CHAPTER 9

Mobility Support in Special Situations

CONTINGENCY OPERATIONS

POSSIBLE SCENARIOS

Future combat will see US forces involved in two possible scenarios. In one case, war may begin where substantial US Army units are already stationed. In the second, conflict could begin in areas where there are few or no existing US forces. Combat operations in this second case will be required generally for two reasons: vital natural resources require immediate US protection, or an allied nation is militarily threatened. Such operations will require a rapid deployment of US forces into unfamiliar terrain or environments. Deployment of US forces under these circumstances is called contingency operations.

INITIAL FORCES MOBILITY

Mobility planning (chapter 3) will be critical to the actual deployment phase of a contingency operation. Once the mission to deploy is given, the estimate, planning, and preparation process begins. The engineer terrain analysis detachments, using their tactical terrain analysis data base, develop all available information on the contingency area.

Special topographic products and tactical maps are then produced. Using this information, the mobility planner analyzes the contingency deployment area. Obstacles, mined areas, and the existing road and communications network are studied in detail. The analysis of existing air landing facilities and availability of suitable areas for development of forward aviation landing sites is extremely important. Once analyzed, the designation and priority of countermine, counterobstacles, gap crossing, and mobility combat construction (combat roads and trails and FACE) tasks are made. This information determines the structure of the engineer force in the deployment plan.

Assault phase. The assault force will usually consist of lightly equipped combat units. Light infantry, airborne, or air assault units are commonly tasked for contingency assault missions. These forces may not require extensive engineer mobility support for clearing mines and booby traps, but their logistics support will often demand concentrated engineer effort. Engineers could be tasked to construct helicopter landing zones and low altitude parachute extraction system (LAPES) zones, and to repair or expand existing airfields.

Lodgement and expansion phases. In the lodgement and expansion phases, the ability to move units and supplies over land will increase in importance. Because of enemy resistance, greater emphasis will be placed on countermine and counterobstacle activities. Mobility efforts, although expanded in quantity, are executed within concentrated areas of terrain. Once the theater becomes developed, mobility support for offensive operations will predominate. Combat engineer units that supported the initial deployment and lodgement phases would be reinforced to maintain unit freedom of movement.

THE THREAT

Any conceivable Threat configuration could oppose friendly forces in a contingency operation. To insure that friendly forces establish a strong foothold, enemy mobility and air superiority must initially be countered. Countermobility, survivability, and mobility tasks are used to protect the assault force, achieve initial objectives, and prohibit the enemy from maintaining uncontested superiority on the ground and in the air.

TERRAIN ASPECTS

Topography, climate, and habitation of the contingency area will significantly affect mobility activities. Section III of this chapter deals with mobility techniques that apply to special terrain areas and environments. These include the terrain in mountains, deserts, and jungles and the environments associated with cold weather regions and urban combat operations.

EQUIPMENT AND SUPPLY LIMITATIONS

Contingency operations begin with a rapid deployment of forces. Normal supply and resupply operations will be delayed and will have to catch up with the initial forces. As initial deployment will most likely consist of a light force, heavy engineer equipment will be scarce. This will significantly limit mechanical breaching methods and combat trail development. Contingency forces must plan extensively for manual and explosive means to maintain the momentum of operational movement.

ALLIED FORCES

The United States maintains substantial forces in Europe. In the event of combat there, these forces can materially assist force development and sustainment. The European theater of operation has been well defined for years. This has enabled peacetime planning, base development, and the establishment of detailed host nation support agreements.

COMBINED OPERATIONS

OTHER THEATERS

In other potential combat theaters, international agreements with US allies on principles and procedures do not exist or are only partially developed. These theaters will present more demanding challenges. In both of the possible theaters of operation, combat activities will involve combined operations with allied forces.

INTEROPERABILITY

Interoperability is the capability of multinational forces to operate together smoothly in combat operations. This includes the ability to plan, exchange information, and execute mobility tasks in support of one another. Commanders involved in combined operations must be aware of SOPs, STANAGs, and any other procedural agreements made between forces. In addition, a commander should train as much as possible with equipment, methods, and supplies organic to friendly foreign forces mobility efforts. When a host nation with the required capability exists, host nation support (HNS) agreements may provide equipment or labor for road maintenance or development of aviation ground sites. These assets can free US engineer assets for other high priority engineer tasks.

OPERATIONS IN THE NORTH ATLANTIC TREATY ORGANIZATION

European forces come under the umbrella of the North Atlantic Treaty Organization (NATO). The mobility planner in Europe is concerned with the terrain and climatic characteristics of the three NATO regions.

AFNORTH. The Northern European Command, also know as Allied Forces, Northern Europe (AFNORTH), is made up of Norway, Denmark, and the northern portion of Germany. Climatic conditions in this area vary from cold and wet in the southern areas to almost subarctic in the northern tip of Norway and Sweden.

AFCENT. Allied Forces, Central Europe (AFCENT) includes most of Western Europe, specifically West Germany. The climate of this area is cold and wet most of the year. The terrain is generally rolling and open, with many urban and built-up areas of 50,000 population and greater. Mobility tasks, especially gap crossing, will be critical, as this region possesses a diverse network of drainage features.

AFSOUTH. Allied Forces, Southern Europe (AFSOUTH) includes Italy, Greece, Turkey, and the Mediterranean. The climate is bitter cold in some regions but is generally warm in most areas. The terrain of northern Italy, Greece, Turkish Thrace, and eastern Turkey is mountainous. The plains of the Po River Valley, however, provide for generally unrestricted mobility and direct fire. The ability to overcome enemy reinforcing obstacles will dominate the battle for this key mobility corridor.

OPERATIONS IN THE PACIFIC COMMAND

Forces stationed from the west coast of the Americas across the Pacific Ocean to the western shores of Southeast Asia come under the umbrella of the Pacific Command (PACOM). Two important areas of the command are Japan and Korea. As in NATO, important differences in capabilities, doctrine, and equipment exist among various national forces in PACOM. Unlike NATO, few STANAGs exist to negotiate the differences. Again, environmental considerations are critical for the mobility planner in these areas.

Korea. The threat to the Republic of Korea is the powerful North Korean Army. The climate and terrain in which mobility activities in Korea would take place include mountainous, rugged topography with a temperate, monsoonal climate. Most of the terrain favors light infantry operations, yet two major avenues of approach from the north allow mechanized activity. Freedom of movement revolves around the trafficability of existing routes and aircraft landing facilities. The cultivation of rice in most regions and confluence of rough terrain has created numerous tactical choke points. The repair or maintenance of existing trafficways and the development of combat routes are critical factors in mobility planning.

Japan. The five major islands of Japan have climate similar to that of the US east coast. The terrain of the islands is mostly mountainous, with the urban and population centers located in the remaining habitable areas. As in Korea, there is limited written agreement on operational activities between US forces and Japan. Significant efforts must be made to insure interoperability of forces. Mobility tasks will most likely involve freedom of movement for forces in mountainous terrain.

OPERATIONS IN THE CENTRAL COMMAND

Forces stationed or selected for operations within a region bounded by the Persian Gulf, the horn of Africa, and the nations of Southwest Asia come under the control of the Central Command (CENTCOM). Formerly known as the Rapid Deployment Joint Task Force (RDJTF), the CENTCOM focuses on contingency operations within its assigned area. As is the case with the PACOM, few agreements exist among multinational forces which influence the CENTCOM region. The mobility planner, in developing operational considerations for CENTCOM, must consider desert and jungle environments.

SPECIAL TERRAIN AND ENVIRONMENTS

CONSIDERATIONS

Mobility tasks undertaken in areas with special terrain or unique environmental conditions will require special considerations. Terrain and weather extremes tax the combat capabilities of personnel and equipment. Mobility planners and engineers must understand the special characteristics of these terrain areas and weather environments. Knowledge of the critical advantages and disadvantages of these areas is necessary in applying the different mobility functions under combat conditions. This section will explain operational differences in the planning and execution of mobility support tasks for mountain, desert, jungle, cold region, and urbanized terrain.

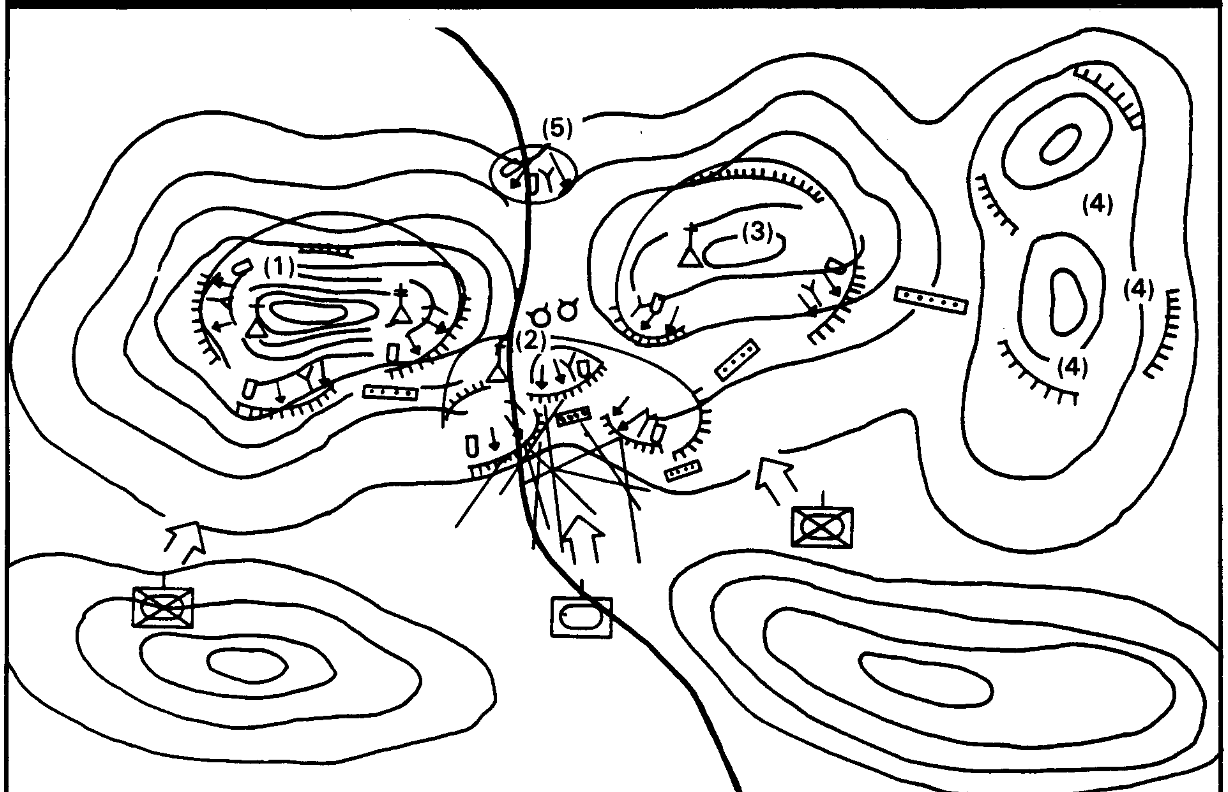
MOUNTAINOUS TERRAIN

Specific characteristics of mountainous regions vary widely. Mountains may rise abruptly to forma terrain barrier or they may rise gradually as a series of parallel ridges extending for miles. They may also be a combination of isolated peaks, rounded crests, eroded ridges, and high plains. In almost all cases, these regions have rugged, poorly trafficable terrain with steep slopes and local relief greater than 500 meters. They do differ in climate, however. In desert regions, the mountains are dry and barren with daily temperature extremes. Mountains in jungle regions are frequently covered by lush vegetation, further limiting trafficability. The Alpine-type ranges are generally inaccessible to vehicles.

Mobility planning considerations. Tactical movement of forces and supplies will be difficult in rugged mountain areas. Most of the terrain is divided into narrow valleys bounded by high hills. Roads and trails are usually few with steep gradients and numerous curves. The objective of most mountain operations is to open, secure, or deny the use of passes, choke points, or other key points on lines of communication. Usually, these operations require significant combat engineer participation.

The Threat will use the largest part of its force to defend mountain passes as they are considered the tactical key to an entire mountain range. Figure 9-1 depicts a deliberate Threat mountain defensive position. In defending a pass, the Threat occupies the heights dominating the pass as well as the most important spurs on the approaches to it. Weapons are distributed in depth along the slopes. The approaches to the pass are covered by flanking fires and crossfire. Roads through the pass are mined and narrow spots prepared for demolition. Explosives also may be installed for the purpose of creating slides. In wooded terrain, Threat defensive positions are organized at the forward edge of the

FIGURE 9-1. THREAT COMPANY IN THE DEFENSE (MOUNTAINS)



Key:

(1) First motorized rifle platoon.
(2) Second motorized rifle platoon.
(3) Third motorized rifle platoon (-).
(4) Adjacent unit.
(5) Reserve (one squad from 3d platoon).
Light machine gun.
Antitank grenade launcher.
Observation post.
Company commander's command and observation post.
Antitank mines.
Fougasses or explosives.
APC.

woods or on commanding heights. Elevated platforms are built in trees for machine guns and observation posts. Antitank and antipersonnel mines, artificial landslides, and other obstacles are widely used.

Countermine tasks in mountainous terrain. Minefields in mountainous areas normally require breaching activities as the reinforcing value of the rugged terrain makes such minefield almost impossible to bypass. Command and control of a breaching, hasty or deliberate, is more difficult than in open terrain. This is due to the lack of maneuver space and the increased chance of observed covering fire from concealed enemy forces. Mechanical mine devices, such as mine rollers or plows, are not easily employed in mountainous terrain. The lack of roads and trails and predominance of large rock outcropping force the use of explosive or manual methods. Care must be used with explosive line charges to prevent rockslides or avalanches started by the explosive shock. Breaching forces should use military judgment in establishing safe stand-off distances in these cases.

Counterobstacle tasks in mountainous terrain. A series of well-placed obstacles will create a formidable barrier in rugged terrain. Engineer mobility support to counterobstacle tasks will be extensive. Due to restricted trafficability, counterobstacle equipment and personnel should be employed near the front of advancing forces. Washouts, craters, landslide rubble, and point obstacles will have to be breached or reduced. Bypass will almost always be difficult or impossible. In certain mountain areas, light equipment, demolitions, and manual efforts will have to be used. Obstacles covered by fire will present particularly dangerous situations. Support and assault forces must gain superior fields of fires over defending forces. This will involve selection and use of key high ground protecting the breach site.

Gap-crossing tasks in mountainous terrain. Gap-crossing requirements in mountainous terrain could be extensive. Well-placed enemy point obstacles or strongpoint defenses of trafficable routes can easily deny mechanized maneuver. Light forces, supported by engineer assets for spanning short gaps, are best suited to mountain operations. Deliberate gap crossing will normally have to be executed in order to maintain mobility. The time factors involved will generally be restrictive for swift moving operations.

Combat road, trail, and FACE tasks in mountainous terrain. Combat engineer construction in mountainous areas is directed mainly at opening or maintaining the use of passes and other key terrain. Usually, excessive amounts of cut and fill are required for construction of mountain combat roads and trails. Expedient combat construction work is thus limited to the repair and maintenance of existing roads and trails. Sidehill cuts will be used when possible. Because of extensive slopes, rains, and seasonal thaws, the design of drainage facilities is very important. Abnormal gradients on combat trails and roads may be necessary to insure that construction keeps pace with tactical operations. Turnouts should be planned and built at least every one-half kilometer. These expedient holding areas can accommodate slow or stalled vehicles and reduce traffic congestion.

The development of air landing strips or helicopter landing zones will constitute the majority of FACE tasks in mountainous terrain. Due to rocky ground, extensive clearing is difficult, if not impossible. Standoff space from rock wall faces must be cleared and a level landing surface provided. Demolitions may be required for the clearing of large rocks.

DESERT REGIONS

Deserts are arid, barren regions of the earth incapable of supporting normal life due to lack of freshwater. Temperatures vary according to latitude and season. Annual rainfall may vary from 0 to 10 inches but is often totally unpredictable. Desert terrain also varies considerably from place to place, the sole common denominator being lack of water. The three types of deserts are mountain, rocky plateau, and sandy or dune.

Mountain deserts are characterized by scattered ranges or areas of barren hills or mountains, separated by dry, flat basins. High ground may rise gradually or abruptly from flat areas to a height of several thousand feet above sea level. Most of the infrequent rainfall occurs on high ground and runs off rapidly. This runoff takes the form of flash floods, eroding deep gullies and ravines, and depositing sand and gravel around the edges of the basins. Water rapidly evaporates, leaving the land barren (figure 9-2).

Rocky plateau deserts, shown in figure 9-3 on page 9-8, have relatively slight relief interspersed by extensive flat areas with quantities of solid or broken rock at or near the surface. These desert areas usually have steep-walled eroded valleys, known as wadis in the Middle East and canyons in the United States. The narrower of these valleys can be dangerous to personnel and material due to flash flooding.

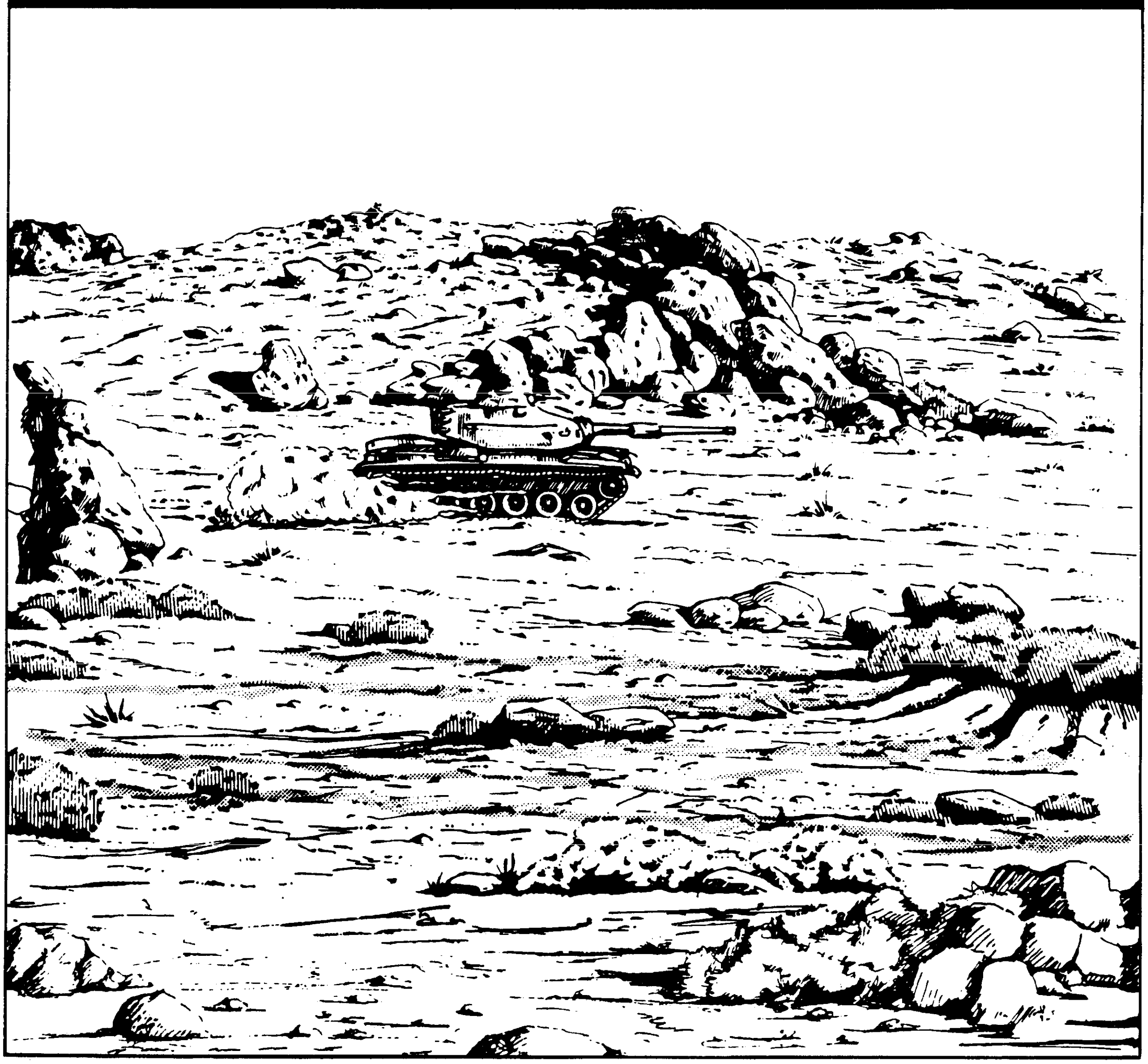
Sandy or dune deserts are extensive flat areas covered with sand or gravel. "Flat" is relative in this case, as some areas may contain sand dunes that are over 1,000 feet high and 10 to 15 miles long. Trafficability in such terrain will depend on gradients of the dunes and texture of sand. Other areas, however, may be totally flat for distances of 3,000 meters or more (figure 9-4 on page 9-9).

FIGURE 9-2. MOUNTAIN DESERT

Mobility planning considerations. Roads and trails are scarce in the open desert, as complex road systems are not needed. Some surfaces, such as lava beds or salt marshes, may preclude any form of routine vehicular movement. However, ground forces can often travel in any direction necessary, although speed of movement will vary depending on surface texture. Trails exist in many deserts for use by caravans and nomadic tribes and vary in width from a few to over 800 meters. Vehicular travel in mountainous desert country may be severely restricted.

Extremes. Extremes in desert weather and light conditions must be considered in the planning and execution of mobility tasks. The day to night temperature may fluctuate as much as 70 degrees Fahrenheit, imposing a strain on personnel and sometimes affecting equipment. Desert winds can achieve almost

FIGURE 9-3. ROCKY PLATEAU DESERT



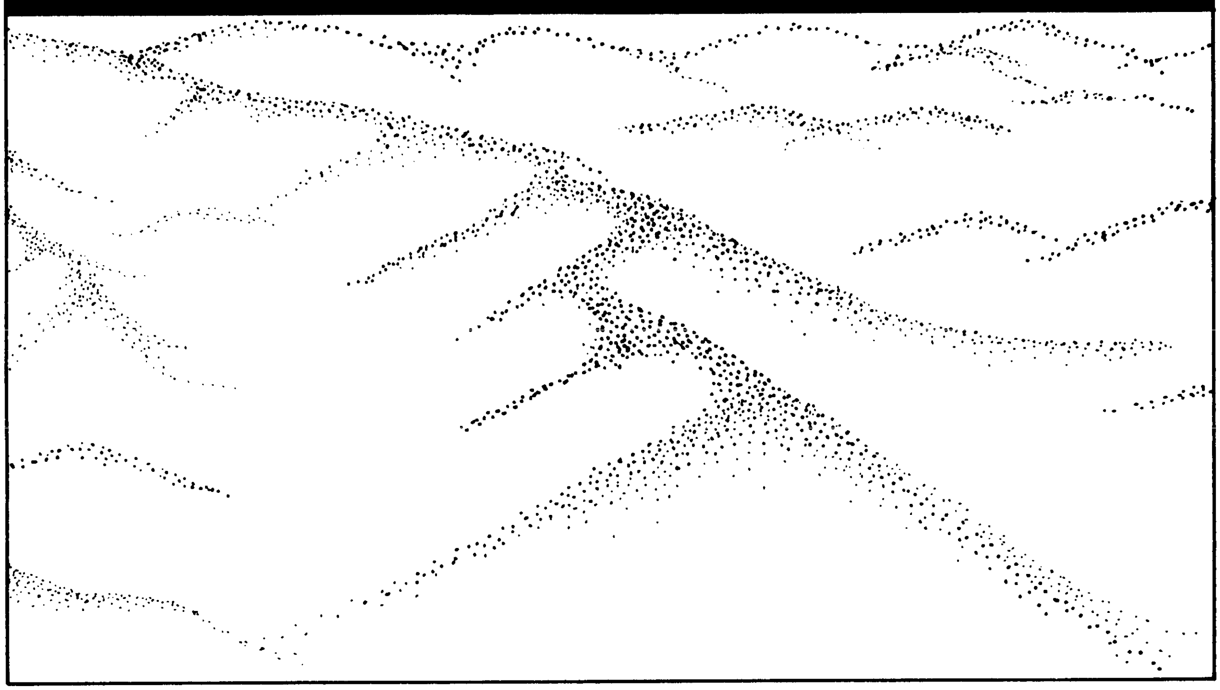
hurricane force. The dust and sand blown by these winds can make maintenance very difficult and restrict visibility to a few meters. Rain may consist of a single violent storm per year with high surface water runoff which will either reduce trafficability in wadi areas or somewhat improve it if the terrain is pure sand. Also, rain occurring several hundred miles away can cause flooding with otherwise dry streambeds suddenly becomming hazardous.

Threat defensive. Threat defensive tactics in desert terrain are marked by a wide dispersion of forces with large unoccupied areas between Threat forces. These gaps are kept under observation by patrols and ambush parties during the day and by observation posts at night. Alternate direct-fire weapons positions are prepared to cover gaps, and they are also covered by indirect fire. Regimental minelaying teams, supported by division minelayers, emplace minefield to protect company strongpoints and canalize enemy armor into fire pockets. They can lay approximately 500 meters of minefield per hour, with a density of 500 to 1,000 mines per kilometer. Minefield are covered by antitank weapons and can be rigged for arming or detonating by remote control. Dummy positions are also used.

Night defensive. The Threat emphasizes defense at night and during sandstorms. Motorized rifle companies move to alternate positions after early evening nautical twilight (EENT) as a deception measure, and tanks and infantry carriers protected by infantry squads move forward and to the flanks to ambush and to cover intervals between units. Strongpoints maybe encountered not only as part of a deliberate defense, but also as protection for vital installations or key terrain features. The type of strongpoint will vary. Two examples of likely platoon-size strongpoints are shown in figure 9-5 on page 9-10.

Countermine tasks in desert terrain. Mines will be used frequently to impede force mobility. Since bypass of small minefield is

FIGURE 9-4. DUNE DESERT



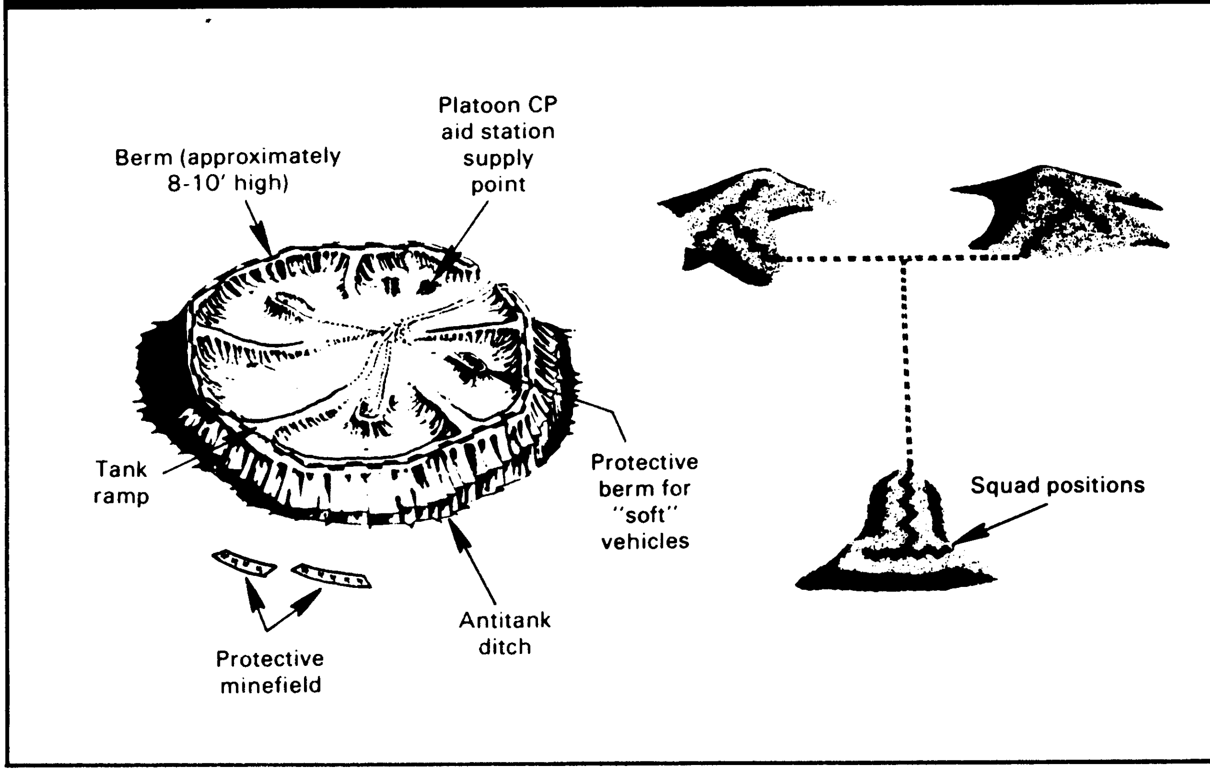
relatively easy in desert terrain, enemy minefield will need to be extensive. However, US forces should be alert for the nuisance mining of desert tracks and road edges. Mines are easy to emplace and camouflage in most desert soils. Large phony minefield, prominently marked, might be effective once US soldiers are mine-conscious. Engineers must be well forward to quickly locate and breach or bypass minefield and preserve force mobility. Since minefield can be easily installed or altered by the enemy, thorough and constant mine reconnaissance is required in a desert environment.

Counterobstacle tasks in desert terrain. Use of existing desert obstacles may permit a force to establish a defensive position that cannot be turned from either flank. However, these are rare. For example, only five natural defensive positions exist over a distance of 3,800 kilometers west of El Alamein in Egypt. In any case, an attacking force capable of airmobile or extended ground operations can usually find away over or around an obstacle. The defending force can then be bypassed, contained, or taken from the rear.

Gap-crossing tasks in desert terrain. Although trafficable across the basins, desert routes present unique gap-crossing difficulties. Desert areas may be cut by dry, steep-walled eroded valleys. In dry weather, these gaps are trafficable without the use of extensive gap-crossing equipment. However, flash flooding can swiftly turn them into wet gaps. Desert areas present several other unique gap-crossing considerations.

Pipelines. Exploration for and exploitation of

FIGURE 9-5. THREAT PLATOON STRONGPOINTS



minerals occur in many desert areas, especially in the Middle East. Wells, pipelines, refineries, quarrying and crushing plants may be of strategic and tactical importance. Pipelines are often raised 1 meter off the ground. Where this is the case, pipelines can inhibit movement. These obstacles can be crossed by assault bridging in areas where bridging is possible, by tunneling under the pipes, or by building earthen ramps over them. In locations where pipelines do not need to be kept intact, they can be breached by explosives.

Irrigation ditches. Many desert areas are fertile when irrigated, and a number of villages in deserts depend on irrigation canals. Agriculture in these areas has little effect on military operations except that canals may limit surface mobility. The effect of destruction of an irrigation system on the local population may become an important consideration in an operation estimate. Such ditches can be effectively crossed with assault assets.

Combat road, trail, and FACE tasks in desert terrain. Desert roads are usually scarce and primitive. They may marginally sustain the battle area and forward area traffic. The limited hard surface routes will be necessary for resupply. Therefore, considerable engineer effort may be necessary to develop and maintain combat routes forward to maneuver units. Local resources, such as marsh mud laid on sand, provides an expedient trafficable surface. These routes should be restricted to wheeled traffic only. An abundance of flat, open terrain exists in many desert areas for possible use as forward aviation sites. Soil stabilization may be required but will be limited by the amounts of water and equipment required. Selection of aircraft landing sites should focus on level, open areas. Dust palliative should be used, since soils of desert regions cause extensive dust. These soils also may have limited or varying bearing capacity.

JUNGLE TERRAIN

Jungles are common in tropical areas of the world, mainly Southeast Asia, Africa, and Latin America. The climate varies with location. Close to the equator, all seasons are nearly alike, with rains throughout the year. Farther from the equator, jungles have distinct wet (monsoon) and dry seasons. Jungles are characterized by high temperatures, heavy rainfall, and high humidity throughout the year. The jungle environment includes densely forested areas, grasslands, cultivated areas, and swamps. Cultivated areas exist in jungles and range from large, well-planned and well-managed farms and plantations to small tracts cultivated by individual farmers. Three general types of cultivated areas are rice paddies, plantations, and small farms.

Mobility planning considerations. Jungle terrain and climate impose many restrictions on the freedom of movement for conventional forces. Densely forested areas may make movement difficult. Thick stands of bamboo may slow or even stop tracked vehicles. Jungles in rugged mountainous areas will impede vehicular traffic. Rainy seasons (monsoons) cause rivers and streams to rise and become unfoldable, and heavy rains may cause damage to roads.

Influence on waterways. The inland waterways and coastal (delta) regions are land environments dominated by water routes. There may be one or more major waterways and an extensive network of smaller waterways. Usable roads are scarce, and cross-country movement is extremely difficult. The three regions of drainage features found in jungle terrain follow.

- Upper sector (headwaters). The headwaiters of a waterway are usually formed in a mountainous region. These consist of numerous tributaries which merge to form a river system as the water flows down to the valley. Headwaters are characterized by waterfalls, rapids, and variations in water depth (figure 9-6 on page 9-12).

- Middle sector (central valley). When the waterway reaches the central valley, it has formed a broad river. The river in the valley is wide, slow, and often meanders.

  During periods of heavy rainfall, the course of the river may change. The jungle vegetation grows up along the riverbanks to form an almost solid wall. The banks of the river are often steep and slippery (figure 9-7).

- Delta region (figure 9-8). When the river reaches the low coastal area, it becomes a number of river tributaries depositing a great amount of sediment into a gulf, bay, or ocean. Bottoms of the tributaries normally slope up to a crest or bar at the river's mouth. In some instances, only watercraft with a draft of 1 to 2 meters will be able to cross the crest or bar at high tide.

Use of camouflage. A jungle enemy can be expected to be skilled in the art of camouflage, using bunkers and tunnels as protective survival measures. To slow opposing forces, obstacles, mines, and booby traps may be used. The enemy will move on covered and concealed routes, using darkness for cover. Jungle enemies will probably depend heavily on streams and rivers to provide concealed routes of movement and drinking water.

Role of engineers. Engineers "open up" the jungle. Combat road and trail building and repair, and gap-crossing activities are continuous tasks for the engineers in jungle terrain. Engineers support the infantry in the

FIGURE 9-6. HEADWATERS OF A WATERWAY

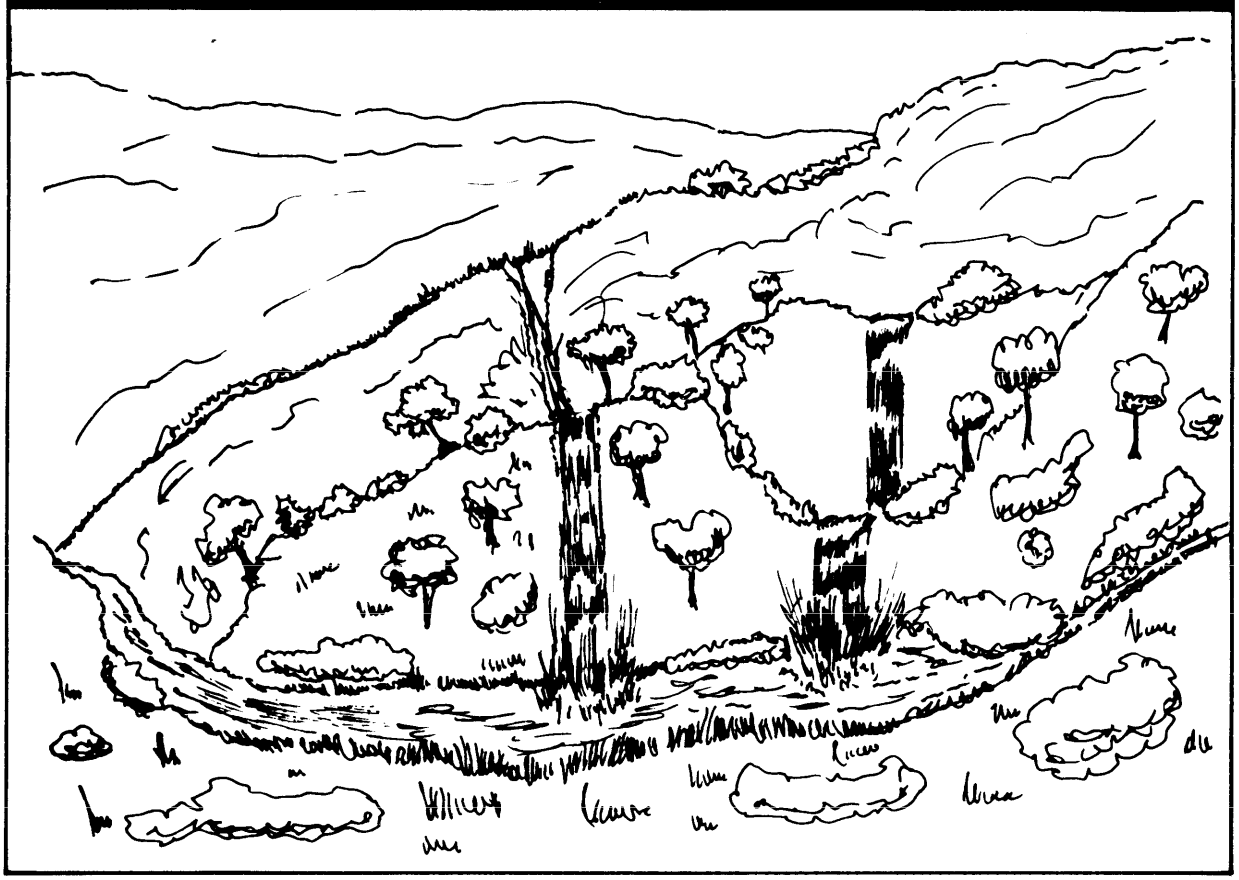


FIGURE 9-7. CENTRAL VALLEY WATERWAY

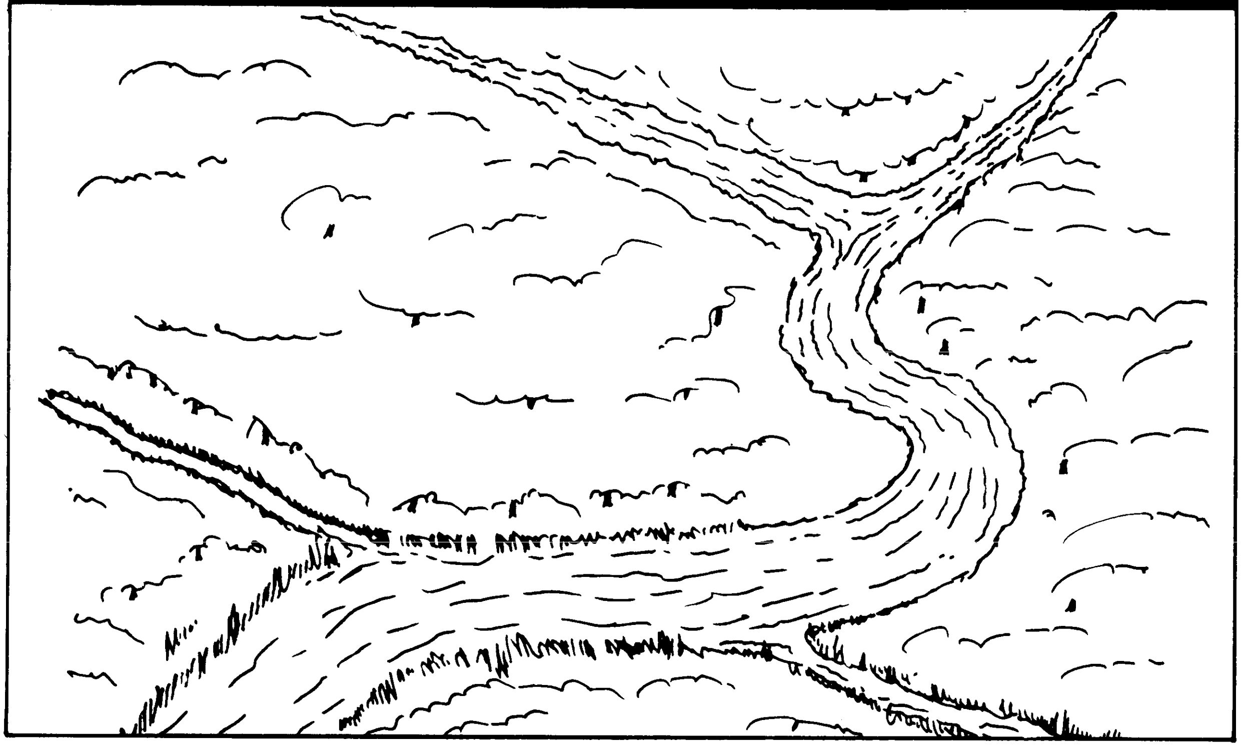
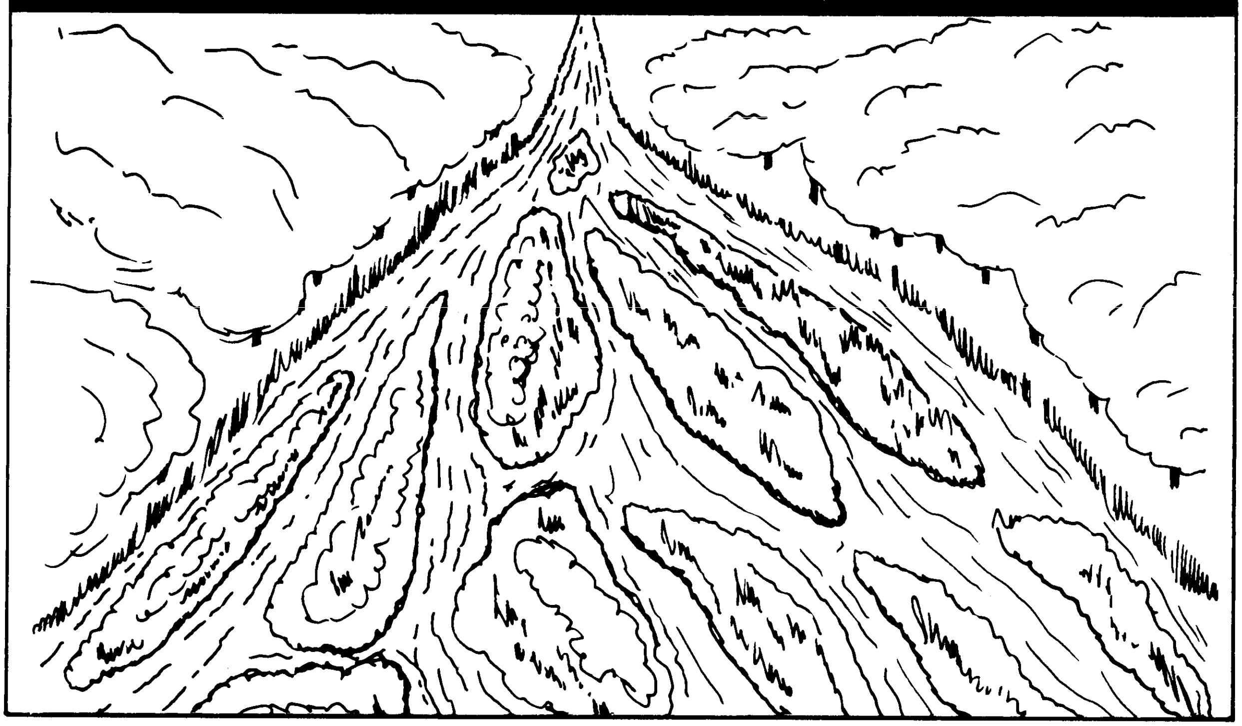


FIGURE 9-8. DELTA REGION



jungle primarily by clearing the way for the movement of friendly forces. It is also essential that the infantry support the engineers, as engineers are extremely vulnerable during construction activities.

Countermine tasks in jungle terrain. Enemy mines will generally be used on or near trafficways or potential helicopter landing zones. Large minefield are unnecessary due to the restrictions of jungle terrain. Countermine tasks are usually conducted as route clearance and security missions. These activities are oriented on a specific route and the surrounding areas to insure that vehicular operations are not interrupted. Whenever possible, route clearance is a combined arms effort involving as a minimum the use of armor, infantry, engineers, artillery, and Army aviation. Route clearance involves deliberate, detailed, and coordinated actions which are slow. The route must often be walked by minesweep teams, and the areas adjoining the route cleared by dismounted infantry. Route security missions are characterized by continuous activity to prevent the enemy from cutting the route or ambushing elements using it.

Gap-crossing tasks in jungle terrain. Inundated areas containing yellowish reeds and cloudy water usually have bottoms too soft to support tracked vehicles. River and stream bottoms usually are untrafficable. The armored vehicle launched bridge (AVLB) can span 17 meters (57 feet) and is more than adequate for most stream crossing. The shoulders of the banks must be able to support the AVLB while tanks cross. When the AVLB is not available, matting or membraned surfaces can be used to provide a firm surface on which vehicles ford small streams. Suspension traverses, bridges, and cableways can be used to move large numbers of soldiers or heavy equipment over wide rivers and ravines or up and down cliffs in a short period of time. Because heavy or bulky material or equipment is needed to construct these expedients, their use is practical only if the needed items can be transported to the site by sea or surface means.

Combat road, trail, and FACE tasks in jungle terrain. Existing roads, normally narrow and winding, are capable of sustaining limited military traffic without expedient repair or surfacing. Generally, all combat roads and trails will have to be built. Special attention should be paid to subgrade drainage. Expanding the right-of-way on roads and trails wider than normal will aid in the drying of road or trail beds.

Airstrips. Construction of LAPES zones, helipads, and airstrips in remote areas are also important tasks for engineers in the jungle. Using demolition and tools, they make an initial clearance of trees and underbrush. For large jobs, follow-on engineers with heavy equipment are brought in to finish the work.

Special problems. Due to the extensive natural drainage systems and high water tables in most jungle areas, drainage and surfacing may require special effort. Most fill materials in jungle environments have a clay base which complicates trafficability. Any protective covering to aid subgrade stability, such as matting or membranes, should be considered. Protecting the surface of these sites from erosion in the rainy season, and protecting aircraft from dust in the dry season, present other problems. Steel matting, T17 membrane (a tough, rubberized fabric), or Peneprime (oil surfacing) are all materials which will keep the dust down and enhance trafficability under varying conditions.

COLD REGION OPERATIONS

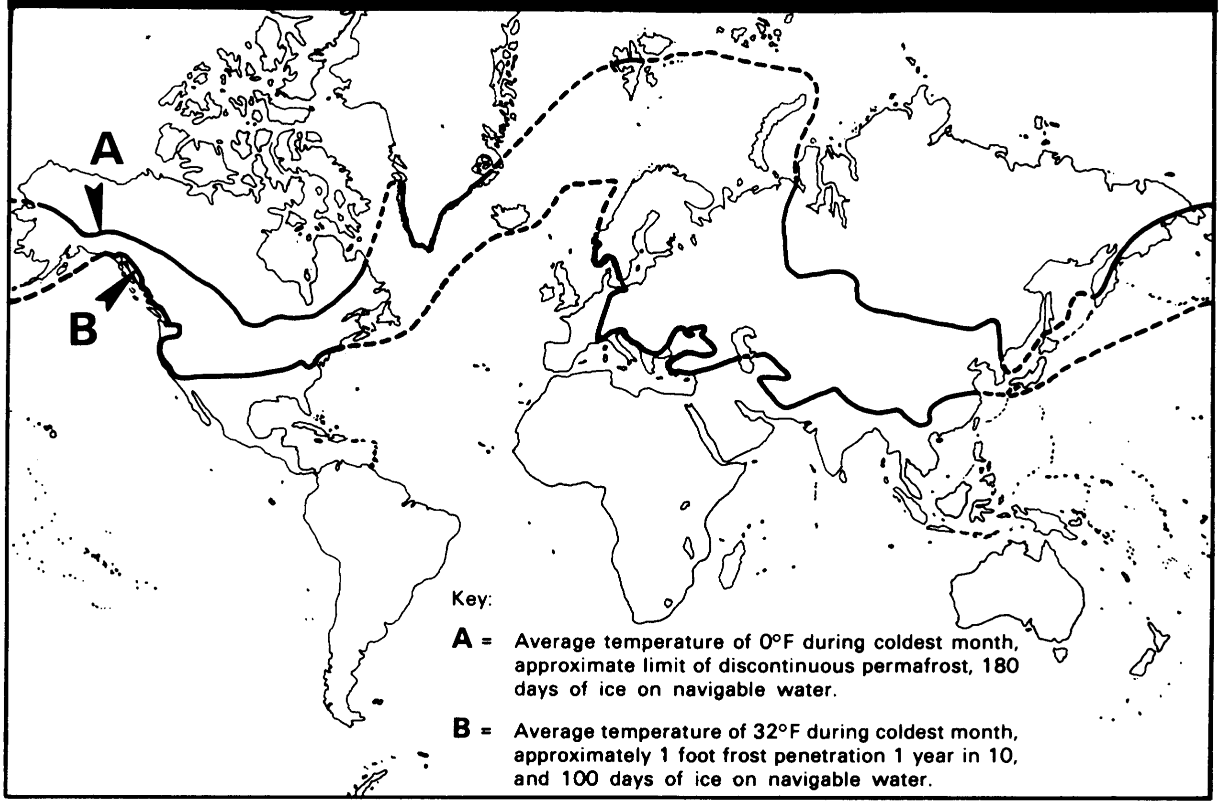
Within the area that lies north of line A, figure 9-9, mobility is affected by inadequate transportation nets. During the winter, low temperatures, snow and ice, and the difficulties of constructing roads and trails, hinder movement. In warmer weather, ice is weakened on lakes and streams, and existing roads may become almost impassable. In arctic areas where permafrost exists, extensive overland movement is difficult during the summer because the underlying permafrost prevents effective drainage, and extensive swampy areas result. Movement by helicopter or by fixed-wing aircraft equipped with conventional landing gear, skis, amphibious landing gear, or flotation kits offers an effective means of mobility in the generally underdeveloped cold regions (figure 9-10 on page 9-16).

Terrain problems. Various types of terrain present different problems. Obstacles to movement in summer include close tree spacing and fallen trees in forested areas, boulders, bogs, rivers, lakes, and swamps. In winter, deep snow becomes an obstacle to movement. In summer, large tundra areas are covered with a thick layer of moss interspersed with extensive marshes. The depth to the permafrost level usually varies from 15 to 60 centimeters (6 to 24 inches). Cross-country tracked vehicular traffic is possible. However, soft, waterlogged soils afford little or no wheel traction. In temperate climate zones (above line B, figure 9-9) terrain varies from rural to urban. Freeze/thaw cycles occur more frequently.

Northern regions comprise about 45 percent of North America and 65 percent of the Eurasian land mass. They are characterized by deep snow, permafrost, and frozen lakes, rivers, and ground. Military operations in cold regions are also influenced by vast distances and isolation.

Glaciers. During the arctic summer, the greatest obstacles to movement over glaciers

FIGURE 9-9. NORTHERN REGION TEMPERATURE BELTS



can be the restricted visibility caused by whiteouts and the opening of deep crevasses, many concealed by weak snow bridges. During the arctic winter, visibility is limited by long hours of darkness and surface travel by vehicle is slowed by periodic ridges (sastrugi) of wind-packed snow. Drifted snow on the lee side of the ridges can cause difficult movement of foot troops. Sastrugi is generally 1 meter (3 feet) in height or less.

Mobility planning considerations. Mobility during winter operations varies considerably. On well-frozen ground with minimal snow cover, mobility can be excellent. Marginally frozen soils and thin frozen crusts break down rapidly under traffic, reducing mobility. Trafficability during thaws or periods of heavy snow deteriorates, especially for wheeled vehicles. Most tracked vehicles produce lower ground pressure than wheeled vehicles and, therefore, generally perform better in deeper snow.

Use of special equipment. Tracked vehicles can become immobilized when snow depth exceeds vehicle ground clearance. High winds combined with heavy snow can produce whiteouts "and snow drifting and bring all movement to a standstill. When such conditions exist, special equipment should be furnished to permit operations over snow. During icing conditions, track pads should be removed from armored vehicles and tire chains mounted on wheeled vehicles. Wheeled vehicle mobility in deep snow can be improved by reducing tire inflation pressure up to 50 percent. This reduces contact pressure which decreases vehicle sinkage and increases the tire's traction. Tire or track slippage in deep snow should be minimized. The effect of spinning is to increase sinkage which increases the possibility of becoming immobilized. It also loosens the snow along the route making it more difficult for subsequent vehicle passage.

Environmental factors. Environmental factors increase the difficulties of mobility tasks. During heavy snowfall, engineer snow

FIGURE 9-10. COLD REGION TERRAIN

removal capability will be necessary to clear main lines of communication and airfields. In remote northern regions, where the road network is usually limited, a major construction effort may be needed to gain access to an area. Satisfactory pioneer roads can be built by grading and compacting existing snow. The numerous streams, swamps, and lakes necessitate increased quantities of gap-crossing equipment as well as increased effort to install and maintain them. Cross-country movement of large forces requires augmented engineer effort. Also, special equipment such as tire chains for wheeled vehicles or removal of track pads on armored vehicles may be necessary.

Countermine tasks in cold region environments. Countermine operations are usually easier in cold weather. Mines are difficult to emplace and are not as effective. Deep snow, either on top of or under mines, may minimize or neutralize the mine's effectiveness. Mined areas are usually easy to bypass. However, detection and breaching may be more difficult due to freezing temperatures and frozen ground, and the concealment of snow cover. Mines placed in a snow cover can be plowed away to make a passage rather easily.

Counterobstacle tasks in cold region environments. Two types of obstacles tend to adversely affect mobility in cold region environments. These are the enemy obstacles constructed with snow or ice and the natural restrictions from movement on snow. Roadblocks can be created by icing roads and snowdrifts or by using ice, timber, and wire cable in conjunction with mines and barbed wire. It is impractical to establish definite rules for through-the-snow operations due to the varied conditions. Most tracked vehicles are slowed by 60 to 70 centimeters (24 to 29 inches) of wet snow. Normal speeds may be maintained after a packed snow trail has been formed. Track-laying vehicles operating in the north should be equipped with steel chevron tracks for all-season, cross-country operations. Dry snow causes few operating difficulties as it has little tendency to pack on suspension systems. Wet clinging snow accumulates on the tracks, suspension idler wheels, and sprockets, and has to be removed occasionally.

Gap crossing tasks in cold region environments. Wet gaps, such as lakes and streams, may be crossed on the ice during the winter months if the ice is sufficiently thick and reasonable precautions are taken.

Crossing sites must be investigated for cracks in the ice cover, air pockets, erosion or bridging of the ice near shore, and thin spots before crossing vehicles or soldiers. Cracking sounds usually precede breakthroughs and give enough warning for troops to get off the ice if they keep moving. Fresh water ice for crossing is subdivided into categories.

Normal or clear ice. Clear ice is transparent ice that freezes at 32 degrees Fahrenheit on rivers and lakes and is the ice by which strength characteristics are measured.

Snow ice. In most northern areas, lake or river ice will become snow-covered during the winter. The snow load depresses the ice cover and the ice fractures. Water then rises up through the ice, saturates the snow, and freezes. Snow ice is generally white because of entrapped air. It is always less dense than clear ice and consequently weaker. The thickness of snow ice should be reduced by one-half when determining its load-carrying capacity from thickness tables for clear ice crossings. For example, when the ice is 24 inches thick, 12 inches of which are white ice and 12 inches are clear ice, the thickness for use in the table would therefore be 18 inches.

Irregular ice. The ice on many streams and small rivers forms under highly variable conditions. The result is an ice cover that does not coincide with the principles of the bearing capacity tables. The ice surface may be hummocky, stepped ridged, and so forth for various reasons. This type of ice may be crossable if it is solid and supported by water.

Table 9-1 shows some of the critical requirement for thickness of clear ice crossings for various loads. Risk ice measurements can be used with safety for individual crossings. The normal ice measurements are for repeated crossings.

Ice bridge. As the freezing process takes place and snowfall accumulates, the natural insulating properties of the ice and snow tend to slow down the freezing process significantly. When time is critical, an ice bridge can be constructed by adding water to the top of the ice. If there is a snow cover, the snow should be removed and stacked on shore or used as berms along the edge of the proposed bridge. The wider the bridge the better. The initial ice thickness should exceed 4 inches to insure troop safety during the construction process. Maximum bridge strength is obtained when the width of the bridge is between 150 and 200 feet. The following points should be considered when planning an ice bridge.

The best method of construction is to flood the ice cover using pumps at various locations along the center of the bridge and let the water spread as it will. Water should be added to the ice surface in 1- to 2-inch increments per day provided this amount freezes solid in 24 hours. If the temperature is below -20 degrees Fahrenheit, up to 3 1/2 inches may be added per day.

Adding logs, brush or grasses to ice bridges to reinforce them should be avoided everywhere but in the arctic because of the solar heat absorption of dark materials.

The last consideration in building a bridge is the addition to the final surface of 3 to 4 inches of snow, if available. The cover provides a wearing surface and prevents the thawing effects of solar penetration. Table 9-2 provides data on time and personnel required for construction of an ice bridge.

Combat road, trail, and FACE tasks in cold region environments. These regions normally have deep snow, permafrost, and reasonably frozen ground and waterways. Cross-country mobility on frozen ground is excellent. However, during thaw conditions, mobility is severely degraded. High winds can create severe snow drifting. Construction of compacted snow walls will reduce the drift buildup on forward area roads. Roads made by combat troops under winter conditions will be improved only to the extent of the capabilities of organic equipment. Roads must be made wide enough to accommodate vehicles which will be using them.

Influence of seasons. Route-selection criteria vary by season. Tracked vehicles do not eliminate the need for roads, regardless of the season. "Permafrost areas require special

TABLE 9-1. ICE-CROSSING DATA

LOAD	THICKNESS OF ICE (inches) 0 - 10°F		MINIMUM DISTANCE BETWEEN UNITS (meters)
	Risk	Normal	
Single soldier on skis	1½	2	5
File of soldiers, 2-meter interval	3	4	-
¼-ton truck	5	8	15
2½-ton truck	13	15½	25
UH-1 helicopter, landing or parked	8	10	20
M109 howitzer	17½	20	40
M60 tank	26½	31½	70

engineer attention in cold region environments. Although these areas are trafficable when frozen, thawing renders them capable of only one pass traffic. Once the soil (or permafrost) is broken by repeated traffic, ruts swiftly erode into deep gullies. These spots then require crossing support from AVLBs.

Selection factors. Selection factors for forward aviation sites such as size, approaches and exits, takeoff and landing direction, and security are the same as for normal operations. Helicopter landing sites can be prepared in winter by packing the snow with troops on skis or snowshoes or with tracked vehicles, if available. Helipads should be marked by an inverted "Y" that contrasts with the snow to provide a reference for depth perception. Airstrips must be marked by objects which contrast with the snow. The panel marker, when used for this purpose, must be adequately secured to the snow-covered surface.

URBAN AREA ENVIRONMENTS

Tactical terrain analysis has traditionally considered some elements of the urban environment such as the allocation of land to agriculture or forestry and the distribution of railway or road networks. However, the focus has been on natural terrain elements. In Europe and other urbanized areas of the world, however, the effects of artificial terrain features on the overall tactical scheme must be considered. How urban terrain elements impact on operations is an important consideration in determining tactical options. A built-up area is a concentration of structures, facilities, and population which forms the economic and cultural focus for the surrounding area. The four categories are large cities, towns and small cities, villages, and strip areas.

Large cities (population greater than 100,000) frequently form the core of a larger, densely populated urban complex consisting of the city, its suburban areas, and small towns. Such complexes have the appearance of a single, large, and continuous city containing millions of people and occupying vast areas of land.

Towns and small cities (3,000 -100,000 people) are, in many cases, located along major lines of communications and situated in river valleys.

Villages (less than 3,000 people) are, in most cases, agriculturally oriented and are usually distributed among the more open cultivated areas of a country.

Strip areas are built-up areas which generally form connecting links between villages and towns. They are also found along lines of communications leading to larger complexes. Although the size and population of strip areas vary, they normally assume along thin linear pattern.

TABLE 9-2. ICE BRIDGE CONSTRUCTION DATA

TYPE OF BRIDGE	LENGTH (feet)	WIDTH AND THICKNESS	PERSONNEL REQUIRED	CONSTRUCTION TIME (hours)
Straight bridge	330	150 feet wide Minimum ice thickness, 16 inches	32	4
Skew bridge	330		32	4
Skew bridge	600		32	8

Note: Fewer personnel are required if mechanical means are used for snow removal.

Villages and small towns will often be caught up in the battle because of their proximity to major avenues of approach or to lines of communications that are vital to sustaining mobility of combat forces.

Mobility planning considerations. The decision to attack or defend an urban complex can result in massive damage and destruction. Constraints on firepower to insure minimum collateral damage within its built-up areas can be expected. Combat operations may be hampered by the presence of civilians in the battle area. Concern for their safety can seriously restrict the combat options open to the commander. The necessity to provide life support and other essential services to civilians can siphon off a substantial amount of military resources and personnel.

Advantages and disadvantages. On the urban battlefield, advantages and disadvantages in the areas of mobility tend to even out for attacker and defender. Initially, however, the defender has a significant tactical advantage over the attacker because of knowledge of the terrain. Unlike deserts, forests, and jungles, the urban battlefield is composed of an ever-changing mix of features. Frequently, commanders of larger forces will have units fighting on open terrain, within built-up areas, or where two distinct terrain forms merge.

Avenues of approach. Urbanized terrain normally offers numerous avenues of approach for mounted maneuver well forward of and leading to urban areas. In the proximity of its built-up areas, however, such routes generally become convergent and restrictive. Bypass may be blocked by urban sprawl and the nature of adjacent natural terrain. Avenues of approach within built-up areas are determined by street patterns, building arrangements, open areas, and underground systems. Mounted forces are restricted to streets, alleys, and open areas between buildings. Dismounted forces should make maximum use of available cover by moving through buildings and underground systems, along edges of streets, and over roofs.

Countermine tasks in urban area environments. Urban operations are time-consuming and dangerous. They restrict mobility. Mine warfare may be extensive. Most developed countries have urban areas that will be difficult to bypass. Mines will be used on streets and alleys to restrict mobility. Off-road or standoff mines will frequently be employed due to the difficulty of burying mines in pavement. Command-detonated mines and mines with trip wires and anti-handling devices will be used extensively against dismounted troops. Buildings, streets, and obstacles may be mined to impede operations (figure 9-1 1).

Counterobstacle tasks in urban area environments. Counterobstacle activities in urbanized terrain place a premimum on thorough reconnaissance. Cities, towns, or urbanized areas provide the enemy with an environment that is easily converted to a fortified position. Therefore, the types of obstacles, their location, and depth must be determined in advance of hasty or deliberate breaches. Engineers must be well forward in urban offensive operations. The engineers must have the capability to reduce mines and obstacles under fire to preserve force mobility. Buildings and areas that may be mined should be bypassed when possible. They should be cleared after enemy resistance has been eliminated. Armored engineer equipment is essential for combat operations in urban areas. The armored combat earthmover (ACE) and the combat engineer vehicle (CEV) are well suited. The ACE can remove rubble and obstacles, rapidly fill craters, and repair roadways. The CEV can remove obstacles and rubble with its blade, winch, and boom. Its 165-millimeter demolition gun is effective against close hardened positions. Bulldozers and other equipment with exposed operators are used only when there are no enemy fires delivered upon the worksite.

FIGURE 9-11. URBAN AREA OBSTACLES REINFORCED WITH MINES

Rubble obstacles

At/Apers mines concealed in and around rubble.

Tape/wire with booby traps hinders clearing groups.

Cratered road

Size of crater must be large enough to prevent bypass.

At/Apers mines are concealed in rubble around crater.