

CHAPTER 2

Fundamentals of Mobility

THE MOBILITY SCHEME

TYPES OF OBSTACLES

An obstacle is any variation in terrain which stops, delays, or directs movement. Examples include rivers, swamps, marshes, forests, rock outcrops, soft soils, flooded areas, built-up urban areas, embankments, ditches, craters, and mines. Obstacles are divided into two major categories, existing and reinforcing. Existing obstacles are natural and cultural features that are already present such as rivers, mountains, and cities. Reinforcing obstacles are created when other obstacles, such as minefield or antitank ditches, are added to the terrain to strengthen existing obstacles.

Existing obstacles. Any existing natural

(forests, swamps) or cultural (buildings or other) feature which disrupts or impedes the movement of a combat force is called an existing obstacle. All existing obstacles are present before a battle begins. Examples of existing obstacles follow.

Untrafficable soil conditions. Soil trafficability and climate conditions will affect cross-country mobility of troops and equipment. The load-bearing capacity of fine-grained soils such as clay, loam, and silt is affected by soil moisture. Flooding can turn large meadows or paddy fields into obstacles. The combination of soft soils and even slight slopes will stop many vehicles. Tracked

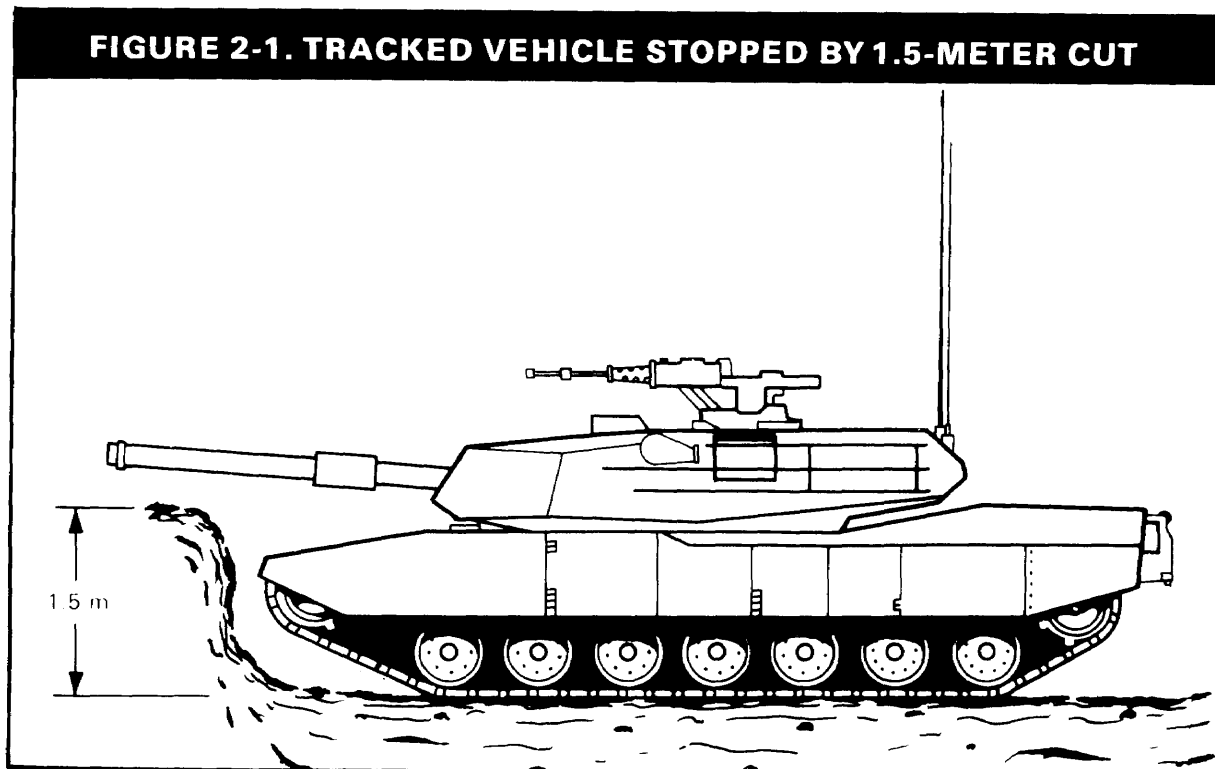
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vehicles have less difficulty than wheeled vehicles with most soils. Soil trafficability is discussed in detail in TM 5-330.

Drainage features, Drainage or surface water features include rivers, streams, canals, irrigation ditches, ponds, marshes, swamps, and lakes. Crossing drainage features by bridging, rafting, or surface means is determined by width, depth, water velocity, and bank and bottom conditions of the feature. Swamps and marshes, where there is no firm ground or it is 1 meter(m) or 3.3 feet (ft) below water level, are effective obstacles against most nonswimming tracked or wheeled vehicles. They are also difficult for infantry to cross. Fordability of a drainage feature is determined by how easily it may be crossed without the use of bridging or rafting equipment. Fordability depends on the capability of the vehicle and the characteristics of the drainage feature. Table B-7 in appendix B provides detailed information on vehicle fording capabilities. Current weather conditions are also important factors in

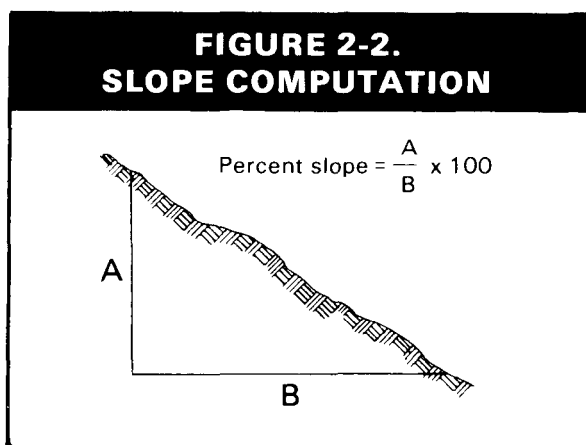
evaluating drainage features. Although streams are normally small and slow during periods of low rainfall, melting snow may cause high water downstream even in regions of low rainfall. In winter months, ice may be strong enough to support traffic and make drainage features the preferred avenues for traffic. Movement on ice is risky, however, because of weak spots. Dry stream channels in arid or desert regions may be the best movement routes during periods of little or no water flow but are subject to flash flooding with little or no warning.

Slope. Flat terrain offers ideal mobility conditions for personnel and motorized equipment. Varying degrees of incline are required to stop or delay different types of vehicles at various times of the year. Land which slopes sharply up or down decreases mobility. Vertical cuts and walls over 1.5 meters (5 feet) or at least the height of the front or rear idlers cannot be crossed by tracked vehicles without special means (figure 2-1). Wheeled vehicles are usually limited to vertical obstacles of



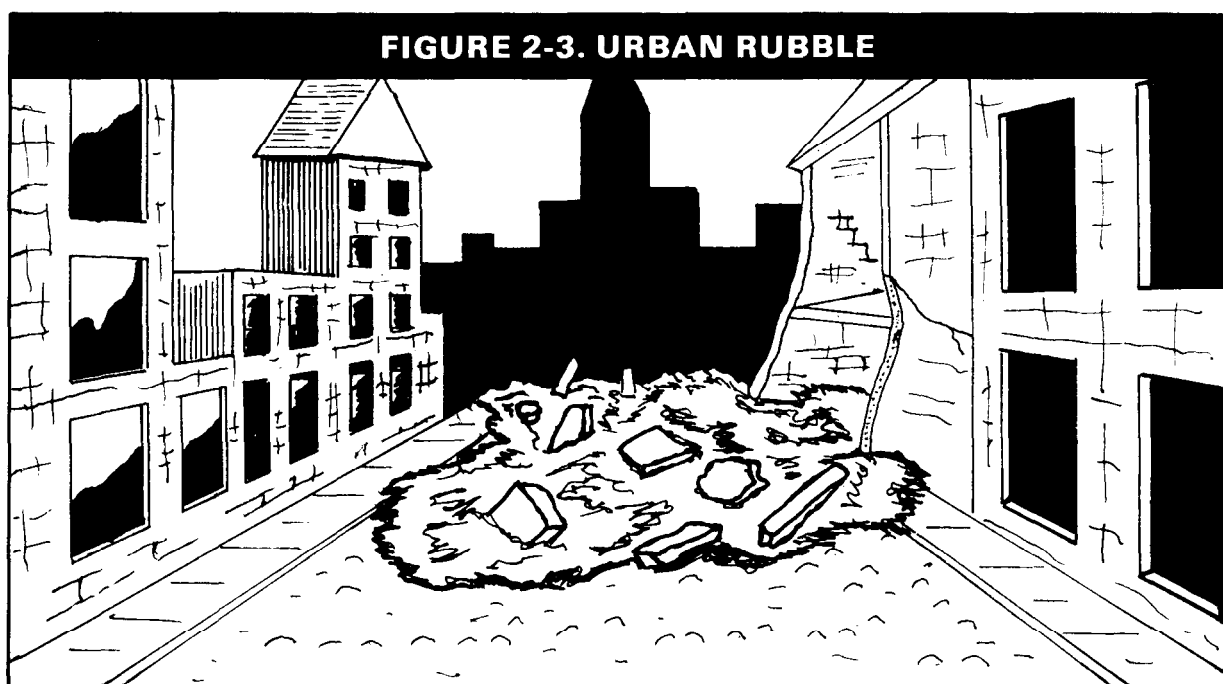
1/3-wheel height or the ground clearance, whichever is smaller. Thick rock walls, railroad embankments, and steep fills or cuts along highways are examples of existing slope obstacles. Tanks can negotiate slopes as steep as 60 percent on ideal ground conditions (figure 2-2). Trees, loose soil, rocks, or other existing features that do not appreciably hinder movement on level ground can make less than a 60 percent slope impassable. While tanks are designed to negotiate slopes up to 60 percent for military

operations, a slope of 45 percent (24 degrees) is considered the practical upper limit. Steep slopes also slow down infantry forces and cause them to tire easily. In evaluating dry, firm terrain for cross-country movement, 60 percent is commonly used as the upper limit for tracked vehicles and 30 percent for wheeled vehicles when numerous passes over the same lane might occur. The formula for computing percent of slope, depicted in figure 2-2, is vertical distance divided by horizontal distance times 100.



Trees. Heavy stands of trees that are 20.5 centimeters (8 inches) or more in diameter and spaced 3-5 meters (10-16 feet) apart or closer are an obstacle to wheeled and tracked vehicles. Forcing through such a stand of trees tends to create a massive obstacle as the fallen trees eventually build on each other.

Built-up areas. The obstacle value of a cultural feature depends on its size, location, and construction. Large cities and towns with masonry buildings located on principal routes can become important obstacles when reduced to rubble (figure 2-3) with streets,



alleys and passageways blocked, cratered or mined. Even if gaps are cleared through the debris, movement is still channelized. Existing road, rail, and waterway networks can directly influence the conduct of the AirLand battle. These lines of communication and transportation facilities are essential to rapid tactical movement, support, and supply. Their existence and trafficability will be a factor in selecting avenues of approach and routes for withdrawal. On the other hand, these features can become obstacles to force mobility. For example, a railroad located across an avenue of approach can create trafficability problems with embankments or lack of enough crossing points.

Snow. Even on otherwise trafficable terrain, accumulation of snow 1 meter (3 feet) deep becomes a major obstacle to personnel and vehicles. Snow less than 1 meter (3 feet) deep is a less effective obstacle but may hide rocks, ditches, small streams, and fallen trees.

In order to judge the ability of wheeled or tracked vehicles to conduct off-route movement, a number of factors are considered. An analysis of existing terrain should include consideration of the critical values cited in table 2-1.

Reinforcing obstacles. Obstacles constructed, emplaced, or explosively created to enhance a military action are called reinforcing obstacles. They can be used to extend existing obstacles or to create obstacle systems in open country. The nature and extent of reinforcing obstacles is limited only by available resources and the imagination of the soldier. Reinforcing obstacles are broadly categorized as mines or other obstacles.

Mines and minefield. Unlike other obstacles, mines can directly inflict personnel casualties and equipment losses. Mines are used to enhance the effect of most other obstacles but may be placed directly on, or in the path of, moving forces. Antitank and

antipersonnel mines can be used singly or in combination.

Other obstacles. Other reinforcing obstacles are created by demolition, construction, and contamination of selected areas. Demolition obstacles are created by the detonation of explosives, including nuclear explosives, or the mechanical destruction of existing features. Examples include the rubble of stone structures, flooding from destruction of a dam, or tree blowdown. Constructed obstacles range from tank ditches to extensive concrete and steel obstacles like "dragon's teeth." Also in this category are barbed wire and timber obstacles such as log cribs, hurdles, and log posts. Emplaced contamination obstacles can be nuclear, chemical, or biological. Contaminating agents are difficult to predict and control, however, as they are dependent largely upon winds for placement and are subject to weather and other environmental factors.

OBSTACLE SYSTEMS

The effectiveness of obstacles is increased when they are combined in number and type. These obstructions are called obstacle systems. The combined effect of a number of less-than-critical features can stop or severely delay vehicles. For example, closely spaced trees much smaller than 25 centimeters (10 inches) in diameter will delay vehicles even on level ground. Usually a tree stem spacing of 1.5 times the vehicle width is required for maneuver in forests. An obstacle system is more effective than any type of obstacle alone. Although a variety of types may be combined, it is usually most effective to strengthen other obstacles with mines. For example, mines emplaced in and around a crater make it far more effective in delaying enemy tanks by adding the possibility of casualties and equipment losses (figure 2-4 on page 2-6).

Combinations of obstacles that do not involve mines are also possible. For example, a crater can be used to deny fording sites across a stream.

TABLE 2-1. CRITICAL VALUES OF CROSS-COUNTRY MOVEMENT

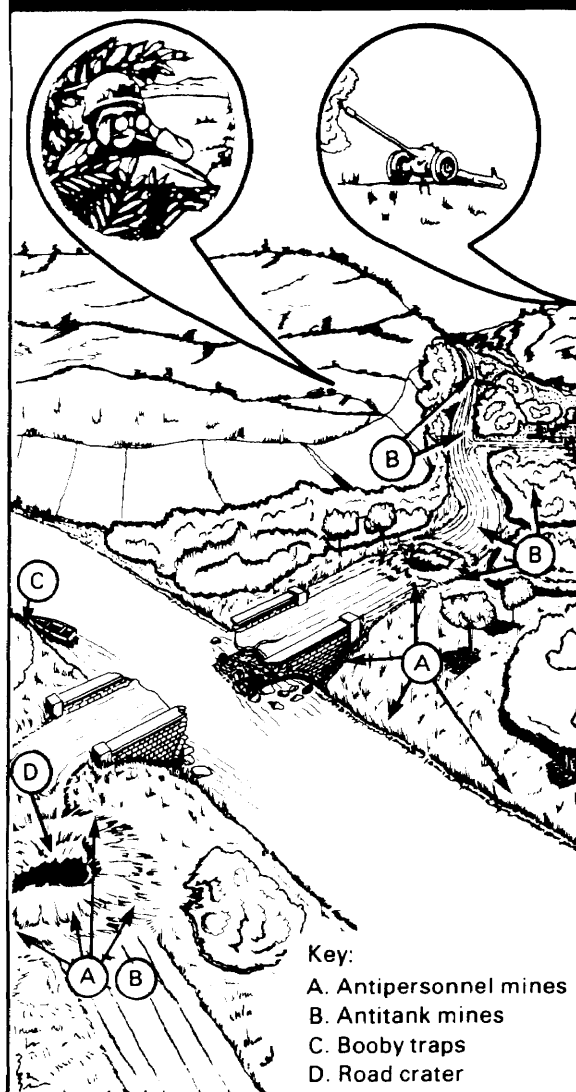
FEATURE	CRITICAL VALUE		EFFECT
Drainage (rivers and streams)	Width	≥ 150 m (492 ft)	Requires corps bridging assets. ¹
	Depth	≥ 1.5 m (5 ft)	Impairs nonswimming vehicles. ¹
	Velocity	≥ 3.7 m (10 fps)	Impairs rafting, float bridging and swimming vehicles.
Ditch	Width	≥ 2.8 m (9.2 ft)	Exceeds tank's self-bridging capability.
	Depth	≥ 1.5 m (5 ft)	Exceeds tank's ability to "step."
Gap	Width	≥ 18 m (60 ft)	Exceeds most AVLBs.
Ford	Depth	≥ 1.5 m (5 ft)	Cannot be forded without special equipment. ¹
Soil	Bearing pressure (Soil type and moisture also affect trafficability)	≤ 8 psi	Hinders tracked and wheeled vehicle movement. ²
Slope	10% (ice covered)		Delays all vehicle movement.
	20% (snow covered)		Delays all vehicle movement.
	30%		Stops most wheeled movement.
	45%		Delays most tank movement.
Vegetation	60%		Stops tank movement.
	Tree diameter with tree spacing	20.5 cm (8 in)	Stops wheeled vehicles.
		3-5 m (10-16 ft)	Delays tracked vehicles.
Snow	Depth	0.5 m (1.6 ft)	Delays tracked and wheeled vehicles.
		1.5 m (4.5 ft)	Delays/immobilizes wheeled vehicles.
Ice	Thickness	0-8 in	Delays all tracked traffic exceeding 6 psi.
	Thickness	0-31.5 in	Will not bear wheeled vehicles.

Notes:

1. Also depends on bottom, bank, and water current conditions.

2. See TM 5-330 for details on soil trafficability.

3. Rainfall affects all other features.

FIGURE 2-4. OBSTACLE SYSTEM

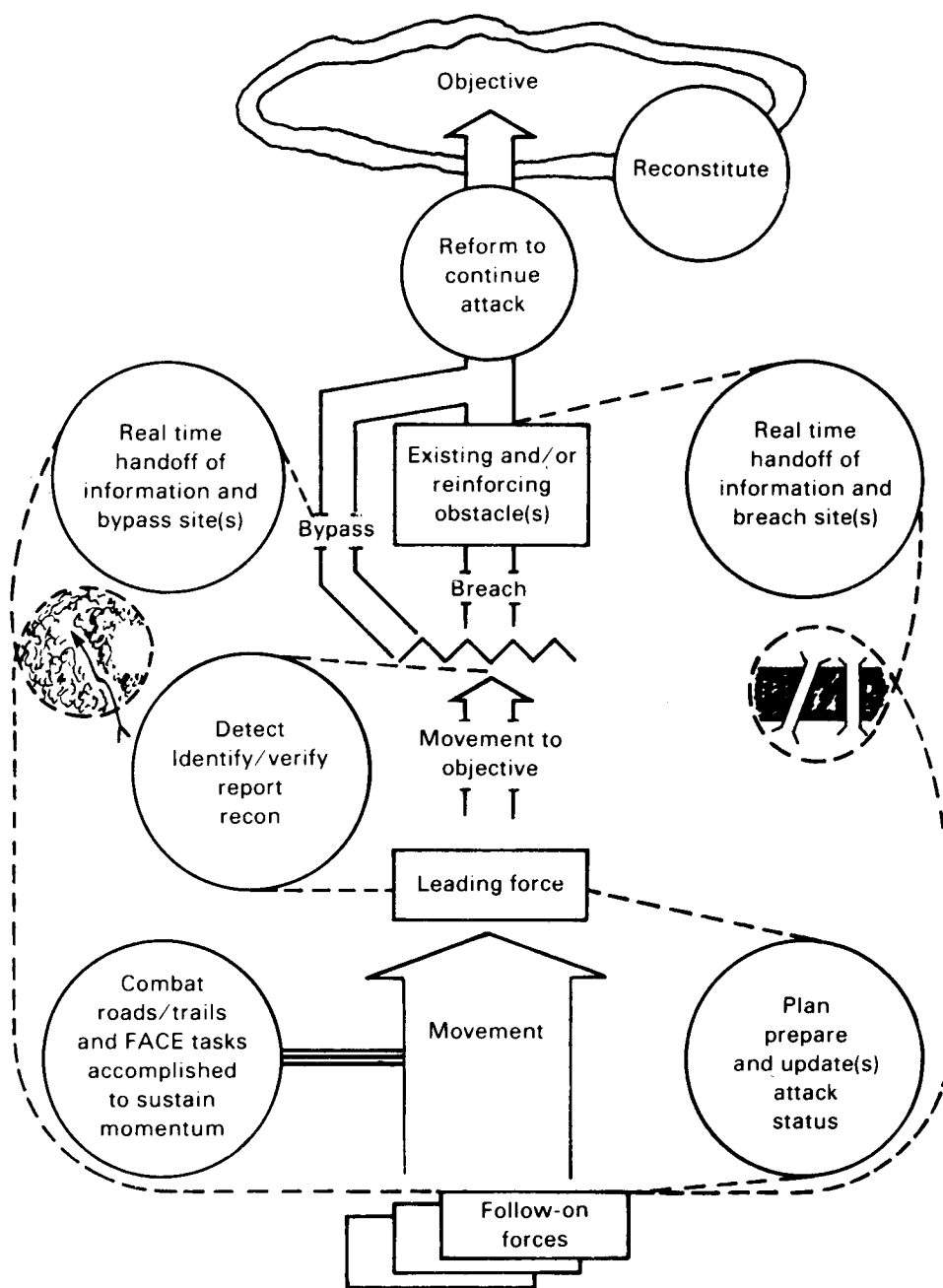
SYSTEMATIC APPROACH

The capability to breach an obstacles not the only factor for success in mobility activities. The ability to overcome obstacles is created through a series of planned engineering activities known as the mobility scheme. This method employs early detection, continuous preparation, and the continuation of tactical movement. It emphasizes the missions necessary to minimize the effects of obstacles. Whether a tactical force is part of an offensive or defensive operation, the

principles of the mobility scheme remain the same.

Organizational elements. The mobility scheme revolves around two organizational elements, the leading and follow-on forces. For the purpose of explanation, these elements can be any type or size of tactical unit. The leading force is usually the first in a tactical march unit. However, this element can also be part of the obstacle detection force in, front of a moving tactical unit. For example, the leading force can vary in range from the reconnaissance elements of a battalion task force to the covering force in a divisional movement to contact. The follow-on forces also vary in size and composition. However, they follow the leading force on the battlefield. Their rates of movement and ability to maneuver are directly affected by the actions of the leading force. The availability and trafficability of routes, bypasses, breach lanes, and crossing sites determine the capability of the follow-on forces to provide support to the leading force.

Combined missions. Complete mobility plans are developed and all participating elements briefed. Figure 2-5 depicts how the components of the mobility scheme interact for a maneuver force conducting an attack. Command, control, and communications channels are structured to allow flexibility of action before, during, and after an obstacle is negotiated. This includes plans for alerting other friendly forces also using the same avenue of approach. Leading forces develop plans for consolidating and moving on toward the operation's objectives. Once the objectives are achieved, established methods for reconstituting lost, damaged, or destroyed mobility assets will allow further mobility activities. All of the above actions must be integrated with the tactical scheme of maneuver and fire support. This combination of missions creates a planned method for overcoming obstacles. Thus, the actions of planning, communication, detection, bypass and/or crossing and/or breaching, command

FIGURE 2-5. MOBILITY SCHEME

and control, consolidation, and reorganization are the major components of the mobility system.

INTERACTION OF FORCES

When the mobility system planning scheme (figure 2-5) is reviewed, the following key points should be recognized:

- Both the leading and follow-on forces plan and prepare. This includes developing orders, command and control, and estimates of needed equipment and supplies for all phases of the operation.
- The leading force will usually determine the nature of the obstacle, the possibility of a bypass, and its tactical value.
- The leading force executes the bypass, breach, or gap-crossing task and marks the obstacle, as necessary.
- After the obstacle is bypassed, breached, or crossed, the leading force rapidly builds up combat power on the far side and continues the attack.
- The leading force provides real-time information on the obstacle and a guard element, if necessary, to assure a successful handoff of the obstacle site to follow-on forces.
- The leading force reorients on the objective, including mobility support systems, in order to continue the cycle of mobility tasks.

Note: Leading force and follow-on force size and composition will vary with the maneuver scheme and tactical situation.

PLANNING AND PREPARATION

Mobility scheme planning is the first critical step in mobility operations. Commanders must expect to encounter obstacles and develop countermeasures which will lessen or eliminate their effect. The plans for mobility are necessarily tied to the scheme of

maneuver and the fire support plan. Full integration of tactical plans will allow the mobility scheme to function effectively for the combined arms team (figure 2-6). Chapter 3 provides a discussion of the planning process. Within the scope of the total mobility scheme, the priority for mobility support during a defensive operation and that for an offensive operation will differ. The mobility support plan is tailored to enhance mission accomplishment and achieve the objectives of the command. Within the scope of the operation, the leading force and follow-on forces exchange mobility plans. Through coordination and staff cooperation, areas of responsibility for mobility support are assigned. When possible, engineers supporting follow-on forces are tasked to improve and maintain bypass routes, create lanes in obstacles, or completely remove the obstacles when necessary. This support will allow the leading force that first overcame the obstacle to continue its movement and maneuver.

GOAL OF PLANNING

The all-important goal of mobility planning, from receiving plans and orders to encountering an obstacle, is to be prepared. This means having a countermine, counter-obstacle, gap-crossing, or engineer work force ready to perform its mission. There are six steps in preparing a unit or individuals for execution of mobility missions within the context of the mobility plan. The commander must—

Determine tasks. Identify tasks that must be done,

Acquire needed resources. Personnel, equipment, and supplies should be requested, organized, and allocated.

Conduct briefings. Soldiers should be informed as to the nature of the operation, obstacles expected, and the plans for overcoming obstacles.

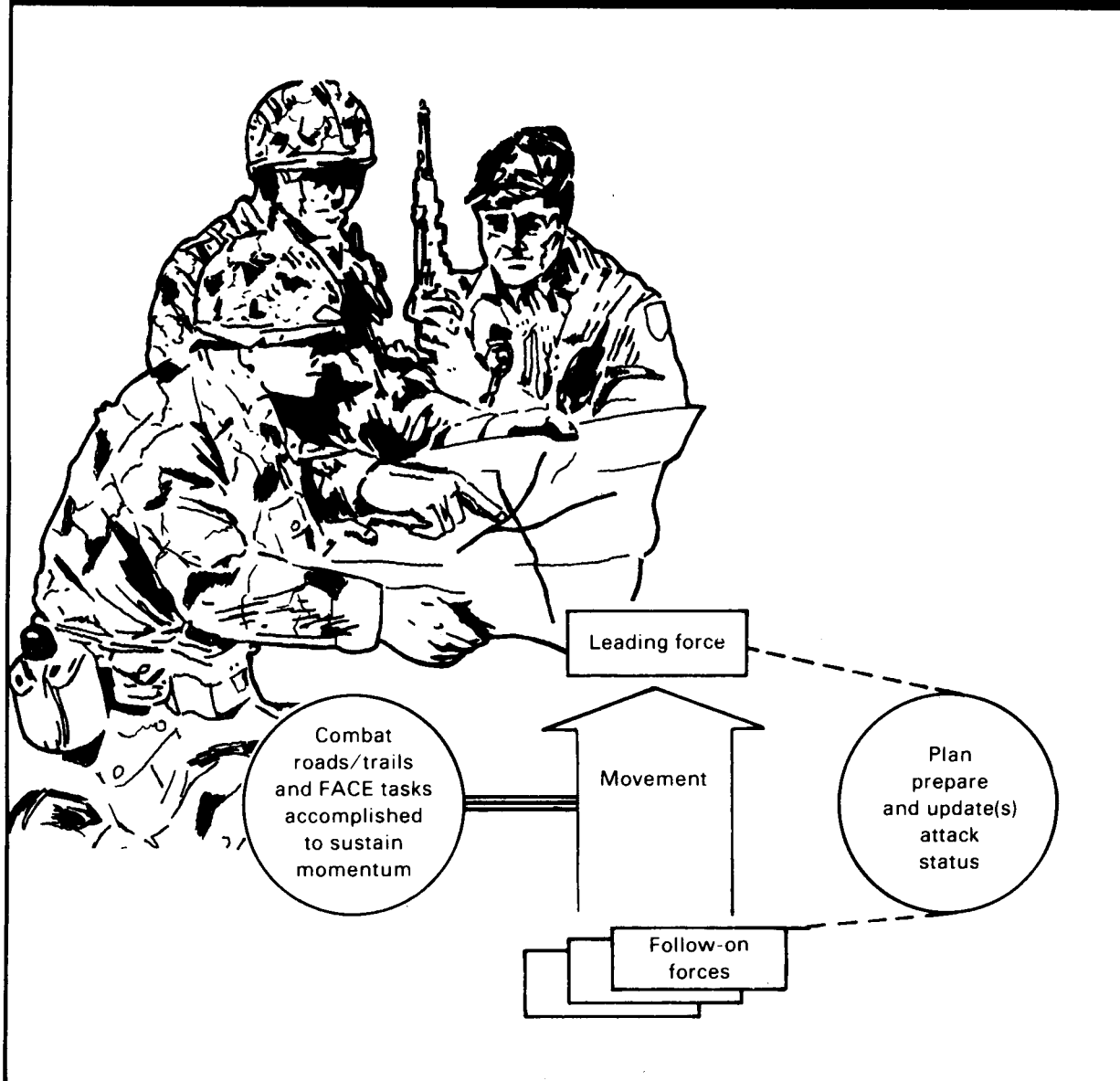
Inspect equipment. Equipment and supplies that are to be used need to be inspected

by leaders. These resources are repaired, maintained or replaced, as required, before the operation begins.

Organize mission forces. In accordance with the plan, personnel and equipment should be organized for movement. This includes placing mobility assets forward in the combined arms teams formations.

Rehearse plan. Critical phases of the plan and the drills required to implement it should be rehearsed thoroughly. Successful mobility activities require participation from the various elements of the combined arms teams. Rehearsals develop understanding of the plan and instill confidence in soldiers. The entire force rehearses critical mobility missions to develop unity of effort.

FIGURE 2-6. PLANNING AND PREPARATION



DETECTION

Detection is the second step in execution of mobility tasks. Detection (figure 2-7) provides the following information:

- Location of obstacle.
- Types of mines in a minefield or types of obstacles.
- Length and width of obstacle area.
- Existence of enemy coverage, including Threat strength, equipment, and fire support.

Early detection of obstacles is preferred and may be done by careful analysis of the terrain and situation in preparation for an operation. This study should include the identification of US-employed obstacles that coincide with possible movement routes. Units should always organize with detection means deployed forward as this increases the likelihood of detection. The methods for obstacle detection include—

- visual detection,
- Physical contact.
- Probing.
- Aerial detection (including reconnaissance aircraft, remotely piloted aerial vehicles, satellites, and radar).
- Electronic detection (including robotics).
- Intelligence reports and staff-produced estimates. Detection methods are most successful when used in combination. Physical contact with an obstacles almost always undesirable except by physical probing of scouts and reconnaissance elements.

RECONNAISSANCE

Mobility reconnaissance can be divided into two categories, hasty and deliberate.

- Hasty reconnaissance is done by personnel of all units. It provides limited route information for planning and executing movement and maneuver.
- Deliberate reconnaissance provides essential and additional mobility data. This information forms the basis for technical classification, estimates of required engineer work, and a thorough analysis of the road and trail network throughout an area of operations. The deliberate reconnaissance, usually performed by engineers, determines the potential for supplementary combat roads and trails and forward aviation sites. Hasty and deliberate reconnaissance reports will be forwarded in accordance with the parent unit's reporting procedures and directives.

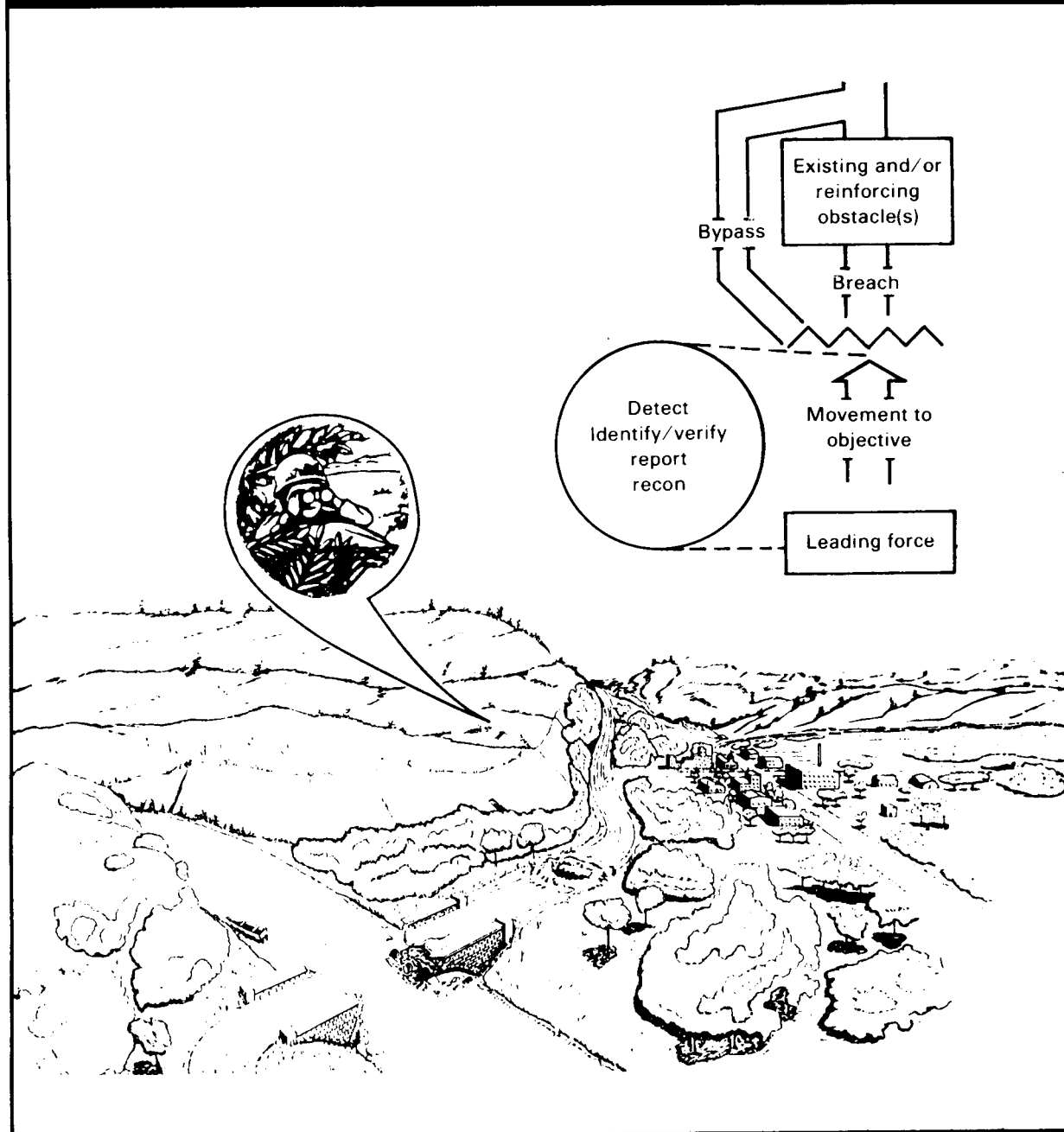
Most reliable method. The most reliable method of mobility reconnaissance is a physical ground reconnaissance. This method can be performed only as far forward as the tactical situation permits. The ability to obtain timely information depends on several factors. These include the unit's equipment, means of communication, and training. The principles of ground reconnaissance are—

- A review of available maps, photographs, and intelligence should precede reconnaissance.
- Aerial reconnaissance, if available, should precede ground reconnaissance.
- Reconnaissance must be repeated as often as necessary to keep information current. Though reconnaissance units usually have a specific mission, personnel should be alert for other useful intelligence information. Attention to detail is important. Quantities, sizes, and other data should be counted or measured in numbers. The ground reconnaissance party should avoid enemy contact or observation unless it is necessary for mission completion.

Aerial reconnaissance. Aerial reconnaissance is fast and covers areas which cannot be seen by ground observers. However, it can be hindered by poor weather conditions. The

aerial observation of some mobility factors, such as stream fordability or location of a minefield's near edge, is limited at the present time.

FIGURE 2-7. MOBILITY SCHEME: DETECTION



TWO OPTIONS

Units encountering mines and obstacles have two immediate options for action, to bypass or breach the obstacle. These choices apply to existing, reinforcing, or obstacle systems. Bypass is the preferred method when it offers a quicker, easier, and tactically sound means to avoid obstacles. Bypassing is done by maneuvering around, under, or over the obstacle or minefield. However, obstacles should be bypassed with maneuver only after consideration of the advantages and disadvantages in each case.

BYPASS ANALYSIS

The leading force commander must assess the advantages and disadvantages of executing a bypass. The commander must weigh the availability of bypass routes against the likelihood of being further channelized or ambushed.

Considerations. The commander also considers missions and boundaries of adjacent units and time restrictions. A good bypass allows the entire force to avoid the primary obstacle without risking further exposure or ambush. It also allows the leading force to conserve breaching assets and maintain momentum. If only portions of the force (infantry on foot or mounted in carriers) can get through a bypass, these troops may be able to maneuver into a position to suppress or destroy the enemy covering the primary obstacle.

Alternative solution. In some cases, breaching may be a better tactical solution than bypassing. Examples of such cases are-

- The best available bypass channelizes friendly forces into a kill zone or ambush.
- The force has the mission of opening the original route for follow-on traffic. Bypass in this case would still necessitate breaching or clearing.
- The best available bypass route will not allow required vehicular rates of speed.

The obstacle is still effective in delaying movement.

- Development of a bypass may require more time or assets than breaching the primary obstacle(s).

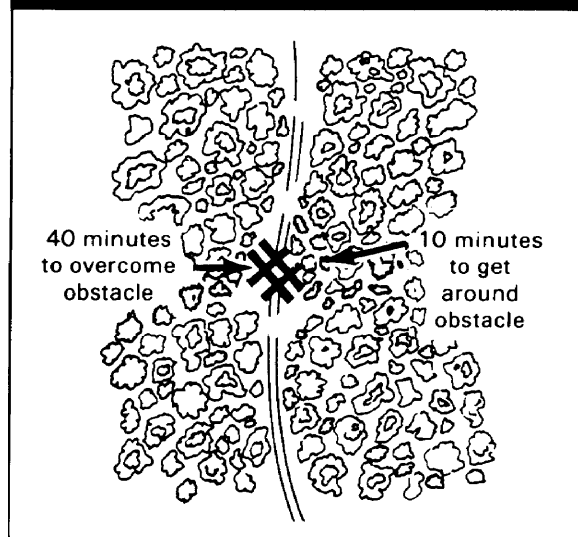
If a suitable bypass is decided upon, the tactical commander should advise and integrate the forces accordingly. The force then moves rapidly through the bypass using available cover, concealment, obscurants, artillery suppression, and electronic warfare.

BYPASS CATEGORIES

When choosing the best bypass route, the commander must consider terrain, intensity of enemy contact, and friendly equipment that will travel the bypass. There are three categories of bypass.

Bypass easy. Bypass easy requires little effort to clear an existing route or force a trail around the obstacle area. In this case, the unit may be able to complete the bypass without additional supplies or equipment. An example of an easy bypass is the clearing of a path around an obstacle using the lead tank or dozer tank organic to the leading force (figure 2-8).

FIGURE 2-8. BYPASS EASY



Bypass difficult. In this case, a suitable bypass may require additional resources, resulting in a temporary loss of momentum. Before a difficult bypass is executed, the commander should consider attempting both a breach and bypass simultaneously. This option would require swift coordination of assets, but would allow the maneuver force the possibility of extending two lanes past the obstacle site. An example of a difficult bypass is the construction of a 100-meter combat trail through a wooded area around a crater (figure 2-9).

Bypass impossible. Here, the obstacle is tied into existing terrain or other obstacles in such a way as to make all bypass efforts impractical. Major demolition or construction effort is necessary to develop a bypass, and it would take longer to establish the bypass than to successfully breach the obstacle. This situation might occur with an enemy minefield sown in the most constricted area of either a mountain pass or a bridge, as shown in figure 2-10.

FIGURE 2-9. BYPASS DIFFICULT

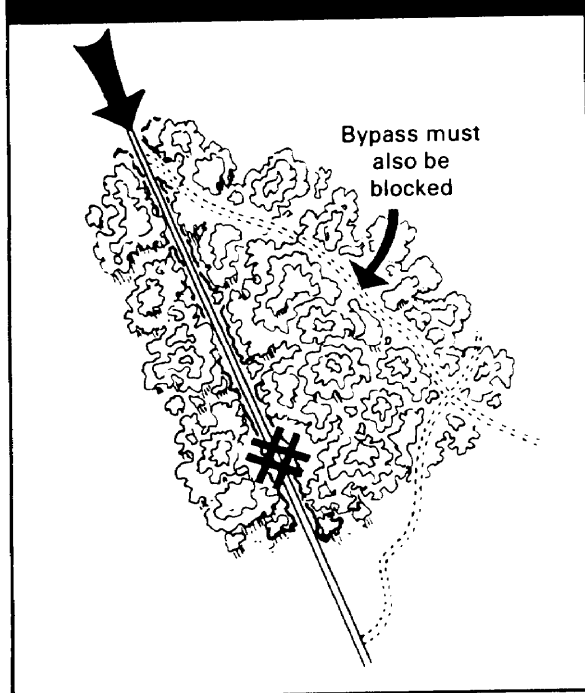
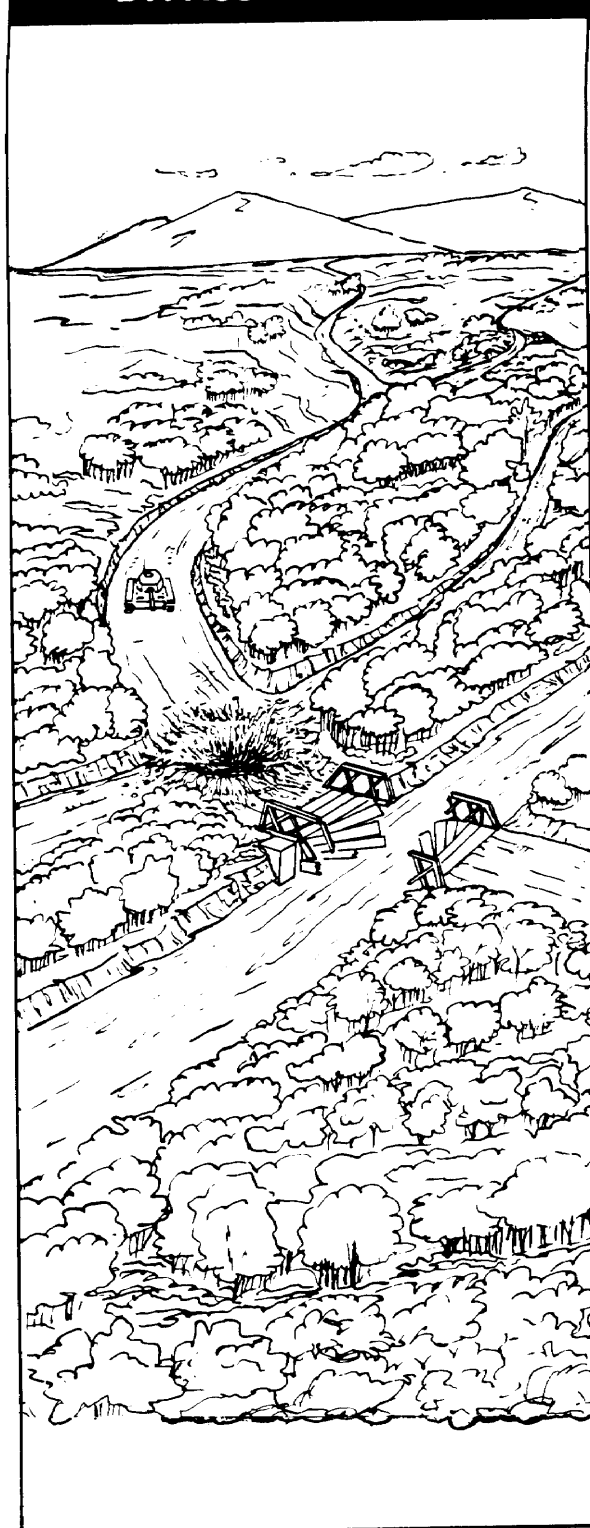


FIGURE 2-10. BYPASS IMPOSSIBLE



Existing and reinforcing obstacles should be bypassed wherever possible.

OBSTACLE NEGOTIATION

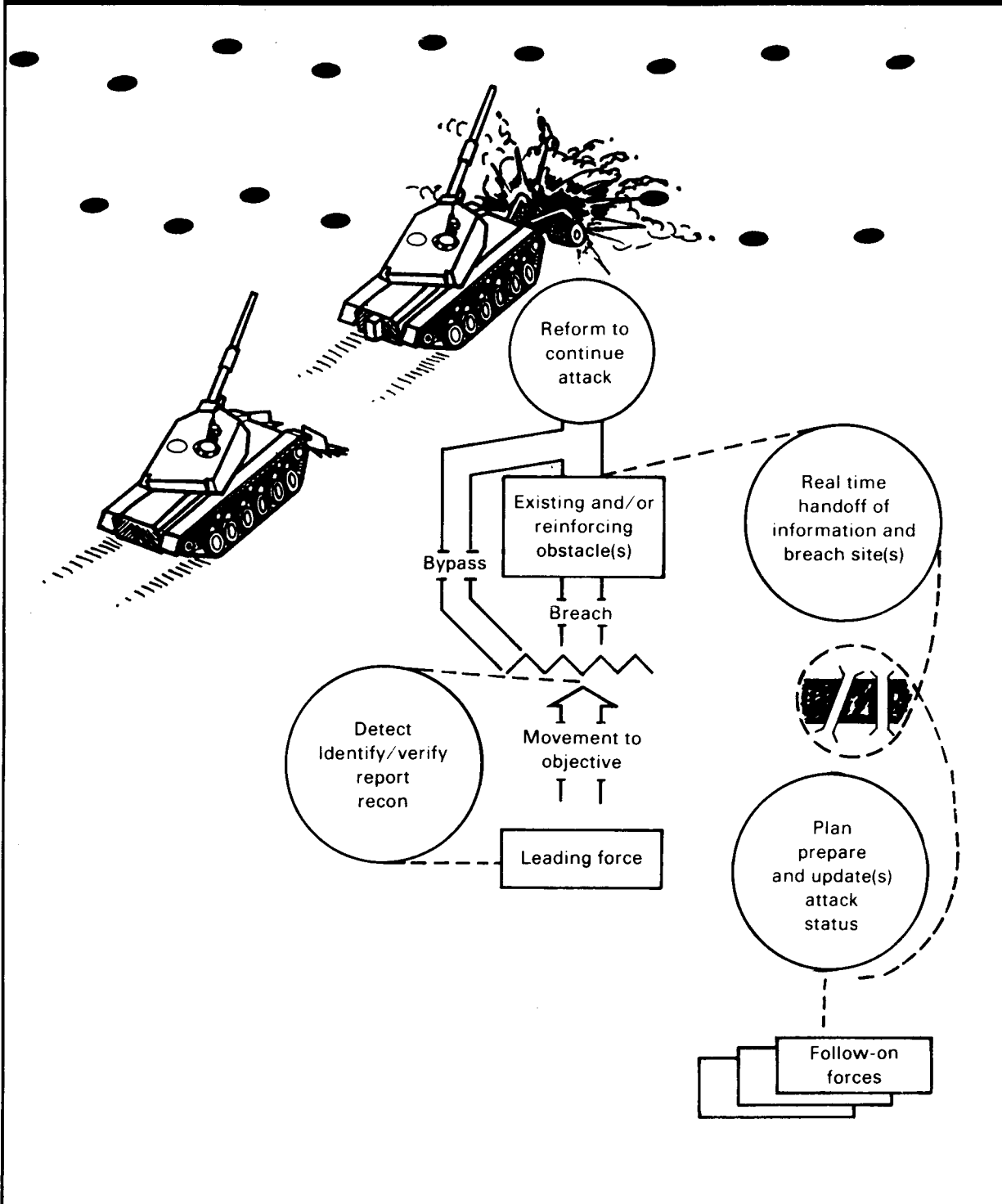
Maneuver commanders are responsible for insuring their force has plans and is organized to overcome obstacles and minefield. Existing and reinforcing obstacles should be bypassed wherever possible. When bypass is not possible or tactically sound, breaching or crossing activities should begin immediately. Engineer support to the leading elements can help in the development of an obstacle breaching or gap crossing.

FORCE PREPARATION

The maneuver commander, with help from the staff and engineer, will develop plans and procedures to maintain the momentum of the force. These plans for breaching or crossing obstacles should be part of the combined arms movement plan (figure 2-11). Engineers should be well forward in advancing columns to assist in mobility tasks. Countermine equipment which may be organic to maneuver forces, such as rollers and plows, also should be located well forward. The initial objective of the breach or a gap crossing is to make a safe route, either vehicle or foot lanes, to the far side. The number and types of lanes breached or crossing sites depend on—

- The number of transit points on the far side of the obstacle required by the maneuver force to execute its mission,
- The size and equipment of the maneuver force.
- The amount and type equipment of mobility support assets.
- The type and size of minefield, obstacle, or gap.
- Time, terrain and enemy disposition.

Threat forces will normally employ mines and obstacles together (figure 2-12 on page 2-16). Plans must be flexible. Where resources permit, commanders should allow for shifts in breaching or crossing locations and the

FIGURE 2-11. OBSTACLE NEGOTIATION

configuration of backup teams and equipment. The specific techniques and preparations for gap-crossing tasks are discussed in chapter 6.

FUNDAMENTALS OF BREACHING

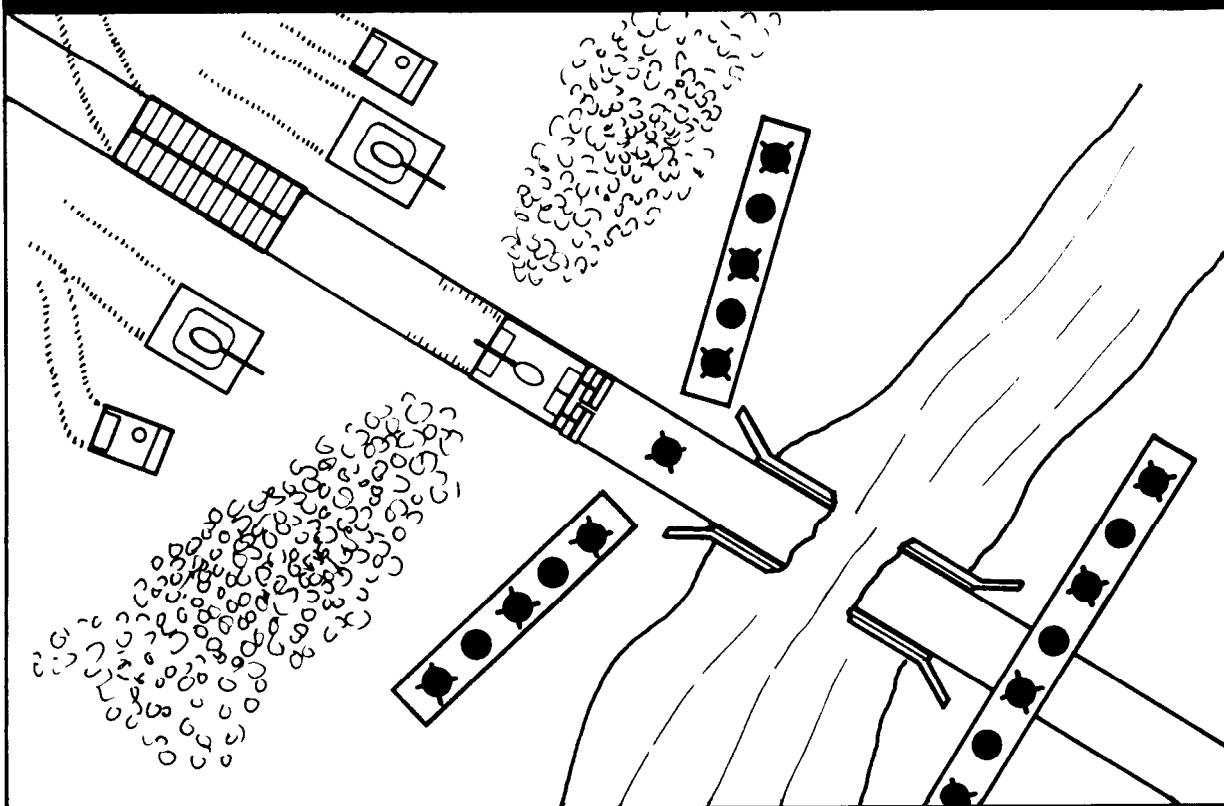
The primary goal of forces encountering an obstacle is to continue the mission as swiftly as possible. Breaching, like bypass, is a means to that end. It follows that the immediate goals of breaching are to—

- Suppress enemy direct fire and observation of the obstacle or minefield.
- Establish forces on the far side of the obstacle or minefield.
- Neutralize or reduce a portion of the obstacle or minefield.

- Cross the main body safely through the minefield or obstacle.

Thus, a breaching activity starts with direct and indirect fires against defending enemy forces. Concurrently, it obscures the far side of the breach area with smoke to conceal breaching assets. A series of foot-lane breaches is created when dismounted infantry troops are available for assault against hastily prepared positions, or lightly defended positions, or in terrain where armored vehicles cannot operate. Available organic mechanized breaching equipment is used to create an initial vehicle-lane breach when a dismounted assault is not possible or practical. In both cases, the lanes are then widened, proofed, and marked for further dismounted or vehicular traffic. The maneuver force then swiftly reconstitutes and continues its mission.

FIGURE 2-12. INTEGRATION OF OBSTACLES AND MINEFIELDS



BREACHING ELEMENTS

The leading force in the mobility system, faced with an obstacle, organizes into three elements.

The support force. The support force (figure 2-13) consists of combat and combat support elements. The force lead element contacts the obstacle, moves to an overwatch position, and becomes the base unit of the support force. These forces deliver direct fire on defended obstacle areas. The support force also includes all units providing overmatching fires and other support (such as electronic warfare and artillery, including counterbattery fire and smoke) to support the entire breaching process. As required, the support force fires are directly controlled by the assault or breaching force commander to insure the necessary close coordination.

The assault force. The mission of the

assault force (figure 2-14 on page 2-18) is to quickly suppress enemy fires in the breach area, cross the obstacle, and destroy the enemy on the far side. An assault force is built around infantry and armor units. Engineers assist the movement of the assault force through the obstacle.

The breaching force. The primary mission of the breaching force (figure 2-15 on page 2-18) is to create, and if necessary, mark lanes in the minefield or obstacle which allow passage of the assault force into the objective. Once the initial passage is completed, the breaching force prepares and marks the necessary lanes to safely pass the remainder of the force. Breaching forces normally are composed of engineers, infantry, and armor. After the required lanes are completed, the breaching force assists the assault force as required. A detailed discussion of breaching

FIGURE 2-13. THE SUPPORT FORCE

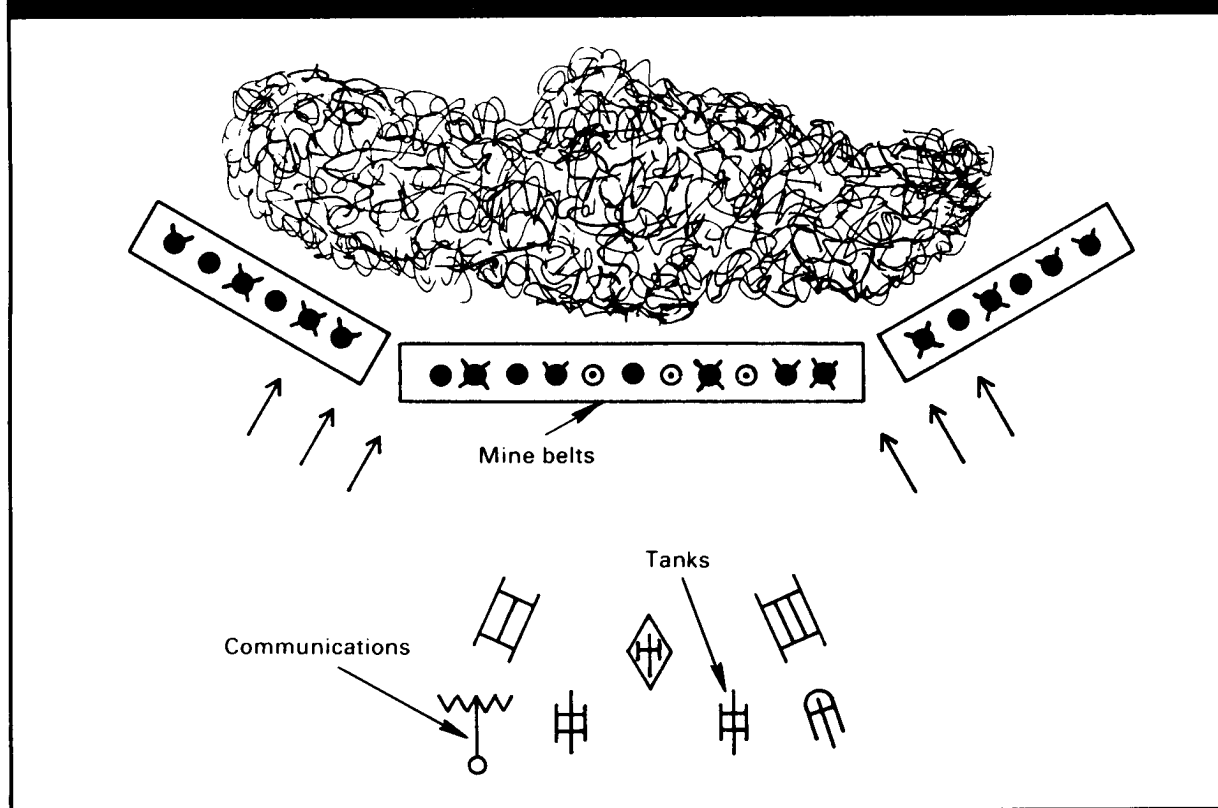


FIGURE 2-14. THE ASSAULT FORCE

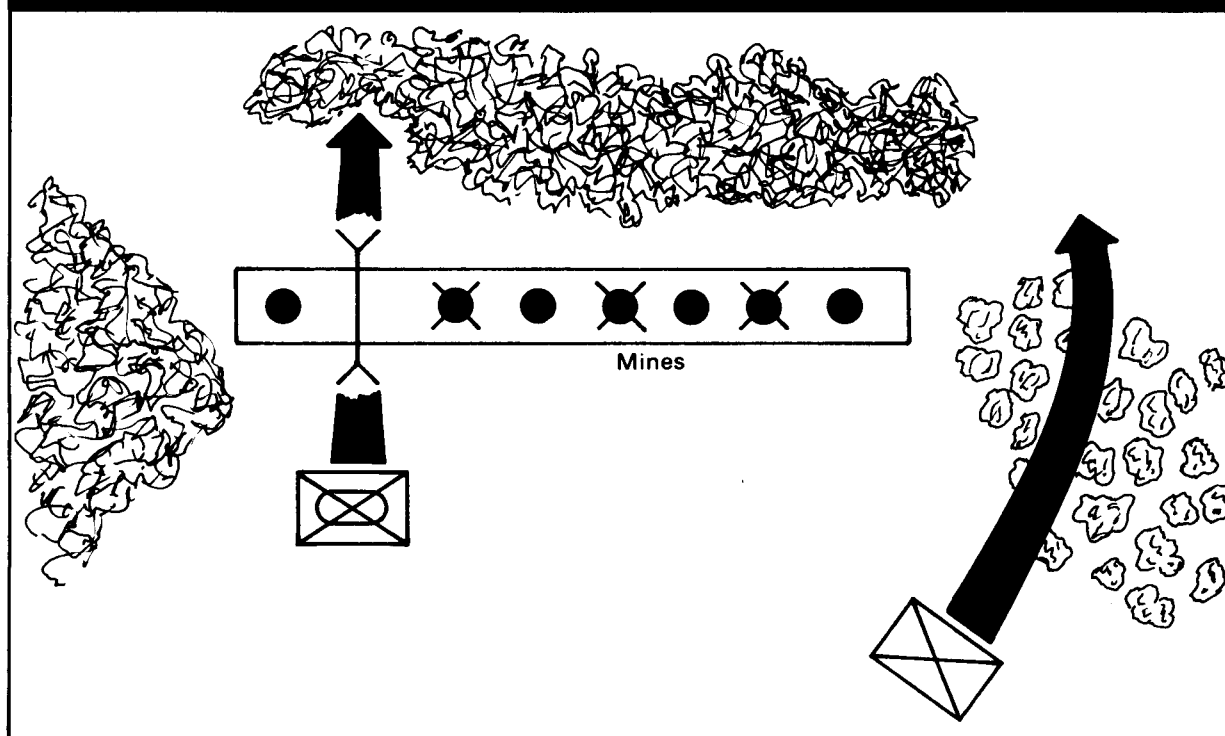
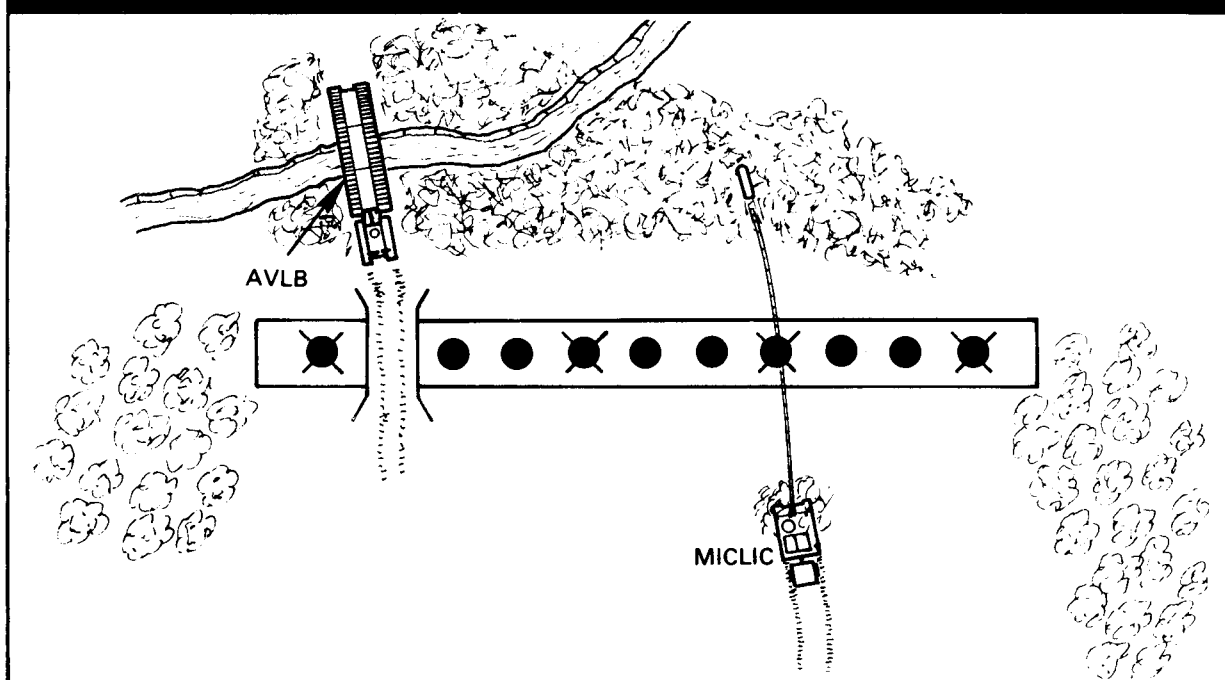


FIGURE 2-15. THE BREACHING FORCE



techniques applicable to each mobility task is provided in chapter 4 (countermine) and chapter 5 (counterobstacle).

Upon completion of the breach, the support force will be the last element of the force to cross the obstacle. Normally the base element of the support force would then become the assault force. Conversely, the previous assault force would become the base element of the support force.

METHODS OF BREACHING

There are three methods of breaching available to the force commander.

Hasty breaching. In the hasty breach, the attacking force maintains the momentum of the attack by attempting to breach “in stride” as it encounters the minefield or obstacle. A hasty breach is conducted by maneuver units with immediately available assets and often without combat engineer participation. The breach is based on mobility drills and is executed aggressively.

Deliberate breaching. The deliberate breach is conducted when it is not possible to take the minefield or obstacle in stride or after a hasty breach has failed. Combat engineer support is essential. A deliberate breach will normally be conducted after momentum has been lost. More time is required for reconnaissance, planning, and build-up of necessary resources than is possible for a hasty breach.

Forcing through. Forcing through is the crossing of an obstacle without the benefit of countermine or counterobstacle equipment. Visual observation is the only means used by dismounted troops or vehicle drivers to avoid obstacles or mines. Negotiating the obstacle in this manner involves the highest risk and is attempted only when it is imperative to maintain the momentum of the attack or no other means is available.

CLEARANCE OR REDUCTION

Minefield clearing or obstacle reduction is

the complete removal or destruction of an obstacle which has been bypassed or breached. It is generally conducted after enemy presence has been eliminated from the obstacle site. Thoroughness and safety, not speed, are the most important considerations here. Manual removal or demolition are used to clear and/or reduce minefield. Mechanical means and demolition are used to reduce obstacles other than minefield. Obstacle clearance and reduction are generally conducted by engineer units. A minefield is cleared or an obstacle reduced in order to—

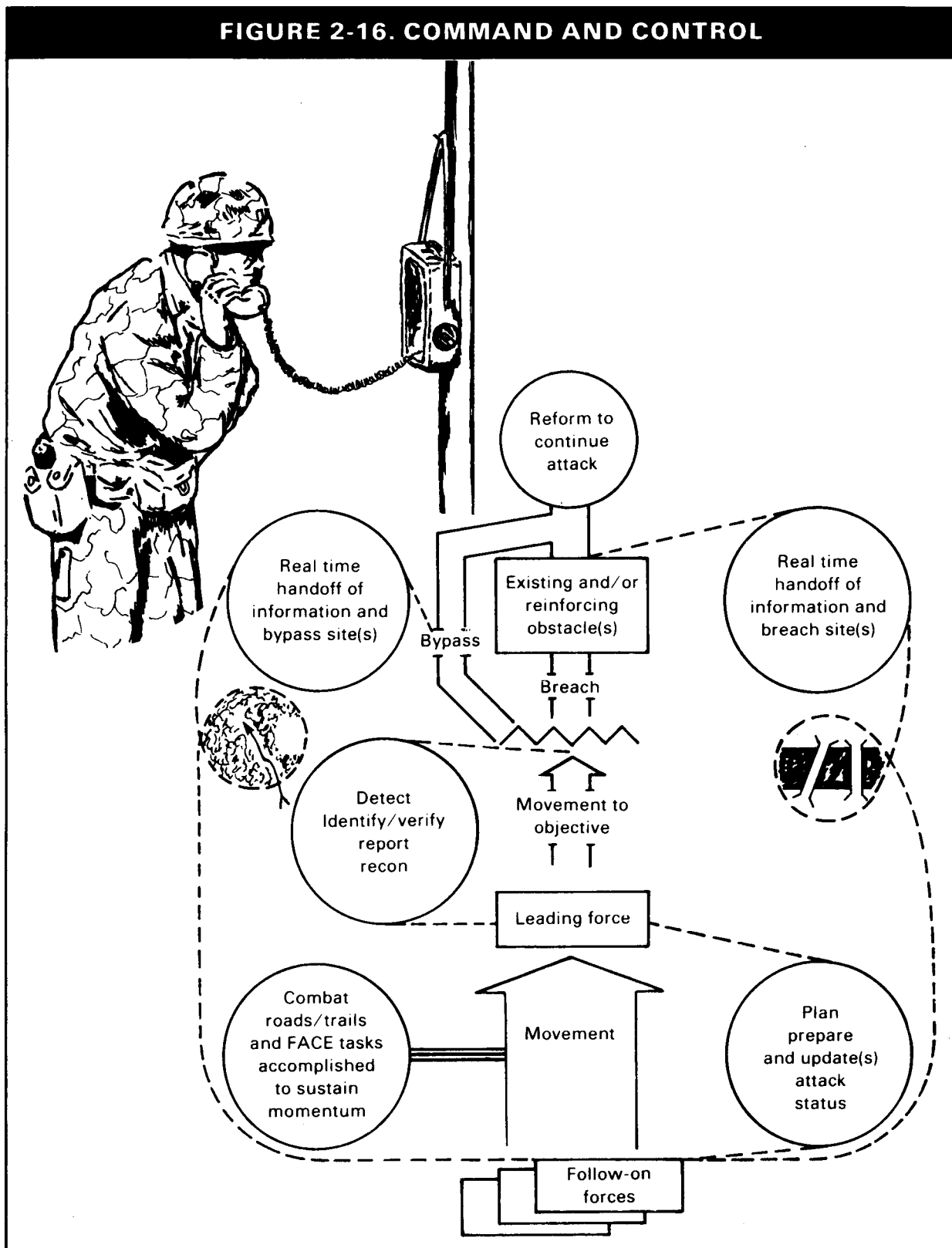
- Regain full use of maneuverable terrain.
- Regain full use of a route.
- Eliminate danger to personnel, equipment, and noncombatants.
- Regain full use of a support facility.

COMMAND AND CONTROL OF MOBILITY MISSIONS

A command, control, and communications (C³) system was developed in the planning and preparation phase. The resulting network links all elements of the combined arms team including engineers providing mobility support and follow-on forces (figure 2-16 on page 2-20). This system may be in the form of radio contact of the engineer element with its parent unit and its supported unit. It may also be simply an engineer guiding traffic safely through a minefield safe lane.

REPORTING, RECORDING, AND MARKING

Reporting, recording, and marking of an encountered minefield during the execution phase are necessary to alert other members of the leading force. These tasks also serve as the basis for handing off the bypassed or breached obstacle to follow-on forces. Command and control of mobility activities are especially crucial at this time. Plans and procedures for reporting, marking, and transfer of obstacle sites are coordinated with follow-on forces.

FIGURE 2-16. COMMAND AND CONTROL

Reporting. Untimely, incorrect, or inadequate obstacle reporting can delay or distort the decision to breach and reduce the dispersion between tactical units. The tactical commander is responsible for reporting any contact with friendly or enemy obstacles to the next higher echelon. When necessary, adjacent units will also be informed. This process allows plans and orders at higher headquarters to be revised and reduces maneuver delay. There are three categories of reports which pertain to the transfer of tactical information involving mobility activities:

- Detection reports alert the force to the location, nature, and when possible, extent of an observed obstacle. Examples are obstacle, situation, and spot reports.
- Reconnaissance reports provide detailed information on the extent of an obstacle, both existing or reinforcing. Route reconnaissance, ford, and terrain reports are examples of this type.
- Minefield reports describe any previously undetected minefield, both enemy and friendly. This type of report should always include a sketch showing minefield location, dimensions, and any other available information. FM 5-102 contains specific information on this subject.

Recording. This activity involves recording obstacle data and transferring this information to tactical status records, maps, and the terrain analysis data base. The data is gathered from combat road, trail, and FACE reconnaissance missions. Specific detail on reporting and recording procedures for each of the mobility missions is included in chapters 4-8.

Marking. This task involves placing visual signals on or around an obstacle, combat road, combat trail, minefield breach or forward aviation facility. Marking is done to prevent accidental contact or exposure with the obstacle or safety hazard. A minefield or obstacle should be immediately marked with marking systems or available resources. In

the case of nonmine obstacles, marking should be located in positions to warn any follow-on forces. Most obstacles, when breached, become defiles. The use of STANAGs or other agreed upon procedures is required to insure that minefield are clearly marked as to extent, width, and perimeter of the breached lanes. Breached lanes may be effectively controlled by fire support. If necessary, breached lanes or bypasses are also guarded by maneuver elements to insure safe transfer of follow-on elements. Guard forces are left by the leading force or provided, in advance, by follow-on forces. Road warning signs are provided on combat roads and trails to warn traffic of mined areas, obstacles, or difficult driving conditions. Air marking panels are provided on landing zones, airstrips, and low altitude parachute extraction system (LAPES) zones to warn pilots of ground level, release points, or hazardous obstructions. In all cases, temporary markings will be replaced by standard marking materials as soon as the tactical situation permits.

TRAFFIC CONTROL

In all mobility missions, the maneuver commander is responsible for establishing a traffic control system. The commander will appoint a designated representative to control and monitor this system at obstacle sites. The objective of traffic control is to expedite tactical movement and prevent the unnecessary massing of personnel and equipment on either side of the obstacle. Plans for a traffic control system include arrangements for staging and holding areas as well as movement.

Staging areas. Staging areas are waiting spaces for forces not engaged in supporting the leading force or convoys. They are located far enough from the obstacle site to facilitate use of alternate routes. Areas selected for staging require—

- Cover and concealment.
- Easy accessibility.

- Sufficient areas for personnel and vehicle and equipment dispersion.

Holding areas. Holding areas are waiting spaces both near and within obstacle areas. They are selected to accommodate vehicles should a sudden interruption occur in the movement of traffic across the obstacle. Vehicles move into these areas and disperse rather than remain on trafficable routes or restrict the flow of traffic through breach lanes or bypasses.

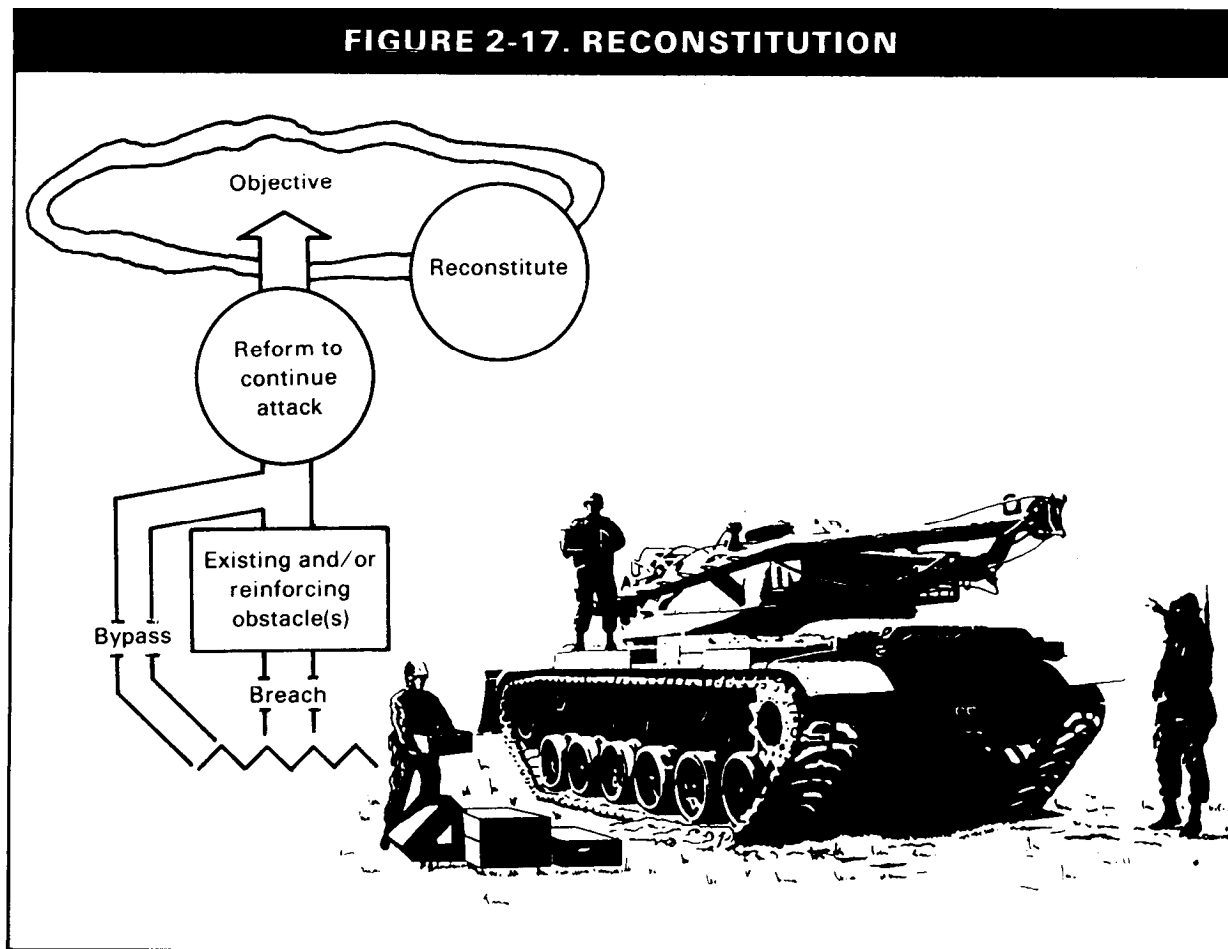
Order of movement. Breaches or bypasses tend to channelize traffic. A prearranged order of movement, disseminated to all elements of a force, will facilitate speedy movement through or around the obstacle area. If

necessary, guides will assist in movement through the obstacle. When possible, light traffic should go through first to prevent ruts formed by heavy vehicles from becoming obstacles to lighter vehicles. The combat situation will dictate the vehicle crossing priorities.

RECONSTITUTION

Successful completion of breaching or bypassing activities depends on how quickly a force can consolidate on the far side and continue its mission (figure 2-17). The traffic control plan should include plans for dispersing forces on the far side once the obstacle is overcome. It should recognize that movement rates for the forces past the obstacle and those negotiating the obstacle are critical. An effective consolidation and traffic

FIGURE 2-17. RECONSTITUTION



control plan will prevent forces from becoming too far apart to provide mutual support on the far side of the obstacle.

LOGISTIC SUPPORT

Logistic support is the provision of adequate material and services to a military force to assure completion of the mission. The execution of bypasses, breaches, or combat construction can be expected to result in some equipment damage or loss. These conditions should be thoroughly anticipated in the planning phase. Logistic support consists of the following four sequential subtasks which apply to all mobility activities:

- Identify mobility systems still available,
- Identify equipment, personnel, supplies (including munitions) required,
- Request and acquire replacements.
- Repair/resupply/decontaminate.

The most important aspect of logistic support is that the process occur swiftly. Mobility logistic support cannot be allowed to delay the continuing movement of forces or critical supplies.

OPERATIONAL CONSIDERATIONS

OPERATIONS SECURITY

Operations security (OPSEC) refers to those measures taken to deny the enemy tactical information until it is too late for them to react. Security must be maintained throughout all phases of mobility activities. Unless steps are taken to deny the Threat knowledge of when, where, how, and with what our forces intend to move, the Threat can react by creating obstacles which will effectively delay any movement or maneuver. Adherence to a well-thought-out OPSEC plan will provide maneuver units and support engineers with an added measure of security against enemy observation and fire. The maneuver force operations staff officer (G3/S3), assisted by the intelligence staff officer (G2/S2), develops the OPSEC plan. A successful security effort includes an integrated effort by commanders, staff, and each soldier of the combined arms team. There are three types of OPSEC measures.

Countersurveillance. Those measures taken to protect the true status of friendly activities and operations are countersurveillance. These include measures to insure the authenticity of communications, the physical protection of radio transmissions (such as radio-listening silence), and the control of information sent over radio equip-

ment. Preventing classified and unclassified information from falling into enemy hands is also a part of countersurveillance. Physical security measures are those that protect equipment, facilities, and activities. These measures are enhanced by camouflage, concealment, and noise and light discipline.

Countermeasures. Those activities which are designed to overcome enemy intelligence collection are OPSEC countermeasures. Countermeasures are designed to reduce the risk of friendly detection and vulnerability. These include the locating, targeting, and destruction of enemy intelligence systems.

Deception operations. Most deception operations involve the creation of false impressions for the enemy force. They include sight, sound, smell, or electronic "pictures" painted by friendly forces that will cause the enemy to react incorrectly. Within the context of mobility tasks, engineer forces conduct deceptive measures as directed. They may include the following:

- Use of dummy equipment.
- Conduct of an activity so it is not what it seems.
- Falsification of material which can be detected or photographed.

- Manipulation of electronic signals.
- Use of feints or movement of a force in a direction intended to mislead.

NUCLEAR, BIOLOGICAL, AND CHEMICAL WEAPONS

Threat doctrine puts a premium on the ability to maneuver and mass troops at critical battlefield locations. Threat forces will employ nuclear, biological, or chemical (NBC) weapons in order to deny that ability to enemy forces. These weapons will likely be used in combination with other obstacles. Initial employment will create confusion and massive casualties. Continued use of these munitions will delay and degrade further friendly operations.

Terrain alteration. Nuclear weapons can alter terrain. Nuclear detonations will produce large amounts of debris such as tree blowdown, craters and building rubble. Also, these weapons will leave radioactive contamination and make areas useless to unprepared units.

Restoration of mobility. Tactical commanders and supporting engineers must be prepared to restore mobility in a nuclear, chemical, or biological environment. As much as possible, forces should avoid contaminated and disrupted areas and still accomplish given missions. In some cases where bypass is impossible or impractical, contaminated areas will have to be crossed. The degree of risk in planning specific routes must be weighed in terms of personnel exposure to nuclear radiation or chemical/biological

contamination. Unit NBC officers and elements will assist in this planning.

Personnel considerations. On the next battlefield, heavy losses are likely to occur from nuclear and chemical weapons. The psychological effects on surviving soldiers will be severe, but these effects can be limited, to some degree, through realistic training. The soldier who is taught how to survive and accomplish missions on a nuclear battlefield will be crucial to mission success. High casualty rates will require two important reactions. First, surviving leaders must be aggressive in taking charge, assessing damage, and continuing the mission. Second, units must be reorganized and supplied.

Mobility countermeasures-NBC. Regardless of the mobility support task required, commanders and engineers must consider the enemy's nuclear, chemical, and biological capability. Random use of chemical mines should be expected as a form of harassment. The enemy is expected to use persistent chemical agents to restrict our movements and to protect its flank. Units must be dispersed before executing mobility support tasks, although massing will be required at the critical time to accomplish the task. Units must be prepared to conduct bypassing, breaching, or clearing activities in a high state of mission oriented protective posture (MOPP).

Logistic consideration. Delays in battlefield logistics may occur as a result of the effects of nuclear weapons. This may result from damage to or contamination of supplies, facilities, and food/water sources.