identified early in the planning process.

F-37. The commander uses deception to conceal the extent of the operation and the actual crossing sites. Obscurants, electronic warfare, and dummy sites reduce the enemy's capability to disrupt the crossing. OPSEC keeps the enemy intelligence collectors from identifying the specific time and place of the crossing.

F-38. The commander may consider retaining nonstandard bridges in defense of the gap if he anticipates future counterattacks back across the gap. He may also only partially destroy bridges to ease their restoration in support of future offensive operations, weighing this decision against the enemy's potential use of them.

F-39. Denial operations are somewhat restrictive. Only those civilian targets with a clearly identified military value may be destroyed or removed. Coordination between the theater command and the HN government is important in the policy development process. The staff judge advocate (SJA) of the division or the command judge advocate (CJA) of the BCT will advise their respective commanders on these issues.

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Appendix G
Security Considerations

Gap crossings have inherent security considerations because of the significance of their purpose and how they are done. The purpose of crossing sites is to enhance mobility by providing avenues of approach and freedom of movement for combat and support forces across linear obstacles. Gap crossings are by nature choke points and provide opportunities for the enemy to easily affect the maneuver of friendly forces. Enemy forces will attack crossing sites in various ways and at various times to disrupt and eventually suspend crossing operations. The engineer force that provides a majority of the expertise, personnel, and equipment for all types of gap crossing is not generally equipped to provide complete security for the gap-crossing site, making them and their equipment vulnerable during emplacement, maintenance, and removal. For these reasons, it is imperative that planners understand the threat and provide the necessary resources to ensure the security of key gap-crossing sites.

GENERAL

G-1. Gap crossings are normally conducted at key locations to promote freedom of movement. They generally are resource intensive operations requiring significant planning, personnel, and equipment to construct and maintain. Due to the nature of a gap, the crossing typically exposes forces by placing them in the open without the ability to adequately maneuver. Forces are restricted to the lane that crosses the gap and metered in their crossing ability to the capacity of the lane or the boats and rafts. Soldiers and Marines and their equipment are often targeted by the enemy for air interdiction, direct and indirect fires, and sabotage. To protect against these activities, planners must take an approach to security that focuses on the three basic areas of air, nearside and farside, and the lane that is the crossing site itself.

AIR SECURITY

G-2. Attacks from enemy air, while not as likely as other types of attacks, can devastate a crossing site and completely destroy crossing assets very quickly. While U.S. forces maintain air superiority, planners must ensure that both tactical and nontactical crossing sites are within AMD system coverage areas. Enemy aircraft and other aerial threats in the airspace that can threaten the crossing site(s) must be identified and defended against. Enemy reconnaissance aircraft and remotely piloted vehicles (RPVs) are included as aerial threats to the crossing site because of the linkages that they will have to killing systems. This is a critical part of the planning and execution of a gap-crossing operation.

NEARSIDE AND FARSIDE SECURITY

G-3. Nearside and farside security can prevent direct- and indirect-fire weapons, EH, and other obstacles from being effectively employed. Near and farside security is not only an important consideration when conducting tactical crossing operations, but is important as well for non-tactical crossing operations. Security of routes leading from assembly areas to entry and exit points on both sides of the gap utilizing patrols conducting route and area reconnaissance (see FM 3.34-170) can avoid potential traffic delays, crossing site disruption, or sabotage. Protection against improvised explosive devices (IEDs) may also need to be considered although this is more applicable to LOC gap-crossing sites than it would be to those supporting combat maneuver.

G-4. Bridges and crossing sites are high priority targets for enemy direct- and indirect-fire systems. Identification and destruction of enemy indirect-fire systems before beginning the crossing is imperative.

The counterfire battery must plan and coordinate counterfiring to address any indirect-fire systems that may acquire the crossing site during the operation. Suppression or destruction of enemy direct-fire means and observation sites must also be planned for in support of gap-crossing operations.

G-5. Obscuration measures, such as smoke, may be employed to provide concealment of the site or to isolate the farside for rapid occupation by maneuver forces (see FM 3-50). Conducting gap-crossing operations at night, while significantly more dangerous from a crossing perspective than daylight crossing operations, and maximizing the advantages of the terrain will also provide additional concealment. This is simply one more consideration in the conduct of the risk assessment by the commander. Other means of camouflage, concealment, and deception (CCD) may also contribute to providing security and protection to gap-crossing operations (see FM 20-3).

CROSSING SITE SECURITY

G-6. In a wet-gap crossing, the actual crossing site is perhaps the most vulnerable location within the crossing area. Moving patrol boats, divers, and other stationary protective systems (such as antimine booms, impact booms, or antiswimmer nets) will assist in preventing waterborne forces or floating devices from damaging or destroying the bridge and closing the lane across the gap.

SUMMARY

G-7. Regardless of the type or classification of the crossing, proactive security measures must be planned and implemented. Because of the complexity of gap-crossing operations and the inability of the units tasked to conduct the crossing to provide site security, it may be imperative that maneuver commanders provide tactical forces that are capable of providing security to gap-crossing sites.

Appendix H

Foreign Bridging Resources

U.S. forces often conduct operations as part of an alliance (North Atlantic Treaty Organization [NATO] and others) or as part of a coalition. As a part of these theatres of operations, Army and Marine engineers can expect to conduct gap-crossing operations with support from other nations, including equipment support. Additionally, U.S. forces may encounter other foreign bridges on the battlefield. As such, engineers should be aware of some of the other types of gap-crossing assets available to these forces. This appendix provides a basic description of some of the more common bridging systems.

GENERAL

H-1. It will become apparent in many cases, particularly with alliance and coalition forces, that other bridging systems may be similar to U.S. bridging systems, but they usually differ in specific details, such as the length of the bridge. Foreign bridges discussed in this appendix are listed by how they are best described utilizing U.S. bridging categories. The categories of foreign bridging discussed are as follows:

- Standard tactical bridging.
- Standard support and LOC bridging.

STANDARD TACTICAL BRIDGING

GENERAL

H-2. Standard tactical bridging normally consists of a fixed span bridging system mounted on a tank chassis that can be emplaced within a matter of minutes. It is designed to support combat maneuver on the battlefield and capable of participating in close combat.

BRITISH ARMORED VEHICLE-LAUNCHED BRIDGES

H-3. The armored bridges developed for the United Kingdom (UK) as part of the BR 90-series replace the old number 8 and number 9 bridges. Slight modifications on the present Chieftain AVLB have been necessary to use the three new bridges, but laying times are very similar (about 4 minutes) due to the use of the same hydraulic system. Soon, the Titan armored vehicle launcher will replace the Chieftain as the primary transporter for the number 10, 11, and 12 bridges. The Titan has a 7.62-millimeter machine gun and stowage for crew man-portable light antitank weapons and is fitted with a CBRN protection system. The new bridges were the first part of the BR 90 system being used by the British.

- **Number 10 Bridge.** The number 10 bridge is launched using the scissors principle. At 26 meters, it is the world’s longest tank bridge capable of spanning a gap of 24.5 meters. See Figure H-1, page H-2.

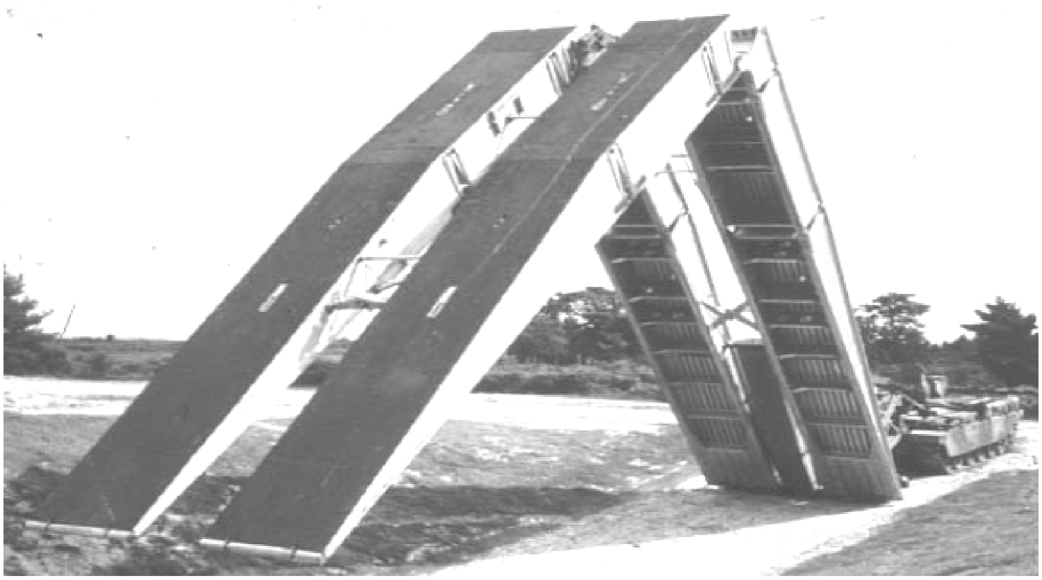

Figure H-1. British Number 10 Bridge in Launch Sequence

- **Number 11 Bridge.** The number 11 bridge consists of four ramp sections and, due to its large overhang, is only constructed for specific tasks. It is launched by the up-and-over method (similar to the number 12 bridge). It is 16 meters long and can span 14.5 meters. See Figure H-2.

Figure H-2. British Number 11 Bridge

- **Number 12 Bridge.** The most significant aspect of the number 12 bridge is that it may be carried in pairs on the AVLB. Both bridges can be launched in sequence without the crew leaving their vehicles. The number 12 uses the up-and-over launch method and is 13.5 meters long. It is capable of spanning a gap of up to 12 meters. See Figure H-3.

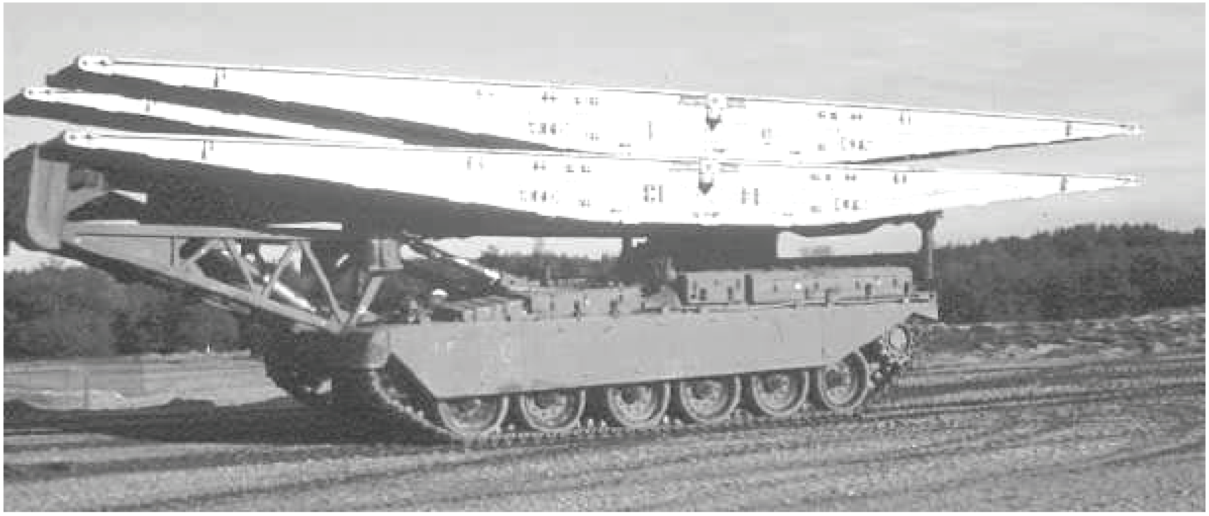

Figure H-3. British Number 12 Bridge

- **Combination Bridging.** Each AVLB is scaled for one number 10 bridge and two number 12 bridges. Like the present range of bridges, these bridges can be laid in combination up to a maximum of 66 meters.
- **Extensions Trestle.** To permit crossing gaps that are wider than the standard number 8 bridge, an extension trestle has been introduced. This trestle is fitted in place of the far-bank end ramps in such a fashion that the trestle is allowed to unfold and swing downwards as the bridge is extended. The trestle then supports the bridge to allow another AVLB to cross and lay an additional bridge. A new trestle, which will incorporate a special panel and will be used with a number 10 bridge, provides the ability to employ combination bridges over a greater range of gap depths and for a wider range of gaps. See Figure H-4.

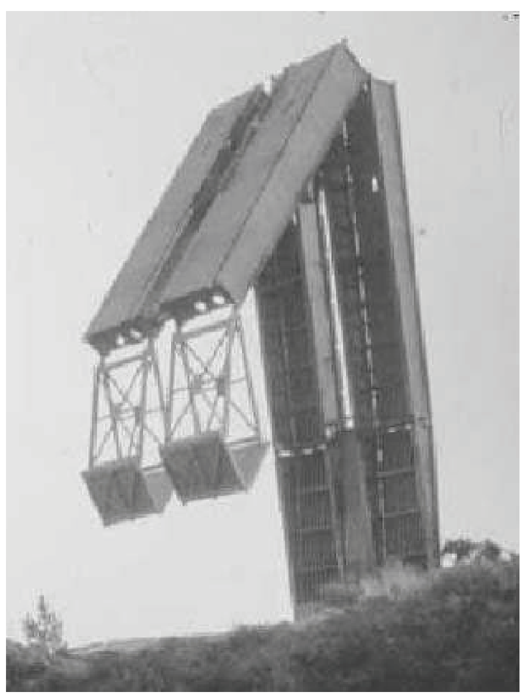

Figure H-4. British Number 10 Bridge With Trestle

GERMAN ARMORED VEHICLE-LAUNCHED BRIDGES

H-4. German engineers employ the Leopard 1 Biber AVLB, the same variant as employed by Canadian engineers. During the past decade, the Germans have begun developing their tactical bridging using various tank chassis. Outlined below are some of the German-made bridging assets employed by other nations:

- **MAN M47/M60 LEGAUN Armored Bridge Layer.** The MAN M47/M60 LEGUAN armored bridge layer is an adaptation of an M47 or M60 MBT chassis, designed to carry and launch the standard MLC 70, 26-meter LEGUAN bridge. With a crew of two, laying operations take between 3.5 to 4 minutes. Forward slopes of up to 20 percent and down to 20 percent can be accommodated, as can traverse slopes of up to 10 percent. The maximum downward laying slope is 0.8 meter. The bridge weighs 10,000 kilograms, with an MLC of 70. The bridge can span gaps up to 24 meters and has a width of 4.01 meters, allowing 1.5 meters for roadway. This bridge can also be adapted to MBT, such as the Centurion, the Leopard 1 or 2, and the M1 Abrams. Currently this version is also used by the Spanish Military. See Figure H-5.

Figure H-5. MAN M47 LEGUAN Armored Bridge Layer

- **MAN Leopard 1 LEGUAN Armored Vehicle-Launched Bridge.** The MAN Leopard 1 LEGUAN AVLB is based on the hull and chassis of the Leopard 1 MBT with all main and subcomponents unchanged. Various items from the removed turret and other components have been modernized and integrated into the AVLB. The 26-meter, aluminum alloy bridge follows standard construction design. Laying procedures remain the same with the exception that before laying, a hydraulically operated tilt-table support blade is lowered under driver control from the front of the hull. Acting as a stabilizer blade it can also be used for light obstacle clearance. Operating with a crew of two, launching and retrieval times are less than 5 minutes. Currently in service with Norway and on order for Belgium. See Figure H-6.

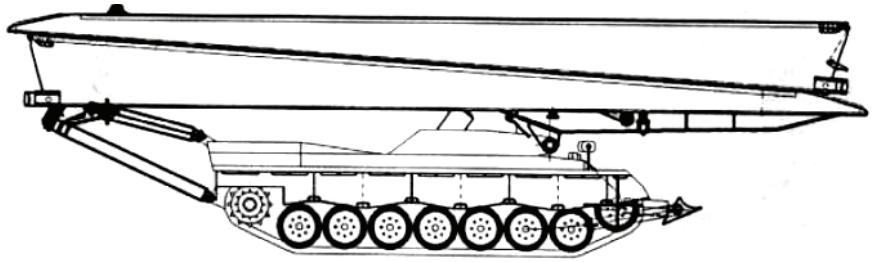

Figure H-6. MAN Leopard 1 LEGUAN Armored Vehicle-Launched Bridge

CANADA LEOPARD ARMORED VEHICLE-LAUNCHED BRIDGE (BEAVER)

H-5. The Leopard AVLB was introduced to the Canadian Forces in 1976. Other NATO and America, Britain, Canada, and Australia (ABCA) countries that currently employ the Leopard AVLB are: Australia, Denmark, Germany, Greece, Italy, the Netherlands, and Norway. The AVLB is a fixed span bridge mounted on a Leopard I tank chassis, using a horizontal launch system instead of the more common scissors launch. The bridge provides an MLC 60 gap-crossing capability for gaps up to 21 meters using prepared abutments or 20 meters using natural banks. It operates with a crew of two, with launching and retrieval times of less than 5 minutes. It has eight launcher tubes that can use smoke rounds to conceal bridge launching or canister-type high explosives (HE) grenades for self defense.

Note. The Chinese-Type 84 bridge layer is similar in design to the German Beaver AVLB.

CZECHOSLOVAKIAN MT-55A ARMORED BRIDGE LAYER

H-6. The MT-55A armored bridge layer (Figure H-7), a joint project between Czechoslovakia and Russia, replaced the earlier MT-34. First produced in 1962, it is based on T-55A tank chassis. There are two types of scissor bridges. The first model of the bridge has circular holes in the sides of the bridge, while the more recent model has solid panels. The difference between the two is that one has a pattern while the other is smooth with a plastic covering. With a crew of two, the bridge takes 3 minutes to lay in position while 3 to 8 minutes are required for recovery. The bridge is 18 meters long and 3.34 meters wide. It has the ability to span gaps up to 17 meters with the maximum capacity of 50,000 kilograms. Standard equipment on the MT-55A includes a CBRN system, a snorkel, an inclinometer, and other equipment for determining the width of the gap before the bridge is laid. This bridge layer is also in service with Croatia, India, Iraq, Russia, Slovakia, Yugoslavia, and some countries in the Middle East.

Note. Slovakia now markets the MT-72. A follow-on, scissors-type bridge that uses the T-72 chassis.

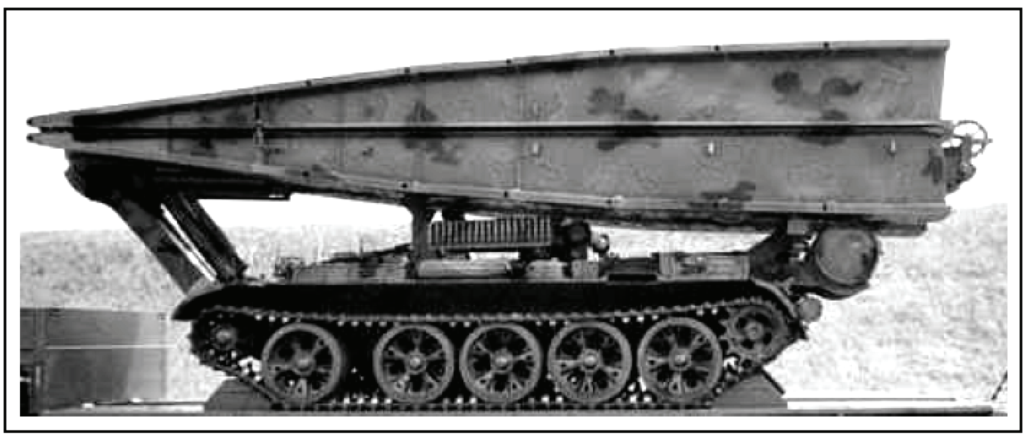

Figure H-7. MT-55A Bridge Layer in the Traveling Position

RUSSIA MTU-72 ARMORED BRIDGE LAYER

H-7. The MTU-72 armored bridge layer (Figure H-8) is a fixed span, aluminum alloy bridge mounted on a T-90 MBT chassis with a crew of two. The bridge provides an MLC 50 gap-crossing capability for gaps up to 18 meters. The bridge can be laid in 3 minutes with recovery in 8 minutes. It is possible to cover a 30-meter span by laying a second bridge in concert with the first. The outrigger dozer with hydraulic control is mounted on the front of the vehicle.

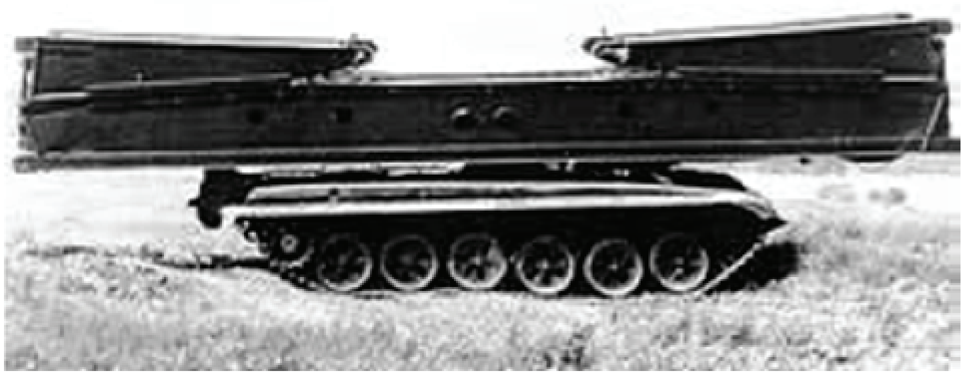

Figure H-8. MTU 72 Armored Bridge Layer

RUSSIA MTU-90 ARMORED BRIDGE LAYER

H-8. The MTU-90 armored bridge layer (Figure H-9) is designed to carry and lay a one-span bridge over ditches, canals, and narrow gaps on the battlefield. The bridge provides an MLC 50 gap-crossing capability for gaps up to 24 meters. Laying the bridge can be accomplished in 3 minutes with recovery in 2 1/2 minutes. It can also support the TMM-6 heavy bridge building system in laying multispan bridges to provide passages for tanks and wheeled vehicles. It is made on the basis of the T-90S MBT chassis. Laying and removing bridge procedures are fulfilled by a crew of two without leaving the cabin. The vehicle carries a single-span bridge. It is equipped with CBRN protection, fire extinguishing, and smoke-screen systems, as well as intercom and radio sets, and night vision device. Special provisions are made to provide protection against armor piercing, incendiary, and hollow-charge projectiles.

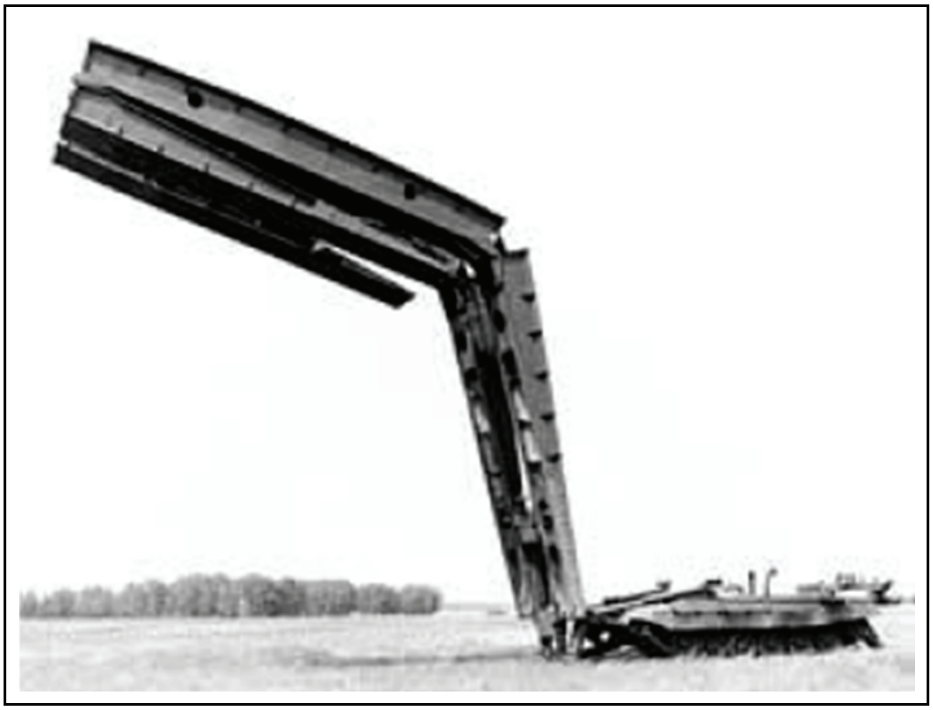

Figure H-9. MTU 90 Armored Bridge Layer

FRANCE–PAA BRIDGE LAYER AND PTA MODULAR ASSAULT BRIDGE

H-9. The PAA bridge layer (Figure H-10, page H-8) is a French bridge that consists of a wheeled vehicle carrying a scissor launched bridge. The vehicle can either lay the bridge and retract from the farside or stay in place with the bridge still attached to it. When deployed, the four wheels are raised off the ground, and the hull of the vehicle is supported on shoes. Combination bridging is possible using an intermediate trestle.

H-10. The MLC is 49 with a span of 21.4 meters, however, the MLC and span vary depending on the nature of the banks and the vehicle position after laying the bridge. If two bridges are laid within 2 meters and parallel to each other, an MLC 70 is possible. A truck is needed as a counterweight when launching the bridge. The bridge width is 3.3 meters, has a crew of three, and a maximum road speed of 60 kilometers per hour.

Figure H-10. PAA Bridge Layer

H-11. The SPRAT (Figure H-11) is an MLC 70 modular assault bridge, whose length is adjusted by the crew according to the width of the gap. It comes in two versions: one version can launch two 14.3-meter bridges or one 26-meter bridge before replenishment; the other can launch three 10.5-meter bridges, or one 10.5-meter plus one 18.7-meter bridge, or one 27-meter long bridge. Operation, launch, and retrieval are fully automated. The system is operated by a crew of two under armor.

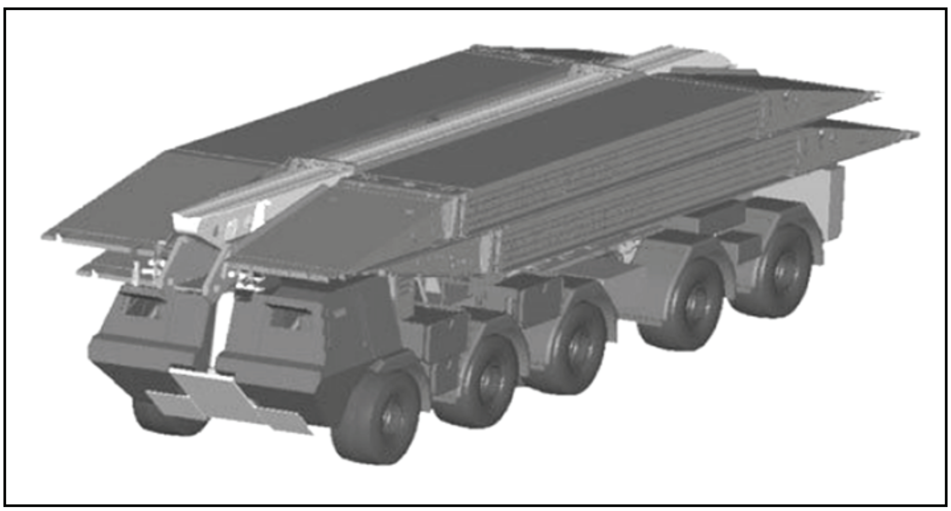

Figure H-11. SPRAT Modular Assault Bridge

India Bridge Layer Tank and Sarvatra Truck-Mounted System

H-12. The bridge layer tank (BLT) is a fixed span, aluminum alloy, bridge mounted on a T-72 tank chassis. It can span gaps up to 20 meters in about 5 minutes.

H-13. The Sarvatra truck-mounted bridging system is a wheel-based, universal bridging system on a Tatra (8 x 8) chassis. A single span provides MLC 70 gap-crossing capability across gaps up to 20 meters. It can be launched or recovered in 15 to 20 minutes (per span) from either end. The bridge has multispan capability of up to 100 meters.

SUPPORT AND LINE OF COMMUNICATIONS BRIDGING

GENERAL

H-14. Standard support and LOC bridging is used to construct bridges that can be dismantled and moved to a new site. These bridges require manpower, time, and transportation depending on the span design. These bridges often support combat maneuver based upon gap characteristics, however, normally replace assault bridging assets to support follow-on forces. The following is a list of some of the available LOC bridges:

- **General Support Bridge.** The general support bridge (GSB) is UK designed and is part of the BR 90 package. Using the automotive bridge launching equipment (ABLE) vehicle, construction of 30 meters of MLC 70 bridge by 10 persons in fewer than 30 minutes has been achieved, a significant improvement over the MGB. Construction is mechanical and uses the cantilever launch rail to build and launch the bridge. All 8 x 8 unipower vehicles offer excellent cross-country mobility. The ABLE vehicle is capable of launching and recovering bridges up to 44 meters long. The two-span bridge (TSB) allows gaps of 62 meters with a floating pier or 60 meters with fixed piers to be crossed. All BR 90 bridges are MLC 70.
- **Mabey & Johnson**. Mabey & Johnson (Figure H-12) is one of Europe's foremost organizations involved in the supply of steel bridging, with almost 150 years of experience. These bridges were designed to replace the ever-popular Bailey bridge and have recently received worldwide attention as the direct result of the hostilities in the Balkans. Currently Mabey & Johnson bridges are in service throughout the world. The most common types of bridging used by military forces are the LSB or the Compact 200.

Figure H-12. Mabey & Johnson Compact 200 Bridge

- **Bailey Bridge.** The Bailey bridge (Figures H-13 and H-14, page H-10) was originally developed by Sir Donald Bailey of the UK and was widely used during World War II. The great advantage of the bridge is its use of standard interchangeable components that (combined with the simplicity of design) enables it to be erected in a short time. Using basic equipment, the maximum span is 61 meters with an MLC of 80. Depending on the version of the Bailey bridge (Bailey, standard, wide, or extra-wide), it can be constructed in three widths (3.28, 3.81, and 4.19 meters). Finally, a double-width Bailey (7.23 meters wide) was developed to permit two-way traffic. Over the years, improvements have included new steel decking that is quick and easy to erect, an antiskid surface and has a long life (unlike the wooden deck). This decking can be used with the standard, wide, extra-wide, or double-width Bailey bridge. Another development is the Bailey panel, which provides an extra 40 percent safe working shear load plus increased bending capacity and is completely interchangeable with the standard Bailey panel. Besides being used as a road bridge, the Bailey bridge has been widely used for other applications including rail and footbridges, retractable lift bridges, derrick supports, and mobile gantries. The Bailey bridge is in service with many armed forces around the world, or it can be found in military and civilian stockpiles as emergency or reserve equipment.

- **M2 Bailey Bridge.** The M2 Bailey bridge has been proven both as a tactical and LOC bridge capable of carrying heavy traffic loads. The M2 Bailey bridge is an all-purpose prefabricated steel-panel bridge designed for portability and speed of erection under adverse conditions. Optimum spans are 12.2 to 61 meters long, with a width of 3.8 meters between steel curbs and 4.3 meters between trusses. The components are manufactured in fixtures to ensure accuracy and interchangeability. The heaviest component weighs 281 kilograms. There are about 15 major components in an average Bailey bridge and about 50 components, fittings, accessories, special items, and tools available. Currently the M2 Bailey bridge is in service with the U.S. Army and other armed forces.

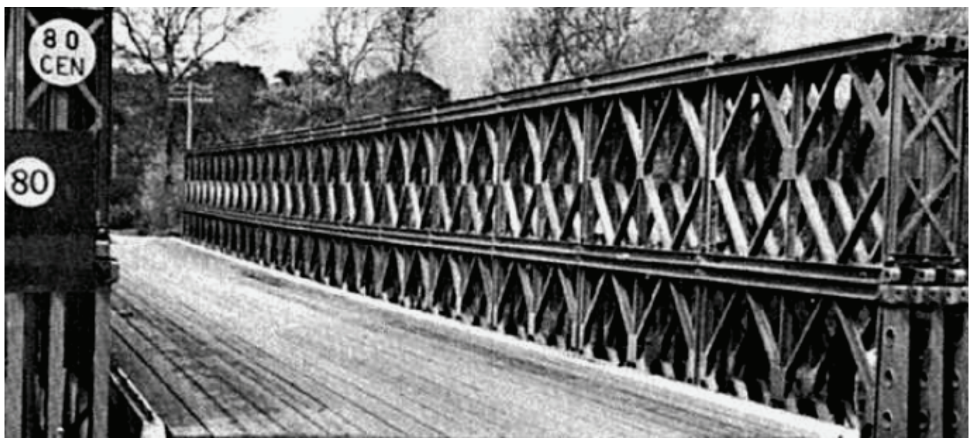

Figure H-13. Bailey Bridge

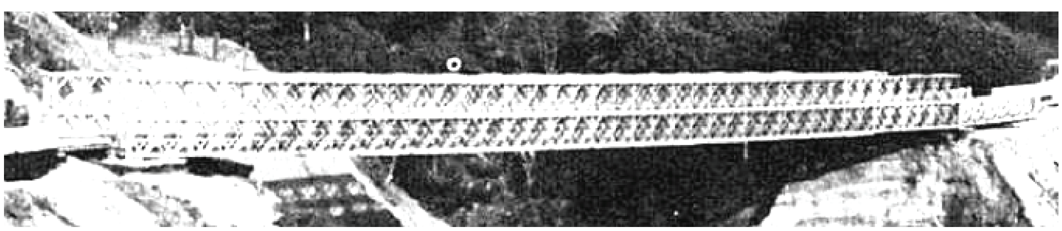

Figure H-14. M2 Bailey Bridge

- **EuroBridge/Faltfestbruecke Foldable Bridge**. In the German military, this bridge is known as the Faltfestbruecke (FFB) (Figure H-15) and has been specified for near combat zones support tasks. It can be employed as a general support bridge during conflicts or out of area operations and for disaster relief. The bridge has been designed for MLC 70 traffic and has a crossing speed of 25 kilometers per hour. The 39.5-meter bridge can be assembled by a crew of six in 60 minutes. It is equipped with a hoisting device for carrying the bridge bays and a traversing beam. The bridge bays are arranged so that when the hoisting device is used, the bays will automatically unfold to a 4.4-meter road width. The bridge is capable of spanning a 38.8-meter gap while maintaining MLC 70. Currently this bridge is used by Germany and Spain.

Figure H-15. EuroBridge/Faltfestbruecke

- **AM-50B.** The AM-50B is a bridge system used by the Czech Republic. It is based on a scissor-launched bridge that is carried, launched, and retracted by a TATRA T 813 or T 815 chassis. The bridge is provided with a detachable telescopic abutment with a length of 1.75 meters to 5.15 meters. It is possible to combine up to eight of these bridges. The bridge is an MLC 50, has a width of 4 meters, and the maximum span of each bridge is 13.5 meters. Installation time is 6 to 8 minutes for one bridge, 15 to 19 minutes for two, 25 to 30 minutes for three, and 34 to 42 minutes for four. See Figure H-16.

Figure H-16. AM-50B

- **TMM-6.** The Russian TMM-6 mobile bridge building system is designed to provide bridge crossing of heavy-wheeled and tracked vehicles (60 tons). With a crew of two, it is found in many countries and used in a variety of roles to include military, disaster relief, and humanitarian operations, as well as in the oil, gas, and mining industry to provide access to remote areas with harsh terrain. The system is composed of a bridge layer mounted on the undercarriage of a wheeled prime mover and bridge elements (bays) with intermediate supports. Depending on the number of bridge bays placed in a series, the length of the bridge crossing can vary in length from 17 meters to lengths greater than 100 meters. Bridge members are transported both by a bridge layer and by special transport vehicle. See Figure H-17, page H-12.

Figure H-17. TMM-6

- **Acrow.** The Acrow panel bridge (Figure H-18) is a Canadian bridge and uses the Bailey unit construction system with its ease of assembly, but employs higher tensile steel and has an advanced design. As with the Bailey, the bridge decking can be either steel or timber. The roadway width may be suited for one or two-way traffic. The bridge can be launched on rollers and is constructed using nonspecialized personnel without a crane. Acrow panels can be used to produce other bridges such as railway bridges. The MLC varies according to construction.

Figure H-18. Acrow Panel Bridge

FLOATING/AMPHIBIOUS BRIDGES AND FERRIES

H-15. Probably the biggest technical advances in military bridging have been made in floating bridges with the amphibious self-propelled units and quick-assembly bridges, such as the medium floating bridge.

- **The M3 Amphibious Bridging and Crossing Vehicle.** The M3 (Figure H-19) was developed in Germany as a follow-on to the M2. It entered service with the German Army and in the UK at the end of 1996. The UK Ministry of Defense purchased 38 vehicles. The Taiwanese have also purchased this system. The M3 is a MLC 31, 4 x 4 wheeled vehicle that is powered by a single diesel engine. It is 12.8 meters long and 3.9 meters high during road operation, achieving a road speed of 85 kilometers per hour. The main hull and side pontoons are constructed exclusively of aluminum alloy that provides no CBRN or direct-fire protection for a crew of three except for the Taiwanese M3s that are equipped with an armored cabin, CBRN protection system, air conditioning system, and a special tropical kit. It has the option of 4-wheel steering, and the ability to adjust tire pressure while on the move. Thus, giving it outstanding cross-country capabilities. The M3 can carry vehicles up to MLC 70 (tracked) and MLC 100 (wheeled). A unique feature of the M3 is that it requires no preparation to enter or exit the water. The water jet-propulsion system gives the M3 a speed of 13 kilometers per hour in the water along with other exceptional ferry capabilities allowing it to be employed from widely dispersed sites. A 100-meter bridge formed by eight M3s is designed to accommodate vehicles of up to MLC70T/100W. A ferry of two linked M3s (Figure H-20, page H-14) carries an MLC 70 MBT. A 100-meter bridge can be built by 24 Soldiers in less than 15 minutes—at least half the time and personnel required to build the M2.

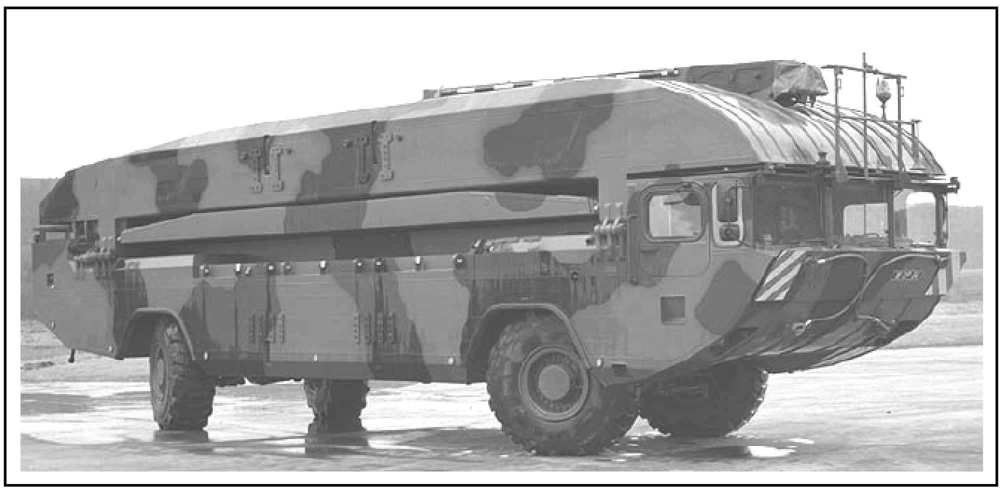

Figure H-19. M3 Amphibious Bridging and Crossing Vehicle

Figure H-20. Linked Amphibious Bridges Deployed

- **MAN Floating Bridge.** The MAN floating bridge (Figure H-21) is an old model based on connected metal pontoons. It permits a variety of configurations: MLC 30-50-80 floating bridge and MLC 80 ferry. It also permits the construction of jetty and floating infrastructure for landing or underwater works. The installation requires cranes and forklifts help to speed up installation. The major advantage is that it doesn't require a dedicated vehicle. Installation of a 100-meter MLC 80 bridge by an engineer platoon takes 18 hours. The bridge is currently in use by Spain and Norway.

Figure H-21. MAN Floating Bridge

- **Two-Span Bridge Pontoon.** The UK two-span bridge pontoon is carried in threes on a DROPS flat rack system. The flat racks can carry payloads up to 15,000 kilograms, with the units being launched into the water from the back of a vehicle. Once in the water, they are fixed back to back. The top pontoon of each load is fitted with a propulsion system similar to that found on the combat support boat operating on the water jet principle. See Figure H-22.

Figure H-22. Launching a Two-Span Bridge Pontoon

- **Damen FAC 540 Floating Bridges and Ferries.** The Damen FAC 540 (Figure H-23) is a fast assault craft that can be used in the construction of floating bridges or light ferries for loads up to MLC 8. All the bridges and ferries are based on using the aluminum hull FAC 540, designed to carry a fully equipped infantry section and an operating crew of two. It is in use with the engineers in Brunei, Malaysia, the Royal Netherlands Marine Corps, and the International Red Cross in Nicaragua.

Figure H-23. FAC 540 Raft

- **EFA Amphibious Bridge.** The EFA is a French amphibious bridging system that is used for wet-gap crossing. In a wet gap, it is also used as a ferry. The bridge element is mounted on top of the vehicle. Before the vehicle enters the water, hinged flaps are deployed on each side and the floats are inflated. Preparation time from road position takes about 6 minutes. The following ferry combinations are possible: a single-rig ferry, a 2-rig ferry, and a 3-rig ferry. A 100-meter floating bridge is formed with four rigs. The bridge has an MLC of 70, with a width of 3.6 meters, a crew of four, and a maximum on-road travel speed of 75 kilometers per hour. See Figure H-24.

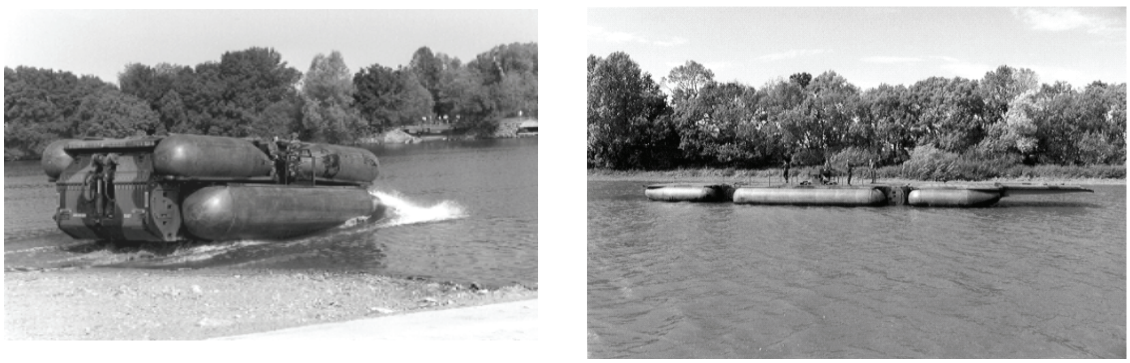

Figure H-24. EFA Amphibious Bridge

- **PFM Motorized Floating Bridge.** The PFM is a French designed asset in service in France, Switzerland, Italy, and Malaysia. It has an MLC of 70 and its length varies based on the number of bridge modules put together. Each module has a 10-meter span a 4.4 meter width and is propelled by two 75-horsepower engines. The module has a crew of three plus an additional transporter driver. A 100-meter bridge or two 50-meter ferries can be constructed in 30 minutes. See Figure H-25.

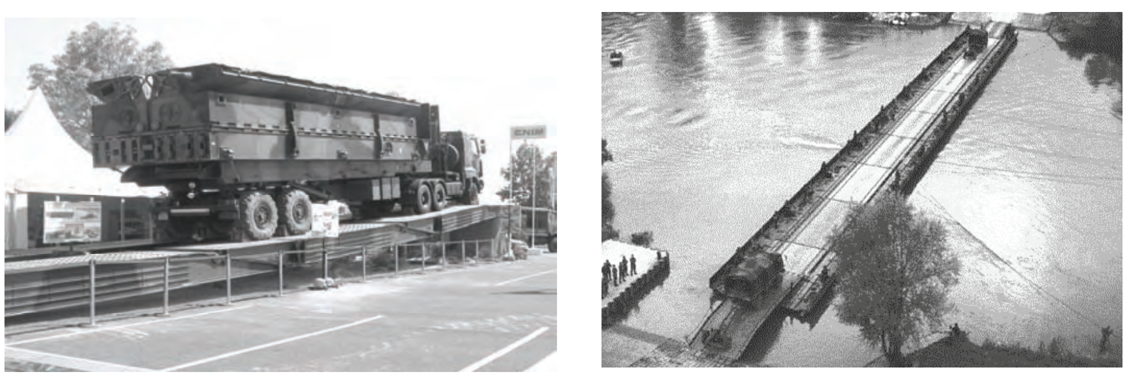

Figure H-25. PFM Motorized Floating Bridge

- **PTS-10 Tracked Amphibious Self-Propelled Transport Vehicle**. The PTS-10 system is in use in the Czech Republic, Russia, and Poland for wet gap crossing. It is a tracked amphibious self-propelled transport vehicle for floating transport of persons, casualties, materiel, and some equipment with loading and unloading on land or for transportation on land. It can be used in flow velocities of up to 2.5 meters per second. Design load-bearing is 5,000 kilograms on land and 10,000 kilograms on water. It can transport 72 persons including all personal equipment or 12 injured on stretchers. The vehicle has an MLC of 10, a width of 3.3 meters, a crew of two, and a maximum on-road travel speed of 42 kilometers per hour or 10 kilometers per hour in the water. See Figure H-26.

Figure H-26. PTS-10

Railway Bridges

H-16. Standard bridging railway bridges are valuable assets because they are not commonly used in other countries. In most cases, repair or reinforcement of existing railroad bridges should be considered.

MAN SE Railway Bridge

H-17. The MAN SE railway bridge is a panel bridge that is similar to the Bailey bridge but is much stronger. It has two configurations: upper deck and lower deck. With the upper deck configuration, it can span gaps up to 40.95 meters; with the lower deck up to 50.4 meters. It is designed to withstand the crossing of locomotives with 30 tons per axle and wagons with 20 tons per axle. Installation time is 20 to 30 hours with a 50-man crew and two cranes. This bridge requires a prepared abutment (existing railway abutments or concrete abutment). Spain and Italy are the only NATO countries with existing military railway bridges in their inventory. See Figure H-27, page H-18.

Figure H-27. MAN SE Railway Bridge

CONCLUSION

H-18. As outlined in this chapter, there are many pieces of equipment available worldwide that refer to bridging in all forms. Due to the wide array of equipment, engineers should collect data and be knowledgeable of the various bridges and bridging assets that may be encountered in theater. Many publications offer details at length and can be found on the internet. One of the most comprehensive and up-to-date publications is offered by Jane's <www.janes.com> and is readily accessible in book form as well as electronically.

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Glossary

SECTION I – ACRONYMS AND ABBREVIATIONS

AA	assembly area
AAV	amphibious assault vehicle
ABCA	America, Britain, Canada, and Australia
ABLE	automative bridge launching equipment
ACE	armored combat earthmover
ACR	armored cavalry regiment
ADC	assistant division commander
AFCS	Army Facilities Components System
AFJPAM	Air Force joint pamphlet
AFR	Air Force reserve
AFTTP	Air Force technical training publication
AMD	air and missile defense
AN/PSS	Army-Navy/portable special search
AO	area of operations
AOR	area of responsibility
AR	Army regulation
ARNG	Army National Guard
ARNGUS	Army National Guard of the United States
ART	Army task
AT	antitank
ATTN	attention
AUTL	Army Universal Task List
AVLB	armored vehicle-launched bridge
BCT	brigade combat team
BEB	bridge erection boat
BHL	battle handover line
BLT	bridge layer tank
bn	battalion
BRSC	Brown & Root Services Corporation
BSB	brigade support battalion
BSTB	brigade special troops battalion
C2	command and control
CAB	combined arms battalion
CAC	crossing area commander
CAE	crossing area engineer
CAS	close air support

CBRN	chemical, biological, radiological, and nuclear
CBT	common bridge transporter
CCD	camouflage, concealment, and deception
CCDR	combatant commander
CCIR	commander's critical information requirements
CEB	combat engineer battalion
CFA	call forward area
CFZ	critical friendly zone
cgo	cargo
CJA	command judge advocate
cm	centimeters
co	company
COA	course of action
COE	contemporary operational environment
const	construction
COTS	commercial off-the-shelf
CP	command post
CPIC	Coalition Press Information Center
CPS	collective protective shelter
CSC	crossing site commander
CSE	combat support engineer
CV	combat vehicle
DA	Department of the Army
DCG	deputy commanding general
DCO	deputy commanding officer
DCP	detainee collection point
DD	double double
DIVENG	divisional engineer
DOD	Department of Defense
DPRE	displaced persons, refugees, and evacuees
DROPS	demountable rack offload and pickup system
DS	double story; double single
DSB	dry support bridge
DTO	division transportation officer
DWFK	deepwater fording kit
EA	engagement area
EEP	engineer equipment park
EFV	expeditionary fighting vehicle
EH	explosive hazards
EIC	end item code
EMW	expeditionary maneuver warfare

EN	engineer
ENCOORD	engineer coordinator
EOD	explosive ordnance disposal
equip	equipment
ERP	engineer regulating point
ERT	engineer reconnaissance team
ESB	engineer support battalion
F	fahrenheit
FA	field artillery
FEBA	forward edge of the battle area
FFB	Faltfestbruke
FM	field manual
FMT	forward maintenance team
FMI	field manual interim
FOM	freedom of movement
fps	feet per second
FOLAV	family of light armored vehicles
FRAGO	fragmentary order
FSCL	fire-support coordination line
ft	feet
G-2	Assistant Chief of Staff, Intelligence
G-3	Assistant Chief of Staff, Operations
G-4	Assistant Chief of Staff, Logistics
G-5	Assistant Chief of Staff, Plans
GSB	general support bridge
HBCT	heavy brigade combat team
HE	high explosive
HEMTT	heavy expanded-mobility tactical truck
HL	holding line
HMMWV	high-mobility, multipurpose wheeled vehicle
HN	host nation
HQ	headquarters
IBCT	infantry brigade combat team
ICV	infantry carrier vehicle
IEBL	inter-entity boundary line
IED	improvised explosive device
IMPIN	implementing instructions
in	inch(es)
inf	infantry
IPB	intelligence preparation of the battlefield
IPE	individual protective equipment

IPTF	International Police Task Force
IRB	improved ribbon bridge
ISO	International Organization for Standardization
ISR	intelligence, surveillance, and reconnaissance
JAB	joint assault bridge
JP	joint publication
KBR	Kellogg, Brown, & Root
LAR	light armored reconnaissance
LAV	light assault vehicle
LAVFOV	light armored vehicle family of vehicles
LCAC	landing craft air cushion
LCM-8	landing craft, mechanized 8
LCU	landing craft, utility
LOA	limit of advance
LOC	line of communications
LRS	link reinforcement set
LSB	logistics support bridge
LTF	logistics task force
LV	launch vehicle
LZ	landing zone
m	meter(s)
MAJ	major
MAC	mobility augmentation company
MAGTF	Marine air-ground task force
maint	maintenance
MBT	main battle tank
MCAP	mine-clearing armor-protected
M/CM/S	mobility, countermobility, and survivability
MCRP	Marine Corps reference publication
MCWP	Marine Corps warfighting publication
MDMP	military decision-making process
ME	maneuver enhancement
MEF	Marine expeditionary force
METT-T[C]	mission, enemy, terrain and weather, troops and support available, and time available [Army adds "civil considerations"]
MGB	medium girder bridge
MI	military intelligence
MLC	military load classification
MND(N)	multinational division (north)
MND(SW)	multinational division (southwest)
MOD2	modification 2

MOU	memorandum of understanding
mps	meters per second
MRBC	multirole bridge company
MSI	multispectral imagery
MSR	main supply route
MTOE	modified table of organization and equipment
MTV	medium tactical vehicle
NATO	North Atlantic Treaty Organization
NCO	noncommissioned officer
NLT	no later than
No.	number
NSN	national stock number
NTTP	naval tactics, techniques, and procedures
NWP	naval warfare publication
OAKOC	observation and fields of fire, avenues of approach, key terrain, obstacles, and cover and concealment
obj	objective
OBM	outboard motor
OBSTINTEL	obstacle intelligence
OCONUS	outside the continental United States
OE	operational environment
OPLAN	operation plan
OPORD	operation order
OPSEC	operations security
OTH	over the horizon
PIR	priority intelligence requirements
PL	phase line
PLS	palletized load system
plt	platoon
PM	provost marshal
PMCS	preventive-maintenance checks and services
PMO	provost marshal office
P/N	part number
POC	point of contact
POL	petroleum, oil, and lubricants
prep	preparation
RCT	regimental combat team
REB	rapidly emplaced bridge
REBS	rapidly emplaced bridge system
recon	reconnaissance
RL	release line

ROE	rules of engagement
RP	release point
RPV	remotely piloted vehicle
S-2	intelligence staff officer
S-3	operations staff officer
S-4	logistics staff officer
SBCT	Stryker brigade combat team
SC	signal corps
sec	section
SFOR	stabilization force
SJA	staff judge advocate
SOP	standing operating procedure
SOSRA	suppress, obscure, secure, reduce, and assault
spt	support
sqdn	squadron
SRB	standard ribbon bridge
SS	single story; single single
STOM	ship-to-objective maneuver
SU	situational understanding
TAC CP	tactical command post
TBD	to be done
TC	training circular
TCMS	Theater Construction Management System
TCP	traffic control post
TD	triple double
TF	task force
TLP	troop-leading procedure
TM	technical manual
TMR	transportation movement request
TO	task organization
TOE	table(s) of organization and equipment
TRADOC	United States Training and Doctrine Command
trk	truck
TS	triple single
TT	triple triple
TSB	two span bridge
UK	United Kingdom
U.S.	United States
USAID	United States. Agency for International Development
USAR	United Stated Army Reserve
USAEUR	United States. Army, Europe

USMC	United States Marine Corps
vol	volume
WARNORD	warning order

SECTION II – TERMS

assured mobility

Actions that give the force commander the ability to maneuver where and when he desires without interruption or delay to achieve the mission. (FM 3-34)

assault position

(Army) A covered and concealed position short of the objective, from which final preparations are made to assault the objective. (FM 3-90) (Marine Corps). That position between the line of departure and the objective in an attack from which forces assault the objective. Ideally, it is the last covered and concealed position before reaching the objective (primarily used by dismounted infantry).

assembly area

(joint, NATO) – 1. An area in which a command is assembled preparatory to further action. 2. In a supply installation, the gross area used for collecting and combining components into complete units, kits, or assemblies. (Army) The area a unit occupies to prepare for an operation. Also called AA. (FM 3-90)

attack position

(joint) The last position occupied by the assault echelon before crossing the line of departure. See FM 3-90. (FM 1-02)

***bridgehead**

(joint) An area of ground held or to be gained on the enemy's side of an obstacle. (Army) In gap-crossing operations, an area on the enemy's side of the linear obstacle that is large enough to accommodate the majority of the crossing force, has adequate terrain to permit defense of the crossing sites, provides security of crossing forces from enemy direct fire, and provides a base for continuing the attack.

***bridgehead force**

A force that assaults across a gap to secure the enemy side (the bridgehead) to allow the buildup and passage of a breakout force during river crossing operations.

***bridgehead line**

(joint, NATO) The limit of the objective area in the development of the bridgehead. See also objective area.

***call forward area**

1. In gap-crossing operations, waiting areas within the crossing area where final preparations are made. (FM 3-90.12) 2. In air movement, the area at the departure airfield where plane loads are assembled in a ready condition prior to being directed to the loading ramp area. (FM 55-1) Also called CFA.

command

(Army) The authority that a commander in the military service lawfully exercises over subordinates by virtue of rank or assignment. Command includes the leadership, authority, responsibility, and accountability for effectively using available resources and planning the employment of, organizing, directing, coordinating, and controlling military forces to accomplish assigned missions. It includes responsibility for unit readiness, health, welfare, morale, and discipline of assigned personnel. (FMI 5-0.1)

command and control

(Army) The The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of a mission. Commanders exercise command and control through a command and control system. (FM 6-0)

control

(Army) The regulation of forces and warfighting functions to accomplish the mission in accordance with the commander's intent. (FMI 5-0.1)

covert breach

A breaching operation that is planned and intended to be executed without detection by opposing forces. Its primary purpose is to reduce obstacles undetected to facilitate the passage of maneuver forces. (FM 3-34.2)

***covert crossing**

A gap-crossing operation that is planned and executed without detection by opposing forces. It's primary purpose is to facilitate undetected infiltration on the far side of a gap and is normally conducted by battalion and smaller forces.

***crossing area**

(joint, NATO) 1. A number of adjacent crossing sites under the control of one commander. 2. (joint only) A controlled access area for a gap-crossing operation used to decrease traffic congestion at the river. It is normally a brigade-sized area defined by lateral boundaries and release lines 3 to 4 kilometers (based on mission, enemy, terrain and weather, troops and support available, time available) (Note. The Army definition adds "and civil considerations.") from each side of the river. (JP 1-02)

***crossing area commander**

The officer responsible for the control of all crossing units, assault units, and support forces while they are in the crossing area.

***crossing force**

The unit that has responsibility to establish the bridgehead. Also see bridgehead line; crossing area; crossing site.

***crossing force commander**

The individual designated to control the lead brigades during the assault across the gap to secure the bridgehead line.

***crossing site**

The location along a water obstacle or other gap where the crossing can be made using amphibious vehicles, assault boats, rafts, bridges, or fording vehicles.

***crossing site commander**

The individual, normally an engineer company commander or a platoon leader, responsible for the crossing means and the crossing site. He commands the engineers operating the crossing means and the engineer regulating points at the call forward areas and the staging areas for that site. See also bridgehead.

***deliberate crossing**

(joint, NATO) The crossing of an inland water obstacle or other gap that requires extensive planning and detailed preparations. See also bridgehead; bridgehead line; hasty crossing; river crossing.

***engineer regulating point**

Checkpoint to ensure that vehicles do not exceed the capacity of the crossing means and to give drivers final instructions on site-specific procedures and information, such as speed and vehicle interval. Also called ERP.

***ford**

A shallow part of a body of water or wet gap that can be crossed without bridging, boats, ferries, or rafts. It is a location in a water barrier where the physical characteristics of current, bottom, and approaches permit the passage of personnel, vehicles, and other equipment where the wheels or tracks remain in contact with the bottom at all times. See also gap; reconnaissance; river crossing.

***gap**

A ravine, mountain pass, river, or other terrain feature that presents an obstacle that may be bridged.

***gap crossing**

Projecting combat power across a linear obstacle (wet or dry gap).

***gap-crossing operations**

A mobility operation consisting of river crossing, brigade-level crossing, and special gap-crossing operations conducted to project combat power across a linear obstacle (wet or dry gap).

***hasty crossing**

(joint, NATO) The crossing of an inland water obstacle or other gap using the crossing means at hand or those readily available, and made without pausing for elaborate preparations. See also bridgehead; deliberate crossing.

***holding line**

In retrograde gap-crossing operations, the outer limit of the area established between the enemy and the water obstacle to preclude direct and observed indirect fires into the crossings.

***line of communications bridging**

Bridges used to establish semipermanent or permanent support to planned road networks that anticipate high-volume traffic. These bridges are typically placed in locations free from the direct influence of force on force combat operations.

mobility

A quality or capability of military forces which permits them to move from place to place while retaining the ability to fulfill their primary mission. (JP 1-02)

***nonstandard bridging**

Bridging that is purposely designed for a particular gap and typically built utilizing commercial off-the-shelf (COTS) or locally available materials.

operational environment

(joint) A composite of the conditions, circumstances, and influences which affect the employment of military forces and bear on the decisions of the unit commander. Some examples are as follows: a. **permissive environment**—Operational environment in which host country military and law enforcement agencies have control as well as the intent and capability to assist operations that a unit intends to conduct. b. **uncertain environment**—Operational environment in which host government forces, whether opposed or receptive to operations that a unit intends to conduct, do not have totally effective control of the territory and population in the intended operational area. c. **hostile environment**—Operational environment in which hostile forces have control and the intent and capability to effectively oppose or react to the operations a unit intends to conduct. See FM 3-07.

***overbridging**

A method used to reinforce, provide emergency repair, or augment existing bridges or bridge spans utilizing standard bridging. In close combat this is typically provided through the employment of tactical bridging.

retrograde

A type of defensive operation that involves organized movement away from the enemy. (FM 3-0)

***river crossing**

A type of gap-crossing operation required before ground combat power can be projected and sustained across a water obstacle. It is a centrally planned and controlled offensive operation that requires the allocation of external crossing means and a force dedicated to the security of the bridgehead.

situational understanding

The product of applying analysis and judgment to the common operational picture to determine the relationships among the factors of mission, enemy, terrain and weather, troops and support available, time available, civil considerations. (FM 3-0)

***standard bridging**

Any bridging derived from manufactured bridge systems and components that are designed to be transportable, easily constructed, and reused.

***support bridging**

Bridges used to establish semipermanent or permanent support to planned movements and road networks. They are normally used to replace tactical bridging when necessary.

***tactical bridging**

Bridges that are used for immediate mobility support of combat maneuver forces in close combat. They are very often employed under the threat of direct or indirect fire and are intended to be used multiple times for short periods.

traffic control post

Manned post used to preclude interruption of traffic flow or movement along designated routes. They are used to support maneuver and mobility support operations only when needed. (FM 3-19.4)

***waiting area**

A location adjacent to the route or axis that may be used for the concealment of vehicles, troops, and equipment while an element is waiting to resume movement. Waiting areas are normally located on both banks (or sides) close to crossing areas.

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DOCUMENTS NEEDED

These documents must be available to the intended users of this publication.

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READINGS RECOMMENDED

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General, United States Army
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Official:

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Administrative Assistant to the
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Deputy Commandant for Combat Development and Integration

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