FM 5-36

DEPARTMENT OF THE ARMY FIELD MANUAL

ROUTE RECONNAISSANCE AND CLASSIFICATION

HEADQUARTERS, DEPARTMENT OF THE ARMY
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CHANGE
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DEPARTMENT OF THE ARMY
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ROUTE RECONNAISSANCE AND CLASSIFICATION

FM 5–36, 14 May 1965, is changed as follows:

1. Make the following pen and ink changes.

Page	Paragraph	Line	Action
1–2	1–3	8	Change (FM–30) to (FM 5–30).
1–5	1–11*a*	10	Delete (app. IV).
2–15	Fig. 2–3	Serial No. 21*a*	Add to the symbol shown a second dashed line parallel to and ⅛ inch from the existing dashed line.
2–18	2–15	8	Delete (see app. IV).
3–48	Fig. 3–56	.....	Delete.
4–2	4–4*c*	5	Delete (app. IV).
4–3	4–6	9	Change 150–200 to 15–20.
		11	Change 150 to 15.

2. Remove old pages and insert new pages as indicated below.

Remove pages	Insert pages
2–63 and 3–64	2–63 and 2–64
3–45 through 3–48	3–45 through 3–47
AIV–1	AIV–1 through AIV–24

3. This transmittal sheet should be filed in front of the publication for reference purposes.

By order of the Secretary of the Army:

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General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
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The Adjutant General.

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DCSPER (2)
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OPO (1)
TSG (1)
CofEngrs (10)
CofCh (1)
USA Armor Bd (2)
USAMB (2)
USACDC Agcy (2) except
  USACDCARTYA (6)
  USACDCAVNA (6)
  USACDCMSA (4)
  USACDCEA (15)
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Div Arty (5)
Bde (5)
Regt/Gp/Bat Gp (5)
Bn (2)
Co/Btry (1) except
  5–7, 5–17, 5–27, 5–37,
  5–127, 5–147, 5–157,
  5–227, 17–17, 17–197,
  19–37, 19–57, 19–67 (5)
USACDCCCISG (1)
USACDCTA (5)
PMS Sr Div Units (1)
PMS Jr Div Units (1)
PMS Mil Sch Div Units (1)
USMA (100)
USACGSC (25)
Joint Sch (5)
Br Svc Sch (10) except
  USAQMS (25) USASWS (10)
  USASCS (10) USAAMS (15)
  MFSS (10) USACAS (2)
  USAADS (5) USAAVNS (2)
  USAOGMS (6)
US Army Tng Cen (5)
AMS (2)
USACDCCSSG (5)
USACDCCAG (5)
USACDCSWCAG (2)
USACDCIAS (1)
USACDCEC (5)
USACDCNG (1)
MAAG (2)
Mil Msn (2)

NG: State AG (3): Units same as active Army except allowance is one copy each unit.
USAR: Same as active Army.
For explanation of abbreviations used, see AR 320–50.

FIELD MANUAL
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ROUTE RECONNAISSANCE AND CLASSIFICATION

* This manual supersedes FM 5-36, 15 August 1960.

CHAPTER 1

GENERAL

Section I. INTRODUCTION

1-1. Purpose

Maneuver, one of the principles of war, is an essential ingredient of combat power. It, in itself, is not decisive; however, when properly employed in conjunction with the principles of mass and economy of force, decisive combat results are obtainable. Maneuver is dependent on adequate lines of communication within the area of operations. Without prior intelligence concerning available routes, a commander's scheme of maneuver and logistical plan is jeopardized. To support this intelligence requirement, doctrinal procedures are established by this manual for the collection, evaluation, and reporting of terrain data concerning military routes. In addition, instructional and reference material applicable to the technical classification of routes to sustain military traffic is furnished for reconnaissance personnel regardless of branch.

1-2. Scope

a. This manual describes the influence of the operational environment in reconnaissance operations, the intelligence aspects and fundamentals of route reconnaissance, and methods of reconnoitering and classifying routes for military use. Emphasis is placed on natural and manmade characteristics of routes which influence traffic flow. The interruption of movement by enemy action, an equally important consideration in route reconnaissance, is discussed in general terms only; specific details are not within the scope of this manual although thoroughly discussed in field manuals appropriate to the mission and organization of the reconnoitering force (see app. I). Route reconnaissance as presented by this manual is divided into two categories: hasty reconnaissance and deliberate reconnaissance. Hasty reconnaissance provides limited route information necessary for planning and executing normal military movement and is a prerequisite of tactical maneuver. Deliberate route reconnaissance, on the other hand, provides essential and additional engineer data which form the basis for technical classification and thorough analysis of routes throughout an area of operation. The remaining portion of the text discusses special types of terrain reconnaissance and route marking. Traffic control reconnaissance although a form of ground reconnaissance, is not considered in the text but discussed in detail in FM 19-25.

b. This manual incorporates terminology and methods of reporting, classifying, and marking military routes as approved for use by member nations of the North Atlantic Treaty Organization (NATO), the Southeastern Treaty Organizations (SEATO), and the United States, United Kingdom, Canadian, and Australian Armies Nonmateriel Standardization Program. In each appropriate paragraph throughout the text, applicable promulgating agreements—NATO Standardization Agreement (STANAG), SEATO Standardization Agreement (SEASTAG), and Standardization of Operations and Logistics (SOLOG)—are identified by short title and number. Additionally, a compilation of related standardization agreements is cited in appendix I.

c. The material presented herein is applicable to peacetime and counterinsurgency operations as well as to limited war either nuclear or nonnuclear and general war.

d. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be forwarded directly to the Commanding Officer, U.S. Army Combat Developments Command Engineer Agency, Fort Belvoir, Va.

1–3. Combat and Engineer Intelligence

Combat intelligence is evaluated information of the enemy, weather, and geographic features of the terrain required by a commander to plan and conduct tactical operations (FM 30–5). *Engineer intelligence is also concerned with information regarding terrain features and the effects of weather and terrain on engineer activities within an area of operations* (FM–30). Both fields of intelligence conduct route reconnaissance to acquire terrain information. Close cooperation between engineer intelligence and other intelligence agencies is, therefore, essential to avoid duplication in the overall collection effort. Additionally, standard methods of reporting route reconnaissance data as presented by this manual facilitate the exchange of information and aid in the wide as well as timely dissemination of route intelligence.

1–4. Definitions (AR 320–5)

a. Lines of communication (logistic routes) are all routes, land, water, and air which connect an operating military force with a base of operations and along which supplies and reinforcements move.

b. A route of communication is a network of roads, etc., over which supplies are carried and combat movements are made. Routes of communication include navigable waters, aircraft landing facilities, and rail facilities.

c. A route is the road or roads, including tracks and bridges, used when moving from one place to another. It includes those roads, bridges, tunnels, fords, and other terrain features affecting traffic flow selected for military movement.

d. Route reconnaissance is the careful survey of a route for military purposes, often by aerial vehicle. The purpose of route reconnaissance is to collect, evaluate, and report information which will aid in the selection of a route or routes to be used for the movement of troops, equipment, and supplies in military operations.

1–5. Systems of Measurement (STANAG 2015 and SOLOG 53)

In accordance with AR 525–8, velocities and linear distances of a tactical nature are expressed in the metric system throughout the text. Tabular data and structural dimensions, however, are given in the English system for ease in mathematical computations. In reporting the results of route reconnaissance, either the metric system or the English system or both may be used to fit the requirements of the command. Webster's standard abbreviations such as "km" (kilometers), "m" (meters), "ft" (feet), and "mi" (miles) must be used to clearly identify measurement units. When operations are in conjunction with allies and if only one measurement system is used, the reporting headquarters prepares a table or diagram showing the relationship between the two systems to accompany the report. Tables for ease in converting from one system of measurement to the other are included in appendix II.

Section II. INFLUENCE OF THE OPERATIONAL ENVIRONMENT ON RECONNAISSANCE

1–6. General

The operational environment is composed of the conditions and circumstances which influence the employment of military forces and which consequently, bear on the decisions of the commander. Major elements comprising the operational environment include: The national and military objectives of the operation;

the terrain and climatic features of the area of operations; the characteristics and attitudes of the local population; the nature of the conflict to include the weapons systems employed or threatened; and the composition and missions of the opposing forces. The combination of these variable elements creates a wide range of conditions and circumstances within which military forces must be capable of operating effectively.

1-7. Mission

The mission of the command is the single factor of the operational environment that dominates reconnaissance operations. Reconnaissance is conducted to assist in the production of intelligence necessary to support the military plan. Information is collected, evaluated, and interpreted for its significance in relationship to the accomplishment of the mission. Thus, a knowledge and understanding of the overall unit mission is desirable to insure that personnel engaged in reconnaissance do not overlook important information. *Reconnaissance is continuous and does not cease in the absence of specific missions.* Logical missions are assumed, and reconnaissance continues in the anticipation of an assignment.

1-8. Characteristics of the Area of Operations

Terrain and weather are important factors in military operations. Route reconnaissance is frequently employed to gather terrain information and to determine the effects of climatic variations on specific terrain features within an operational area.

a. Terrain.

(1) *Observation and fire.* The effect of observation on both friendly and enemy operations is considered. High ground that affords line-of-sight observation and good fields of fire are of particular importance.

(2) *Concealment and cover.* Concealment is protection from observation. Cover is protection from fire. Every advantage afforded to friendly forces by the terrain and conditions of visibility to provide concealment and cover is exploited.

(3) *Obstacles.*

(*a*) The effect of obstacles, either in restraint or in support of operations, is considered.

(*b*) Obstacles may be natural, manmade, or combinations thereof to include obstacles created by chemical and nuclear fires.

(*c*) Obstacles are employed by both friendly and enemy forces to strengthen a defense, to deny use of key terrain for observation and defensive positions, to assist in economy-of-force measures, and to protect the flank of a moving force. Obstacles are also used to separate attacking echelons such as dismounted infantry from tanks.

(*d*) Nuclear weapons can create the following obstacles: areas of induced and fallout radiation, craters, rubble, fires, and tree blowdown.

(4) *Key terrain.* Key terrain is any locality or area the control of which affords a marked advantage to either combatant. Key terrain is seized, neutralized, or controlled by other means in order to deny its use by the enemy or permit its subsequent use by friendly forces.

(5) *Avenues of approach.*

(*a*) Likely avenues of approach are analyzed in accordance with the availability of observation and fire, concealment and cover, obstacles, key terrain, space for dispersion and maneuver, trafficability, and the effects of nuclear weapons.

(*b*) In analyzing avenues of approach for airmobile operations, the major concern is achieving or avoiding tactical surprise. Favorable air routes provide adequate airspace and defilade to limit the enemy's detection and interception capability. Heavily forested and swampy areas provide good routes

since ground troops have little opportunity to see or fire at low-flying aircraft. Ridges reduce the possibility of detection by radar. However, steep defiles or canyons are avoided because possible downdrafts may affect the control of aircraft.

b. Weather. Weather conditions have an important bearing on reconnaissance and are a vital consideration in operational planning. Weather primarily affects mobility and visibility, both on the ground and aloft, and is of special importance in the conduct of operations that include nuclear, chemical, and biological warfare. Fallout, chemical, and biological cloud travel is channelled by weather conditions. Meteorological elements which have a significant influence on operations are wind directions and speed, temperature, humidity, cloud cover, precipitation, and atmospheric stability. Weather intelligence provided by weather teams at the tactical operations center (TOC) contains forecasts for these meteorological elements and light data such as beginning morning nautical twilight (BMNT), sunrise, sunset, and evening nautical twilight (EENT), moonrise, and moonset.

1-9. Civil Population

The attitude, actions, and capabilities of the civil population significantly affect reconnaissance operations. A friendly populace confers valuable assistance in the collection of intelligence data. Time is saved in the collection of terrain information through the interrogation of friendly civilians who have intimate knowledge of the local area. High water levels and similar seasonal data are, at times, only available from local interrogations. Conversely, a hostile population makes reconnaissance operations more difficult. Bridge classification and route directional signs, for example, may be removed or altered; misleading information may cause delay; and reconnaissance parties may expect continual harassment by unfriendly civilians. Regardless of the civil attitude, however, care must be exercised in evaluating all data obtained from civilian sources.

1-10. Nature of the Conflict

The same general requirements for terrain information exist under all forms of warfare. The nature of the conflict, however, may change the emphasis placed on the various aspects of reconnaissance.

a. Cold War. Under the conditions of cold war, reconnaissance requirements are influenced by the preparation of military forces for conflict. Without active enemy opposition, terrain intelligence is emphasized. Reconnaissance of routes within probable areas of operation is made to meet contingencies that may arise during open warfare.

b. Counterinsurgency. In counterinsurgency situations, route reconnaissance is essential for the conduct of counterguerrilla warfare and those nonmilitary activities employed to win the support of the populace. Subversive insurgency movements are generally associated with developing countries and, particularly, in the remote or rural areas of these countries. Consequently, these areas do not have adequate roads. Trails, rivers, and canals are used for military operations and commerce. Route reconnaissance may be required to provide information for the construction of roads and airlanding facilities to support military and nonmilitary activities.

c. Limited War. In limited conventional war, route reconnaissance considers not only terrain features but also the likelihood and effect of the disruption of lines of communications by enemy action or adverse weather. The immediate emphasis is determined by the requirement to support the existing operational situation; reconnaissance personnel must, however, be prepared to quickly assume greater responsibilities resulting from an expansion of the conflict. In limited nuclear war, reconnaissance requirements vary in accordance with the severity and type of nuclear exchange.

d. General War. Nuclear warfare is characterized by relatively sudden and drastic changes in the tactical situation. Dispersion, mobility, decentralization of control, rapid exploitation, and the reduction of reaction time are characteristic. Under this type of environment, route reconnaissance assumes even great-

er importance. Not only will more routes be required to support military operations, but reconnaissance personnel must be ever alert to recognize wide spread areas of contamination created by mass destruction weapons.

1-11. Friendly and Enemy Forces

a. Friendly Forces. In general, intelligence operations are oriented on characteristics of the operational environment which are external to the command; that is, the terrain, weather, and enemy. However, route reconnaissance is further affected by the mission, composition, organization, and size of the unit for which routes are being reconnoitered. Reconnaissance personnel must be completely familiar with vehicular specifications and limitations (app. IV). If route reconnaissance is conducted by other than organic elements, it is desirable that liaison agents accompany the supporting reconnaissance element.

b. Enemy Forces. Although not within the scope of this manual, reconnaissance personnel must be trained to recognize and counter enemy action. Enemy influence along a route may vary from nuisance mining to stubborn defensive resistance. A route, regardless of location, is always vulnerable to interdiction by enemy air and missile or artillery attack. Reconnaissance personnel must avoid drawing undue attention to their operations especially in likely target areas such as bridges, road junctions, and defiles. As reconnaissance parties are usually small in number and generally operate in areas remote from friendly forces, the threat of attack is ever present whether close to the FEBA or in rear areas where infiltrators or irregular forces may stage ambushes or establish road blocks. Regardless of the reconnaissance mission, the threat of enemy interference must be considered at all times, and reconnaissance personnel constantly prepared to take positive steps to overcome opposition.

Section III. INTELLIGENCE ASPECTS OF RECONNAISSANCE

1-12. Intelligence Requirements

a. General. Intelligence requirements are those variable factors concerning the weather, terrain, and enemy which, when known, materially assist in the execution of a unit's mission. Because of the ever changing operational environment, intelligence requirements are not constant. A commander relies on his intelligence staff officer (S2/G2) for the production of intelligence. The intelligence officer, in turn, requests or directs appropriate individuals or organizations that collect intelligence information—henceforth referred to as collection agencies—to provide data in support of the intelligence effort. In accordance with their capabilities, agencies employ various methods in collection. Those most common in acquiring terrain information are: interrogation, observation and listening posts, ground and airborne surveillance devices, air and ground reconnaissance, and radiological monitoring and survey. Collection capabilities, however, are rarely sufficient to satisfy all intelligence requirements simultaneously. Therefore, collection resources within the command are directed toward definite intelligence objectives in priority of need. To facilitate the establishment of priorities, intelligence requirements are categorized as *essential elements of information* and *other intelligence requirements.*

b. Essential Elements of Information. Essential elements of information (EEI) are the highest priority intelligence requirements. An EEI is an item of intelligence or information of the characteristics of the area of operations and the enemy which the commander feels he needs before he can reasonably arrive at a sound decision. These decisions are of the type which involve the mission of the command and the choice of a course of action to accomplish the mission. The nature and number of EEI will vary with the type of operation, the phase of the operation, and the extent and accuracy of the available information and intelligence. When the available information and intelligence are complete enough to satisfy the commander in making a decision with confidence,

the commander has no outstanding priorities; however, at no time is the available information or intelligence so complete that additional requirements do not exist.

c. Other Intelligence Requirements. Other intelligence requirements are derived from command and staff requirements which are important but do not qualify as EEI. After the allocation of means to collect information necessary to satisfy the EEI's, the remaining means are used for the collection of information that also significantly affect the mission.

1-13. Sources of Intelligence

Sources of information are the actual origin from which information concerning the operational environment is obtained. An important consideration by collection agencies is the selection of proper sources. A knowledge of sources and type of information which each can provide is essential in planning reconnaissance missions. The more common sources applicable to reconnaissance operations are: friendly troops; enemy activity; prisoners of war; local civilians; recovered friendly military personnel; imagery; maps; captured documents; weather forecasts; and studies, reports, and other reference material of intelligence value.

1-14. Friendly Troops

All units have capabilities which contribute to the collection of intelligence information. Combat and combat support units are especially useful for supplying information of enemy and terrain in forward areas. Some units such as armored cavalry units and long-range reconnaissance patrols are specifically organized for ground reconnaissance operations. Target acquisition and surveillance units collect information by ground and aerial observation. Combat service support units acquire significant amounts of terrain data during the conduct of normal operations. Military police units are valuable sources of information concerning physical characteristics of areas occupied by friendly forces. Civil affairs units are capable of gaining much information about the area of operations by close liaison with the indigenous population and through perusal of civil records and files.

1-15. Enemy Activity

Enemy activity is also a source of terrain information; however, the volume and type of information concerning enemy activities are limited by the capabilities of available detection and observation equipment and the measures taken by the enemy to conceal his activities. For example, intelligence reports concerning the type and size of enemy vehicles utilizing a bridge provide an estimate of the bridge's capacity. In addition, information that the enemy is not engaged in certain activities is often of great significance. For example, negative reports of enemy movement along a route apparently suitable for military traffic may indicate the presence of mines or other obstacles barring travel.

1-16. Prisoners of War, Civilians, and Recovered Personnel

a. Prisoners of war are valuable sources of information, particularly of the immediate battle area. Maximum information is obtained through skillful handling of prisoners of war from the time of capture until interrogation is completed. Personnel conducting interrogations are carefully briefed on the desired information and are provided with appropriate aids such as maps and aerial photos.

b. Civilians who have been within enemy-controlled areas may be valuable sources of information and often give information readily. Such sources can provide information on terrain in enemy-controlled areas and may provide information of enemy installations and activities. Civilians are particularly valuable sources of information in cold war operations.

c. Military personnel recovered from enemy-controlled areas are sources of information of the area of operations and enemy dispositions and activities. Interrogation of recovered military personnel is conducted in accordance with regulations prescribed by the theater headquarters.

1-17. Imagery

a. Permanent imagery obtained by ground and airborne sensors is an excellent source of graphic information for terrain evaluation.

Current types of image-producing sensors are the camera, infrared detector, and radar. Each of these types of image-producing sensors operates in a different portion of the electromagnetic spectrum and each detects and records different data.

b. Imagery obtained by airborne sensors, manned or unmanned, is particularly useful in reconnaissance planning. If properly employed, it is an excellent means for collecting information to assist in—

(1) Locating enemy offensive and defensive installations; supply installations and lines of communications; and armored, motorized, and personnel concentrations.
(2) Analyzing terrain.
(3) Confirming or denying intelligence information obtained from other sources of agencies.
(4) Preparing target folders.
(5) Assessing damage.
(6) Preparing mosaics and panoramas for planning purposes.
(7) Correcting maps and making map supplements.

1-18. Maps and Geodetic Data

Maps provide a basic source of terrain information. The reliability of a map is determined by the data used in preparation, and the date of production or revision is generally included as a part of the marginal data. Maps are supplemented by aerial or ground photographs and other permanent imagery means, sketches, visual observation, trig lists, and gazetteers. Trig lists are publications containing the exact location and elevation of bench marks and other survey points together with a complete description of their characteristics. Trig lists are of particular value to artillery, missile, and engineer units and are required for locating and orienting certain surveillance devices. Special maps and overlays are designed for specific purposes, such as trafficability, transportation facilities, and soils, and may be of particular value in terrain evaluation. The classification of U.S. maps by type and scale is described in AR 117-5.

1-19. Captured Documents

Enemy documents may provide great assistance in the field terrain intelligence. Compilations of route data by the enemy and captured maps can considerably reduce the collection effort. However, the possibility that a document has been purposely planted to deceive intelligence personnel concerning enemy activities and terrain is ever present.

1-20. Weather Forecasts

Weather information in the field army consists of weather forecasts, weather observations, both surface and aloft, and weather summaries. Weather forecasts are provided by the Air Weather Service (AWS) of the Air Force. These forecasts are based on the weather observations provided within the field army by AWS observing teams and artillery meteorological sections supplemented by observations from other units. Weather summaries of past weather conditions are compiled as required by both army and air force units.

1-21. Reports, Studies, and Reference Material

a. General Sources. Valuable terrain information can be found in a wide variety of both technical and nontechnical books, periodicals, and reports published by governmental and private agencies. These include trade journals, economic atlases, tide tables, pilots' handbooks, tourist guides, and similar publications. Unpublished systematic records covering meteorological, hydrological, and similar scientific data prepared by governmental agencies, engineering firms, private societies, and individuals also contribute valuable terrain information. While utilized chiefly for terrain studies made at higher headquarters, material of this type, when locally available, can be of considerable value to lower echelons.

b. Intelligence Reports. Strategic intelligence studies prepared at the National level by the Department of Defense (DOD) or by oversea commands provide detailed information concerning major geographical areas. Such studies include—

(1) *National intelligence surveys.* These studies present a concise digest of the basic intelligence required for strategic planning and the operations of major units. Each study describes the pertinent terrain characteristics of a specific area, supported by descriptive material, such as maps, charts, tables, and bibliographies.

(2) *Engineer intelligence studies (EIS).* These are a series of documents describing in detail those natural and manmade features of an area that affect the capabilities of military forces. These studies are being supplemented and in some cases superseded by DOD and command initiated lines of communications, port, and terrain type studies.

(3) *Lines of communication (LOC) studies.* These studies, prepared on either medium scale maps or single small scale foldup sheets, contain an analysis of transportation facilities with general information on railroads, inland waterways, highways, airfields, pipelines, ports and beaches.

(4) *Route reconnaissance reports.* Most important for terrain information at lower levels are local reports which summarize data obtained by physical route reconnaissance. Such reports are of particular value in providing current, detailed information about routes of communication. The preparation of these reports is discussed throughout this text.

Section IV. RECONNAISSANCE OPERATIONS

1-22. General

Reconnaissance is the directed effort in the field to collect information of the enemy and the area of operations through ground and air activities. The purpose of reconnaissance is to obtain information of the enemy and the area of operations for the production of intelligence. Reconnaissance information and the resulting intelligence seek to reduce the unknown aspects of the enemy and the area of operations and to contribute to the accuracy of evaluating risks and the successful application of combat power. *Reconnaissance is a continuing responsibility of each commander and every soldier.* Unit training, standard operating procedures, and the commander's instructions to subordinates must emphasize the important of timely and accurate reports of both positive and negative information of the enemy and operational area.

1-23. Fundamentals of Reconnaissance

Reconnaissance operations vary with the operational environment; with the assigned mission; and with the size, type, and composition of the reconnaissance element. Ground reconnaissance operations are performed in conformance with the following fundamentals:

a. Orient on the Location or Movement of the Intelligence Objectives. Units engaged in reconnaissance operations maneuver according to the location or movement of the intelligence objective rather than the location or movement of friendly forces. The objective may be enemy troops, a terrain feature, or a locality. To effectively perform reconnaissance, commanders of reconnaissance elements are allowed maximum freedom of action commensurate with the mission.

b. Report All Information Accurately. Reconnaissance is conducted to obtain information to be used in the production of intelligence. All items of military significance are reported. Moreover, to be of value, reconnaissance reports must be complete, timely, and accurate.

c. Avoid Decisive Engagement. Units performing reconnaissance obtain information by stealth whenever possible; combat is conducted only when necessary to gain the desired information and in self-defense. The reconnaissance mission must not be jeopardized by unnecessary combat.

d. Maintain Contact with the Enemy. In the performance of a reconnaissance mission to obtain information of an enemy force, visual

or electronic contact with the enemy is gained as soon as possible. Once contact has been made, it is maintained and is not voluntarily broken without proper authority. Contact may be maintained either by ground or aerial surveillance.

e. Develop the Situation. When enemy contact is made or an obstacle is encountered, the situation is developed rapidly. To determine the location, composition, and disposition of the enemy force or obstacle, evasive or combat action is quickly undertaken in accordance with specific reconnaissance instructions.

1–24. Types of Reconnaissance Missions

There are three types of ground reconnaissance missions: route, zone, and area. The type to be employed is determined after considering the nature and urgency of the information desired, the operational environment, and the composition of the reconnaissance force.

a. Route Reconnaissance.

(1) Route reconnaissance is directed in order to obtain information of the enemy, obstacles, route conditions, and critical terrain features along a specific route.

(2) The techniques employed and the requirements of route reconnaissance are less time consuming and are, consequently, performed more rapidly than other types of reconnaissance.

b. Zone Reconnaissance.

(1) Zone reconnaissence is the directed effort to obtain detailed information of all routes, terrain, and enemy activity in a zone established by definite lateral boundaries. Zone reconnaissance is more thorough and time consuming than other reconnaissance missions.

(2) When the enemy's location is in doubt or if it is desired to locate suitable routes or determine conditions of cross-country trafficability, zone reconnaissance may be directed. The width of the zone assigned to reconnaissance elements is determined by the road net, terrain type, information desired, anticipated enemy action, troops available, weather, visibility, and time allotted to accomplish the mission.

c. Area Reconnaissance.

(1) Area reconnaissance is the directed effort to obtain detailed information of all routes, terrain, and enemy forces within any clearly defined area.

(2) Area reconnaissance is performed to gain information of definite geographical areas such as towns, woods, or stream-crossing sites. An area may be reconnoitered for enemy activity or to determine an area's suitability for use by friendly forces as an assembly area, defensive position, or other purposes. Similar reconnoitering techniques are employed as those prescribed for zone reconnaissance.

1–25. Reconnaissance in Force

A reconnaissance in force differs from a route, zone, or area reconnaissance in that it is a limited objective offensive operation by a considerable force to discover and test the enemy's dispositions and strength or to develop other intelligence. Route reconnaissance teams are often included in reconnaissance in force operations to assist in gathering terrain information. Although the primary aim of a reconnaissance in force is to gain intelligence information, it may discover weaknesses in the enemy disposition which, if exploited promptly, may enhance tactical success. A reconnaissance in force normally develops information more rapidly and in more detail than other reconnaissance methods.

1–26. Reconnaissance of Suspect Areas

a. In reconnoitering areas along a route which are likely to be defended by enemy detachments such as bridge approaches, defiles, or built-up areas, reconnaissance should commence from the flanks or rear. Detailed observation precedes actual reconnaissance; and approach routes are checked for mines, booby-traps, and signs of ambush.

b. When time is available, dismounted personnel are first sent forward covered by the remaining elements of the unit. The number of dismounted personnel depends upon the size of the objective and upon available approaches, cover, and concealment. If the dismounted patrols find that the near edge of the area is clear, the remainder of the unit moves quickly forward. The dismounted patrols then continue the reconnaissance, overwatched and followed closely by the remainder of the unit.

c. In conducting a mounted reconnaissance, part of the unit remains mounted and moves forward cautiously but rapidly, overwatched by the remaining mounted elements. If the near edge of the area is clear, the overwatching elements move forward quickly and the advance continues.

1-27. Reconnaissance by Fire

a. Reconnaissance by fire is accomplished by firing on likely or suspected enemy positions in an attempt to remove camouflage and to cause the enemy to disclose his presence by movement or return fire. During reconnaissance by fire, positions being reconnoitered must be observed continuously so that enemy activity can be quickly and definitely located.

b. Reconnaissance by fire may be employed by route reconnaissance teams as a security measure when time is critical and the loss of surprise is not essential.

c. If the enemy returns the fire, the situation is further developed. If the fire is not returned, the reconnaissance continues. However, caution should be exercised, for reconnaissance by fire often fails to disclose the presence of well-disciplined troops.

1-28. Reconnaissance at Night

Route reconnaissance operations are slower and less effective at night. Night reconnaissance is limited usually to electronic surveillance devices, dismounted patrolling, observation of routes, and the use of listening posts. Only against light enemy resistence and upon favorable terrain can vehicular reconnaissance be employed without being preceded by dismounted patrols. Use of night vision devices are often helpful; and when employed, their use is integrated into the overall reconnaissance and security plan.

1-29. Reconnaissance by Aircraft

a. General. Aerial reconnaissance is a valuable aid in route reconnaissance. Aerial reconnaissance has the capability of covering enemy lines of communication such as roads, air landing facilities, railroads, and waterways. This is accomplished by means of visual and airborne sensor systems. Aerial reconnaissance may be conducted by medium range aircraft of the division aerial surveillance and target acquisition platoon, other army aircraft, or aircraft of the air force. *Visual aerial reconnaissance* is normally employed in fluid situations to obtain *general* information concerning enemy movements and locations and the condition of roads, bridges, terrain features, and waterways. *Photographic reconnaissance* is employed to deny or confirm, in detail, information obtained by visual reconnaissance or other means. Reports from photography provide information on the condition, surface material, and width of roads and trails; the condition, type, classification, length, width, and construction material of bridges; and information concerning fording sites, bypasses, and obstacles.

b. Army Aviation. Battlefield surveillance by army aircraft supplements and, in some cases, replaces ground reconnaissance. To fulfill reconnaissance requirements, commanders not having organic aircraft request aerial support through intelligence channels (see FM 30-20). Army aircraft may be employed in conjunction with and in close support of ground reconnaissance parties. Aircraft are useful in selecting routes for ground reconnaissance and in locating enemy forces which may delay or endanger ground reconnaissance elements. Aircraft may also confirm and obtain additional information of activities and installations initially detected by other means. Often, it is possible to combine reconnaissance capabilities by placing ground reconnaissance teams aboard army aircraft. This procedure permits ground elements to be dropped off at terrain features which require detailed inspection while the air-

craft continues more general battlefield surveillance. Under nuclear warfare conditions, aircraft are effective in conducting radiological surveys and, subsequently, locating routes through or around contaminated areas. The airborne infrared detector and side looking airborne radar (SLAR) have the capability of providing surveillance during periods of reduced visibility. The sensor carrying aircraft has in addition a night photographic capability. To assist in reconnaissance planning, characteristics of army aircraft to include range, load, and speed are shown in table 4–4.

c. Drones. Drones may be used to supplement route reconnaissance when it would be impractical or too hazardous to use manned aircraft. In addition, the drone also has a night photographic capability. However, weather, visibility, and enemy activity must be considered before employing drones carrying visual, photographic, and electronic sensor devices (see FM 1–130).

d. Coordination. The value of visual aerial surveillance lies in the quantity and speed with which information can be relayed to friendly units. Visual observation from aircraft bridges the gap between ground reconnaissance and data gathered by aerial photography and other means of permanent imagery. Coordination of ground and aerial reconnaissance activities to include communication between cooperating elements must be specified in the overall reconnaissance plan. Aerial reconnaissance personnel require detailed briefings similar in nature to those received by ground collection agencies to insure that reconnaissance missions are understood and effectively executed. Methods for expeditiously processing and disseminating the great bulk of intelligence data that is normally acquired from aerial reconnaissance are mandatory. Imagery interpretation personnel, who are located at division and higher headquarters, should be called upon to assist in the analysis of route imagery coverage. In most cases, these personnel, by virtue of their training, are more capable of quickly interpreting imagery than the staff of the supported unit. Therefore, to expedite reconnaissance reports and insure completeness, written reports, not photographic prints, are normally sent to the supported unit.

e. Techniques. In aerial battlefield surveillance, identification of objects on the ground is simplified when observed from several lines of view. An additional aid in aerial observation is to view ground objects with the sun to the rear; this procedure relieves eye-strain for personnel in the aircraft; whereas, enemy ground observers, who must continually look into the sun, become quickly fatigued. Area search supplemented by route reconnaissance is the normal method of conducting aerial battlefield surveillance although specific search may be instituted in densely populated areas or where observation of a limited number of terrain features will satisfy intelligence requirements (see FM 1–80).

f. Limitations. Terrain orientation is difficult for the inexperienced observer, however, practice soon overcomes initial confusion. Much information can be collected by a trained and experienced observer even though observation is limited by the speed and vibration of the aircraft, the altitude from which observation is made, enemy air defense and concealment measures, and conditions of adverse weather and visibility. Specific limitations of inflight visual observation applicable to route reconnaissance are—

(1) Strength data of bridges and similar structures can only be estimated and confirmation is usually required by ground reconnaissance or aerial photography.
(2) Terrain surface type are easily misinterpreted.
(3) Mined and boobytrapped areas are difficult to locate.
(4) The load-carrying capacity of roads and cross-country routes are difficult to establish.
(5) Stream depths, bottom conditions, and current velocities can only be estimated.
(6) Critical dimensions such as stream widths and vehicular overhead and horizontal clearances cannot be accurately measured.

1-30. Route Reconnaissance Planning

EEI and other intelligence requirements provide the framework for collection. Orders and requests for specific intelligence information are sent to the collection agencies. Upon receipt of a mission, reconnaissance agencies commence planning. Sources of information are first checked for data already available concerning the reconnaissance target (see para. 1-13). Reconnaissance plans are drawn up and completed sufficiently early to give executing units time to make their own preparations, conduct the reconnaissance, and report results in sufficient time to be of use. (For a suggested organization of a route reconnaissance patrol, see app. III.) Reconnaissance instructions are complete and include exactly what information is to be obtained, the time by which the information is to be reported, where the information is to be sought, action to be taken upon enemy contact, and when the mission is to be executed. Essential details include:

a. Pertinent known information of the enemy, friendly troops, and the area of operations.

b. Proposed plans of higher commands to include anticipated traffic flow (single or double) along the route and types of vehicles to be employed.

c. Specific information desired.

d. Route or routes to be reconnoitered.

e. When, where, and how information is to be reported.

f. Time of departure.

g. Appropriate control measures.

h. Action to be taken when the mission is completed.

i. Special equipment requirements.

1-31. Coordination and Control During Reconnaissance Operations

a. To insure maximum results from collection and to avoid unnecessary duplication, reconnaissance is coordinated at all levels of command. Coordination is accomplished primarily by the assignment of one specific mission to each reconnaissance element. Route and time schedules may be employed to assist in coordination of reconnaissance elements.

b. Commanders of reconnaissance elements normally employ radio as the primary means of control. Phase lines, checkpoints, contact points, boundaries, routes, objectives, and time limitations provide further assistance in directing reconnaissance units. Liaison personnel, staff officers, messengers, and aircraft are also employed to transmit reconnaissance instructions and relay reports.

CHAPTER 2

RECONNAISSANCE AND CLASSIFICATION OF EXISTING ROUTES

Section I. ROUTE CLASSIFICATIONS

2-1. General

a. The ability of an army to carry out its mission depends heavily upon available lines of communications and, in particular, the land routes over which troops, equipment, and supplies are moved. Vehicular routes not only supplement rail and air transportation but occasionally assume the entire logistical burden during periods in which other routes are disrupted by enemy action or adverse weather. Therefore, reconnaissance and classification of existing vehicular routes in the theater of operations is of great importance to the success of the tactical plan.

b. Hasty route reconnaissance is conducted to determine the immediate military trafficability of a specified route. Such information is vital to all units engaged in planning and executing vehicular movement and is limited to critical terrain data which is necessary for route classification and meets the intelligence requirements of the situation. A route is a composite of terrain factors. Full appreciation of a route's capability cannot be determined until each factor affecting traffic flow is separately analyzed. The report of hasty route reconnaissance usually consists of a map overlay supplemented by additional reports (dependent on the detail required) concerning various aspects of the terrain. The route reconnaissance overlay is accurate, clear, and concise. Standard topographic (FM 21-31), military (FM 21-30), and route reconnaissance symbols are employed to insure that route reconnaissance reports are universally understood. The route reconnaissance overlay, discussed in the following section, includes a summary of pertinent reconnaissance symbols.

c. Deliberate route reconnaissance is made when sufficient time and qualified personnel are available to provide necessary data for a thorough analysis and classification of significant terrain features along a route to include, when required, repair or demolition procedures. Deliberate reconnaissance, therefore, by its very nature is detailed. Deliberate route reconnaissance reports differ from hasty reconnaissance reports only in the degree and completeness of reported information. Usually, an overlay is employed to point out the exact map location of each reconnoitered terrain feature. Inclosures are attached to the overlay which describe in detail each terrain feature covered by the report. The use of DA Reconnaissance Report forms as inclosures establishes a permanent record and insures that sufficient detail is included concerning important route characteristics.

2-2. Terrain Considerations

Factors of terrain which are important in route reconnaissance and require consideration, when applicable, are—

a. Existing routes and their physical characteristics.

b. Gradients and radii of curvature.

c. Bridges.

d. Vehicular fording, ferrying, and swimming sites.

e. Tunnels, underpasses, and similar obstructions to traffic flow.

f. Artificial obstacles such as areas of CBR contamination, roadblocks, craters, and minefields.

g. Rock falls and slide areas.

h. Drainage.

i. Other natural or manmade features, such as wooded and built-up areas, which may affect movement.

2-3. Military Route Definitions (STANAG 2151)

a. A *basic military road network* includes all routes designated in peacetime by the host nation to meet anticipated allied and national military vehicular movement and transportation requirements. A basic network has sufficient capacity and is equipped with necessary facilities to support normal military movements.

b. A *military road maneuver network* is the system of routes required by a commander to conduct a specific military operation including logistical support. The network is formed around the existing basic military road network within the area of operations which may be modified, if required, to meet the military situation. The military road maneuver network is designated and controlled by the military commander exercising local territorial responsibility.

c. An *axial route* is part of a military road maneuver network which leads to and runs generally perpendicular to the FEBA. It is identified by an odd number and is depicted on military maps and overlays by a solid line.

d. A *lateral route* is part of a military road maneuver network which runs generally parallel to the FEBA and leads into or across axial routes. It is identified by an even number and is depicted on military maps and overlays by broken lines.

e. Road capacity expressed in vehicles or tons varies in accordance with the amount of traffic. The maximum capacity of a route expressed either in vehicular flow or tonnage is essential in transportation planning (see FM 55-15).

(1) The *road capacity in vehicles* is the maximum traffic flow obtainable on a given roadway using all available lanes, usually expressed in vehicles per hour (vph) or vehicles per day (vpd). The capacity of a specific route is limited to the maximum traffic flow at its most restrictive point.

(2) The *road capacity in tons* is the maximum number of tons which can be moved over a particular route in the same direction within a specified time. It is generally expressed in tons per hour and is the product of the number of vehicles per hour (vph) and the average payload of the vehicles using the route. (For example: 200 vph x 5 tons per vehicle = 1000 tons per hour.)

(3) *Existing conditions* determine the amount and type of traffic flow. These conditions include—

(*a*) Route characteristics (terrain, type of surface, width of traveled ways, maintenance requirements, and load capacities).

(*b*) Military traffic regulations (density, speed limit, and traffic direction).

(*c*) Types of vehicles employed.

(*d*) Light and weather conditions.

f. A *movement credit* is the time allocated for one or more vehicles to move over a controlled route (STANAG 2154). Movement credits are issued by the appropriate traffic control headquarters in the operational area.

g. A *controlled route* is a route subject to traffic or movement restrictions. Controlled routes include the following:

(1) A *supervised route* is a route over which control is exercised by means of traffic control posts, traffic patrols, or both. A movement credit is required for convoys of 10 or more vehicles or by individual vehicles of exceptional size or weight.

(2) A *dispatch route* is a road over which full control, both priority and regulation of traffic movement, is exercised. A movement credit is required by individual vehicles as well as by groups of vehicles regardless of number or type.

(3) A *reserved route* is a controlled route which is either:

(*a*) Allocated exclusively to a particular command or unit. (For example, a route reserved exclusively for the 10th Division);

(*b*) or intended to meet a particular requirement. (For example, a route reserved exclusively for evacuation.)

h. An *open route* is a route for which no movement credit is required.

i. A *one-way road* is a route on which vehicles move in one direction only.

j. A *signed route* is a route along which a unit has placed unit directional signs on its own initiative, for its exclusive use, and under the conditions prescribed by the command or maneuver regulations.

k. A *route where guides are provided* is a route included in one of the above categories upon which a unit has placed guides on its own initiative and under the conditions prescribed by the command or maneuver regulations; these guides direct personnel and vehicles of their own unit but do not direct other units.

l. Prohibited route or a *prohibited section of route* is one over which traffic is prohibited regardless of cause.

2-4. Route Classification System (STANAG 2015 and SOLOG 53)

The route classification system is designed to assist in planning and executing military movement. Normally, classification is actually carried out during hasty route reconnaissance. When technical difficulties are encountered, however, and if adequate time is available, thorough route classification is accomplished by military engineers whose findings are based on the information contained within route reconnaissance reports. Basic route classification is established for favorable conditions of light and weather. Conditions other than favorable, such as blackout movement, require special considerations; if reconnaissance personnel are to adequately fulfill their mission, reconnaissance instructions must include circumstances other than normal by which movement is contemplated. *Routes are classified according to the factors of minimum width, worst route type, least bridge military load classification, and obstructions to traffic flow.*

2-5. Widths

The width of a route including bridges, tunnels, roads, and other constrictions is the narrowest width of the route expressed in meters or feet.

a. Route widths are illustrated in figure 2-1.

b. The number of lanes of a given route is determined by the width of the traveled way. The average width of a lane required for the movement of one column is established at 3.50 meters (11½ ft) for wheeled vehicles and 4 meters (13 ft) for tracked vehicles. Single lanes accommodate vehicular traffic in one direction only with no overtaking in the same direction or passing in the oncoming direction.

c. Traffic flow is determined by the number of lanes (table 2-1).

(1) A route or traveled way is *single flow* when it allows a column of vehicles to proceed and, in addition, *individual* oncoming or overtaking vehicles to pass at predetermined points. The width of a single flow route, therefore, is equal to at least 1½ lanes.

(2) A route is *double flow* when it allows two columns of vehicles to proceed simultaneously either in the same or opposite direction. The width of a double flow route, therefore, is equal to at least two lanes.

Table 2-1. Route widths (STANAG 2151)

Traffic flow possibilities	Widths for wheeled vehicles	Widths for tracked vehicles
Single flow	5.50 meters to 7 meters (18 ft to 23 ft)	6 meters to 8 meters (19½ ft to 26 ft)
Double flow	Over 7 meters (23 ft)	Over 8 meters (26 ft)

(3) If reconnaissance personnel are to perform hasty route reconnaissance, instructions should indicate if the anticipated traffic is to be single or

double flow and whether the route is for the use of wheeled vehicles or tracked vehicles. In other words, those conducting reconnaissance are informed of what traveled way widths are to be considered and reported as width obstructions. By referring to table 2–1 it can be seen that a width obstruction for single flow, wheeled traffic does not exist until the traveled way is reduced below 5.50 meters; whereas this minimum width must be increased to 6 meters to accommodate single flow, tracked vehicles. For double flow traffic, a width obstruction is not present for wheeled vehicles until the traveled way is reduced below 7 meters; whereas for tracked vehicles, the width is critical below 8 meters. In the absence of instructions, routes are reconnoitered and reported based on the minimum traveled way width for double flow, tracked vehicles (8 meters). On the other hand, if a route is to be reconnoitered to determine the type of vehicles the route will accommodate, procedures of deliberate road reconnaissance (sec. V, ch. 3) are undertaken to ascertain critical widths.

2–6. Route Type

For the purpose of classification, routes are designated by their ability to withstand the

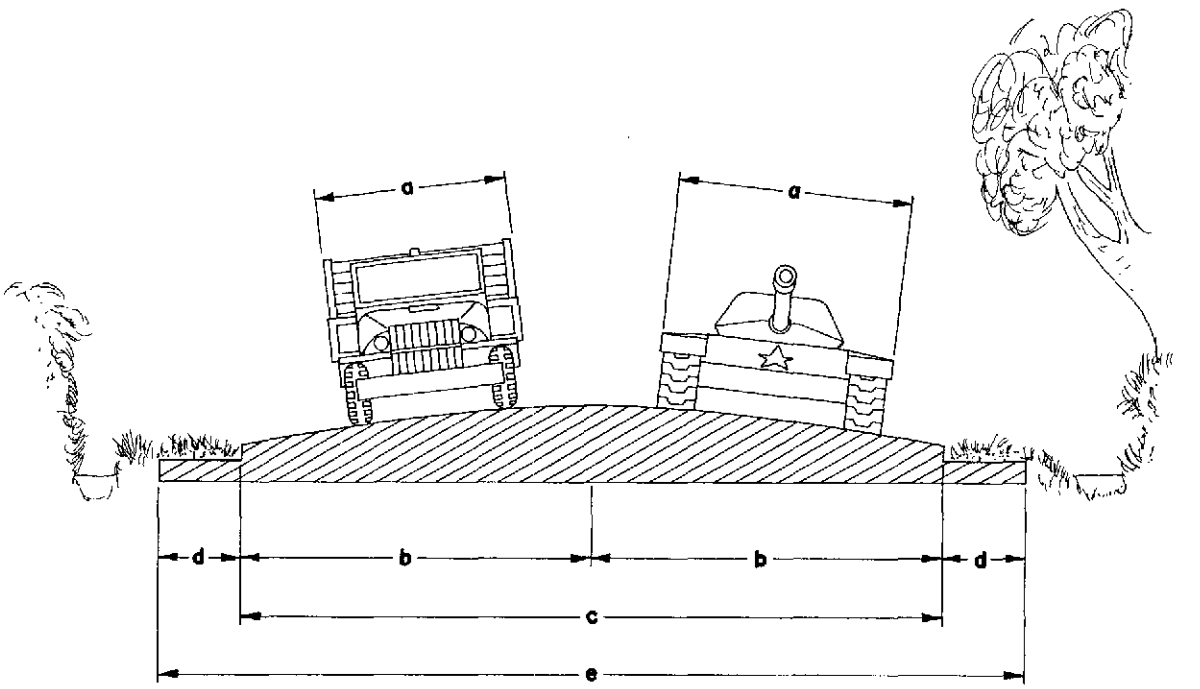


Figure 2–1. Route widths (STANAG 2151).

effects of weather. Route type is determined by the worst section of the route. Routes as classified by type are—

a. Type X—All-Weather Route is any route which with reasonable maintenance is passable throughout the year to traffic never appreciably less than maximum capacity. The roads which form this type of route normally have waterproof surfaces and are only slightly affected by precipitation or temperature fluctuations. At no time is the route closed to traffic by weather effects other than temporary snow or flood blockage.

b. Type Y—All-Weather Route (Limited Traffic Due to Weather) is any route which with reasonable maintenance can be kept open in all weather but sometimes only to traffic considerably less than maximum capacity. The roads which form this type of route usually do not have waterproof surfaces and are considerably affected by precipitation or temperature fluctuations. Traffic may be completely halted for short periods. Heavy unrestricted use during adverse weather may cause complete collapse of the surface.

c. Type Z—Fair-Weather Route is any route which quickly becomes impassable in adverse weather and cannot be kept open by maintenance short of major construction. This category of route is so seriously affected by weather that traffic may be brought to a halt for long periods.

2–7. Military Load Classification

a. General. The military load classification system is a load capacity rating system which considers a vehicle's weight and type and its effect on routes and bridges. The classification system is represented by whole numbers assigned to vehicles, bridges, and routes. (For detailed discussion, see secs. III and IV, ch 3.) Most allied military vehicles are externally marked with their respective classification number (see para. 2–53). Bridges and routes are assigned military load classifications based on their safe load capacity and physical dimensions.

b. Route Classification. Normally, *the lowest bridge military load classification number regardless of vehicle type or conditions of traffic flow determines the military load classification of a route.* By selecting the lowest bridge classification number, it is assured that the route is not overloaded. In those cases where vehicles bear a higher military load classification than the route, the route reconnaissance overlay is checked or a special reconnaissance is initiated to determine if a change in traffic control procedures, such as a single flow crossing, may permit utilization of the route by heavier traffic. If no bridge is located on the route or if roads are particularly bad, the worst section of road governs the route's classification (see sec. V, ch. 3).

c. Classification of Military Road Maneuver Networks. The classification of a military road maneuver network is fixed by the minimum route classification of the network. To facilitate movement of heavier equipment, however, individual routes included in a lower classification network may be grouped and identified in the following general categories (STANAG 2151):

(1) Average traffic routes:
Classification 50

(2) Heavy traffic routes:
Classification 80

(3) Very heavy traffic routes:
Classification 120

Whenever possible, the basic military road maneuver network is composed of average routes (Classification 50) and includes a number of heavy traffic routes (Classification 80) and a few very heavy traffic routes (Classification 120).

2–8. Obstructions to Traffic Flow

Route obstructions are factors which restrict the type and amount or speed of traffic flow. Route obstructions with the exception of bridge capacities, which are reported separately as a military load classification, are indicated in the route classification formula (para. 2–9) by the abbreviation (OB). Moreover, reconnaissance symbols are used to describe the nature of each obstruction on the route reconnaissance overlay (see fig. 2–2). Obstructions to be reported include—

a. Overhead obstructions such as bridges, tunnels, underpasses, overhead wires, and overhanging buildings whose overhead clearance is less than 4.25 meters (14 ft).

b. Reduction in traveled way widths which are below standard minimums prescribed for the type of traffic flow (single or double, wheeled or tracked, see table 2–1). Examples are bridges, tunnels, craters, lanes through mined areas, and projecting buildings or rubble.

c. Gradients (slopes) of 7 percent or greater.

d. Curves whose radii of curvature are less than 30 meters (100 ft).

e. Ferries.

f. Fords.

2–9. Route Classification Formula

The route classification formula is developed from notations expressed in the *standardized sequence* of minimum traveled way width, route type, lowest military load classification, and an obstruction or obstructions if present. The formula briefly describes a specific route and is used together with a route reconnaissance overlay. If an obstruction(s) appears in the route classification formula it is necessary to refer to the route reconnaissance overlay in order to determine the exact nature of the obstruction(s). Illustrative formulas are shown below:

a. 20ft Z 10. This example formula describes a fair-weather route with a minimum traveled way of 20 feet and a military load classification of 10. This route, based on its minimum width of traveled way (see table 2–1), accommodates both wheeled and tracked, single flow traffic without obstruction.

b. 20ft Z 10 (OB). This example formula describes a route with similar characteristics as in example *a.* but with an obstruction(s). This obstruction(s) could consist of one or more of the following:

(1) Overhead clearances of less than 4.25 meters (14 ft).

(2) Grades of 7 percent or greater.

(3) Curves with radii 30 meters (100 ft) or less.

(4) Fords and ferries.

(5) It should be noted that 20 feet of traveled way limits this route to single flow traffic without a width obstruction. If the route is to be used for double flow traffic, however, 20 feet of traveled way constitutes an obstruction and is indicated in the formula as an obstruction (OB).

c. 7m Y 50 (OB). This example formula describes a limited all-weather route with a minimum traveled way of 7 meters, a military load classification of 50 and with obstruction(s).

Note. For *double flow, wheeled traffic* the traveled way width is adequate; however, the route's width is not suitable for double flow, tracked vehicles. This width constriction would be indicated as (OB) in the route classification formula if the route were to be used for both types of vehicles.

d. 10.5m X 120 (OB). This example formula describes an all-weather route with a minimum traveled way width of 10.5 meters, which is suitable for double flow traffic of both wheeled and tracked vehicles, a military load classification of 120 with an obstruction(s).

2–10. Special Conditions

a. Snow Blockage. The effects of snow are not normally considered as an obstruction to traffic flow in route classification since vehicular movement is determined by the depth of the snow and the availability of snow removal equipment. In those cases, however, where snow blockage is regular, recurrent, and serious; the formula for classifying a route is followed by the symbol (T), for example:

(1) 20ft Y 50 (T).

(2) 7m Y 50 (OB) (T).

b. Flooding. The effect of flooding on traffic flow is also not normally considered in route classification. However, where flooding is regular, recurrent, and serious, the formula for classifying a route is followed by the symbol (W); for example:

(1) 20ft Y 50 (W).

(2) 7m Y 50 (OB) (W).

Section II. ROUTE RECONNAISSANCE OVERLAYS

2-11. General

This section provides guidance in the preparation of route reconnaissance overlays used in hasty and deliberate reconnaissance. A summary of route reconnaissance symbols used in overlay preparation is included. The route reconnaissance overlay is an accurate and concise report of the conditions affecting traffic flow along a specified route and is the preferred method of preparing a route reconnaissance report. An overlay normally satisfies the requirements of hasty route reconnaissance. If, however, more detail is required to support the reconnaissance, the overlay is supplemented with written reports describing critical route characteristics in more detail. An example of a route reconnaissance overlay is shown in figure 2-2.

2-12. Route Reconnaissance Checklist

To insure that critical terrain data during route reconnaissance are not overlooked and to aid in the preparation of reconnaissance reports, a checklist based on the characteristics of the area of operations is recommended. General items for consideration are—

a. Identification and location of the reconnoitered route.

b. Distances between easily recognized points both on the ground and map.

c. The percent of slope and length of grades which are 7 percent or greater.

d. Sharp curves whose radii of curvature are 30 meters (100 ft) or less.

e. Bridge military load classifications and limiting dimensions to include suitable bypasses.

f. Locations and limiting data of fords and ferries.

g. Route constrictions, such as underpasses, which are below minimum standard and, if appropriate, the distances such restrictions extend.

h. Locations and limiting dimensions of tunnels to include suitable bypasses.

i. Suitable areas for short halts and bivouacs which offer drive-off facilities, adequate dispersion, cover, and concealment.

j. Areas of rock falls and slides which may present a traffic hazard.

2-13. Route Reconnaissance Symbols

Figure 2-3 provides a summary of standard route reconnaissance and related symbols. In addition, references which explain the symbol in greater detail, are provided for each entry.

2-14. Reporting of Opened and Closed Routes (STANAG 2096 and SOLOG 107)

Reconnaissance personnel may often find themselves required to report the closure of *axial* or *lateral routes* or a portion of such routes due to enemy action, climatic conditions, or other reasons. In addition to reporting the closure of a route, it is usually necessary to reconnoiter and report suitable bypasses or detours. Conversely, when routes are again opened, a report to this effect is also required. Standardized formats for both situations (figs. 2-4 and 2-5) have been developed. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11-170), the formats, which are reproduced locally, may also be used to supplement overlay or map reconnaissance reports. The originator completes only those parts of the format which are applicable or for which information is available. Each item of the report, however, must be accompanied by the appropriate letter designation from the format to establish the correct category of information. Messages are preceded by the term, ROUTECLOSEDREP or ROUTEOPENREP, which ever applies, or an identifying codeword.

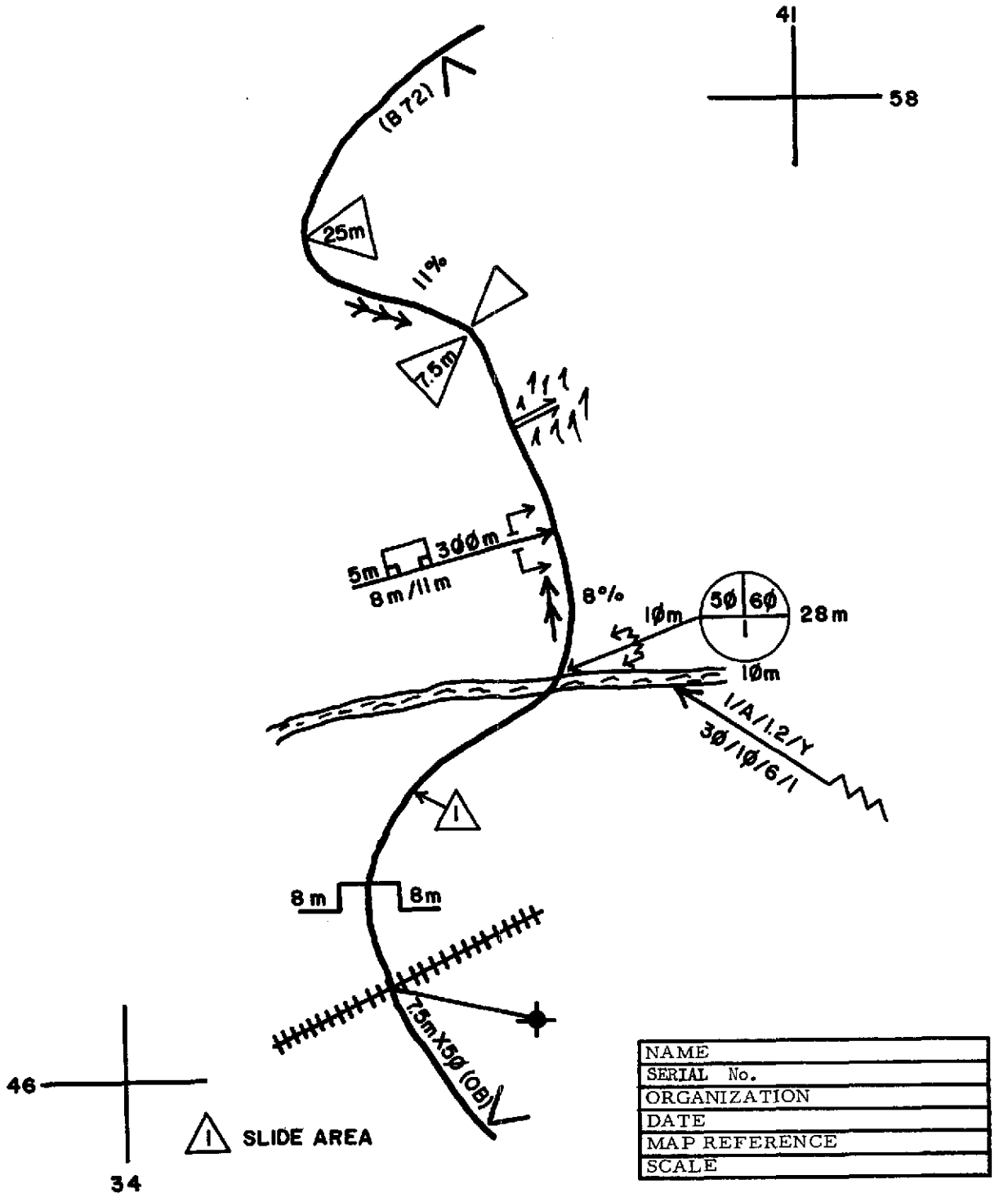


Figure 2-2. Example of route reconnaissance overlay.

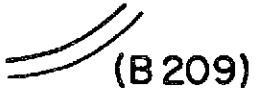
Serial Number	Explanation	Symbol	Remarks	Reference
1.	Civil or military route designation		Designation written in parentheses along route.	STANAG 2253 SOLOG 96
2.	Critical point		To be numbered and described in legend. Critical points may be used to point out features not adequately covered in other reconnaissance symbols.	STANAG 2253 SOLOG 96
3.	Limits of sector		Limits of reconnoitered sector of route.	STANAG 2253 SOLOG 95
4.	Route classification formula	10.5m X 120 6m Z 8(OB) 9m Y 20(OB) W	Expressed in order of: width, type, military load classification, obstructions, if present, and regular flooding or snow blockage: X - all weather route Y - all weather route (limited traffic) Z - fair weather route T - regular snow blockage W - regular flooding	FM 5-36 (Sec I, Ch 2) STANAG 2015 SOLOG 53

Figure 2-3. Standard route reconnaissance symbols.

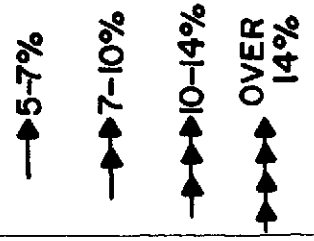
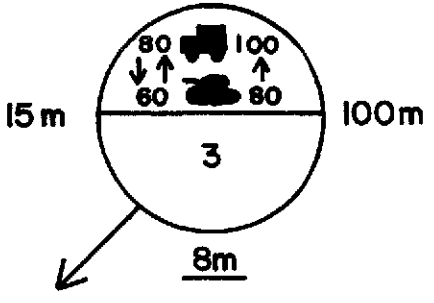
Serial Number	Explanation	Symbol	Remarks	Reference
5.	Grades		Arrows point in uphill direction; to the right of symbol is shown the actual percent of slope; length of arrow represents length of grade if map scale permits.	FM 5-36 (Sec III, Ch 2) STANAG 2253 SOLOG 96
6.	Sharp curves		Vertex of triangle points to map location of curve. Radius in feet or meters is inscribed within symbol.	FM 5-36 (Sec II, Ch 2) STANAG 2253 SOLOG 96
7.	Full bridge symbol		Arrow extends to map location of bridge; minimum width is placed below, overhead clearance to the left, and overall length to the right of basic symbol. Lower portion of symbol indicates bridge serial number; upper portion, military load classification data. Underlined values are those below minimum standard.	FM 5-36 (Sec VII, Ch 2) DA Form 1295 STANAG 2096 STANAG 2252 SOLOG 94 SOLOG 107

Figure 2-3—**Continued.**

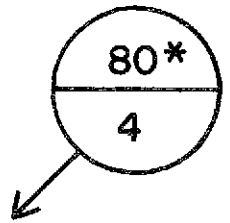
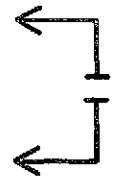
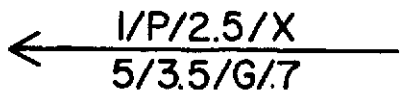
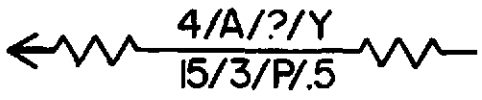
Serial Number	Explanation	Symbol	Remarks	Reference
8.	Abbreviated bridge symbol		Arrow extends to map location of bridge. Lower portion of symbol indicates bridge serial number; upper portion, military load classification for single flow traffic; asterisk denotes other classifications to be found in accompanying inclosure.	FM 5-36 (Sec VI, Ch 2) DA Form 1249 STANAG 2096 STANAG 2252 SOLOG 94 SOLOG 107
9.	Bypass Easy		Used in conjunction with bridge and tunnel reconnaissance symbols.	FM 5-36 (Sec VII, Ch 2) STANAG 2252 & 2253 SOLOG 94 & 96
10.	Bypass Difficult		Used in conjunction with bridge and tunnel reconnaissance symbols.	FM 5-36 (Sec VII, Ch 2) STANAG 2252 & 2253 SOLOG 94 & 96
11.	Bypass Impossible		Used in conjunction with bridge and tunnel reconnaissance symbols.	FM 5-36 (Sec VII, Ch 2) STANAG 2252 & 2253 SOLOG 94 & 96

Figure 2-3—**Continued.**

Serial Number	Explanation	Symbol	Remarks	Reference
12.	Ford		Arrow extends to ford location. Data above the line expressed in order of serial number, ford type, stream velocity, in meters per second, and seasonal limitations. Data below the line expressed in order of length, width, bottom type, and depth. Question marks indicate unknown information. Difficult approaches are represented by zigzag lines corresponding in position to shore where approach is located.	FM 5-36 (Sec V, Ch 2) DA Form 1251 STANAG 2274 STANAG 2096 SOLOG 107



Ford Type	Seasonal Variations	Bottom Type
A-vehicular	X-none	M-mud
P-foot	Y-significant	C-clay
D-deepwater, tank		S-sand
S-swimming vehicles		G-gravel
		R-rock
		P-artificial paving

Figure 2-3—**Continued.**

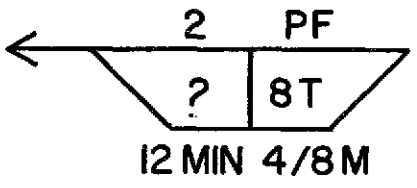
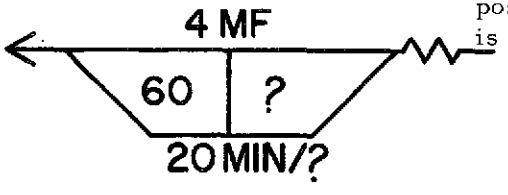
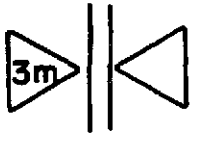
Serial Number	Explanation	Symbol	Remarks	Reference
13.	Ferry	 	Arrow extends to map location. Data above symbol is expressed in order of ferry serial number and ferry type. Data inside symbol is expressed in order of military load classification and dead weight capacity; data below symbol is expressed in order of turn around time and width and length of cargo space. Question mark indicates unknown information. Difficult approaches are represented by zigzag lines corresponding in position to shore where approach is located. Ferry Type AF-vehicular PF-foot MF-military	FM 5-36 (Sec V, Ch 2) DA Form 1252 STANAG 2274 STANAG 2096 SOLOG 107
14.	Width constriction		Route constriction in width; width expressed in feet or meters of useable traveled way in triangle corresponding to the side of the traveled way in which the construction occurs.	FM 5-36 (Sec IV, Ch 2) STANAG 2253 SOLOG 96

Figure 2-3—Continued.

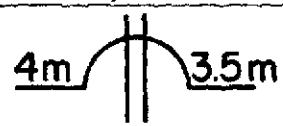
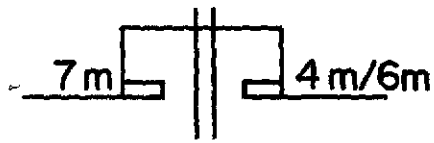
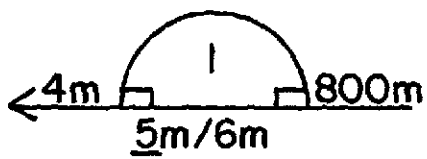
Serial Number	Explanation	Symbol	Remarks	Reference
15.	Arch constriction		Width expressed in meters or feet to right of symbol, overhead clearance to left.	FM 5-36 (Sec V, Ch 2) STANAG 2253 SOLOG 96
16.	Rectangular construction with sidewalks		Width of traveled way followed by total width including sidewalk expressed in feet or meters to right of symbol, overhead clearance to left.	FM 5-36 (Sec IV, Ch 2) STANAG 2253
17.	Tunnel with sidewalks		Arrow extends to map location. Serial number is placed inside the symbol. The width of the traveled way followed by total width including sidewalks in meters or feet is placed below the symbol. Underlined widths indicate reduction of widths below that of the outside route. Overhead clearance is placed to the left of the symbol and total tunnel length to the right. A question mark represents unknown information. Bypasses are shown by standard symbol notations.	FM 5-36 (Sec IV, Ch 2) DA Form 1250 STANAG 2096 STANAG 2274 SOLOG 107

Figure 2-3—Continued.

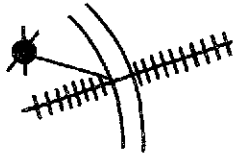
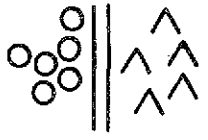
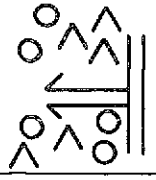
Serial Number	Explanation	Symbol	Remarks	Reference
18.	RR grade crossing		Level crossing; passing trains will interrupt traffic flow.	STANAG 2253 SOLOG 96
19.	Concealment		Route lined with trees; deciduous trees (left) and evergreen (right).	STANAG 2253 SOLOG 96
20.	Concealment and vehicular turn off		Arrow denotes possibility of driving off route for concealment in a mixed forest stand.	STANAG 2253 SOLOG 96
21.	Roadblock, craters, and blown bridges a. Proposed		Center of the symbol indicates position of block.	FM 21-30 STANAG 2019 SOLOG 28

Figure 2-3—Continued.

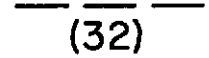
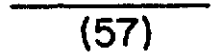
Serial Number	Explanation	Symbol	Remarks	Reference
21. (Cont'd)	b. Prepared but passable			
	c. Completed			
22.	Lateral route		Broken lines; identified by even number.	FM 5-36 (Sec I, Ch 2) STANAG 2151
23.	Axial route		Solid line; identified by odd number.	FM 5-36 (Sec I, Ch 2) STANAG 2151
24.	Unknown or doubtful information			FM 21-30 STANAG 2019 SOLOG 28

Figure 2-3—Continued.

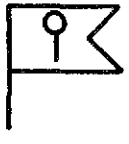
Serial Number	Explanation	Symbol	Remarks	Reference
25.	Parking area			FM 21-30 STANAG 2019 SOLOG 28
26.	Traffic control post			FM 21-30 STANAG 2019 SOLOG 28
27.	Traffic control headquarters			FM 21-30 STANAG 2019 SOLOG 28

Figure 2-3—Continued.

ROUTECLOSEDREP[a]					
Explanation	Letter designation	(1)[b]	(2)[c]	(3)[c]	(4)[c]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
From grid reference (* * *)	CHARLIE				
To grid reference (* * *)	DELTA				
Reason for road closure	ECHO				
Estimated duration	FOXTROT				
Detour from grid reference (* * *) to grid reference (* * *) including if possible, military load classification of detour, width, type surface, gradual or sharp curves, and gentle or steep grades.	GOLF				
Cross-country bypass permitted for (* * *) (vehicle types and military load classification number).	HOTEL				
Additional information	INDIA				

Notes. [a]. Applicable for axial and lateral routes only.
[b]. First route in report; report by serial number if assigned.
[c]. Additional routes in report.

Figure 2-4. Route closed report.

ROUTEOPENREP[a]					
Explanation	Letter designation	(1)[b]	(2)[c]	(3)[c]	(4)[c]
Map sheet(s)	ALPHA				
Date and time route is opened	BRAVO				
From grid reference (* * *)	CHARLIE				
To grid reference (* * *)	DELTA				
Military load classification number of route	ECHO				
Minimum widths	FOXTROT				

Notes. [a]. Applicable for axial and lateral routes only.
[b]. First route in report; report by serial number if assigned.
[c]. Additional routes in report.

Figure 2-5. Route open report.

Section III. SLOPE AND RADIUS CURVATURE

2-15. Percent of Slope (STANAG 2253)

The rise or fall of a ground form is known as slope. Slope can be expressed as steep or gentle, but these terms are too general for reconnaissance purposes. The speed at which vehicles or personnel can move is seriously affected by the slope of the ground, and all vehicles have limitations as to the steepness of slope which can be negotiated (see app. IV). A more exact manner in which to describe slope, therefore, is required to indicate the effect a given slope will have on traffic flow. To meet this requirement, reconnaissance personnel compute and report the percent of slope for critical gradients. Percent of slope is the ratio of the change in elevation (vertical distance) to horizontal ground distance multiplied by 100 (fig. 2-6). Percent of slope is used to describe slopes which rise or fall. If not shown by symbol, a rising slope *in the direction of travel* is preceded by a plus (+) sign, and a falling slope, by a minus (—) sign. Important to remember in computing percent of slope is that the *vertical distance and the horizontal distance must always be expressed in the same unit of measure.*

2-16. Methods for Determining Percent of Slope

a. Clinometer. An instrument for directly measuring percent of slope is known as a clinometer. This instrument is organic equipment for most engineer units.

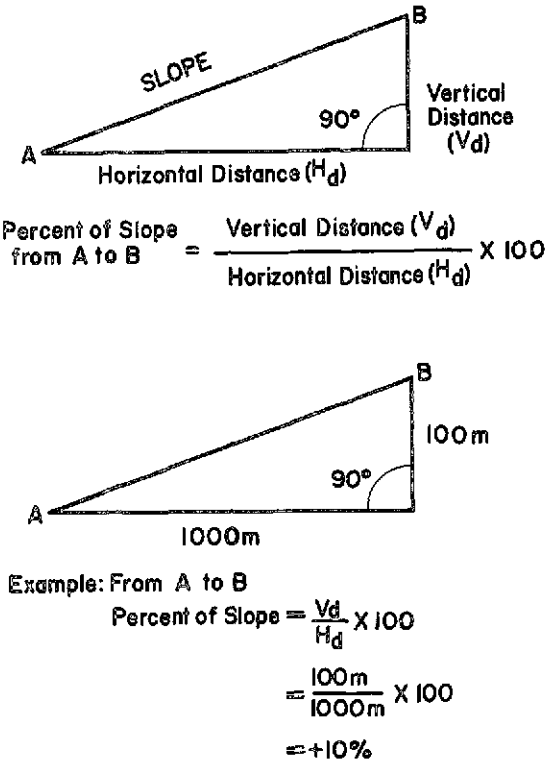


Figure 2-6. Determining percent of slope.

b. Map. An approximate means of determining percent of slope is accomplished with a large scale map of the area. Once the slope has been identified on the map, the difference in elevations between the top and bottom of the slope is found by reading the elevation contours or spot elevations. Then, the slope distance (usually road distance; see FM 21-26) is measured and converted to the same unit of measurement as the elevation difference. The vertical distance and the horizontal distance are substituted in the percent of slop formula, and the percent of slope is computed (fig. 2-7). This method is not suitable, however, where cuts or fills have been employed to reduce the gradient of the route.

c. Line of Sight and Pace. An expedient method of estimating percent of slope is based on the line of sight of a man and the measurement of ground distance by use of the pace. The eye level of the average man is 1.75 meters (5 ft, 7 in) above the ground. The pace of the average man is .75 meter (30 in).

Note. These measurements should be accurately determined for each member of a reconnaissance team.

To determine percent of slope, the individual, who stands at the bottom of the slope and keeps his head and eyes level, sights on a spot up the slope. This spot should be easily identifiable or, if not, another member of the team may be sent forward to mark the location. The individual making the sighting then walks forward to the marked spot recording the number of paces. This procedure is repeated until the top of the slope is reached—fractions of an eye level height must be estimated. Vertical distance is then computed by multiplying the number of sightings by the eye level height. Horizontal distance is computed by totaling the number of paces and *converting to meters by multiplying by the factor, .75.* Percent of slope can then be calculated by substituting the values into the percent of slope formula (fig. 2-8). Because this method considers horizontal ground distance and incline distance as equal, reasonable accuracy may be obtained for slopes only less than 30 degrees. Moreover, *this method requires considerable practice to achieve acceptable accuracy.*

d. Angle of Slope. Another method of determining percent of slope is to first measure the angle of slope by means of an elevation quadrant, aiming circle, M2 compass, or binoculars with standard reticle. If the instrument of angle measurement is mounted above ground level, *care must be taken that the entire angle of slope is measured;* compensation is made for a difference in height by siting above the slope a corresponding distance to that of the instrument above the ground. It is also important that angle measurement be conducted at the base of the slope. Then, by referring to table 2-2 and entering the column corresponding to the measured angle of slope, the percent of slope may be read directly (fig. 2-9).

Table 2-2. Conversion of degrees and mils to percent of slope.

Degrees of slope	Mils of slope	Percent of slope
1	18	1.7
2	36	3.5
3	53	5.2
4	71	7.0
5	89	8.7

Table 2-2. Conversion of degrees and mils to percent of slope—Continued.

Degrees of slope	Mils of slope	Percent of slope
10	178	17.6
15	267	26.7
20	356	36.4
25	444	46.6
30	533	57.7
35	622	70.0
40	711	83.9
45	800	100.0
50	889	108.7
55	978	117.6
60	1067	126.7

2-17. Methods of Recording Percent of Slope (STANAG 2253 and SOLOG 96)

Most vehicles which are required to negotiate slopes of 7 percent or greater for any significant distance will be slowed down. Route reconnaissance, therefore, is required to locate such obstructions to traffic flow and to accurately report slope characteristics. Reconnaissance symbols have, consequently, been adopted to symbolically portray gradients (percent of slopes) on maps and overlays. A single headed arrow along the trace of a route pointing in the uphill direction indicates a 5 but less than 7 percent grade; two arrowheads represent a grade greater than 7 but less than 10 percent; three arrowheads represent a grade greater than 10 but less than 14 percent; and four arrowheads represent a grade over 14 percent (fig. 2-10). The value of the grade in percent of slope is further written to the right of the arrow. Whenever the map scale permits, the length of the arrow shaft drawn to scale represents the approximate length of the grade (fig. 2-2). It should be remembered that *slopes of 7 percent or greater are considered as obstruction to traffic flow and are indicated by the abbreviation (OB) in the route classification formula* (para. 2-8).

2-18. Radius of Curvature

The speed at which vehicles can move along a specified route is also affected by sharp curves. For reconnaissance purposes, curves whose radii of curvature are less than 30 meters (100 ft), are reported. *Curves of this nature are considered as obstructions to traffic flow and are indicated by the abbreviation (OB) in the route classification formula* (para. 2-8).

2-19. Methods of Measuring Curves

a. The radius of a very sharp curve may be estimated by using a tape to swing an arc as illustrated in figure 2-11. The curve is inscribed as a part of a circle by swinging an arc with tracing tape from the experimentally located center of a circle. The length of the tape from the center of the circle to its circumference is the radius of the curve. This method is practical for curves having a radius up to 15 meters and located on relatively level ground.

Note. In figures 2-11, 2-12, and 2-13; C = centerline; PC = point of curvature; and PT = point of tangency.

b. Another method for determining the approximate radius of a curve is by laying out right triangles (3:4:5 proportion) at the PC and PT locations as shown in figure 2-12. The intersection, O, formed by extending the base legs of each triangle, represents the center of a circle. Therefore, the distance R from point O to either points PC or PT represents the curve radius.

c. Another method for determining the radius of a curve (fig. 2-13) is based on the formula—

$$R = c^2/8m + m/2$$

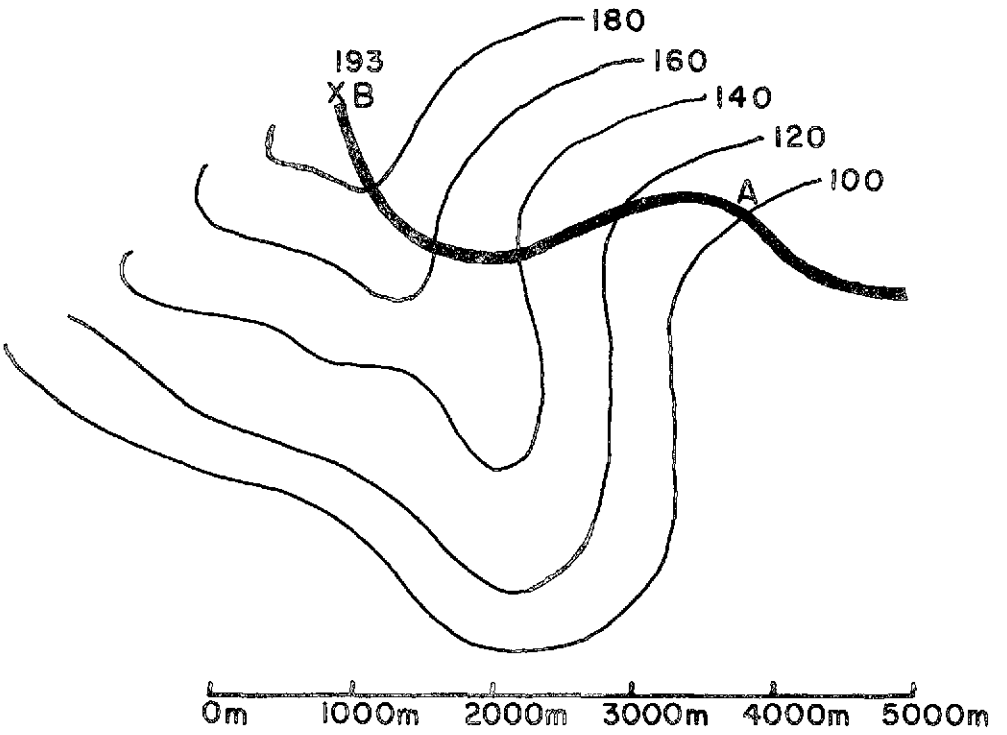
c = length of tape
m = perpendicular distance from the center of tape to the centerline (℄) of road.
R = radius of the circle

By fixing m always at 2 meters, the formula becomes—

$$R = c^2/16 + 1$$

2-20. Methods of Recording Radius of Curvature (STANAG 2253 and SOLOG 93)

Sharp curves along a specified route whose radii are less than 30 meters (100 ft) are symbolically represented on maps or overlays by means of a triangle whose vertex points to the exact map location of the curve. In addition, the measured value in meters or feet for the radius of curvature is inscribed inside the triangle (fig. 2-14).



Find: Percent of slope along road Section A to B.

Answer:

Spot Elevation B	=	193 m
Spot Elevation A	=	100 m
Difference in Elevation (Vd)	=	93 m

Road distance A to B using a piece of paper and graphic scale (see FM 21-26) ≈ 3720 m

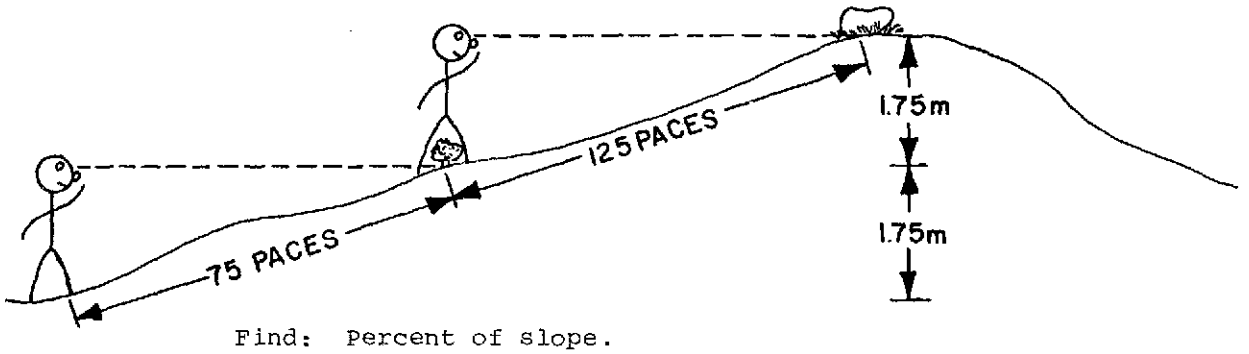
$$\text{Percent of slope} = \frac{Vd}{Hd} \times 100$$

$$= \frac{93}{3720} \times 100$$

$$= + 2.5\ \%$$

NOTE: When map elevation and contour interval are stated in feet, the vertical distance must first be converted to meters (app. II).

Figure 2-7. Determining percent of slope using map method.



Find: Percent of slope.
Given: Eye level height = 1.75 m
Pace = .75 m

Answer: Vertical Distance = 2 x 1.75 m
= 3.50 m
Horizontal Distance = (75 paces + 125 paces) x .75
= 150 meters

$$\text{Percent of Slope} = \frac{\text{Vertical Distance (Vd)}}{\text{Horizontal Distance (Hd)}} \times 100$$

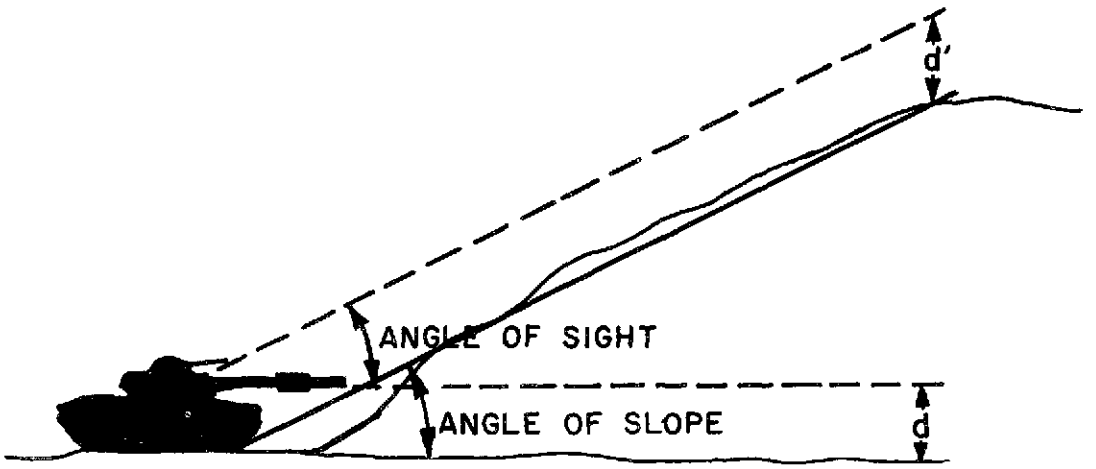
$$= \frac{3.50}{150} \times 100$$

$$= 2.34\%$$

Figure 2-8. Determining percent of slope using line of sight and pace method.

Given: A tank measures the angle of slope using the elevation quadrant and direct fire sight as 70 mils. What is the percent of slope?

Answer: Using Table 2-2 enter the table under the mils column and reading to the right of the closest value to 70 mils (71 mils) a percentage of slope of +6.9 percent is found.



d' - equal distance above slope to that of elevation quadrant above ground as mounted inside tank.

Figure 2-9. Determining percent of slope using angle of slope.

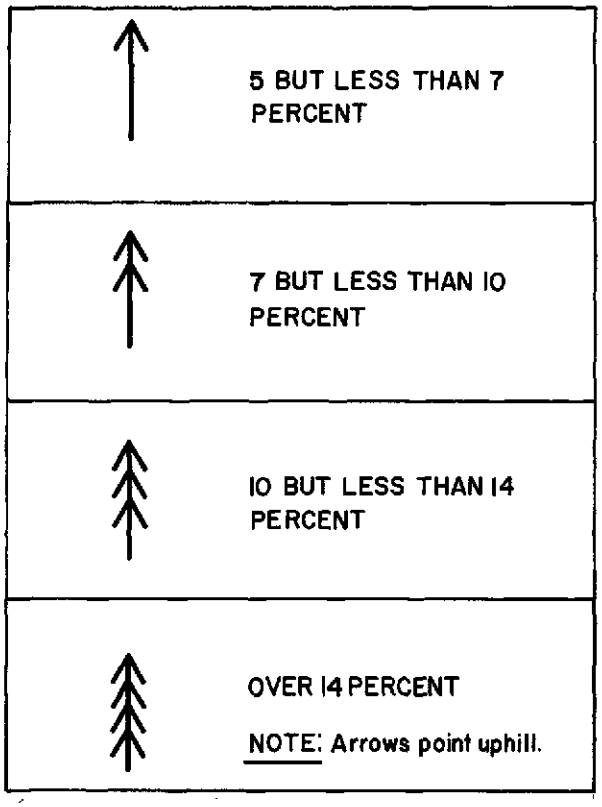


Figure 2–10. Symbolic representation of percents of slope.

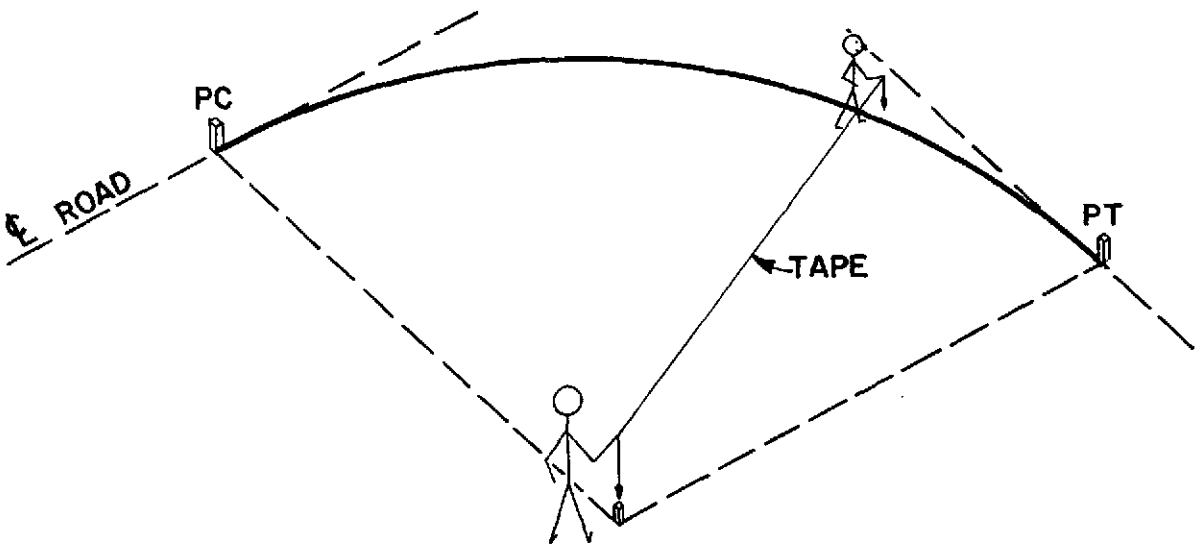


Figure 2–11. Curve radius by using tape.

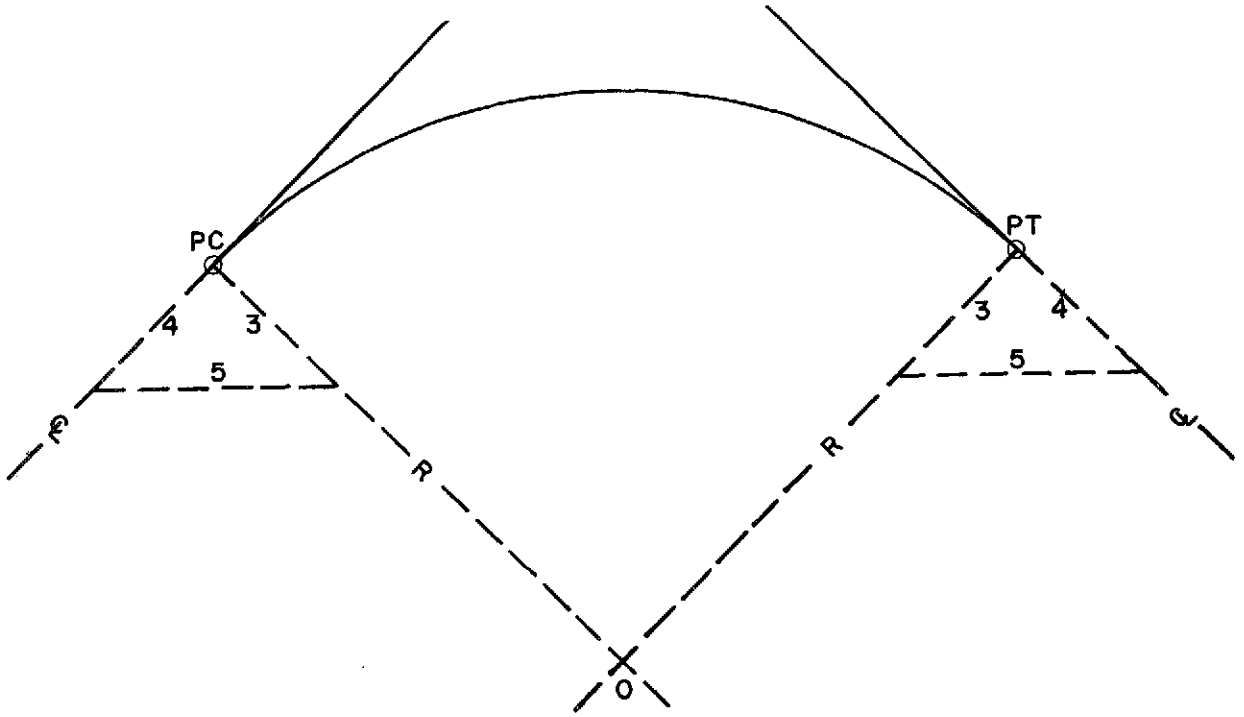
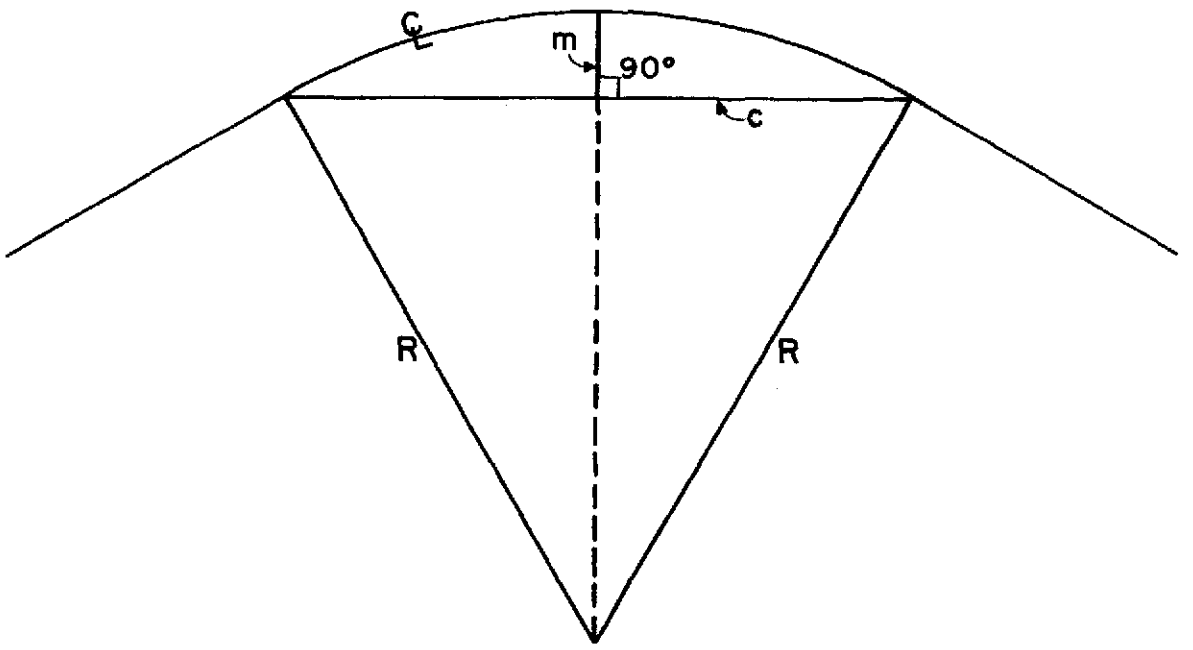


Figure 2–12. Curve radius by locating center of circle.



In the practical application of the formula, m is measured from the centerline of the curve toward the estimated center of the circle and c is measured perpendicularly to m, making sure that m is at the mid-point of c. For example: If c is measured to be 15 meters and m equals 2 meters, then:

$$R = c^2/8m + m/2$$

substituting $m = 2$

$$R = c^2/16 + 1$$

substituting $c = 15$

$$R = \frac{(15)^2}{16} + 1$$

$$R = 15 \text{ meters}$$

NOTE: When m is equal to 2 meters and R is equal to 30 meters, c equals 21.7 meters. Thus, when measuring c and retaining m fixed at 2 meters, any value greater than 21.7 meters will give a value of R greater than 30 meters, and the curve need not be reported.

Figure 2-13. Measuring a curve using formula: $R = c^2/8m + m/2$.

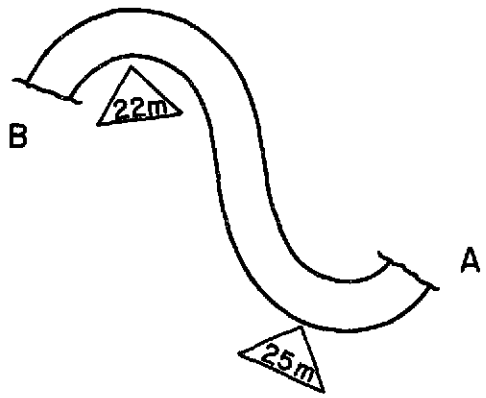


Figure 2-14. Curves along route A—B have radii of curvature of 25 and 22 meters respectively.

Section IV. TUNNELS, UNDERPASSES, AND SIMILAR OBSTRUCTIONS

2-21. General (STANAG 2253 and SOLOG 96)

Obstructions to traffic flow which limit the physical dimensions of vehicles utilizing a specific route are also important aspects of route reconnaissance. Reductions in traveled way widths, such as narrow streets in built-up areas, drainage ditches, embankments, and war damage, limit vehicular movement. Moreover, underpasses and other covered traveled ways may restrict traffic flow not only as to width but also as to height.

a. Widths. Reduction of traveled way widths below the minimum standards for the type and flow of traffic under consideration (table 2-1) are obstructions and are indicated by the symbol (OB) in the route classification formula (para. 2-8).

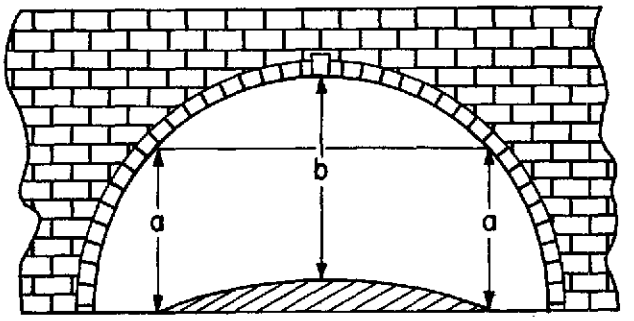
b. Overhead Clearance. Particular care is required in measuring overhead clearances. Overhead clearance is defined as the *least distance between the surface of traveled way and any obstruction vertically above it.* Reconnaissance personnel must, therefore, insure that measurement is made of the minimum clearance as based on careful analysis of each individual structure. Overhead clearance is influenced by the crown of the traveled way, the design of the overhead ceiling, and the percent of slope of the approaches (fig. 2-15). Overhead clearance less than 4.25 meters (14 ft) is considered an obstruction to traffic flow and is indicated by the symbol (OB) in the route classification formula (para. 2-8).

2-22. Reconnaissance Symbols for Route Constrictions

a. Widths. Constrictions in the traveled way width below minimum requirements (table 2-1) are depicted on maps and overlays by two opposing triangles with the width of the traveled way in meters or feet written inside the triangle corresponding to the lane in which the constriction occurs (fig. 2-16*a*).

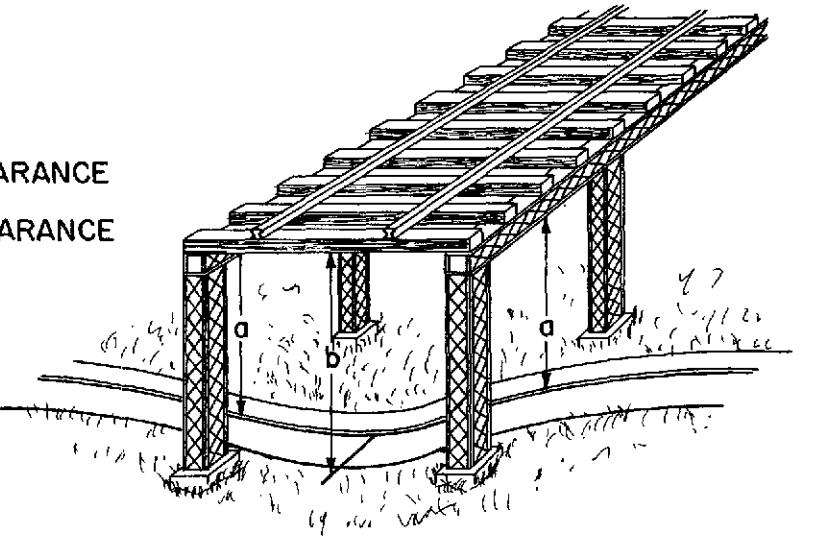
b. Underpasses. An underpass is symbolically portrayed on maps and overlays by a figure which typifies the structure's ceiling and is drawn superimposed over the route at the map location. To the right of the constriction symbol is written the width in meters or feet, and to the left, the overhead clearance (fig. 2-16*b* and *c*). If sidewalks permit emergency passage of wider vehicles, the sidewalks are symbolically represented; and the width of the traveled

way is first written followed by a slash and the total width including sidewalks of the structure (fig. 2–16*d*). Reconnaissance personnel should note, however, that in structures with arched ceilings, and extension of the width does not necessarily mean that the structure will accommodate wider vehicles because of a resulting decrease in overhead clearance.



a - MINIMUM OVERHEAD CLEARANCE

b - MAXIMUM OVERHEAD CLEARANCE



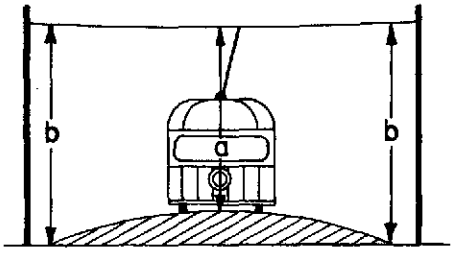
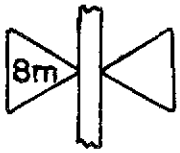
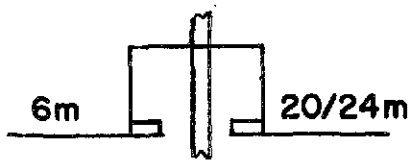


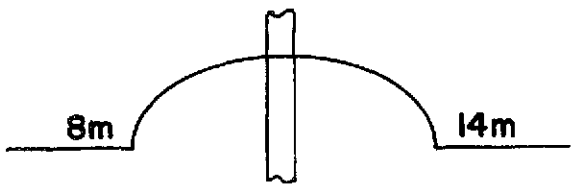
Figure 2–15. Measurement of overhead clearances.



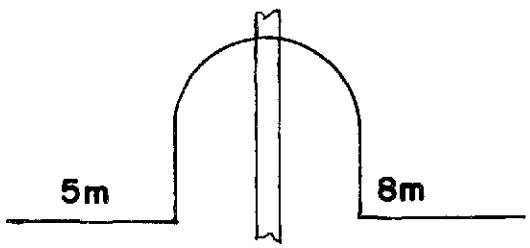
a. Width constriction of 8 meters.



b. Underpass with sidewalks, traveled way width 20 meters, total width 24 meters, and overhead clearance 6 meters.



c. Arch constriction, traveled way width 14 meters, and overhead clearance 8 meters.



d. Underpass with arched ceiling, width 8 meters, overhead clearance 5 meters.

Figure 2-16. Route constrictions.

2-23. Route Constriction Reports

If additional information is required concerning a traffic constriction which cannot be adequately portrayed by symbols, the TUNNELREP (para. 2-28) or the Tunnel Reconnaissance Report Form (DA Form 1250), which ever is more appropriate, may be modified and employed.

2-24. Marking of Route Constrictions

Traffic control information and technical limitations are posted when necessary. Signs

are either rectangular in shape and conform to the military specifications outlined in paragraph 2–52 or conform to the Geneva Convention (fig. 5–1). Telltales indicating overhead clearance restrictions may also be employed (see fig. 2–43).

2–25. Tunnel Reconnaissance (STANAG 2274)

a. A tunnel is defined as an underground gallery or section of a road which has been artifically covered (for example, a snowshed) for the passage of a route.

b. Tunnel reconnaissance determines essential information such as serial number, location, type, length, width including sidewalks, bypasses, alinement, gradient, and cross-section.

2–26. Types of Tunnels

A tunnel consists of a bore, a tunnel liner, and a portal. Common shapes of tunnel bores (fig. 2–17) are semicircular, elliptical, horseshoe, and square with arched ceiling. Tunnels may be unlined (fig. 2–18), masonry lined (fig. 2–19), or concrete lined (fig. 2–20). Portals may be constructed of masonry (fig. 2–21) or of concrete (fig. 2–22). Alinement of tunnels may be straight (fig. 2–23) or curved (fig. 2–24).

2–27. Tunnel Reconnaissance Symbol (STANAG 2274)

Limited tunnel information is recorded on maps or overlays by means of symbols as illustrated in figure 2–25.

a. The geographic *location* of the tunnel is shown by an arrow from the symbol to the location of the tunnel on a map or overlay.

b. A *serial* number is assigned each tunnel for ease in subsequent reference. Serial numbers must not be duplicated within any one map sheet, overlay, or document. The number is recorded inside the symbol.

c. The *length* of the tunnel is shown in meters or feet and is placed to the right of the symbol.

d. The *width* of the traveled way is shown in meters or feet and is placed below the symbol. If sidewalks permit the emergency passage of wider vehicles, the sidewalks are symbolically represented and the width of the traveled way is first written followed by a slash and the total width including sidewalks. Reconnaissance personnel should note, however, that in structures with arched ceilings, an extension of the width does not necessarily mean that the structure will accommodate wider vehicles because of a resulting decrease in overhead clearance. When the traveled way of the outside route is reduced by the traveled way width of the tunnel, the tunnel width dimension in the symbol is underlined.

e. Overhead clearance is shown in meters or feet to the left of the symbol.

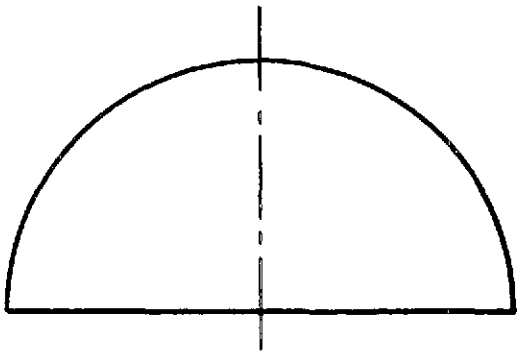
f. Bypasses are symbolically indicated on the line extending from the tunnel symbol to the map location using conventional reconnaissance symbols (see para. 2–61*g*).

2–28. Format for Electrically Transmitting Tunnel Information (STANAG 2096 and SOLOG 107)

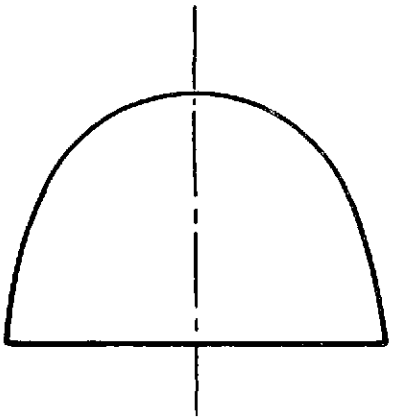
To provide standardization in reporting essential tunnel reconnaissance data by electrical means, the format shown in figure 2–26 has been adopted. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11–170), the format, which is reproduced locally, may also be used to supplement written route reconnaissance reports especially when more detailed information is required. The originator completes only those parts of the format which are applicable or for which information is available. Each item of the report, however, must be accompanied by the appropriate letter designation from the format to establish the correct category of information. Messages are preceded by the term, TUNNELREP, or identifying codeword.

2–29. Tunnel Reconnaissance Report Form

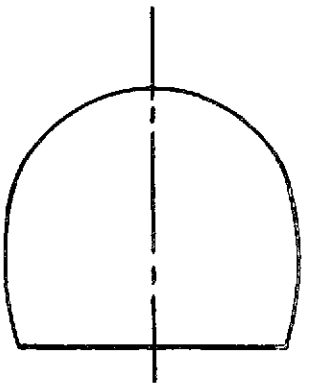
DA Form 1250 (fig. 2–27) Tunnel Reconnaissance Report, may be used to report detailed tunnel information and is more commonly used in deliberate reconnaissance. Short forms or worksheets for field work may be designed and produced by the unit making the recon-



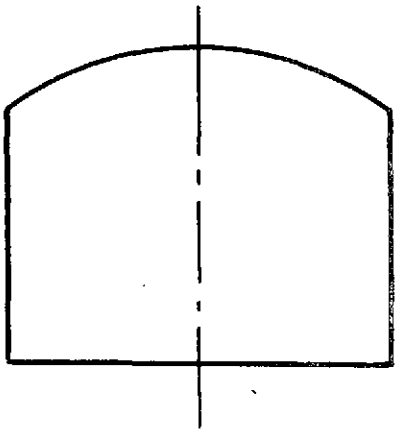
SEMI-CIRCULAR



ELLIPTICAL



HORSE-SHOE



SQUARE WITH ARCHED CEILING

Figure 2-17. Common types of tunnel bores or cross-sections.

naissance. Information is entered on the tunnel reconnaissance report form as follows:

a. Identification (items 1-11). Enter all information which establishes positive identification of the tunnel by route number, route location, map series and sheet number, grid reference, tunnel number, type of tunnel, and geographic reference name.

b. Dimensions (items 12-17). Enter overall tunnel dimensions as indicated in figure 2-28. This applies also to tunnels which branch off the main tunnel.

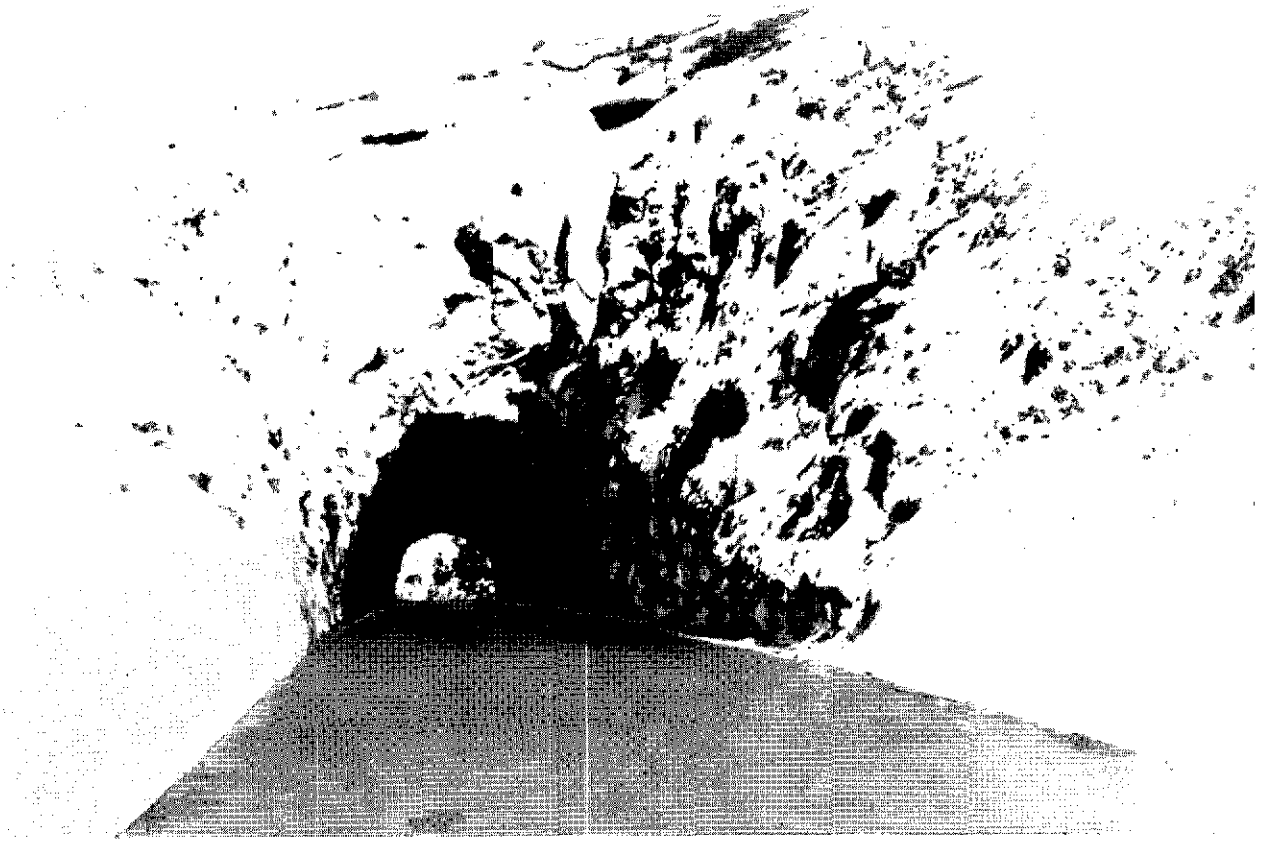


Figure 2–18. Typical unlined tunnel.

c. Specifications (items 18–21). Enter the type of lining material, type of portal material, type of ventilation, and drainage means. Under item 21, also record any lighting facilities available; if none, so state.

d. Special Considerations (items 22–29). Enter here whether the tunnel is chambered for demolition, the date of completion of the tunnel, and its present condition. Enter also bypass possibilities; the gradient and passability of approaches; in-tunnel restrictions; and any geological information pertinent to maintenance, improvement, or safety.

e. Sketches (items 30–32). Draw a plan and profile, a portal view, and a cross-section of the bore.

(1) The plan includes geographic positioning of the tunnel, approach routes, and terrain features in the immediate area of the tunnel with emphasis on special features which affect possible bypasses. Tunnel alinement is shown including straight sections, angles, and curves. The profile shows the gradient to and from the tunnel, the gradient of the tunnel floor (designating

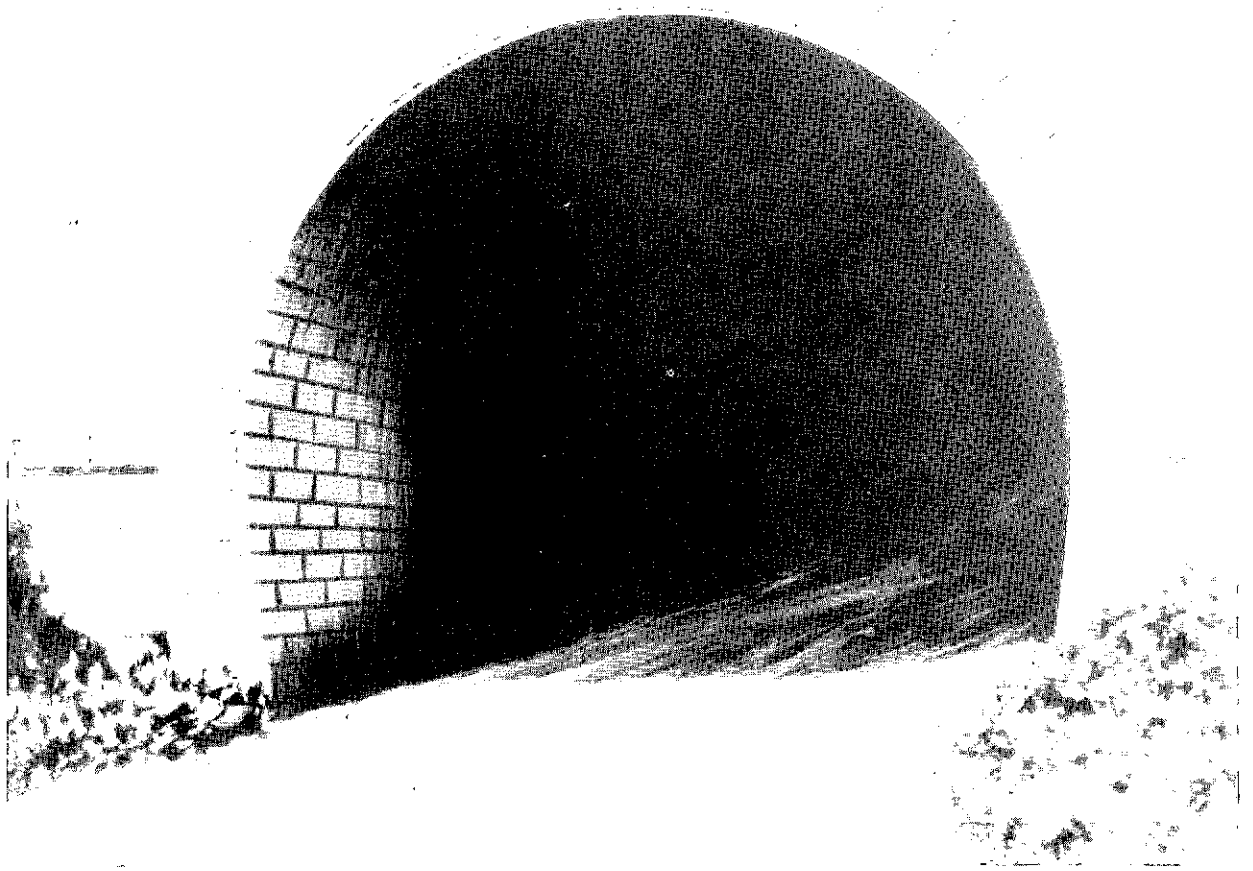


Figure 2–19. Typical masonry lined tunnel.

any change in grade), and the relation of the tunnel to the terrain through which it passes.

(2) The portal view shows the mouth of the tunnel, the material of which it is constructed, and its position in relation to the surrounding terrain. It further shows a limited section of the approach route.

(3) The cross-section of the tunnel bore shows detailed information regarding the allowable traffic width, the shape of the bore as it may affect load heights and widths, and possible man-made or natural obstructions.

f. Remarks (item 33). Include here any pertinent information not mentioned above and attach appropriate photographs if available.

Figure 2-20. Typical concrete lined tunnel.

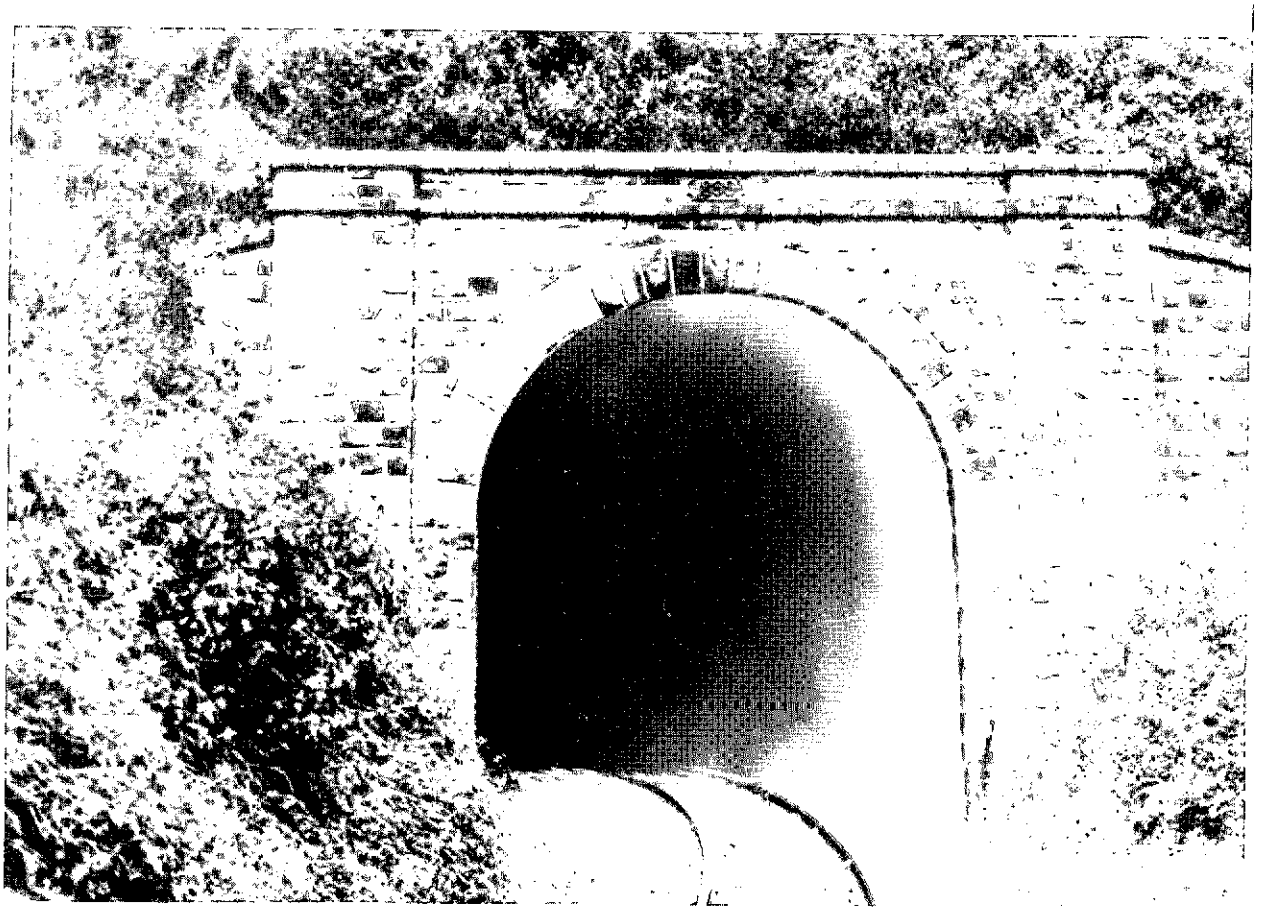


Figure 2–21. Typical masonry tunnel portal.

Figure 2–22. Typical concrete tunnel portal.

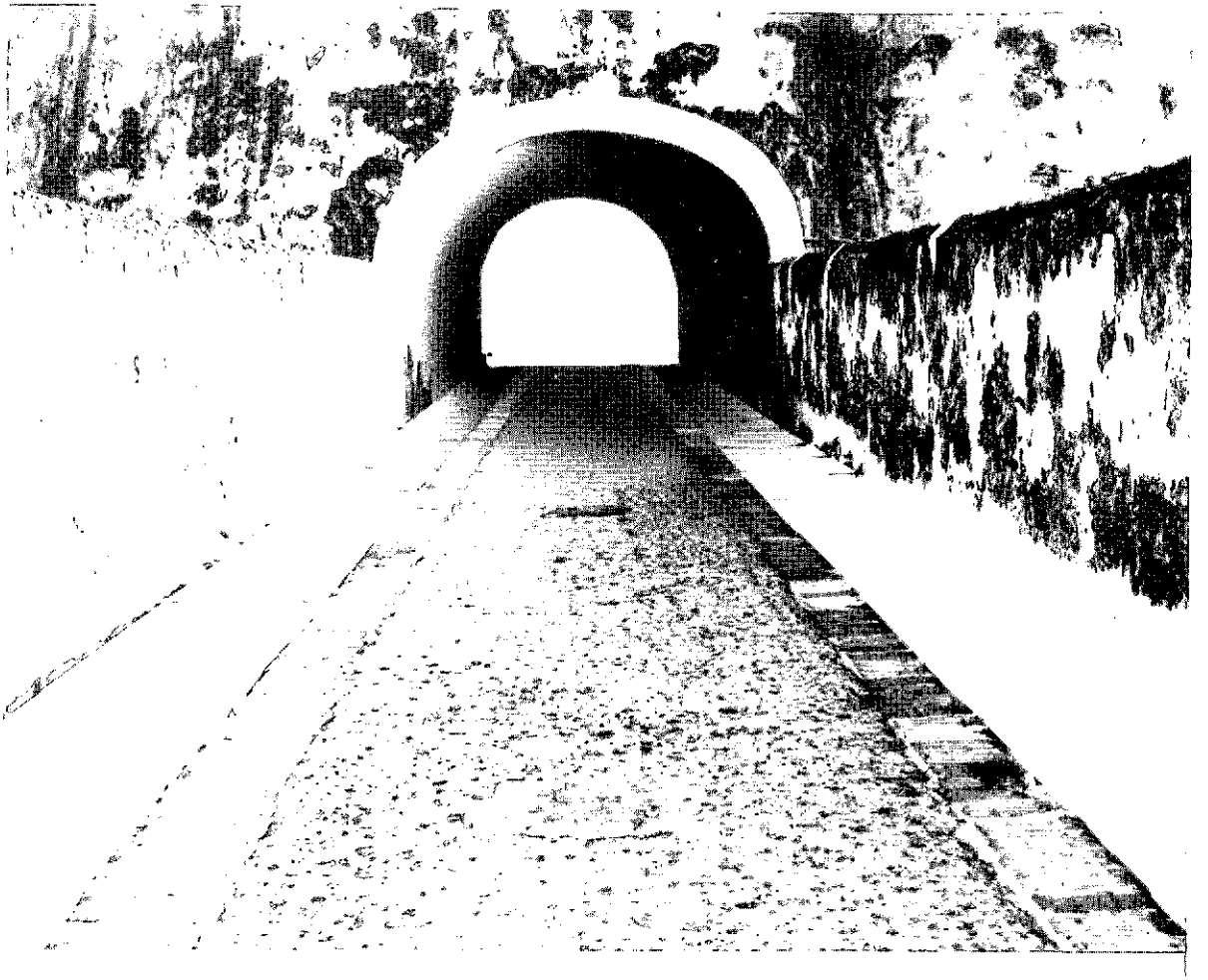


Figure 2–23. Tunnel with straight horizontal alinement.

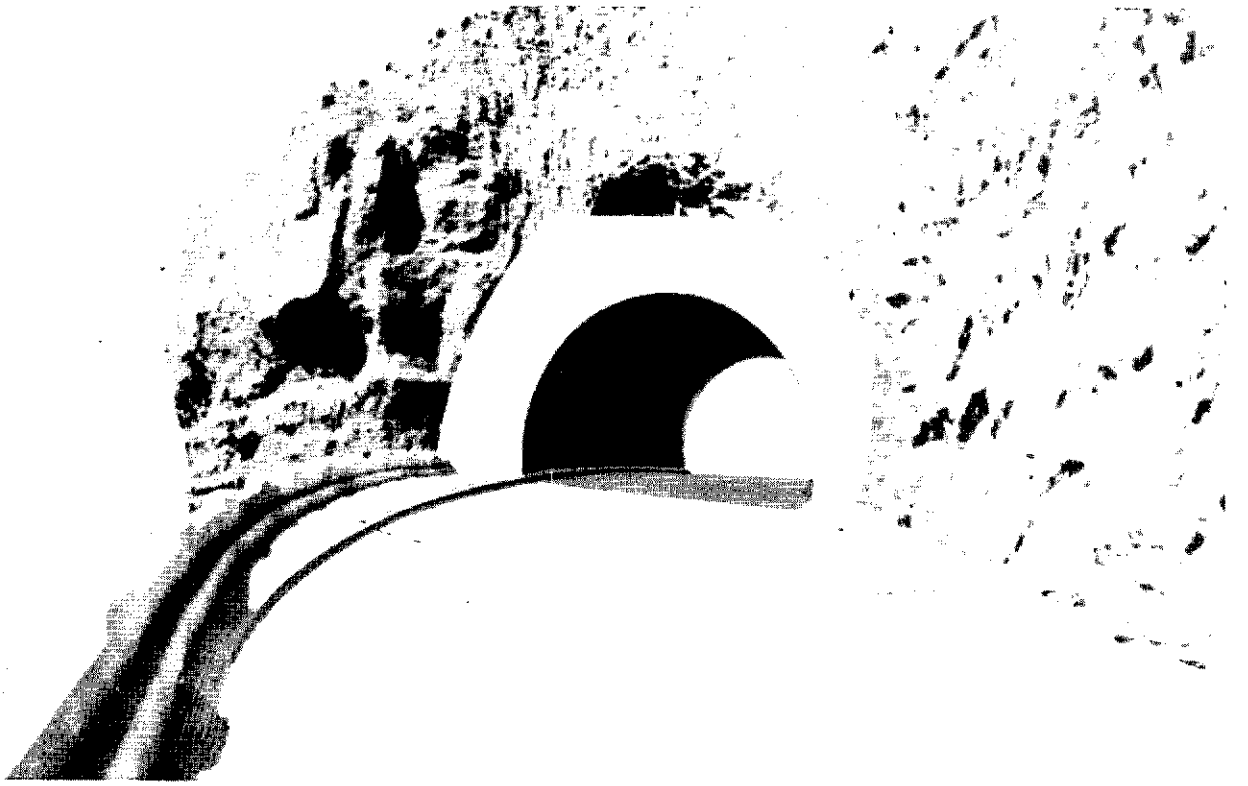
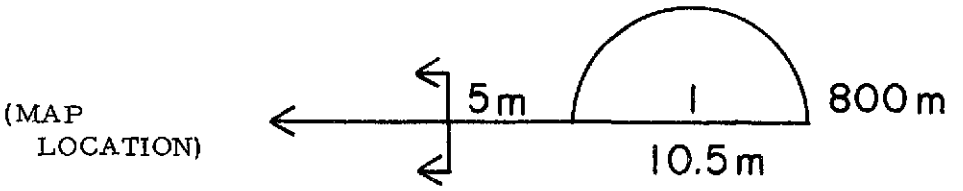
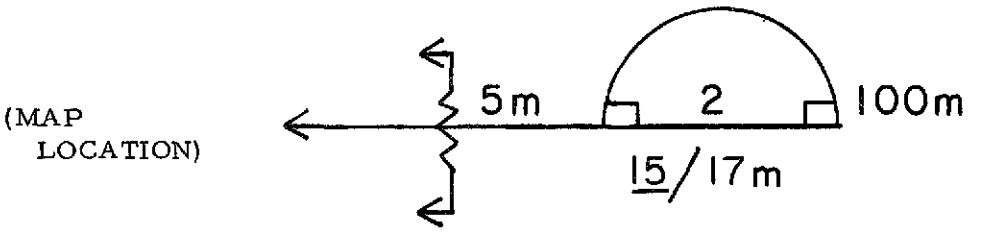


Figure 2–24. Tunnel with curved horizontal alinement.



a. Tunnel number 1, 5 meters overhead clearance, 10.5 meters width of traveled way, 800 meters length, and easy bypass available.



b. Tunnel number 2, 5 meters overhead clearance, 15 meters width of traveled way, 17 meters total width including sidewalks, 100 meters in length, and difficult bypass available. Reduction of the traveled way of the route is represented by the underlined tunnel width.

Figure 2-25. Tunnel reconnaissance symbols.

TUNNELREP					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid coordinates)	CHARLIE				
Length	DELTA				
Width	ECHO				
Overhead clearance	FOXTROT				
Gradient (percent of slope)	GOLF				
Type of tunnel	HOTEL				
Condition	INDIA				
Bypasses	JULIET				
Other information	KILO				

Notes. [a]. First tunnel in report; report by serial number if assigned.

[b]. Additional tunnels in report.

Figure 2-26. Tunnel report format.

TUNNEL RECONNAISSANCE REPORT (FM 5-36)

DATE: 14 JUNE 1964

TO: (Headquarters ordering reconnaissance): COMMANDING OFFICER, ATTN: S2; 21ST ENGR BN (21ST INF DIV)

FROM: (Name, grade and unit of reconnaissance officer): JOHN H. DOE 1/LT CO A 21ST ENGR BN

1. ROUTE OR LINE		2. FROM (Initial Point)	3. TO (Terminal Point)	4. DATE/TIME (Of signature)
HIGHWAY	RAILROAD			
VA 617	N/A	UT 122864	UT 097899	14 1800 JUN64

5. MAP SERIES NR	6. SHEET NUMBER	7. GRID REFERENCE		8. TUNNEL NUMBER
		TYPE	COORDINATES	
V 734	5561-III	UTM 1:50,000	UT 098888	T-1

9. LOCATION FROM NEAREST TOWN			10. TYPE (Subaqueous, Rock, Soil)
DISTANCE	DIRECTION	NAME OF NEAREST TOWN	
10.0 Km	NORTHWEST	FT BELVOIR, VIRGINIA	ROCK

11. NAME (Mountain or Water feature)	12. LENGTH	13. NUMBER OF TRACKS	14. ROADWAY WIDTH
ACCOTINK MTS.	100 m	N/A	7.5 m

15. CLEARANCE		16. GRADE (Percent)	17. ALINEMENT (Straight or radius of curve)
VERTICAL	HORIZONTAL		
6.0 m	8.0 m	3%	STRAIGHT

18. LINING (Material)	19. PORTALS (Material)	20. VENTILATION (Type)
CONCRETE	STONE	NATURAL

21. DRAINAGE: EXCELLENT

22. CHAMBERED FOR DEMOLITION	23. COMPLETED (Year)	24. CONDITION (Check appropriate box)
☐ YES ☑ NO	1908	☐ EXCELLENT ☑ GOOD ☐ FAIR ☐ POOR

25. BYPASSABILITY: EASY

26. ALTERNATE CROSSING: BACKLICK ROAD TO SHIRLEY HWY

27. APPROACHES: FAIR (4%)

28. IN-TUNNEL RESTRICTIONS: NONE

29. GEOLOGIC DATA: LIMESTONE

DA FORM 1 JAN 56 1250

Figure 2-27. Tunnel reconnaissance report (DA Form 1250).

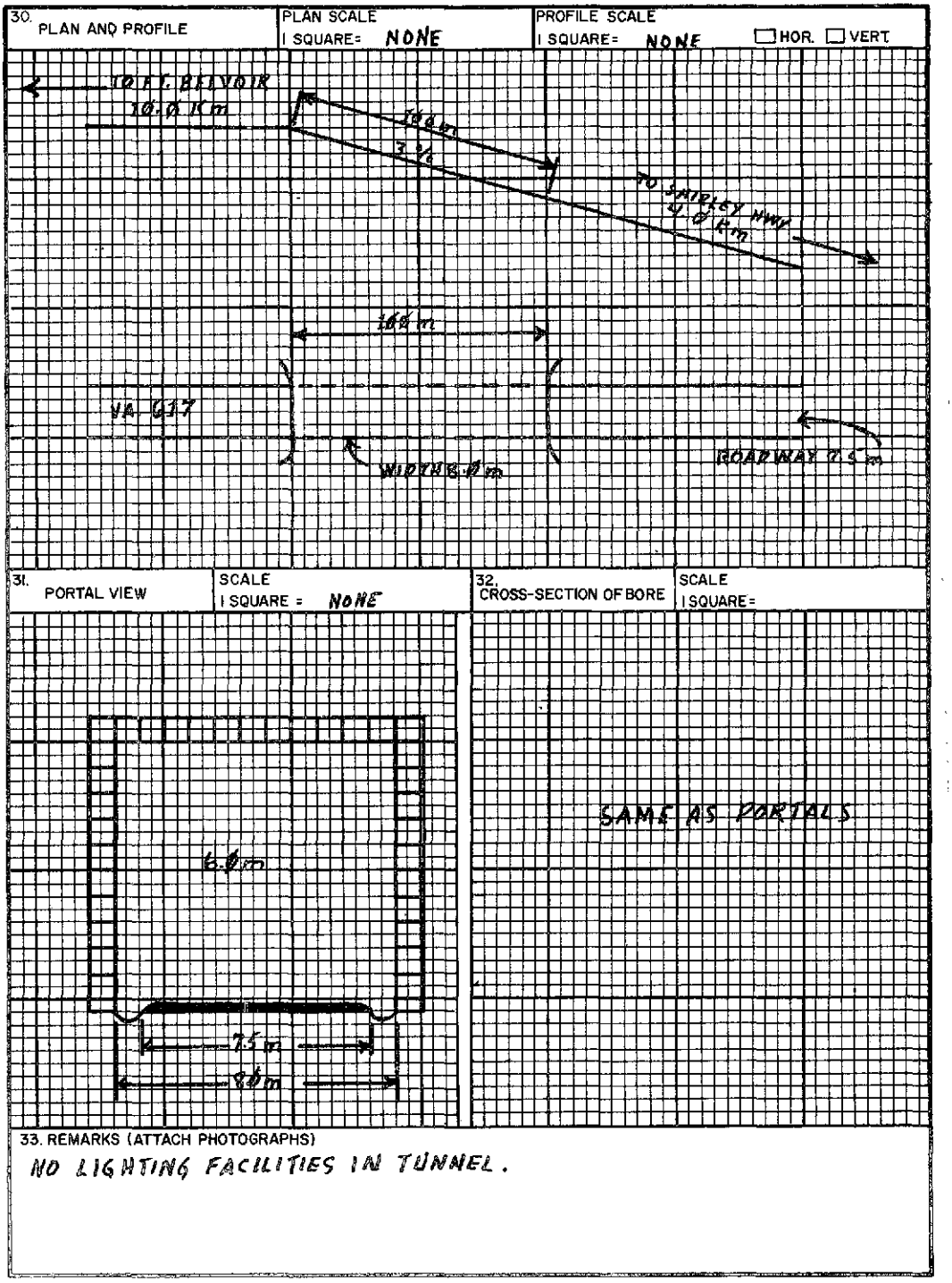
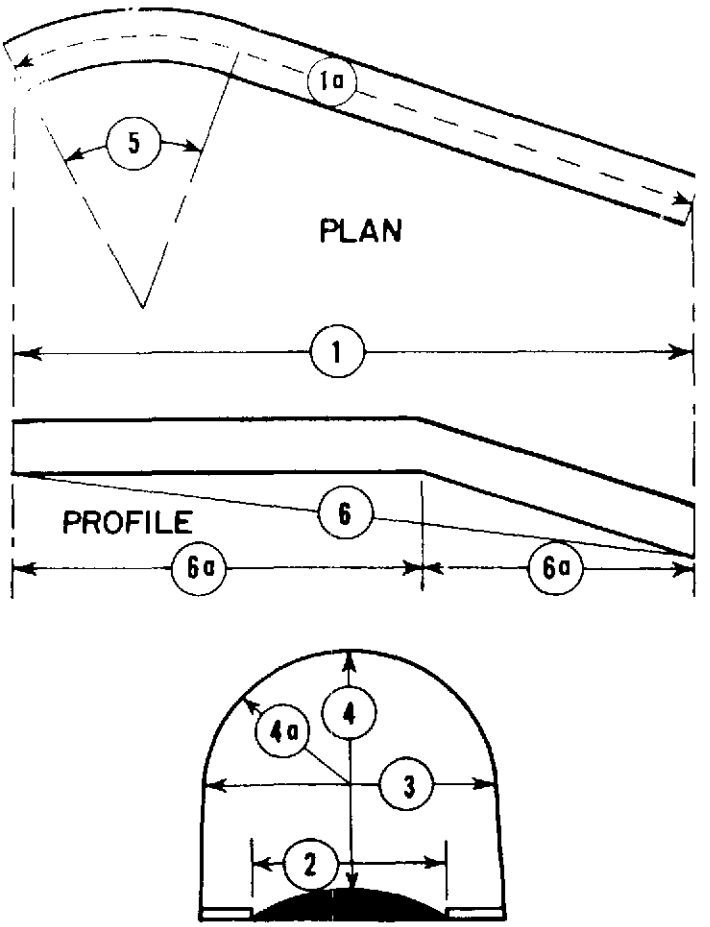


Figure 2-27—Continued.



1. Portal-to-portal length of tunnel.
1a. Centerline distance of tunnel.
2. Effective width of the traveled way, curb-to-curb.
3. Horizontal clearance, is the minimum width of the tunnel bore measured at least four feet above the traveled way.
4. Overhead clearance, is the minimum distance between the top of the traveled way and the lower edge of the tunnel ceiling or any obstruction below the ceiling, such as trolley wires or electric light wires.
4a. Rise of tunnel arch (radius of curved portion).
5. Radius of curvature of the traveled way either measured or estimated.
6. Gradient is the percentage of rise of the traveled way between portals.
6a. Change in gradient within the tunnel (percentage of rise each way from break of grade).

Figure 2-28. Standard dimensional data for tunnels.

Section V. VEHICULAR FORDING, SWIMMING, AND FERRYING OPERATIONS

2-30. General

Modern military vehicles and equipment provide the commander with increased capabilities to conduct vehicular fording, swimming, and ferrying operations. Mass destruction weapons demand dispersion and the reduction of obstructions to traffic which create lucrative targets. It can be expected, therefore, that the employment of the inherent stream crossing characteristics of modern military vehicles will become increasingly more common. Reconnaissance personnel will be required to locate and accurately report suitable stream crossing sites. Considerations of terrain common to fording, swimming, and ferrying operations are: depth of stream, width of stream, approaches to the stream, entrances and exists to the stream, stream velocities, and natural and manmade obstacles (fig. 2-29). *Fords and ferries are considered as obstructions to traffic flow and are indicated by the abbreviation (OB) in the route classification formula* (para. 2-8).

2-31. Determining Depth of Stream

Field expedients are usually required such as measured poles or weighted ropes for determining depths. Depth readings are normally taken every three meters. A sluggish stream or river may become a torrent in a few hours or even minutes as a result of sudden heavy rainfall. This is particularly true in tropical and arid regions. Therefore, depths and currents must be checked at frequent intervals to provide warning of such changes. Additional factors which require consideration are upstream locks or dams which may cause floods when opened or destroyed thus temporarily disrupting crossing.

2-32. Determining Stream Width

a. Using a Compass (fig. 2-30). From a point on the near shore and close to the water's edge, the azimuth to a point on the opposite shore is taken and recorded. *Another* point on line at a right angle to the azimuth selected is established on the near shore from which the azimuth to the same point on the far shore is 45° (800 mils) at variance with the previously recorded azimuth. The distance between the two points on the near shore is measured; this distance is equal to the distance across the stream.

b. Using a Surveying Instrument (fig. 2-31).

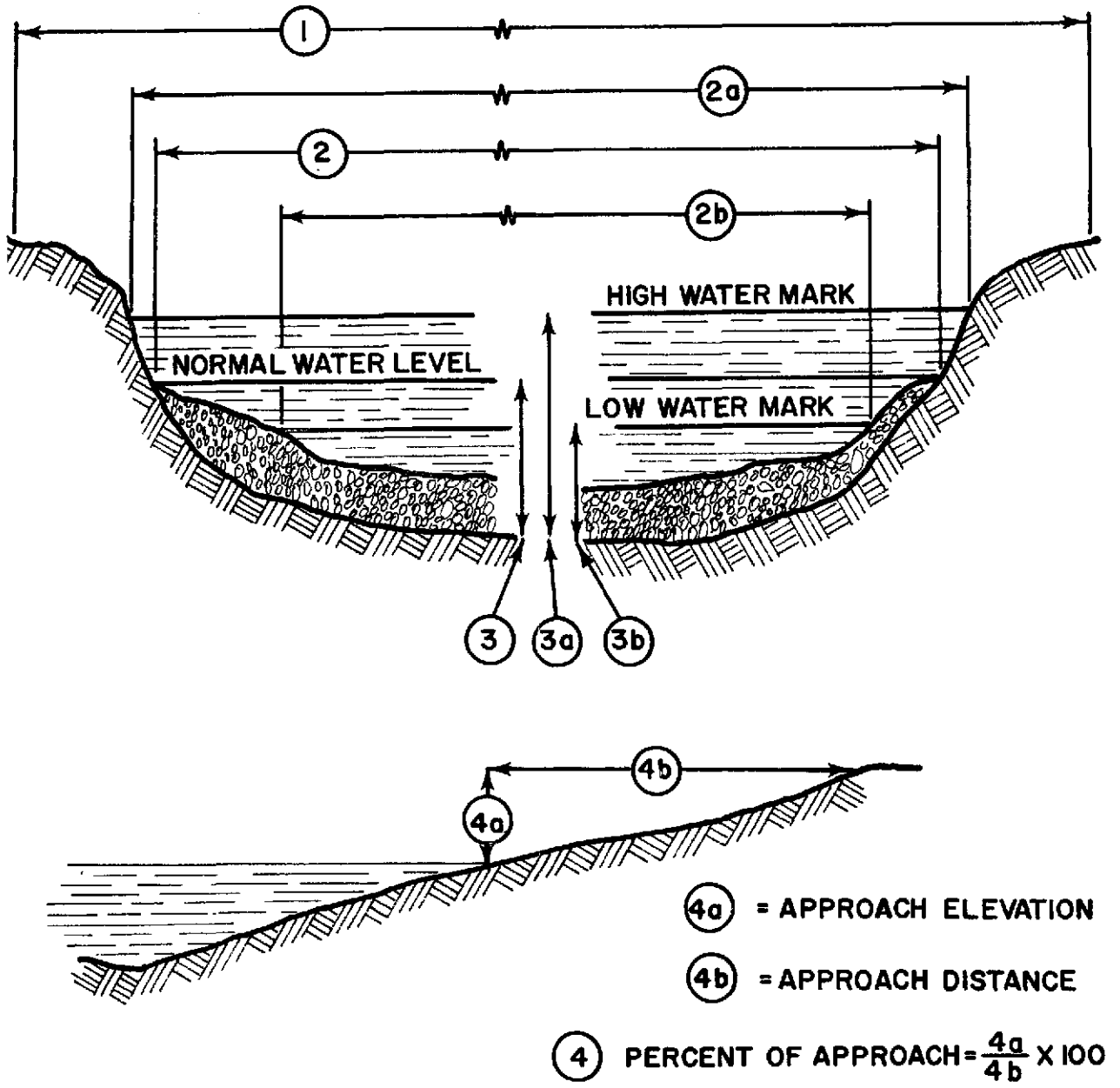
(1) *Trigonometric relationships.* Using a transit, aiming circle, azimuth indicator, or alidade, the angle between two points a known distance apart on the near shore and a third point directly across the river from one of these points is measured. The distance across the stream is computed using trigonometric relationships (app. II and TM 5-232).

(2) *Using stadia formula.* A man is sent across the stream with either a stadia rod or range pole. Using either a transit or level, the intercept between the stadia hairs is determined and the distance computed using the stadia formula as described in TM 5-232.

c. Short Gaps. In the measurement of short gaps, one member of the reconnaissance team holds an end of a tape or rope on the near bank. Another member of the team crosses to the opposite bank and pulls the tape tight. The length of tape which corresponds to the distance across the gap is then measured. This method is particularly useful during darkness when lights are prohibited. The width of the gap may be indicated on the tape and measured later in an area where lights may be used.

2-33. Determining Stream Velocity

Current velocities vary in different parts of a stream. In general, the current is usually slower near the shore and swifter in the main channel; similarly, the current is slower as the stream widens. To determine the velocity of a stream, a distance is measured along the riverbank. A light object which floats is thrown into the stream, and the time the object requires



1. The width of stream bed from bank to bank.
2. The actual width of the water measured at normal stage. In addition, maximum width 2a and minimum width 2b are estimated, based on local observations or records of high water and low water, and then recorded.
3. The actual depth of the stream at normal water level.
3a. Estimated maximum water depth based on local observations or records.
3b. Estimated minimum water depth based on local observations or records.
4. The slope of the approaches. It is the slope of the stream banks through which the approach roads are cut. This is expressed as the ratio between elevation 4a and distance 4b.

Figure 2-29. Standard dimensional data for streams.

to float the measured distance is recorded. This procedure is then repeated. The average time of the tests is then used in the following formula to determine stream velocity (fig. 2-32):

$$\frac{\text{Measured Distance in Meters (Ft)}}{\text{Average Time in Seconds}} = \text{Stream velocity in meters (ft) per second}$$

Once the stream velocity in meters (ft) per second has been determined, this figure may be converted to other units of measurements by using the appropriate conversion factor (see app. II).

2-34. Entrances and Exits

Gentle sloping entrances and exists are desirable for fording the swimming operations. Slope is expressed in percent as described in paragraph 2-16. Vehicle maximum grade capabilities are found in appendix IV although it must be remembered that these figures are for ideal conditions and that a vehicle's capability is significantly reduced in climbing wet, icy, or rutted banks. Even the most gradual slopes may require improvement before crossing operations can commence. Bank can often be improved by use of pioneer tools, bulldozers, combat engineer vehicles, or tank dozers. When reconnaissance personnel have determined that improvements to the banks are required, the amount and type of necessary work is included in the route reconnaissance report.

2-35. Obstacles

Obstacles to river-crossing operations include:

a. Escarpments or high vertical banks.

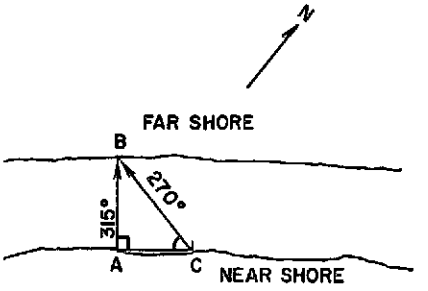
b. Mines and boobytraps at entrance and exit sites and along likely approaches. Moreover, mines may also be submerged in stream channels or attached to poles and floating logs.

c. Debris and floating obstacles such as large quantities of logs and brush; poles or floating logs with wire attached for fouling propellers and suspension systems; and, in cold weather, ice crusts or ice floes.

2-36. Ford Reconnaissance

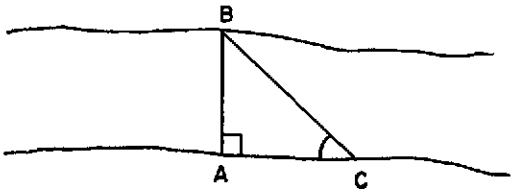
A ford is a location in a water barrier where the physical characteristics of the current, bottom, and approaches permit the passage of personnel and/or vehicles and other equipment whose suspension systems remain in contact with the bottom (fig. 2-33). Physical characteristics of a ford are summarized in table 2-3 and explained as follows:

a. Trafficability. Fords are classified according to their crossing potential for foot or wheeled and tracked vehicles. Fordable depths for vehicular traffic can be increased by suitable waterproofing, or in the case of modern tanks, by the addition of deep water fording



A IS THE POINT ON THE NEAR SHORE
B IS THE POINT ON THE FAR SHORE
AB IS THE DISTANCE TO BE MEASURED
AZIMUTH OF LINE AB IS 315°
AZIMUTH OF LINE CB IS 270°
DIFFERENCE BETWEEN AZIMUTH AB & AZIMUTH CB=45°
DISTANCE ALONG AC EQUALS DISTANCE ALONG AB

Figure 2-30. Measuring stream width with compass.



THE ANGLE AT A IS 90°
THE ANGLE AT C IS MEASURED

$$\text{TAN} = \frac{AB}{AC} \qquad AB = \text{TAN C} \times AC$$

Figure 2-31. Measuring stream width using surveying instrument.

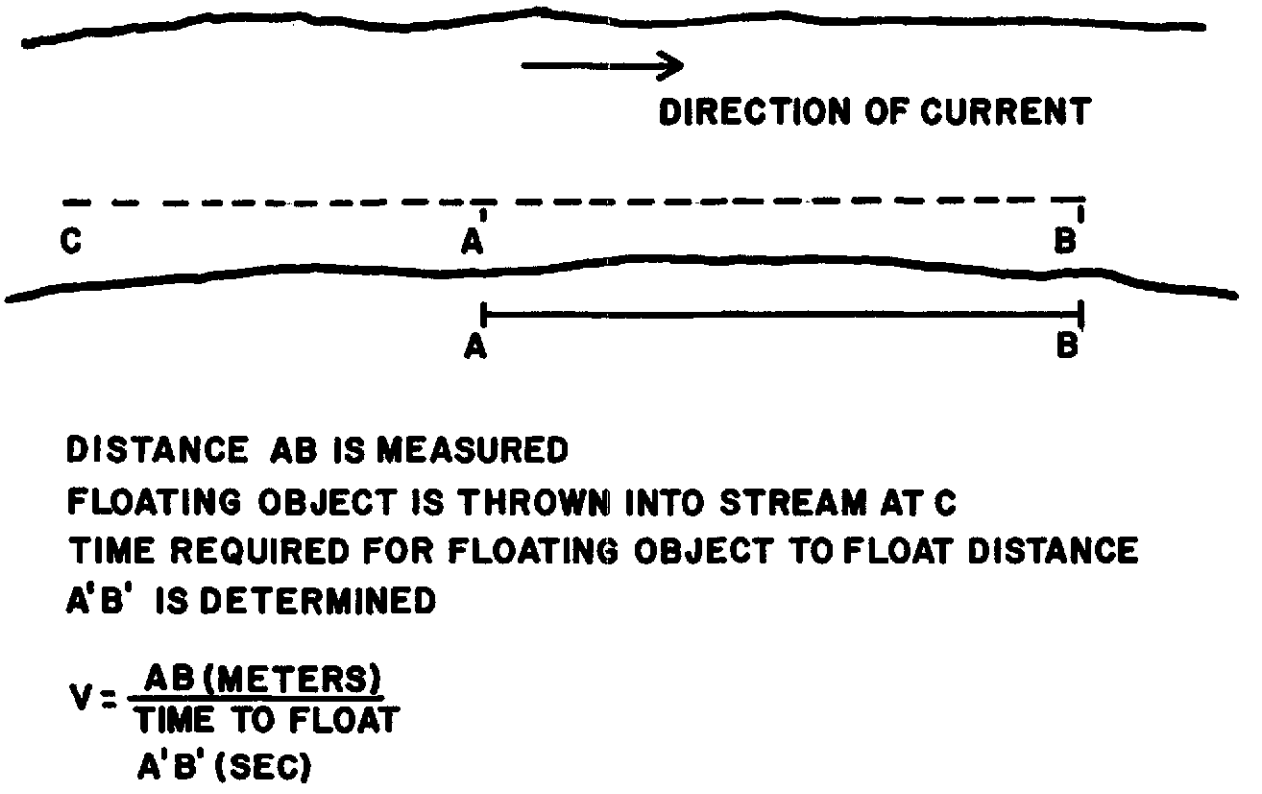


Figure 2-32. Method of determining stream velocity.

kits which permit fording of depths up to 4.3 meters (14 ft).

b. Approaches. Approaches may be paved with concrete or a bituminous surface material but are usually unimproved. The composition and the slope of the approaches to a ford should be carefully noted to permit determination of its trafficability in inclement weather and after fording vehicles have saturated surface material.

c. Bottom. The composition of the stream bottom of a ford determines its trafficability. It is important, therefore, to determine if the bottom is composed of sand, gravel, silt, clay, or rock and in what combination. In some cases, the natural river bottom of a ford may have been improved to increase load-bearing capacity and to reduce the water depth. Improved fords may have gravel or concrete surfacing, layers of sandbags, metal screening or matting, timber (corduroy) or wooden planking. Bottom conditions are determined by checking the stability and composition of the bed. If the water is shallow, this can be accomplished by wading across the obstacle. In deeper water, underwater reconnaissance personnel may be required to determine bottom conditions (see para. 2-37).

d. Climatic Conditions. Seasonal floods, excessive dry seasons, freezing, and other extremes of weather materially affect the fordability of a stream. For this reason, the climatic effect to which a ford may be subjected is considered.

e. Current. The velocity of the current and the presence of debris are recorded in order to

determine their effect, if any, on the condition and passability of the ford. Current is estimated as swift (more than 1.5 meters per second), moderate (1 to 1.5 meters per second), and slow (less than 1 meter per second).

Table 2-3. Trafficability of fords.

Type of traffic	Shallow fordable depth (meters)	Minimum width (meters)	Maximum desirable percent of slope for approaches[1]
Foot	1 (40")	1 (40") (single file) 2 (80") (column of 3's)	100%
Trucks and truck-drawn artillery.	.6 (24")	3.6 (12')	33%
Light tank	1 (40")	4.2 (14')	50%
Medium tanks [2]	1.2 (48")	4.2 (14')	50%

[1] Based on hard, dry surface.

[2] Depths up to 4.8 meters can be negotiated with deep water fording kit.

f. Low Water Bridges. During high water periods, low water bridges may be easily confused with paved fords as both are completely submerged. This type of bridge consists of two or more intermediate supports with concrete decking and located wholly within ravines or gullies. In reconnaissance it is important to differentiate between this type of bridge and a paved ford because of corresponding military load limitations.

2-37. Underwater Reconnaissance

a. Physical reconnaissance and selection of deep water fording sites are conducted by teams trained and equipped for underwater reconnaissance. When the water obstacle is narrow, underwater reconnaissance personnel may enter from the near bank and conduct their reconnaissance by swimming to the far bank. When the distance between banks cannot be easily spanned by swimming personnel, swimming vehicles or reconnaissance boats enter the water once an entrance has been selected and drop off teams at regular intervals. Craft remain in the water during reconnaissance and pick up swimmers when the operation is completed unless the area is under enemy fire or observation. In this case, divers swim to the friendly shore; or if on the far side of a wide obstacle, they signal when ready to be picked up. Additionally, helicopters can be used to drop off teams in the water or place teams on the far shore if the situation permits.

b. To assist underwater reconnaissance teams in maintaining direction, weighted ropes may be placed across the bottom of the water obstacle. Attached to these ropes are buoys or other floating objects to indicate the area of responsibility of each team. When the current is in excess of 1.3 meters per second (4.25 feet per second), underwater reconnaissance personnel have difficulty maintaining a position along the line selected. To assist swimmers another weighted rope, parallel to the directional rope, may be placed upstream with lateral lines connecting both ropes.

c. During periods of good visibility and when the water is clear, bottom conditions can be easily determined. Under blackout conditions, however, or when the water is murky, reconnaissance is much slower since swimmers must feel their way across. If the tactical situation permits, searchlights and flares may be employed in addition to waterproof lights used by the swimmers.

d. The length of time that underwater reconnaissance personnel can remain in the water depends upon their training, the current, water temperature, and equipment. When conducting a reconnaissance in any current, a swimmer expends more energy, tires more easily, and uses his air supply more quickly. In temperatures between 70° and 85° F, divers can work comfortably in their underwear but chill in 1 to 2 hours if not exercising. In temperatures above 85° F, the diver overheats and the maximum temperature that can be endured, even at a rest, is 96° F. Protective covering is usually needed when the water temperature is below 70° F; furthermore, in cold water sense of touch and ability to work with hands are affected. Air tanks vary in size; the capacity of the tank and working conditions govern how long a diver can operate. Extra tanks should be readily available for underwater reconnaissance teams and recharging equipment located so as to be responsive to team requirements.

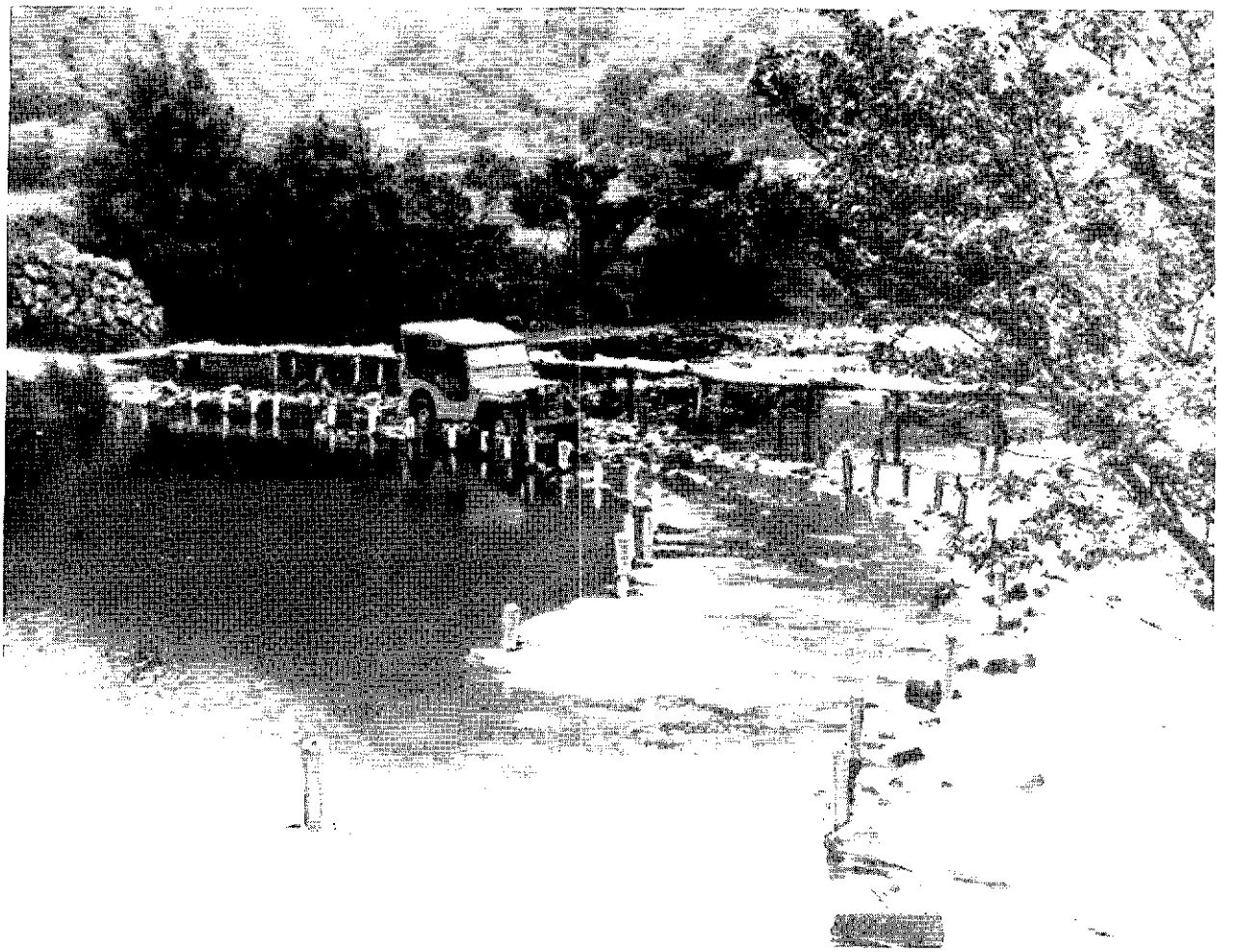


Figure 2–33. Typical ford crossing.

2–38. The Ford Reconnaissance Symbol (STANAG 2274)

Limited ford information is recorded on maps or overlays by means of symbols as illustrated in figures 2–2 and 2–34.

a. The geographic *location* of the ford is shown by an arrow from the symbol to the location of the ford on a map or overlay. The symbol may be drawn on either side of the stream.

b. A *serial number* is assigned each ford for ease in subsequent reference. Numbers must not be duplicated within any one map sheet, overlay, or document. The number is recorded to the extreme left and above the arrow leading to the ford.

c. The *type* of ford is placed after the serial number; the letters, A—Auto, P—Pedestrian and animal, D—Deep water, tank, and S—Swimming vehicles, are used to designate ford type.

d. Normal *velocity of stream* expressed in meters per second is placed after the ford type.

e. Seasonal limiting factors follow the stream velocity notation and are shown by the letters—

X—no seasonal limitation except for sudden flooding of limited duration.

Y—significant seasonal limitations.

f. Length of the ford is expressed in meters and is recorded to the extreme left and *below* the arrow leading to the ford.

g. Width of the ford is also expressed in meters and follows the ford length notation.

h. The *nature of the bottom* is shown after the ford width by the most appropriate letter symbol—

M—mud
C—clay
S—sand
G—gravel
R—rock
P—artificial paving

i. The *normal depth* of water at the deepest point is expressed in meters and is placed below the arrow immediately after the symbol expressing the type of bottom.

j. A *difficult approach* is shown by irregular lines placed on the corresponding side of the basic symbol. The left and right bank of a stream is ascertained by looking in the direction of the current (downstream). Attention must be paid to the direction of the stream flow in drawing this portion of the symbol.

k. All elements of the ford symbol are separated by slashes (/).

l. If any item of the ford symbol is unknown or undetermined a question mark (?) is substituted therefor.

2-39. Format for Electrically Transmitting Ford Information (STANAG 2096 and SOLOG 107)

To provide standardization in reporting essential ford reconnaissance data by electrical means, the format shown in figure 2-35 has been adopted. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11-170), the format, which is reproduced locally, may also be used to supplement route reconnaissance reports especially when more detailed information than can be depicted by the ford reconnaissance symbol is required. The originator completes only those parts of the format which are applicable or for which information is available. Each item of the report, however, must be accompanied by the appropriate letter designation from the format to establish the correct category of information. Messages are preceded by the term, FORDREP, or identifying codeword.

2-40. Ford Reconnaissance Report Form

When more detailed information is required concerning a specific ford, especially when conducting deliberate reconnaissance, the Ford Reconnaissance Report Form (DA Form 1251) is used to provide a permanent record of ford information (fig. 2-36). If required, short forms or worksheets for rapid field work may be designed and produced for reconnaissance purposes. Details to be entered on the Ford Reconnaissance Report Form are as follows:

a. Identification (item 1-10). Enter all data which establishes positive identification of the ford as to route, map sheet, grid reference, ford serial number, geographic location, and name of stream or crossing.

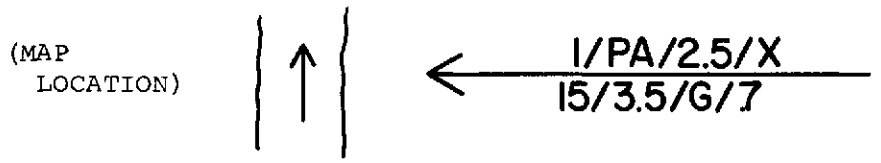
b. Characteristics of Crossing (item 11). Record the width and depth of the crossing and the velocity of the stream at present water level and at low, mean, and high level. Also give data, season, or month(s) for each of these. Figure 2-29 illustrates the dimensions to be recorded at each water level.

c. Description (item 12-17). Record the composition of the stream bottom, composition and percent of slope of approaches, type of pavement (if any) of approaches and ford, usable width of approaches and ford, and any hazards such as flash floods or quicksand which would affect the trafficability of the ford.

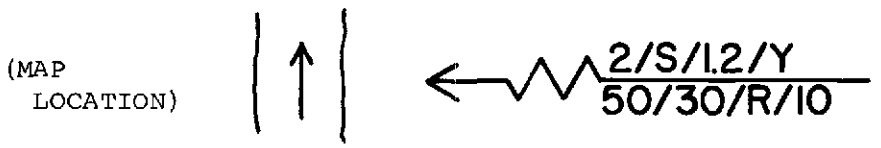
d. Remarks (item 18). Enter here any other pertinent data not recorded elsewhere on the report. This should include description of approach roads, guide markers, depth gages, availability of and distances to bypasses and alternate crossings, and any other information which may assist in the classification of the ford.

e. Sketches (items 19 and 20). Draw sketches of the ford showing both a profile and a site plan.

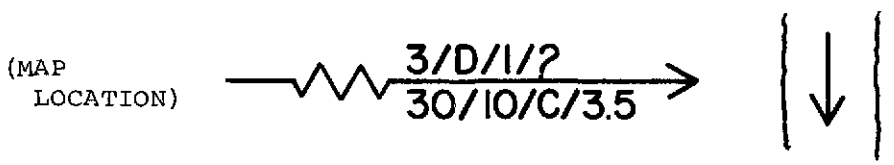
(1) The profile sketch indicates the water level and the elevation of the stream bottom and approaches.



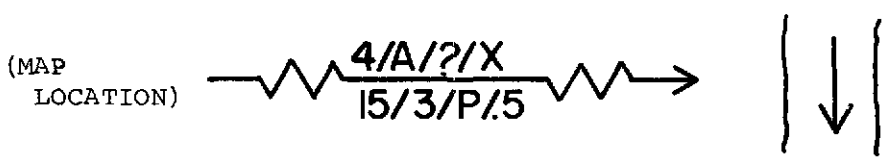
Ford Number 1, pedestrian and vehicular stream velocity 2.5 meters per second, no seasonal limitation, 15 meters long, 3.5 meters wide, gravel bottom, .7 meters in depth without difficult approaches.



Ford Number 2, swimming vehicles, stream velocity 1.2 meters per second, seasonal limitations, 50 meters long, 30 meters wide, rock bottom, 10 meters in depth with difficult approach on the left bank.



Ford Number 3, tank deep water ford, stream velocity 1 meter per second, seasonal limitations unknown, 30 meters long, 10 meters wide, clay bottom, 3.5 meters in depth with a difficult approach on the right bank.



Ford Number 4, vehicular ford, stream velocity unknown, no seasonal limitations, 15 meters long, 3 meters wide, artificial paving, .5 meters in depth with difficult approaches on both banks.

Figure 2-34. Examples of the ford symbol.

FORDREP					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid coordinates and ford type)	CHARLIE				
Minimum width	DELTA				
Maximum depth	ECHO				
Stream velocity	FOXTROT				
Type of bottom	GOLF				
Maximum percent of slope on bank exits and entrances.	HOTEL				
Military load classification	INDIA				
Other information	JULIET				

Notes. [a]. First ford in report; report by serial number if assigned.
[b]. Additional fords in report.

Figure 2-35. Ford report format.

(2) The site plan gives the alinement of the ford and its approaches with appropriate dimensions. Terrain and other site features in the immediate area of both banks are shown. Also the north arrow and the direction of flow of the stream are indicated.

f. Remarks (item 21). Include here any pertinent information not mentioned above. Additionally, whenever a ford is reconnoitered, it is photographed if possible. Photographs should show the banks, the approaches, and the stream in one view. The photograph should be taken while a military vehicle is crossing to give an indication of water depth and the location of the ford.

2-41. Marking of Fords

Instructions for fording and swimming vehicles will be indicated by standard bridge signs (para. 2-52). A circular bridge classification sign is employed if the ford is classified as to load-bearing capacity. In addition, rectangular signs are employed to indicate crossing instructions such as maximum permissible crossing speeds, reminders of wet brakes, depth of ford, etc. Provisions should also be made to indicate the trace of the ford across the water barrier. Marking may be accomplished by poles protruding above the water or by ropes supported by buoys. Consideration should also be given to marking the ford under conditions of limited visibility. Shielded electric lamps may be used in a manner similar to that prescribed for marking lanes through minefields (see FM 20-32).

2-42. Reconnaissance in Support of Vehicular Swimming Operations

For purposes of reconnaissance, vehicular swimming operations are considered as a special type of ford reconnaissance (fig. 2-37). Most details of ford reconnaissance are pertinent to swimming operations including depth and bottom characteristics of the crossing site, especially stream entrance and exits as well as sandbars and other obstructions that may exist in the stream channel. The ford reconnaissance symbol, the format for electrically transmitting ford data, and the Ford Reconnaissance Report Form (DA Form 1251) are applicable when modified with the notation that the site is appropriate for swimming vehicles only. Of particular significance to this type of reconnaissance are—

a. Geographic location.
b. Serial number.
c. Stream velocity.
d. Seasonal limiting factors.
e. Length of ford.
f. Depth limitations.

FORD RECONNAISSANCE REPORT (FM 5-36)

DATE: 14 JUNE 1964

TO: (Headquarters ordering reconnaissance): COMMANDING OFFICER, ATTN: S2 21ST ENGR BN (21ST INF DIV)

FROM: (Name, grade and unit of reconnaissance officer): John H. Doe
JOHN H. DOE 1/LT CO A 21ST ENGR BN

1. ROUTE NUMBER	2. FROM (Initial Point)	3. TO (Terminal Point)	4. DATE/TIME (Of signature)
VIRGINIA 617	UT 122864	UT 097899	14 1800 JUN 64

5. MAP SERIES NUMBER	6. SHEET NUMBER	7. GRID REFERENCE TYPE	7. GRID REFERENCE COORDINATES	8. FORD NUMBER
V734	5561-III	UTM 1:50,000	UT 100886	1

9. LOCATION FROM NEAREST TOWN: DISTANCE	DIRECTION	NAME OF NEAREST TOWN	10. CROSSING (Name of stream or other body of water)
11.0 Km	SOUTHEAST	FT. BELVOIR, VIRGINIA	ACCOTINK CREEK

11. CHARACTERISTICS OF CROSSING

WATER LEVELS	WIDTH	DEPTH	VELOCITY	DATE	SEASON OR MONTH(S)
TODAY	7.3 m	0.5 m	1.5 mps	14 JUN 64	SPRING
LOW	6.1 m	0.3 m	1.1 mps	07 AUG 64	SUMMER
MEAN	7.3 m	0.5 m	2 mps		
HIGH	8.4 m	1.8 m	2.2 mps		

12. BOTTOM: ☐ SAND ☑ GRAVEL ☐ STONE ☐ OTHER (Specify):

13. APPROACHES: ☐ FIRM ☐ SOFT ☑ PAVED

14. SLOPE RATIO: 10 %

15. TYPE OF PAVEMENT	16. USABLE WIDTH	17. HAZARDS (Flash floods, quicksand, etc.)
BITUMINOUS	8.2 m	UNKNOWN

18. REMARKS (Description of Approach Roads, Guide Markers, Depth Gages, etc.)

NO DEPTH GAGE

DA FORM 1 JAN 65 1251

Figure 2-36. Ford reconnaissance report form (DA Form 1251).

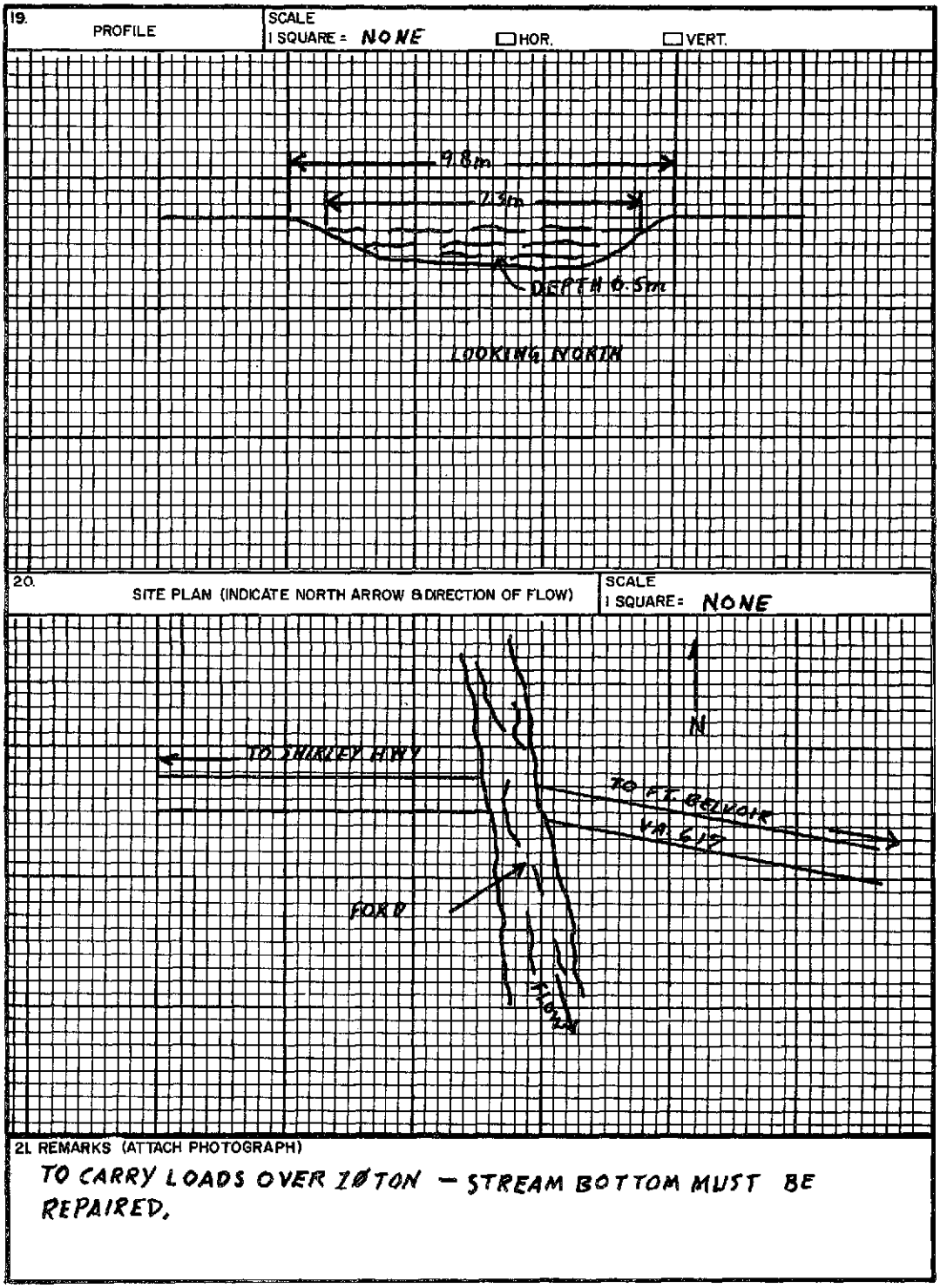


Figure 2-36—Continued.

g. Approaches into the water until the vehicle is waterborne. Additionally, landing sites must be sufficiently wide to allow vehicles to exit although subjected to the lateral force of the stream current.

2-43. Ferry Types

A ferry site is a place or passage where traffic and cargo are conveyed across a river or other water barrier by a floating vehicle which is called a ferry or ferryboat. Ferries encountered in route reconnaissance vary widely in physical appearance and capacity depending upon the width, depth, current, and the characteristics of the traffic to be moved. Propulsion of ferries may be by oars, cable and pulleys, poles, stream current (trail and flying ferries), or by steam, gasoline, and diesel engines. Construction of ferryboats varies widely ranging from expedient rafts to ocean-going vessels.

2-44. Existing Civil Ferries and Ferry Sites

a. Usually, the capacity of a civil ferryboat is expressed in tons and total number of passengers and, in addition, is often assigned a military load classification number. When more than one ferry is employed for a given site, the capacity of each is reported.

b. Ferry slips or piers are generally provided on the shore to permit easy loading of passengers, cargo and vehicles. The slips may vary from simple log piers to elaborate terminal buildings. A distinguishing character-

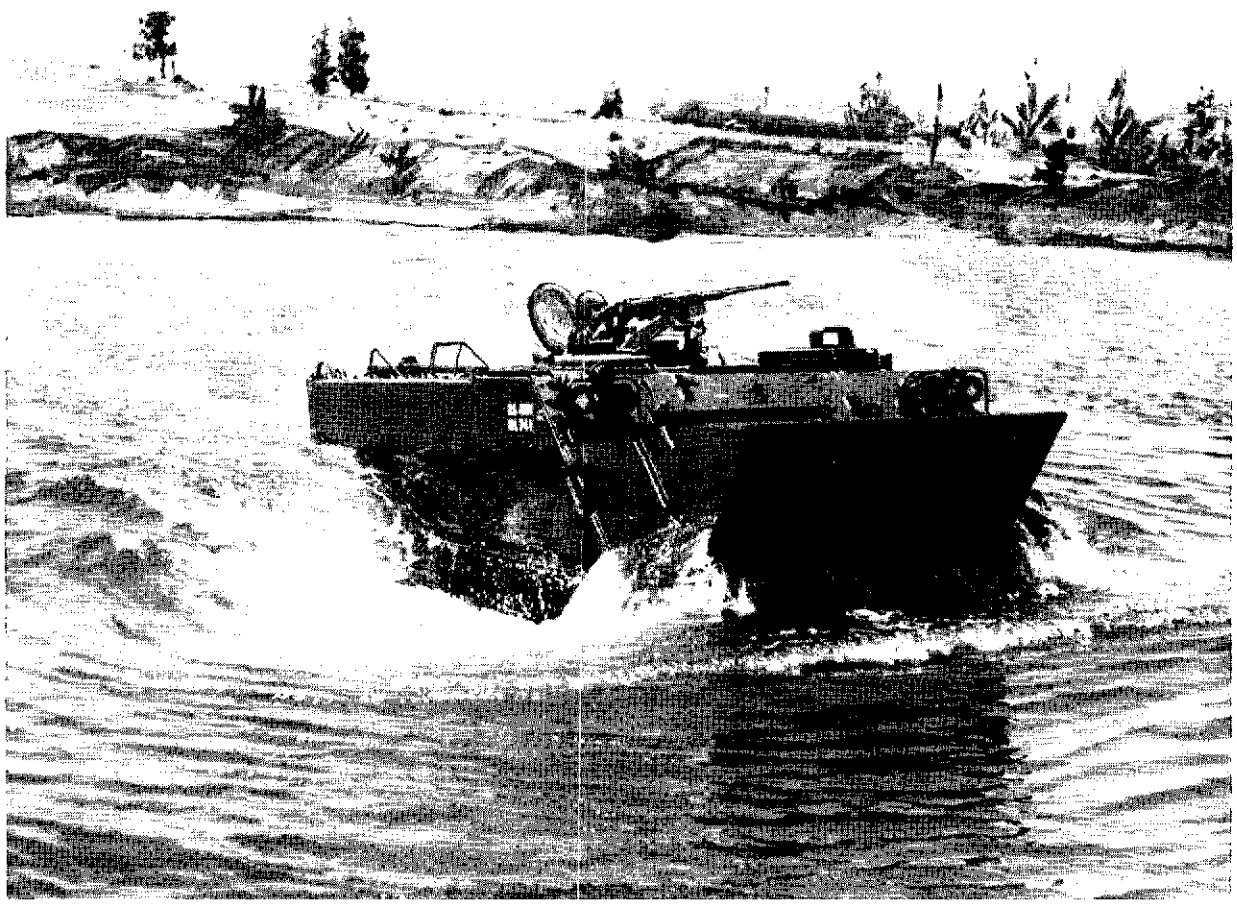


Figure 2-37. Armored personnel carrier, M113.

istic o[illegible] slip is often the floating pier whi[illegible] adjusts to the height of the fe[illegible] luctuations in the water depth.

[illegible] utes to ferry installations [illegible]n im[illegible] bearing on the use of the ferry. Th[illegible] the condition of the approaches [illegible] load-carrying capacity of landing facilities investigated and recorded.

d. Limiting characteristics of ferry sites are considered, such as:

(1) Width of the water barrier from bank to bank.

(2) The distance and time traveled by the ferryboat from one side to the other side.

(3) Depths of the water at each ferry slip.

e. Climatic conditions have a marked effect on ferry operations. Fog and ice substantially reduce the total traffic-moving capacity and increase the hazard of the water route. Therefore, data on tide fluctuations, freezing periods, floods, excessive dry spells, and their effects on ferry operation are considered.

2-45. Military Ferry and Rafting Sites

Reconnaissance personnel may be required to locate and report suitable sites for military rafting and/or ferrying operations. Equipment presently available for such operations are either components of military floating bridges, which are assembled into rafts at the water's edge, or units of the mobile assault bridge (MAB) which consists of individual self-propelled amphibious vehicles assembled into a ferry when in the water (fig. 2-28). For military rafting operations, the following site characteristics are desirable:

a. Current velocity between 0 and 1.5 meters per second.

b. Banks which permit loading without a great deal of preparation.

c. Approaches which permit easy access and egress.

d. Strong natural holdfasts.

e. No shoals, sandbars, or snags.

f. Sites clear of obstacles immediately downstream.

g. Sites clear of mines and boobytraps.

h. Sufficient depth to prevent grounding the raft or ferry during loading and unloading operations or when crossing.

i. Holding areas for vehicles awaiting passage.

2-46. Ferry Reconnaissance Symbol (STANAG 2274)

Limited ferry information is recorded on maps or overlays by means of symbols as illustrated in figure 2-39.

a. The *geographic location* of the ferry is shown by an arrow from the symbol to the location of the ferry on a map or overlay. The symbol may be drawn on the map or overlay on either side of the stream.

b. A *serial number* is arbitrarily assigned each ferry for ease in subsequent reference. Numbers must not be duplicated within any one map sheet, overlay, or document. The number is recorded to the extreme left and above the symbol.

c. The *type* of ferry (AF—vehicular ferry, PF—pedestrian ferry, MF—military ferry) is shown after the serial number.

d. The *military load classification* of the ferry is expressed by a value placed inside the symbol and to the left.

e. The *dead weight capacity* of the ferry is shown inside the symbol to the right of the military load classification.

f. The *turn around time* is shown by the number of minutes required and is placed to the left and below the symbol.

g. The *length and width* (in that order) of the area aboard the ferry available to accommodate cargo is separated by a slash (/) and placed below the symbol to the right of the turn around time.

h. A *difficult approach* is shown by irregular lines placed on the corresponding side of the basic symbol (see para. 2-38*j*). Attention must be paid to the direction of stream flow in drawing this portion of the symbol.

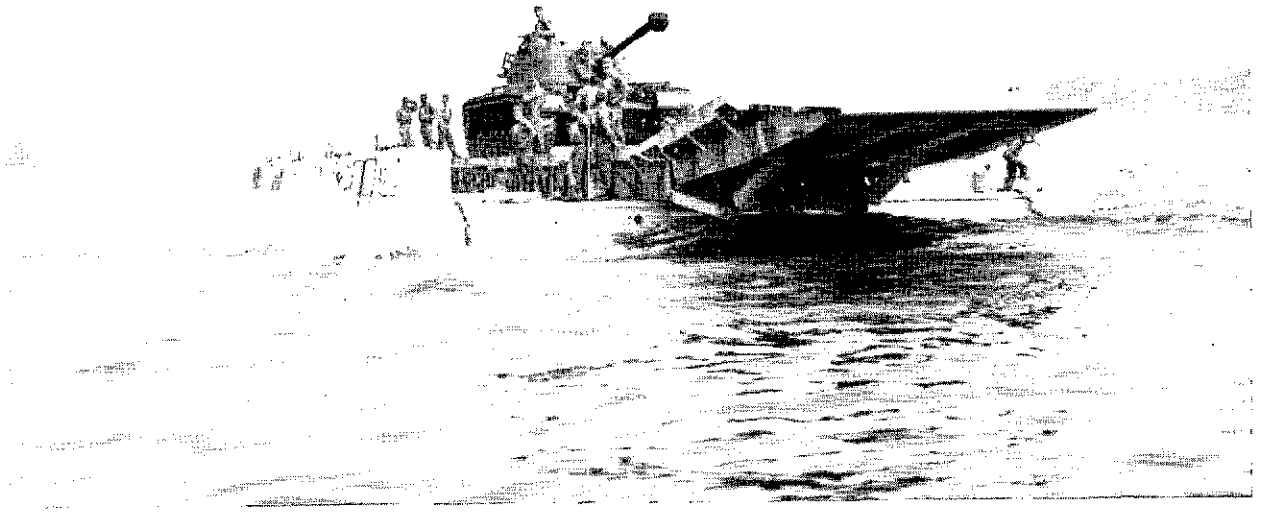


Figure 2–38. Mobile assault ferry.

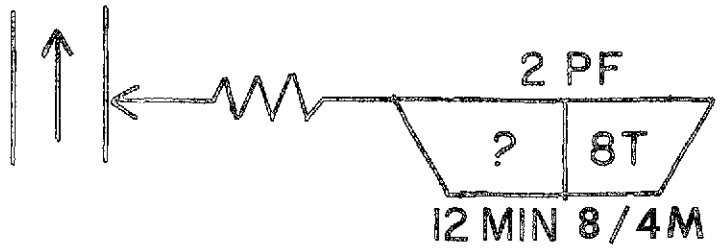
i. Question marks (?) are substituted for unknown or undetermined information.

2–47. Format for Electrically Transmitting Ferry Site Information (STANAG 2096 and SOLOG 107)

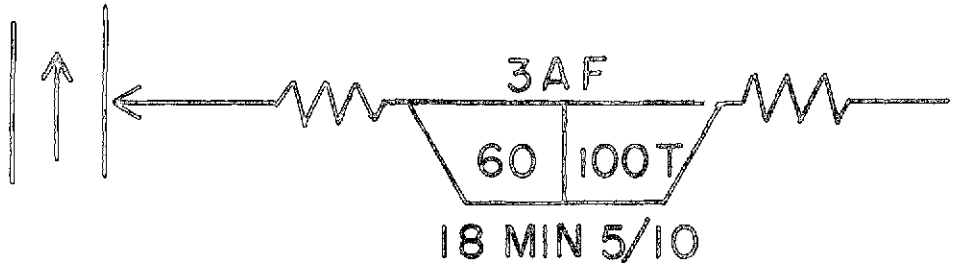
To provide standardization in reporting ferry site reconnaissance data by electrical means, the format shown in figure 2–40 has been adopted. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11–170), the format, which is reproduced locally, may also be used to supplement written route reconnaissance reports especially when more detailed information is required. The originator completes only those parts of the format which are applicable or for which information is available. Each item of the report, however, must be accompanied by the appropriate letter designation from the format to establish the correct category of information. Messages are preceded by the term, FERRYSITEREP, or identifying codeword.

2–48. Ferry Reconnaissance Report Form

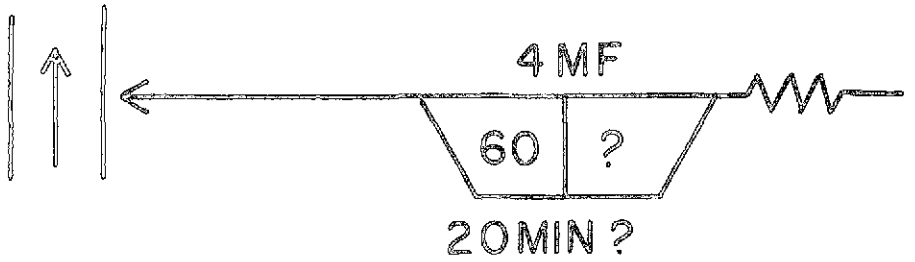
When more detailed information is required concerning a ferry or ferry site, especially when conducting deliberate reconnaissance, the Ferry Reconnaissance Report Form (DA Form 1252) is used to provide a permanent



Ferry Serial Number 2, pedestrian ferry, military load classification unknown, 8-ton dead weight capacity, 12-minute turn around time, a cargo area 4 meters by 8 meters, and a difficult left bank approach.



Ferry Serial Number 3, auto ferry, military load classification of 60, 100-ton dead weight capacity, 18-minute turn around time, a cargo area of 5 meters by 10 meters, and difficult approaches on both banks.



Ferry Serial Number 4, military ferry, military load classification of 60, unknown dead weight capacity, 20-minute turn around time, and a difficult approach on the right bank.

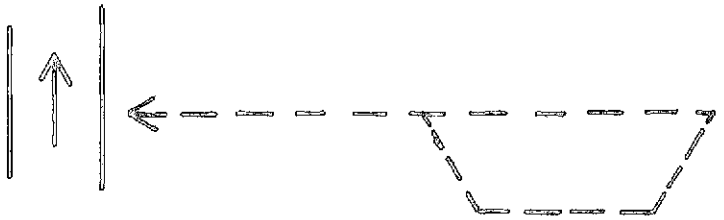


Figure 2-39. Examples of ferry symbols.

FERRYSITEREP					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid reference)	CHARLIE				
Military load classification of approaches	DELTA				
Possibilities for concealment and cover	ECHO				
Width of water obstacle	FOXTROT				
Depth of water at the banks to include tidal information.	GOLF				
Stream velocity	HOTEL				
Slope on bank approaches and bank conditions	INDIA				
Holding areas for road and water transport	JULIET				
Additional information such as maximum number of rafts the site can accommodate, work required in man-hours for preparation, and existing stream crossing equipment.	KILO				

Notes. [a]. First ferry site in report; report by serial number if assigned.

[b]. Additional ferry sites in report.

Figure 2-40. Ferry site report format.

record of ferry information (fig. 2-41). Short forms or worksheets for rapid field work may be designed and produced by the unit making the reconnaissance. Information to be entered on DA Form 1252 is as follows:

a. Identification (items 1-11). Enter all information which establishes positive identification of the ferry by route, map sheet, grid reference, ferry serial number, classification, geographic location, and the name of the stream or body of water.

b. Limiting Features (item 12). Enter any limiting features which would affect ferry operations such as condition of vessels, terminals, floods, low water, freezing, and tides. Also seasons and dates for any limiting climatic conditions are given.

c. Description (items 13-15). Record the depth of the stream or body of water at low, mean, and high water levels; the crossing time; and the length of the course.

d. Vessel features (item 16). Record the pertinent design features of the vessel(s) used. This information includes the number and construction type of units, the method and power of propulsion, length, beam, draft, gross and net tonnage, and capacity.

e. Terminal Features (item 17). Designate the geographic direction of the banks by circling the appropriate abbreviation (NESWN). Enter the name, the dimensions of the slips, and specific docking approaches, the number of rail lines on or near the slip, and the number of sidings.

f. Remarks (item 18). Enter facilities for transferring freight and in those cases where railroad cars are loaded directly on the ferry. In addition, use this space to amplify details given in paragraphs above. Include obstructions, navigational aids, availability of and distances to alternate crossings, and other pertinent data not recorded elsewhere. Photographs should be taken of all ferries reconnoitered in support of DA Form 1252. These photographs include the ferry site, the ferry slips, the ferryboats, and the approach routes. If the ferryboats are not self-propelled, the photographs include auxiliary equipment such as cables, towers, and winches.

g. Sketches (items 19 and 20). Draw a sketch showing the route alinement plan and two sketches showing terminal views on both sides of the crossing.

(1) The route alinement plan indicates the geographical course of the ferry,

terminals, and approaches to the slips. Particular care is taken in recording obstructions. Navigational aids such as buoys and lights are shown. The position of the approaches including surrounding terrain features is included in the sketch.

(2) Two separate sketches are made showing each terminal including the geographical position of each bank and details of the slips, ramps, and bumper piles.

2–49. Ferry Applications of Bridge Markings

Marking for ferries is accomplished in accordance with applicable instructions for marking bridges (para. 2–52). Hazard, regulatory, and guide signs, as appropriate, are posted on approach routes and at ferry slips (fig. 2–42).

FERRY RECONNAISSANCE REPORT
(FM 5-36)

DATE: 14 JUN 1964

TO: (Headquarters ordering reconnaissance)
COMMANDING OFFICER, ATTN:
S2, 21ST ENGR BN (21ST INF DIV)

FROM: (Name, grade and unit of reconnaissance officer)
John H. Doe
JOHN H. DOE 1/LT CO A 21ST ENGR BN

1. ROUTE OR LINE		2. FROM (Initial Point)	3. TO (Terminal Point)	4. DATE/TIME (Of Signature)
HIGHWAY	RAILROAD			
VA 617	N/A	LORTON, VA	HOBY, MD	14 1800 JUN 64

5. MAP SERIES NR	6. SHEET NUMBER	7. GRID REFERENCE		8. FERRY NR	9. CLASS
		TYPE	COORDINATES		
V 734	5561-III	UTM 1:50,000	UT 134830	1	40

10. LOCATION FROM NEAREST TOWN			11. CROSSING (Name of stream or body of water)
DISTANCE	DIRECTION	NAME OF NEAREST TOWN	
8.0 Km	EAST	LORTON, VA	POTOMAC RIVER

12. LIMITING FEATURE (Condition of vessels, terminals, floods, low water, freezing, tides etc.) (Seasons and Dates)
CAPACITY OF LANDING - ANGELS POINT

13. WATER LEVELS (Depths)			14. CROSSING TIME	15. LENGTH
LOW	MEAN	HIGH		
3.2 m	4.7 m	7.6 m	11 MINUTES	1.0 Km

16. VESSEL FEATURES (Attach photographs)

UNITS	CONSTRUCTION TYPE	PROPULSION METHOD			LENGTH	BEAM	DRAFT	TONNAGE		CAPACITY		
		TYPE	UNITS	HP				GROSS	NET	PASS	VEHICLE	R.R. CARS
2	OPEN	DIESEL	2	210	22.5m	7.6m	1.6m	85	85	200	8 MAX	N/A

17. TERMINAL FEATURES

DIRECTION OF BANK	NAME	SLIP			DOCKING FACILITIES	APPROACHES				
		WIDTH	DEPTH	CAPACITY		HIGHWAY			RAILROAD	
						SURF	LANES	CLASS	TRACKS	SIDING
N E (S) W N	LITTLE RENO	13.2m	3.0m	1 BOAT	GOOD	ASPH	2	45	N/A	N/A
(E) S W N	ANGELS PT	14.8m	4.8m	1 BOAT	GOOD	CONC	2	55	N/A	N/A

18. REMARKS (Amplify above details. Note obstructions, navigational and other pertinent data)

DA FORM 1 JAN 55 1252

Figure 2-41. Ferry reconnaissance report form (DA Form 1252).

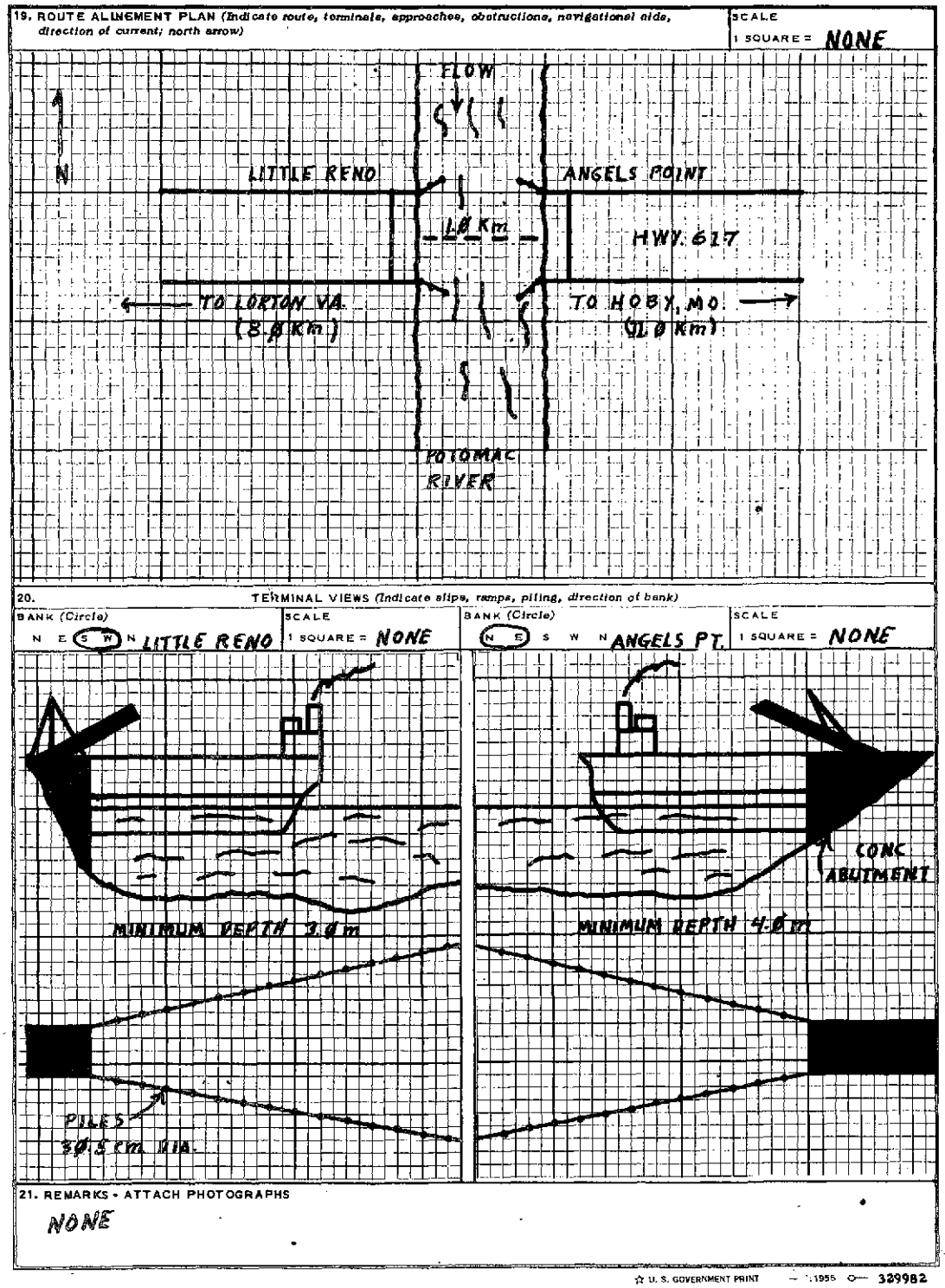


Figure 2-41—Continued.

Ferries are marked in the same manner as bridges

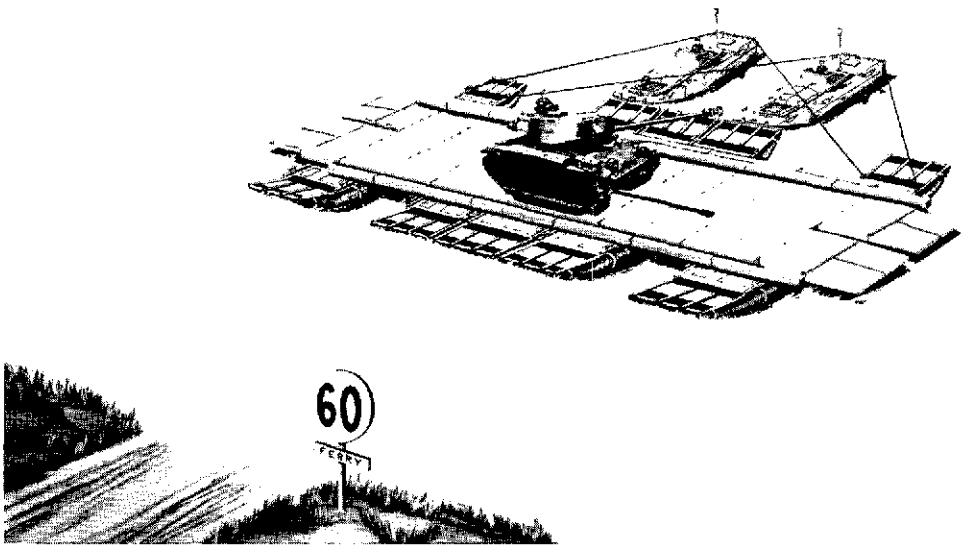


Figure 2-42. Example of ferry markings.

Section VI. THE MILITARY LOAD CLASSIFICATION

2-50. General

Bridge reconnaissance requires a general knowledge of the vehicle and bridge military load classification system and bridge traffic control procedures. Hence, these elements are discussed before outlining hasty bridge reconnaissance (sec. VII, ch. 2) and deliberate bridge reconnaissance procedures (sec. II, ch. 3). The bridge and vehicle classification system is developed in conformance with standardization agreements and provides a means by which a driver can determine whether or not his vehicle can safely cross a specific bridge. The purpose of the system is to protect the bridge, vehicle, load, and driver (fig. 2-43).

2-51. Classification of Bridges (STANAG 2021, SEASTAG 2021, and SOLOG 45R)

Before a driver can determine whether or not his vehicle can cross a given bridge, he must know—(1) the military load classifications of the bridge and his vehicle, (2) the width of the bridge compared to the width of his vehicle, (3) the overhead clearance of the bridge compared to the height of his vehicle, and (4) the traffic control measures required during crossing.

a. Military Load Classification Numbers. The capacity of a bridge is represented by a

Failure to observe the military load classification system

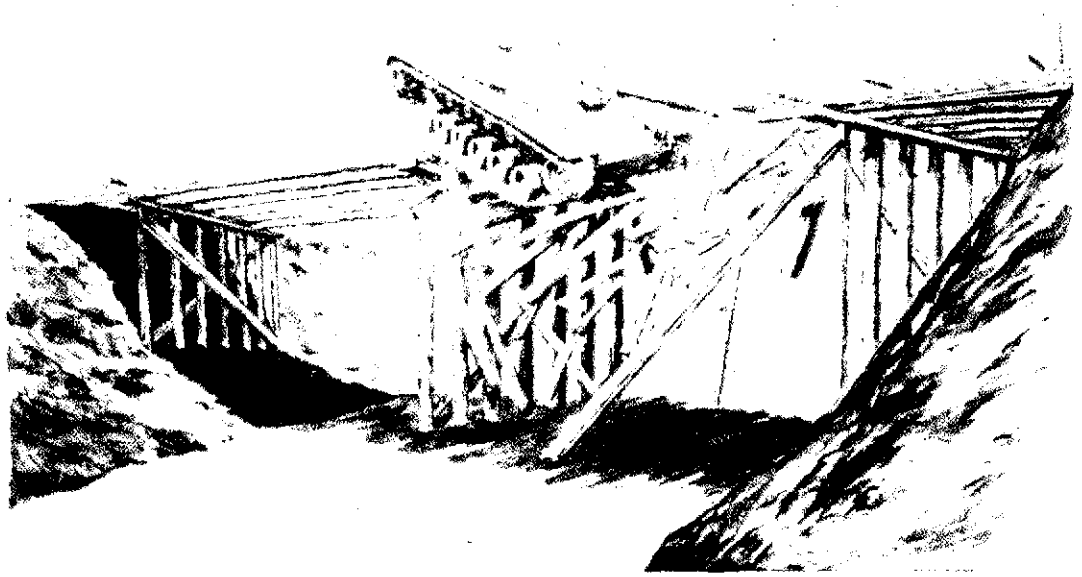


Figure 2–43. Example of bridge failure.

military load classification number. This number, which is usually posted on the bridge, designates the safe capacity of the bridge. If not posted, the procedure used to determine the bridge military load classification number is discussed in section III, chapter 3. In addition, most military vehicles display a vehicle classification sign. This classification number represents the effect a vehicle with its payload has on a bridge when crossing and its determination is discussed in section IV, chapter 3. The driver compares his vehicle classification number with the bridge classification number. If his vehicle classification number is equal to or less than the bridge classification number, the vehicle can execute a normal crossing (para 2–54).

b. Minimum Lane Widths. Bridges may be obstructions to traffic flow in that the traveled way of the overall route may be reduced below minimum standards prescribed by table 2–1. If so, the bridge is reported as a width obstruction (OB) in the route classification formula. Table 2–4 lists the minimum width requirements for one- and two-lane bridges according to military load classification. If a bridge of a specific class meets these width requirements, no posting of the width is required; and it is understood that there are no width limitations for standard military vehicles crossing the bridge in accordance with the military load classification system. If a one-lane bridge meets all the requirements except minimum width for a certain classification, the classification is not downgraded, but the width is posted as outlined in paragraph 2–52, and appropriate travel restrictions imposed. A two-lane bridge must meet the minimum lane widths prescribed in table 2–4. If it does not, it must be downgraded to a class within the limits of its actual width. Bridge lane widths are used to determine classification, for posting, and for controlling crossing vehicles; they should not be confused with minimum traveled way widths specified for routes.

Table 2–4. Minimum Lane Widths for Bridges

Bridge classification	Minimum width between curbs*	
	One lane	Two lane
4–12	2.75 meters (9′–0″)	5.50 meters (18′–0″)
13–30	3.35 meters (11′–0″)	5.50 meters (18′–0″)
31–60	4.00 meters (13′–2″)	7.30 meters (24′–0″)
61–100	4.50 meters (14′–9″)	8.20 meters (27′–0″)

**Note.* A minimum 25 cm (10″) horizontal clearance is required 30 cm (12″) above the curbs for all classifications (see fig. 3–19).

c. Minimum Overhead Clearance. Minimum overhead clearances for various bridge classifications are shown in table 2–5. If the overhead clearance of a bridge does not meet minimum requirements, the clearance restriction is posted; often a telltale or other warning device is employed prior to the bridge to indicate overhead clearance limitations (fig. 2–44). However, only overhead clearances less than 4.25 meters (14 ft) are reported as (OB) in the route classification formula (para 2–9).

Table 2–5. Minimum Overhead Clearances for Bridges

Bridge classification	Minimum overhead clearance
Up to 70	4.25 meters (14 ft–0 in)
Above 70	4.70 meters (15 ft–6 in)

2–52. Bridge Classification Signs (STANAG 2010, SEASTAG 2010, and SOLOG 24)

Standardization agreements establish the following system of posting bridge classifications. In addition, special arrangements may be made by theater commanders to indicate vehicles of exceptional width or to indicate low overhead obstructions. There are two general types of standard military bridge signs. These are *circular and rectangular in shape.*

a. Circular Signs Both civil and military bridges in an operational area which have been classified have circular signs indicating the military load classification. These signs have

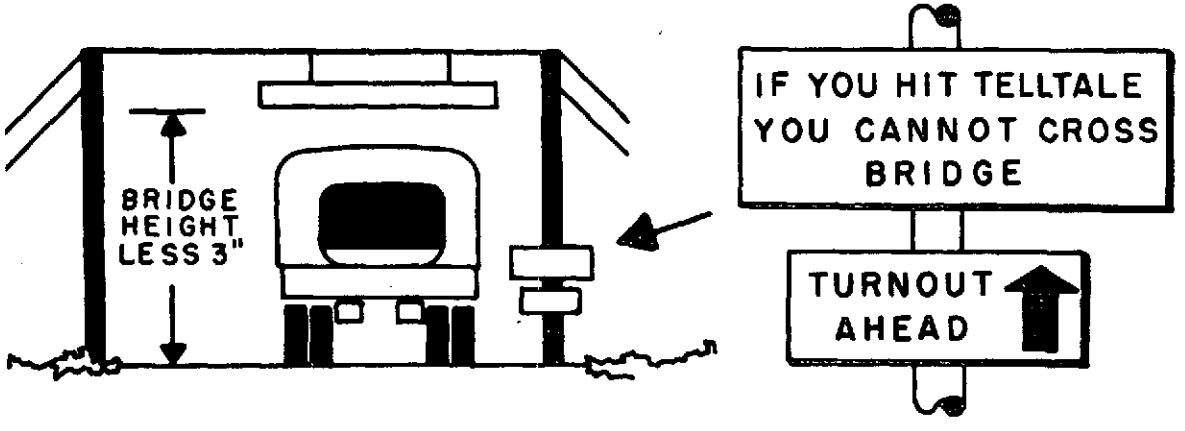


Figure 2–44. Typical telltale indicating overhead clearance of a bridge.

a yellow background with black inscriptions. The inscription is as large as the diameter of the sign allows. Circular signs are of two types: *normal* circular signs and *special* circular signs.

(1) *Normal circular signs.*

(*a*) Signs for one lane bridges are a minimum of 41 centimeters (16 inches) in diameter (fig. 2–45).

(*b*) Signs for two lane bridges are a minimum of 51 centimeters (20 inches) in diameter and are divided into right and left sections by a vertical line. The classification for double flow traffic is shown on the left half with two parallel vertical arrows beneath the number, and the classification for single flow traffic is shown on the right half of the signs with one vertical arrow beneath the number (fig. 2–46).

(2) *Special circular signs.*

(*a*) If a bridge has separate classifications for wheeled and tracked vehicles, a special circular sign which indicates both classifications is used (fig. 2–47). The sign is a minimum of 51 centimeters (20 inches) in diameter and is divided into two sections by a horizontal line. On the top half, the wheeled classification is shown along with a symbol representing a wheeled vehicle. On the bottom half, the tracked classification is shown along with a symbol representing a tracked vehicle.

(*b*) Where similar conditions pertain to a two lane bridge, the normal and the special signs for wheeled and tracked traffic may be combined (fig. 2–47).

b. Rectangular Signs. Additional instructions and technical information are inscribed on rectangular signs. Rectangular signs are a minimum of 41 centimeters (16 inches) in height or width and have a yellow background upon which the appropriate letters, figures, or symbols are inscribed in black. The inscription is as large as the sign permits. Separate rectangular signs are used if necessary to show width limitations, height limitations (fig. 2–48), or technical information (fig. 2–49). Width and height signs are not required on bridges where existing civilian signs are already in place and are sufficiently clear. In those countries which conform to the Geneva Convention of 1949, international height and width signs (fig. 5–1) may be used in lieu of rectangular military signs.

c. Multilane Bridges. Bridges of three or more lanes are special cases which require individual consideration in posting. To determine the number of lanes, minimum widths for the respective load classification (table 2–6) are used. Often, heavier loads can be carried on a restricted lane(s) than on other lanes. For example: a bridge lane may be damaged, thereby reducing capacity; or, conversely, lanes may be structurally designed to accommodate significantly heavier loads (figs. 2–50 and 2–51). Under such circumstances, standard bridge classification signs are posted for each lane, and the restricted lanes are marked by barricades, painted lines, or studs.

d. Positioning of Bridge Signs. Bridge signs are positioned so as to help maintain an uninterrupted flow of traffic across the bridge. The locations of circular and rectangular signs, special military load classification numbers, and appropriate warning signs are as follows:

(1) Circular bridge classification signs are placed at both ends of the bridge in such a position as to be clearly visible to all oncoming traffic.

(2) Rectangular signs other than those indicating height restrictions are place immediately below the bridge classification (circular) signs.

(3) Signs which indicate height restrictions are placed centrally on the overhead obstruction.

(4) Special classification numbers are never posted on standard bridge marking signs.

(5) Appropriate advance warning signs are placed on the approaches to bridges as required.

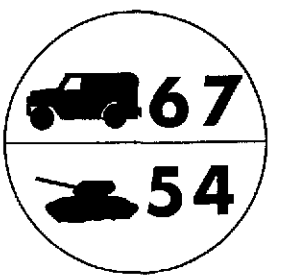
Figure 2–45. Typical single lane bridge sign.

Figure 2–46. Typical two lane bridge sign.

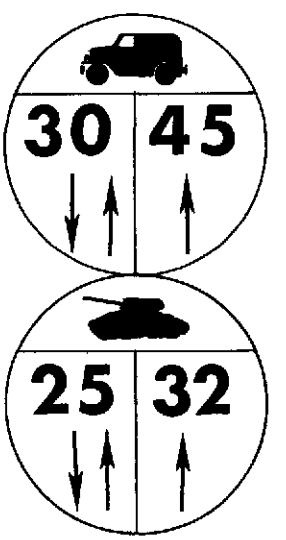
2–53. Classification Signs for Vehicles (STANAG 2010, SEASTAG 2010, and SOLOG 24)

A military vehicle is assigned a military load classification number which represents the effect of the vehicle on a bridge. Allied standard military vehicles with a gross weight over 3 tons and trailers with a rated payload over 1½ tons are classified. Military load classification numbers for standard army vehicles are listed in appendix IV, and a discussion of how vehicle classifications are derived is provided in section IV, chapter 3. Vehicles are divided into two categories for classification purposes: single and combination vehicles.

a. Single Vehicles. A single vehicle is any vehicle which has only one frame or chassis such as a tank or 2½ ton truck. Single vehicles have the classification number marked on a circular sign with black numerals on a

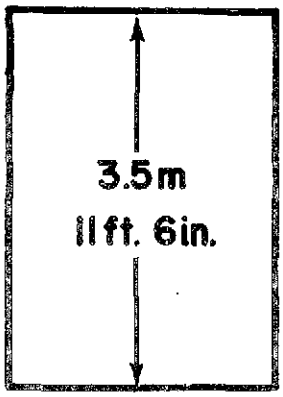


SINGLE LANE



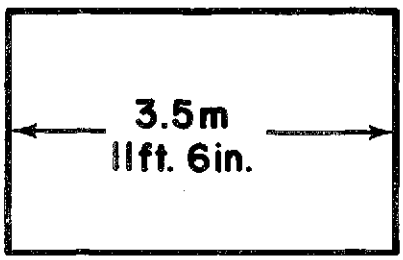
DUAL LANE

Figure 2–47. Typical dual classification signs.

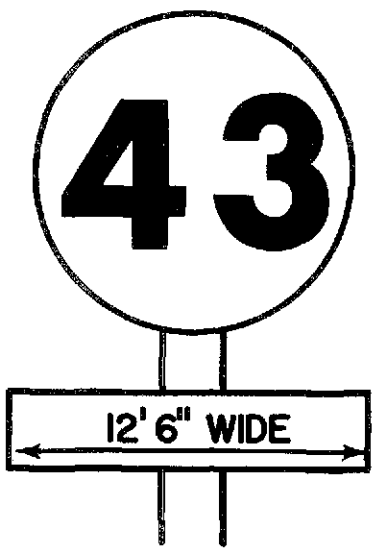


HEIGHT SIGN

YELLOW BACKGROUND.
LETTERS, FIGURES AND
SYMBOLS IN BLACK.



WIDTH SIGN



WIDTH LIMITATION POSTED ON A SINGLE FLOW BRIDGE.

Figure 2-48. Width and height signs.

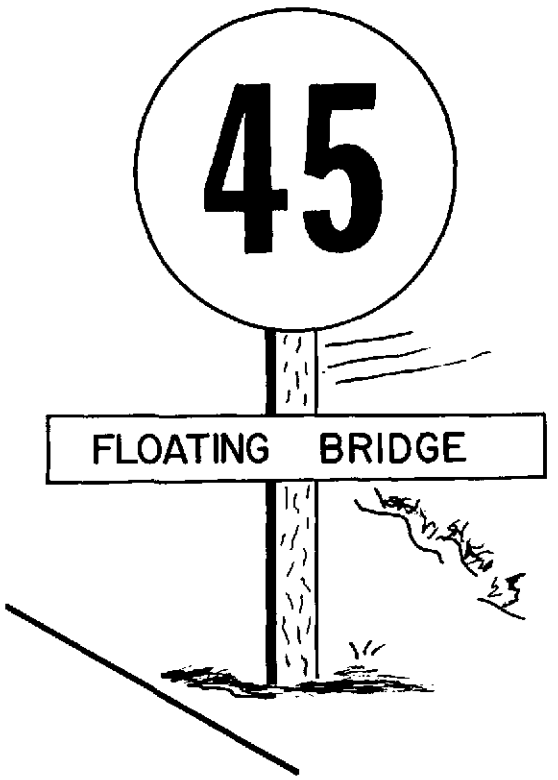


Figure 2–49. Typical sign for a floating bridge.

yellow background. This sign is installed or painted on the front of the vehicle and below the driver's line of vision (fig. 2–52).

b. Combination Vehicles. A combination vehicle is a vehicle consisting of two or more single units which operate as one vehicle such as a prime mover pulling a semitrailer. The sign on the front of the combination vehicle (towing vehicle) has the letter "C" in red above the classification number of the combination. In addition, each component vehicle of the combination carries a sign on the right side which gives the classification number of the component (fig. 2–53).

c. Special Classification. Military vehicles may, at times, carry loads which are greater or lesser than their normal rated payloads. In this event, a special military load classification number may be assigned to the vehicle thus increasing (or decreasing) the normal vehicle classification number by an amount equal to the overload (or underload) in short tons (figs. 2–54 and 2–55).

d. Nonstandard Combination. An example of a nonstandard combination is a single vehicle towing another vehicle at a distance less than 30.5 meters. If the sum of the vehicles' military load classification numbers is less than 60, then the military load classification of the nonstandard combination is nine-tenths (.9) the sum of the two classification numbers. If, however, the sum of the two vehicle classification numbers is 60 or over, the *total sum* represents the military load classification number of the combination (fig. 2–56).

e. Special Purpose Vehicles. Such vehicles are also posted with their military load classification numbers (fig. 2–57).

2–54. Types of Crossings

There are two types of crossings—normal and special.

a. Normal Crossings. Normal crossings may be made whenever the vehicle military load classification number is equal to or less than the bridge military load classification number. Only normal convoy discipline is imposed; that is, a minimum spacing of 30.5 meters (100 feet) between vehicles and a maximum speed of 40 KPH (25 MPH). There are two types of normal crossings: single flow and double flow.

(1) *Normal single flow.* This type crossing is possible when the vehicle classification number is equal to or less than the number posted on a single flow bridge or equal to or less than the single flow classification of a double flow bridge. *If a single flow crossing is made in accordance with the single flow classification number on a double flow bridge, oncoming traffic must be temporarily halted while the vehicle is driven down the centerline of the bridge thereby creating a temporary obstruction to double flow traffic.*

(2) *Normal double flow.* This type crossing is possible when the vehicle classification number is equal to or less than the single flow classification number of one of the lanes for a multilane

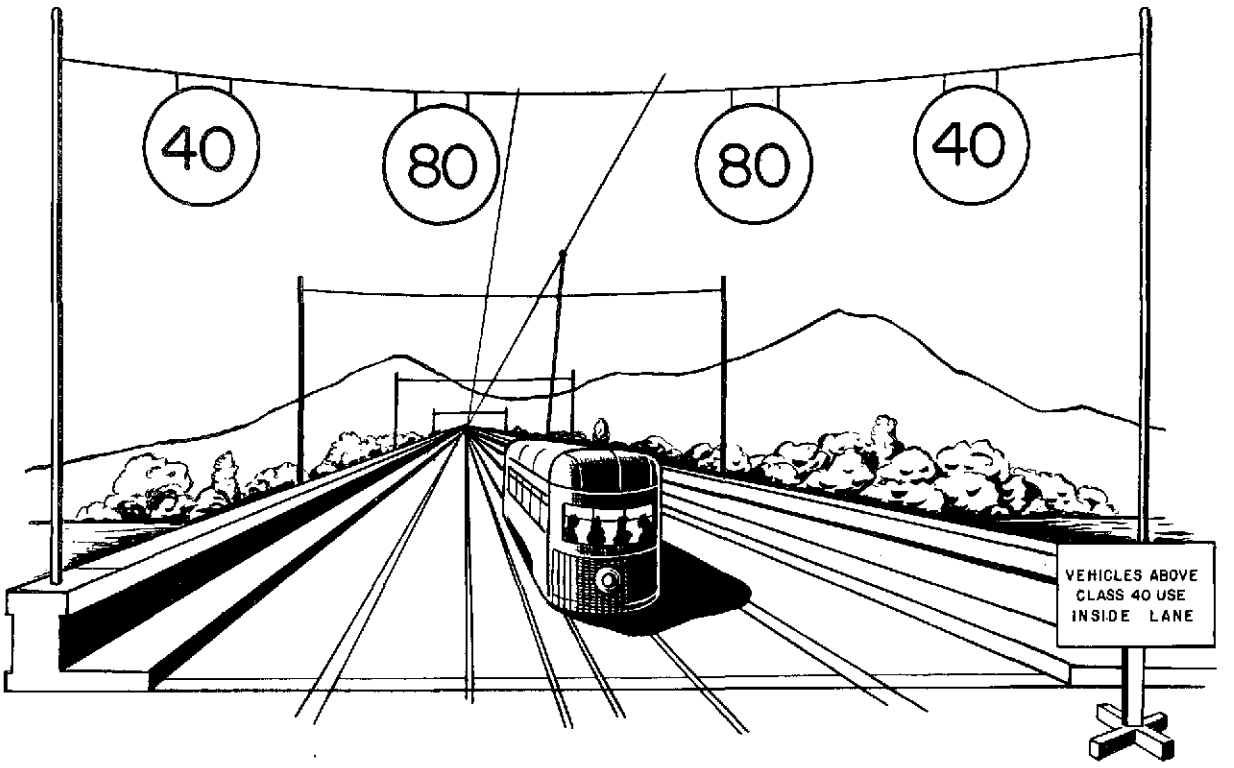


Figure 2-50. Typical multilane bridge applications of bridge classification signs and regulatory signs.

bridge. Double flow traffic may be maintained with this type crossing.

b. Special Crossings. Under exceptional conditions, vehicles may be authorized by the local tactical commander to cross bridges when the bridge classification number is less than the vehicle classification number. These crossings are known as special crossings and are of two types—caution and risk.

(1) *Caution crossings.* A caution classification number may be obtained for nonstandard fixed bridges by multiplying the classification number for single flow traffic by 1.25 (5/4). For standard military prefabricated fixed and floating bridges the caution classification is obtained from appropriate technical manuals (see app. I). Caution crossings require that vehicles remain on the centerline of the bridge, maintain a spacing of 50 meters between vehicles, do not exceed a speed of 12 KPH (8 MPH); and do not stop, accelerate, or shift gears while crossing.

(2) *Risk crossings. A risk crossing may be made only on standard military prefabricated fixed and floating bridges.* The classification number for risk crossings is obtained from appropriate technical manuals (app. I). Risk crossings may be made only in the gravest emergency. Risk crossings require that vehicles remain over the centerline; do not exceed a speed of 5 KPH (3 MPH); and do not stop, accelerate, or shift gears on the bridge. Only one vehicle is allowed to cross at a time, and an engineer officer inspects the bridge after each

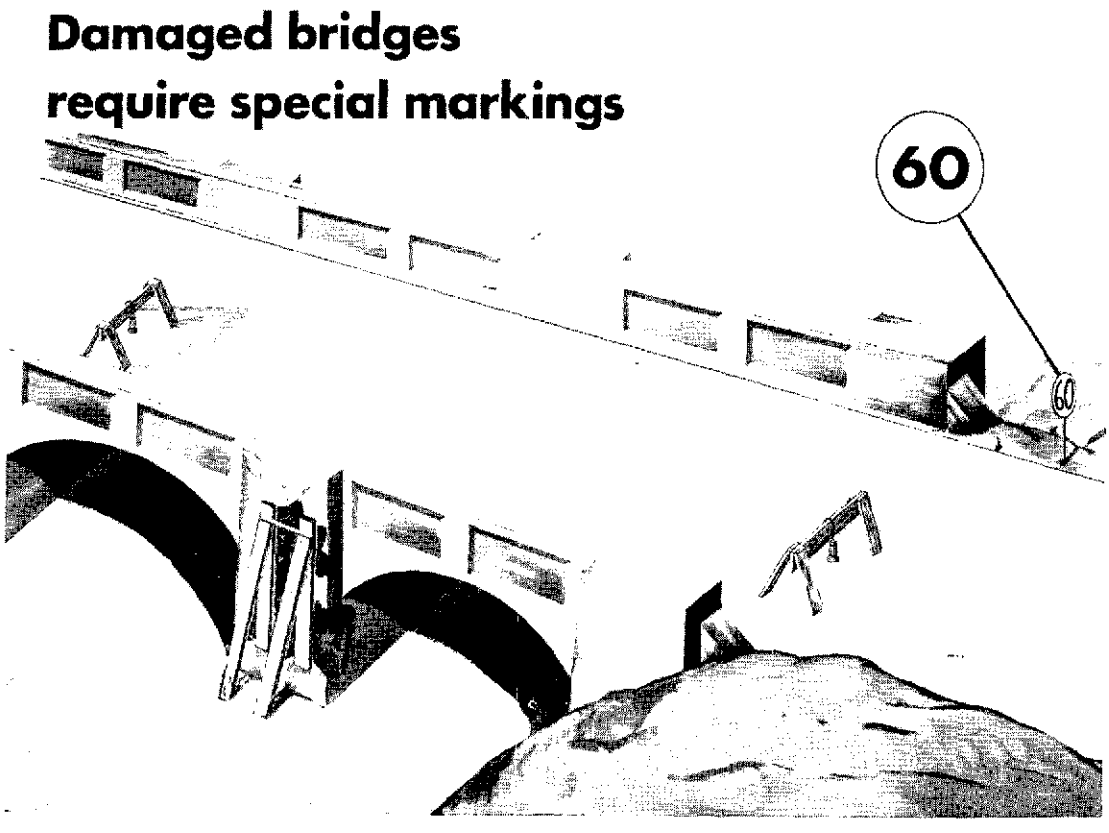


Figure 2-51. Example of posting a damaged bridge.

risk crossing for signs of failure. Damage is repaired before traffic can be resumed.

2-55. Bridge Traffic Control Procedures

a. The posting of permanent standard bridge signs and other signs necessary for proper and efficient control of traffic across a bridge is the responsibility of the engineers. Supplementary signs are used when necessary to warn vehicles requiring special controls while crossing. When necessary, holding areas, turnouts for parking and unloading vehicles, and checkpoints are activated near bridges to provide the necessary control during crossings. Figure 2-58 is an example of standard bridge signs and supplementary signs that may be used at bridge and other crossing sites.

b. Traffic control measures are usually outlined in the traffic circulation plan and the traffic control plan of the commander exercising territorial jurisdiction over the area in which the bridge is located. These control measures are usually made known to drivers by means of temporary or permanent route signs posted on bridge access roads. Checkpoints may also be established to insure that users of the bridge have complied with the traffic control regulations prior to entry onto the bridge. In addition, other control measures may be required for other than normal type crossings.

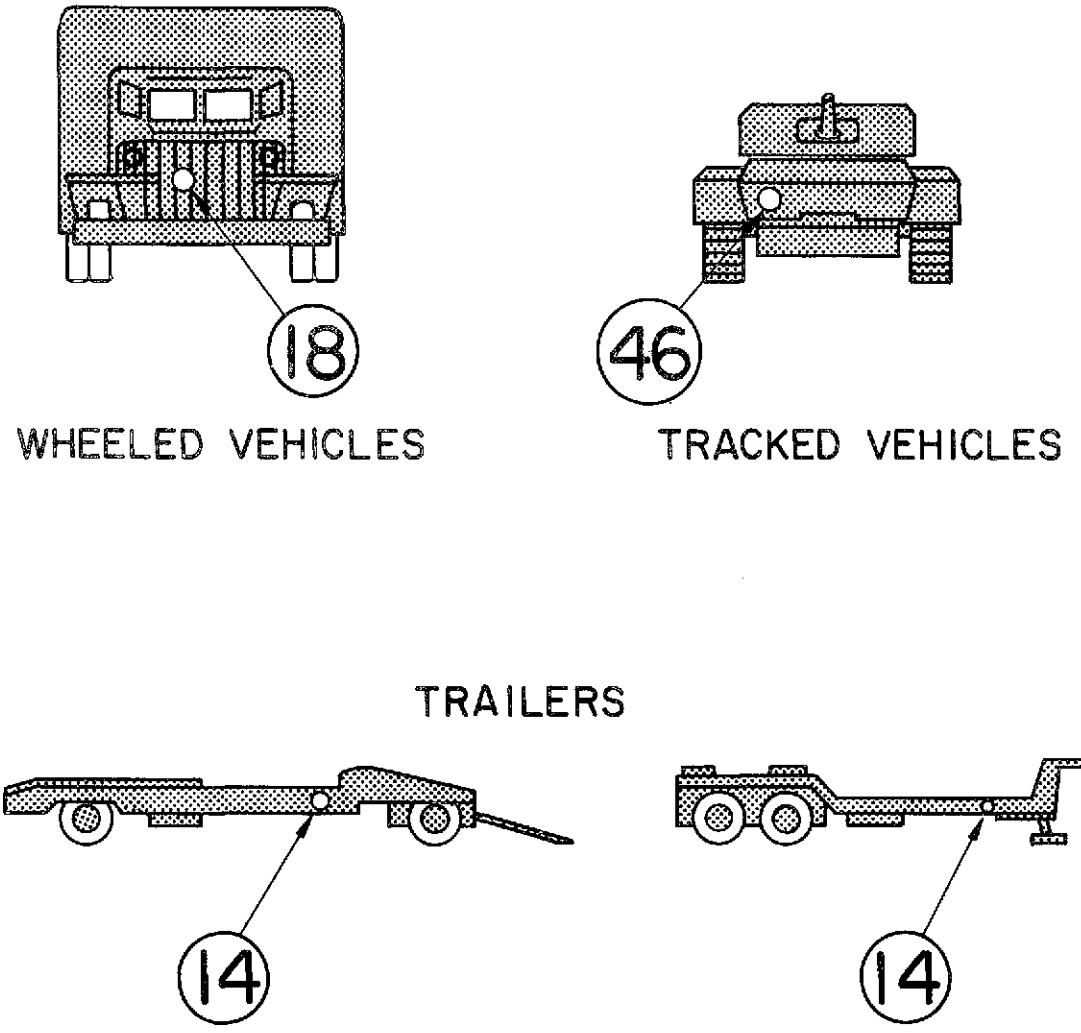


Figure 2-52. Marking of single vehicles.

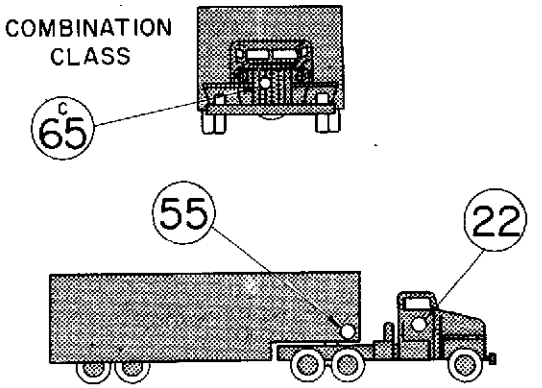


Figure 2-53. Marking of typical combination vehicles.

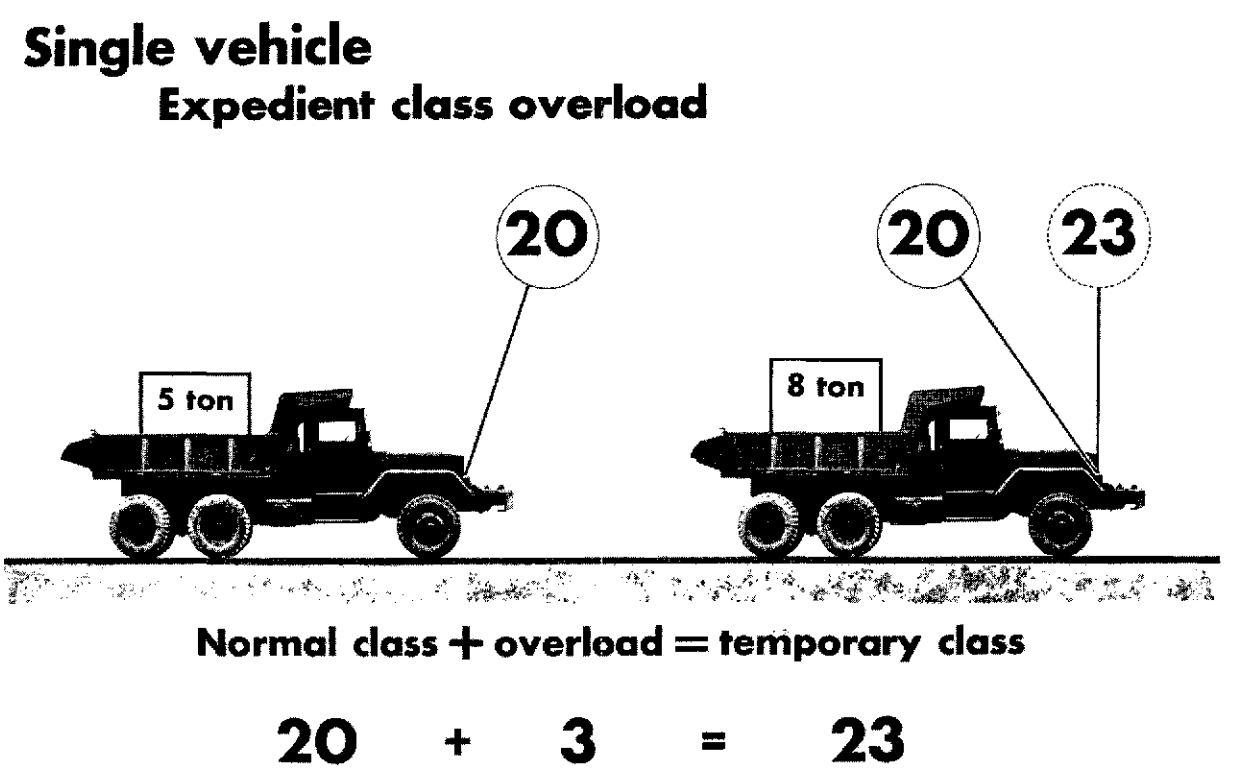


Figure 2-54. Example classification of an overload.

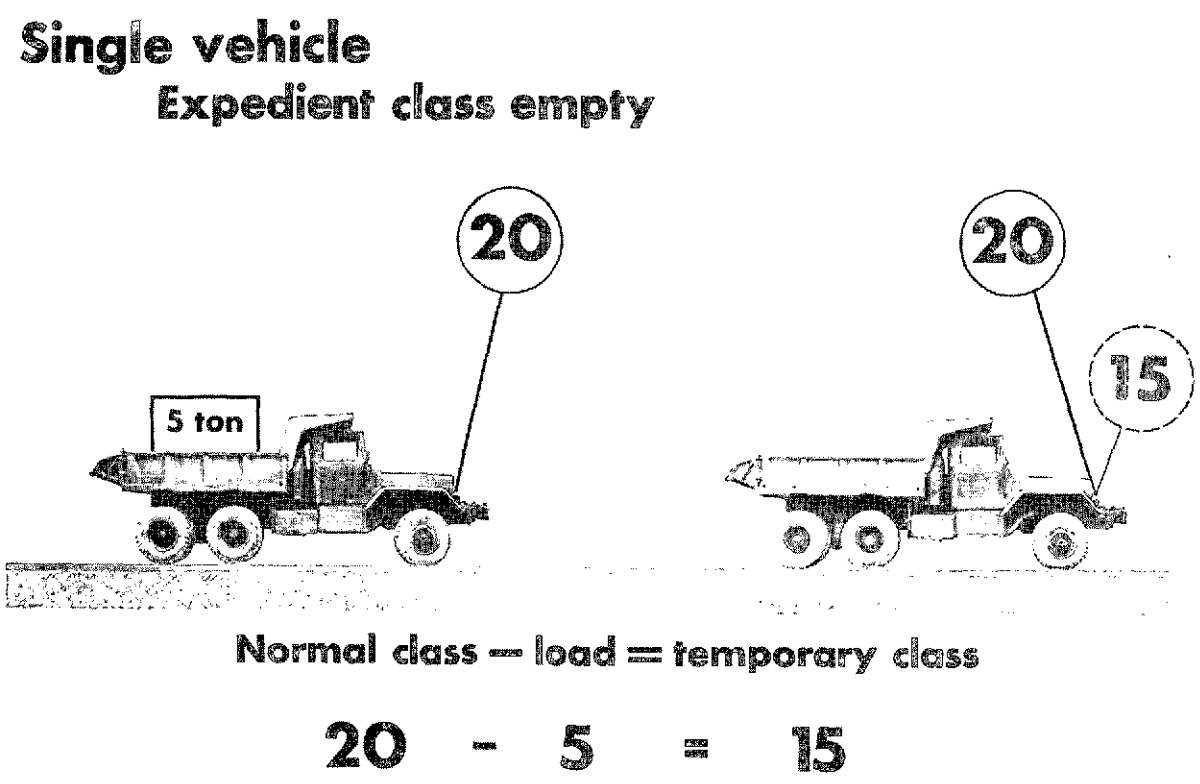
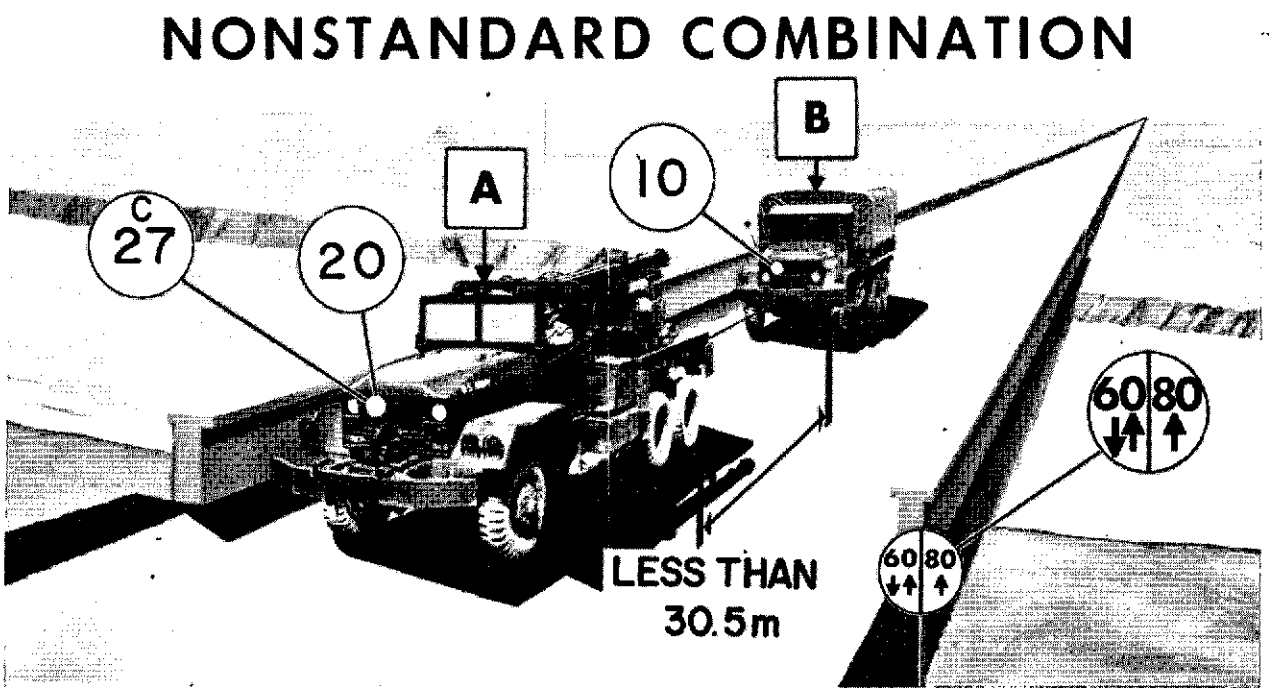


Figure 2–55. Example classification of an underload.



Distance between A and B is less than 30.5 meters
Classification A $^{(20)}$ + Classification B$^{(10)}$ = 30
Classification 30 is less than classification 60

Classification of combination = .9 (30)
= 27

Figure 2-56. Example classification of a nonstandard combination.

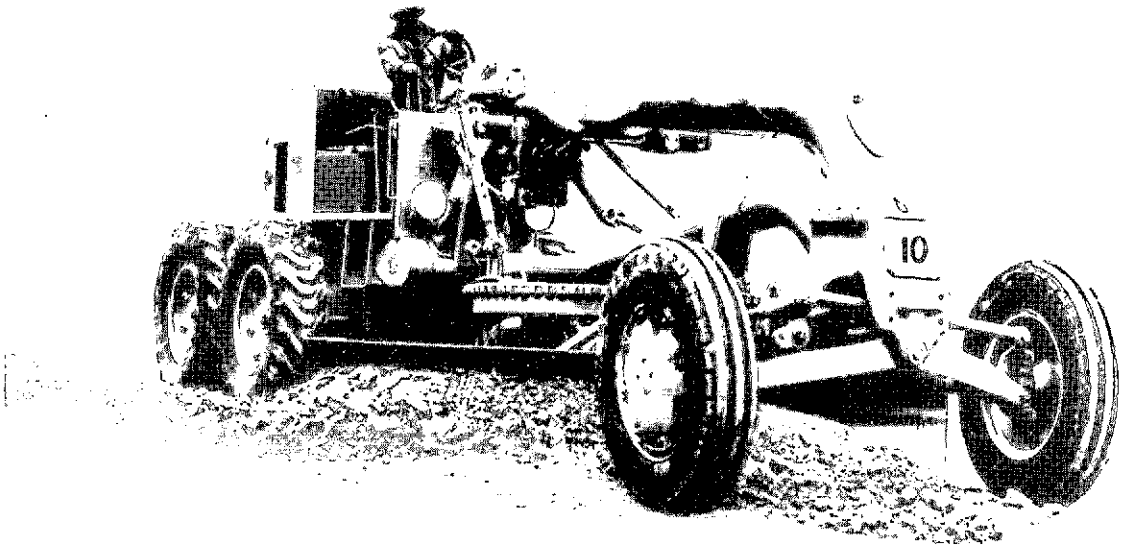


Figure 2-57. Location of classification sign on a special purpose vehicle.

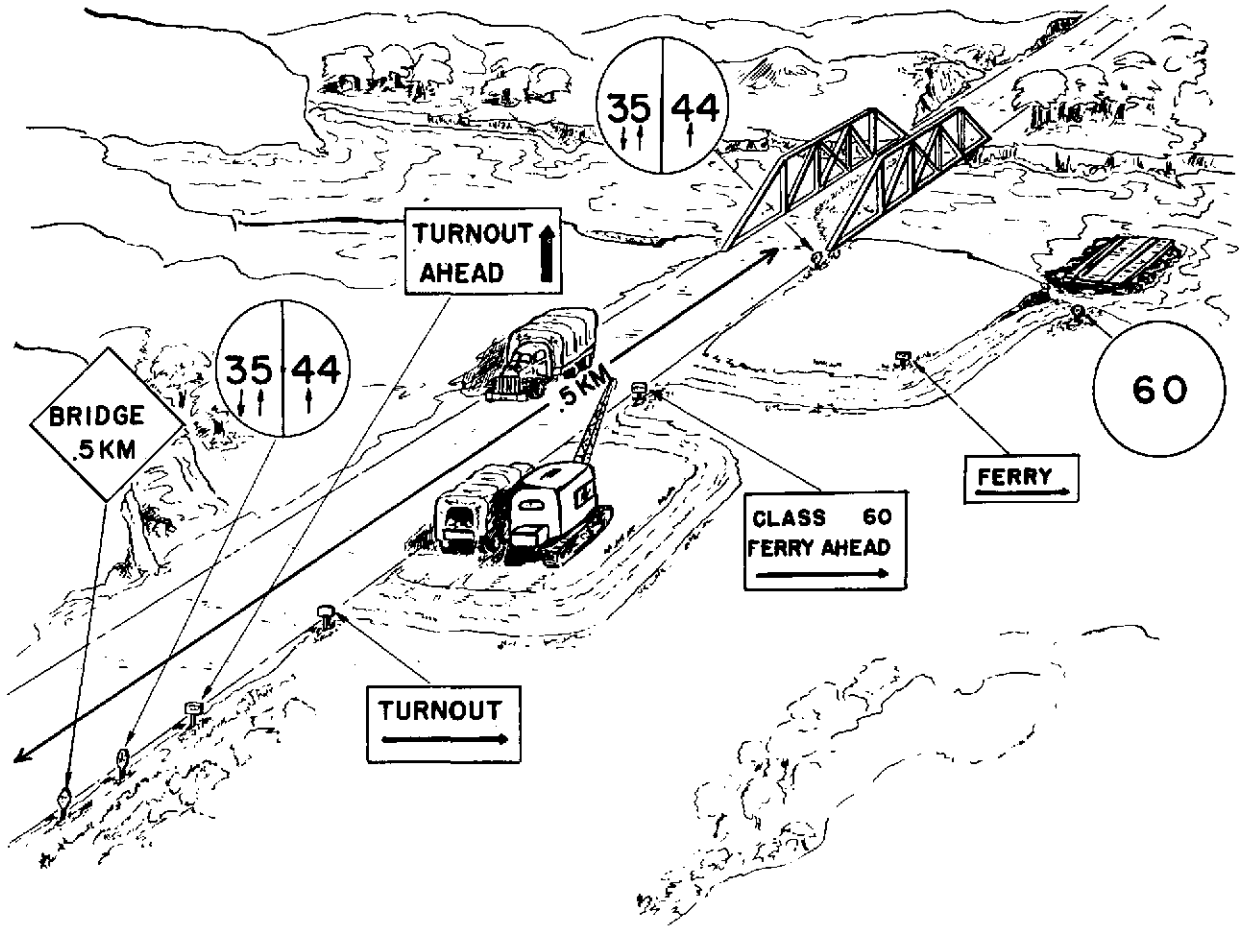


Figure 2–58. Standard bridge signs and typical supplementary signs.

Section VII. HASTY BRIDGE RECONNAISSANCE

2–56. General

A bridge is a structure that carries a roadway or railway over a depression or obstacle. A bridge which is completely supported by its two abutments (end supports) is called a single-span bridge; a bridge having one or more intermediate supports between the abutments is a multispan bridge. From a military standpoint, bridges may be divided into two main types: bridges already existing in an area of operations and those constructed for military purposes during the course of a specific operation. Existing bridges vary in size and complexity from simple wood trestle and stringer bridges to multispan arch or suspension bridges, and it is with these types of bridges that bridge reconnaissance is primarily concerned. Military bridges, on the other hand, which are usually constructed and classified by army engineers, include floating bridges, standard prefabricated bridges, and field-fabricated bridges.

2–57. Bridge Nomenclature

In general, a bridge has two principal parts: the substructure (lower part) and the superstructure (upper part). In addition, bridge approaches and bypasses are important features of a bridge complex and are included in bridge reconnaissance. Basic bridge nomen-

clature is shown in figure 2–59. (For further discussion, see sec. II, ch. 3.)

a. Substructure. The substructure consists of the transverse supports for the superstructure. These supports are either abutments or intermediate supports. The substructure takes the load directly from superstructure and transmits it to the ground.

b. Superstructure. The superstructure consists of the stringers, flooring, curbing, walks, handrails, trusses, and other components forming that part of the bridge above the substructure.

(1) *Stringers.* Stringers rest on and span the distance between the intermediate supports or abutments. Stringers are the main load-carrying members of the superstructure; they receive the load from the flooring and transmit it to the substructure.

(2) *Flooring.* The flooring system often consists of two parts: decking and tread. The decking is laid directly over the stringers at right angles to the centerline of the bridge. The tread is laid parallel to the centerline of the bridge and between the curbs.

(3) *Curbs.* Curbs are usually placed at both edges of the flooring and guide the suspension system of crossing vehicles. Curbs determine the maximum axle width which the bridge will accommodate. Most bridges, however, allow for vehicular overhang beyond the wheels or tracks; this allowance is termed *horizontal clearance* above the curbs (see fig. 3–19).

(4) *Handrails.* Railings along the bridge are constructed to guide drivers and to serve as a protective measure for both vehicular and foot traffic.

(5) *Truss.* Some bridges incorporate trusses in the superstructure either above or below the traveled way to increase its load-carrying capacity. A truss is a structural element composed of a system of members joined together to form a series of triangles.

c. Approach. An approach applies generally to the immediate portions of the route leading to a bridge. Many times, approaches are constructed to provide access to a bridge as either a fill that rises to the bridge or as a cut that slopes down to the bridge. Approaches are often mined or boobytrapped and, consequently, require thorough investigation during reconnaissance.

d. Bypasses. See para. 2–61*g*.)

2–58. Typical Bridge Spans (STANAG 2252 and SOLOG 94)

Bridges are most effectively described by span type and construction material. The more common types of spans are shown in figure 2–60. (For further discussion, see para. 3–13.)

a. Number symbols are assigned to represent types of span construction (table 2–6).

Table 2–6. Span Type

Type of span construction	Number symbol
Truss	1
Girder	2
Beam	3
Slab	4
Arch (closed spandrel)	5
Arch (open spandrel)	6
Suspension	7
Floating	8
Others (to be specified by name)	9

b. Moreover, letter symbols are assigned to represent material used in span construction (table 2–7).

Table 2–7. Construction Material

Material of span construction	Letter symbol
Steel or other metal	a
Concrete	k
Reinforced concrete	ak
Pre-Stressed concrete	kk
Stone or brick	p
Wood	n

c. Both symbols when used in combination, therefore, identify a particular bridge by span type and construction material. For example, the symbol "4ak" describes a slab span of reinforced concrete.

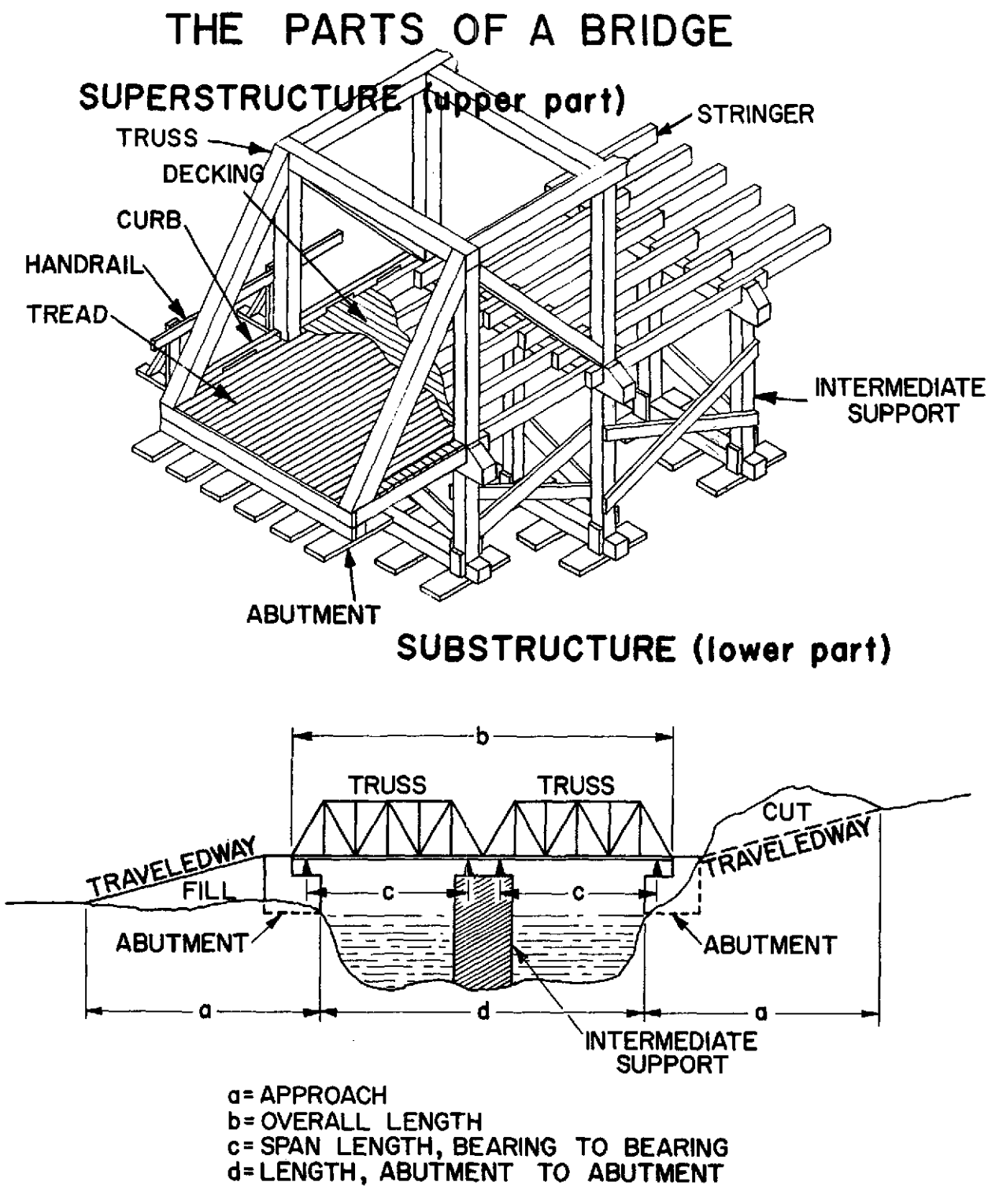


Figure 2–59. Typical bridge nomenclature.

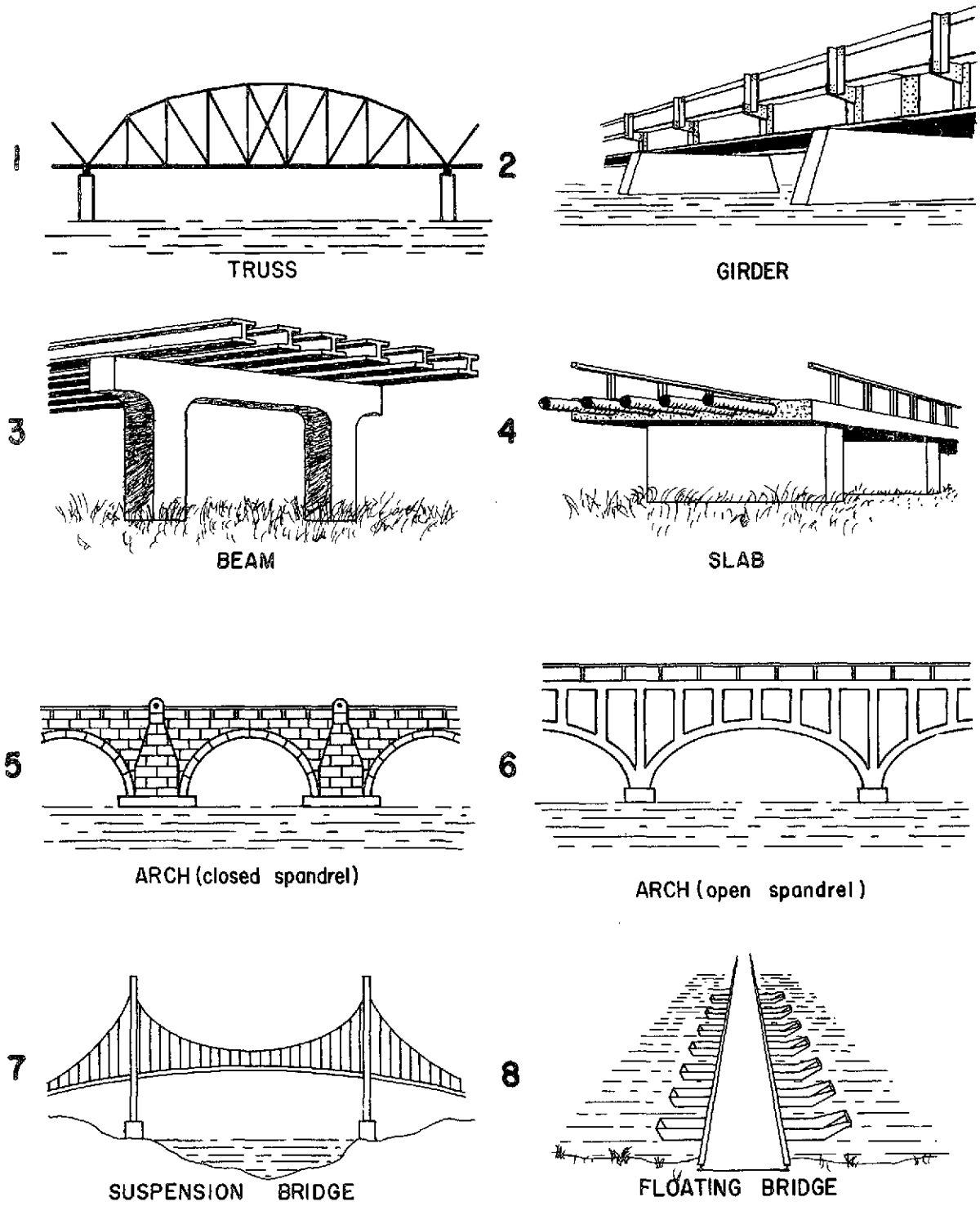


Figure 2–60. Typical bridge spans.

2-59. Bridge Reconnaissance

The purpose of bridge reconnaissance is to collect bridge data necessary to support operational planning and movement. There are two types of bridge reconnaissance depending upon the amount of time and qualified personnel available: hasty and deliberate. Hasty bridge reconnaissance is performed to acquire limited bridge information (para. 2-60) necessary to determine the suitability of a bridge for immediate tactical use. Time and other limitations preclude a more complete coverage. If calculation of a bridge's military load classification is required, deliberate reconnaissance procedures (sec. II, ch. 3) are undertaken in sufficient detail to provide dimensional data for structural analysis. If a bridge fails to meet the minimum traveled way width for the type of traffic flow under consideration (table 2-1) or a minimum overhead clearance of at least 4.25 meters (14 feet), it is reported as (OB) in the route classification formula (para. 2-8).

2-60. Limited Bridge Information (STANAG 2252 and SOLOG 94)

Limited bridge information includes those elements determined by hasty reconnaissance necessary for planning and conducting normal vehicular movement. These elements are serial number of the bridge, geographic location, military load classification, overall length, width of traveled way, overhead clearance, and available bypasses. Limited bridge information is recorded on a map or overlay by means of bridge reconnaissance symbols described in paragraph 2-61 or 2-62.

2-61. Full Bridge Symbol

The full bridge symbol (fig. 2-61) consists of a divided circle. Data which make up the full bridge symbol are recorded as follows:

a. The *geographic location* of the bridge is shown by a line extending from the symbol to the exact map location (fig. 2-2).

b. A *bridge serial number* is assigned for ease in future reference. Serial numbers are not duplicated within any one map sheet, overlay, or document. Subsequent identification, therefore, requires the map sheet and overlay number as well as the bridge serial number. The serial number is recorded in the lower portion of the symbol.

c. The *military load classification* number of the bridge is shown in the top portion of the circle. This number indicates the carrying capacity of the bridge; both classifications for single and double flow traffic are included. In those instances where dual classification for wheeled and tracked vehicles exists, both classifications are symbolically shown.

d. The *overall length* of the bridge is the distance between abutments measured along the bridge centerline. This value is shown by the dimension placed to the right of the circle and is expressed in either meters or feet.

e. The *minimum traveled way width* is the clear distance between curbs. This value is shown by the dimension placed below the symbol and is expressed in either meters or feet. Any width which is less than that required for the number of lanes according to the bridge classification number is underlined (table 2-4).

f. The *overhead clearance* is the minimum distance between the traveled way and any obstruction above it. This value is shown by a dimension to the left of the circle and is expressed in meters or feet. Any overhead clearance less than the minimum required by the bridge classification number is underlined (table 2-5). Unlimited overhead clearance is indicated by the symbol ∞ (infinity).

g. *Bypasses* are local detours along a specified route which enable traffic to avoid an obstruction. Bypasses are classified as *easy*, *difficult*, or *impossible*. Each type bypass is represented symbolically on the line extending from the bridge symbol to the map location (fig. 2-61) and defined as follows:

(1) *Bypass easy.* This is a local detour by means of road or cross-country movement to an alternate crossing site which can be made with an increased distance to the overall route of *no more* than 15 minutes or 6.5 km (4 mi). Improvement or construction of this type bypass requires *less* than

four hours by a combat engineer platoon with appropriate equipment.

(2) *Bypass difficult.* There is no difference in distance; however, this type bypass differs from bridge bypass easy in that *more* than four hours are required by a combat engineer platoon with appropriate equipment in improvement or construction.

(3) *Bypass impossible.* This situation exists when:

(*a*) No alternate bridge is available within an acceptable distance.

(*b*) The terrain prohibits cross-country movement or temporary road construction.

(*c*) Characteristics of the stream prohibit fording or construction of temporary crossing means.

(*d*) Depth or slope of the obstacle prohibits construction of approaches to the crossing site.

(4) *Bypass limitations.* Bypasses which are limited to specific vehicle type such as to those capable of swimming or deep water fording are accordingly noted on the reconnaissance report.

h. A *question mark* (?) is used to indicate information which is unknown or undetermined and is included as part of the bridge reconnaissance symbol.

2–62. Abbreviated Bridge Symbol

If the scale of the map or size of the document is too small to accommodate the full bridge symbol, an *abbreviated symbol* may be be used (fig. 2–62). This necessitates an accompanying inclosure to the route reconnaissance overlay; the bridge report format (para. 2–63) or DA Form 1249 is suitable for this purpose. The abbreviated symbol consists of a circle divided by a horizontal line. Data which make up the abbreviated symbol are recorded as follows:

a. The location and serial number for the abbreviated bridge symbol is indicated in the same manner as for the full bridge symbol (para. 2–61*a* and *b*).

b. Only the military load classification for *single flow traffic* is represented in abbreviated bridge symbols, and this classification is shown in the upper portion of the circle. Where there are separate single flow classifications for tracked and wheeled vehicles, the lower classification number is shown. However, if a bridge has more than one classification, the classification number shown in the abbreviated symbol is marked with an asterisk (*); and those classifications not shown are included in the accompanying inclosure.

2–63. Format for Electrically Transmitting Bridge Information (STANAG 2096 and SOLOG 107)

To provide standardization in reporting bridge reconnaissance data by electrical means the format shown in figure 2–63 has been devised. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11–170), the format, which is reproduced locally, may also be used to supplement route reconnaissance overlays especially when the abbreviated bridge symbol is employed. The originator reports only those parts of the format which are applicable or for which information is available. Each item of the report, however, must be accompanied by the appropriate letter designation from the format to establish the correct category or information. Messages are preceded by the term, BRIGREP, or identifying codeword.

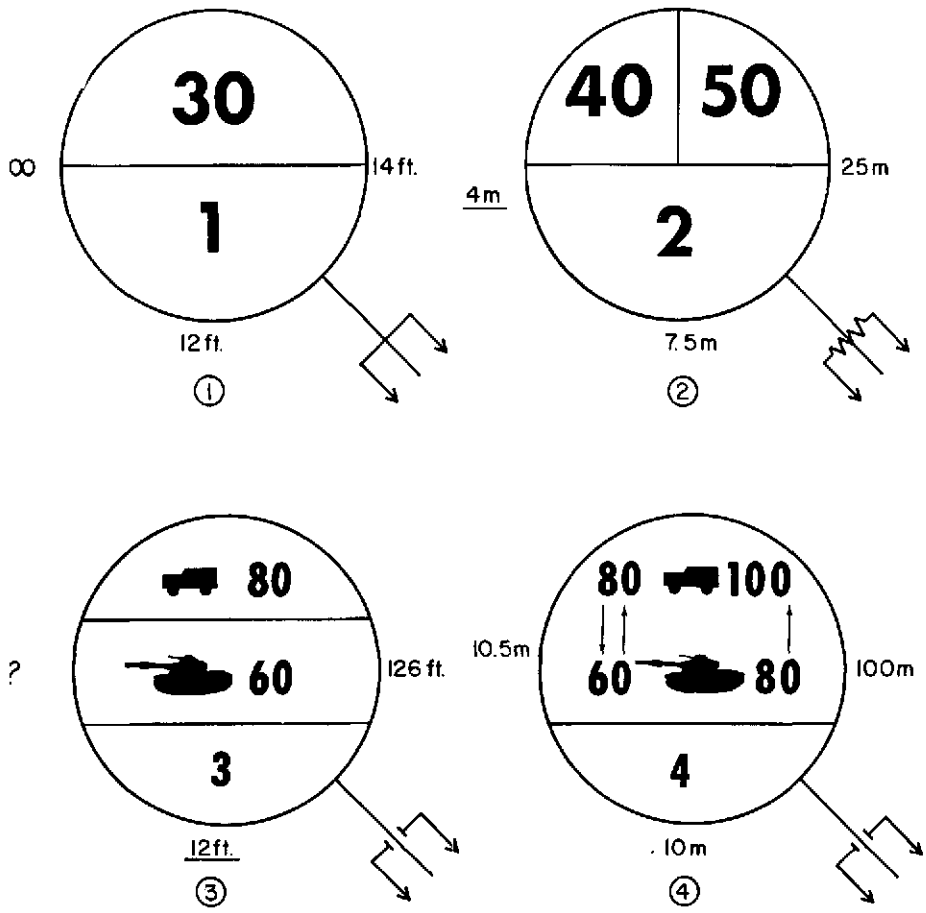
2–64. Reconnaissance of Bridge Sites

a. Reconnaissance personnel other than engineers may often be required to assist in selecting sites for military bridging. General reconnaissance considerations in selecting bridge sites are as follows:

(1) *Access routes.*

(*a*) The bridge site should be located to take maximum advantage of the existing road net on both sides of the site.

(*b*) The reconnaissance should include the location of concealed areas which are accessible to the main road net to be used as holding areas



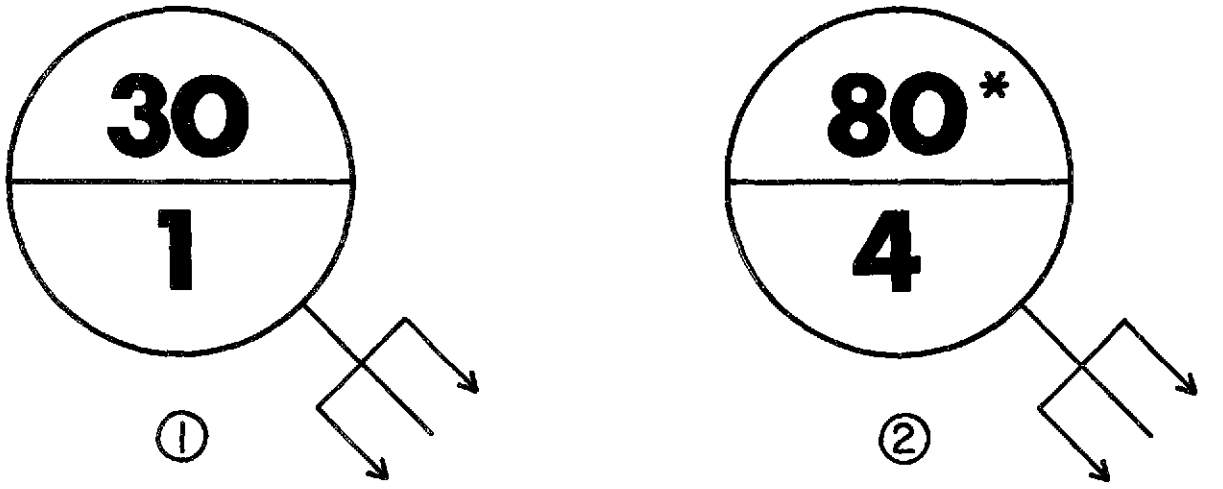
1. This symbol represents a single flow bridge, classification 30, assigned the arbitrary serial number 1, with an overall length of 14 feet, traveled way width of 12 feet, unlimited overhead clearance, and easy bypass conditions.

2. This symbol represents a classification 40 double flow and classification 50 single flow bridge assigned the arbitrary serial number 2 with an overall length of 25 meters, traveled way width of 7.5 meters, overhead clearance 4 meters, and difficult bypass conditions. The overhead clearance of 4 meters is less than 4.25m specified by STANAG 2021, and the dimension is, therefore, underlined.

3. This symbol represents a single flow bridge assigned the arbitrary serial number 3 which is classification 80 for wheeled vehicles and classification 60 for tracked vehicles with overall length of 126 feet, traveled way width of 12 feet, overhead clearance unknown, and impossible bypass conditions. The traveled way width is less than specified by STANAG 2021, and the dimension is, therefore, underlined.

4. This symbol represents a double flow bridge assigned the arbitrary serial number 4, which is classification 80 double flow and classification 100 single flow for wheeled vehicles; classification 60 double flow and classification 80 single flow for tracked vehicles with overall length 100 meters, traveled way width of 10 meters, overhead clearance 10.5 meters, and impossible bypass conditions.

Figure 2-61. Examples of the full bridge symbol.



1. This symbol represents a single flow bridge, Classification 30, assigned the serial number 1 with easy bypass conditions. The elements of essential bridge information are found in an accompanying inclosure.

2. This symbol represents a bridge assigned the serial number 4 with easy bypass conditions, in which the lower single flow classification is 80. The asterisk denotes that there are other classifications for the bridge which are found in an accompanying inclosure.

Figure 2-62. Examples of the abbreviated bridge symbol.

Explanation	BRIGREP Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid coordinates)	CHARLIE				
Type of bridge (use symbols explained in para. 2-58).	DELTA				
Single flow classification	ECHO				
Double flow classification	FOXTROT				
Physical condition of bridge	GOLF				
Minimum width of traveled way	HOTEL				
Overhead clearance	INDIA				
Bypasses	JULIET				
Other significant information	KILO				

Notes. [a]. First bridge in report; report by serial number if assigned.
[b]. Additional bridges in report.

Figure 2-63. Bridge report format.

for vehicles waiting their turn to cross the bridge.

(2) *Approach roads.*

(*a*) Reconnaissance should consider the construction required for bridge approaches at each site. Often, the time required to construct approaches is the controlling factor in

the selection of a bridge site. Approaches should be straight and without excessive grade.

(*b*) A turnaround near the bridge site is needed for moving trucks and semitrailers during the construction phase.

(3) *Width of stream.* The width of the stream must be determined accurately enough to establish the amount of materials and equipment needed.

(4) *Banks.*

(*a*) The character and shape of the banks should be analyzed with sufficient detail to establish the type of abutments required.

(*b*) Banks should be firm and should not be so high or so steep as to require excessive grading for the approach. Straight stretches of the stream should be selected whenever possible because the banks will be subject to less scour.

(5) *Flow characteristics.* The velocity of the stream and data on the rise and fall of the water should be determined. A good bridge site is one where the current is steady, parallel to the bank, and slow to moderate (0 to 1.5 meters per second).

(6) *River bottom.* The character of the river bottom should be noted so the type of support and footings can be determined.

(7) *Profile.* In order to determine the heights of bridge supports, an accurate cross section of the defile should be made.

(8) *Local materials.* The reconnaissance should locate the nearest source of materials that can be used in construction. Sources include standing timber, nearby demolished buildings or bridges, and sources of sand and gravel for bridge approaches.

b. The armored vehicle launched bridge (AVLB) is a bridge with a military load classification of 60 which is designed to be transported, launched, and retrieved by a modified turretless tank chassis (fig. 2-64). The AVLB is used to cross short gaps (18 meters or less) in a minimum of time and with a minimum exposure of bridging personnel to enemy fire. The gaps to be crossed may consist of antitank ditches, road craters, streams, demolished bridge spans, railroad cuts, and similar obstacles frequently found in the combat zone. The bridge can be launched and recovered on uphill grades of 28 percent, downhill grades of 19 percent, and transverse grades of 11 percent. In all cases the *bank conditions must support the launching vehicle and provide sufficient bearing to allow the bridge to support its rated load after launching* (TM 5-216).

2-65. Drainage Considerations

Drainage is an important aspect of route reconnaissance. The entire serviceability of a route depends on the adequacy of the drainage system (TM 5-335). The washout of a single culvert may result in a traffic obstruction or close a route at a critical time. The development of a soft spot may lead to rutting, displacement, and eventual closing of a route for repairs. In addition, drainage systems are vulnerable to demolition by enemy forces. It is, therefore, incumbent on all reconnaissance personnel to inspect the drainage system, to report structures in need of repair and debris which may clog the system, and to check likely sites for prepared demolition or acts of sabotage. The more common components of drainage systems are—

a. Open Channels. Open channels or ditches provide the simplest as well as the most common method of handling surface water. Gutters or combination curbs and gutters are used to collect and control surface runoff where open ditches would be impractical. Deep or wide ditches bordering routes are definite traffic hazards. These ditches may reduce the width of the traveled way and require posting with caution signs.

b. Embankments. Dikes, berms, or intercepting embankments are used along shoulders of high fills or along the tops of cut slopes to

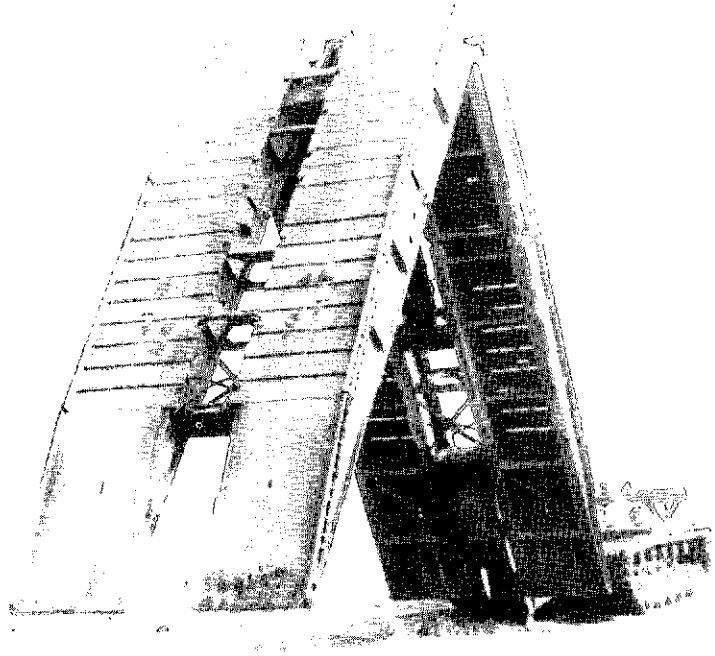


Figure 2–64. Armored vehicle launched bridge.

collect runoff. Such runoff may be directed into ditches or natural drainage courses to prevent the erosion of unstable slopes.

c. Culverts (fig. 2–65). Culverts are used under roads and air landing facilities to carry water that cannot be diverted to natural drainage channels by other means. Culverts are relatively short and conform generally to the grade and alinement of the open ditch, stream, or natural drainage course at the inlet and outlet ends. Culverts are particularly good demolition targets.

d. Dips. Dips are portions of a route, normally paved, which may be used as fords for crossing shallow arroyos or washes in semiarid regions subject to flash floods and in other locations where the construction of a bridge is impractical or too expensive.

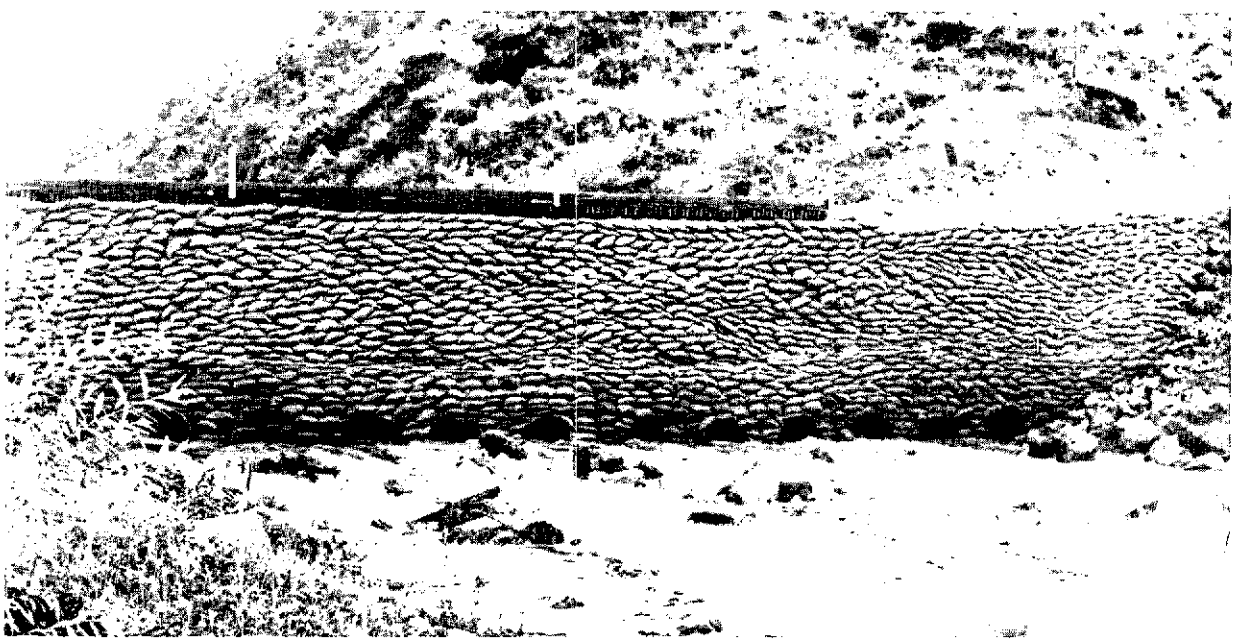


Figure 2–65. Causeway with culverts.

CHAPTER 3

DELIBERATE BRIDGE AND ROAD RECONNAISSANCE

Section I. GENERAL

3-1. Deliberate Bridge and Road Reconnaissance

With the exception of bridges and roads, sufficient information for the conduct of deliberate route reconnaissance is prescribed in chapter 2. In this chapter, deliberate reconnaissance procedures for bridges and roads are discussed separately because of their technical nature and to facilitate instruction of those personnel, primarily engineers, who bear staff responsibility for the technical classification of existing routes. Section II, chapter 3 is devoted to deliberate bridge reconnaissance, section V, chapter 3, to deliberate road reconnaissance, and section VI to engineer reconnaissance.

3-2. Computation of Military Load Classifications

To a great extent, route classification is based on the military load classification system. Existing bridges in a theater of operations as well as enemy and civilian nonstandard vehicles requisitioned for military use may often require the computation of their respective classifications. To meet this likelihood, section III, chapter 3 (Bridge Military Load Classification) and section IV, chapter 3 (Vehicle Military Load Classification) are introduced following deliberate bridge reconnaissance to which the classification system is closely related.

Section II. DELIBERATE BRIDGE RECONNAISSANCE

3-3. General

The purpose of bridge reconnaissance is to collect bridge data necessary to support operational planning and movement. There are two methods of bridge reconnaissance:

a. Hasty Bridge Reconnaissance. Hasty reconnaissance is performed to acquire limited bridge information necessary to determine the suitability of a bridge for immediate tactical use. This type of reconnaissance is discussed in section VII, chapter 2.

b. Deliberate Bridge Reconnaissance. Deliberate reconnaissance, on the other hand, is conducted when sufficient time and qualified personnel are available to consider all aspects of a bridge required for thorough structural analysis. This analysis may be for the purpose of repairs, demolition, or to calculate the military load classification.

3-4. Types of Bridge Information (STANAG 2252 and SOLOG 94)

Three categories of bridge information are established to assist in reconnaissance and standardization of reports:

a. Essential Bridge Information. Essential bridge information is acquired mainly for engineer purposes. The elements of essential information are: serial number; location; military load classification; overall length; traveled way width; overhead clearance; bridge bypasses; horizontal clearance; underbridge clearance; and a description of each span to include type and material of span construction, span length, and other pertinent information.

b. Limited Bridge Information. Limited bridge information includes those elements of essential bridge information necessary for planning normal road movement. These ele-

ments are serial number, location, military load classification, overall length, traveled way width, overhead clearance, and bridge bypasses (see para. 2-60).

c. Additional Bridge Information. Additional bridge information includes other items of description which are desirable to know in planning for the prolonged use of a bridge. This category of information may include descriptions of the approaches to the bridge and characteristics of the gap or obstacle spanned by the bridge. Also descriptions of abutments, intermediate supports, and bridge structural data such as type and material of construction may be included.

3-5. Bridge Reconnaissance Report Form

The Bridge Reconnaissance Report (DA Form 1249) supplements the route reconnaissance overlay and is used more often in conducting and reporting deliberate reconnaissance. The instructions for making the reconnaissance guide the reconnaissance party in the amount of detail required. Short forms or bridge information tables may be designed and produced by the unit making the reconnaissance when DA forms are not available.

3-6. Essential Bridge Information

Elements of essential bridge information are recorded in the columns of the Bridge Reconnaissance Report Form (fig. 3-1) as follows:

a. Column 1. The assigned serial number of the bridge is entered. This number corresponds to the serial number used in the bridge symbol of the route reconnaissance overlay (para. 2-61 and 2-62).

b. Column 2. Bridge location is reported by means of UTM grid coordinates.

c. Column 3. Horizontal clearance is the clear distance in meters or feet between the inside edges of the bridge structure measured at a height of 30 centimeters (12 inches) above the surface of the traveled way. If the horizontal distance between the inside of the curb and the inside of the bridge structure is less than 25 centimeters (10 inches), the horizontal clearance is *underlined.* Unlimited horizontal clearance is indicated by the symbol (∞).

d. Column 4. Underbridge clearance is the minimum clear distance in meters or feet between the underside of the bridge and the surface of the ground or water at mean level. Mean water level can be determined from gaging station records, observation of high and low water marks, or information gained from local inhabitants.

e. Column 5. Structural data for each span and the number of consecutive identical spans is recorded. Spans are listed in sequence starting from the west. In those cases where the orientation of the bridge is so close to north and south as to create uncertainty as to which is the most westerly span, the abbreviation for north (N) is inserted in column 5 preceding the number of spans; and the spans are listed in sequence starting from the north.

f. Column 6. The type of span construction is recorded by applicable number symbol (table 2-6).

g. Column 7. The construction material of each span is recorded by letter symbol (table 2-7).

h. Column 8. Span length is recorded in meters or feet. This is the center-to-center distance between supports. The following special information is also recorded:

(1) Spans which are not usable because of damage or destruction are indicated by the symbol (#) placed after the dimension of the span length.

(2) Spans which are over water are indicated by placing the symbol (W) after the dimension of the span length.

i. Unknown Information. Any item of information which is unknown or undetermined is represented by a question mark (?) in the appropriate column of the report.

3-7. Limited Bridge Information and Bypasses

The elements of limited bridge information and bypass conditions are reported by means of bridge symbols described in paragraphs 2-61 and 2-62. Bridge symbols are shown on maps or overlays near the bridge location with a line leading to the exact map location. If

BRIDGE RECONNAISSANCE REPORT
(FM 5-36)

DATE: 1 JUN 1964

SIGNATURE: John H. Doe 1st. Lt. CE

TO: *(Headquarters ordering reconnaissance)* COMMANDING OFFICER, ATTN: S2; 185TH ENGR BN (21ST INF DIV)

FROM: *(Name, grade, and unit of officer or NCO making reconnaissance)* John H. Doe 1/Lt Co A 21st ENGR BN

MAPS *(Country, scale and sheet number or name)*: Virginia, Annandale, 1:25,000; Sheet 5561

DATE/TIME GROUP *(Of signature)*: 0116 30R

ESSENTIAL BRIDGE INFORMATION

SERIAL NO. 1	LOCATION 2	CLEARANCE HORIZONTAL 3	CLEARANCE UNDER-BRIDGE 4	SPANS NUMBER 5	SPANS TYPE OF CONSTRUCTION 6	SPANS TYPE OF CONSTRUCTION MATERIAL 7	SPANS LENGTH AND CONDITION 8	ADDITIONAL BRIDGE INFORMATION *(Add columns as needed)* *(Military load class, overall length, roadway width, vertical clearance, bridge by-pass)*
1	LA972687	∞	6Ft	1	3	h	13.5 Ft.W	
2	LA972997	9.5m	6.5m		4	K	4 m	
					1	a	16m w*	
					4	k	4 m w	
3	LA965650	∞	23m	6	3	ak	25m	
4	LA956643	10.5	8.5	3	6	K	10	
				2	2	a	20 w	
				3	6	K	10	

DA FORM 1 JUL 60 1249 PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

GPO 9 27 814

Figure 3–1. Example bridge reconnaissance report (DA Form 1249) used in conjunction with the full bridge symbol and reconnaissance overlay.

the full bridge symbol is employed, no limiting information will be noted on the Bridge Reconnaissance Report (DA Form 1249). If the abbreviated bridge symbol is employed, however; additional columns, 9 through 13, are added to the additional bridge information section of DA Form 1249 (fig. 3–2) to insure completeness of information. DA Form 1249 accompanies the same overlay or map sheet as the bridge symbol, and each symbol is cross-referenced by serial number.

3–8. Bridge Sketches

Sketches on the back of DA Form 1249 depict as much information as necessary (fig. 3–3. *Minimum required detail* is as follows:

a. A side elevation which shows the general features of the bridge including the number of spans, piers, and abutments and their type and material of construction. Critical dimensions such as span length, height above stream bed, water level, and panel length are also noted. A cross section of the obstacle (e.g., stream or gorge) may be also included in the sketch.

b. The critical span (the span with the least load-carrying capacity) which is sketched in cross section showing sufficient details of construction upon which to base computation of the military load classification and to ascertain maintenance, reinforcement, and demolition requirements. Such items as width of span, type and materials of construction, and structural design are included. Tables 3–1 and 3–2 outline the required dimension measurements for each of the seven basic types of spans.

c. Cross sections of critical members which are sketched in sufficient detail to provide a basis for calculating the strength of individual members.

d. The site plan sketch which shows the location of the bridge; the alinement of the bridge relative to approaches; the gap or obstacle spanned; the location of unusual features such as damage or obstructions; the classification, dimensions, and gradient of approaches; the direction of flow of the stream; and sufficient topographical detail of the barrier to indicate possible fording sites.

3–9. Bridge Photographs

DA Form 1249 is accompanied by up-to-date photographs if possible. Both ground and aerial photographs are desirable. The minimum photographic coverage includes a side view, a view from the traveled way of the bridge, and a view from underneath the flooring.

3–10. Additional Bridge Information

Items of information in addition to essential bridge information which is collected and recorded when practicable or required are—

Table 3–1. General dimension data required for each of the seven basic types of bridges.

Number on figure	Dimension data	Basic type of bridge						
		Simple stringer (fig. 3–23)	Slab (fig. 3–21)	T-beam (fig. 3–21)	Truss (fig. 3–31)	Girder (fig. 3–39)	Arch (fig. 3–42)	Suspension (fig. 3–51)
1	Overall length	x	x	x	x	x	x	x
2	Number of spans	x	x	x	x	x	x	x
2	Length of spans	x	x	x	x	x	x	x
2a	Panel length	-------	-------	-------	x	-------	-------	x
3	Height above streambed	x	x	x	x	x	x	x
3a	Height above estimated normal water level.	x	x	x	x	x	x	x
4	Traveled way width	x	x	x	x	x	x	x
5	Overhead clearance	-------	-------	-------	x	-------	-------	x
6	Horizontal clearance	x	x	x	x	x	x	x

Notes.

1. The figures referred to are outline drawings of the basic type of bridges.
2. The letter "x" indicates that the dimension is required.

BRIDGE RECONNAISSANCE REPORT
(FM 5-36)

DATE: 1 Jun 1964

SIGNATURE: John H. Doe.

TO: (Headquarters ordering reconnaissance) (COMMANDING OFFICER, ATTN: S2 21ST ENGR BN (21ST INF DIV)

FROM: (Name, grade, and unit of officer or NCO making reconnaissance) John H. Doe 1st Lt. Co A 21st ENGR BN

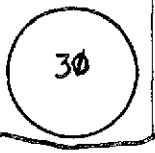
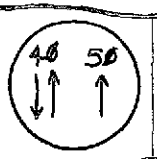
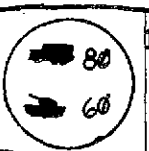
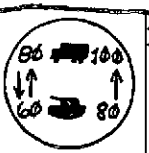
MAPS (Country, scale and sheet number or name) Virginia, Annandale, 1:25000; Sheet 5561

DATE/TIME GROUP (Of signature) 011900Z

ESSENTIAL BRIDGE INFORMATION

SERIAL NO. 1	LOCATION 2	CLEARANCE HORIZONTAL 3	CLEARANCE UNDER-BRIDGE 4	SPANS NUMBER 5	SPANS TYPE OF CONSTRUCTION 6	SPANS TYPE OF CONSTRUCTION MATERIAL 7	SPANS LENGTH AND CONDITION 8
1	LA 072687	∞	6Ft.	1	3	h	13.5 Ft (W)
2	LA 118759	9.5m	6.5m		4	K	4 m
					1	a	16mw *
					4	K	4mw
3	LA 165650	∞	23	5	3	ak	25m
4	LA 156643	10.5	8.5	3	6	K	10 m
				2	2	a	20mw
				3	6	K	10m

ADDITIONAL BRIDGE INFORMATION (Add columns as needed)
(Military load class, overall length, roadway width, vertical clearance, bridge by-pass)

Military Load Classification 9	Overall Length 10	Traveled Width 11	Overhead Clearance 12	Bridge By-Pass 13	Remarks 14
	14FT	12 FT.	∞	Easy	NONE
	25m	7.5m	4m	Difficult.	NONE
	126m	12	∞	Impossible	NONE
	100m	10	10.5m	Impossible	NONE

DA FORM 1 JUL 60 1249 PREVIOUS EDITION OF THIS FORM IS OBSOLETE. GPO 927514

Figure 3–2. Example bridge reconnaissance report (DA Form 1249) used in conjunction with the abbreviated bridge symbol and reconnaissance overlay.

Table 3-2. Capacity dimension data required for each of the seven basic types of span.

Letter designation	Capacity [a] dimension data	Basic types of bridge										
		Simple stringers (fig. 3-23)					Slab (fig. 3-21)	T-beam (fig. 3-21)	Truss (fig. 3-31)	Girder (fig. 3-39)	Arch (fig. 3-42)	Suspension (fig. 3-51)
		Timber		Steel								
		Rectang.	Log.	I-beam	Channel	Rail						
a	Thickness of wearing surface.	x					x	x	x	x	x	x
b	Thickness of flooring, deck, or depth of fill at crown.	x					x	x	x	x	x	x
c	Distance, c-to-c, between T-beams, stringers, or floor beams.	x	x	x	x	x	-----	x	x	x	x	x
d	Number of T-beams or stringers.	x	x	x	x	x	-----	x	x	x	-----	x
e	Depth of each T-beam or stringer.	x	([b])	x	x	x	-----	x	x	x	-----	x
f	Width of each T-beam or stringer.	x	-----	([c])	([c])	([c])	-----	x	x	x	-----	x
g	Thickness of web of I-beams, WF-beams, channels, or rails.	-----	-----	x	x	x	-----	-----	x	x	-----	x
h	Sag of cable	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	x
i	Number of each size of cable.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	x
j	Thickness of arch ring	-----	-----	-----	-----	-----	-----	-----	-----	-----	x	-----
k	Rise of arch	-----	-----	-----	-----	-----	-----	-----	-----	-----	x	-----
l	Diameter of each size of cable.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	x
m	Depth of plate girder	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
n	Width of flange plates	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
o	Thickness of flange plates.	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
p	Number of flange plates	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
q	Depth of flange angle	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
r	Width of flange angle	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
s	Thickness of flange angle.	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
t	Depth of web plate	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
u	Thickness of web plate	-----	-----	-----	-----	-----	-----	-----	-----	x	-----	-----
v	Average thickness of flange.	-----	-----	x	-----	-----	-----	-----	-----	-----	-----	-----

Note. x indicates required dimensions.

[a] Capacity is computed by the use of formulas and data outlined in the bridge classification card or SOLOG 105 (app. V).

[b] Diameter.

[c] Width of flange.

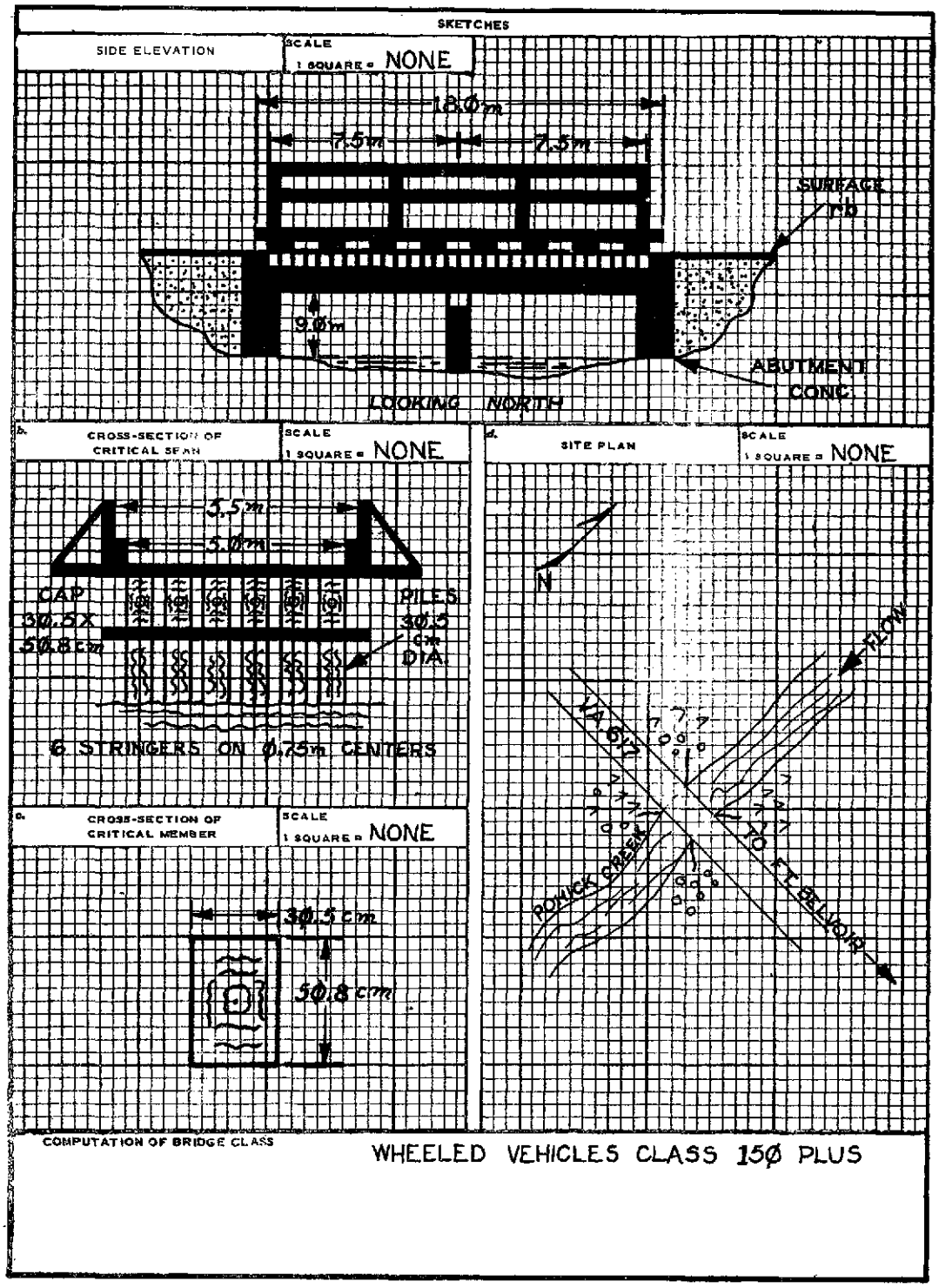


Figure 3–3. Example bridge sketch rear side of DA Form 1249.

a. Approaches to include limiting factors, minimum traveled way width, surface material, and obstructions.

b. Nature of crossing or obstacle to include naming the geographical feature over which the bridge spans and reporting its width and depth. If the crossing is over a water obstacle, additional information includes current condition; width and depth at mean water level; tidal conditions; flood susceptibility; proximity of dams, locks, etc.; nature and slope of banks; and type of stream bottom.

c. Abutments to include foundation conditions, type and material of construction, and bearing areas (para. 3–11).

d. Intermediate supports to include foundation conditions, type and material of construction, bearing areas, height above ground or mean water level, horizontal clearance between supports at ground or mean water level, special design features such as ice breakers, and critical dimensions required for demolition or strength calculations (para. 3–12).

e. Bridge structure to include a detailed description of the type and material of construction to include wearing surface, deck or flooring, and supporting members (para. 3–13). Also included are capacity dimensions where applicable (table 3–2), engines and machinery for swing, lift, bascule, and retractile bridges; supply, utility, or communication lines supported by the bridge; date of construction; and critical dimensions for demolition and calculation of the military load classification.

f. Repair information to include a description of the nature of repair or the reinforcement needed; an estimate of time, labor, and material required; availability of construction material nearby; and results to be expected from repairs or reinforcement (TM 5–312). Extensive repair information is generally attached to the Bridge Reconnaissance Report using DA Form 1711–R (see para. 3–35).

g. Demolition information to include a description of the demolition procedures planned and the expected effect; a description of any prior preparation; and an estimate of time, labor, and material required to execute the demolition (FM 5–25).

h. Alternate crossing sites to include data concerning the approaches; the type of crossing (e.g., ferry, ford, or floating bridge); and an estimate of the time, labor, and materials needed to construct alternate crossings.

3–11. Bridge Abutments

Bridge abutments are the ground supports at the shore end of a bridge. They may be constructed of concrete, masonry, or earth with a wooden end wall and abutment sill. Typical abutments are—

a. Straight abutment (fig. 3–4).

b. T-type abutment (fig. 3–5).

c. U-type abutment (fig. 3–6).

d. Wing-type abutment (fig. 3–7).

e. Earth abutment with timber abutment sill and end wall (fig. 3–8).

f. Pier abutment (fig. 3–9).

g. Box abutment (fig. 3–10).

3–12. Bridge Intermediate Supports

Intermediate supports for bridges are ground supports between abutments. They may be log pile bents (fig. 3–11), timber trestle bents (fig. 3–12), timber pile piers (fig. 3–13), crib piers (fig. 3–14), masonry piers (fig. 3–15), prefabricated steel trestle piers (fig. 3–16), open type concrete piers (fig. 3–17), or solid concrete piers (fig. 3–18).

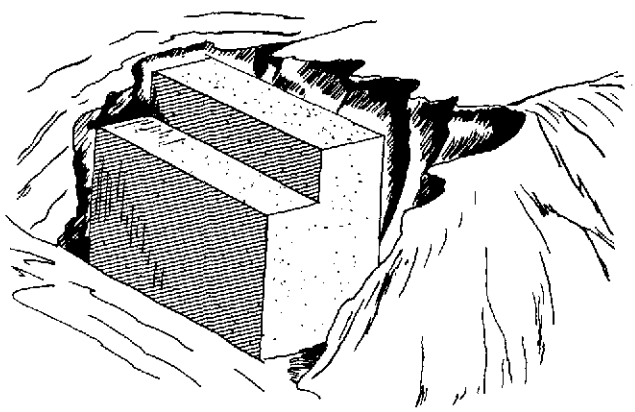


Figure 3–4. Typical straight abutment.

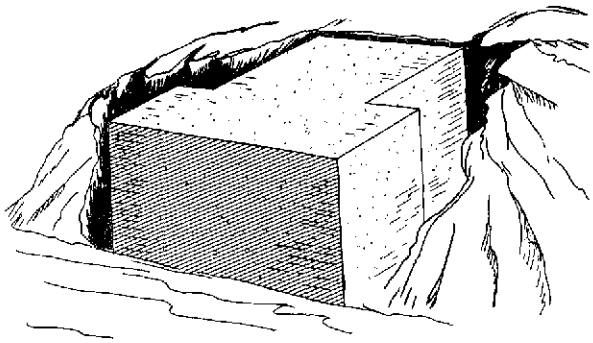


Figure 3–5. Typical T-type abutment.

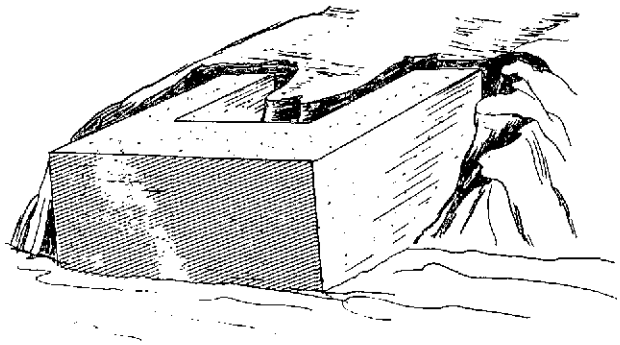


Figure 3–6. Typical U-type abutment.

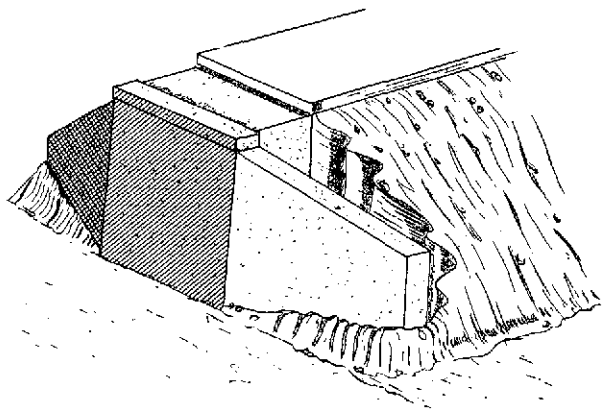


Figure 3–7. Typical wing-type abutment.

3–13. Bridge Spans

a. General. Bridge spans may be divided into two general types—fixed bridges and movable bridges.

(1) Fixed bridge spans (fig. 2–60) are further divided according to structural design. These designs, which are discussed in more detail in subparagraphs *b* through *h*, are cantilever, slab, beam (simple or continuous

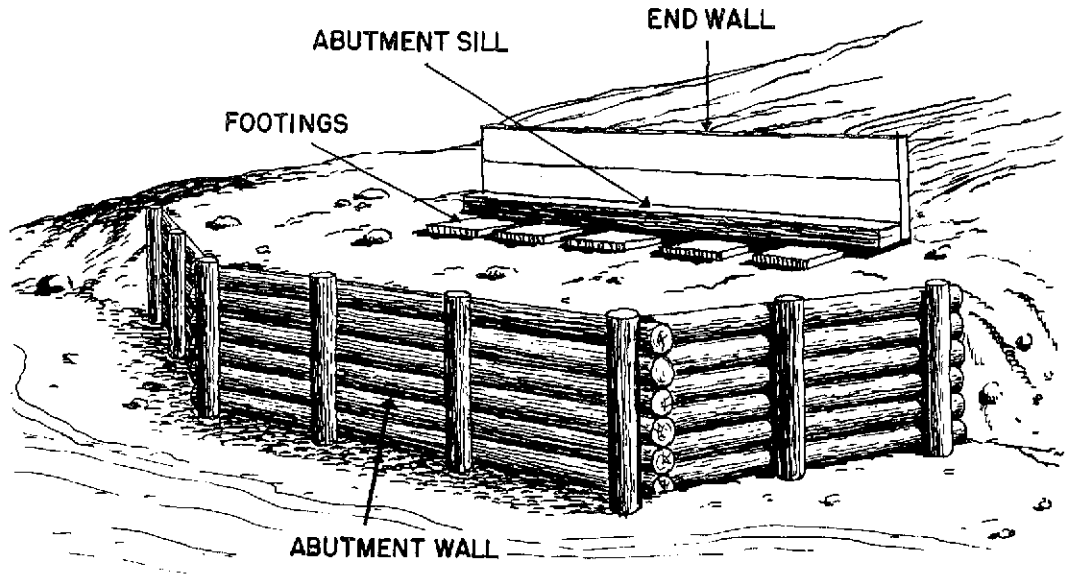
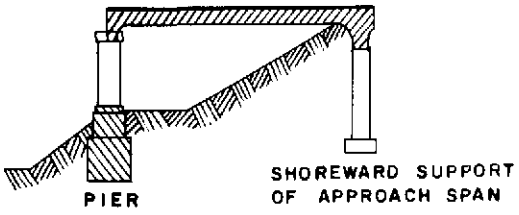
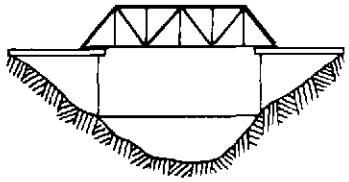


Figure 3–8. Typical earth abutment, with timber abutment sill and end wall.



PIER ABUTMENT

Figure 3-9. Typical pier abutment.



BOX ABUTMENT

Figure 3-10. Typical box abutment.

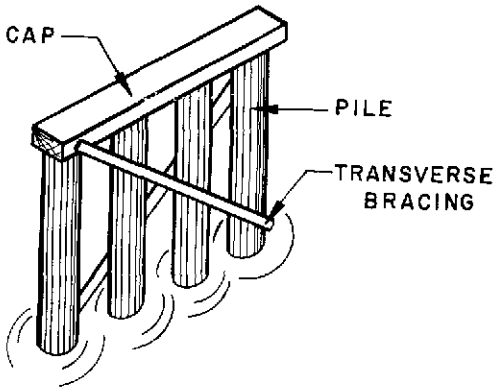


Figure 3-11. Pile bent.

stringer), truss, girder, arch, suspension, and ponton.

(2) Movable bridges are discussed in subparagraph *i*.

(3) Principal bridge span dimensional data are illustrated in figure 3-19, and required dimensional measurements are given in table 3-1.

(4) Required dimensional data for determining the capacity of individual bridge members are illustrated in table 3-2.

b. Cantilever Bridges. A cantilever bridge is one in which two self-supporting beams or trusses project from piers toward each other with no intermediate support. These beams are either joined directly or connected by a suspended span (fig. 3-20).

c. Slab Bridges.

(1) Slab bridges are short span bridges consisting primarily of a reinforced concrete slab resting directly on the abutments or intermediate supports. A wearing surface of bituminous material, gravel, or wooden planks is usually laid over the concrete, but sometimes the upper side of the slab serves also as the wearing surface. Care should be taken not to mistake hollow girder bridges for slab bridges. The distinguishing features of hollow girded bridges are long spans and relatively deep sections. Very few slab bridges span more than 9 meters and very few hollow girder bridges span less than 15 meters.

(2) A standard dimension data guide for concrete bridges is shown in figure 3-21. A typical concrete slab bridge is illustrated in figure 3-22.

d. Beam Bridges.

(1) The majority of all bridges with short spans are simple stringer bridges. Stringers are generally constructed of steel, concrete, or wood. A standard dimension data guide for simple stringer bridges is illustrated in figure 3-23. The most common types of stringers are as follows:

(*a*) *Wooden stringers.*
1 Rectangular timber (fig. 3-24).
2 Log (fig. 3-25).

(*b*) *Steel stringers.*
1 I-beam (figs. 3-26 and 3-27).
2 Wide flange (WF) beam.
3 Channel.
4 Rail.
5 Plate girder.

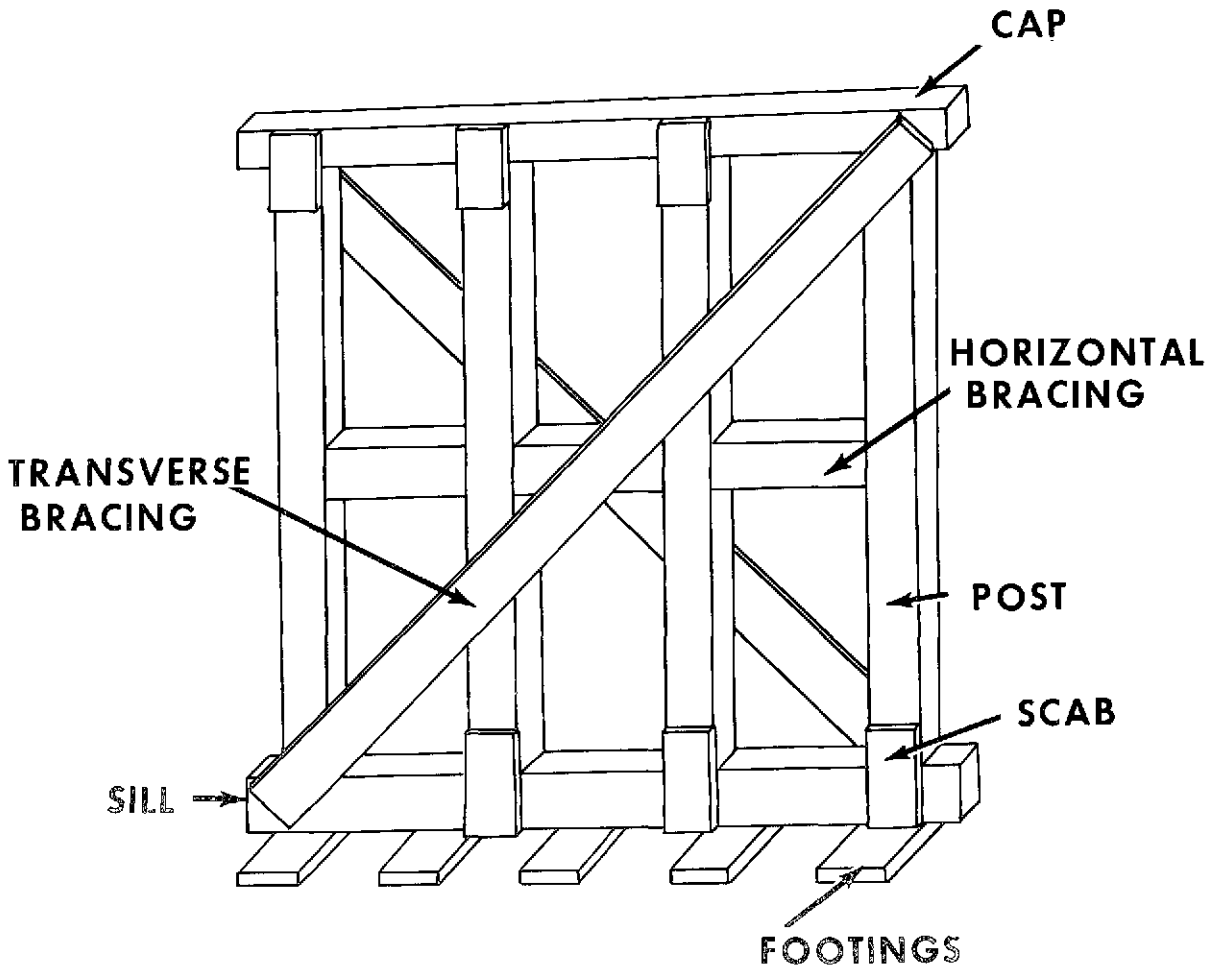


Figure 3–12. Timber trestle bent.

(2) Beam bridges may also be constructed of reinforced concrete in the form of slabs resting on a series of rectangular beams. Beams and slabs are poured integrally. The beams may be reinforced with standard rods, steel T-beams, I-beams, or channels. The wearing surface of the traveled way may consist of bituminous material or wooden planking laid on top of the concrete slab. A standard dimension data guide for concrete bridges is illustrated in figure 3–21. Typical single span and multispan concrete bridges are illustrated in figures 3–28, 3–29, and 3–30.

e. Truss Bridges.

(1) Truss span bridges are used for spans which are too long for simple stringer or girder bridges. The truss is a compound beam in which the components are arranged to form one or more triangles in the same plane. It supports the traveled way and transmits the load to the abutments and intermediate supports. Trusses are usually constructed of steel although wood truss bridges are found in or near areas where timber is abundant.

(2) A standard dimension data guide for truss bridges is illustrated in figure 3–31.

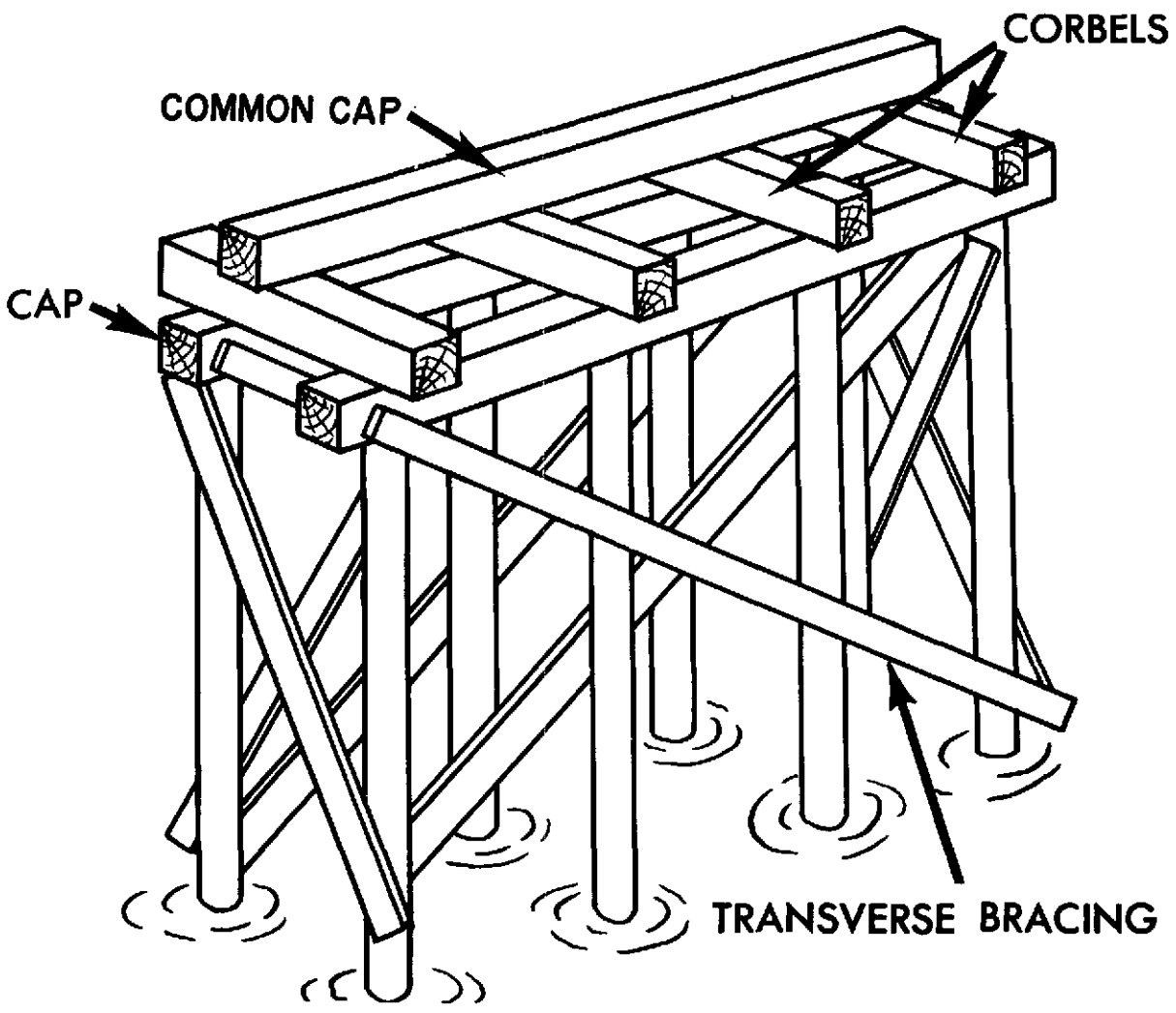


Figure 3–13. Timber pile pier.

(3) The position of the traveled way determines the truss type (fig. 3–32).
  (*a*) *Deck truss.* The traveled way is located above or on the top chord.
  (*b*) *Through truss.* The traveled way is situated near the bottom chord, and overhead bracing (crosswise) is frequently provided.
  (*c*) *Pony (half-through) truss.* The traveled way is located close to the top chord, and no overhead bracing (crosswise) is provided.

(4) Common types of bridge trusses are illustrated in figure 3–33, but it is not generally required to include their names in bridge reconnaissance reports.

(5) Typical truss bridges are illustrated as follows:
  (*a*) Typical steel deck truss bridge (fig. 3–34).
  (*b*) Typical timber truss bridge (fig. 3–35).
  (*c*) Typical steel through truss bridge (Warren type) (fig. 3–36).
  (*d*) Steel pony truss span (figs. 3–37 and 3–38).

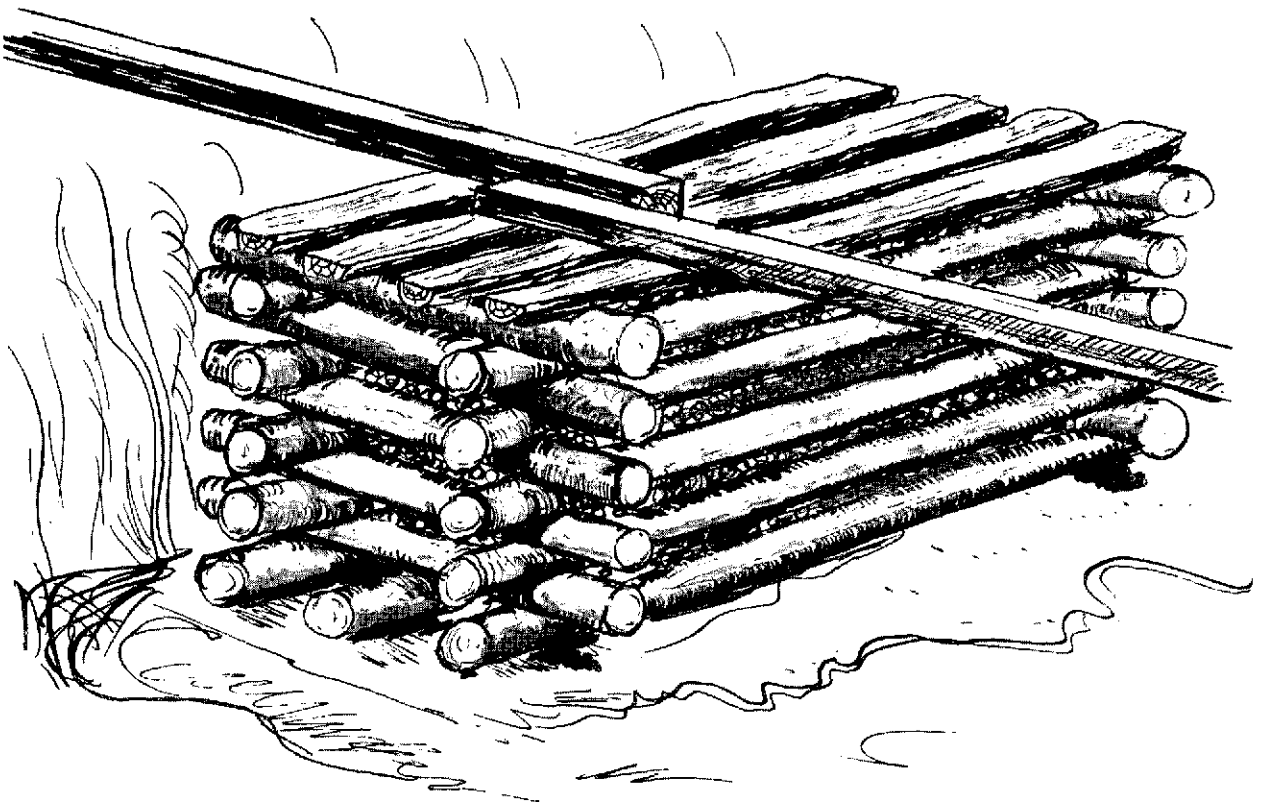


Figure 3–14. Typical crib pier.

f. Girder Bridges.

(1) Girder span bridges are composed of girders and a floor system. The girder is a compound steel beam, formed from plates, shapes (such as angles, channels, and Z-sections), lattice work, bars, and other elements, which transmit the traveled way loads to the intermediate supports and abutments. The floor system is composed of stringers, floor beams, flooring, and a traveled way. Normally, girder spans are constructed of steel, but occasionally they are made of prestressed concrete.

(2) A standard dimension data guide for plate girder spans is illustrated in figure 3–39.

(3) *Identification of girder bridges is difficult. They may be mistaken for truss bridges or simple stringer bridges.* Therefore, it is important to make close inspection of girder bridges and to identify their component parts accurately when capacity calculations are involved. The common types of plate girders are single plate or box type girders. The bridges constructed of these girders are deck plate girder bridges or through plate girder bridges.

(*a*) *Plate girder span.* The plate girder span is the most common type. The traveled way is usually located above the top flange plate of the girder. A typical multispan plate girder bridge is illustrated in figure 3–40.

(*b*) *Through type girder span.* If the floor system is carried at or near

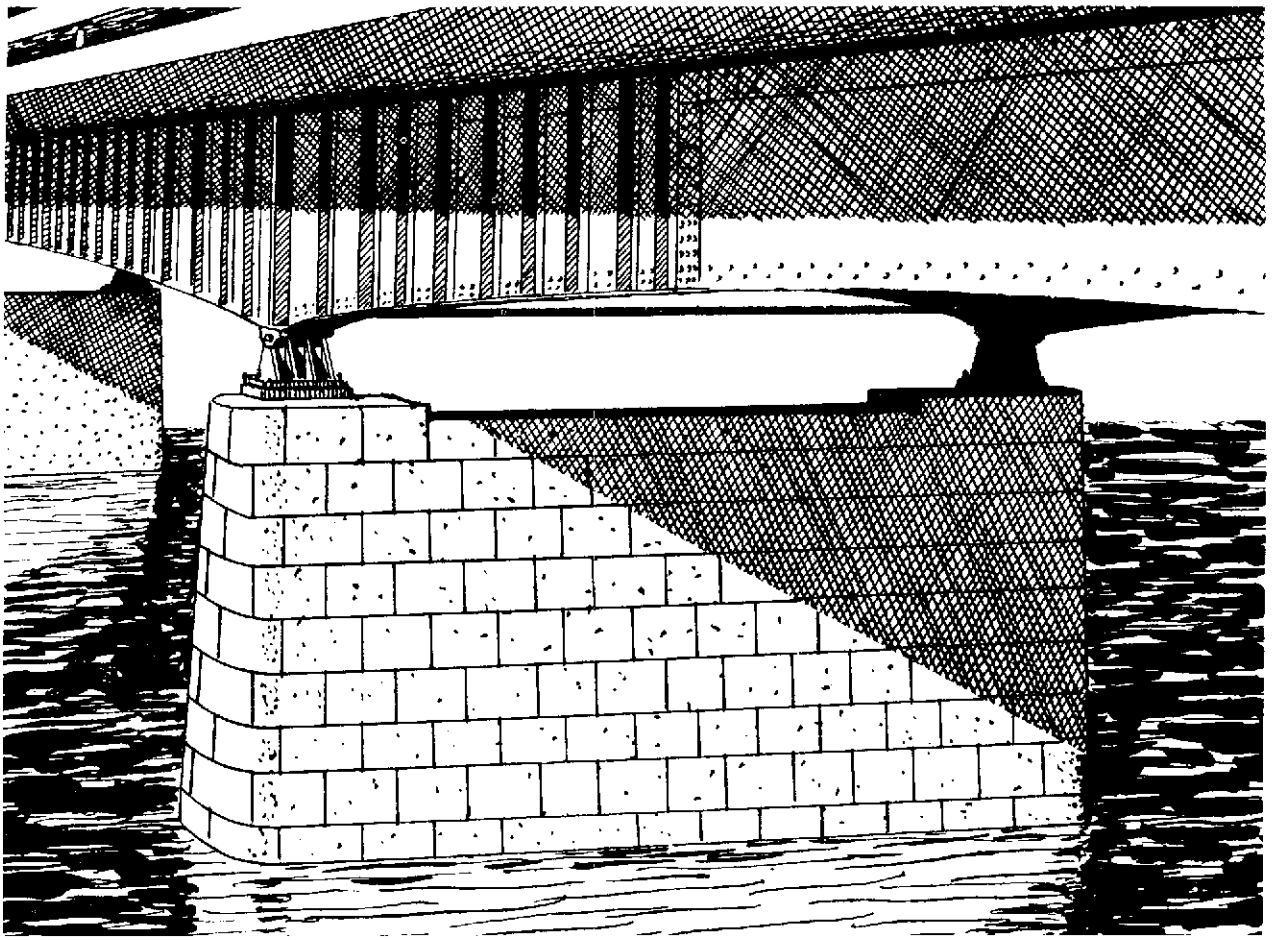


Figure 3–15. Typical masonry pier.

the level of the lower chords so that the traffic passes between or through the girder, the structure is called a through type girder bridge. This type is illustrated in figure 3–41.

g. Arch Bridges.

(1) Arch span bridges are constructed in many types and variations. Basically, an arch bridge consists of an arch (including an arch ring), a crown, a fill and hinges, and a floor system. A standard dimension data guide for arch bridges is illustrated in figure 3–42. Common types of arch construction used in bridges are illustrated in figure 3–43. Nomenclature of arch bridges is given in figure 3–44.

(2) Classification of arch spans, for reconnaissance report purposes, may be given as follows:

(*a*) Masonry arch (solid earth-filled) and deck type (fig. 3–45). The Bridge Classification Card (para. 3–16) describes in detail the requirements for classifying masonry arch bridges.

(*b*) Concrete arch, either solid (earth-filled) or open (spandrel) type, with the traveled way usually supported above the arch ring by a series of columns, posts, or small arches (figs. 3–46 and 3–47).

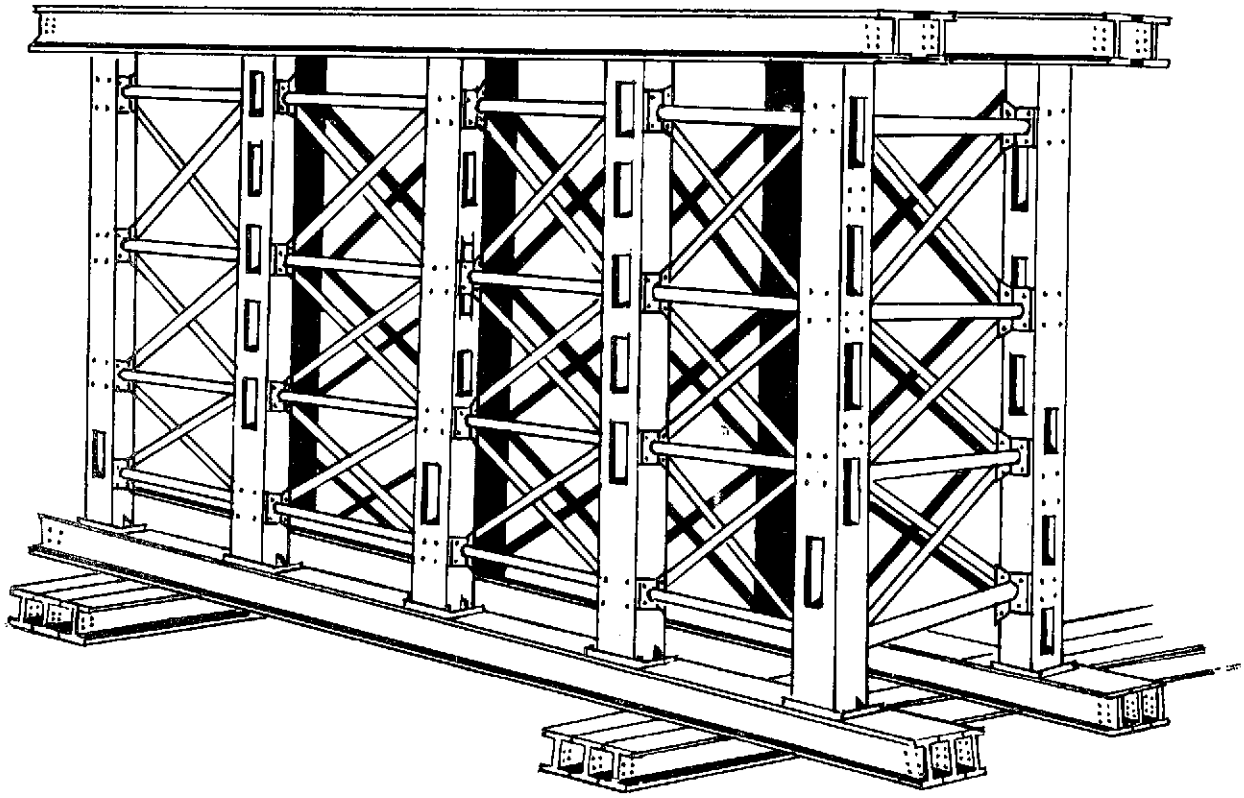


Figure 3–16. Typical prefabricated steel trestle pier.

(*c*) Steel arch, either deck type with the traveled way resting on the top (horizontal) member or a trussed steel arch, or through type (arch) with the traveled way suspended from the arched member (truss or beam) by a series of bars, I-beams, or webbed (latticed) vertical members (figs. 3–48, 3–49, and 3–50).

h. Suspension Bridges.

(1) Suspension spans have the traveled way suspended by means of vertical cables or ropes from two or more suspension cables which pass over towers and are anchored at the ends. Suspension bridges are usually employed where the construction of intermediate supports is impracticable due to the depth of the bridge gap or where navigation must pass under the bridge.

(2) A standard dimension data guide for suspension bridges is illustrated in figure 3–51. Typical suspension bridges are shown in figures 3–52, 3–53, and 3–54.

i. Movable Bridges.

(1) Movable bridges (fig. 3–55) may be classified as follows:

(*a*) Swing bridges.

(*b*) Lift bridges.

(*c*) Bascule bridges.

(*d*) Retractile bridges.

(2) Deliberate reconnaissance of movable bridges requires special engineer training.

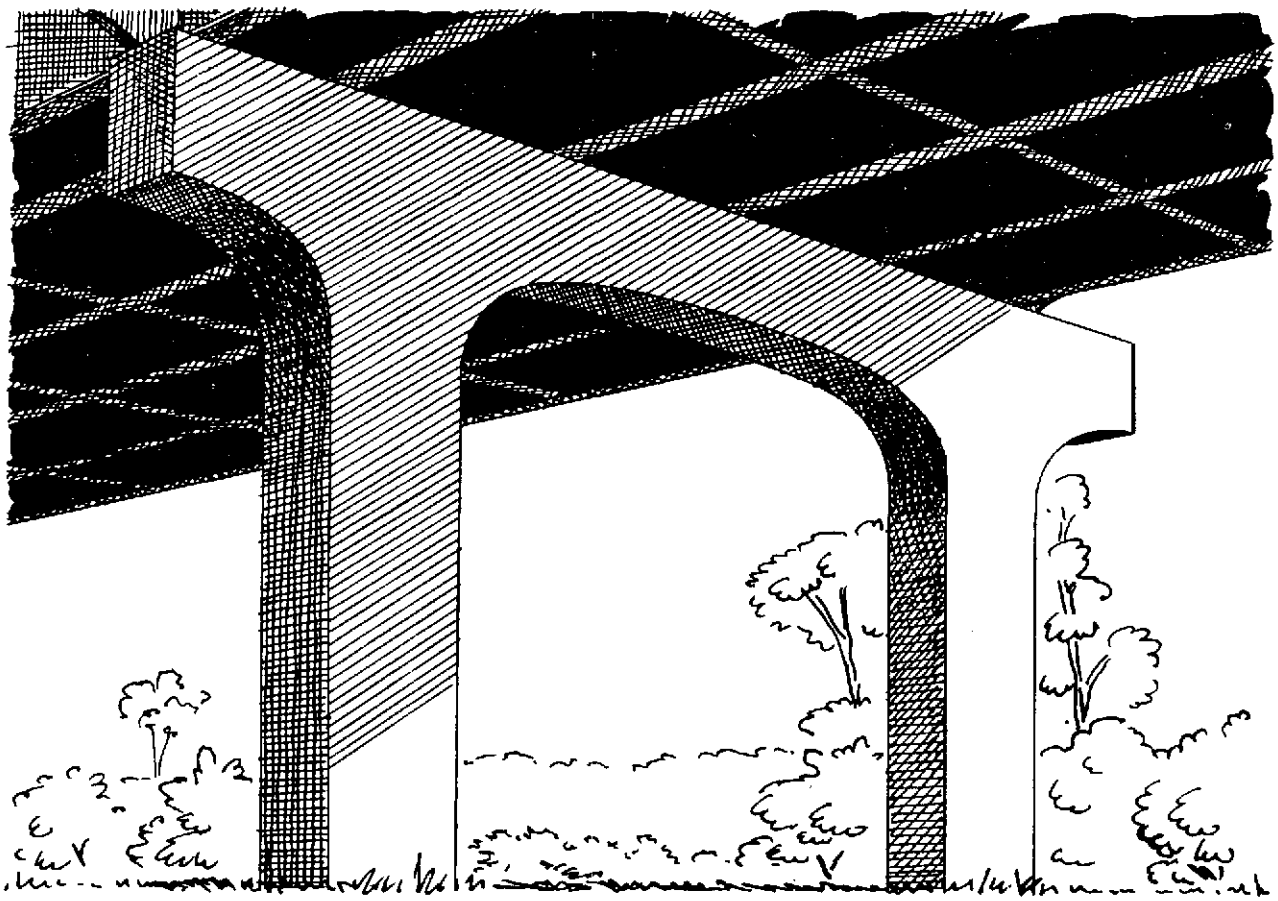


Figure 3–17. Typical open type concrete pier.

j Ponton (Floating) Bridges. A ponton (floating) bridge (fig. 3–55) is a temporary bridge which is supported by low, flat-bottomed boats or other floating structures. The major components are the floats, saddle assembly, and the superstructure which carries the traveled way. Some types of military bridges are provided with a ramp or trestle to facilitate the approach. Ponton bridges are usually replaced as soon as possible by more premanent structures. Although they are essentially nonmovable bridges of a temporary nature, they may be released at one end to allow passage of ships.

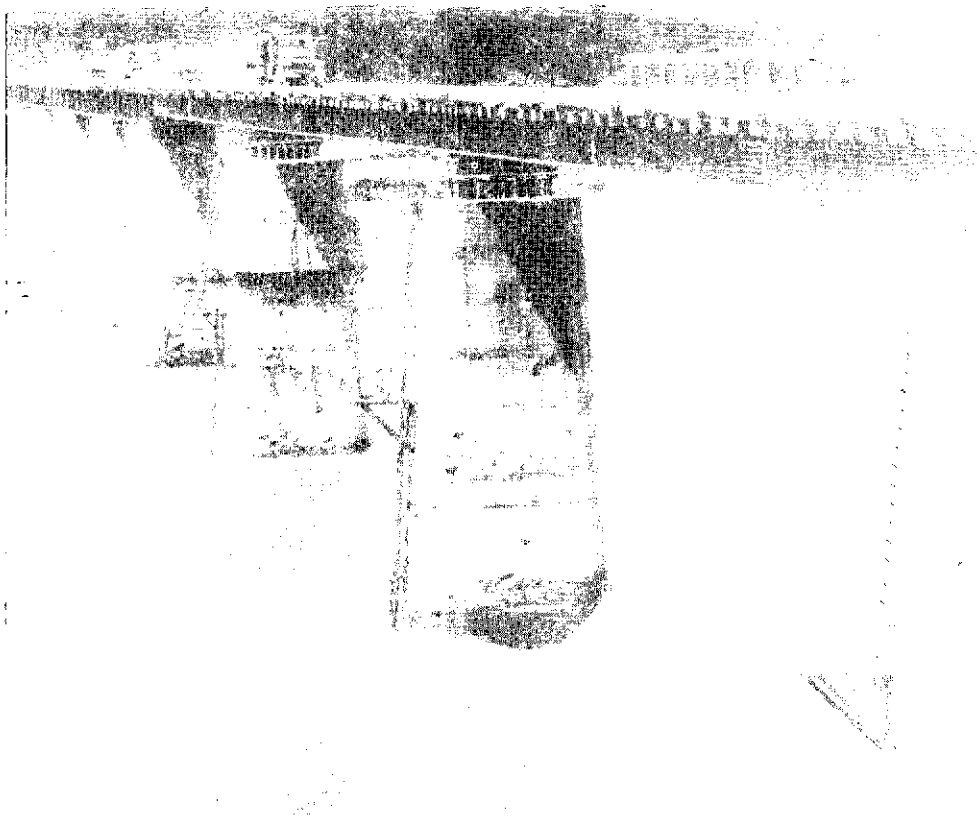
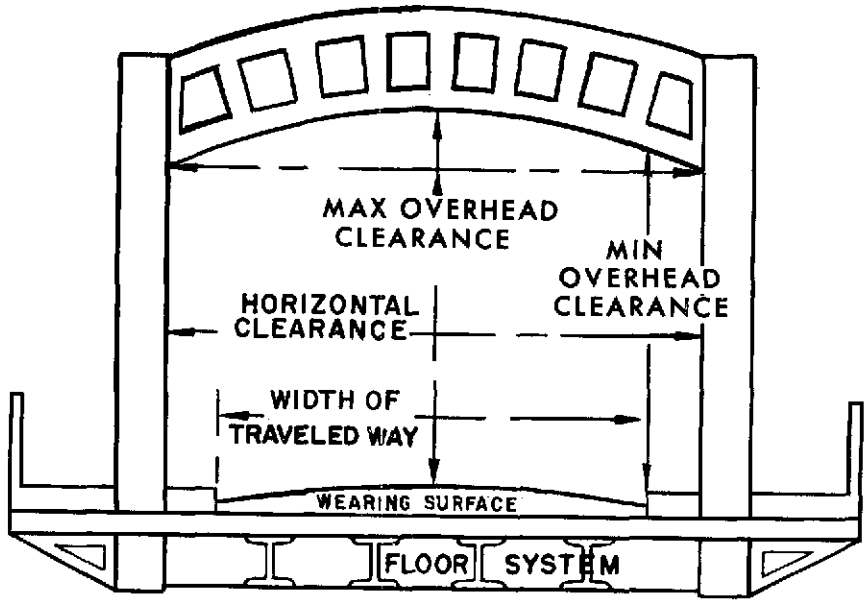
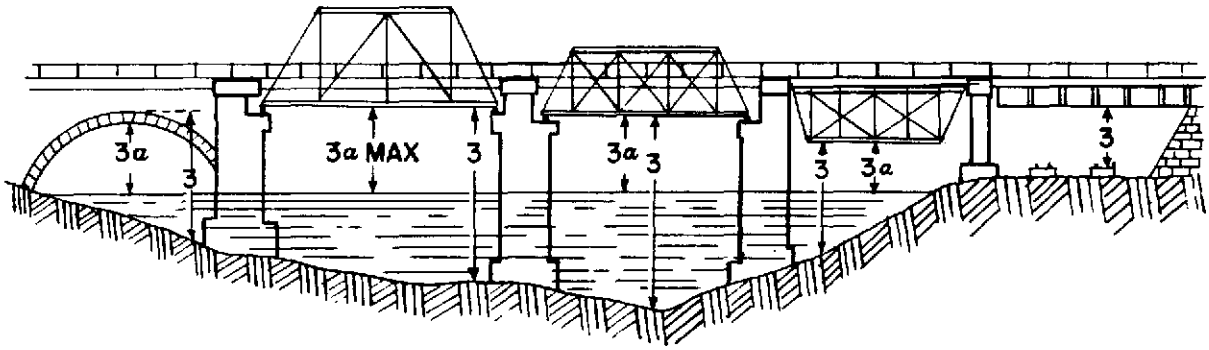


Figure 3–18. Typical solid concrete pier.



MEASURING WIDTH OF ROADWAY AND CLEARANCES



DIMENSION 3 - HEIGHT ABOVE STREAMBED (GROUND)
DIMENSION 3a - HEIGHT ABOVE NORMAL WATER LEVEL

MEASURING HEIGHT ABOVE STREAM BED AND NORMAL WATER LEVEL.

Figure 3–19. Principal bridge span dimensional data.

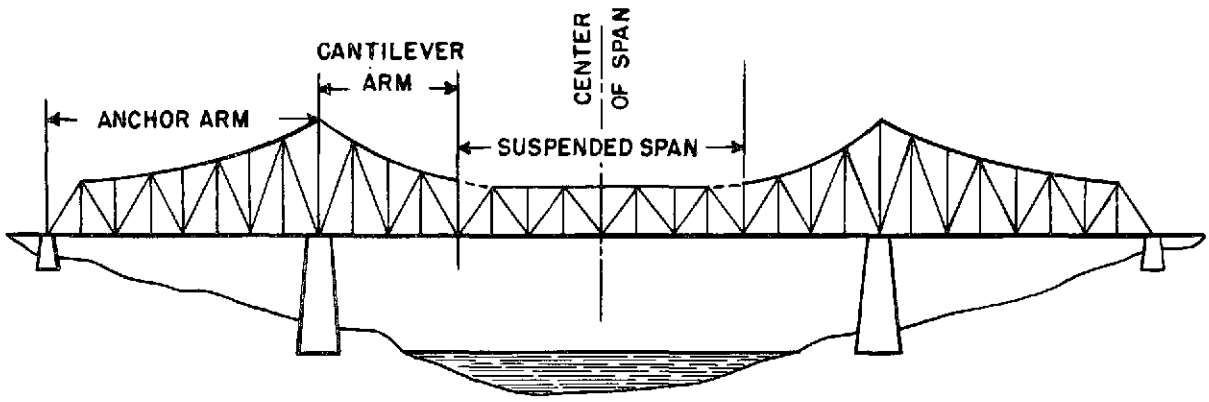
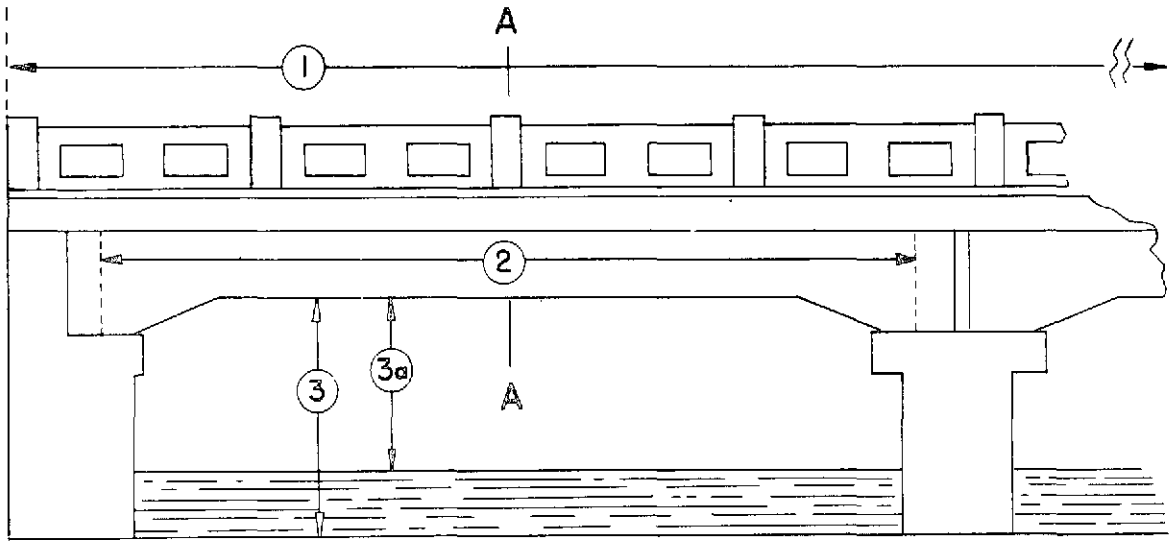
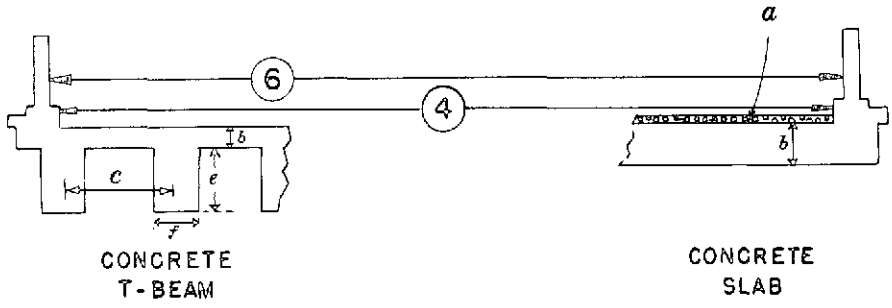


Figure 3-20. Typical cantilever bridge.





SECTION A-A

Figure 3-21. Standard dimension data guide for concrete bridges.

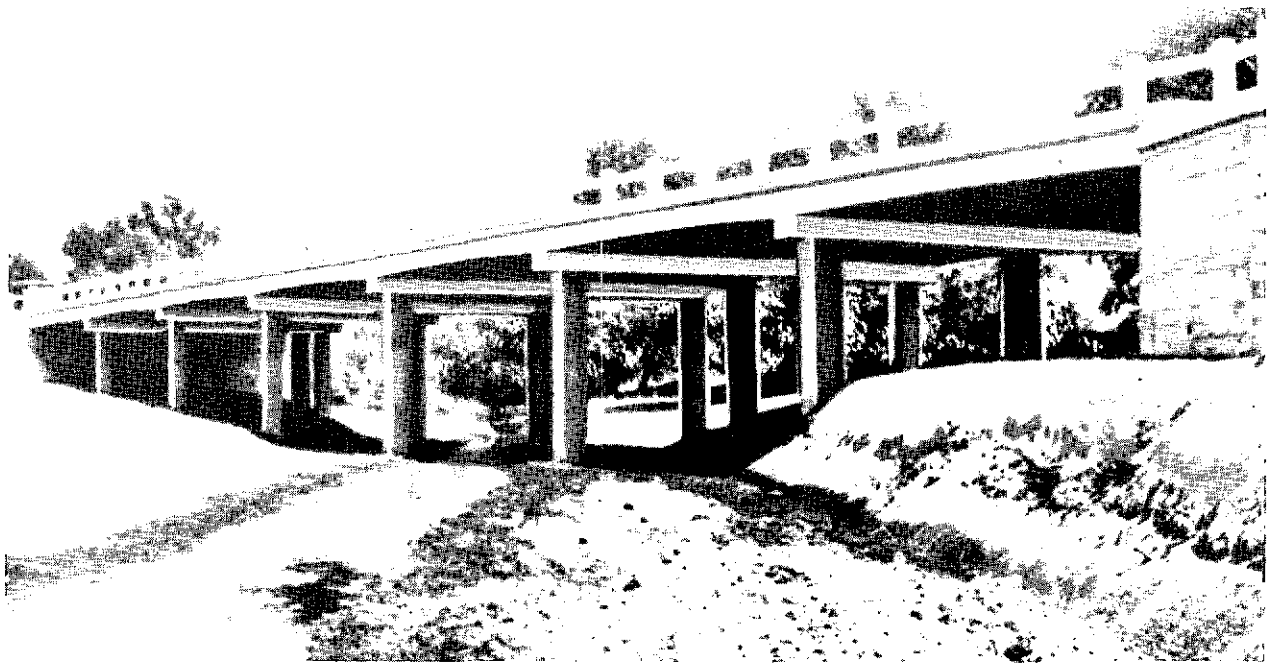


Figure 3–22. Typical concrete slab bridge.

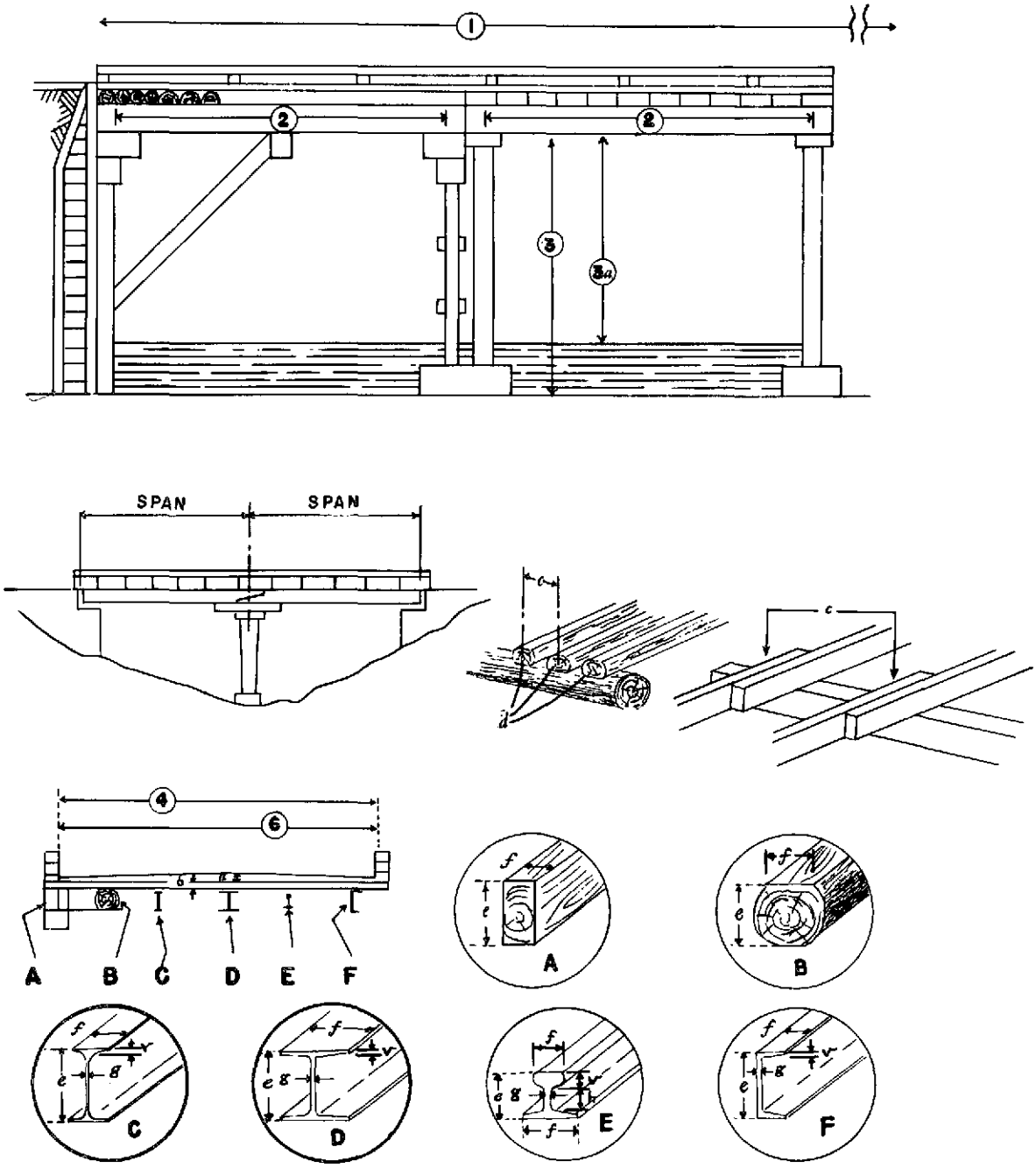


Figure 3-23. Standard dimension data guide for simple stringer bridges.

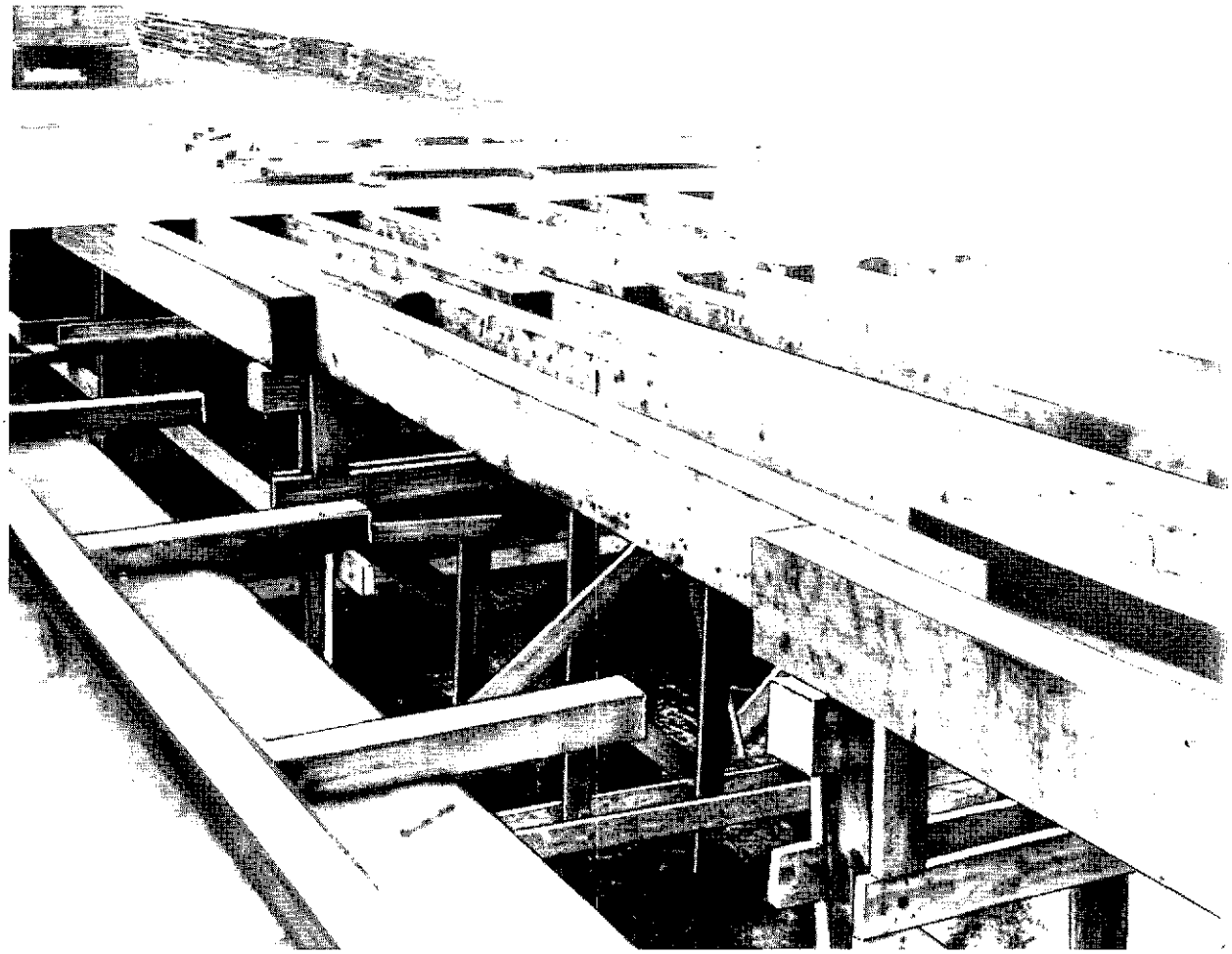


Figure 3–24. Simple stringer bridge with rectangular timber stringers.

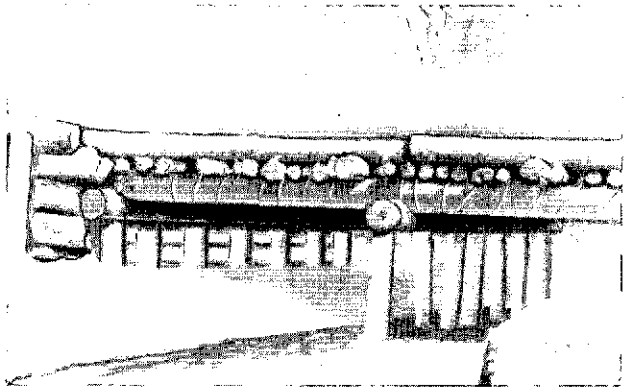


Figure 3-25. Simple stringer bridge with log stringers.

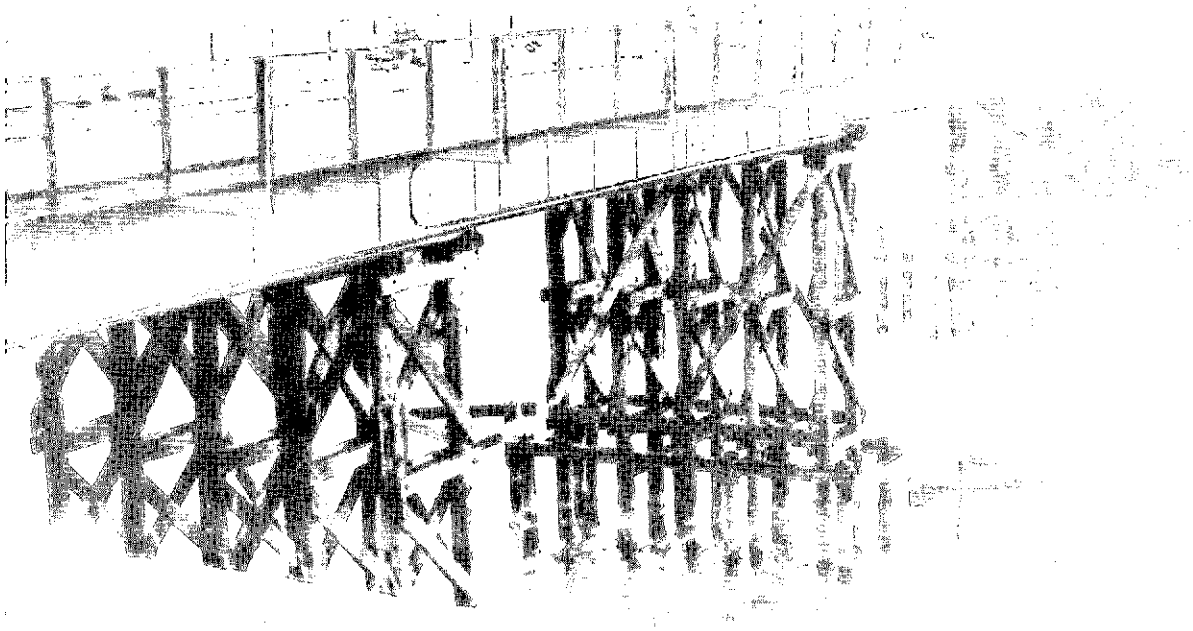


Figure 3-26. Simple stringer bridge with steel I-beams and timber flooring.

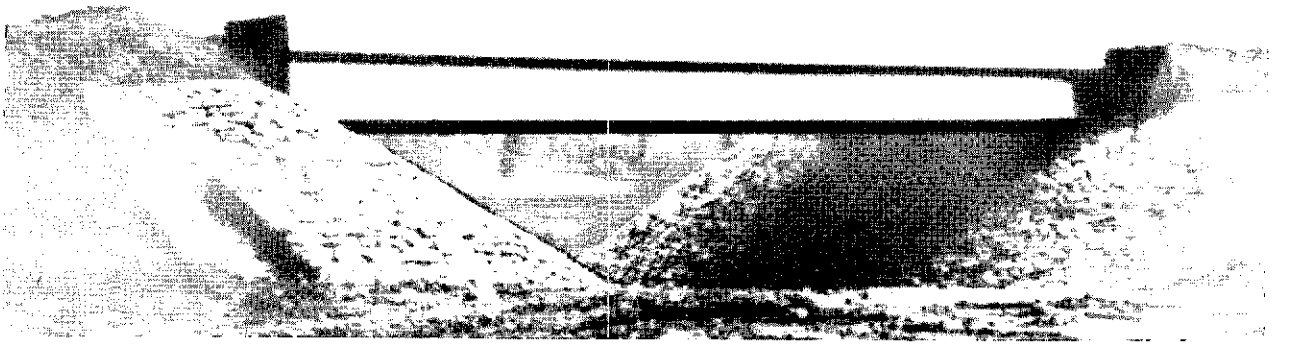


Figure 3–27. Simple stringer bridge with steel I-beams and concrete slab flooring.

Figure 3–28. Typical single span concrete bridge.

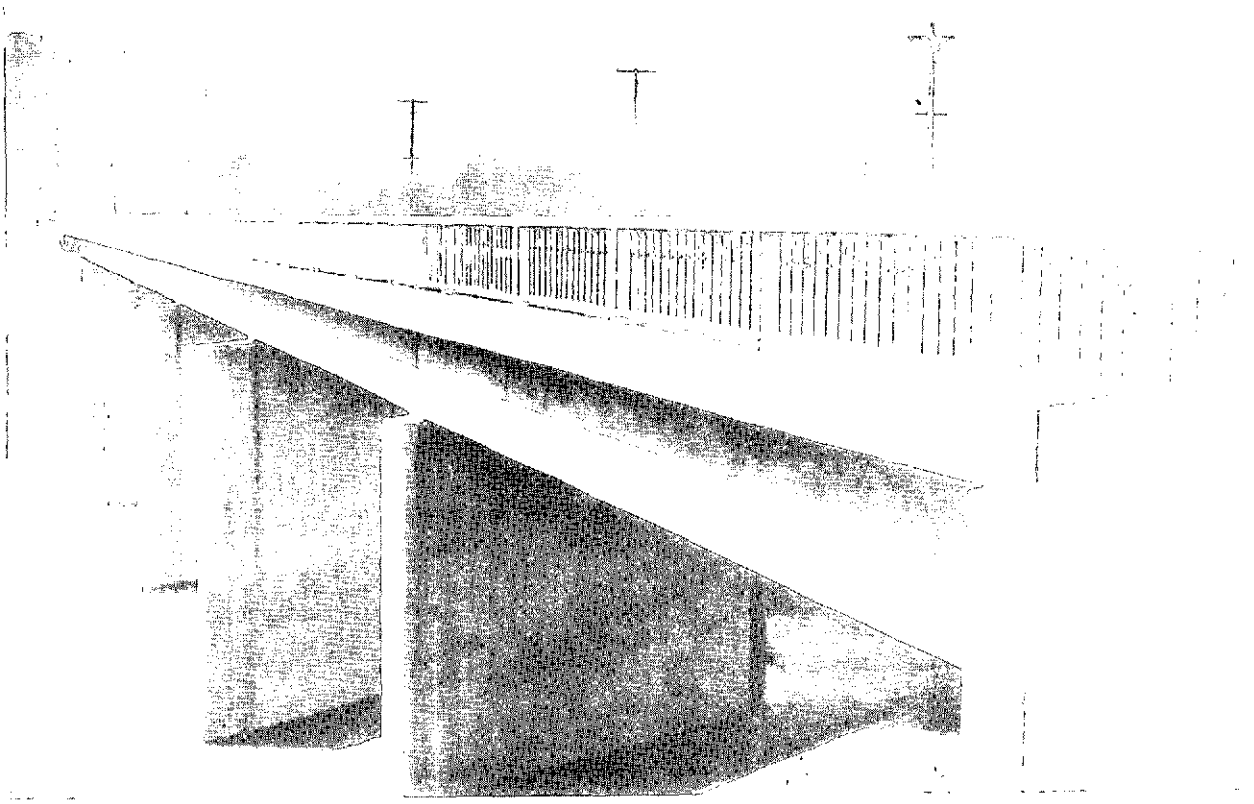


Figure 3-29. Typical concrete bridge.

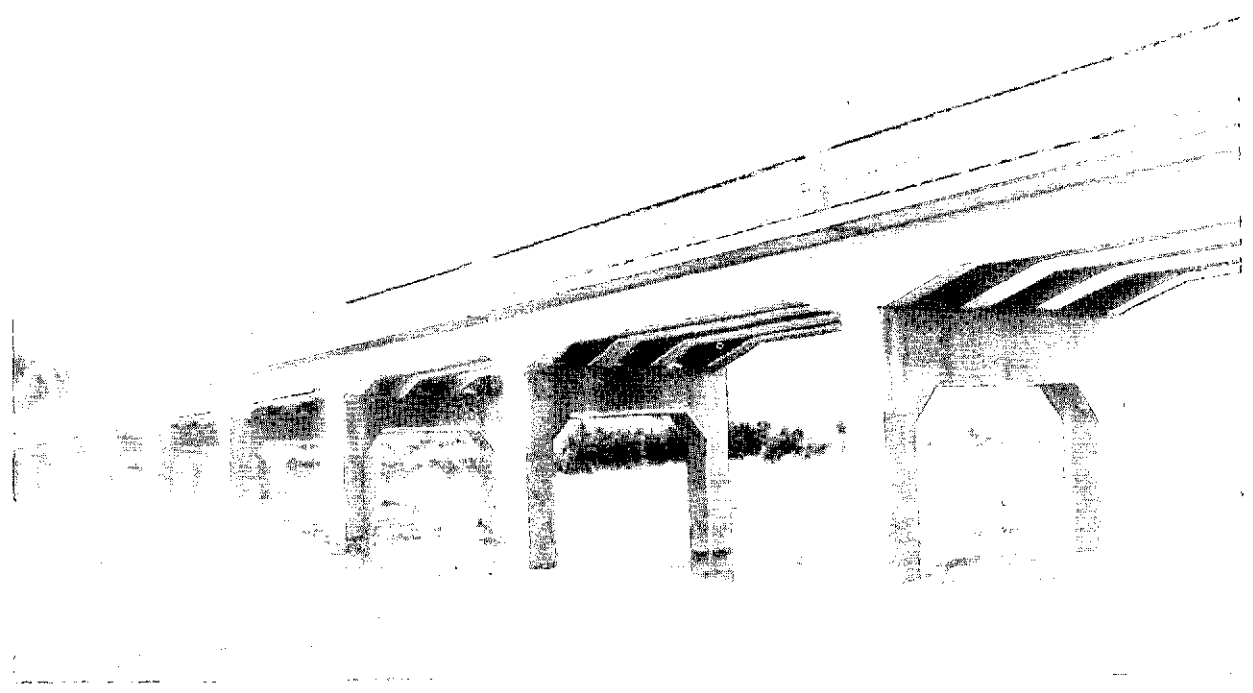


Figure 3-30. Typical multispan concrete T-beam bridge.

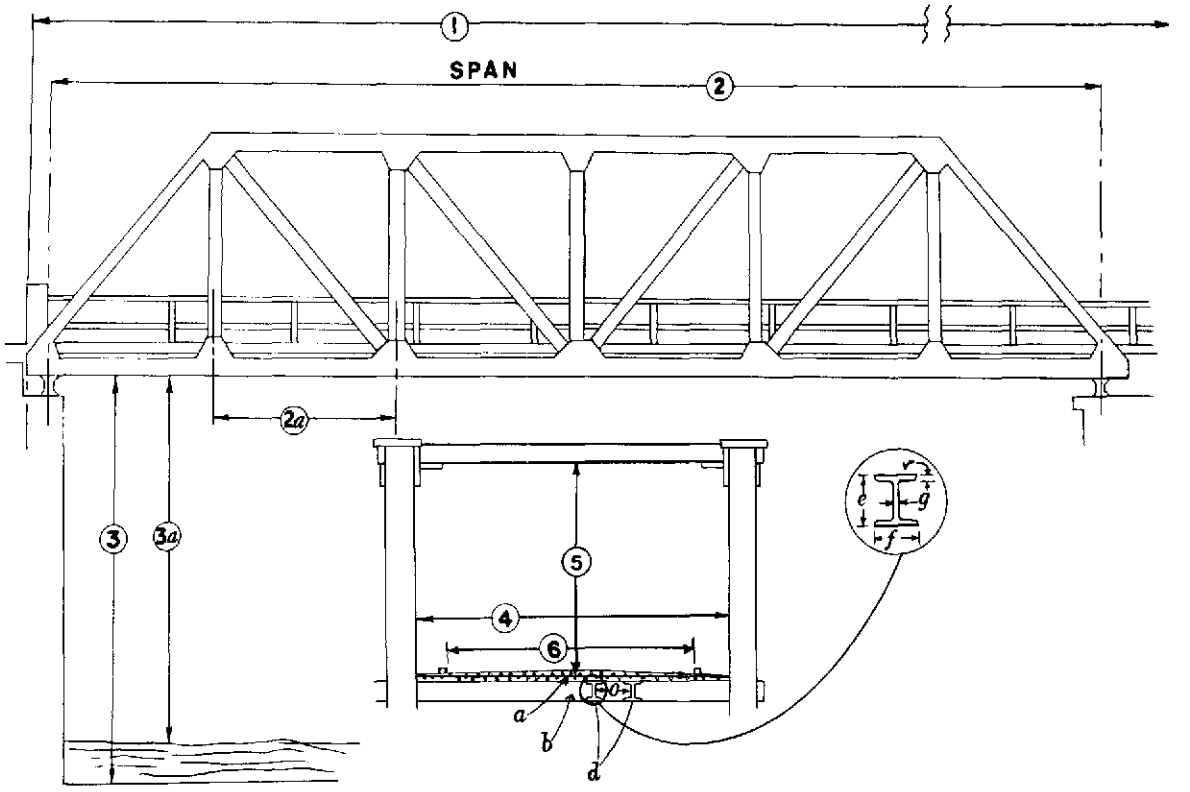
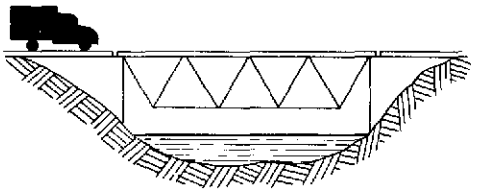
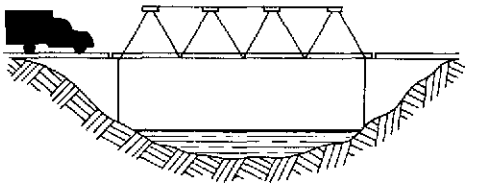


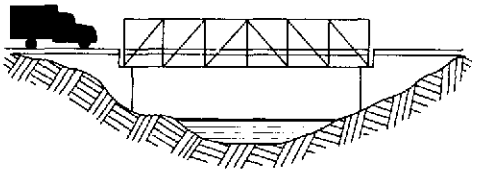
Figure 3–31. Standard dimension data guide for steel truss bridges.



DECK TYPE



THROUGH TYPE



HALF-THROUGH OR PONY TYPE

Figure 3–32. Classification of truss types by position of traveled way.

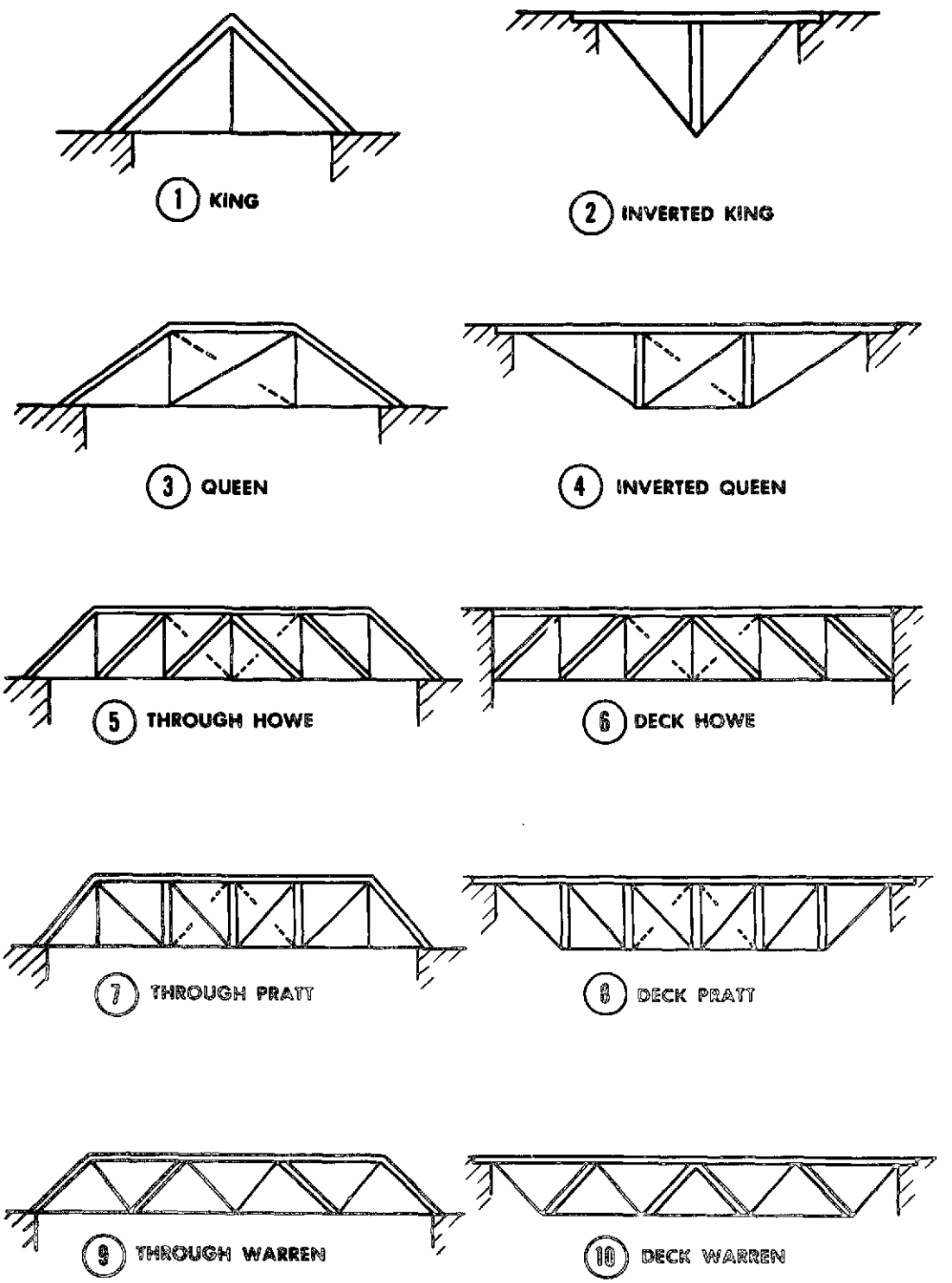


Figure 3–33. Common types of bridge trusses.

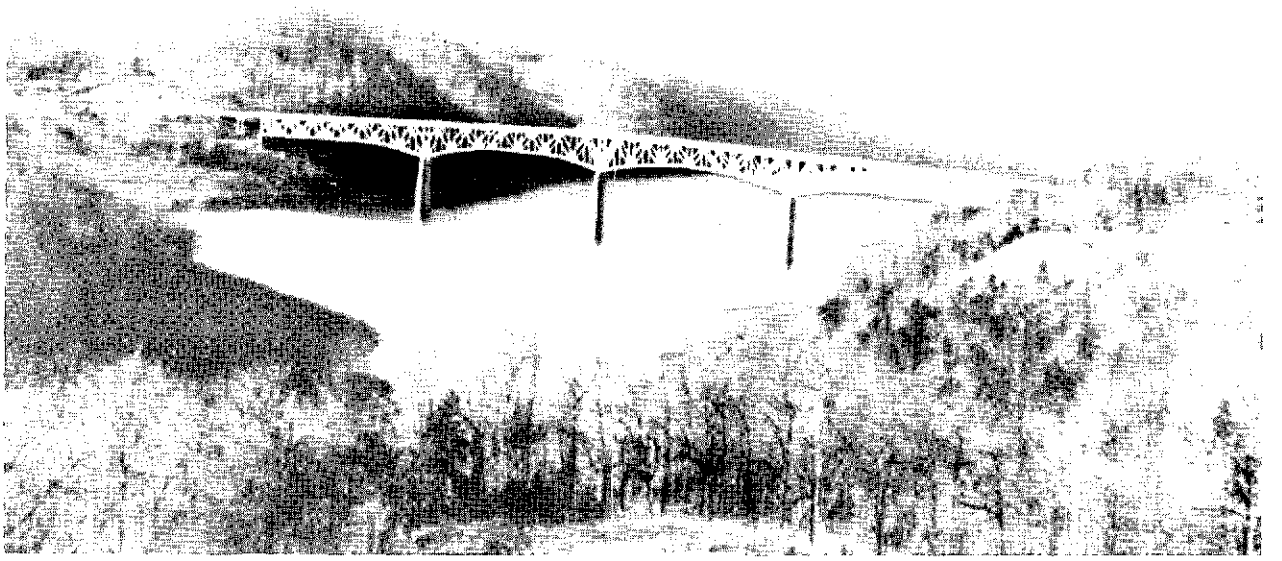


Figure 3–34. Typical steel deck truss bridge.

Figure 3-35. Typical timber truss bridge.

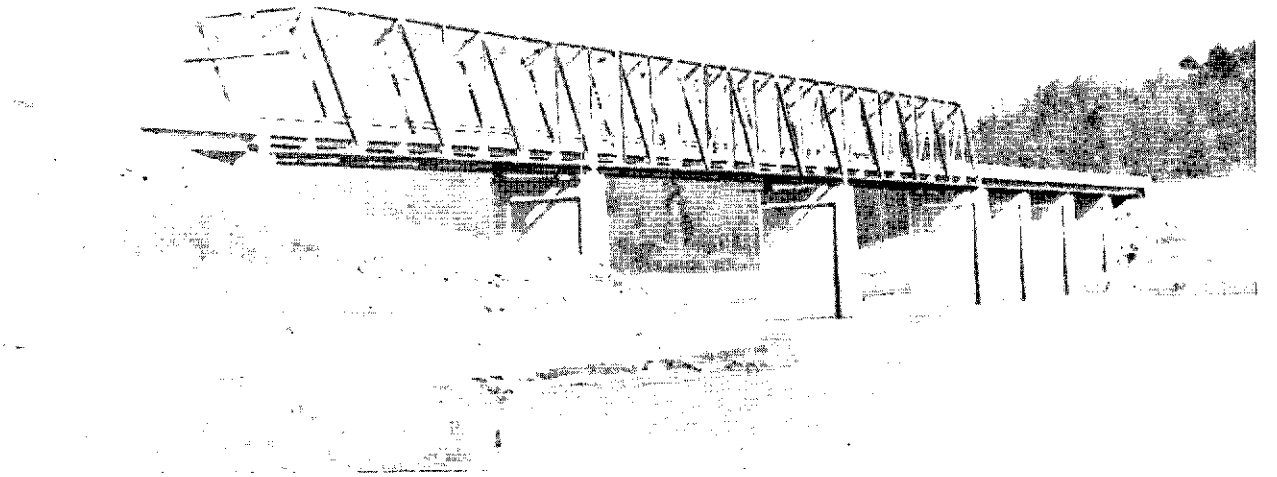


Figure 3–36. Typical steel through truss bridge (Warren type).

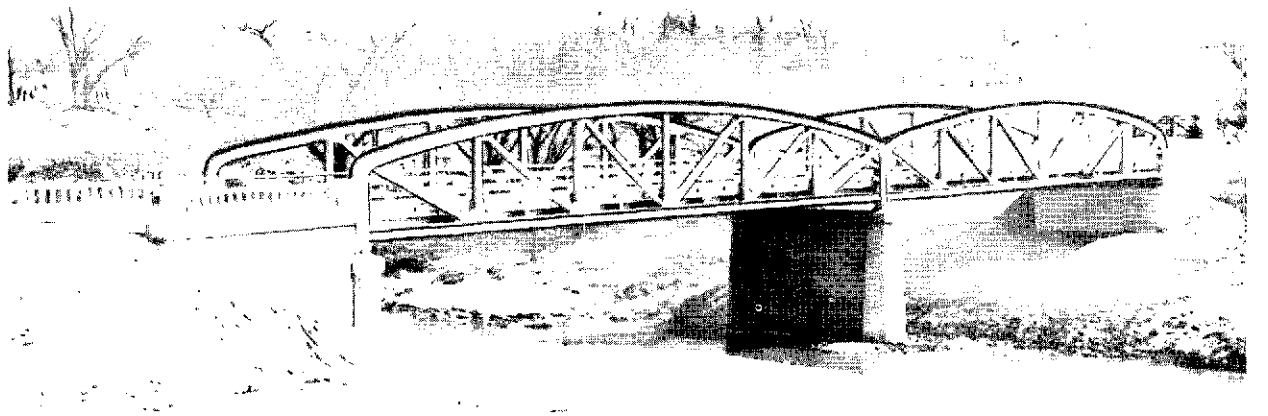


Figure 3–37. Pony truss highway bridge.

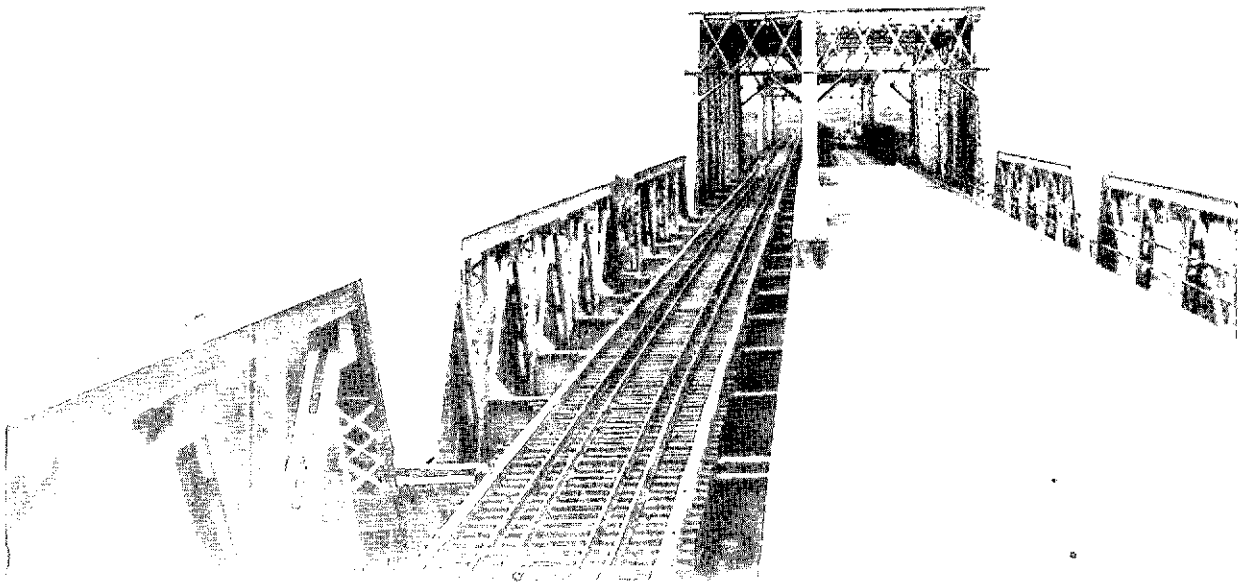


Figure 3–38. Pony truss and through truss forming combination bridge.

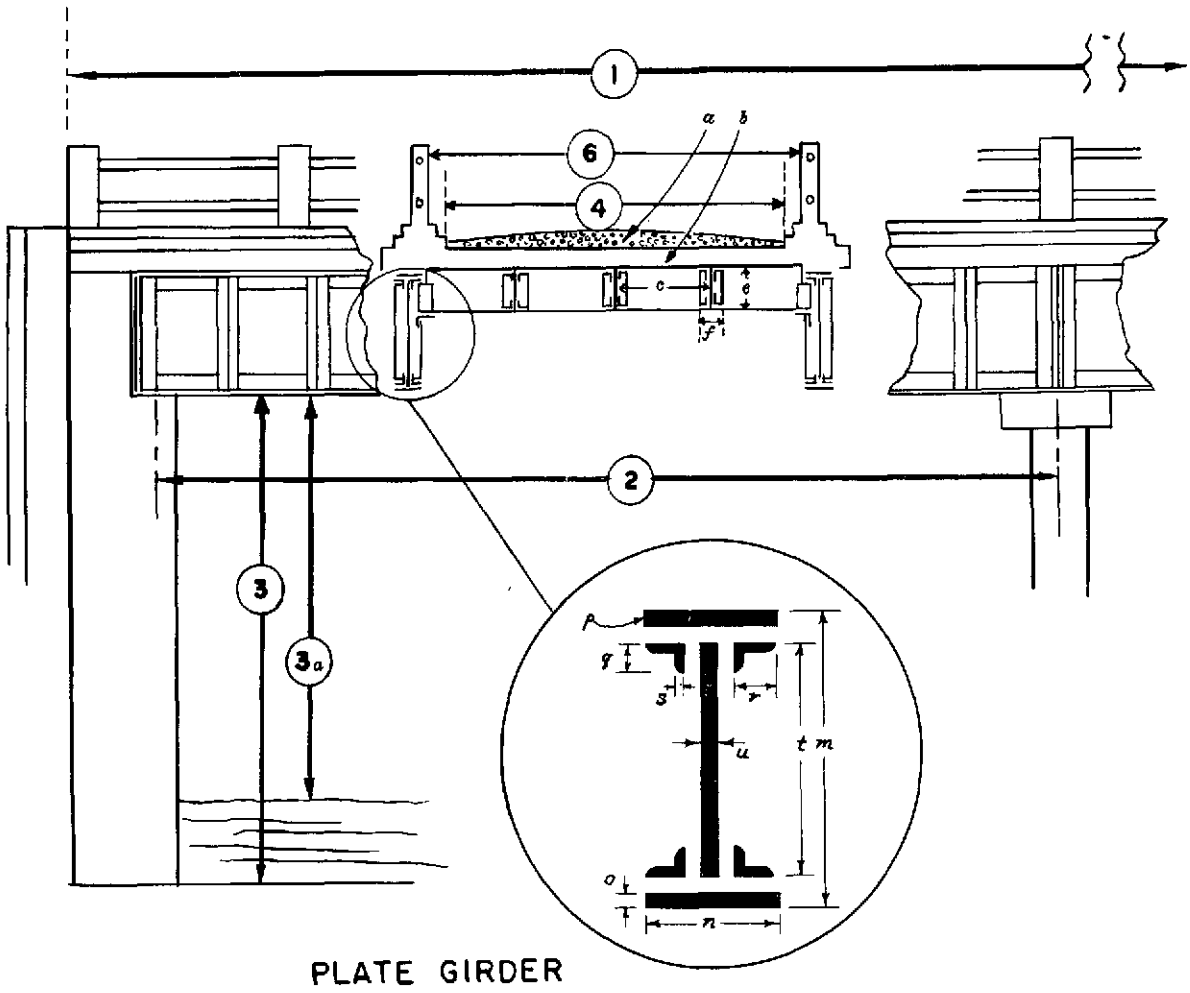


Figure 3-39. Standard dimension data for plate girder bridges.

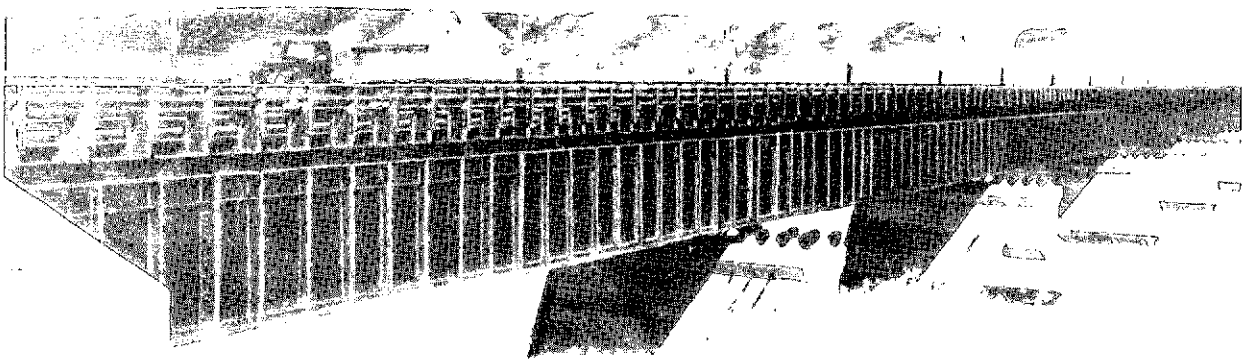


Figure 3-40. Typical multispan plate girder bridge.

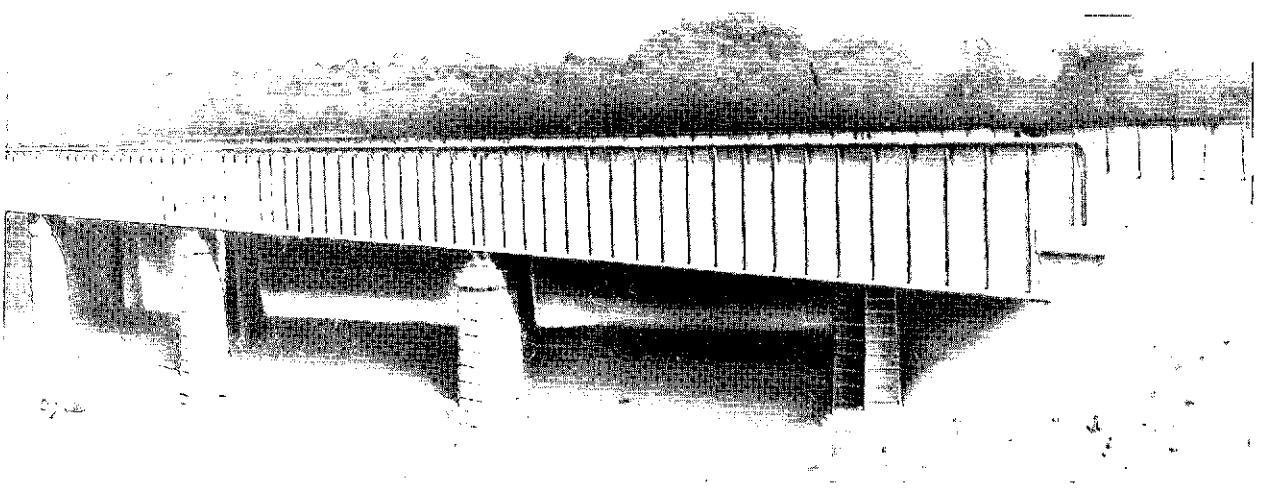


Figure 3-41. Through type girder bridge.

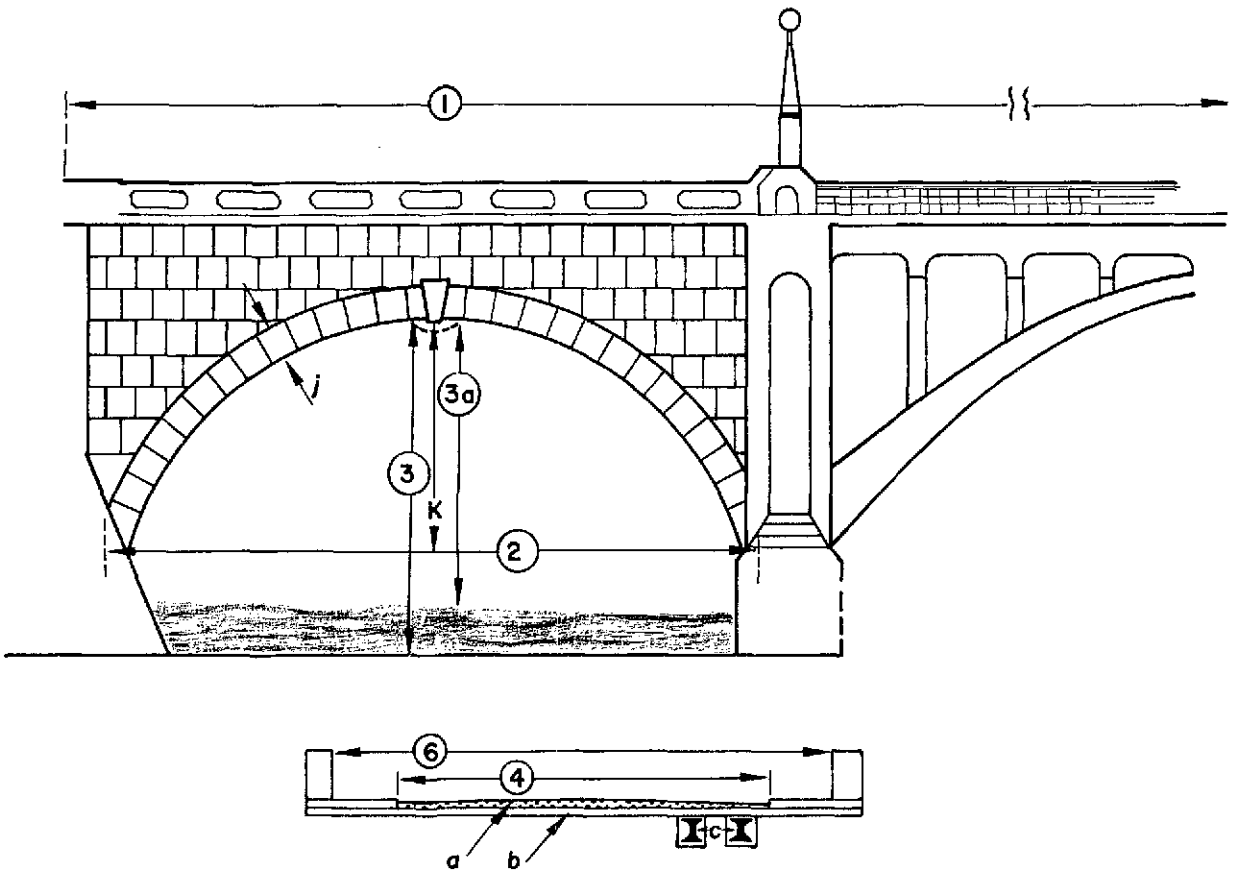


Figure 3–42. Standard dimension data guide for arched bridges.

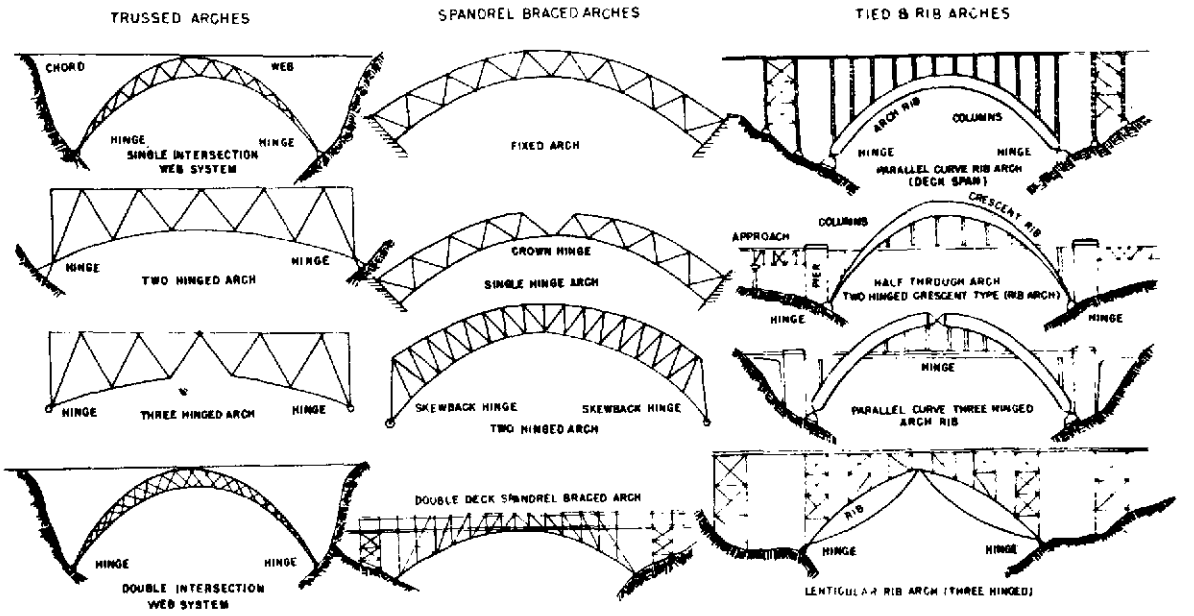


Figure 3–43. Common types of arch construction.

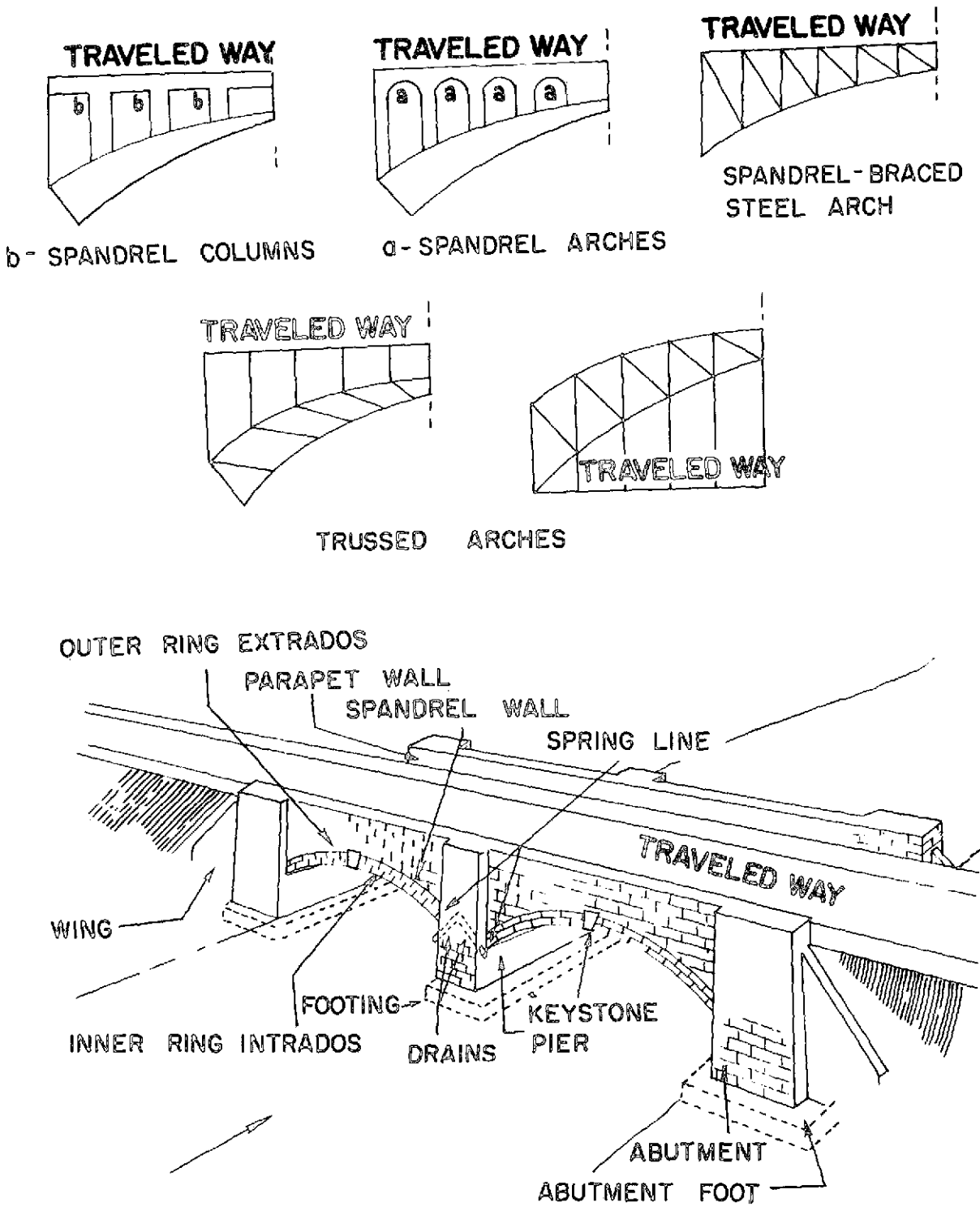


Figure 3-44. Nomenclature of arched bridges.

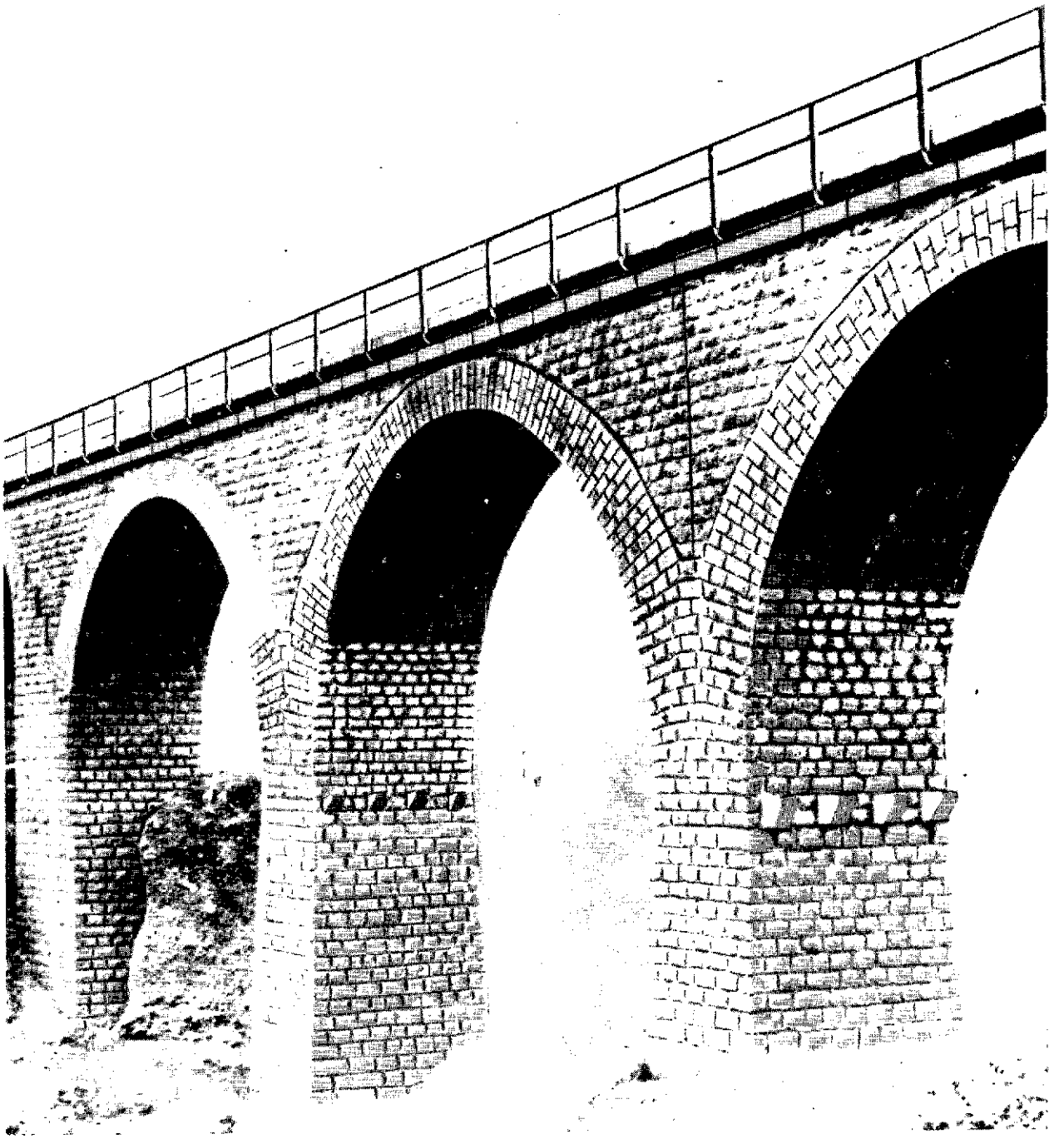


Figure 3–45. Typical solid masonry arch bridge.

Figure 3-46. Typical solid concrete arch bridge.

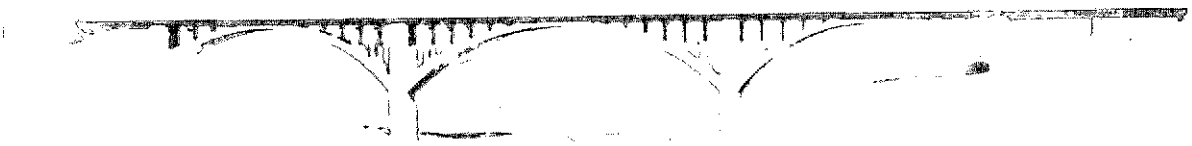


Figure 3-47. Typical open type (spandrel) concrete arch bridge.

Figure 3-48. Parallel curve, steel rib, arch bridge.

AGO 8282A

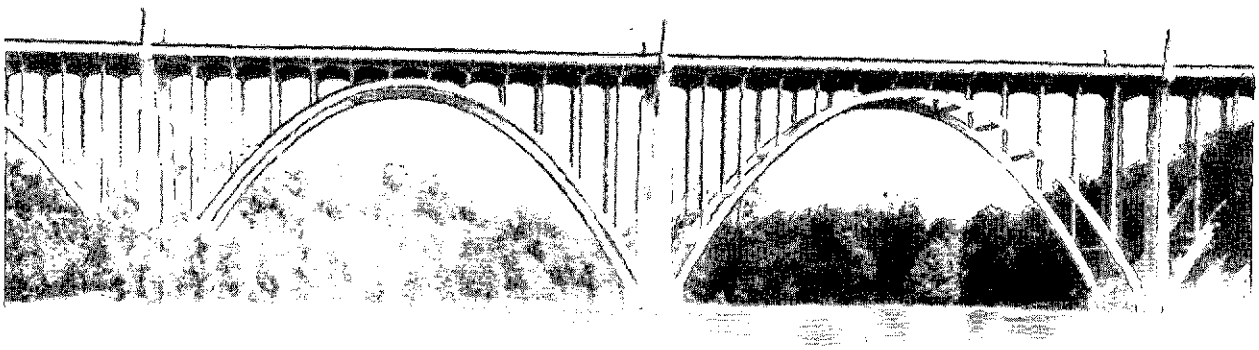


Figure 3-49. Steel trussed deck arch bridge.

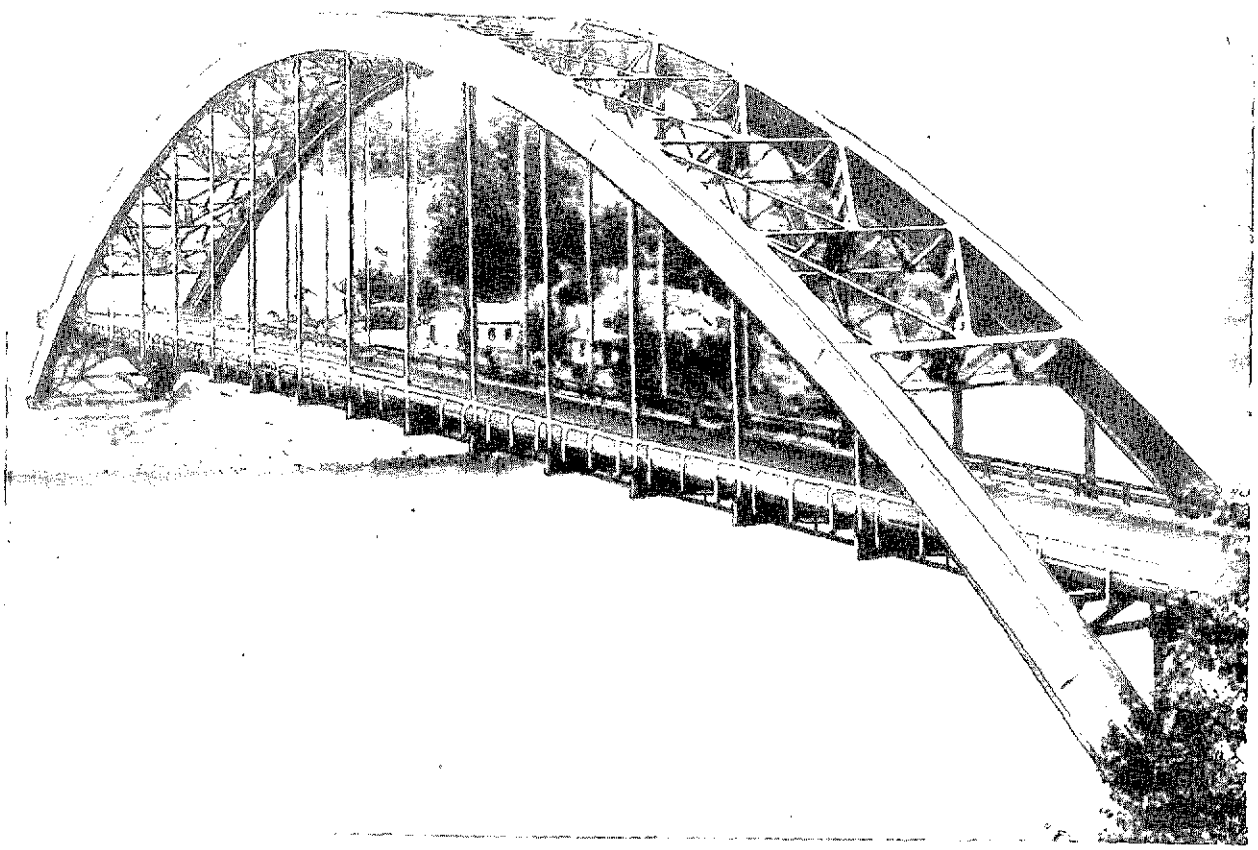


Figure 3-50. Steel arch bridge, through type.

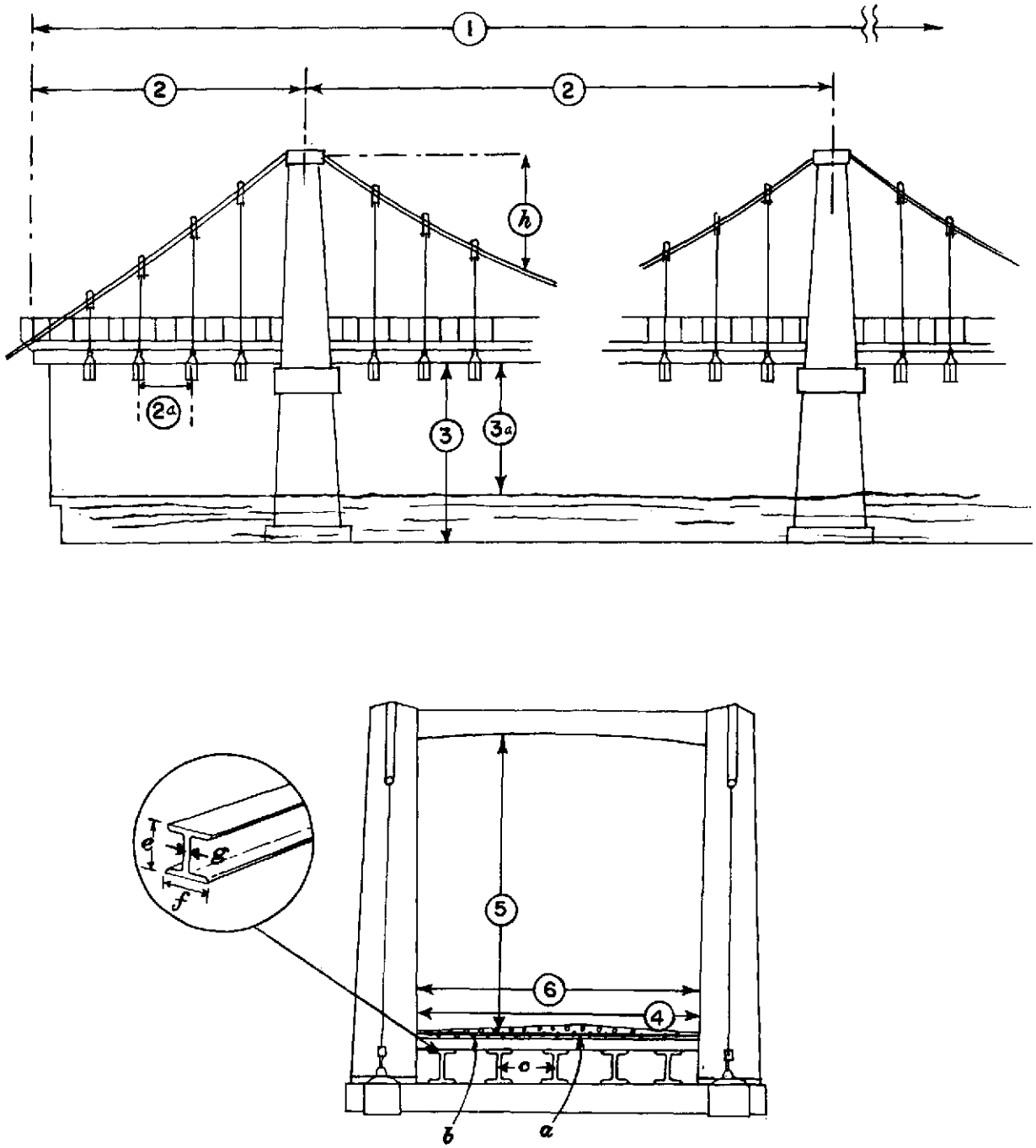


Figure 3-51. Standard dimension data guide for suspension bridges.

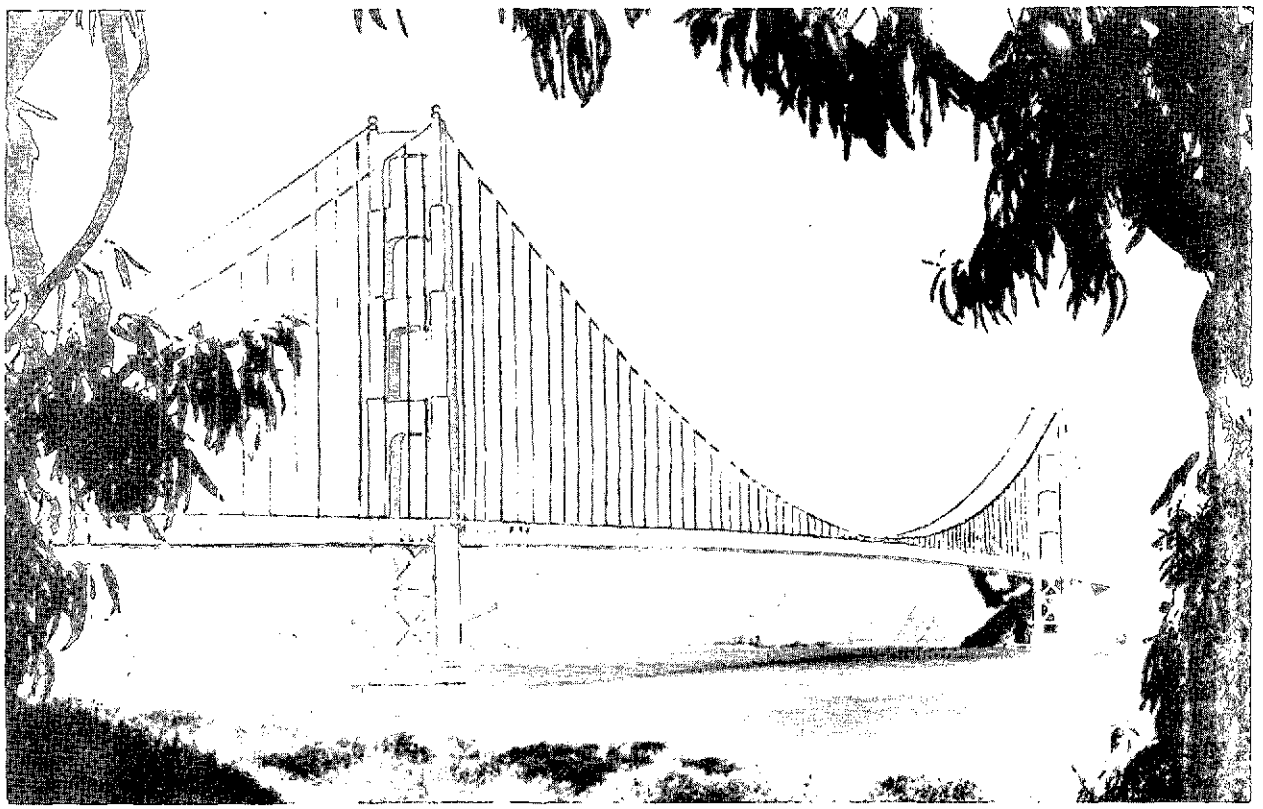


Figure 3–52. Suspension bridge with steel cable, steel reinforcing truss, steel floor beams, and external sway bracing.

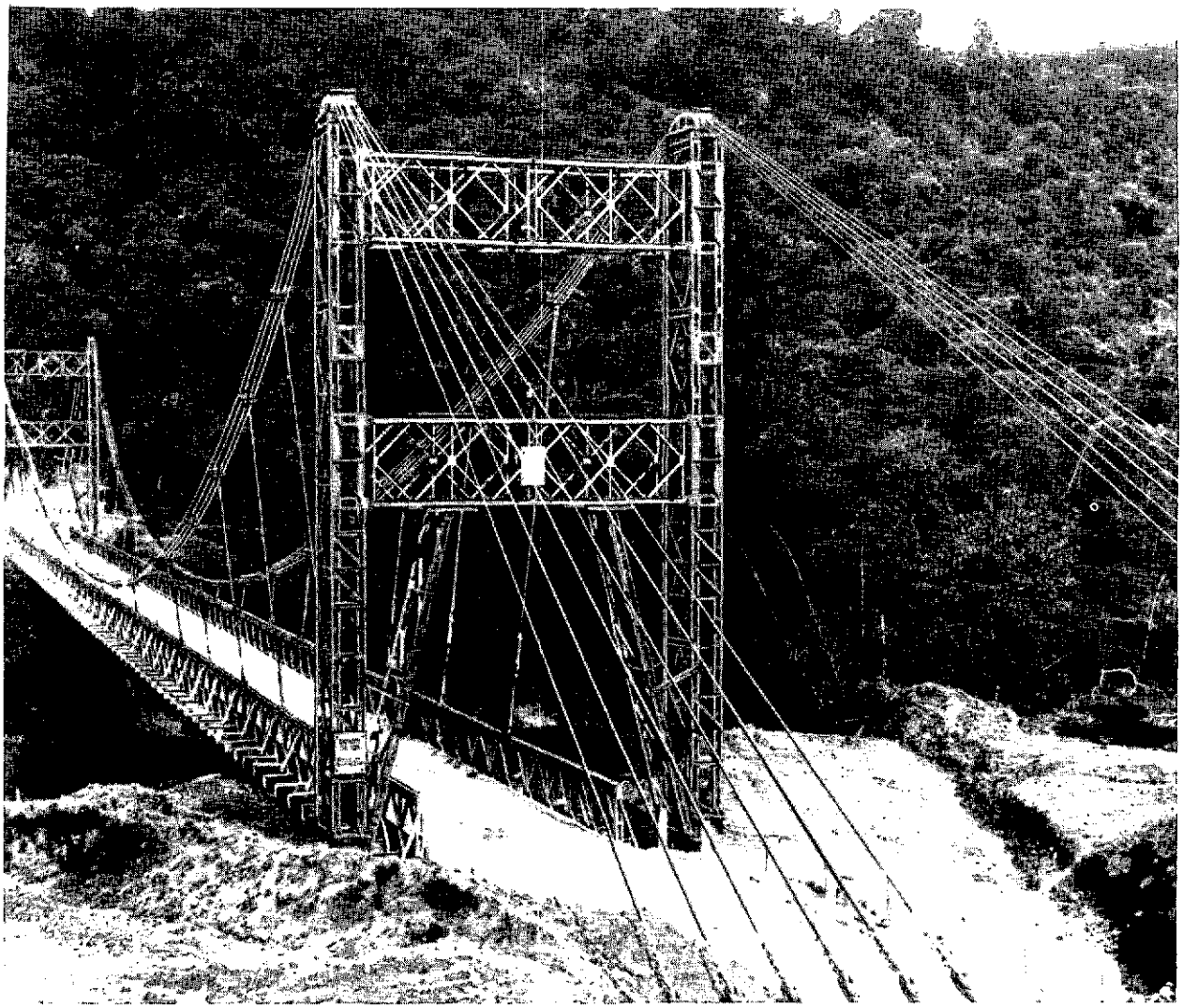


Figure 3-53. Bailey type suspension bridge.

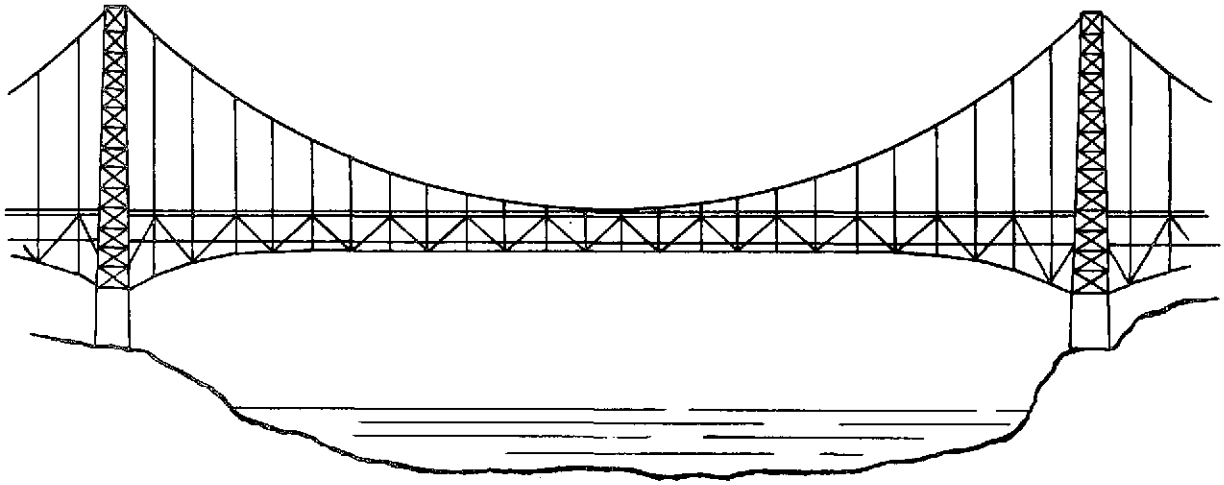
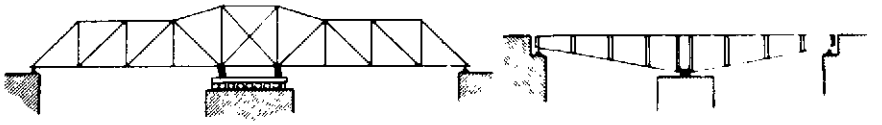
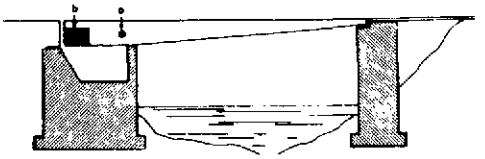


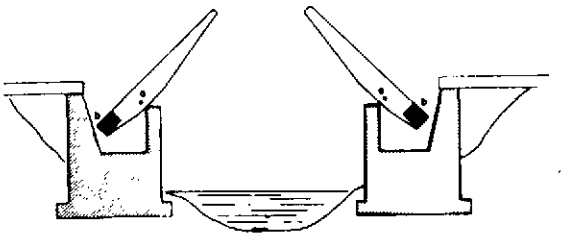
Figure 3-54. Steel suspension bridge.



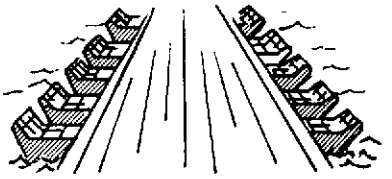
SWING BRIDGES
a. trunnion
b. counterweight



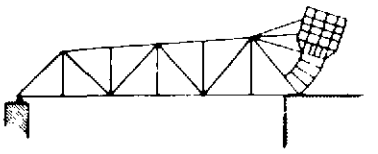
SINGLE LEAF TRUNNION TYPE
BASCULE BRIDGE



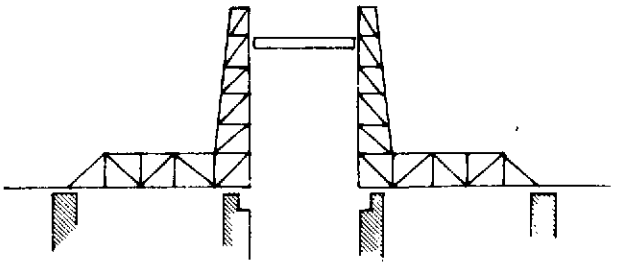
DOUBLE LEAF TRUNNION TYPE
BASCULE BRIDGE



FLOATING BRIDGE



ROLLING LIFT TYPE
BASCULE BRIDGE



VERTICAL LIFT BRIDGE

Figure 3-55. Classification of movable bridges (by type of movable structure) and ponton (floating) bridge.

Section III. BRIDGE MILITARY LOAD CLASSIFICATION

3–14. General

a. A mobile army must make maximum use of existing bridges; but before any existing bridge can be used to capacity, it requires classification in terms of the bridge and vehicle military load classification system which has been adopted by the U.S. and allied nations. The classification of each bridge is posted to prevent overloading which may cause failure and, thereby, hamper future operations. To classify bridges various methods are available; however, this manual limits discussion to only one of these methods—GTA 5–35, The Bridge Classification Card (para 3–16).

b. In the United States, load capacities and vehicle dimension restrictions are normally regulated and posted by individual state and county governments. Where bridges in foreign areas are not posted, it is sometimes possible to ascertain bridge dimensions and capacities by consulting local civil authorities or military intelligence agencies. In many cases, however, data is not available, and the bridge on a route will require computation of their respective military load classifications.

c. Bridge classification is basically the reverse of design procedure. In designing a bridge, the desired classification is established, and the required quantity and size of individual bridge members are calculated. In classifying a bridge, however, the members are already present; their dimensions need only be recorded and strength characteristics considered to compute the load capacity.

3–15. Classification Factors

a. Before the classification of a bridge can be determined, observations and measurements which influence the classification of the bridge are noted as follows:

(1) *The number of members.* In many cases the stringer is the critical member of the bridge. However, a check of the capacity of the posts must be made as outlined in the Bridge Classification Card. Therefore, all load carrying members of the bridge are included in the reconnaissance data.

(2) *Size of members.* Exact and complete dimensions pertinent to specific bridge members are taken as previously outlined in tables 3–1 and 3–2.

(3) *The span length.* Span length is measured from center to center of supports. The classification of the bridge is usually based on the weakest span; and if the weakest span is readily apparent, no other spans need be investigated. However, if the weakest span is difficult or impossible to locate by visual observation, all spans require classification. Even if several spans appear identical, actual measurements are taken to prevent error.

(4) *The width of the traveled way.* The traveled way width is the measured distance between the inside faces of the curbs.

(5) *General condition.* It is essential to note the general condition of the bridge paying particular attention to evidences of damage from natural causes (rot, etc.) or enemy action. Classification procedures presume that a bridge is in good condition. If the bridge is in poor condition, the classification obtained from mathematical computations requires appropriate reduction in accordance with the classifier's judgment.

3–16. Bridge Classification Card

a. The Bridge Classification Card (GTA 5–35) provides a rapid means of classifying bridges. It utilizes a partially graphic method together with several approximations to simplify procedures. The card outlines the procedures for determining the classification of *simple deck type, masonry arch, concrete T-beam, concrete slab, and truss type bridges.*

b. A deck type bridge is one in which the traveled way is supported on or near the line of top members with little more than a handrail system at the sides.

(1) Deck type bridges are usually classified by investigation of the superstructure only, as a balanced design in the substructure is generally assumed.

(2) For simplicity, the superstructure is divided into three categories: the curb and

handrail system, the flooring system, and the stringer system.

(*a*) The curb and handrail system acts only as a guide for vehicles crossing the bridge. It has no structural role, and needs only to be sufficiently adequate to meet safety requirements.

(*b*) Timber flooring systems are checked by the rule of thumb given in paragraph E of the Bridge Card. If the flooring does not meet the specified criteria or if members are damaged, reinforcement or repair is necessary prior to final classification. An analysis of a concrete slab floor is virtually impossible without construction details pertaining to the reinforcing steel. However, it is usually safe to assume that the deck has been designed to give adequate load resistance.

(*c*) The stringer system is classified using the charts and procedural outline given in the bridge classification card.

3–17. Other Classification Methods

The Bridge Classification Card is based on many assumptions in arriving at a specific military load classification. This method is an expedient means for rapidly estimating the military load classifications of simple structure bridges under field conditions. When time and qualified personnel are available to provide a more detailed analysis or the bridge is of complicated design, more precise methods are employed (TM 5–312).

Section IV. VEHICLE MILITARY LOAD CLASSIFICATION (STANAG 2021, SEASTAG 2021, and SOLOG 45R)

3–18. General

a. The basis of the vehicle military load classification system is the effect a vehicle has on a bridge while crossing. The effect is the result of a combination of factors which includes the gross weight of the vehicle; the distribution of this weight; the outside-to-outside width of tires or tracks; tire size and air pressure; the speed at which the vehicle crosses the bridge; and the resulting impact on the bridge. Heavy loads common to military equipment, such as artillery and tanks, make vehicle classification an extremely important factor in determining the suitability of a given route. Classification is applicable not only to individual wheeled vehicles but also to track-laying vehicles, towed vehicles, and vehicles being moved by transporter. In order to compute the total classification of some of these combinations, each component requires separate evaluation.

b. A list of standard vehicles, their weights, and classifications are given in appendix IV. Temporary classification under emergency conditions may be made by comparing the axle loads, gross weight, and dimensions of the unclassified vehicle with those of a similar classified vehicle. A temporary classification thus derived may be used, however, the using unit verifies as soon as possible the temporary classification.

3–19. Data Required for Vehicle Classification

a. The data required for mathematical computation of a vehicle's classification are shown in figures IV–1 through IV–7 (app IV).

b. Often, some of the necessary data for vehicle classification may be obtained from the vehicle weight and dimension card (STANAG 2163) which is displayed by vehicles during their transport (fig. 3–57).

3–20. Assignment of Classification Numbers

a. Military vehicles are described as wheeled or tracked. For classification purposes, military vehicles are further divided into two categories: single vehicles and combination vehicles.

(1) A single vehicle is any military vehicle which has only one frame or one chassis. Examples are prime movers, tanks, full trailers, and gun carriages (fig. 2–52).

(2) A standard combination vehicle is a military vehicle consisting of two or more single vehicles which are connected to-

gether and operate as one unit. Examples are prime movers with semitrailers and trucks towing trailers or gun carriages (fig. 2–53). A nonstandard combination is, for example, a single vehicle towing another vehicle at a distance less than 30.5 meters (fig. 2–56).

b. Classification numbers are assigned to all vehicles in military use which have a gross weight exceeding 3 tons and to all trailers which have a rated payload exceeding 1½ tons. Baggage and other pole-type trailers with a rated capacity of 1½ tons or less will normally be combined with their towing vehicles for classification purposes although optional classification numbers may be assigned.

c. Temporary classification numbers may be assigned under special conditions (see para 2–53*c* and *d*).

3–21. Mathematical Procedure for Vehicle Classification (STANAG, SEASTAG 2021 and SOLOG 45R)

The mathematical computation of a vehicle's military load classification is beyond the capability of route reconnaissance teams. If a requirement to determine a vehicle's classification exists, reconnaissance personnel supply higher headquarters with the dimensional characteristics of the vehicle in question (para 3–20), and request computation of the military and classification number (see TM 5–312).

3–22. Field Procedure for Computation of Vehicle Classification

It sometimes becomes necessary to classify a vehicle under field conditions. If time does not permit an accurate mathematical computation of the military load classification, the following procedures for wheeled and tracked vehicles may be used *to estimate* a vehicle's classification:

a. Wheeled Vehicles. The axle loads and spacings for the wheeled hypothetical vehicles upon which the vehicle classification system is based (TM 5–312), represent typical military vehicles of the United States and allied nations. Therefore, any expedient rules which apply to the hypothetical vehicles also apply to a majority of actual military vehicles. The classification of wheeled hypothetical vehicles is approximately equal to 85 percent of the gross weight. The initial task, then, is to determine the vehicle's gross weight. If the air pressure in the tires (in pounds per square inch) is known, it is multiplied by the total area in square inches of the tires in contact with the ground. This yields the approximate weight of the vehicle in pounds which is then *converted to tons.* The expedient classification for the wheeled vehicle will be 85 percent of its weight in tons. If no gage is available for measuring tire pressure, 75 psi may be selected as an average value. For vehicles having unusual load characteristics or odd axle spacings, a more deliberate vehicle classification procedure, as outlined in STANAG 2021, is required.

b. Tracked Vehicles. The procedure for classifying tracked vehicles in the field is similar to the procedure for wheeled vehicles. Two

VEHICLE WEIGHT AND DIMENSION CARD
. . . . . (3d language)

State unit of measure used.
. . . . . (3d language)

WEIGHT . . . . . .
. . . . (3d language)

LENGTH . . . . . .
. . . . (3d language)

BREADTH . . . . . .
. . . . . (3d language)

HEIGHT . . . . . .
. . . . (3d language)

GROUND PRESSURE OR
MAXIMUM AXLE LOAD . . . . . .
. . . . . (3d language)

Figure 3–57. Vehicle weight and dimension card (STANAG 2163).

Directions for Use

1. This card is designed to display vehicle laden weight and dimensions to all concerned with loading it on any means of transport, e.g., to an aircraft, ship, etc.

1. ..... (3d language) .....

2. Accurate weight and dimensions will be printed in chalk by the unit or depot preparing a vehicle for movement. This card will then be fixed inside the windscreen on the passenger's side. On tanks or other vehicles without windscreens, this card will be fixed on a suitable surface on the opposite side of the vehicle from the driver's seat, where it can easily be seen. If possible, it should be protected from inclement weather.

2. ..... (3d language) .....

3. This is a NATO form and whoever "chalks in" the weights and dimensions should use his country's normal system of weight and measurement.

3. ..... (3d language) .....

Figure 3-57—Continued.

considerations are applicable: (1) The classification of tracked vehicles may be taken as equal to the gross weight in tons. (2) The area of the track in contact with the ground may be used to determine the gross weight of the vehicle. As the pressure on the soil is approximately equal to one ton per square foot, the expedient classification number for a tracked vehicle is equal to the number of *square feet of area* in contact with the ground.

Section V. ROAD RECONNAISSANCE AND CLASSIFICATION

3-23. General (STANAG 2253 and SOLOG 96)

A road is the open way provided for the convenient passage of vehicles. Road reconnaissance is conducted to determine the traffic capabilities of a particular road and to provide more detailed information than that required by the route classification formula. Road classification is based upon limiting characteristics, obstructions, snow blockage, flooding, civil and military road designation, turnouts, and available cover and concealment.

3-24. Road Classification Formula

a. Basic Formula. The road classification formula is developed from symbols expressed in the following order: limiting characteristics, width, construction material, length, and obstructions if present. The formula describes briefly a specific section of road and is used in conjunction with road reconnaissance reports.

(1) *Limiting characteristics.* The formula will be prefixed by the symbol, A, if there are *no limiting characteristics*, and by the symbol, B, if there is *one or more limiting characteristics.* An unknown or undetermined characteristic is represented by a question mark together with the feature to which it refers; both are inclosed in brackets. A listing of limiting characteristics, descriptive criteria, and corresponding letter symbols are outlined in table 3-3.

Table 3-3. Criteria for determination of limiting characteristics.

Limiting characteristics	Criteria	Symbol
Sharp curves	Sharp curves with radius less than 30 meters (100 feet) are also reported as obstructions.	c
Steep gradients	Steep gradients, 7 percent or steeper. Such gradients are also reported as obstructions.	g
Poor drainage	Inadequate ditches, crown or camber, or culverts; culverts and ditches blocked or otherwise in poor condition.	d
Weak foundation	Unstable, loose, or easily displaced material	f
Rough surface	Bumpy, rutted, or potholed to an extent likely to reduce convoy speeds	s
Excessive camber or superelevation.	Falling away so sharply as to cause heavy vehicles to skid or drag toward the shoulders.	j

(2) *Width.* The minimum width of the traveled way is expressed in meters or feet followed by a slash and the combined width of the traveled way and the shoulders; e.g., 14/16 feet (fig. 2-1). A description of the shoulders is not reported as part of the formula but by a separate notation which specifies the surface of the shoulders (grass, metaling, etc.), condition (unusable, emergency only, capable of improvements), width, vegetation, and critical side slopes. To report a dual road in which the two traveled ways are narrowly separated by a fixed barrier, pavement, or turf centerline; the width of each traveled way is first noted followed by the combined width including shoulder; for example, 7 + 7/18 meters. If the two traveled ways are significantly divided, however; each is reported as two distinct roads.

(3) *Road surface materials.* Road surface material is also expressed by a letter symbol. Symbols to be used for this purpose are listed in table 3-4 and are further related to the X, Y, and Z route types of the route classification formula (para. 2-6).

Table 3–4. Symbols for type of surface materials.

Symbol	Material	Route type
k	Concrete	Type (X); generally heavy duty.
kb	Bituminous (asphaltic) concrete (bituminous plant mix)	Type (X); generally heavy duty.
p	Paving brick or stone	Type (X); generally heavy duty.
rb	Bitumen penetrated macadam, waterbound macadam with superficial asphalt or tar cover.	Type (X); or type (Y); generally medium duty.
r	Waterbound macadam, crushed rock or coral	Type (Y); generally light duty.
l	Gravel or lightly metalled surface	Type (Y); generally light duty.
nb	Bituminous surface treatment on natural earth, stabilized soil, sand-clay or other select material.	Type (Y) or (Z); generally light duty.
b	Used when type of bituminous construction cannot be determined.	Type (Y) or (Z); generally light duty.
n	Natural earth stabilized soil, sand-clay, shell, cinders, disintegrated granite, or other material.	Type (Z); generally light duty.
v	Various other types not mentioned above	(Indicate length when this symbol is used.)

(4) *Length.* The length of the road expressed in kilometers or miles may be shown, if desired, in brackets following the surface material notation.

(5) *Obstructions.* Existence of obstructions, if present, along a road is expressed by placing the symbol (OB) at the end of the formula. Details of obstructions affecting the traffic flow of a road are not shown in the formula but are reported separately by appropriate symbols on accompanying maps or overlays or by written inclosures. Obstructions to be reported are as follows (see para. 2–8 for details):

(*a*) Overhead obstructions (less than 4.25 meters or 14 feet).

(*b*) Constrictions in traveled way widths.

(*c*) Gradients (slopes of 7 percent or greater.

(*d*) Curves with radii 30 meters (100 feet) or less.

(6) *Special conditions.* If blockage is regular, recurrent, and serious; the effects of snow blockage and flooding are indicated in the road classification formula. In such cases, the symbol (T) for snow blockage or (W) for flooding follows the road classification formula (para. 2–10).

(7) *Additional information.* The civil and military designation of the road, cover and concealment, possibilities of movement off the road, and similar information are indicated by appropriate symbolic notation on an accompanying map or overlay (fig. 2–2).

b. Classification Formula Examples. Usage and proper sequence of presentation are illustrated in the following examples of the road classification formula:

(1) *A 5.0/6.2m k.* This formula describes a road with no limiting characteristics or obstructions, a minimum traveled way of 5.0 meters, a combined width of traveled way and shoulders of 6.2 meters, and a concrete surface.

(2) *B g s 14/16 ft 1 (OB).* This formula describes a road with limiting characteristics of steep gradients and a rough surface; a minimum traveled way of 14 feet and a combined width of 16 feet; gravel or lightly metalled surface; and obstructions.

(3) *B c (f?) 3.2/4 8m p (4.3 km) (OB) (T).* This formula describes a road with limiting characteristics of sharp curves and unknown foundation; a

minimum traveled way of 3.2 meters and a combined width of 4.8 meters; paving brick or stone surface; 4.3 kilometers long; with obstructions; and subject to snow blockage.

c. Bridge, Ford, and Ferry Information. Such information is not included in the formula for road classification. Instead, this information is expressed by means of appropriate symbols placed on the map or overlay report as explained in paragraphs 2–12 and 2–13.

d. Slides and Drainage. Where rock slides or falling rock present a traffic hazard or poor drainage characteristics may cause seasonal obstructions, the locations are pointed out by means of critical point symbols on a map or overlay and explanatory information is included in a legend or written inclosure.

3–25. Capacity of Roads

The load-bearing capacity of a road is its ability to support traffic and is expressed by a military load classification number. In determining the load-bearing capacity of roads, an elementary knowledge of road structure and design as outlined in TM 5–330 is desirable. Briefly, the component parts of a road generally consist of a pavement or surface, a base course, and a subgrade (fig. 3–58).

a. The surface or pavement of a road is the top portion of the road structure. It comes into direct contact with the wheeled or tracked load and is designed to resist traffic wear and to prevent surface water from infiltrating into the road substructure. Surfaces may consist of various materials as listed in table 3–4.

b. The base course of a road is the intermediate portion of a road structure which distributes the induced stresses from the wheeled or tracked load to the subgrade. Base courses are usually made from gravel or crushed rock.

c. The subgrade is the foundation of a road structure which supports the load placed upon the surface of the road. Roads usually have a subgrade composed of locally available natural materials.

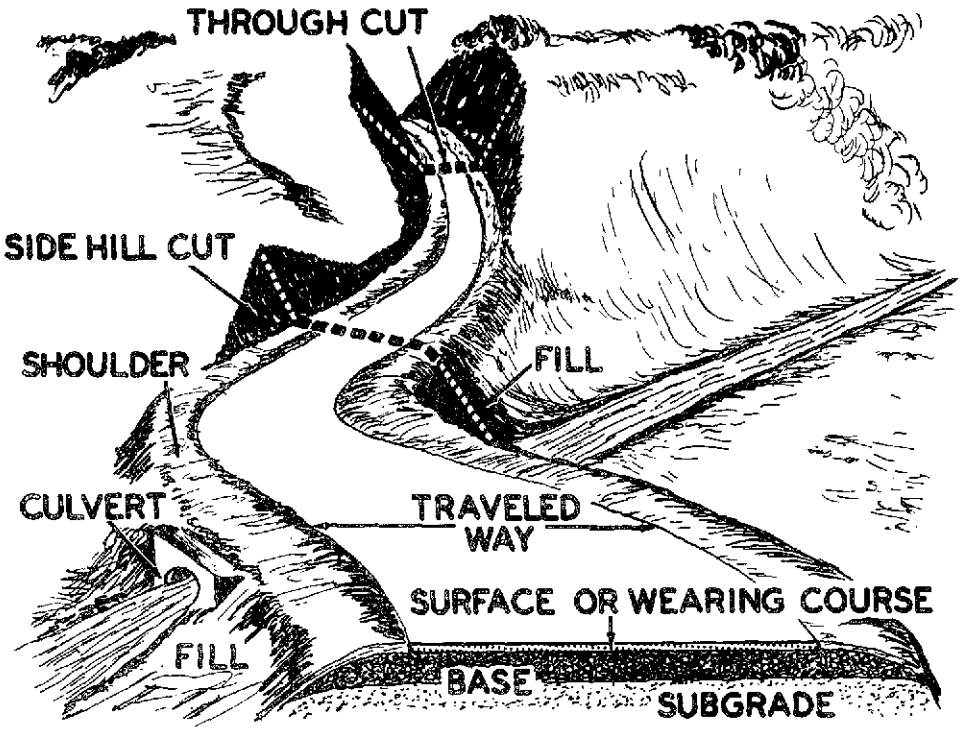


Figure 3–58. Road nomenclature.

3-26. Surfaces

Surfaces of roads are either flexible or rigid (table 3-4).

a. Flexible road surfaces may be composed of natural earth; earth stabilized with oil, cement, etc.; or bituminous pavement.

b. Rigid road surfaces are usually made of portland cement concrete. Brick, block, and stone are also considered as rigid surfaces.

3-27. Soils

Soils form the base course for the vast majority of roads. Soils are considered according to type, characteristics, and allowable foundation bearing pressure. Principal soil types are described in table 3-5, and characteristics of soils for construction purposes are outlined in table 3-6.

Table 3-5. Principal soil types.

Name	Description
Gravel	A mass of detached rock particles, generally waterworn, which pass a 3-inch sieve and are retained on a No. 4 sieve (0.187 inches).
Sand	Granular material composed of rock particles which pass a No. 4 sieve (0.187 inches) and are retained on a No. 200 sieve (0.0029 inches). It is difficult to distinguish sand from silt when the particles are uniformly small. Dried sand, however, differs from silt in that it has no cohesion and feels more gritty.
Silt	A fine, granular material composed of particles which pass the No. 200 sieve (0.0029 inches). It lacks plasticity and has little dry strength. To identify: prepare a pat of wet soil and shake it horizontally in the palm of the hand. With typical inorganic silt, the shaking action causes water to come to the surface of the sample, making it appear glossy and soft. Repeat tests with varying moisture contents. Squeezing the sample between the fingers causes the water to disappear from the surface and the sample quickly stiffens and finally cracks or crumbles. Allow sample to dry, and test its cohesion and feel by crumbling with the fingers. Typical silt shows little or no dry strength and feels only slightly gritty in contrast to the rough grittiness of fine sand.
Clay	Extremely fine-grained material composed of particles which pass the No. 200 sieve (0.0029 inches). To identify: work a sample with the fingers, adding water when stiffness requires. Moist sample is plastic enough to be kneaded like dough. Make further test by rolling ball of kneaded soil between palm of hand and a flat surface. Clay can be rolled to a slender thread, about ⅛ inch in diameter, without crumbling; silt crumbles, without forming a thread. Measure hardness of dry clay by finger pressure required to break a sample. It requires much greater force to break dry clay than dry silt. Clay feels smooth in contrast to the slight grittiness of silt.
Organic	Soil composed of decayed or decaying vegetation; sometimes mixed with fine-grained mineral sediments, such as peat or muskeg. Identified by coarse and fibrous appearance and odor. Odor may be intensified by heating. Plastic soils containing organic material can be rolled into soft, spongy threads.

3-28. Determining Load-Bearing Capacity

a. The load-bearing capacity of a road with a flexible surface is determined by allowable wheel load and is expressed as a whole number corresponding to the military load classification number. Classification numbers and their relationship to axle and wheel loads are illustrated in table 3-7. Road classification for tracked vehicles is normally not assigned. Other factors, such as wear and tear on road surfaces by track action, usually determine the road's capability to support tracked vehicles.

b. Computation of the approximate load-bearing capacity of a road with flexible surface for wheeled vehicles is made by measuring the thickness of the surface, the thickness of the base course, and determining the type of subgrade material. Once this information has been ascertained, the military load classification of the road may be estimated by referring to tables 3-5 and 3-6 and figure 3-59. The accuracy of this method is dependent upon the experience and judgment of those conducting the reconnaissance.

Table 3–6. Soil characteristics pertinent to roads and airfields.

Major Divisions (1)	(2)	Letter (3)	Symbol: Hatching (4)	Symbol: Color (5)	Name (6)	Value as Foundation When Not Subject to Frost Action (7)	Value as Base Directly under Bituminous Pavement (8)	Potential Frost Action (9)	Compressibility and Expansion (10)	Drainage Characteristics (11)	Field CBR (12)
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW		Red	Well-graded gravels or gravel-sand mixtures, little or no fines	Excellent	Good	None to very slight	Almost none	Excellent	60-80
		GP		Red	Poorly graded gravels or gravel-sand mixtures, little or no fines	Good to excellent	Poor to fair	None to very slight	Almost none	Excellent	25-60
		GM d		Yellow	Silty gravels, gravel-sand-silt mixtures	Good to excellent	Fair to good	Slight to medium	Very slight	Fair to poor	40-80
		GM u		Yellow	Silty gravels, gravel-sand-silt mixtures	Good	Poor	Slight to medium	Slight	Poor to practically impervious	20-40
		GC		Yellow	Clayey gravels, gravel-sand-clay mixtures	Good	Poor	Slight to medium	Slight	Poor to practically impervious	20-40
	SAND AND SANDY SOILS	SW		Red	Well-graded sands or gravelly sands, little or no fines	Good	Poor	None to very slight	Almost none	Excellent	20-40
		SP		Red	Poorly graded sands or gravelly sands, little or no fines	Fair to good	Poor to not suitable	None to very slight	Almost none	Excellent	10-25
		SM d		Yellow	Silty sands, sand-silt mixtures	Good	Poor	Slight to high	Very slight	Fair to poor	20-40
		SM u		Yellow	Silty sands, sand-silt mixtures	Fair to good	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	10-20
		SC		Yellow	Clayey sands, sand-clay mixtures	Fair to good	Not suitable	Slight to high	Slight to medium	Poor to practically impervious	10-20
FINE GRAINED SOILS	SILTS AND CLAYS LL < 50	ML		Green	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Fair to poor	Not suitable	Medium to very high	Slight to medium	Fair to poor	5-15
		CL		Green	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Fair to poor	Not suitable	Medium to high	Medium	Practically impervious	5-15
		OL		Green	Organic silts and organic silt-clays of low plasticity	Poor	Not suitable	Medium to high	Medium to high	Poor	4-8
	SILTS AND CLAYS LL > 50	MH		Blue	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	Not suitable	Medium to high	High	Fair to poor	4-8
		CH		Blue	Inorganic clays of high plasticity, fat clays	Poor to very poor	Not suitable	Medium	High	Practically impervious	3-5
		OH		Blue	Organic clays of medium to high plasticity, organic silts	Poor to very poor	Not suitable	Medium	High	Practically impervious	3-5
HIGHLY ORGANIC SOILS		Pt		Orange	Peat and other highly organic soils	Not suitable	Not suitable	Slight	Very high	Fair to poor	

Notes:

1. Column 3. Division of GM and SM groups into subdivisions of d and u are for roads and airfields only; subdivision is basis of Atterberg limits
2. Column 7, values are for subgrades and base courses except for base course directly under bituminous pavement.
3. In column 8, the term "excellent" has been reserved for base materials consisting of high quality processed crushed stone.
4. In column 9, these soils are susceptible to frost.

Table 3-7. Hypothetical wheeled vehicle classification numbers and their significance.

Hypothetical vehicle classification number	Maximum single axle load (tons)	Maximum single wheel load (pounds)
4	2.5	2,500
8	5.5	5,500
12	8.0	8,000
16	10.0	10,000
20	11.0	11,000
24	12.0	12,000
30	13.5	13,500
40	17.0	17,000
50	20.0	20,000
60	23.0	23,000
70	25.5	25,500
80	28.0	28,000
90	30.0	30,000
100	32.0	32,000
120	36.0	36,000
150	42.0	42,000

(1) The California Bearing Ratio (CBR) is a measure of the shearing resistance of soil under controlled density and moisture conditions (fig. 3-59). It is expressed as a ratio of the unit load required to force a piston into the soil to the unit load required to force the same piston the same depth into standard crushed stone.

(2) An example computation of the load-bearing capacity of a road with flexible surface is as follows:

(*a*) By field inspection, it is determined that a road has an 8-inch compacted gravel *base course* and a *flexible 3-inch bituminous surface* for a combined thickness of 11 inches. By use of the soil identification method explained in table 3-5, it is determined that the *subgrade* consists of clayey silts with low plasticity.

(*b*) Clayey silts with low plasticity are shown in table 3-6 to be in the ML range of soil groupings and to have safe California Bearing Ratio (CBR) between 5 to 15 or an average value of 10.

(*c*) Referring to figure 3-59 for an 11-inch combined thickness of flexible surface and base course and a subgrade CBR value of 10, the permissible wheel load is approximately 13,000 pounds.

(*d*) Reference to table 3-7 shows that this wheel load expressed as the next lower whole value corresponds to a military load classification number of 30.

(*e*) The road is, therefore, assigned the military load classification number 30.

c. If the military load classification number of the road is larger than the classification number for the weakest bridge on a route, the bridge classification number determines the capacity of the route.

3-29. Road Reconnaissance Report Form

The Road Reconnaissance Report (DA Form 1248) provides the information required for road classification (fig. 3-60). Characteristics of a given road may change considerably in relatively short distances. Therefore, any road reconnaissance report may require the use of several copies of the reporting form to cover all portions of the selected road. In this event each sheet is numbered at the lower right hand corner followed by the total number of sheets. Short forms or worksheets for rapid field work may be designed and produced by the unit making the reconnaissance when DA Forms are not available.

3-30. Method of Using DA Form 1248

Any item specified by the report which is undetermined or unknown is represented by a question mark (?) in the appropriate column of the form. If the width of the traveled way varies, item 6 of the form indicates the lower and upper limits of the traveled way width; and the corresponding extent of widths is shown on the mileage chart on the back of the form. Similarly, if the data for items 9, 10, 11, and 12 differ for various stretches of road, the differences are indicated by placing the appropriate road classification formula (para. 3-27) on the mileage chart opposite the portion of road to which it applies. Obstructions are listed and described in section III of the form

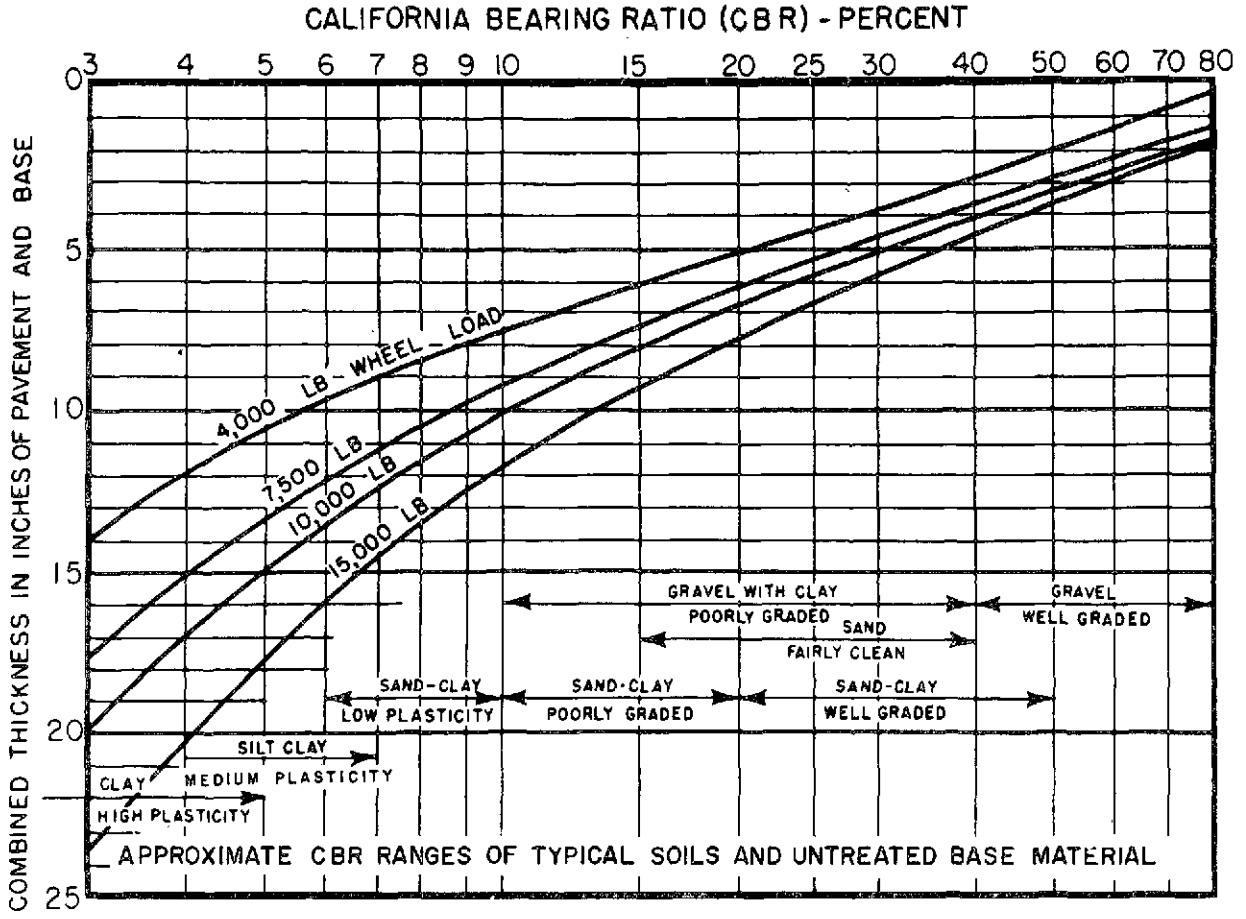


Figure 3–59. Load-bearing capacity of roads with flexible surface.

and are further shown on an accompanying map or overlay by appropriate route reconnaissance symbols (fig. 2–3). The mileage chart on the reverse side of DA Form 1248, reading from the bottom up, is also used to show the location of salient features along the road; either measurement system may be used with the unused side available for notations.

ROAD RECONNAISSANCE REPORT
(FM 5-36)

DATE: 1 JUNE 64

TO: (Headquarters ordering reconnaissance)
COMMANDING OFFICER, ATTN:
S2; 21ST ENGR BN (21ST INF DIV)

FROM: (Name, grade and unit of officer or NCO making reconnaissance)
John H. Doe
JOHN H. DOE 1/LT CO A 21ST ENGR BN

1. MAPS	a. COUNTRY	b. SCALE	c. SHEET NUMBER OF MAPS	2. DATE/TIME GROUP (Of signature)
	QUANTICO	1:50,000	5561-III	01 1800 JUN 64

SECTION I - GENERAL ROAD INFORMATION

3. ROAD GRID REFERENCE FROM	TO	4. ROAD MARKING (Civilian or Military number of road)	5. LENGTH OF ROAD (Miles or kilometers, specify)
UT 122864	UT 097899	VIRGINIA 617	16.0 Km

6. WIDTH OF ROADWAY (Feet or meters, specify): 6.7 - 9.3 METERS

7. RECONNAISSANCE — DATE: 1 JUN 64 — TIME: 1000 HRS

8. WEATHER DURING RECONNAISSANCE (Include last rainfall, if known):
CLEAR - TEMP. 84°
LAST RAINFALL - APPROX. 28 MAY 64

SECTION II - DETAILED ROAD INFORMATION
(When circumstances permit more detailed information will be shown in an overlay or on the mileage chart on the reverse side of this form. Standard symbols will be used.)

9. ALINEMENT (Check one ONLY)

	(1) FLAT GRADIENTS AND EASY CURVES
	(2) STEEP GRADIENTS (Excess of 7 in 100)
	(3) SHARP CURVES (Radius less than 100 ft (30m))
✓	(4) STEEP GRADIENTS AND SHARP CURVES

10. DRAINAGE (Check one ONLY)

	(1) ADEQUATE DITCHES, CROWN/CAMBER WITH ADEQUATE CULVERTS IN GOOD CONDITION
✓	(2) INADEQUATE DITCHES, CROWN/CAMBER OR CULVERTS, ITS CULVERTS OR DITCHES ARE BLOCKED OR OTHERWISE IN POOR CONDITION

11. FOUNDATION (Check one ONLY)

✓	(1) STABILIZED COMPACT MATERIAL OF GOOD QUALITY
	(2) UNSTABLE, LOOSE OR EASILY DISPLACED MATERIAL

12. SURFACE DESCRIPTION (Complete items 12a and b)

a. THE SURFACE IS (Check one ONLY)

	(1) FREE OF POTHOLES, BUMPS, OR RUTS LIKELY TO REDUCE CONVOY SPEED
✓	(2) BUMPY, RUTTED OR POTHOLED TO AN EXTENT LIKELY TO REDUCE CONVOY SPEED

b. TYPE OF SURFACE (Check one ONLY)

	(1) CONCRETE		(6) WATERBOUND MACADAM
✓	(2) BITUMINOUS (Specify type where known): CHECK CHART		(7) GRAVEL
			(8) LIGHTLY METALLED
			(9) NATURAL OR STABILIZED SOIL, SAND CLAY, SHELL, CINDERS, DISINTEGRATED GRANITE, OR OTHER SELECTED MATERIAL
	(3) BRICK (Pave)		
	(4) STONE (Pave)		(10) OTHER (Describe):
	(5) CRUSHED ROCK OR CORAL		

SECTION III - OBSTRUCTIONS
(List in the columns below particulars of the following obstructions which affect the traffic capacity of a road. If information of any factor cannot be ascertained, insert "NOT KNOWN")
(a) Overhead obstructions, less than 14 feet or 4.25 meters, such as tunnels, bridges, overhead wires and overhanging buildings.
(b) Reductions in road widths which limit the traffic capacity, such as craters, narrow bridges, archways, and buildings.
(c) Excessive gradients (Above 7 in 100)
(d) Curves less than 100 feet (30 meters) in radius)
(e) Fords

SERIAL NUMBER a	PARTICULARS b	GRID REFERENCE c	REMARKS d
1	SHARP CURVE - RADIUS 27.5m	UT 122869	SEE OVERLAY
2	STEEP GRADE - 8% - UPHILL EAST	UT 115875	LENGTH 300 m
3	NARROW BRIDGE - TRAVELED WAY 5.0m	UT 109879	SEE BRIDGE RPT. #1
4	UNDERPASS - V.C. 4.05m	UT 102883	SEE OVERLAY
5	ROAD CRATER - LGT. 7.5m	UT 101884	SEE RECON RPT #1
6	FORD - LGT. 7.3m - WIDTH 8.2m	UT 100886	SEE FORD RPT #1
	BOTTOM GRAVEL - DEPTH 0.5m		

DA FORM 1 JUL 60 1248 PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

Figure 3-60. Road reconnaissance report (DA Form 1248).

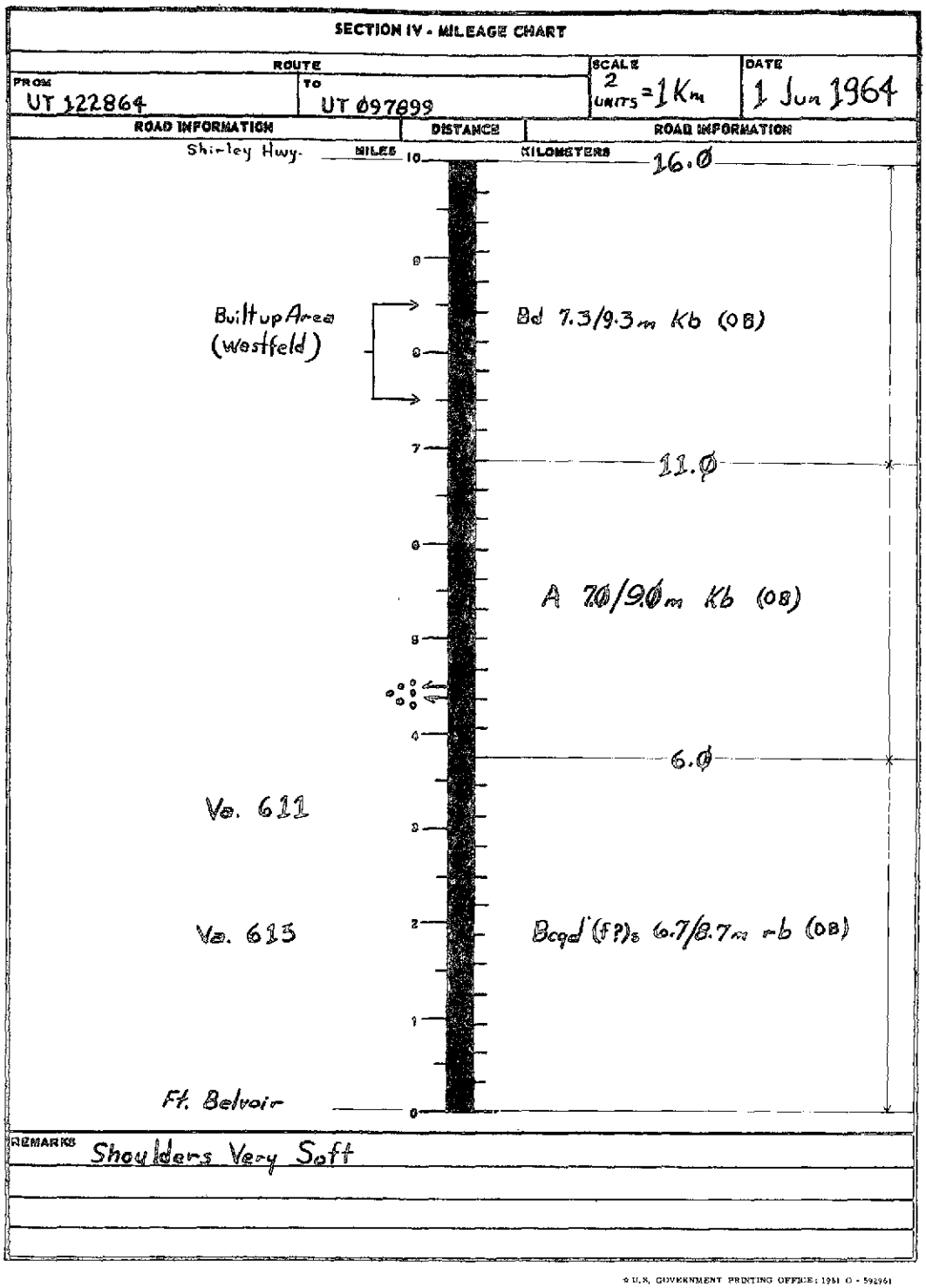


Figure 3-60—Continued.

Section VI. ENGINEER RECONNAISSANCE

3–31. General

Engineer reconnaissance, which is terrain reconnaissance conducted to support engineer activities, is designated as either general or special. *General engineer reconnaissance* provides engineer information of a broad nature within the operational area and is concerned with locating and evaluating those items, such as construction material, resources, and terrain features, which have engineer implications. General reconnaissance missions may be assigned on a zone, area, or route basis. *Special engineer reconnaissance,* on the other hand, obtains more detailed information regarding a specific engineer task or tasks; normally, such reconnaissance follows and supports general engineer reconnaissance. Special reconnaissance may be assigned as either an area or route reconnaissance mission.

3–32. Engineer Reconnaissance Techniques

When general or special engineer reconnaissance is assigned as a route reconnaissance mission, appropriate procedures and reconnaissance techniques previously outlined in this manual are followed. Moreover, engineer reconnaissance is often conducted in conjunction with deliberate route reconnaissance in order to determine route conditions (including work estimates) and to locate construction material by which the route may be improved or maintained. The technical nature of engineer reconnaissance requires the issuance of detailed reconnaissance instructions. A check list to insure that important engineer aspects are not overlooked is recommended (fig. 3–61). The results of engineer reconnaissance are usually reported on an overlay which does not differ significantly from the route reconnaissance overlay (sec. II, ch. 2). Standard route reconnaissance report forms and engineer reconnaissance forms (para. 3–35) are employed to supplement the reconnaissance overlay.

3–33. Engineer Resource Symbols (STANAG 2269)

The location of important terrain features are shown on the reconnaissance overlay by conventional military, topographic, and reconnaissance symbols. In addition, symbols have been standardized to represent the more common engineer resources and construction materials (fig. 3–62). In those cases where symbols fail to provide an adequate explanation, each symbol is keyed by serial or critical point number on the overlay and is referenced and fully described in accompanying inclosures.

3–34. Formats for Electrically Transmitting Engineer Information (STANAG 2096 and SOLOG 107)

To provide standardization in reporting engineer reconnaissance information by electrical means, the formats shown below have been adopted. Although primarily designed for electrical transmissions in conjunction with standard message forms (DD Form 173 and DA Form 11–170), the formats, which are produced locally, may also be used to supplement engineer reconnaissance reports especially when more detailed information than can be depicted by overlay symbols is required. The originator completes only those parts of the format which are applicable or for which information is available (figs. 3–63 to 3–69). Each item of the report, however, is accompanied by the appropriate letter designation from the format to establish the correct category of information. Messages are preceded by the type of the report or identifying codeword.

a. Installation (fig. 3–63).

b. Road making equipment (fig. 3–64).

c. Local resources such as quarries, timber stands, sawmills, and brickyards (fig. 3–65).

d. Enemy stores and equipment (fig. 3–66).

e. Water points (fig. 3–67).

f. Dams and sluices (fig. 3–68).

g. Obstacles (fig. 3–69).

3–35. Engineer Reconnaissance Report (DA Form 1711–R)

DA Form 1711–R (fig. 3–70) is used to report those items of engineer reconnaissance not adequately covered by DA report forms previously discussed in route reconnaissance. The

RECONNAISSANCE INSTRUCTIONS NO._____

_____
(Organization)

TO:_____ Effective_____
(Hour and Date)

MAPS_____

Complete report to_____ at_____
(Organization) (Place, Time, and Date)

Reconnoiter and report information as indicated below by items checked. Report also any other information; of technical importance incidentally secured

DETAILED INSTRUCTIONS
Areas, special features or structures special reports and work estimates required.

1. ROADS: Classify using symbols.
2. BRIDGES, FORDS AND FERRIES: classify using symbols. Possible by-pass for existing crossings.
3. Obstacles to our movement: natural and artificial; include demolitions, mines, boobytraps.
4. TERRAIN: general nature, ridge system, drainage system including fordability, forests, swamps, areas suitable for mechanized operations.
5. ENGR MATERIALS: particularly road material, bridge timbers, lumber, steel, explosives.
6. ENGR EQUIPMENT: rock crushers, sawmills, garages, machine shops, blacksmith shops, etc.
7. ERRORS AND OMISSIONS ON MAPS USED.
8. BARRIERS to enemy movement: natural, artificial and sites for construction of improvement. (work estimates)
9. WATER POINTS: recommended locations.
10. STREAMS: general description, width, depth, banks, approaches, character of bottom and means to be used at possible crossing sites. Navigability?
11. DEFENSIVE POSITIONS.
12. BIVOUAC AREAS: entrances, soil, drainage, sanitation, concealment.
13. PETROLEUM STORAGE AND EQUIPMENT.
14. UTILITIES: water, sewage, electricity, gas.
15. PORTS: wharves, sunken obstacles, cargo handling facilities, storage facilities, transportation routes.
16. CONSTRUCTION SITES: Drainage, water supply, power source, earthwork, access, acreage, soil.

BY ORDER OF_____

Figure 3–61. Engineer reconnaissance check list.

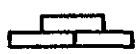
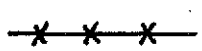
Serial Number	Description	Symbol
1.	Sawmill	
2.	Lumber Yard	
3.	Stone	
4.	Aggregate (including gravel, slag, etc.)	
5.	Sand	
6.	Cement concrete products	
7.	Stocks of bricks and other clay products	
8.	Iron and steel stock	
9.	Wire stock	
10.	Paint	
11.	Glass stock	
12.	Gypsum and lime products	

Figure 3-62. Engineer resources symbols.

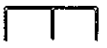
Serial Number	Description	Symbol
13.	Asphalt and bituminous stock	
14.	Stocks of roof covering	
15.	Building hardware	
16.	Industrial gasses	
17.	Cordage, nets, yarns	
18.	Civil engineering firms	
19.	Building contractors	
20.	Factories	
21.	The factory symbol may be used in connection with other symbols to indicate a factory or plant producing (as a main product) the represented material.	
22.	Steel rolling mills and foundries	
23.	Engineering workshops	

Figure 3-62—Continued.

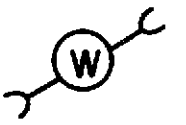
Serial Number	Description	Symbol
24.	Mobile heavy construction equipment	
25.	Forestry equipment	
26.	Quarrying equipment	
27.	Stores handling and transportation equipment	
28.	Powered hand tools	
29.	Water purification equipment (civilian)	
30.	Electrical supply equipment	
31.	Military water point	

Figure 3-62—Continued.

form may be locally reproduced on 8 x 10½ inch paper. The engineer reconnaissance form is used together with a reconnaissance overlay to provide a convenient as well as uniform mean for reporting the results of engineer reconnaissance. The form is divided into four sections—

a. Heading. Completion of this section is self-explanatory.

b. Body.

(1) The *key* provides reference to the item of the report and its corresponding

location on the reconnaissance overlay. The serial or critical point number of the object is entered in this column.

(2) The *object* to be explained is shown in this column either by conventional symbol or brief written description.

(3) If a *work estimate* (see subpara. *d* below) is included as part of the report, enter YES; if not, NO.

(4) In the *additional remarks* column, report the location of the object by grid coordinates followed by explanatory remarks, calculations, and an appropriate sketch.

c. Authentication (Signature Block). Completion of this section is self-explanatory.

d. Work Estimate. The other side (reverse side) of DA Form 1711-R is used to indicate the amount and type of engineer effort required for construction or repair (fig. 3-71). Each work estimate is keyed by serial or critical point number to the appropriate object on the reverse side of the form. Only those columns which are appropriate need be completed. Additional sketches may be drawn, if needed, to better explain the type work required.

Installation Report

Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Nature	DELTA				
Capacity, including capacity as shelter or storage	ECHO				
Condition	FOXTROT				
Additional information	GOLF				

Notes. [a]. First installation in report; report by serial number if assigned.
[b]. Additional installations in report.

Figure 3-63. Installation report format.

Road-Making Equipment Report

Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type	DELTA				
Number	ECHO				
Condition	FOXTROT				
Additional information	GOLF				

Notes. [a]. First road-making equipment in report; report by serial number if assigned.
[b]. Additional road-making equipment in report.

Figure 3-64. Road-making equipment report format.

Local Resources Report

Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type	DELTA				
Quantity of stock	ECHO				
Capacity and output per day	FOXTROT				
Additional information	GOLF				

Notes. [a]. First local resource in report; report by serial number if assigned.
[b]. Additional local resources in report.

Figure 3-65. Local resources report format.

Enemy Stores and Equipment Report					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type	DELTA				
Quantity	ECHO				
Condition	FOXTROT				
Additional information	GOLF				

Notes. [a]. First enemy stores and equipment in report; report by serial number if assigned.
[b]. Additional enemy stores and equipment in report.

Figure 3-66. Enemy stores and equipment report format.

Water Point(s) Report					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type (well, spring, watercourse, lake or pond)	DELTA				
Rate of delivery of water	ECHO				
Total quantity of water available in sources and description of water in source, i.e. brackish, clear, etc.	FOXTROT				
Existing pump and storage facilities	GOLF				
Accessibility	HOTEL				
Additional information	INDIA				

Notes. [a]. First water point in report; report by serial number if assigned.
[b]. Additional water points in report.

Figure 3-67. Water point report format.

Dam and Sluice Report					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type	DELTA				
Dimensions	ECHO				
Condition	FOXTROT				
Additional information	GOLF				

Notes. [a]. First dam or sluice in report; report by serial number if assigned.
[b]. Additional dams or sluices in report.

Figure 3-68. Dam and sluice report format.

Obstacle Report					
Explanation	Letter designation	(1)[a]	(2)[b]	(3)[b]	(4)[b]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (grid references)	CHARLIE				
Type	DELTA				
Enemy weapons having action on the obstacle, if any.	ECHO				
Additional information	FOXTROT				

Notes. [a]. First obstacle in report; report by serial number if assigned.
[b]. Additional obstacles in report.

Figure 3-69. Obstacle report format.

ENGINEER RECONNAISSANCE REPORT | PAGE 1 OF 4 PAGES

TO: CO: 21ST ENGR BN | FROM: CO A 21ST ENGR BN.

FILE NO. | PARTY LEADER (NAME, GRADE, ORGANIZATION) THOMAS P TAYLOR 2d LT | PLACE - HOUR - DATE UT586788 112000 MAR 65

REPORT NO. 1 | CO A 21ST ENGR BN.

MAPS QUANTICO, VIRGINIA 1:50,000 SHEET 5561 III

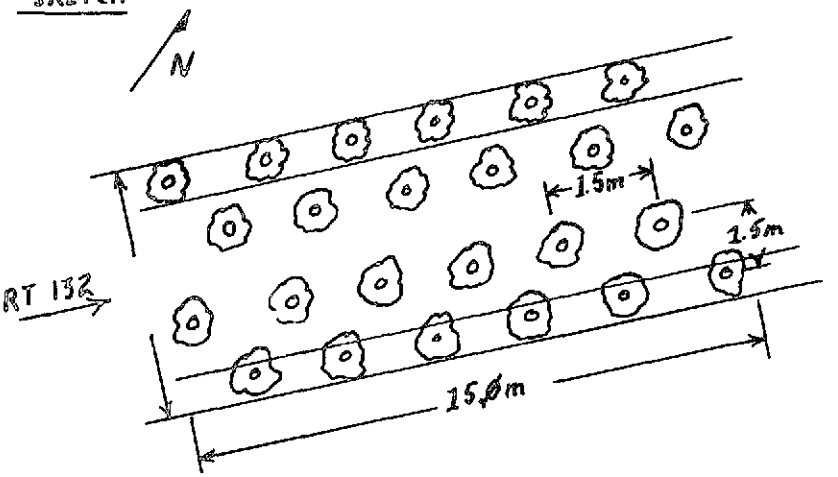
DELIVER TO (Organization, Place, Hour and Date)
S2: 21ST ENGR BN. UT556461 122000 MAR 65

KEY	OBJECT	TIME OBSERVED	WORK ESTIMATE?
1		0900	YES

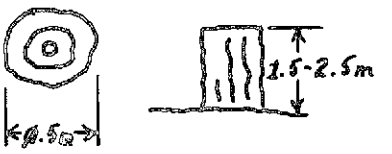
ADDITIONAL REMARKS AND SKETCH

UT058684 - LOG POST OBSTACLE BLOCKING RT 132

SKETCH



(24) LOG'S @ 0.5m. DIAMETER, C-C 1.5m.
ON ALL SIDES, 1.5m. TO 2.5m. ABOVE GROUND



ENGINEER WORK ESTIMATES ON OTHER SIDE

TYPED NAME, GRADE AND ORGANIZATION
THOMAS P TAYLOR 2d LT.
CO A 21ST ENGR BN.

SIGNATURES
Thomas P Taylor

DA Form 1711-R, 1 Jun 61 Edition of 1 May 56 is obsolete.

Figure 3-70. Engineer reconnaissance report form (DA Form 1711-R).

ENGINEER RECONNAISSANCE REPORT | PAGE 2 OF 4 PAGES

TO: CO: 21ST ENGR BN | FROM: CO: CO A 21ST ENGR BN

FILE NO.

REPORT NO. 1

PARTY LEADER (NAME, GRADE, ORGANIZATION): THOMAS P. TAYLOR 2d LT, COA 21ST ENGR BN

PLACE - HOUR - DATE: UT 586708, 11 2000 MAR 65

MAPS QUANTICO, VIRGINIA 1:50,000 SHEET 5561 III

DELIVER TO (Organization, Place, Hour and Date)
S2: 21ST ENGR BN UT 556461 12 0100 MAR 65

KEY	OBJECT	TIME OBSERVED	WORK ESTIMATE?	ADDITIONAL REMARKS AND SKETCH
1	⫽	—	—	CONT. OBSTACLE NOT DEFENDED: BYPASS: DIFFICULT (↓ ~~↓~~) DUE TO SWAMPY TERRAIN
2	X	0920	NO	UT509686 - GRAVEL PIT IN OPERATION QUANTITY: APROX. 6,000 YD³ STOCKPILED RANGING FROM 1 IN. TO 3 IN. IN DIAMETER TYPE: CRUSHED GRANITE COMMUNICATIONS: GOOD ACCESS ROADS WITH AMPLE SPACE FOR TURN AROUND AND LOADING.
3	■	0940	NO	UT 50974 - ABANDONED ENEMY EQPT. QUANTITY & TYPE: (2) "ZIPLO" MODEL 200 CRAWLER CRANES. (OPERATIONAL) CHECKED FOR BOOBY TRAPS - NONE

ENGINEER WORK ESTIMATES ON OTHER SIDE

TYPED NAME, GRADE AND ORGANIZATION
THOMAS P TAYLOR 2d LT
COA 21ST ENGR BN

SIGNATURES
Thomas P. Taylor

DA Form 1711-R, 1 Jun 61 — Edition of 1 May 56 is obsolete.

Figure 3-70—Continued.

ENGINEER RECONNAISSANCE REPORT | PAGE 3 OF 4 PAGES

TO: CO: 21ST ENGR BN | FROM: CO: COA 21ST ENGR BN

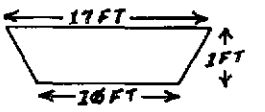
FILE NO. | PARTY LEADER (NAME, GRADE, ORGANIZATION) THOMAS P. TAYLOR 2dLT | PLACE - HOUR - DATE UT 586708

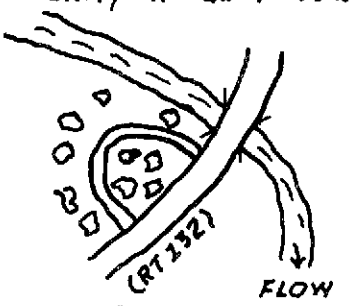
REPORT NO. 1 | COA 21ST ENGR BN | 112000 MAR 65

MAPS QUANTICO, VIRGINIA 1:50,000 SHEET 5561 III

DELIVER TO (Organization, Place, Hour and Date)
S2: 21ST ENGR BN UT556461 120100 MAR 65

KEY	OBJECT	TIME OBSERVED	WORK ESTIMATE?	ADDITIONAL REMARKS AND SKETCH
4	BIV AREA	1035	NO	UT512692 – POSSIBLE BIVOUAC AREA SIZE: 700m X 900m COMMUNICATIONS: GOOD ACCESS ROAD W/GOOD DRAINAGE & HARD SURFACE SITE CONDITIONS: GOOD DRAINAGE WITH FIRM SOIL, GOOD C/C, GOOD OBSERVATION & F/F
5	(WP)	1150	NO	UT558680 – POSSIBLE WATER POINT QUANTITY: Q=AV6.4 A=13.5 FT^2 V=35FPM Q=(13.5)(35)(6.4)=3,012 GPM QUALITY: CLOUDY, NO ODOR, NO OBSERVED SOURCE OF POLUTION, SPL WAS TAKEN FOR TESTS COMMUNICATIONS: GOOD ACCESS RDS FROM MSR, GOOD TURN AROUNDS & PARKING ON SITE SITE CONDITIONS: GOOD, SLOPE OF BANKS 5%, BIVOUAC AREA ON SITE FOR W.P. TEAM, BRIDGE POSSIBLE ARTILLERY TARGET





ENGINEER WORK ESTIMATES ON OTHER SIDE

TYPED NAME, GRADE AND ORGANIZATION
THOMAS P. TAYLOR
COA 21ST ENGR BN

SIGNATURES
Thomas P. Taylor

DA Form 1711-R, 1 Jun 61 Edition of 1 May 56 is obsolete.

Figure 3-70—Continued.

ENGINEER RECONNAISSANCE REPORT | PAGE 4 OF 4 PAGES

TO: CO: 21ST ENGR BN | FROM: CO: C O A 21ST ENGR BN

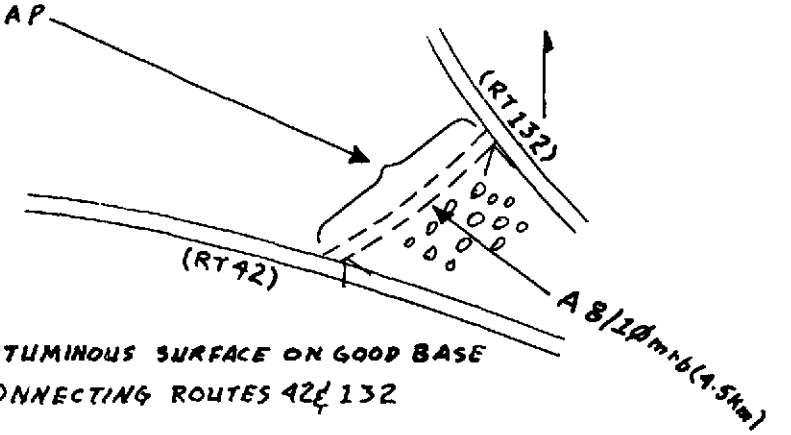
FILE NO. | PARTY LEADER (NAME, GRADE, ORGANIZATION) THOMAS P. TAYLOR 2d LT | PLACE - HOUR - DATE UT586708

REPORT NO. 1 | C O A 21ST ENGR BN | 11 2000 MAR 65

MAPS QUANTICO, VIRGINIA 1:50,000 SHEETS 5561 III

DELIVER TO (Organization, Place, Hour and Date)
S2: 21ST ENGR BN UT556461 12 0100 MAR 65

KEY	OBJECT	TIME OBSERVED	WORK ESTIMATE?	ADDITIONAL REMARKS AND SKETCH
6	MAP ERROR	1200	NO	UT557963 TO UT558003 ROAD NOT SHOWN ON MAP
7	W	1230	NO	UT761432 EXISTING WATER PURIFICATION PLANT SUPPLYING WATER TO THE CITY OF YUCU OUTPUT 60,000 GAL PER DAY



ENGINEER WORK ESTIMATES ON OTHER SIDE

TYPED NAME, GRADE AND ORGANIZATION
THOMAS P. TAYLOR 2d LT
C O A 21ST ENGR BN

SIGNATURES
Thomas P. Taylor

DA Form 1711-R, 1 Jun 61 Edition of 1 May 56 is obsolete.

Figure 3-70—Continued.

ENGINEER WORK ESTIMATE

LOCATION KEY	DESCRIPTION OF WORK	UNIT REQ'D	HOURS	EQUIPMENT TYPE	EQUIPMENT NO.	EQUIPMENT HOURS	MATERIALS TYPE	MATERIALS UNIT	MATERIALS QUANTITY
⚠	REMOVE LOG POST FROM ROUTE 132 BY DEMO	1 SQD	2	DEMO SET #1	1	2	TNT	#	240
							D-CORD	FT	140
$P = \frac{D^2}{40} = \frac{(19.2)^2}{40} = 9.3\#$				D-7 CAT	1	2			
∴ 10 #/POST							NON ELECT CAPS	EA	25
240 # TOTAL							TIME FUSE	FT	4
							M-2 FUSE LIGHTER	EA	1

RECONNAISSANCE REPORT ON OTHER SIDE

Figure 3–71. Work estimate (reverse side of DA Form 1711–R).

CHAPTER 4

SPECIAL TERRAIN RECONNAISSANCE

Section I. GENERAL

4-1. Introduction

Chapters 2 and 3 outline route reconnaissance procedures for existing vehicular routes in an operational area. Military activities, however, are not confined to road networks; and in many situations, other types of routes such as waterways, trails, and footpaths, are called upon to supplement existing routes or, at times, completely support military operations. Under such circumstances, it becomes necessary to initiate area or zone reconnaissance to exploit the capabilities of modern cross-country vehicles and aircraft as well as route reconnaissance to ascertain the potential of supplementary routes.

4-2. Scope of Reconnaissance

Special terrain reconnaissance is greatly influenced by the operational environment; consequently, standardized formats and DA forms have not been prepared, in most cases, to report terrain data. Moreover, special terrain reconnaissance is not easily divided into hasty and deliberate reconnaissance procedures. For the most part, requirements for terrain information is determined by the headquarters initiating the reconnaissance; consequently, reconnaissance instructions must be more detailed than in routine route reconnaissance operations. Overlay reports utilizing conventional military and reconnaissance symbols are the preferred method of rendering special terrain reconnaissance reports. Nevertheless, particular attention must be given to other reporting techniques before reconnaissance elements are dispatched.

Section II. CROSS-COUNTRY MOVEMENT

4-3. General (STANAG 2259 and SOLOG 100)

Cross-country movement refers to the feasibility for tactical movement by military tracked and wheeled vehicles away from all-weather routes. The increased capability of military vehicles to negotiate rough terrain provides the commander with additional means to maintain mobility. Although prepared routes are still essential for large-scale operations, especially combat support and combat service support activities, natural and manmade obstacles along a specified route may often be avoided or bypassed by executing cross-country detours. Reconnaissance personnel, therefore, are required to recognize and analyze the cross-country characteristics of an area. Factors of terrain that affect cross-country movement are slope, soil composition, vegetation, manmade features, and drainage. Weather is also an important consideration; but unlike the other factors, weather affects cross-country movement indirectly by influencing soil composition and drainage. Rarely, does one factor by itself determine cross-country movement; more commonly, it is a combination. Therefore, although each factor is discussed separately below, reconnaissance personnel must realize that cross-country movement is usually dependent on a variety of these factors.

4-4. Slope

a. Ground reconnaissance permits on-the-spot determination of slope percentages. An instrument such as a clinometer for slope measurement is recommended since slopes tend to appear, particularly to the untrained eye, much steeper than they actually are. Because of the time involved, slopes can be accurately measured only on critical approaches; therefore, great reliance must be placed upon other sources such as maps and aerial photographs for obtaining general slope data over large areas.

b. Aerial photographs and aerial battlefield surveillance are admirably suited for quick investigation of slopes and are, perhaps, the best source of information other than ground reconnaissance in ascertaining this factor. Aerial photographs provide permanent imagery records of macro-relief features such as hills and mountains as well as micro-relief features such as small gullies and rock ledges. Ditches, for example, which are not generally depicted on topographic maps but which appreciably affect cross-country movement, usually appear plainly on aerial photographs.

c. In evaluating terrain for cross-country movement, a 45 percent slope is commonly accepted as the reasonable upper limit for tanks and a 30 percent slope for wheeled vehicles (app. IV). If other factors are extremely favorable, these percents of slope may be increased somewhat; but if unfavorable, reduction must be made in accordance with the prevailing conditions. For vertical slopes, such as rock ledges or curbs, heights between .6 to 1.2 meters (2 to 4 feet) are the practical upper limits for tracked vehicles and .15 to .3 meter (6 to 12 inches) for most wheeled vehicles.

4-5. Soil Composition

a. Soil trafficability is defined as the capacity of soil to support traffic by military vehicles and is not the same as cross-country movement. Soils, when dry, will support vehicles almost without exception, but when wet, their capacity to sustain cross-country movement is variable and difficult to evaluate. Engineers may be called upon to perform empirical tests in order to determine soil trafficability (TM 5-530); however, inspection and passes with trial vehicles are usually adequate for most purposes.

b. The part of the soil most important to cross-country mobility is the top layers, particularly from .15 to .30 meter (6 to 12 inches) in depth although soil to a depth of .60 meter (2 feet) may occasionally be of consequence. To a large extent, weather determines the amount of moisture in the soil. If the moisture content is known, it is possible on the basis of weather forecasts to predict what the content may be at a later date; however, there is a point where soil becomes saturated and the amount of moisture will not be appreciably exceeded. When the weather is warm enough to support plant growth, soil moisture becomes rapidly depleted. Slippery and sticky soils may also be troublesome, but they seldom cause immobilization of traffic, particularly tracked vehicles. Nearly all immobilizations from soil are the result of loss of traction caused by vehicles sinking so deeply that they become high-centered. Soil trafficability characteristics are generally applicable for wet periods only.

c. Soils may be classified as to type such as sand, silt, clay, etc., (tables 3-5 and 3-6) or as to *trafficability class* (TC) as defined below and further clarified in table 4-1.

(1) TC I—Soil permits at least 50 vehicle passes in trace or one or more maneuvers by individual vehicles (starts, stops, sharp turns, or crossings of another trace) in the same location.

(2) TC II—Soil permits approximately 10 to 50 passes in trace; maneuvers by individual vehicles are risky; cautious driving necessary; movement by vehicles following in trace should be avoided.

(3) TC III—Soil permits 1 to approximately 10 passes in trace; maneuvers by individual vehicles extremely risky; very cautious driving nec-

essary; movement by vehicles following in trace must be avoided.

(4) TC IV—Soil permits no vehicular passes, and engineer work is required for movement.

Table 4-1. Trafficability Characteristics of Wet Soils (STANAG 2259 And SOLOG 100)

Trafficability class	Soil type	Slipperiness effects	Stickiness effects	Comments
I	Coarse-grained cohesionless sands and gravels.	Slight to none.	None -----	Will support continuous traffic of military vehicles. Wheeled vehicles with standard tires may be immobilized in dry sands.
I, II	Inorganic clays of high plasticity, fat clays.	Severe to slight.	Severe to slight.	Usually will support more than 50 passes of military vehicles. Going will be difficult at times.
II, III	Clayey gravels, gravel-sand-clay mixtures. Clayey sands, sand-clay mixtures. Gravelly clays, sandy clays, inorganic clays of low to medium plasticity, lean clays, silty clays.	Severe to slight.	Moderate to slight.	Often will not support 50 passes of military vehicles, but usually will support limited traffic. Going will be difficult in most cases.
III, IV	Silty gravels, gravel-sand-silt mixtures. Silty sands, sand-silt mixtures. Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity. Inorganic silts, micaceous or diatomaceous fine sandy or silty soils; elastic silts. Organic clays of medium to high plasticity, organic silts.	Moderate to slight.	Slight ----	Usually will not support 50 passes of military vehicles. Often will not permit even a single pass. Going will be extremely difficult in most cases.

4-6. Vegetation

The term vegetation includes not only natural growth but also crops and orchards. Nearly all forests, dependent upon the size of the tree diameters, have a slowing effect on wheeled vehicular movement. Trees with trunk diameters less than two inches are only a slight hindrance for tracked vehicles; whereas, the practical upper limit of tree diameters to be toppled by medium tanks is from 150–200 centimeters (6 to 8 inches). Trees somewhat less than 150 centimeters (6 inches) in diameter, however, may cause an obstacle when growing very close together. The average distance to permit vehicular passage between trees which cannot be felled is from 4.5 to 6 meters for both wheeled and tracked vehicles. This distance is greater in width than standard military vehicles, but allowance is made for individual vehicle maneuver.

4-7. Manmade Features

Manmade features are those works of man such as railroad embankments, built-up areas, stone walls, hedgerows, dikes, cuts, fills, etc., which are deterrents or obstacles to movement.

4-8. Drainage

The water features of an area comprise its drainage. They include streams and canals; drainage and irrigation ditches; lakes, marshes, bogs, and swamps; artificial bodies of standing water such as reservoirs and ponds as well as such subsurface outlets as springs and wells. The character of these drainage features, is determined by precipitation, temperature, relief, surface runoff, ground-water flow, and various types of manmade drainage construction. If bridges, fords, or special purpose vehicles are unavailable, engineer assistance is usually required to negotiate obstacles of this

type. During cross-country movement, low areas are avoided in which water runoff is likely to maintain soil saturation. These areas can often be recognized by the deeper green and greater density and height of foliage and grasses.

4-9. Cross-Country Movement in Snow

Snow may be considered as similar in its effect upon cross-country movement as certain type soils. Snow in itself is seldom a critical obstacle for tracked vehicles although it frequently may be a hindrance especially on slopes. Snow, because of its slippery nature, reduces the steepness of slopes which can be negotiated. On level or gently sloping terrain, the mobility of tracked vehicles is generally retained in snow up to 1 meter (3 feet) in depth. In those locations where snow accumulates to depths greater than 1 meter such as in forested or mountainous areas, cross-country movement is generally prohibited by other more decisive terrain factors. Snow is considerably more of an obstruction and hazard for wheeled vehicles. Even though traction can be enhanced by tire chains or reduced tire pressure, icy conditions which make movement of wheeled vehicles difficult may be created by snow which barely covers the ground. If the depth of snow exceeds .3 meter (12 inches), standard wheeled vehicles are likely to become immobilized unless the snow is well packed. When the ground is snow covered, it is difficult to predict the trafficability because of the changing condition of the snow during the day. Wet snow in the morning may freeze by the afternoon; or a wind-packed snow slab may support a tracked vehicle during one part of the day and may not during another time of the day. When the air temperatures are above 15° F., snow may form a serious obstacle to cross-country movement because at these temperatures the snow may become wet. A depth of 1 meter or more of this wet snow will normally immobilize a tank.

4-10. Crossings on Ice

a. Conditions Governing Crossings on Ice. Crossing a water barrier on ice depends upon the weather and ice conditions. Sudden rises in temperature above the freezing point weaken the ice; artillery fire or demolitions may breakup the ice. However, under favorable conditions, crossings on ice are practicable and can be successfully executed by large bodies of troops and heavy equipment.

b. Load-Bearing Capacity of Ice. The strength of ice varies with the structure of the ice; the purity of the water from which it is formed; the cycle of freezing, thawing, and refreezing; temperature; snow cover; and water currents under the ice. Warm weather reduces the carrying capacity of an ice layer even though thickness remains the same since the ice rapidly becomes porous. Tables 4-2 and 4-3 are based on the characteristics of good quality waterborne ice. These data may be used as a planning factor until actual load tests are made to determine the capacity of the ice.

Table 4-2. Ice Load-Carrying Capacity for Sleds

Ice thickness (cm/in)	Gross sled weight (tons)
15/6	1
17.5/7	2
23/9	5
33/13	10
40/16	15
46/18	20

Table 4-3. Ice Load-Carrying Capacity for Personnel and Equipment

Load type	Gross weight (tons)	Minimum (risk) ice thickness (cm/in)	Normal ice thickness (cm/in)	Minimum distance between loads (m/yd)
Soldier on skis or snowshoes	0.1	4/1.2	5/2	5/5.5
Soldier on foot	0.1	5/2	7/3	5/5.5
Infantry (column of 2)	--------	7.6/3	10/4	7.3/8
Infantry (column of 4)	--------	10/4	13/5	10/11

Table 4-3. Ice Load-Carrying Capacity for Personnel and Equipment—Continued

Load type	Gross weight (tons)	Minimum (risk) ice thickness (cm/in)	Normal ice thickness (cm/in)	Minimum distance between loads (m/yd)
Whld veh loads up to:	3.5	23/9	25/10	15/16.5
Whld veh loads up to:	6	30/13	35/14	20/22
Whld veh loads up to:	10	40/16	45/17	25.6/28
Whld veh loads up to:	15	61/24	70/26	30/33
Trckd veh loads up to:	3.5	20/8	25/10	15/16.5
Trckd veh loads up to:	10	30/12	35/13	20/22
Trckd veh loads up to:	12.5	40/16	45/18	25.6/28
Trckd veh loads up to:	25	61/24	70/28	40/44
Trckd veh loads up to:	45	71/28	80/32	50/55
Trckd veh loads up to:	60	81/32	90/36	60/66
Helicopter OH136	1.2	15/7	18/8	N/A
Helicopter CH21C	7.7	30/13	35/14	N/A
Helicopter CH37B	15.5	50/14	56/23	N/A
Aircraft O1E	1.2	15/8	23/9	N/A
Aircraft U1A	3.8	25/10	30/12	N/A
Aircraft U6A	2.5	20/8	25/10	N/A
Aircraft CV2	14.3	61/24	70/28	N/A

c. Points for consideration during reconnaissance for ice crossing sites are—

(1) The ice formation along the shore is generally thinner and more likely to develop cracks in comparison to ice conditions in the center of a frozen stream or lake.

(2) When a current of water flows under a large section of ice, the ice in contact with the current is subject to greater temperature fluctuations than ice in adjacent or surrounding areas; hence, the ice may be of reduced strength.

(3) Shallow water ice is usually thinner than deep water ice.

(4) Good quality ice is characterized by clearness and freedom from air bubbles and cracks.

(5) Muskeg lakes contain a great deal of vegetation which retards freezing and results in ice of poor quality.

(6) The carrying capacity of reinforcing ice layers formed by alternate freezing and thawing and ice formed from slush is considered as only half as strong as that of prime, natural ice.

(7) During freezing weather the thickness of ice is increased by removing the snow cover.

(8) Ice which is left unsupported because of a drop in water level is of reduced strength.

(9) During extremely cold weather the cracks caused by the contraction in the ice may be significantly enlarged by heavy traffic resulting in a reduction of ice strength.

4-11. Cross-Country Movement Studies (STANAG 2259 and SOLOG 100)

Cross-country movement data are often overprinted on standard military topographic maps. Reconnaissance personnel may find such studies useful in planning and conducting reconnaissance missions. The desirable map scale of such studies is 1:100,000; however, map scales may vary from 1:25,000 to 1:250,000. Cross-country movement data are organized into terrain types, which are areas with reasonably similar combinations of slope, soil composition

(including moisture content), and vegetation. Each terrain type is, subsequently, divided into smaller terrain groups which are evaluated for cross-country movement. The following three groups are standard:

a. Terrain Group A includes terrain with soil rated as Trafficability Class I regardless of seasonal variations. Terrain Group A is overprinted without color (white) except for areas of steep slopes which are depicted by thin diagonal magenta lines.

b. Terrain Group B includes terrain with soil rated as Trafficability Class I more than 50 percent of the time but is seasonally rated as Trafficability Class II, III, or even IV. Terrain Group B is overprinted in two tones of yellow, the darker representing soil more susceptible to seasonal miring. As in Terrain Group A, areas of steep slopes are indicated by thin diagonal magenta lines.

c. Terrain Group C includes terrain with soil rated only as Trafficability Class II, III, or IV except for prepared routes through the area. Group C will usually include poorly drained terrain such as bogs, swamps, and marshes or terrain which is too rough and steep for vehicular movement. Magenta in three tones indicates this terrain group; the lighter tone represents terrain which offers better prospects for some seasonal movement; the intermediate tone for terrain which offers poorer prospects for movement; and the darkest tone for terrain which is too steep for movement.

d. Other Terrain Features. In addition to soil trafficability, other terrain features which influence cross-country movement are represented by conventional map symbols and colors.

(1) *Steep slopes in terrain other than Group C.* Dark magenta is used to represent escarpments, cuts, embankments, gravel pits, and other slope obstacles in areas otherwise not too steep for movement.

(2) *Vegetation.* Green represents vegetation primarily forests that hinder movement. Distinctive patterns of green may be employed to represent different types of vegetation.

(3) *Drainage.* Blue is used to depict water obstacles.

(4) *Urban areas.* Built-up areas are represented by overprints of black crisscross lines.

Section III. RECONNAISSANCE OF TACTICAL LANDING AREAS

4–12. General

Although landing area construction remains an engineer responsibility, the increased number of aircraft within any army area requires that all reconnaissance personnel be generally familiar with terrain characteristics pertinent to airmobile operations. This section, therefore, is designed to acquaint personnel with specifications of the more common types of *army aircraft* and their corresponding landing requirements. Aviation technicians and construction engineers will still be required to reconnoiter the more permanent types of landing facilities, especially those for USAF aircraft; however, procedures are herewith provided for preliminary reconnaissance. For greater detail, see FM 1–100 and TM 5–330.

4–13. Role of Army Aviation

The mission of army aviation is to augment the capability of the army to conduct prompt and sustained combat incident to operations on land. Aerial operations within the capabilities of army aircraft normally do not duplicate those of USAF. Army aircraft are designed to perform the following functions:

a. Command and control.

b. Battlefield surveillance and aerial observation.

c. Aeromedical evacuation.

d. Air mobility for troops, equipment, and supplies.

e. Aerial fire support.

4–14. Characteristics of Army Aircraft

Army aircraft are sturdy, relatively easy to maintain, and capable of operating from short, unimproved fields. To assist in reconnaissance planning, pertinent specifications of U.S. Army aircraft are listed in table 4–4, and aircraft are illustrated in figures 4–1 and 4–2.

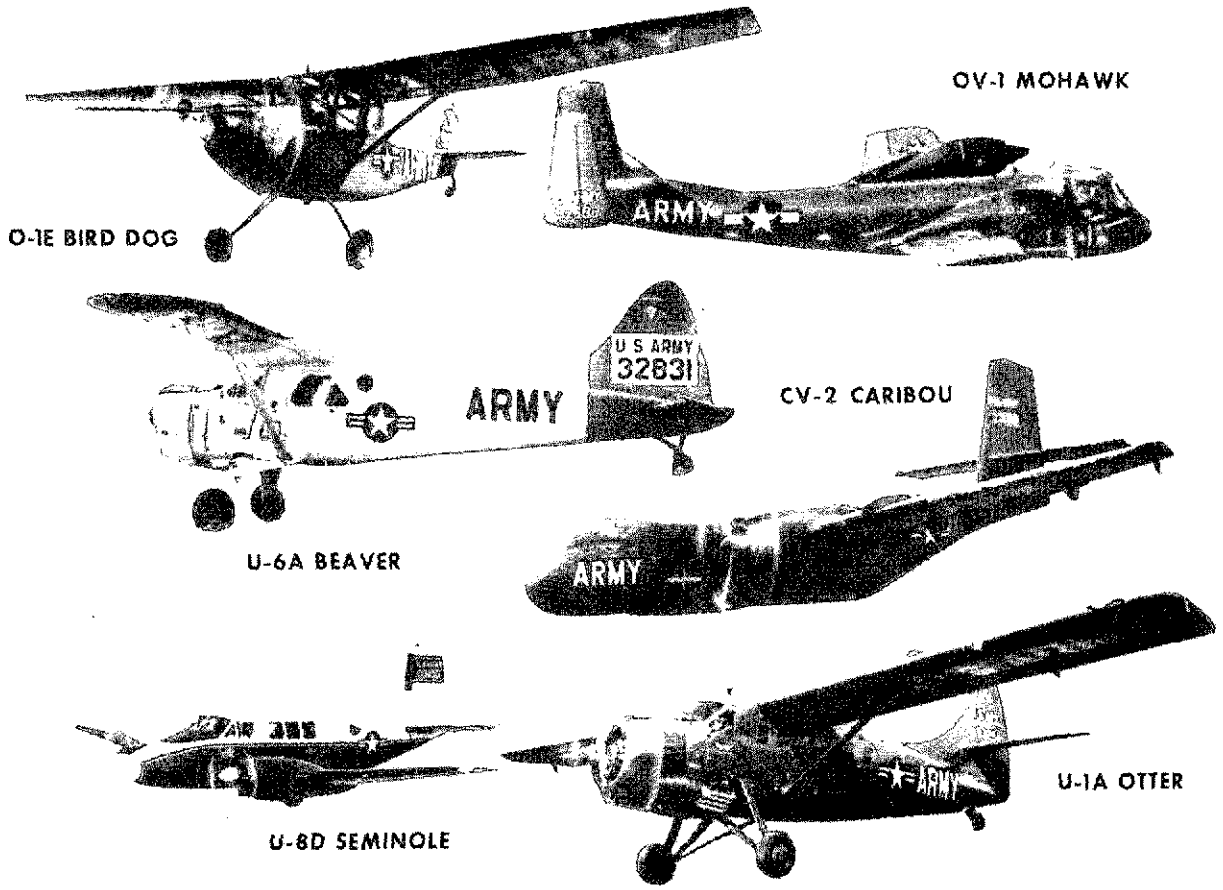


Figure 4-1. Army fixed wing aircraft.

4-15. Classes of Air Landing Areas

Army landing areas are divided into three general classes based on standards of construction.

a. Pioneer. A pioneer air landing area is selected to permit operations of fixed and/or rotary winged aircraft under favorable weather conditions with, at least, a minimum of safety factors. Construction and maintenance effort may or may not be required.

b. Hasty. A hasty air landing area is built to provide an operable margin of safety. This type facility allows reasonably safe and efficient operations except under prolonged conditions of adverse weather. The choice of finished surfaces depends upon soil conditions, weather, season, availability of surfacing material, and anticipated length of time the facility is to be used. Portable surfacing or soil stabilization processes are normally employed.

c. Deliberate. A deliberate air landing area is constructed according to established standards of safety and efficiency. Runways must have a well-graded, thoroughly compacted base

Table 4-4. Army aircraft characteristics.

Use operational data shown below as a planning guide only. Variations in weather, altitude, humidity, and other conditions will cause the values to vary.

a. Crew, Passengers, and Critical Dimensions.

	O-1E (Bird Dog)	OV-1 (Mohawk)	U-6A (Beaver)	U-1A (Otter)	U-8D (Seminole)	CV-2 (Caribou)	OH-18G (Sioux)	OH-18H (Sioux)	OH-23C (Raven)	OH-23D (Raven)	UH-19D (Chickasaw)	UH-1A (Iroquois)	UH-1B (Iroquois)	CH-21C (Shawnee)	CH-34C (Choctaw)	CH-37B (Mojave)	CH-47A (Chinook)
Recommended crew (200 lbs per man)	1	2 [a]	1	2	1	2	1	1	1	1	2	1	2	2 [b]	2 [b]	3 [b]	2 [b]
Passenger capacity:																	
Troop seats (240 lbs per man) [c]	1	0	4	8	4	32	1	1	2	2	10	4	6	20	12	23	33
Patients [d]:																	
Litters	-------	NA	2	6	NA	14	2 [e]	2 [e]	2 [e]	2 [e]	6	2	2	12	8	24	24
Ambulatory	1	-------	2	3	-------	8	-------	-------	-------	-------	-------	3					
Dimensions (ft and in.):																	
Length—fuselage	25'10"	41'0"	30'5"	41'10"	31'6"	72'7"	31'5"	31'5"	28'2"	28'6"	42'2"	39'6"	39'6"	52'7"	46'9"	64'11"	49'10"
Length—blades unfolded	NA	NA	NA	NA	NA	NA	41'5"	41'5"	40'6"	40'8"	62'3"	52'10"	53'0"	86'4"	65'10"	88'0"	98'2"
Length—blades folded	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	42'2"	NA	NA	52'7"	87'0"	55'8"	49'10"
Width—blades folded	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	11'7"	9'4"	NA	14'0"	13'0"	27'4"	12'1"
Width—tread	7'7"	9'2"	10'2"	11'2"	12'9"	28'1½"	7'6"	7'6"	7'6"	7'9"	11'0"	8'4"	8'4"	14'4"	12'0"	19'9"	10'4"
Height—extreme	7'6"	12'8"	9'0"	12'5"	11'6"	31'9"	8'8"	9'4"	9'10"	10'2"	15'3"	15'2"	11'6"	15'5"	15'10"	22'4"	18'6"
Diameter—main rotor	NA	NA	NA	NA	NA	NA	35'2"	35'2"	35'0"	35'5"	53'0"	43'9"	44'0"	44' ea	56'0"	72'0"	59'0"
Diameter—tail rotor	NA	NA	NA	NA	NA	NA	5'8"	5'8"	5'8"	5'6"	8'9"	8'5"	8'6"	NA	9'4"	15'0"	NA
Wing span	36'0"	42'0"	48'0"	58'0"	45'4"	96'5"	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tire size (in.)	6.00×6	8.50×10 6.50×8	8.50×10	11.00×12	8.50×10	11.00×12	NA	NA	NA	NA	7.50×10 6.00×6	NA	NA	24.00×7.7	11.00×12 6.00×6	8.50×10 6.00×6	22×5.5 16×4.4
Cargo door:																	
Dimensions (in.):																	
Width	45"	NA	39" (max)	46" (L.)	30"	73½"	NA	NA	NA	NA	48"	48"	48"	45" (cargo)	52"	87"	90"
Height	33"	-------	40" 25" (min) 40"	45" 80" (R.) 45"	30"	74"	-------	-------	-------	-------	48"	48"	48"	59" 37" (rsq) 59"	48"	67" (nose) 72" 48" (bottom) 72" 72" (right)	78"
Location on fuselage	Right	NA	Right & left	Right & left	Right	Rear	NA	NA	NA	NA	Right	Right & left	Right & left	Right (rescue) left (cargo)	Right	Nose bottom right	Rear

Cargo compartment:																	
Height of floor above ground (in.)	22″	NA	46″	46″	NA	45½″	NA	NA	NA	NA	30″	27″	26″	38″	34″	36″	30″
Length—useable (in.)	NA	NA	76″	152″	NA	(f)	NA	NA	NA	NA	120″	48″	48″	240″	164″	364″	360″
Width—floor (in.)	NA	NA	48″	52″	NA	78½″	NA	NA	NA	NA	60″	80″	80″	50″	59″	81″	90″
Height—clear of obstructions (in.)	NA	NA	51″	59″	NA	74″	NA	NA	NA	NA	72″	48″	48″	62″	70″	67″	78″
Cargo space (max) (cu ft)	NA	NA	125	286	NA	1,090	NA	NA	NA	NA	300	109	107	422	363	1,142	1,462

[a] Figures are from design data and are subject to change.

[b] Unit SOP may include crew chief in addition to crew shown.

[c] Seats shown are those in the passenger compartment of the aircraft.

[d] Litter spaces shown may be used for ambulatory patients. When both litter and ambulatory spaces are shown, any combination of the total number may be used.

[e] Cargo may be carried on litter racks in lieu of patients.

[f] 28′9″ to forward edge of loading ramp; 32′6″ to aft edge of loading ramp.

b. Range, Loading, Lashing, and Balance Factors.

	O-1E	OV-1	U-6A	U-1A	U-8D	CV-2	OH-13G	OH-13H	OH-23C	OH-23D	UH-19D	UH-1A	UH-1B	CH-21C	CH-34C	CH-37B	CH-47A
Max range (ferry)[a]																	
Nautical miles	350	1,500	590	900	1,260	1,017	150	170	88	158	230	188	141	295	240	200	1,037
Kilometers	648	2,780	1,095	1,670	2,330	1,880	278	315	163	293	426	348	261	547	445	370	1,920
Max range with payload (full fuel)[a]:																	
Nautical miles	350	400	575	720	980	850	145	170	77	135	185	82	126	255	195	180	200
Kilometers	648	742	1,065	1,335	1,815	1,575	269	315	143	250	343	152	234	473	361	334	370
Average cargo payload (lb) vs range[b]																	
Nautical miles / *Kilometers*																	
250 / 463	(c)	(c)	1,135	1,960	(c)	5,100											
300 / 556			1,120	1,885		4,900											
350 / 649			1,105	1,810		4,675											
400 / 741			1,090	1,735		4,475											
450 / 833			1,075	1,660		4,275											
500 / 926			1,060	1,585		4,050											
550 / 1,020			1,045	1,510		3,875											
600 / 1,110				1,435		3,650											
650 / 1,205				1,360		3,450											
700 / 1,297				1,285		3,250											
750 / 1,390						3,025											
800 / 1,482						2,800											
850 / 1,575						2,625											
900 / 1,666																	
950 / 1,760																	
External cargo:																	
Maximum recommended external load (lb)[d]	145[e] per wing	1,950	500 per wing	NA	NA	NA	NA	NA	NA	NA	1,000	2,500	2,200	3,000	4,000	10,000	16,000
Rescue hoist capacity (lb)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	400	NA	NA	400	600	600	600
Floor load capacity (psi):																	
Distributed[f]	NA	NA	0.7	0.35–1.05	NA	13	NA	NA	NA	NA	0.327	----	1.04	0.9	1.4	2.08	1.4
Concentrated	NA	NA	1.4	1.4	NA	40	NA	NA	NA	NA	----	----	2.08	2.36	----	4.8–11.1	10–25
Capacity (lb) per running foot of cargo compartment[f]	NA	NA	400	655	NA	1,200	NA	NA	NA	NA	235	1,000	1,000	500	990	2,020	1,510
Special cargo handling equipment capacities[g]:																	
External hook and sling	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	20	25	25	50	40–50	100	160
Tiedown fittings in floor	NA	NA	9	22	NA	54	NA	NA	NA	NA	----	12	12	25	34	18 94	87 8
	NA	NA	----	20	NA	50	NA	NA	NA	NA	----	----	12.5	20	12	50 22	50 100

Tiedown fittings on each side	NA NA	NA NA	--------- ---------	28 20	NA NA	2 18 100 20	NA NA	NA NA	NA NA	NA NA	--------- ---------	NA NA	NA NA	1 10 50 20	NA NA	NA NA	
Hoist winch	NA	NA	---------	---------	NA	20	NA	NA	NA	NA	6	NA	---------	4	6	20	30
Restraint safety factors [b]:																	
Forward	NA	NA	---------	9	NA	8	NA	NA	NA	NA	4	4	4	4	4	4	4
Rearward	NA	NA	---------	2	NA	2	NA	NA	NA	NA	2	2	2	2	2	2	2
Vertical	NA	NA	---------	2	NA	2	NA	NA	NA	NA	2	2	2	2	2	2	2
Sideward	NA	NA	---------	1.5	NA	1.5	NA	NA	NA	NA	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Center of gravity (in.) [i]	137– 140	148– 153	93.4– 107.7	134.2– 147.8	114– 124.6	347.4– 357.1	(j) 5–2	(j) 5–2	79.5 84.8	79.5 84.8	125– 136	128.0– 137.5	128.0– 137.5	35 [k]– 6.5	130.7– 146.7	228– 245.1	35.3 [k]– 11.8

[a] Includes 30-minute fuel reserve.

[b] Use figure 2.15 when planning for shorter distances.

[c] Primarily passenger-type aircraft.

[d] Limited by payload.

[e] With total fuel and no passenger. Maximum allowable overload of 250 pounds per wing should be used only with minimum fuel required for the mission.

[f] Applies only up to the weight-carrying capacity of the aircraft.

[g] All capacities are shown in hundreds of pounds. For tiedown fittings, top line shows number of fittings; bottom line shows capacities.

[h] Use the following formula to determine the number of lashings required to secure a piece of cargo with a prescribed angle of tie against one thrust direction. Number of lashings required =

$$\frac{\text{Weight of cargo (lb)} \times \text{restraint safety factor} \times 100}{\text{Tensile strength of lashing (lb)} \times \text{percent effectiveness of system}}$$

[i] Forward and aft center of gravity limitations from reference-datum line (RDL), unless otherwise noted.

[j] Forward and aft of center line of rotor mast.

[k] Forward and aft of midpoint between rotor masts.

c. Miscellaneous Operational and Other Data.

	O-1E	OV-1	U-6A	U-1A	U-8D	CV-2	OH-13G	OH-13H	OH-23C	OH-23D	UH-19D	UH-1A	UH-1B	CH-21C	CH-34C	CH-37B	CH-47A
Max recommended gross weight (lb)	2,400 [a]	17,000	5,100	7,600	7,000	28,500	2,350	2,350	2,500	2,700	7,300	7,200	6,400	13,500	13,300	31,000	33,000 [b] 28,300 [c] 25,600 [d]
Operating weight (lb) [e]	1,865	10,694	3,547	5,201	5,260	17,400	1,752	1,887	1,944	1,998	6,100	4,220	4,220	9,700	8,428	22,335	16,000
Payload and fuel (lb) [f]	535	3,824	1,553	2,399	1,740	8,600	598	463	556	702	1,200	2,980	2,180	3,800	4,872	8,645	7,242 [c] 9,717 [d]
Cruise speed with payload (TAS):																	
Knots	87	200	105	100	160	156	60	70	60	60	65	69	80	79	75	80	130
Kilometers per hour	161	371	195	185	296	289	111	129	111	111	120	------	148	129	139	148	241
Max cruise speed with payload (TAS):																	
Knots	96	275	110	105	170	180	78	80	73	80	80	69	90	85	90	80	148 [d] 150 [e]
Kilometers per hour	178	510	204	194	315	334	144	148	135	148	148	------	167	157	167	148	274
Max useable fuel capacity (lb)	246	1,683	828	1,296	1,380	4,332	249	246	159	276	918	812	860	1,800	1,572	4,200	3,126 [c] 3,229 [d]
Fuel consumption (lb) per hour at cruise speed [g]	60	750	144	198	216	1,680	84	84	92	100	270	460	977	515	510	1,320	1,600
Takeoff ground roll at sea level [h]:																	
Feet	284-716	660-1,005	800-1,000	1,400	1,275-1,455	340-725	0	0	0	0	0	0	0	0	0	0	0
Meters	87-218	201-307	244-305	427	389-444	104-221	0	0	0	0	0	0	0	0	0	0	0
Take-off distance to clear 50-foot obstacle at sea level [h]:																	
Feet	110-1,205	1,010-1,450	1,175-1,475	1,700-2,150	2,100-2,400	570-1,200	0-225	0-355	0	0	0	110	0	0	0-565	316-460	0
Meters	34-368	308-442	358-450	518-656	641-732	174-366	0-69	0-108	0	0	0	------	0	0	0-172	96-140	0
Landing distance to clear 50-foot obstacle at sea level [h]:																	
Feet	550-650	858-1,300	1,120-1,200	1,260-1,500	1,970-2,100	760-1,110	0-160	0-195	0	0	0	328	0	0	0-565	302-322	0
Meters	168-198	261-396	342-366	384-457	601-641	232-338	0-49	0-60	0	0	0	------	0	0	0-172	92-99	0

Landing ground roll at sea level [b]:																	
Feet	260	454	500–550	1,370	1,215–1,295	250–480	0	0	0	0	0	0	0	0	0	0	0
Meters	79	139	152–168	418	370–394	76–146	0	0	0	0	0	0	0	0	0	0	0
Turning radius (ft and in.)	21′10″	26′7″	35′	38′	30′1″	6′11½″	24′1″	24′1″	23′	23′	33′	31′	31′	48′6″	41′	56′	49′2″
Type of landing gear (wheels and skids)	3 sgl wheels	3 wheels	2 sgl wheels	2 sgl wheels	3 sgl wheels	3 dual wheels	2 skids	2 skids	2 skids	2 skids	4 sgl wheels	2 skids	2 skids	3 sgl wheels	3 sgl wheels	1 sgl, 2 dual	4 dual wheels

[a] 0–1 has maximum recommended gross weight of 2,400 pounds on long runway and 2,165 pounds for takeoff over barrier.

[b] Maximum alternate gross weight mission at sea level, standard atmosphere, and payload and fuel of 16,000 pounds.

[c] Primary mission to meet the Army "hot day" requirement of 95° F., 6,000 feet, hovering "out-of-ground" effect with a 2-ton payload. All missions based on a 100-NM radius.

[d] Alternate mission to meet the alternate requirement of 100° F., at 3,000 feet, hovering "out-of-ground" effect with a 3-ton payload. All missions based on a 100-NM radius.

[e] Includes aircraft, oil, and crew. Does not include useable fuel.

[f] May be internal, or combination and includes usable fuel and cargo or passengers. When planning for each additional 20 miles of operating radius above 50 NM, reduce UH–19 payload by 10 percent, CH–21 by 9 percent, CH–34 by 5 percent, and CH–37 by 5 percent.

$$\text{Fuel required (lb)} = \frac{\text{Distance (NM)} \times \text{Fuel Consumed Per Hour (lb)}}{\text{Cruise speed (K)}}$$

[g] Assuming 59° F., 29.92 inches Hg, and 2,000-foot altitude. Figures shown represent fuel consumption with payload.

[h] Varies according to load, temperature, humidity, and headwind. These figures give general planning information for emergency airfields.

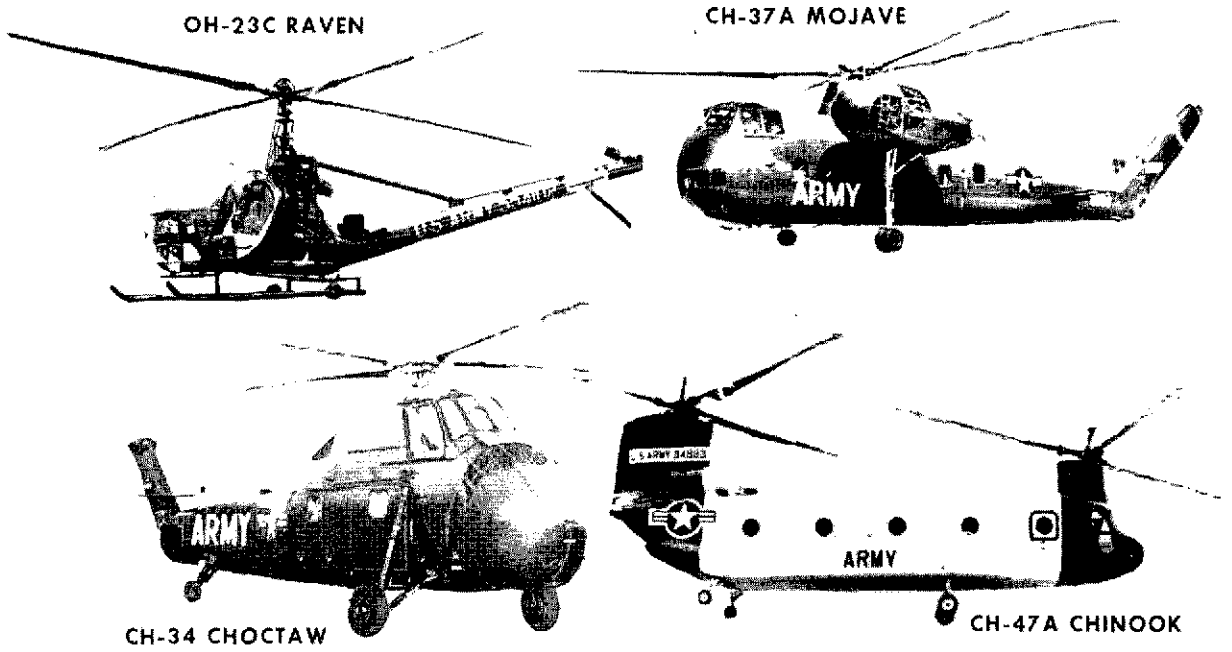


Figure 4–2. Army helicopters.

with a flexible or rigid surface to be operable under all weather conditions.

4–16. Runway Orientation and Dimensions

a. Wind Consideration. Normally, runways are oriented in accordance with the prevailing winds in the area. Particular attention should be paid to gusty winds of high velocity in determining runway locations.

b. Runway Length. The determination of runway length required for any aircraft is empirical in nature and must include not only the surface actually required for landing rolls and takeoff runs but also a reasonable allowance for variation in pilot technique, psychological factors, wind, snow, and other surface conditions as well as unforeseen mechanical failures. Runway length is, therefore determined by applying a factor of safety to the takeoff ground run established for the geographic and climatic conditions at the site (table 4–5).

c. Runway Width. Runway width is primarily based on safe operation under reduced visibility conditions and the lateral stability of the aircraft in the final approach and landing. Values are given in table 4–5 for minimum widths of runway for each class of army air landing facility.

d. Considerations Peculiar to Helicopters.

(1) *"In-ground effect" takeoff.* The flight characteristics of helicopters are affected by the high-pressure region or "ground cushion" between the helicopter and the ground. This cushion, created by the downward displacement of air through the rotor blades, is effective to a height of approximately one-half the rotor diameter and increases the lift capability of the helicopter. The use of this takeoff increases safety and decreases wear on the engine, power train, and associated equipment. It requires a horizontal flight path near the ground until sufficient speed is attained for safe flight.

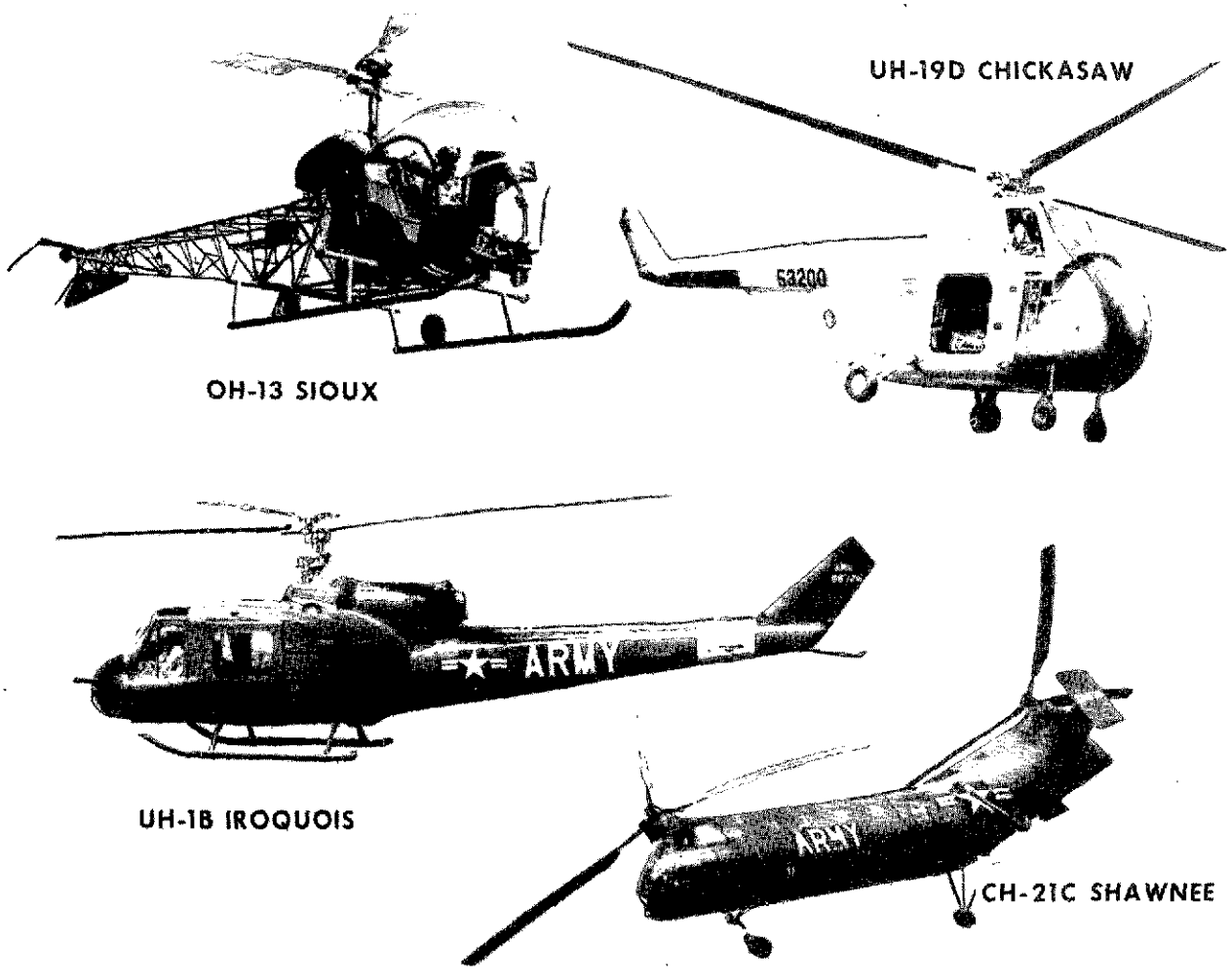


Figure 4-2—Continued.

Table 4-5. Theater of operations army air landing design criteria.

Runway	Pioneer	Hasty	Deliberate
1. Length: Corrected takeoff ground run multiplied by safety factor (to next larger 30 m).	1.25	1.50	1.75
2. Width (minimum)	15m sod or 8m unpaved shoulder gravel or better road; open field.	15m	25m
3. Shoulder width (minimum)	No shoulders	3m	3m
4. Lateral clearance of flightstrip: Runway width plus the two shoulders plus aircraft wing-span but not less than—	45m	60m	90m
5. Runway surfacing	In-place sod or compacted base course	Portable	Flexible pavements.
6. Longitudinal grade (maximum)	10%	5%	3%

Note. This table is to be used in conjunction with the characteristics of the specified aircraft (table 4-4).

(2) *"Out-of-ground effect" takeoff.* When this vertical takeoff method is used, the ground cushion is lost almost immediately after lift-off (height of one-half the rotor diameter). Usually this takeoff method is employed when a sling load is to be lifted or when the takeoff area is too restrictive to permit a ground run or low-level flight. When possible, other techniques should be used since payload is reduced and more risk is involved.

(3) *"Ground run" takeoff.* This type of takeoff employs a similar technique as that used for fixed wing aircraft and involves a run over the ground until sufficient speed is attained for flight. It is employed when the altitude, temperature, or aircraft weight (or a combination of these factors) is such that the aircraft cannot hover close to the ground.

4-17. Reconnaissance for Specific Locations

A pioneer landing area may be selected after brief reconnaissance in accordance with the factors of minimum aircraft operating requirements, accessibility, camouflage, and concealment. On the other hand, the site for a fully developed, deliberate landing area requires detailed reconnaissance. Reconnaissance for air landing areas is best accomplished with a combined map, aerial, and ground survey.

a. Map Reconnaissance. A study of appropriate maps is first made to determine the location of favorable areas, the proximity to the supported unit, type of terrain, and availability of access routes. Map reconnaissance by itself is used only when additional methods are not practical; however, it may be the only method when displacing over long distance or into previously denied areas.

b. Air Reconnaissance. Air reconnaissance usually follows map reconnaissance. Air reconnaissance alone is generally incomplete without followup ground reconnaissance but may suffice if time does not allow or if landing surfaces can be readily determined from the air. Availability and condition of air and ground access routes are an essential part of the reconnaissance.

c. Ground Reconnaissance. A ground reconnaissance is made to determine the nature and condition of the surface and to select exact locations for installations (bivouac, refueling, maintenance, etc.). Ground reconnaissance alone is not entirely satisfactory, but aerial reconnaissance may occasionally be impractical, especially during hours of darkness.

d. Combined Map, Air, and Ground Reconnaissance. Combined map, air, and ground reconnaissance will be used whenever possible. This type of reconnaissance is most effective when:

(1) Sufficient time is available and the weather and tactical situation permit.

(2) A ground reconnaissance is made in conjunction with the air reconnaissance.

4–18. Air Landing Selection Criteria

The following criteria are important in selecting a landing area. These factors are indicative of the specific information which is sought during reconnaissance for landing areas.

a. Accessibility, Communications, and Logistics. One aim of landing area selection is to place a minimum burden on supply channels by insuring that adequate supply routes by land, water, and air are available. The more routes available to the site, the simpler the supply problem.

b. Obstructions. A location which is free from obstructions around the entire landing area is preferable, but an approach zone with no obstructions at each end of the flightway satisfies minimum requirements. Removal of obstructions such as towers, smoke stacks, and trees may often be necessary. Besides physical obstructions, pilot reactions are considered. There is a strong, psychological opposition to landing over obstacles even though well marked and below the glide path. Moreover, a landing area on a plateau with steep sides falling away immediately beyond the overruns may have good approaches; however, under such circumstances, pilots are included to land well down the runway. A canal, ditch, bank, or pole line at the end of a runway has a similar effect. The result of these human reactions is equivalent to a shortened runway, and compensation in the layout of the landing area should be made.

c. Meteorological Conditions. Wind, rainfall, fog, snow, and frost are considered in landing area selection because, singly or in combination, they can delay or damage construction or restrict the operational use of the location. Meteorological data is frequently difficult to obtain. Extensive records of meteorological observations at the exact site are seldom available. To be of value, such records must include observations taken over a length of time at the actual landing area. Because of differences in altitude and topography, meteorological conditions noted in the general location in which the landing area is situated may be misleading as to the conditions which prevail at the landing area itself. This is particularly true of down drafts, cross currents, haze, fog, and precipitation. If practicable, proposed landing areas near prominent features of relief are flight tested to disclose the existence and effect of hazardous air eddies and currents. Ground haze and its effect upon visibility are also checked. Interrogation of local inhabitants may help to confirm meteorological data and, in some cases, may be the only source of such information. However, the primary source is the intelligence sections of division, corps, and army.

d. Drainage Conditions. Drainage conditions include the height of the ground-water table and its seasonal variations, the flood characteristics of streams bordering the location, and tidal variations at coastal locations. Unless care is taken, reconnaissance during the dry season may be misleading. Vegetation sometimes discloses evidence of seasonal seepage or rise in the ground-water table. For example, reeds, sedges, cottonwoods, and willows thrive where seepage occurs, even though the seepage is seasonal. Tree trunks along stream banks scarred by the abrasive action of ice floes during the breakup indicate the elevation of high water.

e. Relief. A location with favorable relief is one located on high ground with sufficient slope for natural drainage and a reasonable smooth surface requiring little earthmoving. Runway surfaces must be smooth enough to permit takeoffs and landings without damage to aircraft even on pioneer landing areas. Uphill takeoffs and downhill landings require longer runways.

f. Soil Characteristics and Quality of Subgrade. The character of the soil at the location determines whether stabilization or surfacing is required and whether the surfacing or pavement can be placed directly on the prepared subgrade or whether a base course is required.

g. Vegetation. The primary consideration in connection with ground vegetation is the amount of clearing and grubbing involved. The difficulties of clearing, grubbing, and stripping

varies in every climatic zone in accordance with the types of vegetation encountered. Considerations most pertinent to clearing are the density of various vegetation and the nature of the root systems.

h. Availability of Local Materials. Reconnaissance should include investigation of sources near the location which yield suitable construction material. The location and evaluation of construction materials are discussed in TM 5-330.

i. Water Sources. Large quantities of water generally are required during construction and subsequent use of landing area; reconnaissance should disclose likely sources. See FM 101-10 and TM 5-700 for further information.

j. Camouflage. Desirable site characteristics include the absence of identifying landmarks and sufficient natural concealment for service installations and supplies. To aid in camouflage, standing trees and brush outside of the landing areas are not removed unless necessary.

k. Ground Defense. In order to maintain a tenable position for air operations, the practicability of ground defense against both ground and air attack is a factor of consideration for each location. Terrain favorable for defense provides observation, fields of fire, concealment, obstacles, and routes of communication. Natural obstructions which prevent air landing in areas adjacent to the facility assist in the defense against hostile air mobile operations.

l. Miscellaneous Factors. There are many factors such as flash floods or sand storms in landing area selection which cannot be anticipated. Such factors are not discussed because they do not have broad application. For a particular location, however, they may be extremely important; and their consideration requires the application of sound judgment coupled with practical experience.

4-19. Reconnaissance Reports for Landing

a. Basic Considerations. Full details on the method, place, and time of submitting reconnaissance reports are included in the instructions given to the reconnaissance party. Reconnaissance reports may be submitted in writing, by electrical means, or both. Prepared forms are desirable since they insure full coverage of information and facilitate comparative evaluation of two or more possible landing areas. Forms should be locally produced and modified to meet the desires of the headquarters concerned and the pecularities of the operational area.

b. Symbols. Reconnaissance symbols and conventional topographic symbols are useful in graphically reporting tactical landing areas.

c. Reports by Electrical Means. It is often imperative that an initial reconnaissance report reach the supported headquarters with the least possible delay. Formats established for this purpose and standardized by STANAG 2096 and SOLOG 107 are illustrated in figures 4-3 and 4-4.

d. Written Reports. The following formats are applicable for written reconnaissance reports:

(1) *Airfield reconnaissance report* (fig. 4-5).

(2) *Ground reconnaissance of undeveloped landing area* (see TM 5-330).

(3) *Ground reconnaissance of captured enemy landing area* (TM 5-330).

(4) *Annexes.* Suitable sketches are attached to written reconnaissance reports when applicable (TM 5-330).

4-20. Marking and Lighting of Landing Areas

a. Airfield Marking.

(1) Runways in the pioneer and hasty configuration are normally marked to identify the airfield and aid the aviator in landing.

(2) Marking is normally accomplished using ground to air signal panels which are issued to all units, company size or larger.

(3) Marking is standard for all airfields and can vary from the minimum requirements (fig. 4-6) to optimum markings (fig. 4-7). These markings are a guide only and can be altered as required for a special situation. The

AIRSITEREP or AIRSTRIPREP[a]					
Explanation	Letter designation	(1)[b]	(2)[c]	(3)[c]	(4)[c]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid references)	CHARLIE				
Dimensions of facility	DELTA				
Type and condition of facility	ECHO				
Additional information	FOXTROT				

Notes. [a]. The above format is adapted from STANAG 2096 and SOLOG 107.

[b]. First air site in report; report by serial number if assigned.

[c]. Additional air sites in report.

Figure 4-3. Format for electrically transmitting reconnoitered air landing area information

AIRFIELDREP[a]					
Explanation	Letter designation	(1)[b]	(2)[c]	(3)[c]	(4)[c]
Map sheet(s)	ALPHA				
Date and time information was collected	BRAVO				
Location (UTM grid references)	CHARLIE				
Number and dimensions of runways	DELTA				
Orientation of runways	ECHO				
Type and surface of runways	FOXTROT				
Condition of runways	GOLF				
Hangers and bulk fuel storage facilities including condition.	HOTEL				
Parking areas for aircraft	INDIA				
Additional information	JULIET				

Notes. [a]. The above format is adapted from STANAG 2096 and SOLOG 107.

[b]. First airfield in report; report by serial number if assigned.

[c]. Additional airfields in report.

Figure 4-4. Format for electrically transmitting reconnoitered tactical landing area information.

marking always includes the length of the usable area and wind indicator (or direction of landing).

(4) Markings can be removed after all aviators become familiar with the runway.

(5) Panels must be secured against both propeller and rotor wash. *Rocks piled on the corners are not adequate* to secure the panels against the severe turbulence created by aircraft. Panels must be secured to stakes in a manner so they cannot loosen when subjected to propeller or rotor wash.

b. Airfield Lighting.

(1) Lighting for runways closely parallels panel marking.

(2) When the standard light set number 6 is not used, light set emergency, battery operated or any fabricated lights can be used as shown in figure 4-8. This minimum lighting may be augmented as shown in figure 4-9.

4-21. Marking and Lighting of Heliports

a. Marking.

(1) Heliports in the pioneer and hasty configuration are normally marked to

AIR RECONNAISSANCE REPORT

DATE 29 SEPT 61 NO. 4

1. To CO, 327 ENGR BN 3. Map Sheet JOHANNASVILLE QUADRANGLE

2. From CO. C 4. 10 MILES NORTH OF JOHNNASVILLE
(Nearest main road center)

5. (a) Coordinates of EAST end of runway NA3 765, 1 900

(b) Length (feet) 5000 FT. BUT MIGHT BE EXTENDED 2000 FT. (SEE ITEM 12)

6. Classification of Site (overall):

Excellent ___ Good ✓ Fair ___ Poor ___ Reject* ___

7. Natural Surface Drainage:

Excellent ___ Good ✓ Fair ___ Poor ___

8. Flying Approaches:

Excellent ___ Average ✓ Poor ___

9. Clearing:

Light ✓ Moderate ___ Excessive ___

10. Aircraft Dispersal:

Unlimited ✓ Adequate ___ Inadequate ___

11. Access Roads:

Good ___ Adequate ✓ Inadequate ___

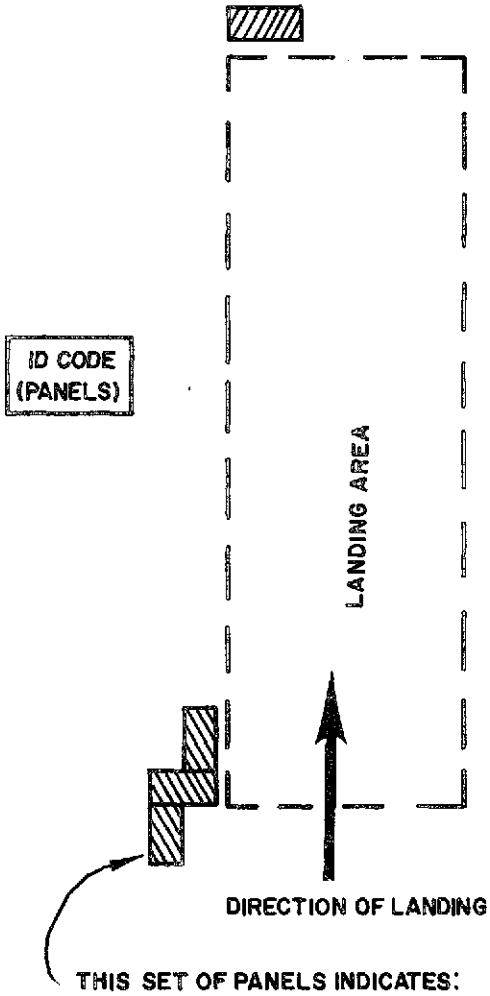
12 Remarks: EXTENSION MENTIONED IN 5(B) ABOVE MUST BE CHECKED AS THERE MAY BE A SWAMP AREA IN THAT SUGGESTED EXTENSION. CANNOT BE CERTAIN FROM AIR OBSERVATION

Lt. Bolinder
(Signature)

1400
(Time)

*If "Reject" classification is indicated, reason(s) for same will be given under remarks.

Figure 4-5. Airfield reconnaissance report of reconnoitered landing area.

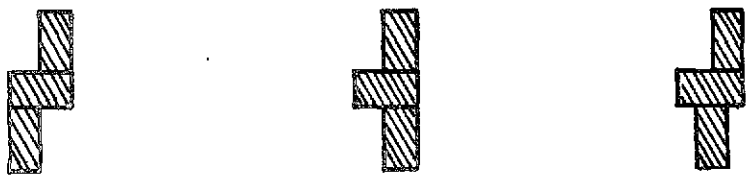


THIS SET OF PANELS INDICATES:

1. FIRST USABLE AREA
2. WIND DIRECTION-CONTROLLED BY TURNING THE BOTTOM PANEL INTO THE DIRECTION OF THE WIND.

EXAMPLE:

3. DIRECTION OF TRAFFIC (RIGHT, LEFT OR OPTIONAL) DIRECTION IS CONTROLLED BY THE LOCATION OF THE WIND PANEL.



RIGHT TRAFFIC LEFT TRAFFIC OPTIONAL

Figure 4–6. Minimum airfield marking.

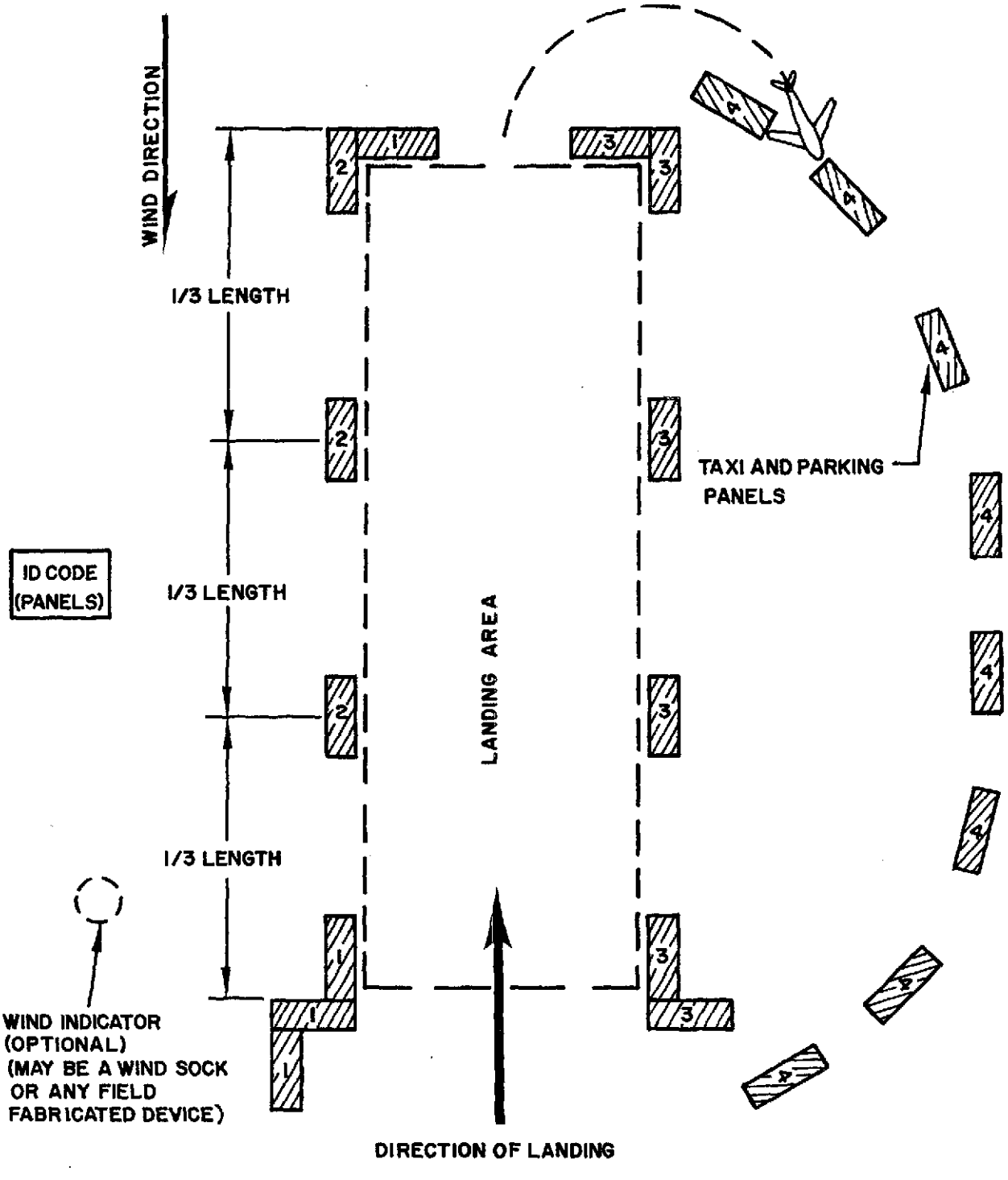


Figure 4-7. Optimum airfield marking.

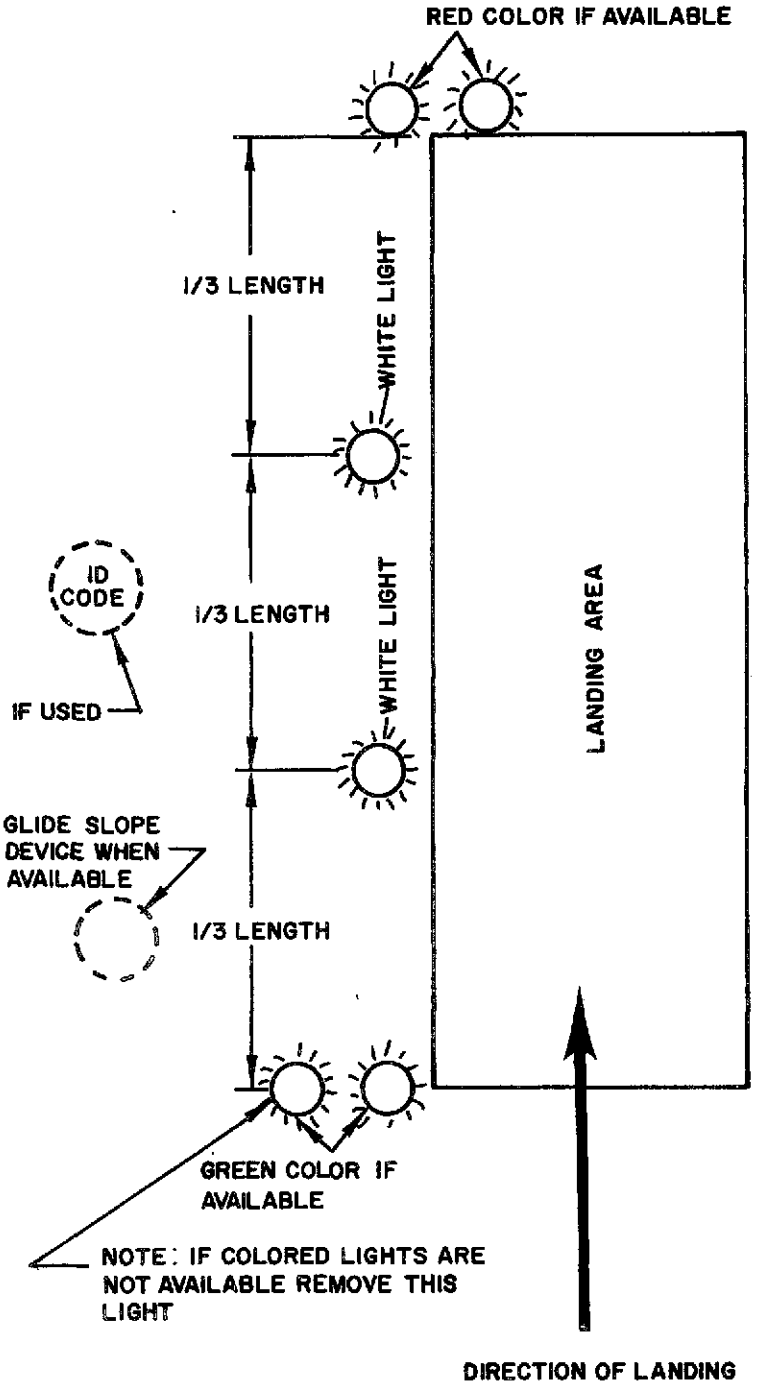


Figure 4-8. Minimum airfield lighting.

identify the heliport and aid the aviator in landing.

(2) Marking is normally accomplished using ground to air signal panels which are issued to all units, company size or larger.

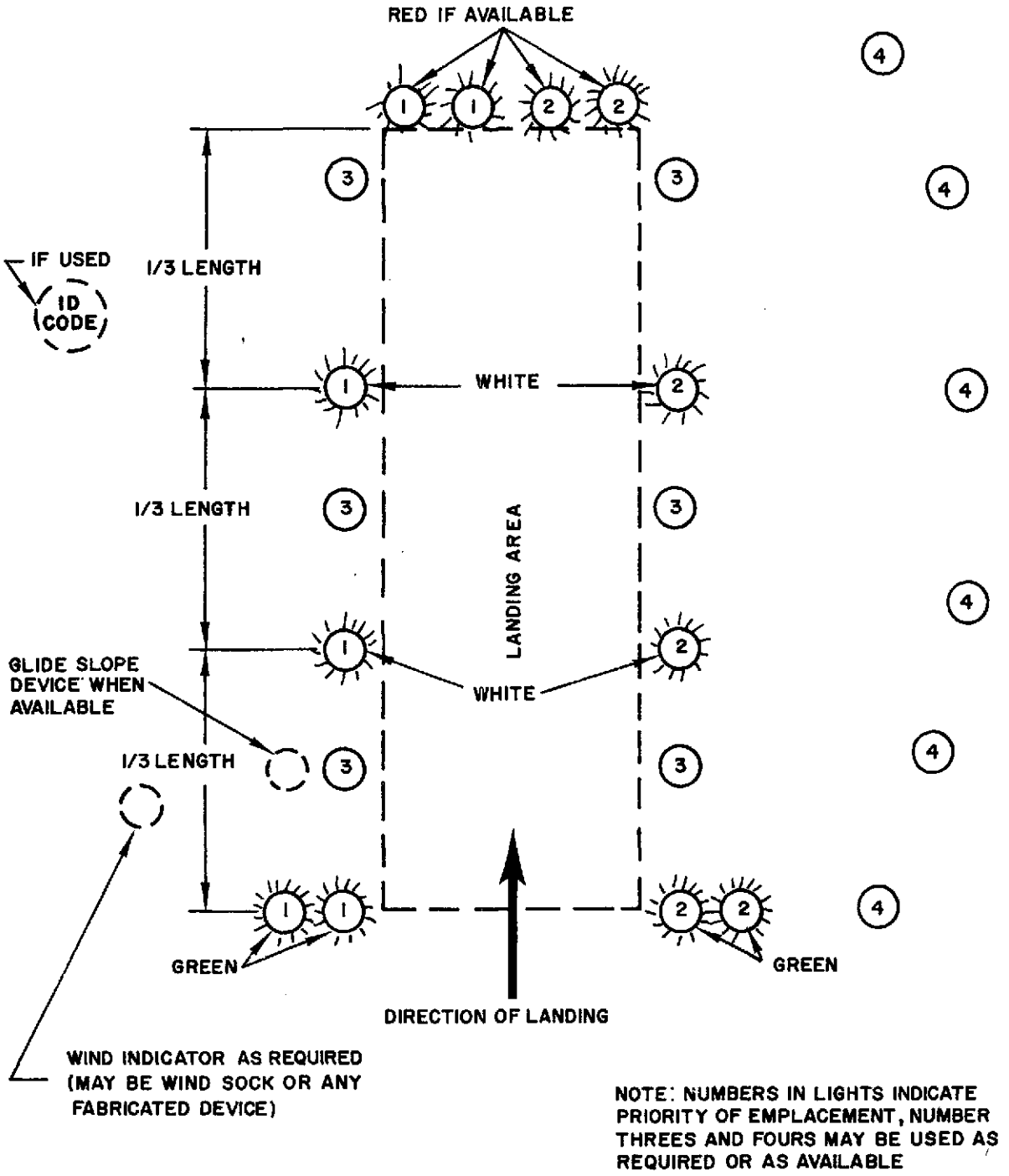


Figure 4-9. Airfield lighting.

(3) Marking for pioneer and hasty heliports is identical and is as shown in figure 4–10.
(4) Markings can be removed after all aviators become familiar with the heliport.
(5) Panels must be secured against rotor wash. Panels are secured to stakes in a manner so they *cannot* loosen when subjected to rotor wash.

b. Lighting.

(1) When light set 7, the standard light set, is used, the glide slope indicator is placed to the *right front* of the two flood lights.

(2) When light set 7 is not used, any light source may be used as shown in figure 4–11.

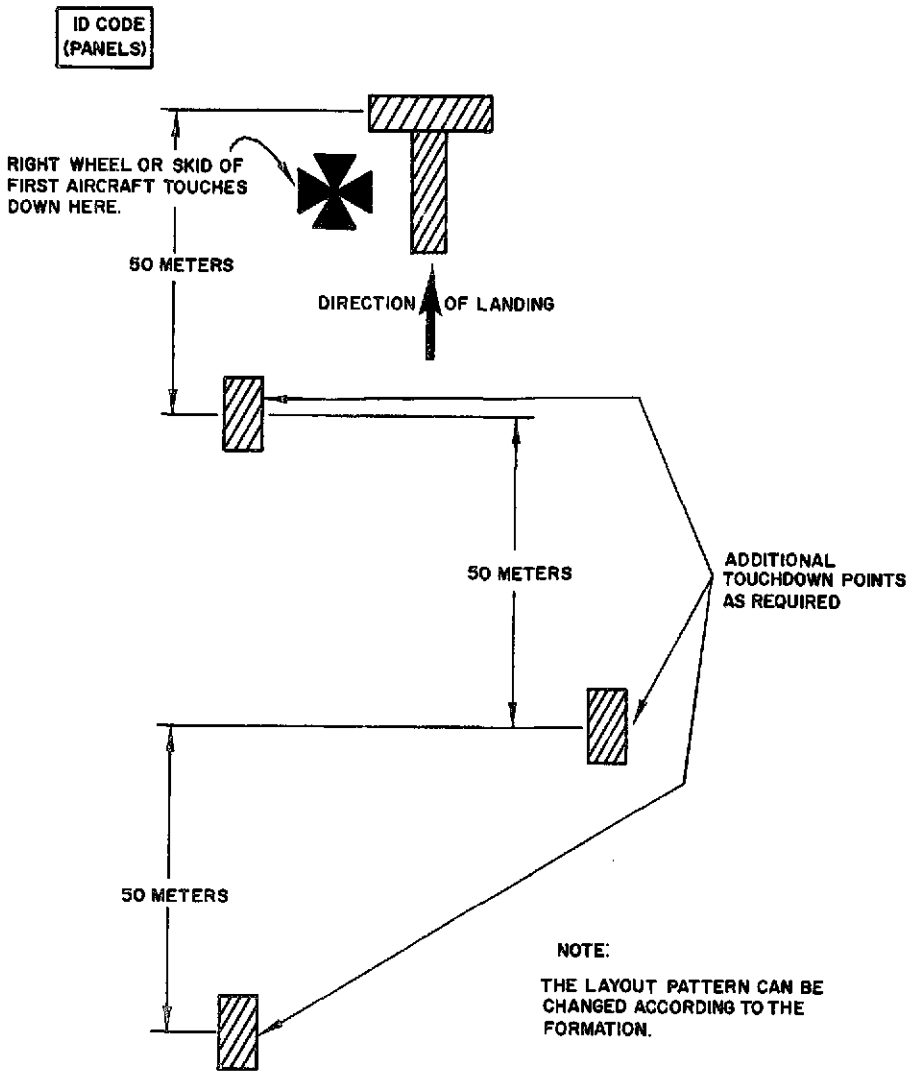


Figure 4–10. Panel marking for pioneer and hasty heliports.

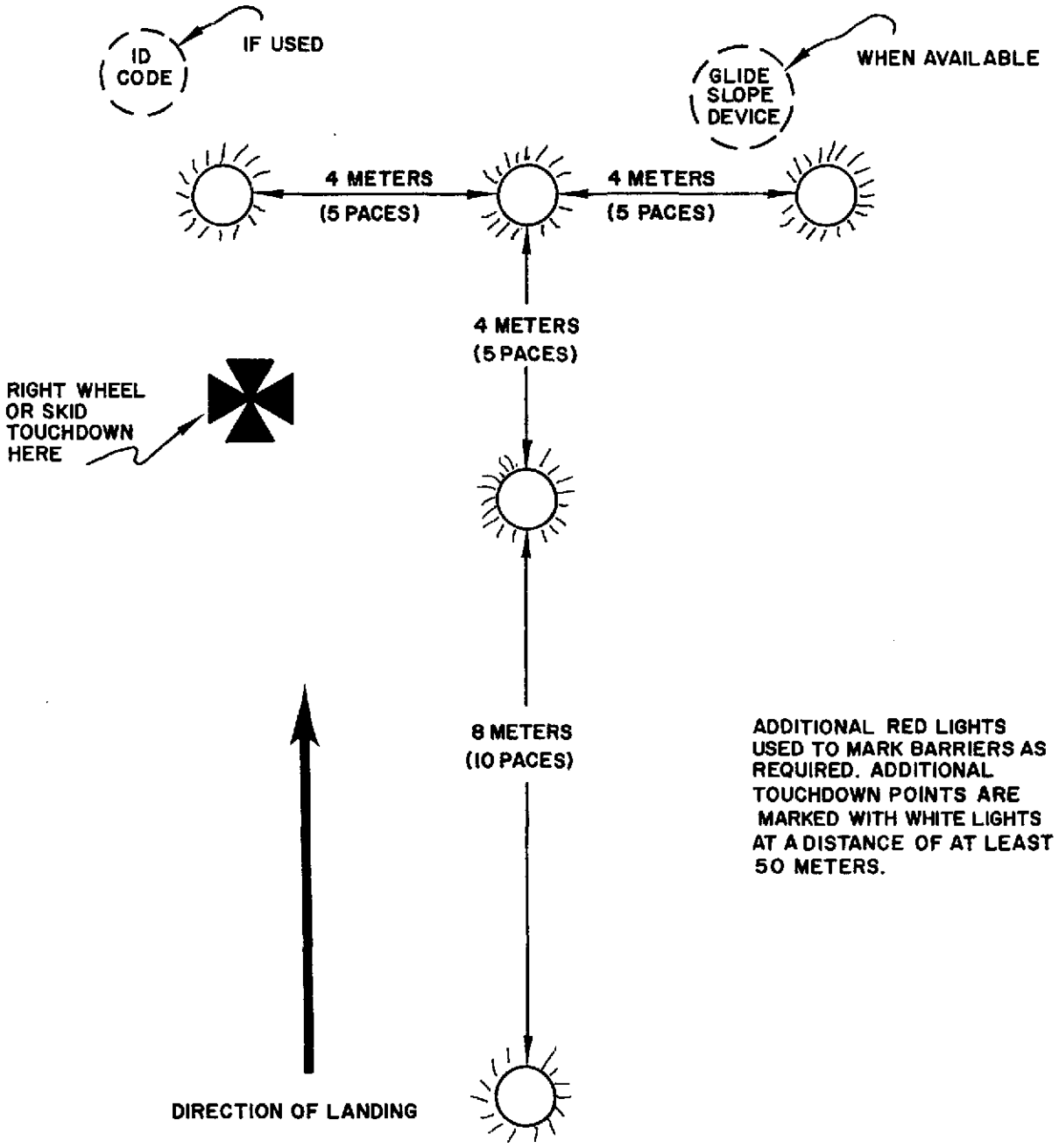


Figure 4–11. Heliport lighting (expedient).

Section IV. RECONNAISSANCE AND MARKING OF INLAND WATERWAYS

4–22. General

The use of inland waterways for military purposes is usually considered only in underdeveloped areas in which alternate routes are either lacking or insufficient. In jungle areas and delta regions, for example, inland waterways may not only offer the best but the only practicable means of extensive ground movement for long distances. The actual capacity of a waterway, the availability of waterborne craft, and the adequacy of terminal facilities are primary elements in the decision to employ inland waterway routes. Waterways are categorized by type—open and restricted. Lakes, rivers, canals, and other inland waterways whose *fairway* (a navigable part of a river, bay, or harbor) can be negotiated without restriction are termed "open" while those inland waterways whose fairways are interrupted by dams, locks, or by a required portage are termed "restricted." (Reconnaissance in support of joint amphibious operations is discussed in FM 110–115.)

4–23. Means of Inland Waterway Reconnaissance

The methods employed in reconnoitering inland waterways are dependent upon the time available, the extent and characteristics of the waterway, the amount of detail required, and the type of reconnaissance craft utilized. A preliminary map or aerial photo study supplemented in instances where aerial observation is not obscured by overgrowth is usually a prerequisite before conducting waterborne reconnaissance. Ground reconnaissance of a waterway may be accomplished either by paralleling the shore on foot or by vehicle, or preferably, by directly following the watercourse employing some mode of water transportation. In either event, means to check critical underwater features of the fairway such as depth, width, and likely underwater obstacles is mandatory. In most cases, army personnel will be required to exercise ingenuity in obtaining suitable reconnaissance craft, at times employing whatever means is locally available. On the other hand, certain engineer and transportation units have organic landing craft and boats which can be adapted for reconnaissance purposes (tables 4–6 and 4–7). In situations where reconnaissance craft may come under hostile fire, consideration should be given to providing each craft with suitable armament and improvised armor plating or sandbag protection. Swimming vehicles, such as the armored personnel carrier, are not generally appropriate for waterway reconnaissance because of their slow water speed, relatively deep draft, and limited maneuverability.

4–24. Preparation for Inland Waterway Reconnaissance

Suitable communications are required by waterborne reconnaissance parties; in most cases, this will be radio. Also, improvised methods for taking depth readings, determining current velocities, and measuring and marking fairways are required (see sec. V, ch. 2). If underwater reconnaissance is anticipated, provisions as outlined in paragraph 2–37 are made. Reconnaissance instructions must be specific, and all personnel thoroughly acquainted with the reconnaissance mission. If the reconnaissance is to be of long duration, methods of refueling and resupply, often by aircraft, are established. Coordination with and assistance from local civilians can be extremely helpful and should be sought when appropriate. In delta regions, swamps, and other areas where water channels abound, navigational aids will be required to maintain direction.

4–25. Considerations in the Conduct of Water Route Reconnaissance

As waterways vary greatly and reconnaissance requirements are not consistent, only general guidance can be offered as to what limiting features determine the movement capability of a specific inland waterway (FM 55–15). Limiting features will largely be dependent upon the operational environment and the contemplated military operation. Major considerations in waterway reconnaissance are as follows:

Table 4–6. Standard Landing Craft, Boats, and Amphibious Vehicles of the Transportation Corps

a. Landing Craft.

Type	Length	Beam	Light displacement (LT)	Draft loaded		Speed, loaded (knots)	Operating range, nautical miles (loaded)	Fuel consumption (gal. per hour)	Crew[1]	Capacity		Cargo space dimensions
				Fwd	Aft					Cargo (LT)	Troops	
Landing craft, utility (LCU) (501 class).	119′	32′	150	3′4″	4′	6.5	700	34	12	133.0	300 (min)	47′6″ × 14′ plus 36′ × 26′ plus 18′2¼″ × 12′6″.
Landing craft, utility (LCU) (1466 class).	115′	34′	180	3′	4′	6.5	700	34	12	160.0	300 (min)	52′ × 29′6″ plus 22′5″ × 14′4″.
Landing craft, mechanized, Mark VI (LCM (6)).	56′	14′	28	3′	4′8″	8.0	128	28	4	32.0	120	37′6″ × 9′6″
Landing craft, mechanized, Mark VIII (LCM (8)).	73′8″	21′	60	3′	5′6″	10.2	284	41	6	53.5	200	42′ × 14′6″
Landing craft, vehicle, personnel (LCVP).	36′	10′5″	8	2′2″	3′	10.5	135	15	4	3.5	36	17′3″ × 7′5″

[1] For around-the-clock operations.

b. Boats.

Type of boat	Designation	Length	Beam	Light displacement (LT)	Maximum draft (aft)	Fuel capacity (gal.)	Fuel consumption (gal. per hour)	Speed, loaded (knots)	Cruising range, loaded (nautical miles)	Crew	Capacity		Remarks
											Cargo	Passenger	
Utility, diesel, plastic, 26′, design 6009.	J[1]	26′6″	8′1″	3.04	4′	80	4	10	200	2	1 LT	12 to 15	Can be transported in cradle on freight vessels.
Picket, diesel, wood, 36′6″, design 243–B.	J[1]	36′6″	10′7″	6	4′	300	10	15	450	4	-------	-------	Can be crated and stowed on deck or in hold of freight vessel. Bow reinforced for beaching.
Picket, diesel, steel, 46′, design 4003.	J	46′4½″	12′3″	9.8	3′6″	370	18	16	328	3	-------	-------	Replaces design 243–B.
Picket, diesel, wood, 65′, design 4002.	Q	64′11″	15′11″	31	6′	900	25	14	500	6	4 LT	5	Replaces design 416.
Passenger and cargo vessel, steel, 65′, design 2001.	T	65′6″	17′8″	66	7′	1,150	19	10.5	635	4	24 LT 1,800 cu ft	24	Normally deckloaded on large cargo ship. Under good conditions, can proceed overseas under own power.

[1] Obsolescent, nonstandard.

c. Amphibious Vehicles.

Type	Length	Beam	Light displacement (LT)	Draft loaded		Speed, loaded	Operating range loaded (miles)	Fuel consumption (gal. per hour)	Crew	Capacity		Cargo space dimensions
				Fwd	Aft					Cargo (LT)	Troops	
Landing vehicle, wheeled (DUKW).	31′	8′2⅞″	6.4	3′6″	4′3″	5 knots, water 50 mph, land	30, water 250, land	8	3	Normal 2.2 Maximum 4.5	25	12′5″ × 6′10″
Lighter, amphibious, 5-ton (LARC-V).	35′	10′	7.2	4′1″	4′3″	8.7 knots, water 25 mph, land	60, water 160, land	20	2	Normal 4.5 Maximum 5.0	Emergency 20.	16′ × 8′8″
Lighter, amphibious, 60-ton (LARC-LX).	62′6¾″	26′7″	87	8′8″	8′8″	7 knots, water 14 mph, land	105, water 210, land	40	8	Normal 53.6 Emergency 89.3	Normal 125. Emergency 200.	38′3″ × 14′
Landing vehicle, tracked, Mark V (LVTP).	29′8″	11′8½″	31.2	5′3″	5′3″	6.7 knots, water 27.8 mph, land	45, water 187, land	47	3	Water 6.0 Land 9.0	34	15′2″ × 7′9″ × 5′3″.

Table 4–7. Standard Engineer Boats

Type craft	Crew	Maximum loads	Max steam velocity	Length	Beam	Weight	Remarks
1. Plastic assault boat:							
a. Paddle propelled	3 men	12 riflemen with individual equipment (in addition to crew).	1.5m/sec	16′	5′4″	291 lb	
b. Employed as storm boat.	1 man	5 riflemen (in addition to crew).	3.3m/sec				Equipped with 25 HP outboard motor.
c. Outboard motor propelled.	2 men	10 riflemen (in addition to crew).	2.4m/sec				Equipped with 25 HP outboard motor.
2. Pneumatic assault boat:							
a. Paddle propelled	3 men	12 riflemen with individual equipment (in addition to crew).	2.4m/sec	17′	5′8″	250 lb	
b. Outboard motor propelled.	1 man	14 riflemen (in addition to crew).	3.3m/sec				Equipped with 25 HP outboard motor.
3. Pneumatic reconnaissance boat: Paddle propelled	3 men	Maximum cargo 600 lb including crew.	1.5m/sec	9′	4′	31 lb	
4. Bridge erection boat	2 men	9 riflemen with individual equipment (in addition to crew).		19′	8′	3800 lb	Propelled by 90 HP inboard engine; maximum speed up to 27 KPH; 30″ draft.
5. Bridge erection boat	2 men	9 riflemen with individual equipment (in addition to crew).		27′	8′2″	6800 lb	Propelled by two 90 HP inboard engines; maximum speed up to 27 KPH; 40″ draft; boat may be divided into two sections to facilitate transporting overland.

a. Restricting widths and depths of fairways.

b. Vertical and horizontal clearance of bridges.

c. Location of dams or other bars to navigation.

d. Location of locks to include dimensions, timing, and method of operation.

e. Frequency, duration, and effect of seasonal floods and droughts to include types and dimensions of levees.

f. Normal freezeup and opening dates.

g. Navigation hazards such as rapids, falls, underwater and antiamphibious mines.

h. Speed and fluctuations of current.

i. Tidal influences.

j. Significant changes in channel direction.

k. Availability of civilian and/or military craft.

l. Number and type of terminal facilities including wharves, cranes, handling equipment, maintenance shops, and port clearance.

m. Aids to navigation such as buoys and lights.

n. Fords and sites suitable for swimming vehicles.

o. Potability, contamination, and sediment movement.

p. Nature of waterway bed.

q. Local organization and administration of waterways to include the indigenous labor force.

4–26. Waterway Reconnaissance Reports

As waterways vary considerably, no standardized forms have been established to report the results of reconnaissance; however, short forms or worksheets based on field requirements are recommended to insure that important aspects of waterway reconnaissance are not overlooked. Generally, reconnaissance information of inland waterways is reported in overlay form utilizing standard route reconnaissance symbols and conventional topographic symbols (fig. 4–12). If reconnaissance information cannot be adequately portrayed in overlay form, written reports describing specific terrain features accompany the overlay report.

4–27. Marking of Inland Waterways

a. The buoyage system employed in United States waters (fig. 4–13) can be readily adapted to marking inland waterways within an operational area. Buoys can be expeditiously fabricated under field conditions in accordance with the needs of the command. Reconnaissance personnel should be familiar with the buoyage system, for frequently the marking of an inland waterway is accomplished in conjunction with its reconnaissance. In developed areas, however, major inland waterways have been marked by the indigenous population. In such circumstances it is generally easier to adapt the local navigational system to meet military needs rather than convert to the U.S. system.

b. Buoys are wooden or metal floats of various shapes, sizes, and colors anchored to the bottom of harbors, bays, rivers, and channels. The primary function of a buoy is to warn of some danger, obstruction, or change in the contours of the bottom, and to delineate the fairways. The different types of buoys are identified by size, shape, coloring, numbering, and the signaling devices with which they are equipped. They are usually marked on charts so that a course can be plotted to avoid the potential hazards indicated.

c. The buoyage system used in the United States employs a simple arrangement of colors, shapes, numbers, and lights. *Buoy characteristics are determined by the location of the buoy with respect to the navigable channels as entered from a seaward direction.* As all channels do not directly connect with the sea, arbitrary assumptions are applied. In such circumstances, operators are required to consult navigational charts to determine the *assumed* seaward direction of the fairway. The principal types of buoys are described below:

(1) A *spar buoy* is usually a large log, trimmed and appropriately painted; it may also be constructed of steel plates joined to form a slim cylinder

The shape of a spar buoy has no significance. Coloring reveals the particular meaning of the buoy.

(2) A *can buoy* is usually constructed of metal and its shape is similar to that of an ordinary tin can. Normally, it it is used to designate the port side (entering from seaward), but may be used to mark the middle of a channel, a junction, or an obstruction. Color indicates its particular purpose. *A can buoy is never used to mark the starboard side of a channel*

(3) A *nun buoy* is also constructed of metal and has a conical top. It is normally used to mark the starboard side of the channel (entering from seaward), but may also be used for mid-channel, junction, or obstruction marking; the color denotes its particular purpose. *A nun buoy is never used on the port side of a channel.*

(4) A *lighted buoy* is a float upon which is mounted a short skeleton tower with a lantern at the top. Its shape has no significance; however, its purpose is indicated by color.

(5) *Bell buoys, gong buoys,* and *whistle buoys* are floats with sound equipment installed. No significance is attached to their shapes.

d. All United States buoys are painted with distinctive colors to indicate their purpose or the side on which they should be passed when entering from seaward.

(1) A *black buoy* marks the port side of a channel or the location of obstructions which must be passed by keeping the buoy on the port side of the vessel. It displays white or green lights at night.

(2) A *red buoy* marks the starboard side of a channel or the location of obstructions which must be passed by keeping the buoy on the starboard side. It displays white or red lights at night.

(3) A *red and black horizontally banded buoy* marks a junction in the channel or an obstruction which may be passed on either side. If the topmost band is black, the preferred channel will be followed by keeping the buoy on the port side when proceeding from seaward; if the topmost band is red, the preferred channel will be followed by keeping the buoy on the starboard side. This buoy may have white, red, or green lights.

(4) A *black and white vertically striped buoy* marks the fairway or mid-channel and may be passed on either side. It displays a white light at night.

(5) *Special-purpose buoys* have distinctive colors and are usually spar buoys. They reveal the locations of anchorage areas, dredging operations, etc.

e. Buoys indicating the starboard side are marked with even numbers; those indicating ing the port side are marked with odd numbers. Mid-channel, junction, and special-purpose buoys are not numbered, but may be lettered for identification.

f. Usually only buoys in key spots have lights; some unlighted buoys have reflectors which may be white, red, or green and have the same significance as lights of the same colors. Black buoys have green or white lights; red ones have red or white lights. Mid-channel buoys use white only while obstruction and junction buoys use the appropriate color to indicate the preferred channel. Channel buoy lights are usually slow flashing (not over 30 flashes per minute). If they mark important turns or dangerous areas, they will be quick flashing with 60 or more flashes per minute. Red and black horizontally banded buoys have interrupted quick flashing lights—a series of quick flashes with dark intervals of about four seconds between series. Mid-channel buoys have short-long flashing lights—groups consisting of a short flash and a long flash repeated at the rate of about eight per minute.

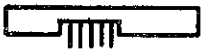
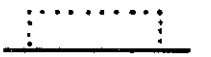
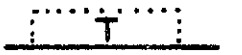
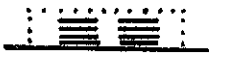
Serial Number	Description	Symbol
	OPERATING FACILITIES	
1.	Slipway, Shipyard	
2.	Tow path	
3.	Bumping posts	
4.	Icebreaker	
5.	Mooring poles	
6.	Shipturning point	
7.	Alongside berth	
8.	Tanker berth	
9.	Lighter berth	
10.	Water level indicator	

Figure 4–12. Conventional symbols for use in military geographic documentation on navigable inland waterways and sea and river ports (STANAG 2254, STANAG 2255, SOLOG 97, and SOLOG 98).

Serial Number	Description	Symbol
	OPERATING FACILITIES (Cont'd)	
11.	Water gauge	
12.	Recording tide gauge	
13.	Highwater mark gauge	
14.	Kilometer stone	
15.	Warning station	
16.	Drinking water supply	
17.	Fueling station	
18.	Coaling station	
19.	Crane	
20.	Traveling crane	

Figure 4-12—Continued.

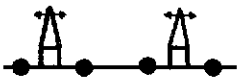
Serial Number	Description	Symbol
	OPERATING FACILITIES (Cont'd)	
21.	Loading berth	
22.	Elevator for oil	
23.	Electricity supply point	
	AUXILIARY SERVICES	
24.	Transformer	
25.	Radar station	
26.	Phone booth	
27.	High tension line	
28.	Telephone overhead line	
29.	High tension cable	

Figure 4-12—Continued.

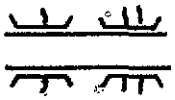
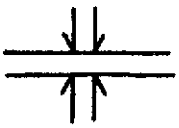
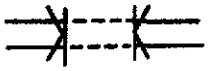
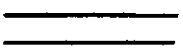
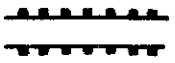
Serial Number	Description	Symbol
	AUXILIARY SERVICES (Cont'd)	
30.	Telephone cable	
31.	Waterworks	
32.	Pumping station	
	WATERWAY CONSTRUCTION AND CHARACTERISTICS	
33.	Aqueduct	
34.	Culvert	
35.	Syphon	
36.	Sewer	
37.	Navigable canal	
38.	Raised canal	

Figure 4–12—Continued.

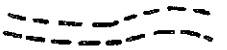
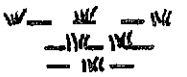
Serial Number	Description	Symbol
	WATERWAY CONSTRUCTION AND CHARACTERISTICS (Cont'd)	
39.	Canal cut	
40.	Fairway	
41.	Dry river bed	
42.	Cataract, rapids	
43.	Waterfall	
44.	Reeds	
45.	Single stones or rocks	
46.	Rock or reef	
47.	Breakwater	
48.	Groins	

Figure 4–12—Continued.

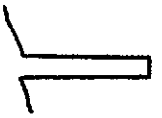
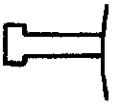
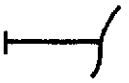
Serial Number	Description	Symbol
	WATERWAY CONSTRUCTION AND CHARACTERISTICS (Cont'd)	
49.	Stone mole or pier	
50.	Wooden mole or pier	
	LANDING STAGES	
51.	- for vehicles	
52.	- for passengers	
	BANK CONSTRUCTION	
53.	Iron	
54.	Brick work or concrete up to 5 m width	
55.	Brick work or concrete over 5 m width	
56.	Wattle work (fascine filling) or grit layer	
57.	Paving	

Figure 4-12—Continued.

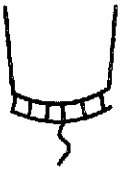
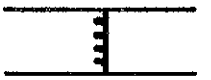
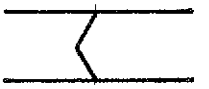
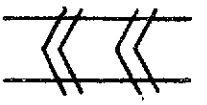
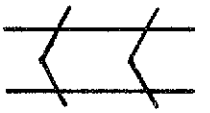
Serial Number	Description	Symbol
	DAMS	
	Dam across a valley	
58.	- of earth or rock filling	
59.	- of masonry or concrete	
60.	Weir	
61.	Sliding-, Safety-, Guard- or Tide-lock	
62.	Emergency gate	
63.	Harbor lock	
64.	Lock	
65.	Ship-lift	
	NAVIGATION SYMBOLS	
66.	Lightship	

Figure 4-12—Continued.

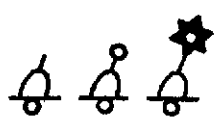
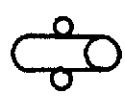
Serial Number	Description	Symbol
	NAVIGATION SYMBOLS (Cont'd)	
67.	Light house	
68.	Light beacon	
69.	Light beacon (coordinated)	
70.	Storm signal mast	
71.	Signal post	
72.	Beacon	
73.	Floating beacon	
74.	Deviation beacon	
75.	Buoys	
76.	Mooring buoy	

Figure 4-12—Continued.

Serial Number	Description	Symbol
	NAVIGATION SYMBOLS (Cont'd)	
77.	Broom (brush)	
78.	Wind indicator, and combined wind indicator and water gauge	
79.	Presignal for swingbridge	
80.	Mooring prohibited	
81.	Free anchorage area	
82.	Wreck, trunk visible	
83.	Wreck, dangerous to surface navigation	
84.	Wreck, not considered dangerous to surface navigation	
	MISCELLANEOUS	
85.	Section mark	

Figure 4-12—Continued.

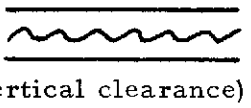
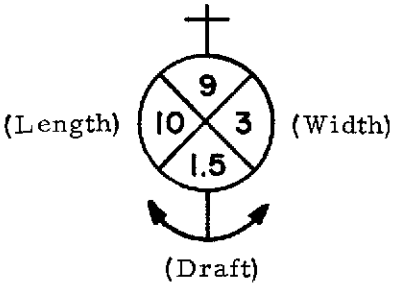
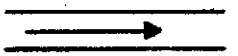
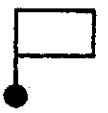
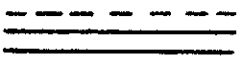
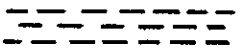
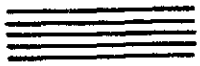
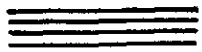
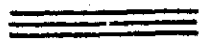
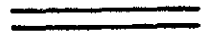
Serial Number	Description	Symbol
	MISCELLANEOUS (Cont'd)	
86.	Extremely variable water level	 (Vertical clearance)
87.	Limit of navigability for vessels with indicated dimensions expressed in meters	
88.	Direction of flow	
89.	River port	
90.	River port connected to a railway	
91.	Canal - green	
92.	River - blue	
93.	Improvement	
94.	Planned	

Figure 4-12—Continued.

Serial Number	Description	Symbol
	MISCELLANEOUS (Cont'd)	
95.	*Canal class O	
96.	*Canal class I	
97.	*Canal class II	
98.	*Canal class III	
99.	*Canal class IV	
100.	*Canal class V	

*Canal Class	SHIP DIMENSIONS			
	Tonnage	Length	Width	Maximum Draft
O	300T	-	-	-
I	300T	38.50 m	5.00 m	3.55 m
II	600T	50.00 m	6.60 m	4.20 m
III	1,300T	67.00 m	8.20 m	3.95 m
IV	1,350T	80.00 m	9.50 m	4.40 m
V	2,000T	95.00 m	11.50 m	6.70 m

Figure 4-12—Continued.

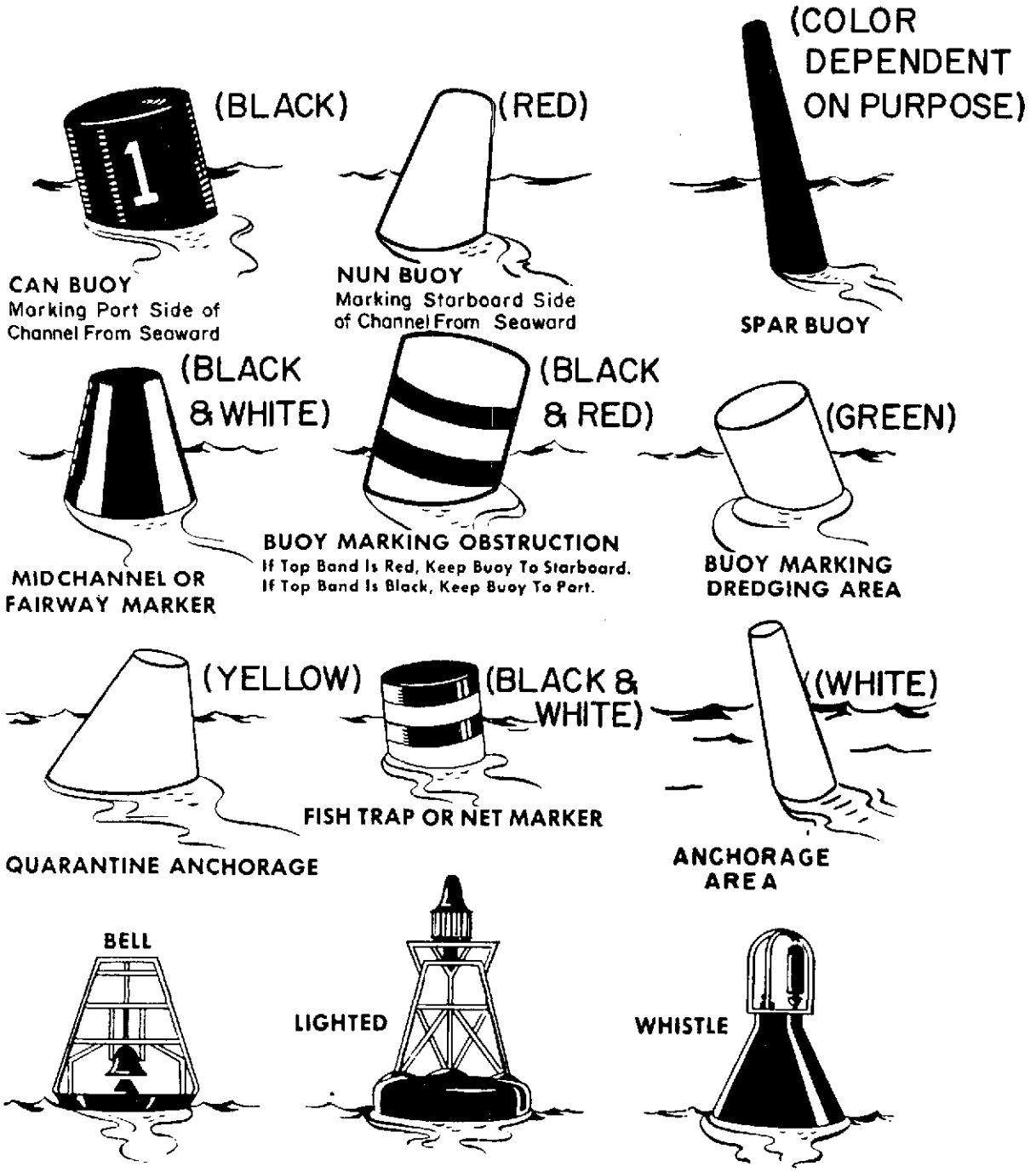


Figure 4-13. Buoyage system of the United States.

Section. V. RECONNAISSANCE OF FOOTPATHS AND TRAILS

4–28. General

A *route of communication* is generally a network of roads over which supplies are carried and combat movements are made; however, in counterinsurgency operations, footpaths and trails rather than roads often may be the only reliable land means of reaching otherwise inaccessible points. Therefore, particularly in underdeveloped areas of the world where insurgencies generally occur, forces must be prepared to carry supplies and to conduct combat movements in areas where only footpaths and trails exist.

4–29. Factors Affecting Reconnaissance

Various factors affect reconnaissance of footpaths and trails in an area of operations. Among these factors are the following:

a. Degree of influence of the enemy in the area.

b. Terrain and climatic features within the area of operations.

c. Degree of training and ability of reconnaissance personnel.

d. Ability to support reconnaissance personnel through use of signal communications and aircraft.

4–30. Trail Marks

Trail marks are normally used to assist in land navigation by identifying a location, showing a direction, or indicating a distance. Trail marks, however, may have other means, such as indicating degree of enemy activity or degree of danger within an area. Trail marking, like route marking, is essentially a form of communication used to convey previously gathered or established information to personnel who are passing through or find themselves at a particular geographic point. Trail marks may be simple or complex, depending upon the degree of permanency desired, the amount of information to be conveyed, and the requirement for secrecy to prevent unauthorized persons from identifying the trail marks and/or correctly interpreting them.

4–31. Methods of Trail Marking

In an operational environment there will likely be standard or accepted trail marks already in use by indigenous personnel of the area. Such trail marks will probably utilize natural land marks and available resources of the area. In general, conventional methods of trail marking include the following:

a. Tree blazing with distance and/or direction being shown by the placement of the blaze mark.

b. Marking the underbrush by breaking branches and/or twigs. Direction and method of breaking may indicate direction and/or distance.

c. Use of sticks, stones, or other indigenous material placed in particular pattern may convey distance and/or direction.

d. Marked sticks placed in the ground may be used to convey information. The length(s) of the stick(s) and/or cuts on the sticks may indicate various types of information.

e. Items abnormal to the environment, such as strings, rags, paper, etc., may be used to mark a trail.

f. Use of paint to mark trees and other landmarks may be used to convey almost any quantity or type of information.

CHAPTER 5

MARKING OF ROUTES

5–1. Purpose and Responsibility (STANAG 2027 and SOLOG 62)

The procedures for the posting of military routes with signs have been standardized for the United States and allied nations; furthermore, the system may be integrated into existing civil systems in accordance with military requirements. Signs affecting routes include those specifically posted for the movement of troops and supplies and those designed to inform and to regulate traffic. Preparation and posting of *permanent signs* for route marking and traffic control is an engineer responsibility. Signs are posted as directed in the traffic circulation plan and traffic control plan. Operational responsibility for route signing, however, remains a command function.

5–2. Dimensions

In general, the size of route signs is not prescribed; however, they must be sufficiently large to be easily read under poor lighting conditions. Exceptions to this rule are bridge classification signs (para. 2–52) for which dimensions are specific. As a guide, signs for civil international road use are normally not less than 16 inches square (fig. 5–1).

5–3. Types and Application of Signs

Standard route signs are grouped into three general types: hazard signs, regulatory signs, and guide signs. Application of the three general types listed in table 5–1.

Table 5–1. General road signs applications.

Type	Application
Hazard ____	Advance warning of stop signs and traffic signals. Bumps. Changes in road width. Crossroad. Curves. Danger or hazard. Dangerous corner. Dips. Junction T. Junction Y. Level railroad crossing, advance warning. Men working. Railroad crossing. Road construction repairs. Road narrows. Slippery road. Steep grades. Steep hill. Turns.
Regulatory__	No entry. One way. Parking restrictions. Specific regulations for vehicles. Speed limit. Stop. Bridge classification.
Guide ______	Detour. Detour begins. Detour ends. Directions. Distances. Information to help driver. Locations. Route number.

a. Military hazard signs are used to indicate traffic hazards. Employment of these signs in a communication zone normally requires coordination with civil authorities. Hazard signs are square in shape and are installed with one diagonal in a vertical position. A military hazard sign not included in the Geneva Convention or in the system of the host country has a yellow background with the legend or symbol inscribed in black (fig. 5–2). The

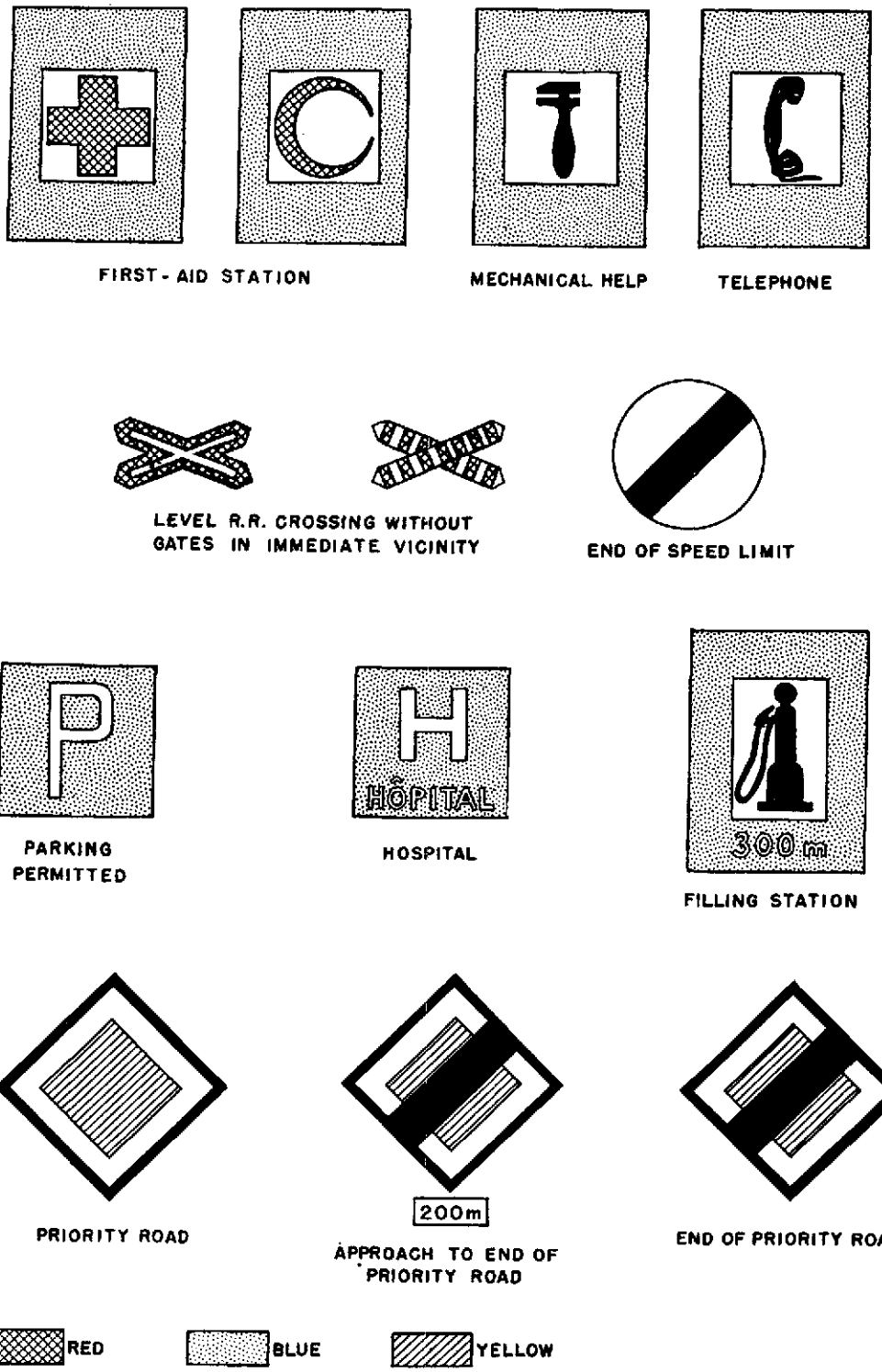
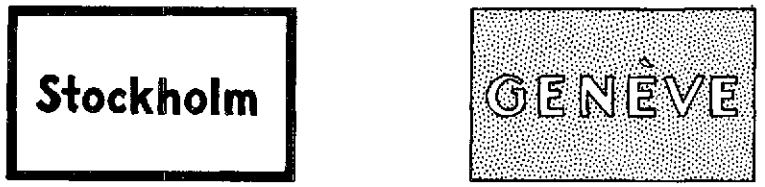


Figure 5–1. Examples of international road signs.

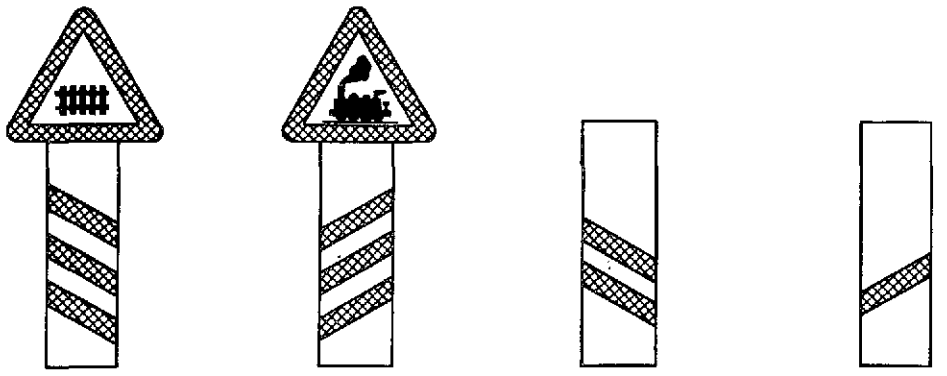
DISTANCE SIGNS



LOCALITY SIGNS

DIRECTION SIGNS

MILESTONE



SUPPLEMENTARY RAILWAY SIGNS

IF SIGN A OR SIGN B IS DISPLAYED, IT MUST BE FOLLOWED BY SIGN C AND THEN SIGN D, INDICATING 2/3 AND 1/3 OF THE DISTANCE TO THE DESIGNATED POINT DESCRIBED IN THE ORIGINAL SIGN.

Figure 5-1—Continued.

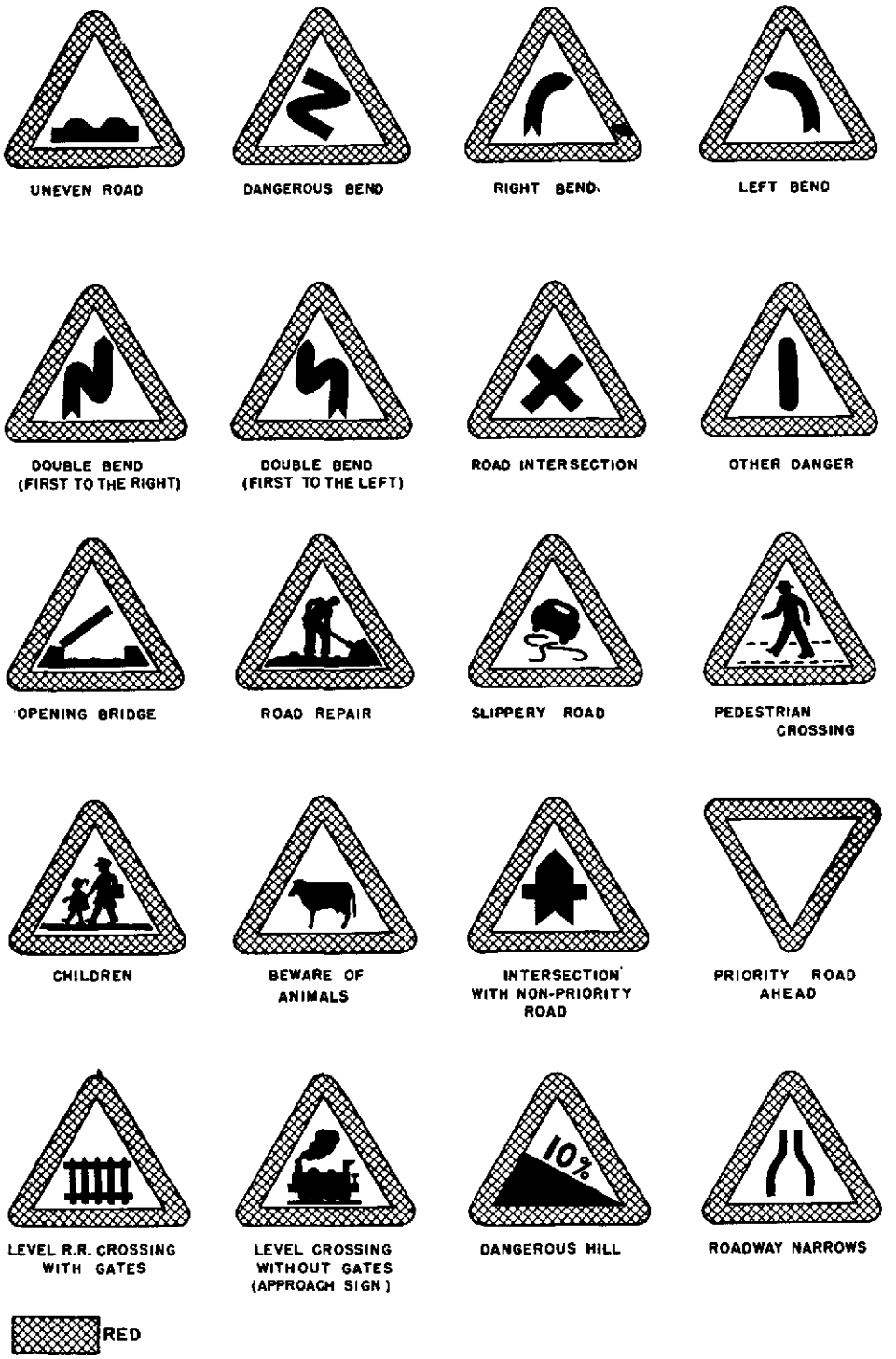


Figure 5-1—Continued.

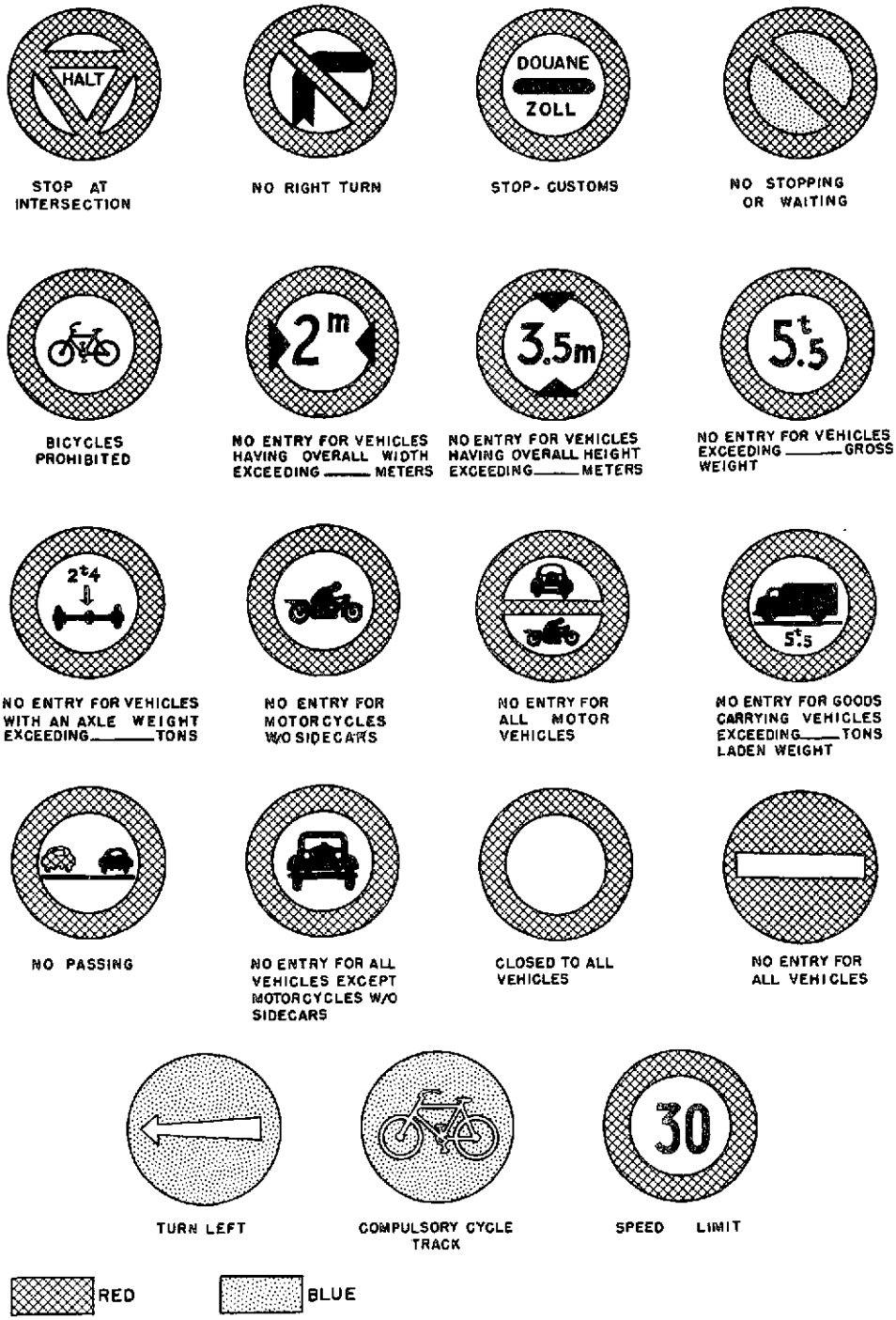


Figure 5–1— Continued.

wording on these signs is in the language or languages determined by the authority erecting the sign. If a *military hazard sign* employs a traffic sign approved by the Geneva Convention or other civil traffic sign designated by the host country, the civil symbol is superimposed on a yellow background (fig. 5–3).

b. Military regulatory signs regulate and control traffic and define the light line. Regulatory signs are rectangular and are posted with the sides vertical (fig. 5–4). Regulatory signs have a black background on which the legend or symbol is superimposed in white; exceptions to this rule are: bridge classification signs, stop signs, no entry signs, and signs applicable to civil as well as military traffic (para. 5–4).

c. Military guide signs indicate direction or location.

5–4. Exceptions to Standard Military Regulatory Signs

a. Stop Signs. Military stop signs are octagonal (8-sided) in shape and consist of a yellow background with the word, STOP, superimposed in black (fig. 5–5).

b. No Entry Signs. No entry signs employ the standard Geneva Convention symbol superimposed on a black background (fig. 5–5).

c. Bridge Markings. See paragraph 2–52.

d. Indication of the Light Line. See paragraph 5–13.

e. Application to Civilians. If military forces erect signs which require compliance by civilian traffic, the civil traffic sign system of the local area is used.

5–5. Guide Signs for Military Axial and Lateral Routes

a. Military route guide signs are rectangular in shape and are posted with the long axis vertical (figs. 5–6 and 5–7). These signs consist of the military route number and the appropriate directional disk. Route guide signs have a black background with white inscriptions.

b. Route guide signs often show the direction of traffic flow. For *axial routes,* differentiation between traffic flow moving toward the FEBA and traffic flow moving away from the FEBA is made by means of a directional disk with barred arrow representing traffic movement toward the rear (fig. 5–6). On route signs of *lateral routes,* the standard direction abbreviations—N, E, S, W, NE, SE, NW, and SW—are used to indicate the general direction of traffic flow (fig. 5–7).

c. If standard signs are not available, military route guide signs may be fabricated from a directional disk placed over a rectangular panel upon which the route number is inscribed (figs. 5–6 and 5–7).

5–6. Other Guide Signs

In addition to guide signs for military routes, guide signs may be employed for informational purposes. These signs depict such information as location, distance, direction, civilian route numbers, and road destinations and are rectangular in shape with black backgrounds and white inscriptions. This type sign is posted with the sides vertical and with the long axis in a position which best accommodates the inscription on the sign (fig. 5–8).

5–7. Signs for Marking Headquarters and Logistical Installations (STANAG 2030 and 2035; SOLOG 63 and 64)

Location signs for headquarters and logistical installations are rectangular and posted with the sides vertical. To mark a headquarters or logistical installation, the appropriate military symbol (FM 21–30) is used. The inscription is black superimposed on a yellow background. The basic symbol may be supplemented by national distinguishing symbols or abbreviations (AR 320–50). *For division headquarters and above, nationality is always indicated.* Colors other than yellow and black are prohibited except for national distinguishing symbols. When security interests require, headquarters and installation markings may be temporarily covered or removed. Lighting requirements are specified by the local commander.

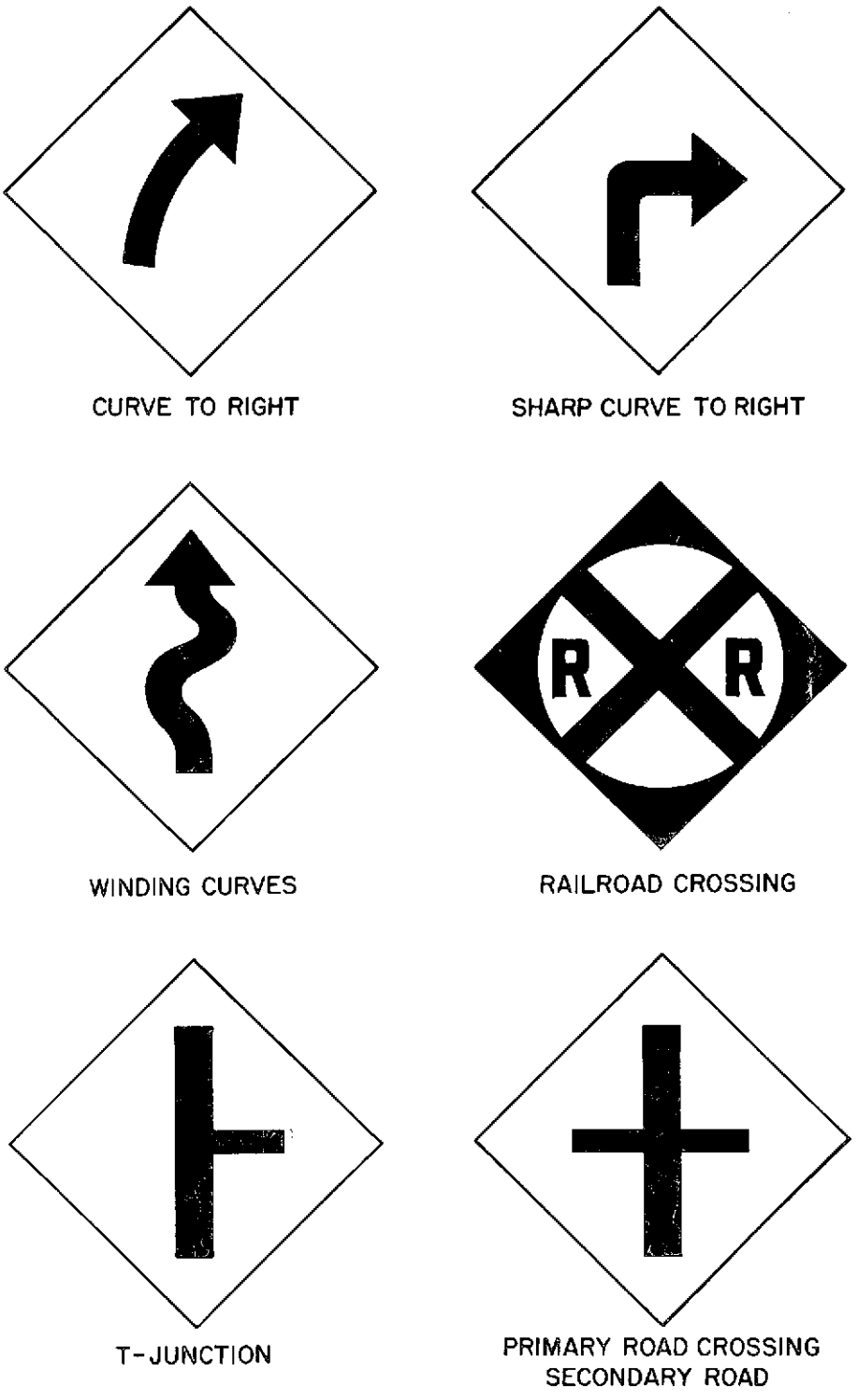


Figure 5-2. Examples of hazard signs not included in the Geneva Convention (yellow background and black symbols or letters).

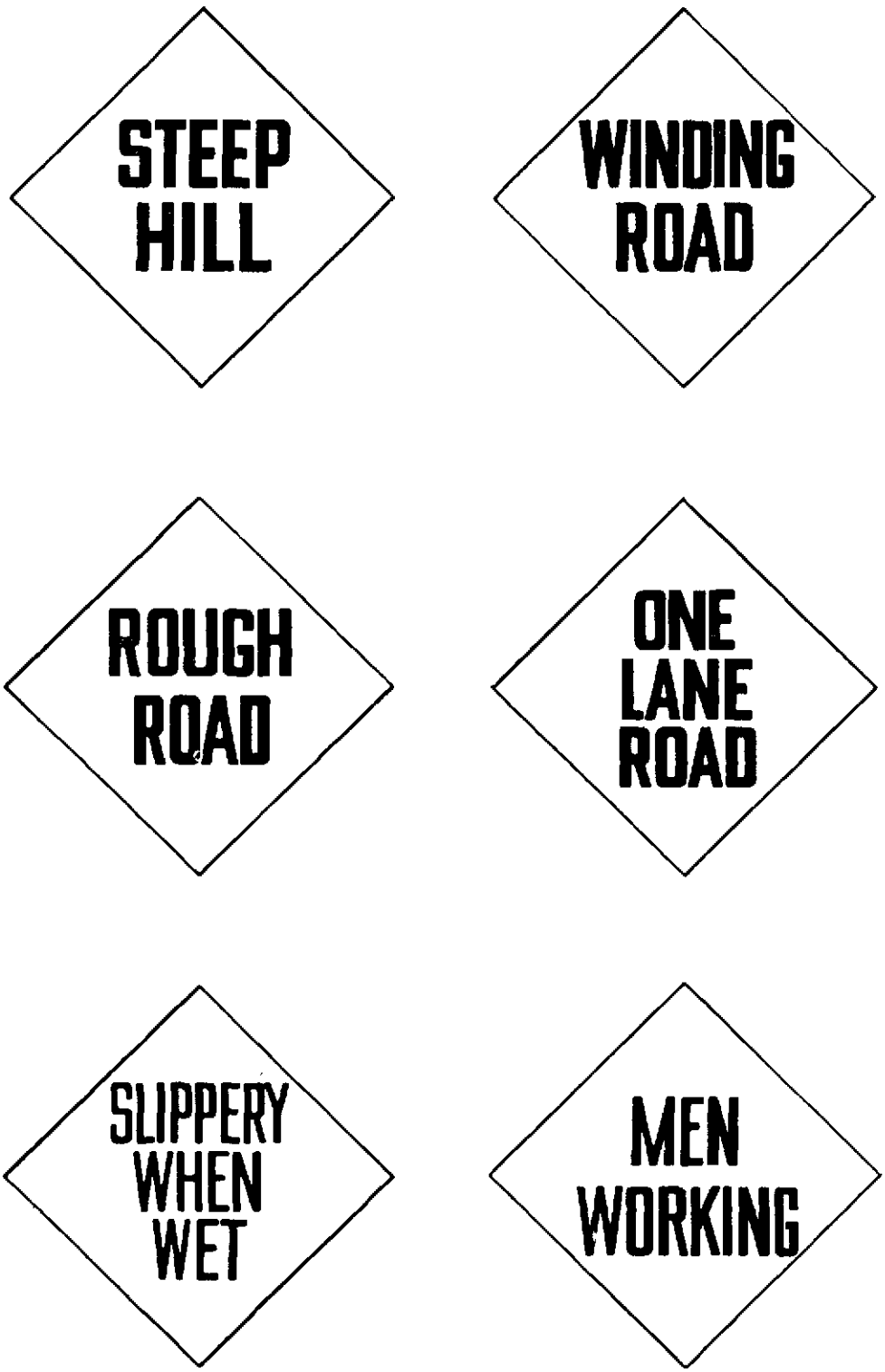


Figure 5–2—Continued.

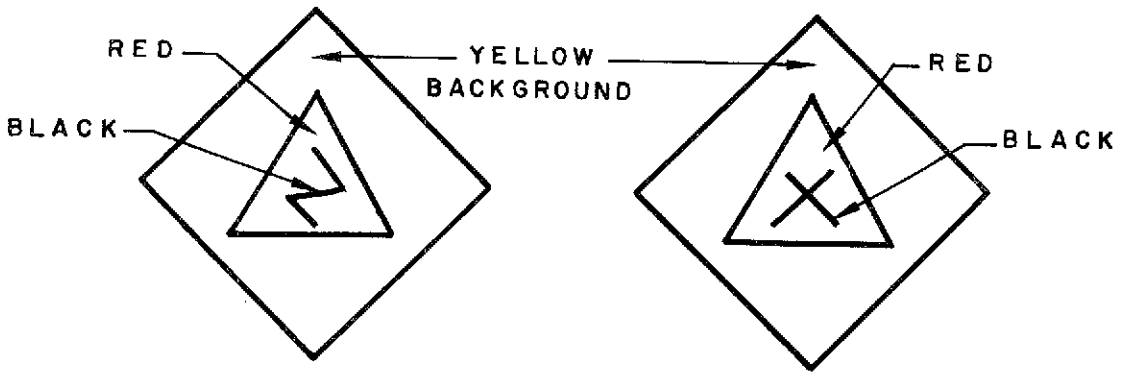


Figure 5–3. Examples of hazard signs included in the Geneva Convention.

5–8. Guide Signs for Casualty Evacuation Routes

a. On a rectangular sign with white background, the following inscriptions *in red* indicate a casualty evacuation route (fig. 5–9).

(1) Directional arrow.
(2) Red cross (red crescent for Turkish Armed Forces).
(3) Unit or subunit designation if required.
(4) Additional information such as unit or national marking if required.

b. An alternate sign may be fabricated from a white disk, four segments of which are cut out to give a cruciform shape. The inscriptions as above are shown in red.

5–9. Directional Disks

a. The directional disk consists of a fixed black arrow, with or without bar, on a white background. Eight equally spaced holes around the edges of the circumference allow the disk to be nailed with the arrow pointing in the desired direction. Disks are no longer than 16 inches in diameter (fig. 5–10).

b. Directional disks are used in conjunction with standard guide signs to indicate military axial and lateral routes (para. 5–5). Moreover, directional disks may be used together with unit signs to indicate direction to locations of major units (group and above). Battalions and smaller units are prohibited from utilizing directional disks; however, any arrow sign which provides a different shape and color from the standard directional disk may be employed to indicate unit location.

5–10. Unit Direction Arrow (STANAG 2154)

Temporary unit direction arrows may be used to mark routes of march. The unit direction arrow consists of a black inscription superimposed on a white background (fig. 5–11). In addition to the direction arrow, the unit identification symbol (a distinctive mark or number) is included as part of the inscription. Unit route signs are placed a short time in advance of the moving column and are picked up by a trail vehicle.

5–11. Military Detour Signs

Military detour signs consist of a white arrow superimposed on a blue square (fig. 5–12). The sign is placed with one diagonal in a vertical position. The number of the diverted route is shown either by placing it on the square over the arrow or by adding the number under the square by means of a small panel. Detour signs as illustrated in figure 5–8 may also be used.

5–12. Road Markers in Northern Areas

Conditions of heavy snow require special attention in posting road signs. Permanent

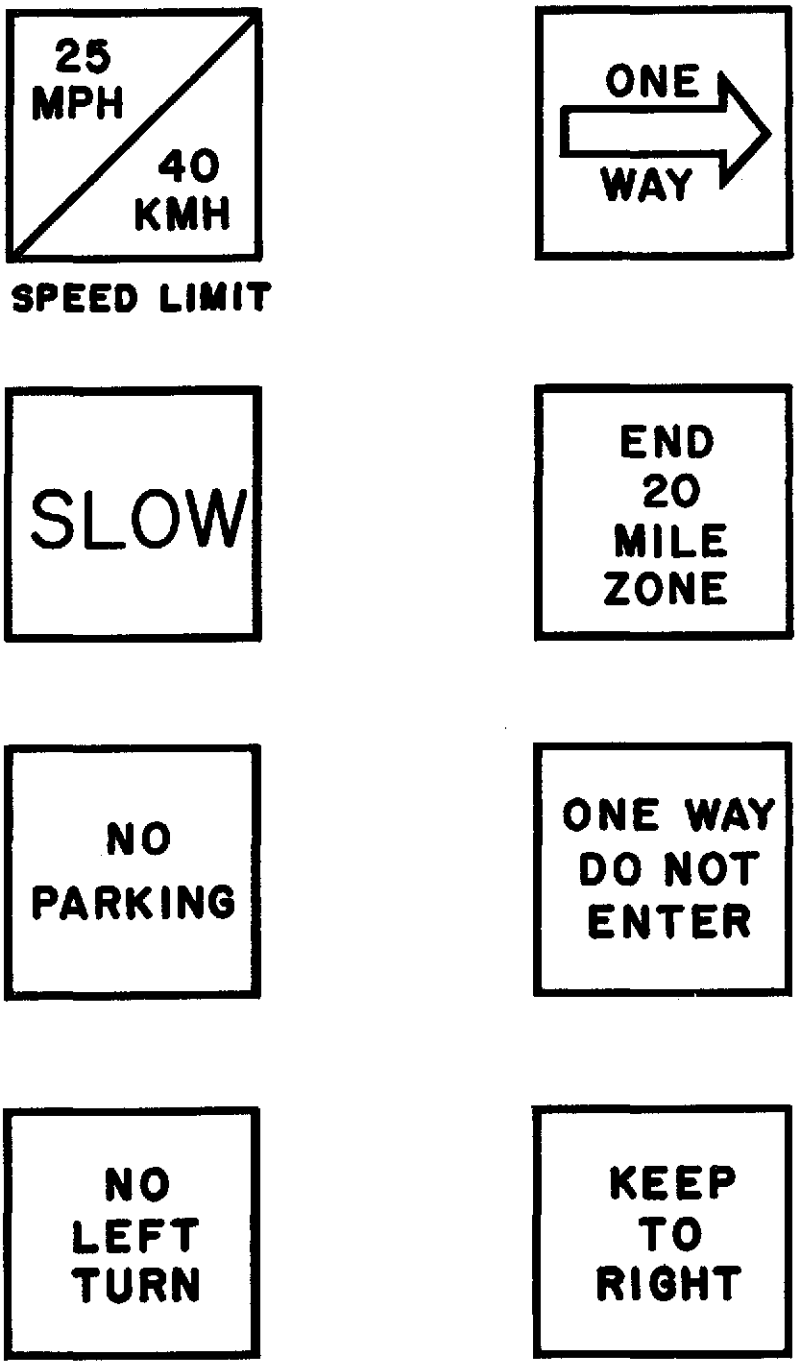


Figure 5-4. Examples of regulatory signs.

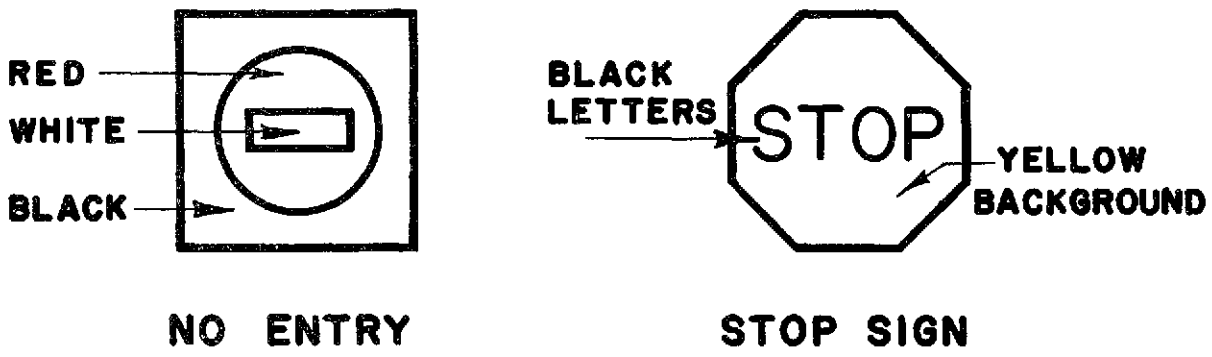


Figure 5-5. Exceptions to standard coloring of regulatory signs.

routes are delineated by durable markers spaced evenly on both sides of the traveled way. In open country, poles of appropriate height with direction markers, snow markers, brushwood, rock cairns, or flags may be employed. Markers should be erected at least one meter off the traveled way to avoid traffic damage. If complete road delineation cannot be accomplished, arrow signs may be erected at prominent points to indicate road direction. Road markers and signs used for long periods in northern areas are checked frequently to insure their positions have not been altered. In areas with prolonged conditions of snow, yellow (international orange) may be substituted for the color, white, on all standard military route signs.

5-13. Indication of the Light Line (STANAG 2024)

The light line is a designated line forward of which vehicles are required to use blackout lights at night. The light line is indicated by a rectangular sign which is preceded by two warning panels which are placed in accordance with the situation and the nature of the terrain (fig. 5-13). The first warning panel is preferably located between 1 kilometer and 500 meters (not to exceed 10 km) before blackout enforcement, and the last warning panel is preferably located between 500 and 200 meters before the light line.

5-14. Lighting of Military Route Signs (STANAG 2012)

The appropriate military authority in the area specifies those signs which are to be illuminated with primary consideration being given to hazard and directional signs. Requirements for illuminating signs vary in accordance with the following conditions.

a. Normal Lighting Conditions. Under normal lighting conditions, it is the responsibility of each armed force to insure that standard signs are visible at night and other periods of reduced visibility.

b. Reduced Lighting Conditions. Under reduced lighting conditions, the positioning of the signs and the methods adopted to make them visible (illumination or reflection) must enable personnel to see them from vehicles fitted with reduced lighting or filtering devices.

c. Blackout Conditions. In a blackout zone, sign illumination is as follows:

(1) Signs are provided with upper shields which prevent light from being directly observed from the air. Additionally, the light illuminating the sign is of such low intensity that it is not possible to locate the sign from the air at altitudes greater than 150 meters by its reflection off the road surface.

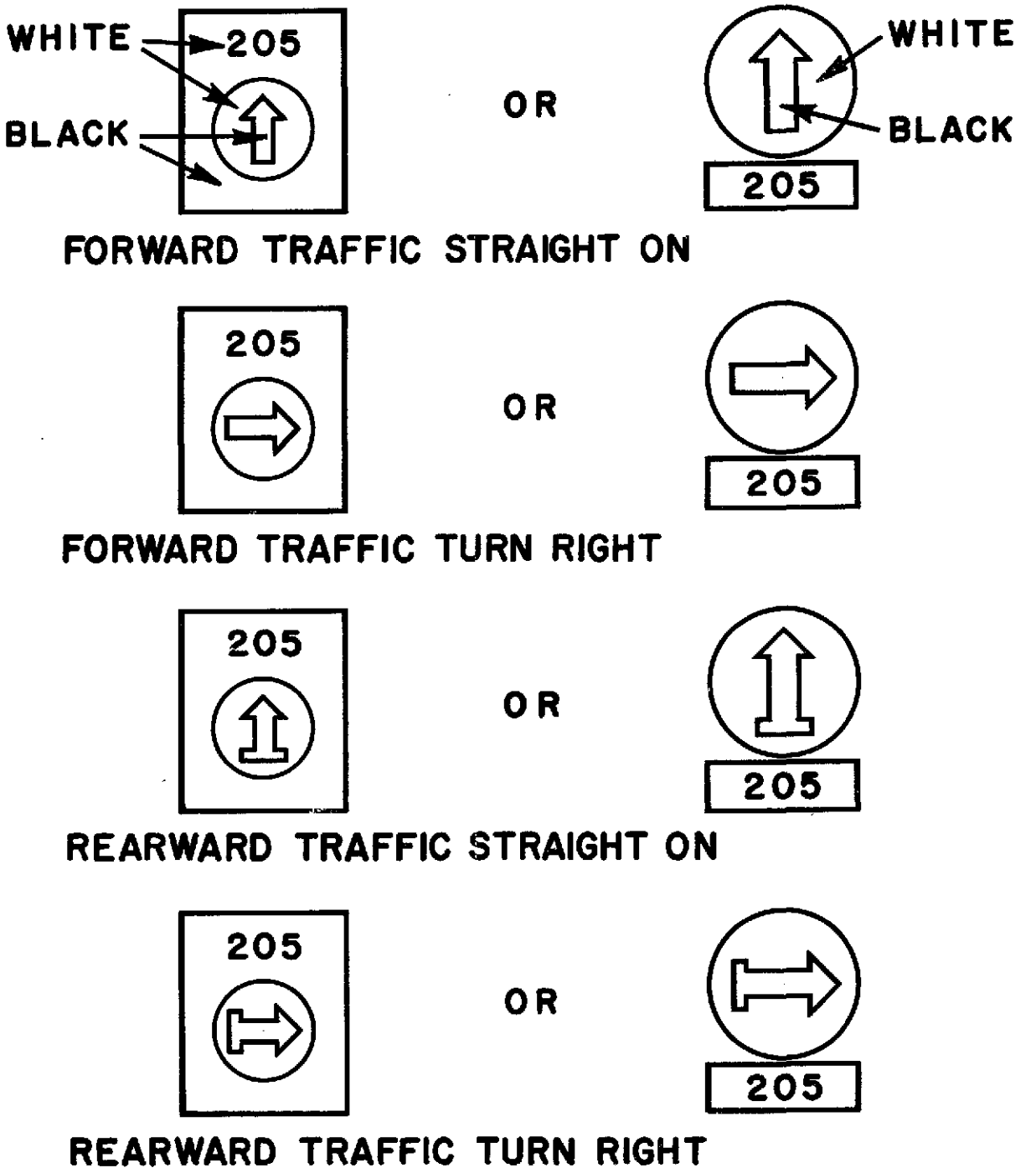


Figure 5-6. Military route guide signs for axial routes.

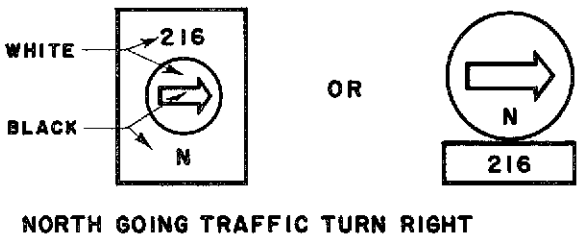


Figure 5–7. Military route guide signs for lateral routes.

(2) Illumination devices are positioned so as to be recognizable by oncoming vehicles at a road distance of 100 meters and readable at a distance of 30 meters.

5–15. Specifications for Route Sign Lighting

a. The system of lighting must remain operational for a minimum of 15 hours without refueling or change of batteries. If the source of light is of an expendable type (such as battery, liquid fuel, etc.), quiet and simple replacement must be possible under combat conditions.

b. When the method of illumination is an independent light source, the equipment must be of light weight, easily stored and transported in small vehicles. Likewise, the system of lighting must be shock, fire, and weather resistant and simple to install and operate.

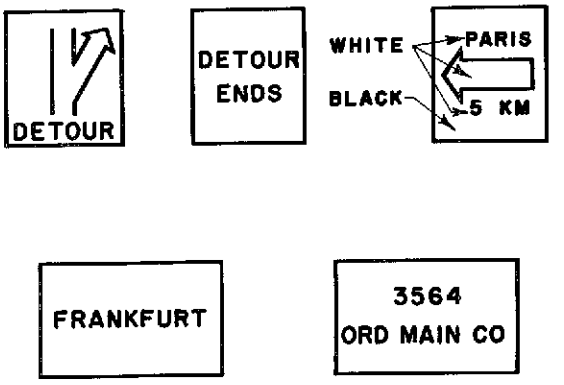


Figure 5–8. Examples of other guide signs.

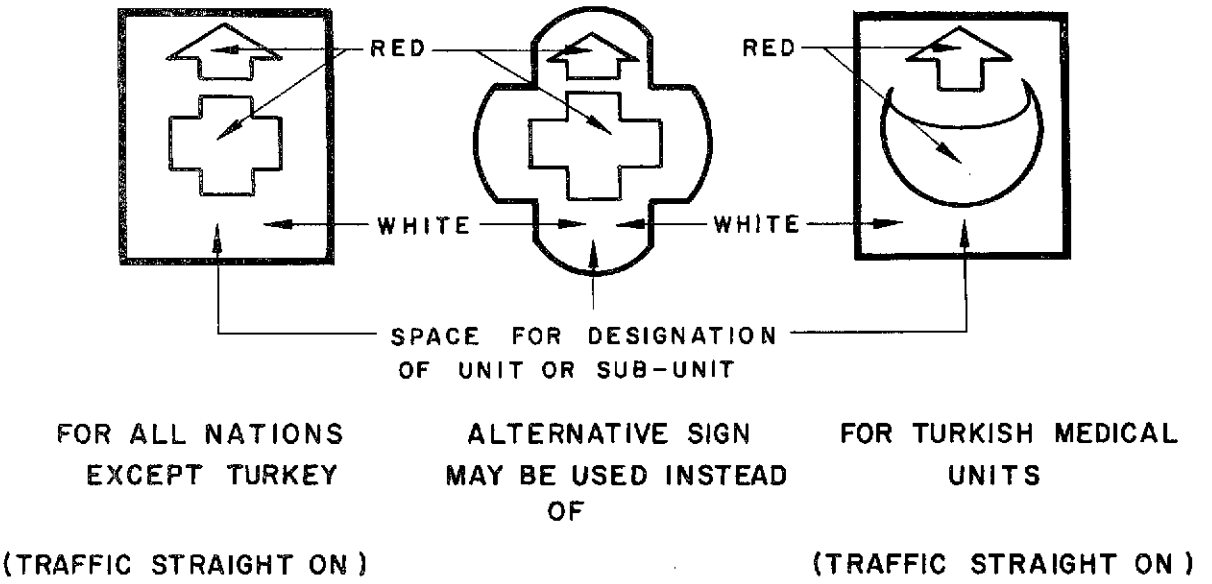


Figure 5–9. Examples of guide signs for casualty evacuation routes.

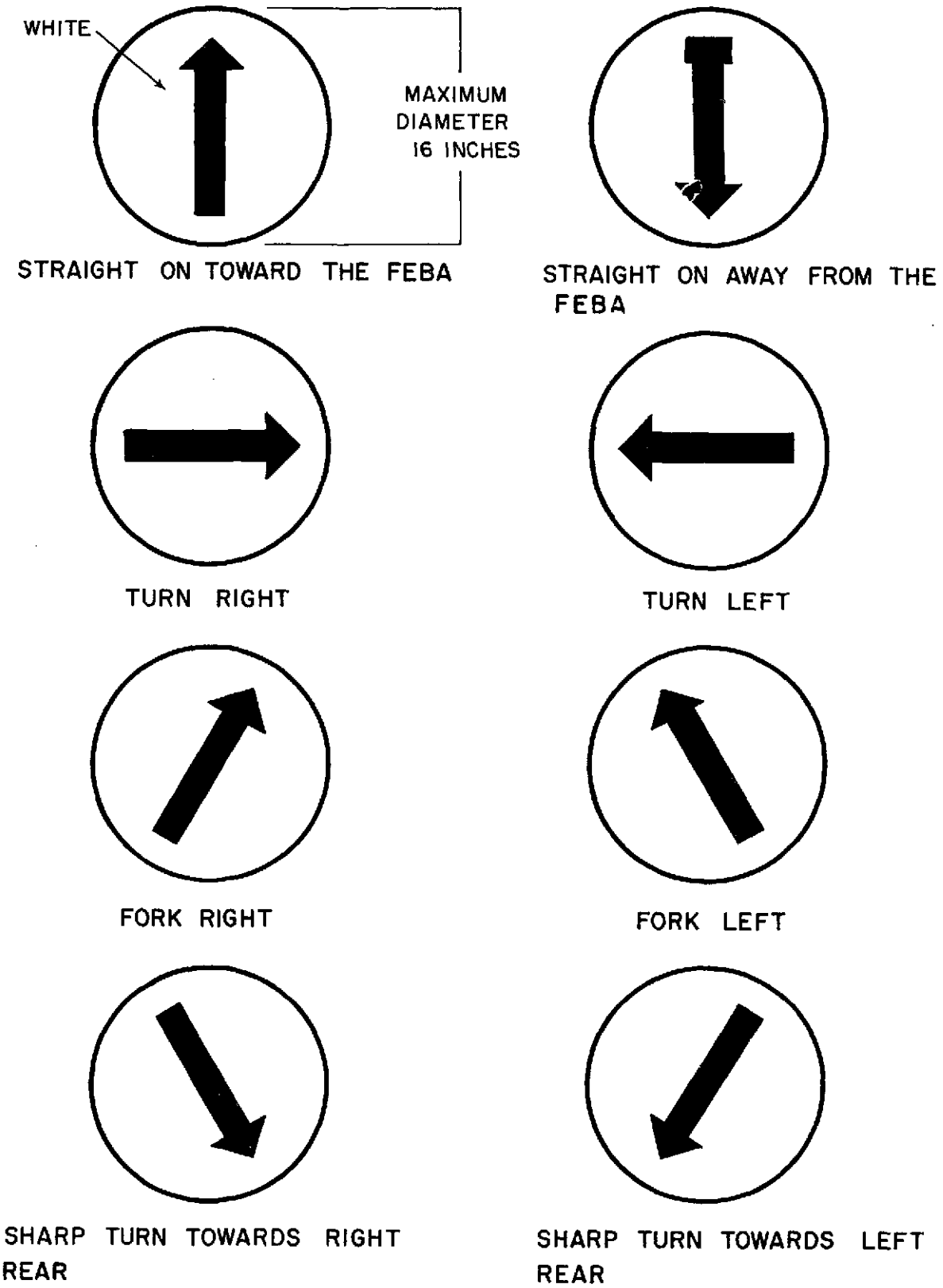


Figure 5-10. Examples of directional disks.

DIRECTION ARROW

(made of paper, synthetic materials, wood, etc)

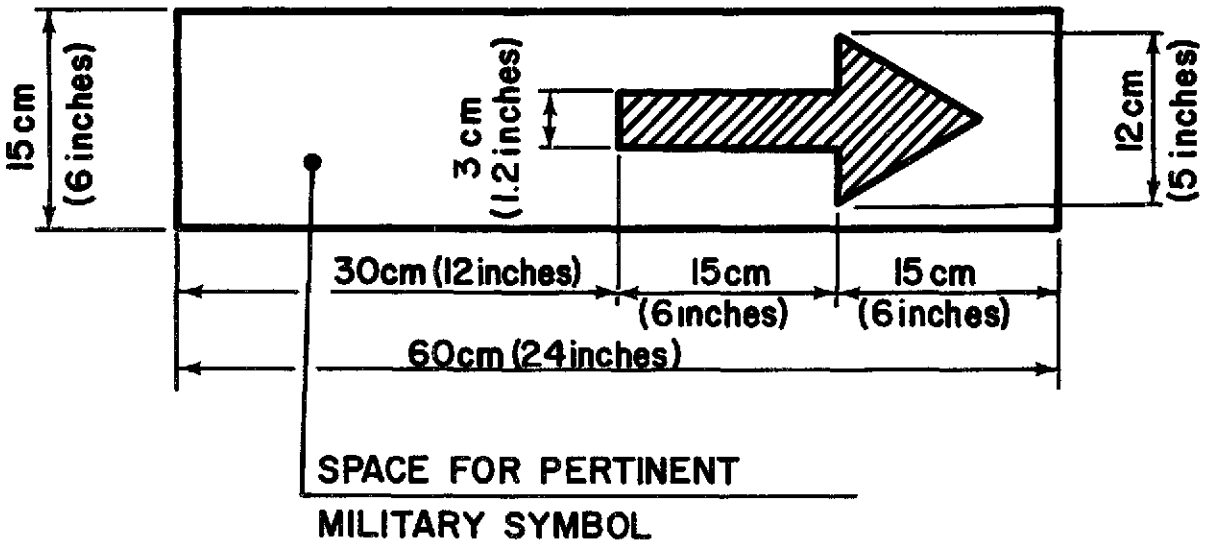


Figure 5-11. Unit direction arrow.

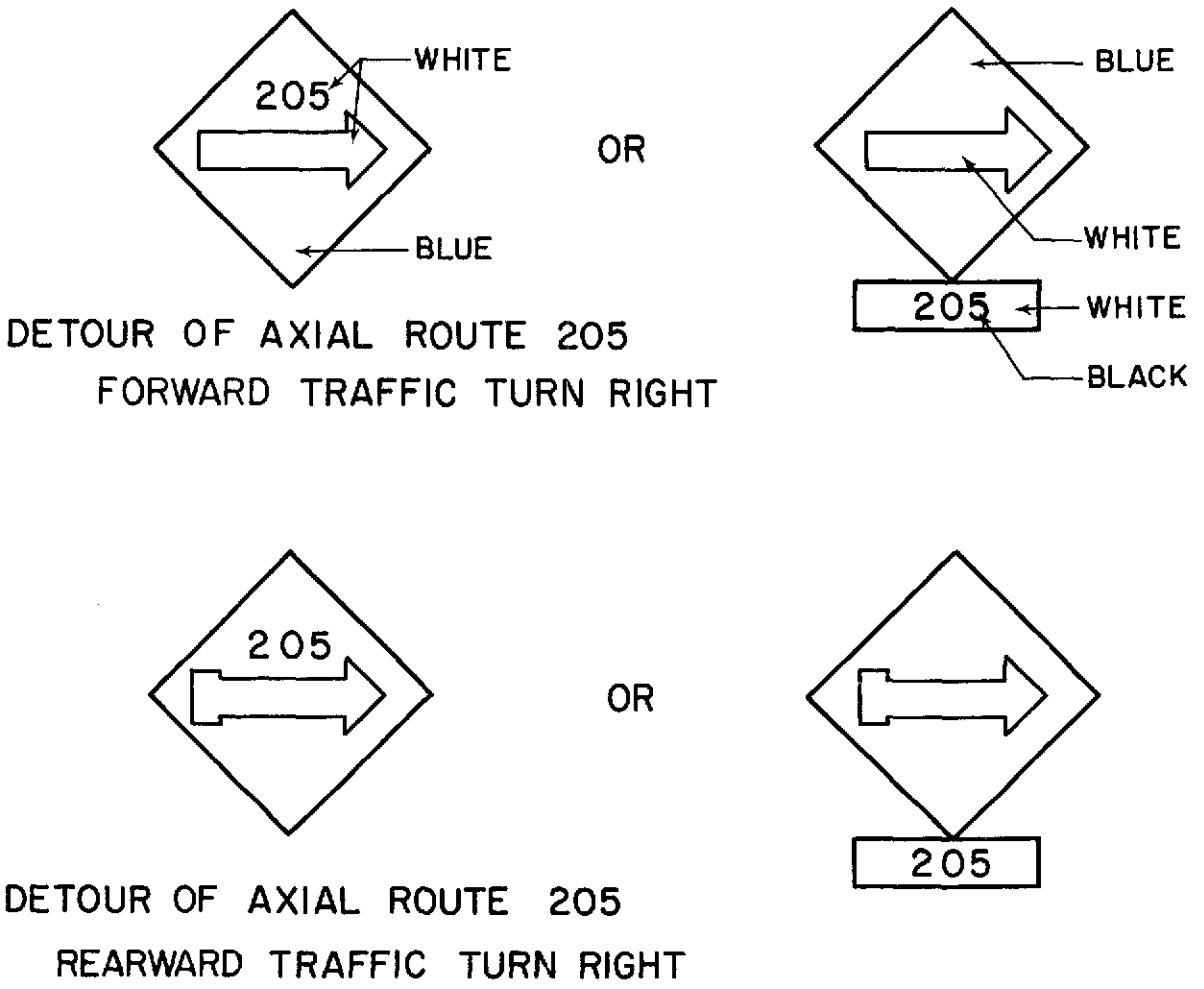
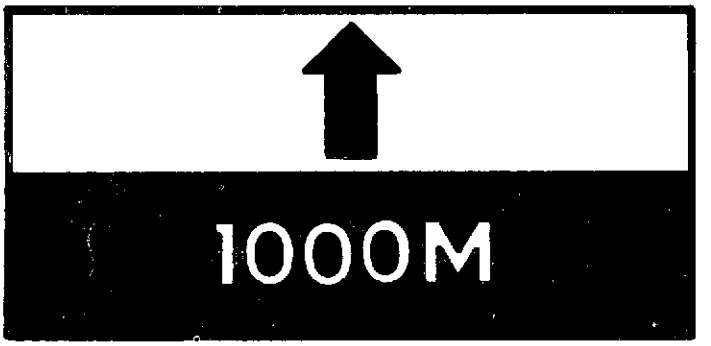


Figure 5-12. Examples of detour signs.

SIZE OF SIGN: 70cm X 60 cm

COLORS: WHITE LETTERING ON BLACK BACKGROUND.

A. WARNING SIGN



B. ENFORCE-MENT SIGN

Figure 5–13. Light line enforcement and warning signs.

APPENDIX I

REFERENCES

1. Army Regulations

AR 117–5	Military Mapping and Geodesy
AR 320–5	Dictionary of United States Army Terms
AR 320–50	Authorized Abbreviations and Brevity Codes
AR 525–8	Use of Metric System for Linear Measurement in United States Army Operations
AR 746–5	Color and Marking of Army Materiel

2. Field Manuals

FM 1–80	Aerial Observer Training
FM 1–100	Army Aviation
FM 1–130	Operation of the AN/USD–1 Surveillance Drone System
FM 3–8	Chemical Corps Reference Handbook
FM 3–12	Operational Aspects of Radiological Defense
FM 5–1	Engineer Troop Organizations and Operations
FM 5–25	Explosives and Demolitions
FM 5–29	Passage of Mass Obstacles
FM 5–30	Engineer Intelligence
FM 5–34	Engineer Field Data
FM 5–35	Engineers' Reference and Logistical Data
FM 6–135	Adjustment of Artillery Fire by the Combat Soldier
FM 17–1	Armor Operations
FM 17–35	Armored Cavalry Platoon, Troop, and Squadron
FM 17–36	Divisional Armored and Air Cavalry Units
FM 17–95	Armored Cavalry Regiment
FM 19–25	Military Police Traffic Control
FM 20–32	Land Mine Warfare
FM 21–26	Map Reading
FM 21–30	Military Symbols
FM 21–31	Topographic Symbols
FM 21–40	Small Unit Procedures in Chemical, Biological, and Radiological (CBR) Operations
FM 21–41	Soldier's Handbook for Chemical and Biological Operations and Nuclear Warfare
FM 21–60	Visual Signals

FM 21–75	Combat Training of the Individual Soldier and Patrolling
FM 21–76	Survival
FM 21–77	Evasion and Escape
FM 24–16	Signal Orders, Records, and Reports
FM 30–5	Combat Intelligence
FM 30–7	Combat Intelligence Battle Group, Combat Command, and Smaller Units
FM 30–10	Terrain Intelligence
FM 30–20	Aerial Surveillance
FM 31–25	Desert Operations
FM 31–30	Jungle Operations
FM 31–50	Combat in Fortified and Built-up Areas
FM 31–70	Basic Cold Weather Manual
FM 31–71	Northern Operations
FM 31–72	Mountain Operations
FM 55–8	Transportation Intelligence
FM 55–15	Transportation Reference Data
FM 55–30	Motor Transportation Operations
FM 57–35	Airmobile Operations
FM 57–38	Pathfinder Operations
FM 100–5	Field Service Regulations—Operations
FM 100–10	Field Service Regulations, Administration
FM 101–10	Staff Officers' Field Manual; Organizational, Technical and Logistical Data (Part I)
FM 110–101	Intelligence, Joint Landing Force Manual
FM 110–115	Amphibious Reconnaissance, Joint Landing Force Manual

3. Technical Manuals

TM 5–210	Military Floating Bridge Equipment
TM 5–216	Armored Vehicle Launched Bridge
TM 5–220	Passage of Obstacles other Than Minefields
TM 5–232	Elements of Surveying
TM 5–277	Panel Bridge, Bailey Type, M2
TM 5–312	Military Fixed Bridges
TM 5–330	Planning, Site Selection, and Design of Roads, Airfields, Heliports in the Theater of Operations
TM 5–335	Drainage Structures, Subgrades, and Base Courses
TM 5–530	Materials Testing
TM 5–700	Field Water Supply
TM 9–500	Ordnance Corps Equipment
TM 30–246	Tactical Interpretation of Air Photos

4. Other DA Publications

DA Pam 108–1	Index of Army Motion Pictures, Film Strips, Slides, and Phono Recordings
DA Pam 310–1	Index of Administrative Publications

DA Pam 310–2	Index of Blank Forms
DA Pam 310–3	Index of Doctrinal, Training, and Organizational Publications
DA Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, Supply Bulletins, Lubrication Orders, and Modification Work Orders
GTA 5–35	Bridge Classification Card
GTA 19–5	Route Signs—Classification, Application, and Design
GTA 19–6	Military Route (Itineraire) Signing—NATO
TA 50–901	Clothing and Equipment (Peace)
TA 50–902	Clothing and Equipment (Mobilization)
TA 50–914	Individual Safety and Protective Clothing and Equipment

APPENDIX II

CONVERSION TABLES, TRIGONOMETRIC RELATIONS, AND NUMERICAL FUNCTIONS

II–1 Conversion Tables

a. Meters to Feet; Feet to Meters.

(1 Meter=3.2808 Feet; 1 Foot=0.3048 Meter)

Meters	Feet or Meters	Feet	Meters	Feet or Meters	Feet
0.3048	1	3.2808	11.8872	39	127.9525
0.6096	2	6.5617	12.1920	40	131.2333
0.9144	3	9.8425	12.4968	41	134.5141
1.2192	4	13.1233	12.8016	42	137.7950
1.5240	5	16.4042	13.1064	43	141.0758
1.8288	6	19.6850	13.4112	44	144.3566
2.1336	7	22.9658	13.7160	45	147.6375
2.4384	8	26.2467	14.0208	46	150.9183
2.7432	9	29.5275	14.3256	47	154.1991
3.0480	10	32.8083	14.6304	48	157.4800
3.3528	11	36.0891	14.9352	49	160.7608
3.6576	12	39.3700	15.2400	50	164.0416
3.9624	13	42.6508	15.5449	51	167.3224
4.2672	14	45.9316	15.8497	52	170.6033
4.5720	15	49.2125	16.1545	53	173.8841
4.8768	16	52.4933	16.4593	54	177.1649
5.1816	17	55.7741	16.7641	55	180.4458
5.4864	18	59.0550	17.0689	56	183.7266
5.7912	19	62.3358	17.3737	57	187.0074
6.0960	20	65.6167	17.6785	58	190.2883
6.4008	21	68.8975	17.9833	59	193.5691
6.7056	22	72.1784	18.2881	60	196.8500
7.0104	23	75.4592	18.5929	61	200.1308
7.3152	24	78.7400	18.8977	62	203.4117
7.6200	25	82.0209	19.2025	63	206.6925
7.9248	26	85.3017	19.5073	64	209.9733
8.2296	27	88.5825	19.8121	65	213.2542
8.5344	28	91.8634	20.1169	66	216.5350
8.8392	29	95.1442	20.4217	67	219.8158
9.1440	30	98.4250	20.7265	68	223.0967
9.4488	31	101.7058	21.0313	69	226.3775
9.7536	32	104.9867	21.3361	70	229.6583
10.0584	33	108.2675	21.6409	71	232.9391
10.3632	34	111.5483	21.9457	72	236.2200
10.6680	35	114.8292	22.2505	73	239.5008
10.9728	36	118.1100	22.5553	74	242.7816
11.2776	37	121.3908	22.8601	75	246.0625
11.5824	38	124.6717	23.1649	76	249.3433

(1 Meter=3.2808 Feet; 1 Foot=0.3048 Meter)

Meters	Feet or Meters	Feet	Meters	Feet or Meters	Feet
23.4697	77	252.6241	27.1273	89	291.9942
23.7745	78	255.9050	27.4321	90	295.2750
24.0793	79	259.1858	27.7369	91	298.5558
24.3841	80	262.4667	28.0417	92	301.8367
24.6889	81	265.7475	28.3465	93	305.1175
24.9937	82	269.0284	28.6513	94	308.3983
25.2985	83	272.3092	28.9561	95	311.6792
25.6033	84	275.5900	29.2609	96	314.9600
25.9081	85	278.8709	29.5657	97	318.2408
26.2129	86	282.1517	29.8705	98	321.5217
26.5177	87	285.4325	30.1753	99	324.8025
26.8225	88	288.7134	30.4801	100	328.0833

b. Millimeters and Equivalent Decimals of Inches.

ADVANCING BY 1 MM

MM	Inches	MM	Inches	MM	Inches	MM	Inches
1	.03937	26	1.02362	51	2.00787	76	2.99212
2	.07874	27	1.06299	52	2.04724	77	3.03149
3	.11811	28	1.10236	53	2.08661	78	3.07086
4	.15748	29	1.14173	54	2.12598	79	3.11023
5	.19685	30	1.18110	55	2.16535	80	3.14960
6	.23622	31	1.22047	56	2.20472	81	3.18897
7	.27559	32	1.25984	57	2.24409	82	3.22834
8	.31496	33	1.29921	58	2.28346	83	3.26771
9	.35433	34	1.33858	59	2.32283	84	3.30708
10	.39370	35	1.37795	60	2.36220	85	3.34645
11	.43307	36	1.41732	61	2.40157	86	3.38582
12	.47244	37	1.45669	62	2.44094	87	3.42519
13	.51181	38	1.49606	63	2.48031	88	3.46456
14	.55118	39	1.53543	64	2.51968	89	3.50393
15	.59055	40	1.57480	65	2.55905	90	3.54330
16	.62992	41	1.61417	66	2.59842	91	3.58267
17	.66929	42	1.65354	67	2.63779	92	3.62204
18	.70866	43	1.69291	68	2.67716	93	3.66141
19	.74803	44	1.73228	69	2.71653	94	3.70078
20	.78740	45	1.77165	70	2.75590	95	3.74015
21	.82677	46	1.81102	71	2.79527	96	3.77952
22	.86614	47	1.85039	72	2.83464	97	3.81889
23	.90551	48	1.88976	73	2.87401	98	3.85826
24	.94488	49	1.92913	74	2.91338	99	3.89673
25	.98425	50	1.96850	75	2.95275	100	3.93700

c. Time Distance Conversion.

Miles per hour	Knots	Feet per second	Kilometers per hour	Meters per second
1	0.8684	1.4667	1.6093	0.447
2	1.74	2.94	3.23	0.897
3	2.59	4.41	4.83	1.34
4	3.46	5.90	6.45	1.78

Miles per hour	Knots	Feet per second	Kilometers per hour	Meters per second
5	4.34	7.33	8.05	2.23
6	5.20	8.80	9.65	2.68
7	6.07	10.30	11.30	3.13
8	6.95	11.80	12.90	3.58
9	7.81	13.22	14.50	4.03
10	8.68	14.67	16.09	4.47
11	9.55	16.20	17.70	4.92
12	10.40	17.62	19.30	5.37
13	11.23	19.10	20.90	5.82
14	12.10	20.60	22.60	6.27
15	13.00	22.10	24.20	6.71
16	13.90	23.50	25.80	7.16
17	14.75	25.00	27.40	7.63
18	15.60	26.40	28.90	8.05
19	16.45	28.00	30.60	8.50
20	17.40	29.30	32.20	8.95
21	18.20	30.90	33.80	9.39
22	19.10	32.30	35.40	9.85
23	20.00	33.80	37.10	10.30
24	20.80	35.30	38.60	10.75
25	21.70	36.70	40.30	11.15
26	22.50	38.20	41.90	11.60
27	23.40	39.70	43.50	12.10
28	24.30	41.20	45.10	12.50
29	25.20	42.60	46.70	13.00
30	26.00	44.20	48.30	13.40
31	26.90	45.60	50.00	13.90
32	27.80	47.00	51.50	14.30
33	28.60	48.50	53.00	14.73
34	29.50	50.00	54.55	15.20
35	30.40	51.50	56.50	15.65
36	31.20	53.00	58.00	16.10
37	32.00	54.50	59.70	16.50
38	32.90	56.00	61.40	17.00
39	33.80	57.50	62.80	17.40
40	34.60	58.80	64.50	17.83
41	35.60	60.50	66.00	18.38
42	36.40	61.90	67.70	18.80
43	37.30	63.40	69.20	19.20
44	38.20	64.80	71.00	19.70
45	38.90	66.50	72.50	20.20
46	40.00	67.50	74.00	20.60
47	40.70	69.70	75.90	21.00
48	41.50	70.50	77.50	21.40
49	42.40	72.00	79.00	21.80
50	43.50	73.80	80.50	22.30
51	44.10	74.90	82.00	22.80
52	45.10	76.50	83.60	23.20
53	46.00	78.00	85.70	23.70
54	46.70	79.50	87.00	24.20
55	47.50	80.90	88.70	24.60
56	48.50	82.20	90.00	25.00
57	49.50	83.90	91.90	25.50
58	50.10	85.00	93.40	25.90
59	51.00	86.80	95.00	26.40
60	52.00	88.10	96.70	26.80
61	53.00	89.60	98.00	27.20

Miles per hour	Knots	Feet per second	Kilometers per hour	Meters per second
62	53.70	91.10	99.80	27.70
63	54.60	92.90	101.70	28.20
64	55.60	94.20	103.00	28.60
65	56.20	95.30	104.50	29.10
66	57.20	97.00	106.00	29.50
67	58.00	98.20	108.00	30.00
68	58.90	100.00	109.50	30.40
69	59.80	101.80	111.00	30.80
70	60.70	103.00	113.00	31.30
71	61.60	104.00	114.00	31.70
72	62.50	106.00	116.00	32.20
73	63.30	107.30	117.30	32.60
74	64.20	109.00	119.00	33.10
75	65.00	110.00	121.00	33.60
100	87.00	147.60	161.00	44.60

II-2 Conversion Factors

a. Linear Measure.

Meters*	Inches	Feet	Yards	Miles		Kilometers	Fathoms
				Statute	Nautical**		
1.0	39.37	3.28083	1.09361	0.0006214	0.0005396	0.001	0.546
.0254	1.0	.0833	.0278	.00001578	.00001371	.0000254	.0139
.3048	12.0	1.0	.3333	.0001894	.0001645	.0003048	.167
.9144	36.0	3.0	1.0	.0005682	.0004934	.0009144	.500
5.0292	198.0	16.5	5.5	.003125	.002714	.005029	2.76
20.1168	792.0	66.0	22.0	.0125	.01085	.02012	11.0
1,609.35	63,360.0	5,280.0	1,760.0	1.0	.8684	1.6094	879.0
1,853.25	72,962.5	6,080.2	2,026.73	1.15155	1.0	1.85325	1,010.0
1,000.0	39,370.0	3,280.83	1,093.61	.6214	.5396	1.0	546.0
219.5	8,640.0	720.0	240.0	.1364	.1184	.2195	120.0
1.829	72.0	6.0	2.0	.00114	.00098	.00183	1.0

* 1 meter = 10 decimeters = 100 centimeters = 1,000 millimeters.
**A nautical mile is the length on the earth's surface of an arc subtended by one minute of angle at the center of the earth.

b. Surface Measure.

Square meters	Square inches	Square feet	Square yards	Square rods	Square miles (statute)	Square kilometers
1.0	1,550.0	10.764	1.196	0.03954	0.000000386	0.000001
.00065	1.0	.0069	.00077	.00000026	.00000000025	.00000000065
.0929	144.0	1.0	.1111	.00367	.0000000359	.0000000929
.8361	1,296.0	9.0	1.0	.0331	.000000323	.000000836
25.293	39,204.0	272.25	30.25	1.0	.00000977	.0000253
4,046.8	6,272,640.0	43,560.0	4,840.0	160.0	.00156	.00405
10,000.0	15,499,969.0	107,639.0	11,960.0	395.37	.00386	.01
2,589,999.0	Sq ft × 144	27,878,400.0	3,097,600.0	102,400.0	1.0	2.59
1,000,000.0	Sq ft × 144	10,763,867.0	1,195,985.0	39,537.0	.3861	1.0

c. Cubic Measure.

Cubic centimeters	Cubic inches	Cubic feet	Cubic yards	U. S. gallons		Measurement tons
				Liquid	Dry	
1.0	0.061	0.0000353	0.0000013	0.000264	0.000227	0.00000088
1,000.0	61.023	.0353	.00131	.2642	.227	.000882
16.39	1.0	.0005787	.0000214	.00433	.00372	.0000144
28,317.0	1,728.0	1.0	.03704	7.481	6.4285	.025
764,559.0	46,656.0	27.0	1.0	201.974	173.57	.677
946.4	57.75	.03342	.00124	.25	.2148	.000837
1,101.2	67.201	.03889	.00144	.2909	.25	.000975
3,785.4	231.0	.13368	.00495	1.0	.8594	.00335
4,404.9	268.803	.15556	.00576	1.1636	1.0	.00388
35,239.3	2,150.42	1.2445	.0461	9.3092	8.0	.0312
1,130,000.0	69,120.0	40.0	1.48	298.0	256.0	1.0

d. Angular Conversions.

Circle	Degrees	Minutes	Seconds	Mils
1.0	360.0	21,600.0	1,296,000	6,400.0
.16	57.3	3,430.0	206,000	1,018.6
.00279	1.0	60.0	3,600	17.778
.0000463	.0167	1.0	60	.297
.00000078	.00028	.0167	1	.00495
.000157	.05625	3.375	202	1.0
.25	90.0	5,400.0	324,000	1,600.0
.50	180.0	10,800.0	648,000	3,200.0

e. Weight.

Kilograms (kg)	Pounds		Tons		
	Troy	Avoirdupois (avdp)	Short (2,000 lb)	Long (2,240 lb)	Metric (1,000 kg)
1.0	2.67923	2.20462	0.001102	0.0009842	0.001
.0000648	.0001736	.0001429	.00000007	.00000006	.00000006
.0311	.08333	.06857	.00003429	.00003061	.0000311
.02385	.07595	.0625	.00003125	.0000279	.00002835
.37324	1.0	.82286	.0004114	.0003674	.0003732
.45359	1.21528	1.0	.0005	.0004464	.004536
907.185	2,430.56	2,000.0	1.0	.89286	.90719
1,016.05	2,722.22	2,240.0	1.12	1.0	1.01605
1,000.0	2,679.23	2,204.62	1.10232	.98421	1.0

f. Speed.

Meters per second	Meters per minute	Feet per second	Feet per minute	Miles per hour	Knots per hour	Kilometers per hour
1.0	60.0	3.28083	196.8	2.23693	1.94254	3.6
.0167	1.0	.055	3.3	.0376	.0324	.06
.30480	18.2	1.0	60.0	.68182	.59209	1.09728
.00505	.303	.0167	1.0	.0113	.0097	.0182
.44704	26.9	1.4667	88.0	1.0	.86839	1.60935
.51479	30.9	1.68894	101.0	1.15155	1.0	1.85325
.27778	16.7	.91134	54.7	.62137	.53959	1.0

g. Temperature.

°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
—66	—54.4	—40	—40.0	—14	—25.6	12	—11.1	38	3.3	64	17.8	90	32.2	116	46.6
—65	—53.9	—39	—39.4	—13	—25.0	13	—10.6	39	3.9	65	18.3	91	32.8	117	47.2
—64	—53.3	—38	—38.9	—12	—24.4	14	—10.0	40	4.4	66	18.9	92	33.3	118	47.8
—63	—52.7	—37	—38.3	—11	—23.9	15	— 9.4	41	5.0	67	19.4	93	33.9	119	48.3
—62	—52.2	—36	—37.8	—10	—23.3	16	— 8.9	42	5.6	68	20.0	94	34.4	120	48.9
—61	—51.6	—35	—37.2	— 9	—22.8	17	— 8.3	43	6.1	69	20.6	95	35.0	121	49.4
—60	—51.1	—34	—36.7	— 8	—22.2	18	— 7.8	44	6.7	70	21.1	96	35.6	122	50.0
—59	—50.6	—33	—36.1	— 7	—21.7	19	— 7.2	45	7.2	71	21.7	97	36.1	123	50.6
—58	—50.0	—32	—35.6	— 6	—21.1	20	— 6.7	46	7.8	72	22.2	98	36.7	124	51.1
—57	—49.4	—31	—35.0	— 5	—20.6	21	— 6.1	47	8.3	73	22.8	99	37.2	125	51.7
—56	—48.9	—30	—34.4	— 4	—20.0	22	— 5.6	48	8.9	74	23.3	100	37.8	126	52.2
—55	—48.3	—29	—33.9	— 3	—19.5	23	— 5.0	49	9.4	75	23.9	101	38.3	127	52.7
—54	—47.8	—28	—33.3	— 2	—18.9	24	— 4.4	50	10.0	76	24.4	102	38.9	128	53.3
—53	—47.2	—27	—32.8	— 1	—18.3	25	— 3.9	51	10.6	77	25.0	103	39.4	129	53.9
—52	—46.6	—26	—32.2	0	—17.8	26	— 3.3	52	11.1	78	25.6	104	40.0	130	54.4
—51	—46.1	—25	—31.7	1	—17.2	27	— 2.8	53	11.7	79	26.1	105	40.6		
—50	—45.6	—24	—31.1	2	—16.7	28	— 2.2	54	12.2	80	26.7	106	41.1		
—49	—45.0	—23	—30.6	3	—16.1	29	— 1.7	55	12.8	81	27.2	107	41.6		
—48	—44.4	—22	—30.0	4	—15.6	30	— 1.1	56	13.3	82	27.8	108	42.2		
—47	—43.9	—21	—29.4	5	—15.0	31	— 0.6	57	13.9	83	28.3	109	42.7		
—46	—43.3	—20	—28.9	6	—14.4	32	0	58	14.4	84	28.9	110	43.3		
—45	—42.8	—19	—28.3	7	—13.9	33	0.6	59	15.0	85	29.4	111	43.9		
—44	—42.2	—18	—27.8	8	—13.3	34	1.1	60	15.6	86	30.0	112	44.4		
—43	—41.6	—17	—27.2	9	—12.8	35	1.7	61	16.1	87	30.6	113	45.0		
—42	—41.1	—16	—26.7	10	—12.2	26	2.2	62	16.7	88	31.1	114	45.6		
—41	—40.6	—15	—26.1	11	—11.7	37	2.8	63	17.2	89	31.7	115	46.1		

h. Simplified Conversion Factors for Quick Computation. The following are accurate to within 2 percent:

Inches to centimeters—Multiply by 10 and divide by 4.
Yards to meters —Multiply by 9 and divide by 10.
Miles to kilometers —Multiply by 8 and divide by 5.
Gallons to liters —Multiply by 4 and subtract ⅛ of the number of gallons.
Pounds to kilograms—Multiply by 5 and divide by 11.

$°C. = \frac{5}{9}(°F. - 32)$

$°F. = \frac{9}{5}\ °C. + 32$

II–3 Map-Distance Conversion

a. Table.

Map distance	Ground distance	Representative fraction (RF) 1/25,000	1/50,000	1/75,000	1/100,000	1/200,000	1/250,000	1/500,000	1/1,000,000
One inch	Inches	25,000	50,000	75,000	100,000	200,000	250,000	500,000	1,000,000
	Feet	2,083	4,167	6,250	8,333	16,667	20,833	41,667	83,333
	Yards	694	1,389	2,083	2,778	5,555	6,944	13,888	27,776
	Kilometers	.635	1.27	1.91	2.54	5.08	6.35	12.7	25.4
	Miles	.393	.790	1.19	1.58	3.15	3.94	7.9	15.76
	Meters	635	1,270	1,910	2,540	5,080	6,350	12,700	25,400
One centemeter.	Inches	9,843	19,685	29,528	39,370	78,740	98,425	196,850	393,700
	Feet	820	1,640	2,460	3,281	6,562	8,202	16,404	32,808
	Yards	273	547	820	1,094	2,187	2,734	5,468	10,936
	Kilometers	.250	.500	.750	1.0	2.0	2.5	5.0	10.0
	Miles	.154	.31	.465	.62	1.24	1.55	3.1	6.2
	Meters	250	500	750	1,000	2,000	2,500	5,000	10,000

b. Examples of use.

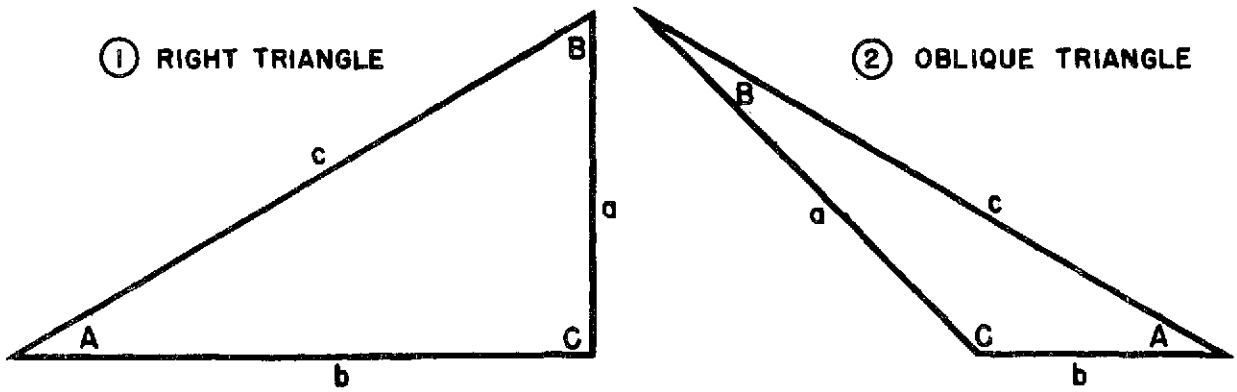
(1) A map distance of 1 inch is equivalent to a ground distance of 4,167 feet on a map with RF of 1/50,000.

(2) A map distance of 1 inch is equivalent to a ground distance of 3.15 miles on a map with RF of 1/200,000.

(3) A map distance of 1 centimeter is equivalent to a ground distance of 273 yards on a map with RF of 1/25,000.

II-4 Trigonometric Functions

a. Trigonometric Relations.



$$\text{Sin } A = \frac{a}{c} \qquad \text{Cos } A = \frac{b}{c}$$

$$\text{Tan } A = \frac{a}{b} \qquad \text{Cot } A = \frac{b}{a}$$

$$\text{Sec } A = \frac{c}{b} \qquad \text{Csc } A = \frac{c}{a}$$

$$\text{Area} = \frac{ab}{2} = \frac{a}{2}\sqrt{c^2 - a^2} = \frac{a^2 \text{ Cot } A}{2} = \frac{b^2 \text{ Tan } A}{2} = \frac{c^2 \text{ Sin } 2A}{4}$$

$$a^2 = b^2 + c^2 - 2bc \text{ Cos } A$$

$$b^2 = a^2 + c^2 - 2ac \text{ Cos } B$$

$$c^2 = a^2 + b^2 - 2ab \text{ Cos } C$$

$$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$$

Where

$$s = \frac{a+b+c}{2}$$

b. Natural Trigonometric Functions.

Angle°	Sin	Cosec	Tan	Cotan	Sec	Cos	Angle°
0	0.000		0.000		1.000	1.000	90
1	.017	57.30	.017	57.29	1.000	1.000	89
2	.035	28.65	.035	28.64	1.001	.999	88
3	.052	19.11	.052	19.08	1.001	.999	87
4	.070	14.34	.070	14.30	1.002	.998	86
5	.087	11.47	.087	11.43	1.004	.996	85
6	.105	9.567	.105	9.514	1.006	.995	84
7	.122	8.206	.123	8.144	1.008	.993	83
8	.139	7.185	.141	7.115	1.010	.990	82
9	.156	6.392	.158	6.314	1.012	.988	81
	Cos	Sec	Cotan	Tan	Cosec	Sin	

Angle°	Sin	Cosec	Tan	Cotan	Sec	Cos	Angle°
10	.174	5.759	.176	5.671	1.015	.985	80
11	.191	5.241	.194	5.145	1.019	.982	79
12	.208	4.810	.213	4.705	1.022	.978	78
13	.225	4.445	.231	4.331	1.026	.974	77
14	.242	4.134	.249	4.011	1.031	.970	76
15	.259	3.864	.268	3.732	1.035	.966	75
16	.276	3.628	.287	3.487	1.040	.961	74
17	.292	3.420	.306	3.271	1.046	.956	73
18	.309	3.236	.325	3.078	1.051	.951	72
19	.326	3.072	.344	2.094	1.058	.946	71
20	.342	2.924	.364	2.747	1.064	.940	70
21	.358	2.790	.284	2.605	1.071	.934	69
22	.375	2.669	.404	2.475	1.079	.927	68
23	.391	2.559	.424	2.356	1.086	.921	67
24	.407	2.459	.445	2.246	1.095	.914	66
25	.423	2.366	.466	2.145	1.103	.906	65
26	.438	2.281	.488	2.050	1.113	.899	64
27	.454	2.203	.510	1.963	1.122	.891	63
28	.469	2.130	.532	1.881	1.133	.883	62
29	.485	2.063	.554	1.804	1.143	.875	61
30	.500	2.000	.577	1.732	1.155	.866	60
31	.515	1.942	.601	1.664	1.167	.857	59
32	.530	1.887	.625	1.600	1.179	.848	58
33	.545	1.836	.649	1.540	1.192	.839	57
34	.559	1.788	.675	1.483	1.206	.829	56
35	.574	1.743	.700	1.428	1.221	.819	55
36	.588	1.701	.727	1.376	1.236	.809	54
37	.602	1.662	.754	1.327	1.252	.799	53
38	.616	1.624	.781	1.280	1.269	.788	52
39	.629	1.589	.810	1.235	1.287	.777	51
40	.643	1.556	.839	1.192	1.305	.766	50
41	.656	1.542	.869	1.150	1.325	.755	49
42	.669	1.494	.900	1.111	1.346	.743	48
43	.682	1.466	.933	1.072	1.367	.731	47
44	.695	1.440	.966	1.036	1.390	.719	46
45	.707	1.414	1.000	1.000	1.414	.707	45
	Cos	Sec	Cotan	Tan	Cosec	Sin	

II-5 Functions of Numbers

No.	Square	Cube	Sq. root	Logarithm	No.	Square	Cube	Sq. root	Logarithm
1	1	1	1.0000	0.00000	51	2601	132651	7.1414	1.70757
2	4	8	1.4142	.30103	52	2704	140608	7.2111	1.71600
3	9	27	1.7321	.47712	53	2809	148877	7.2801	1.72428
4	16	64	2.0000	.60206	54	2916	157464	7.3485	1.73239
5	25	125	2.2361	.69897	55	3025	166375	7.4162	1.74036
6	36	216	2.4495	.77815	56	3136	175616	7.4833	1.74819
7	49	343	2.6458	.84510	57	3249	185193	7.5498	1.75587
8	64	512	2.8284	.90309	58	3364	195112	7.6158	1.76343
9	81	729	3.0000	.95424	59	3481	205379	7.6811	1.77085
10	100	1000	3.1623	1.00000	60	3600	216000	7.7460	1.77815
11	121	1331	3.3166	1.04139	61	3721	226981	7.8102	1.78533
12	144	1728	3.4641	1.07918	62	3844	238328	7.8740	1.79239
13	169	2197	3.6056	1.11394	63	3969	250047	7.9373	1.79934
14	196	2744	3.7417	1.14613	64	4096	262144	8.0000	1.80618
15	225	3375	3.8730	1.17609	65	4225	274625	8.0623	1.81291

No.	Square	Cube	Sq. root	Logarithm	No.	Square	Cube	Sq. root	Logarithm
16	256	4096	4.0000	1.20412	66	4356	287496	8.1240	1.81954
17	289	4913	4.1231	1.23045	67	4489	300763	8.1854	1.82607
18	324	5832	4.2426	1.25527	68	4624	314432	8.2462	1.83251
19	361	6859	4.3589	1.27875	69	4761	328509	8.3066	1.83885
20	400	8000	4.4721	1.30103	70	4900	343000	8.3666	1.84510
21	441	9261	4.5826	1.32222	71	5041	357911	8.4261	1.85126
22	484	10648	4.6904	1.34242	72	5184	373248	8.4853	1.85733
23	529	12167	4.7958	1.36173	73	5329	389017	8.5440	1.86332
24	576	13824	4.8990	1.38021	74	5476	405224	8.6023	1.86923
25	625	15625	5.0000	1.39794	75	5625	421875	8.6603	1.87506
26	676	17576	5.0990	1.41497	76	5776	438976	8.7178	1.88081
27	729	19683	5.1962	1.43136	77	5929	456533	8.7750	1.88649
28	784	21952	5.2915	1.44716	78	6084	474552	8.8318	1.89209
29	842	24389	5.3852	1.46240	79	6241	493039	8.8882	1.89763
30	900	27000	5.4772	1.47712	80	6400	512000	8.9443	1.90309
31	961	29791	5.5678	1.49136	81	6561	531441	9.0000	1.90849
32	1024	32768	5.6569	1.50515	82	6724	551368	9.0554	1.91381
33	1089	35937	5.7446	1.51851	83	6889	571787	9.1104	1.91908
34	1156	39304	5.8310	1.53148	84	7056	592704	9.1652	1.92428
35	1225	42875	5.9161	1.54407	85	7225	614125	9.2195	1.92942
36	1296	46656	6.0000	1.55630	86	7396	636056	9.2736	1.93450
37	1369	50653	6.0828	1.56820	87	7569	658503	9.3274	1.93952
38	1444	54872	6.1644	1.57978	88	7744	681472	9.3808	1.94448
39	1521	59319	6.2450	1.59106	89	7921	704969	9.4340	1.94939
40	1600	64000	6.3246	1.60206	90	8100	729000	9.4868	1.95424
41	1681	68921	6.4031	1.61278	91	8281	753571	9.5394	1.95904
42	1764	74088	6.4807	1.62325	92	8464	778688	9.5917	1.96379
43	1849	79507	6.5574	1.63347	93	8649	804357	9.6437	1.96848
44	1936	85184	6.6332	1.64345	94	8836	830584	9.6954	1.97313
45	2025	91125	6.7082	1.65321	95	9025	857375	9.7468	1.97772
46	2116	97336	6.7823	1.66276	96	9216	884736	9.7980	1.98227
47	2209	103823	6.8557	1.67210	97	9409	912673	9.8489	1.98677
48	2304	110592	6.9282	1.68124	98	9604	941192	9.8995	1.99123
49	2401	117649	7.0000	1.69020	99	9801	970299	9.9499	1.99564
50	2500	125000	7.0711	1.69897	100	10000	1000000	10.0000	2.00000

APPENDIX III

ORGANIZATION OF A TYPICAL MOUNTED ROUTE RECONNAISSANCE PATROL

III-1 General

To insure that reconnaissance patrols are adequately manned and equipped, the operational environment and the specific reconnaissance mission must be considered. Commanders and intelligence officers analyze the reconnaissance mission in the light of their unit's capabilities, both in personnel and equipment. If the mission is beyond organic capabilities, assistance should be expeditiously requested. Most units are required, at times, to conduct route reconnaissance during forward or retrograde movement. On the other hand, many organizations do not have organic reconnaissance elements, and the formation of temporary reconnaissance teams or patrols are necessary. General guidelines for organizing temporary patrols applicable to most situations are:

a. Personnel adequately trained in required reconnaissance techniques.

b. Means of transportation commensurate with the reconnaissance mission.

c. Proper equipment to conduct anticipated measurements and calculations.

d. Means of communication between patrol elements and the dispatching headquarters.

e. Special considerations such as fluency in the local language, security limitations on movement, identification and coordination in conducting passage through friendly lines.

III-2 Organization

A suggested organization for a route reconnaissance patrol is shown in figure III-1. This organization may be varied to meet the needs of the command and the operational environment.

III-3 Equipment

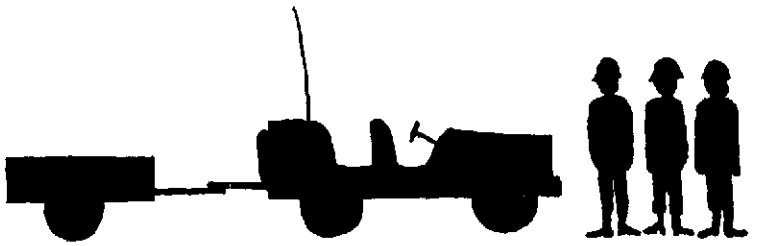
A check list in addition to individual weapons and equipment to accompany a typical route reconnaissance patrol is shown in Table III-1.

Table III-1. Suggested items to accompany route reconnaissance patrol.

Item	Quantity
Truck, utility, ¼ ton, 4x4	2
*Carrier, personnel, armored	2
Trailer, amphibious, cargo, ¼ ton	1
Machine gun, 7.62 mm	1
Pedestal, 7.62 mm machine gun mount	1
Launcher, grenade, 40 mm	1
Binocular 7x50	2
Goggles, sun, plastic	6
Radiacmeter, IM-93/UD	1
Radiacmeter, IM-174/PD	2
Detector kit, chemical agent, VGH, AN-M15A1A	1
Paper, chemical agent detector, VGH, ABC M8	1 bk
Wrist watch	2
Radio set AN/VRC-47, mounted in truck, ¼ ton	1

Item	Quantity
Radio set AN/PRC-25	1
Flashlight	4
Lensatic compass	2
Clinometer	1
Panel marking sets	2
Pioneer tools	1 set/vehicle
Towing chain	2
Material for marking fording and swimming sites	As required
Improvised means of measuring water depths	1
Measuring tape	2
Three-man pneumatic reconnaissance boat	1
Vehicular first aid kit	2
FM 5-34	1
Reconnaissance report forms and formats	As required
Adequate map and aerial photo coverage	As required
Tracing tape (tape, textile)	As required
Camera (polaroid)	1

* Desirable when operating in support of mechanized forces or in northern areas.



PATROL LEADER
RADIO OPERATOR/RECORDER
DRIVER

ASSISTANT PATROL LEADER
MACHINE GUNNER/OBSERVER
DRIVER

Figure III-1. Suggested organization of a route reconnaissance patrol.

APPENDIX IV

MILITARY LOAD CLASSIFICATION FOR STANDARD VEHICLES

IV–1. General

The vehicle classification list presented in this appendix is not complete. However, future changes to the manual will include data on new and current items of equipment as the information becomes available. Data on certain items of equipment no longer standard have been retained in the list when it was judged that their numbers in use by other nations warranted retention. Requests for classification of vehicles should be addressed direct to the Commanding Officer, U.S. Army Combat Developments Command Engineer Agency, Fort Belvoir, Va. 22060. The applicable following format, filled out as completely as possible and modified where required, must accompany each request.

a. Tracked vehicle (fig. IV–1).

b. Wheeled vehicle (fig. IV–2).

c. Trailer (fig. IV–3).

d. Semitrailer (fig. IV–4).

e. Combination track and wheel vehicle (fig. IV–5).

f. Combination wheeled vehicle (fig. IV–6).

g. Combination wheeled (truck-tractor) vehicle (fig. IV–7).

IV–2. Military Load Classification List

The symbols found in the heading of the listing are defined below:

E—Weight or class of vehicle w/o payload.

C—Weight or class of vehicle with rated maximum cross country payload.

H—Weight or class of vehicle with rated maximum highway payload.

The weight classification number to be posted on vehicles will be assigned from the number listed under the "C" subcolumn of the class column. This number is taken from the normal design load of the vehicle. Where no number appears in the "C" column, take the number appearing in the "H" column, and if both of these columns are blank take the number from the "E" column. The listing is organized into tables as follows:

Table IV–1. Tracked vehicles.

Table IV–2. Half-tracked vehicles.

Table IV–3. Wheeled vehicles.

Table IV–4. Towed vehicles.

a. Artillery.

b. Trailers.

c. Semitrailers.

Table IV–5. Construction equipment.

Table IV–6. Missile and fire distribution systems.

a. Pershing.

b. Sergeant.

c. Little John.

d. Honest John.

e. Hawk.

f. Nike-Ajax.

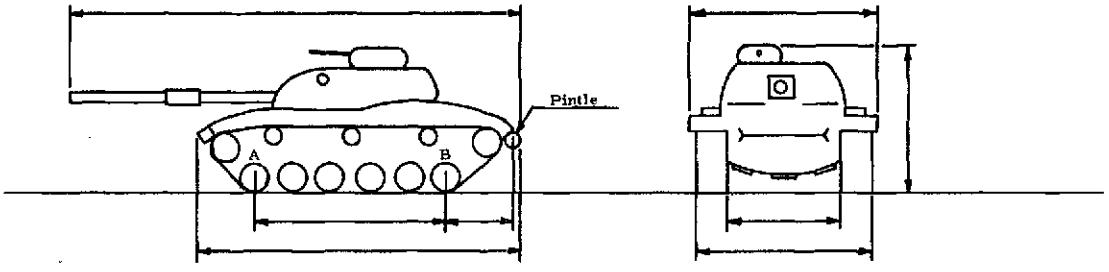
g. Nike-Hercules.

Table IV–7. Combination vehicles.

VEHICLE CLASSIFICATION DATA
TRACKED VEHICLE
DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category	Total Weight	Pay Load	Maximum Towed Load	Maximum Pintle Load
Empty (E)		X		
Laden Cross Country or off Highway (C)				
Laden on Highway (H)				



Traveling Load Category	LOAD		
	A - B	psi A - B	Pintle Maximum
Empty (E)			
Laden Cross Country or off Highway (C)			
Laden on Highway (H)			

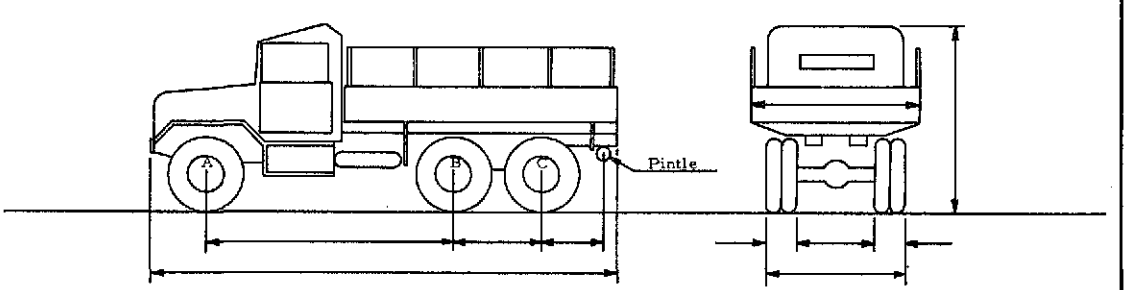
All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–1. Tracked vehicle.

VEHICLE CLASSIFICATION DATA
WHEELED VEHICLE
DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category		Total Weight	Pay Load	Maximum Towed Trailer Load	Maximum Pintle Load
Empty	(E)		X		
Laden Cross Country or off Highway	(C)				
Laden on Highway	(H)				



Traveling Load Category		Loads On				Front Tires			Rear Tires		
		A	B	C	Pintle	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty	(E)										
Laden Cross Country or off Highway	(C)										
Laden on Highway	(H)										

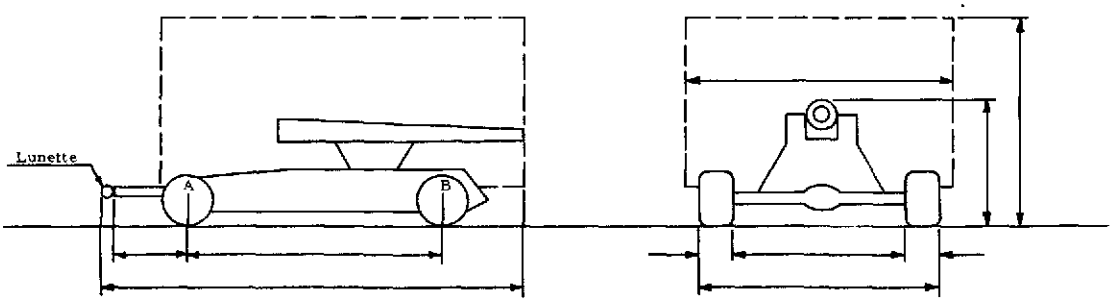
All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–2. Wheeled vehicle.

VEHICLE CLASSIFICATION DATA
TRAILER
DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category		Total Weight	Pay Load	Minimum Towing Vehicle
Empty	(E)			
Laden Cross Country or off Highway	(C)			
Laden on Highway	(H)			



Traveling Load Category		Load On			Front Tires			Rear Tires		
		A	B	Lunette	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty	(E)									
Laden Cross Country or off Highway	(C)									
Laden on Highway	(H)									

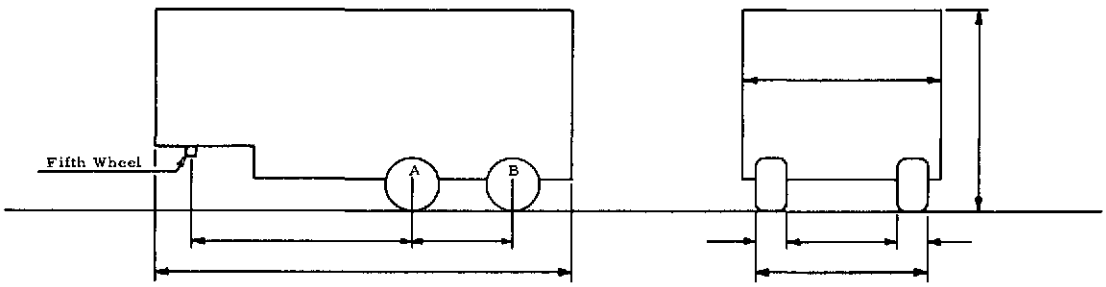
All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–3. Trailer.

VEHICLE CLASSIFICATION DATA
SEMITRAILER
DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category		Total Weight	Pay Load	Fifth Wheel	Minimum Towing Vehicle
Empty	(E)		X		
Laden Cross Country or off Highway	(C)				
Laden on Highway	(H)				



Traveling Load Category		Loads On			Dolly Tires			Rear Tires		
		A	B	Fifth Wheel	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty	(E)									
Laden Cross Country or off Highway	(C)									
Laden on Highway	(H)									

All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–4. Semitrailer.

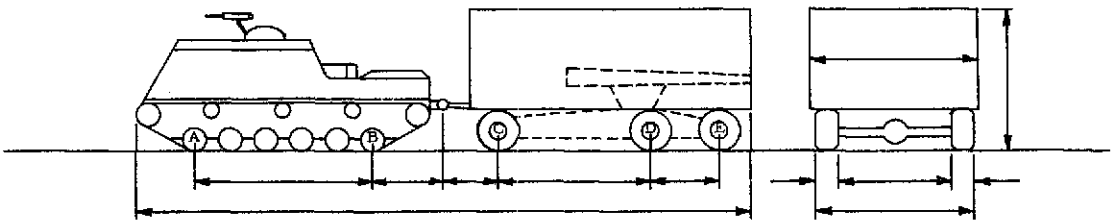
VEHICLE CLASSIFICATION DATA

COMBINATION TRACK AND WHEEL VEHICLE

DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLES

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category		Total Weight of Combination	Pay Load of Combination	Pintle Load
Empty	(E)		X	
Laden Cross Country or off Highway	(C)			
Laden on Highway	(H)			



Traveling Load Category		Loads On						Tires C			Tires D and E		
		A-B	psi A-B	C	D	E	Pintle	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty	(E)												
Laden Cross Country or off Highway	(C)												
Laden on Highway	(H)												

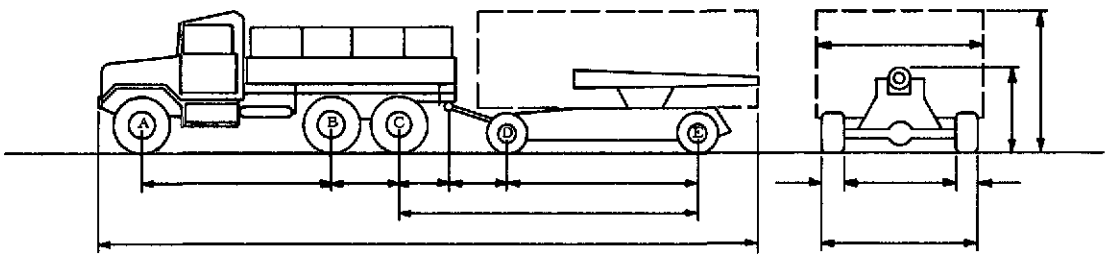
All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–5. Combination track and wheel vehicle.

VEHICLE CLASSIFICATION DATA
COMBINATION WHEELED VEHICLE
DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category	Total Weight of Combination	Pay Load of Combination	Lunette
Empty (E)		X	
Laden Cross Country or off Highway (C)			
Laden on Highway (H)			



Traveling Load Category	Loads On						Tires								
							A			B and C			D/E		
	A	B	C	D	E	Lunette	Number Per Axle	Size	psi	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty (E)															
Laden Cross Country or off Highway (C)															
Laden on Highway (H)															

All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–6. Combination wheeled vehicle.

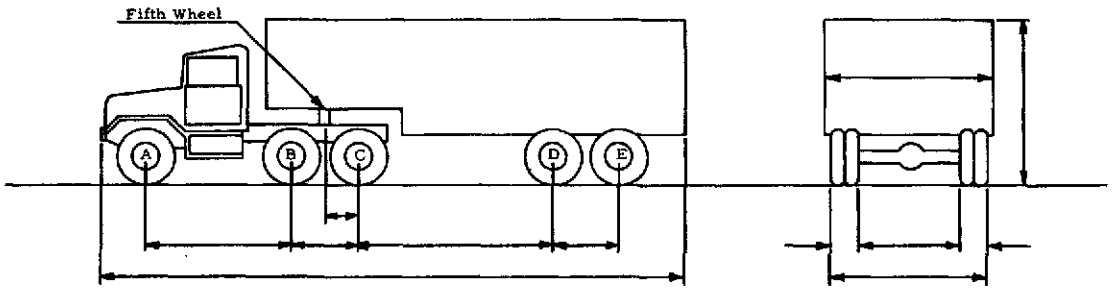
VEHICLE CLASSIFICATION DATA

COMBINATION WHEELED (TRUCK-TRACTOR) VEHICLE

DATA REQUIRED FOR IDENTIFICATION AND LOAD CLASSIFICATION OF SUBJECT VEHICLE

Nomenclature:
Model Number:
Manufacturer:
Federal Stock Number (FSN):

Traveling Load Category		Total Weight of Combination	Pay Load of Combination	Fifth Wheel
Empty	(E)			
Laden Cross Country or off Highway	(C)			
Laden on Highway	(H)			



Traveling Load Category		Loads On						Front Tire A			Tires B and C			Tires D and E		
		A	B	C	D	E	Fifth Wheel	Number Per Axle	Size	psi	Number Per Axle	Size	psi	Number Per Axle	Size	psi
Empty	(E)															
Laden Cross Country or off Highway	(C)															
Laden on Highway	(H)															

All loads in short tons.
All loads to include weight of crew and appurtenances.
Longitudinal dimensions in feet.
Vertical and transverse dimensions in inches.

Figure IV–7. Combination wheeled (truck-tractor) vehicle.

Table IV–1. Tracked Vehicles

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Bulldozer, earthmoving M4, tank mtd (light tank M24)	20.70	22.05	22.05	20	22	22
Bulldozer, earthmoving M6, tank mtd (tank, combat, 90mm gun M47)	49.50	51.60	51.60	50	53	53
Bulldozer, earthmoving M8 (tank, combat, 90mm gun M48)	52.89	57.39	57.39	52	60	60
Bulldozer, earthmoving tank mtd, M9 (tank, combat, 105mm gun, M60 and M60A1)	52.94	54.74	54.74	50	52	52
Bulldozer, earthmoving tractor mtd, M5 (tractor, high-speed, M8A2)	24.25	33.50	33.50	23	32	32
Carrier, cargo, amphibious, M76	4.16	6.02	6.02	4	6	6
Carrier, cargo, amphibious tracked M116	3.94	5.44	5.44	4	5	5
Carrier, cargo, tracked, 6 ton XM548E1	8.00	14.00	14.00	7	13	13
Carrier, command post, light tracked, XM577	11.40	11.95	11.95	11	11	11
Carrier, personnel, full tracked, armored M59	19.35	20.90	20.90	18	19	19
Carrier, personnel, full tracked, armored M75	18.34	20.75	20.75	17	20	20
Carrier, personnel, full tracked, armored M113	9.87	11.31	11.31	9	11	11
Carrier, command and reconnaissance: armored, M114A1	6.45	7.37	7.37	7	7	7
Flamethrower, self-propelled, M132	—	11.46	11.46	—	9	9
Gun, antiaircraft artillery, self-propelled, twin 40mm, M42 and M42A1	22.15	24.90	24.90	20	23	23
Gun, antiaircraft, artillery, self-propelled, twin 40mm, M19A1	16.88	19.25	19.25	16	18	18
Gun, antitank, self-propelled, 90mm, M56	6.25	7.87	7.87	6	8	8
Gun, field artillery, self-propelled, 155mm, M53	44.50	48.00	48.00	42	46	46
Gun, field artillery, self-propelled, 175mm, M107	28.30	31.05	31.05	29	29	29
Howitzer, heavy, self-propelled, full tracked, 8 inch M55	45.00	48.00	48.00	41	46	46
Howitzer, heavy, self-propelled, 8 inch, M110	26.30	28.25	28.25	27	27	27
Howitzer, light, self-propelled, full tracked, 105mm, M37	19.32	23.00	23.00	18	22	22
Howitzer, light, self-propelled, full tracked, 105mm, M52 and M5A1	24.90	26.50	26.50	23	25	25
Howitzer, light, self-propelled, 105mm, M108	20.50	23.45	23.45	20	20	20
Howitzer, medium, self-propelled, full tracked, 155mm, M44 and M44A1	29.00	32.00	32.00	27	30	30
Howitzer, medium, self-propelled, 155mm, M109	22.10	25.50	25.50	24	24	24
Landing vehicle, tracked, command M5 (LVTP5A1 (CMD))	32.1	36.23	36.23	28	36	36
Landing vehicle, tracked, engineer M1 (LVTE1)	41.37	48.75	48.75	37	46	46
Landing vehicle, tracked, howitzer M6 (LVTH6A1)	37.10	43.30	43.30	33	40	40
Landing vehicle, tracked, personnel M5 (LVTP5A1)	32.1	43.89	43.89	28	40	40
Landing vehicle, tracked, recovery M1 (LVTR1A1)	37.51	41.10	41.10	33	37	37
Landing vehicle, tracked, armored MK4	17.72	20.00	20.00	15	18	18
Landing vehicle, tracked, MK4	13.70	18.20	18.20	12	16	16
Launcher, M48A2 tank chassis, transporting	—	49.29	49.29	—	50	50
Launcher, M48A2 tank chassis, transporting, with bridge armored vehicle launched, scissoring type, Class 60	—	64.4	64.4	—	64	64
Launcher, M60 chassis, transporting	—	41.0	41.0	—	38	38
Launcher, M60 chassis, transporting with bridge armored vehicle launched, scissoring type, Class 60	—	50.6	50.6	—	54	54
Mortar, infantry, self-propelled, full tracked, 107mm (4.2 inch) M84	20.56	23.55	23.55	19	22	22
Recovery vehicle, full tracked, heavy M51	56.25	60.00	60.00	54	58	58
Recovery vehicle, full tracked, medium M74	44.30	46.87	46.87	51	54	54
Recovery vehicle, full tracked, medium M88	54.00	56.00	56.00	53	55	55
Recovery vehicle, full tracked, light, armored, M578	23.5	27.00	27.00	25	25	25
Rifle, self-propelled, full tracked, multiple, 106mm, M50	8.22	9.52	9.52	8	9	9
Tank, combat, light, 75mm gun, M24	18.90	20.25	20.25	18	19	19
Tank, combat, full tracked, 76mm, M41, M41A1, M41A2, and M41A3	22.35	25.90	25.90	21	25	25
Tank, combat, full tracked, medium, 90mm gun, M46 and M46A1	46.40	48.50	48.50	45	48	48
Tank, combat, full tracked, 90mm gun, M47	46.50	48.50	48.50	45	48	48
Tank, combat, full tracked, 90mm gun, M48	46.56	49.50	49.50	46	50	50
Tank, combat, full tracked, 90mm gun, M48A1, M48A2, and M48A2C	48.50	52.00	52.00	46	52	52

Table IV–1.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Tank, combat, full tracked, 105mm gun, M60 and M60A1	47.65	52.50	52.50	45	50	50
Tank, combat, full tracked, 120mm gun, M103 and M103A1	58.50	62.50	62.50	57	61	61
Tank, combat, full tracked, flamethrower, M67A1	50.48	52.89	52.89	51	51	51
Tractor, full tracked, high speed, 13 ton, M5, M5A1, M5A2, and M5A4	12.60	15.77	15.17	12	14	14
Tractor, full tracked, high speed, 18 ton, M4, M4A1, M4A1C, M4A2 and M4C	13.56	15.70	15.70	13	15	15
Tractor, full tracked, high speed, M8A1 and M8A2	22.25	31.50	31.50	21	30	30
Tractor, full tracked, high speed, 38 ton, M6	34.30	38.00	38.00	32	37	37
Vehicle, combat engineer, full tracked, T118E1	50.45	57.5	57.5	54	57	57

Table IV–2. Half-tracked Vehicles

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Car, half-track, M2A1	—	9.80	9.80	—	9	9
Carriage, motor, multiple gun, M16	—	10.82	10.82	—	10	10
Carrier, 81mm mortar, half-track, M21	—	10.00	10.00	—	9	9
Carrier, personnel, half-track, M3 and M3A1	—	10.25	10.25	—	9	9

Table IV–3. Wheeled Vehicles

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Ambulance, metropolitan 4 litter, ¾ ton	2.70	—	3.52	3	—	4
Bus, ambulance, 18 litter, 4x2	9.04	—	10.79	8	—	9
Bus, 29-passenger, 4x2	5.25	—	7.75	5	—	8
Bus, 37-passenger, 4x2	7.60	—	11.95	7	—	12
Bridge, float, mobile assault amphibious (French)	—	26.50	26.50	—	25	25
Car, armored, light, 6x6, M8	—	8.25	8.25	—	8	8
Car, armored, type V–100 (commando)	6.80	8.13	8.13	7	8	8
Car, armored, utility, M20	—	7.83	7.83	—	7	7
Chassis, truck, 2½ ton, 6x6, M44 and M44C	5.33	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M45 and M45C	5.47	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M46 and M46C	5.64	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M57	5.41	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M58	5.43	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M133	5.58	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M207 and M207C	5.80	—	—	5	—	—
Chassis, truck, 2½ ton, 6x6, M209	5.60	—	—	5	—	—
Chassis, truck, 5 ton, 6x6, M39	8.75	—	—	8	—	—
Chassis, truck, 5 ton, 6x6, M40 and M40C	8.75	—	—	8	—	—
Chassis, truck, 5 ton, 6x6, M61	9.02	—	—	8	—	—
Chassis, truck, 5 ton, 6x6, M63 and M63C	9.62	—	—	8	—	—
Chassis, truck, 5 ton, 6x6, M139, M139C and M39D	9.80	—	—	8	—	—

Table IV–3.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Decontaminating apparatus, power driven, trk mtd, M9, M45 chassis	8.38	10.08	10.08	7	9	9
Decontaminating apparatus, power driven, trk mtd, M3A3, M45 chassis	7.14	8.84	8.84	6	7	7
Lighter, amphibious, resupply, cargo, 5 ton, (LARC–V)	10.00	15.00	15.00	10	15	15
Lighter, amphibious, resupply, cargo, 15 ton, (LARC–V)	22.50	37.50	37.50	27	50	50
Service unit, flamethrower, trk mtd, M4, M45 chassis	8.25	9.38	9.38	7	8	8
Shop equipment, contact maintenance set No. 3	—	4.45	4.45	—	4	4
Shop equipment, emergency repair M2	—	3.88	3.88	—	4	4
Shop equipment, general purpose repair	—	8.44	8.44	—	8	8
Shop equipment, organizational repair, set No. 2	—	12.0	12.0	—	10	10
Shop equipment heavy mach shop	—	7.70	7.70	—	8	8
Shop equipment small tool repair	—	8.44	8.44	—	8	8
Shop equipment, welding	—	7.70	7.70	—	8	8
Superstructure transporter, amphibious, self-propelled, with superstructure, interior bay mobile assault bridge-ferry	—	23.35	23.35	—	21	21
Superstructure transporter, amphibious, self-propelled, with superstructure, end bay mobile assault bridge-ferry	—	25.80	25.80	—	24	24
Topographic reproduction set, trk mtd, 2½ ton truck, 6x6, carrying one of the following sections:						
Photo mechanical process section	—	12.13	12.13	—	11	11
Plate grainer section	—	10.21	10.21	—	10	10
Press section	—	11.53	11.53	—	11	11
Map layout section	—	9.04	9.04	—	9	9
Plate process section	—	9.47	9.47	—	9	9
Camera section	—	9.74	9.74	—	10	10
Topographic photomapping equipment, trk mtd, 2½ ton, 6x6, carrying one of the following sections:						
Cartographic section	—	10.82	10.82	—	10	10
Copy and supply section	—	11.97	11.97	—	10	10
Rectifier section	—	12.03	12.03	—	11	11
Map revision section	—	10.49	10.49	—	9	9
Multiplex section	—	12.13	12.13	—	11	11
Photomapping section	—	10.72	10.72	—	9	9
Truck, ambulance, ¾ ton, 4x4, M43	4.39	4.97	4.97	3	4	4
Truck, ambulance, 1¼ ton, 4x4, XM676	2.51	3.50	3.50	2	3	3
Truck, amphibious, 2½ ton, 6x6, DUKW, M147	9.60	12.10	13.60	9	11	13
Truck, body and hydraulic crane, fwd model B–666	13.80	—	—	12	—	—
Truck, bolster, 2½ ton, 6x6, M44 chassis	5.49	—	—	8	—	—
Truck, bolster, 2½ ton, 6x6, M45 chassis	6.5	—	—	8	—	—
Truck, bolster, 5 ton, 6x6, M40	9.49	—	—	7	—	—
Truck, cargo, ¾ ton, 4x4, M37 and M37B1	2.85	3.60	3.85	3	4	4
Truck, cargo, 1½ ton, 4x4, XM676	2.33	3.50	3.50	2	3	3
Truck, cargo, 1½ ton, 4 door, 4x4 XM677	2.48	3.50	3.50	2	3	3
Truck, carry all, 1¼ ton, 4x4, XM678	2.51	3.50	3.50	2	3	3
Truck, cargo, 2½ ton, 6x6, M34	6.10	8.77	11.27	5	8	10
Truck, cargo, 2½ ton, 6x6, M35	6.44	8.94	11.44	5	8	10
Truck, cargo, 2½ ton, 6x6, M36 and M36C	6.75	9.25	11.75	6	8	10
Truck, cargo, 2½ ton, 6x6, M135	6.37	9.04	11.54	6	9	11
Truck, cargo, 2½ ton, 6x6, M211	6.79	9.47	11.97	6	8	11
Truck, cargo, 5 ton, 6x6, M41	9.55	13.30	17.05	9	15	18
Truck, cargo, 5 ton, 6x6 M54	9.97	14.97	19.97	8	14	19
Truck, cargo, 5 ton, 6x6, M54A2	10.46	15.46	20.46	9	14	20
Truck, cargo, 5 ton, 6x6, M55 and M55A2	12.03	17.03	22.03	10	16	21

Table IV–3.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Truck, cargo, 16 ton, 4x4, XM437E1	19.34	35.54	35.54			
10′ span	.....	.....	.....	22	45	45
Spans over 50′	.....	.....	.....	16	30	30
Truck, cargo, 10 ton, 6x6, M125	15.80	24.55	33.30	14	25	33
Truck, cargo, 8 ton, 4x4, XM520E1 (GOER)	12.18	20.38	20.38	12	18	18
Truck, command, ¾ ton, 4x4, M42	2.98	3.73	3.90	3	4	4
Truck, dump, 2½ ton, 6x6, M59	7.23	8.79	11.42	6	8	10
Truck, dump, 2½ ton, 6x6, M215	7.44	9.49	11.94	7	9	11
Truck, dump, 2½ ton, 6x6, M342	7.79	10.29	12.79	7	9	12
Truck, dump, 5 ton, 6x6, M51	11.33	16.51	21.51	10	16	21
Truck, dump, 10 cu yd, (15 ton) white model SB–3001, 2320–540–3119	17.70	—	32.70	18	—	76
Truck, dump, 15 ton, 4x2, DED Euclid M5FD	14.3	29.3	29.3	15	72	72
Truck, dump, 15 ton, 4x2, DED Mack model LR	16.25	31.25	31.25	15	72	72
Truck, dump, 15 ton, 4x2, GED Sterling MSB–301	17.71	31.25	32.71	18	76	76
Truck, firefighting, pumper Hesse, M–HC–26, 500 GPM, 2½ ton, 6x6, M44 chassis	8.7	10.3	10.3	8	9	9
Truck, firefighting, crash and pumper, walter, 1,500 GPM, 7 ton, GED	12.78	18.00	18.00	11	17	17
Truck, hopper, 5 ton, international model 201, 2320–273–4426	6.12	—	11.10	5	—	13
Truck, lift, fork, GED, rough terrain, pneumatic tired, 6,000 pound cap, at 24 in load center, baker model, RJF–060:						
FSN 3930–679–4458	8.51	11.51	11.51	9	16	16
FSN 3930–073–8751	11.00	14.00	14.00	12	18	18
FSN 3930–073–8750	15.30	20.30	*20.30	15	29	29
Truck, maintenance ¾ ton, 4x4, M201, and M201B1 (Signal Corps) V41/GT	3.48	4.23	4.40	3	4	4
Truck, maintenance, earth boring, machine and pole setter, 2½ ton, 6x6, V18A1MTQ	8.57	9.56	11.56	8	9	11
Truck, maintenance telephone construction and maintenance, 2½ ton, 6x6, V17A/MTQ	8.28	9.42	11.42	8	9	11
Truck, maintenance repair shop, 2½ ton, 6x6, M46 chassis	—	9.56	9.56	—	8	8
Truck, stake, bridge transport, 5 ton, 6x6, M139	13.2	21.0	21.0	10	18	18
Truck, stake and platform, 1½ ton, 4x2	2.84	4.34	6.23	3	4	7
Truck, tank, gasoline, 2½ ton, 6x6, 1,200 gal, M49 and M49C	6.75	9.42	10.75	6	8	10
Truck, tank, gasoline, 2½ ton, 6x6, 1,200 gal, M217 and M217C	7.17	9.82	11.17	6	9	10
Truck, tank, gasoline, 6 ton, 6x6, 2,000 gal	11.91	17.91	17.91	10	18	18
Truck, tank, fuel servicing, 2,500 gal, 4x4, XM559E1 (GOER)	14.10	23.87	23.87	12	22	22
Truck, tank, fuel servicing, 5,000 gal, 4x4, XM438E2 (GOER)	19.24	35.87	35.87			
10′ span	.....	.....	.....	22	46	46
Spans over 50′	.....	.....	.....	16	30	30
Truck, tank, water, 2½ ton, 6x6, 700 gal	5.96	8.63	8.63	6	8	8
Truck, tank, water, 2½ ton, 6x6, 1,000 gal, M50	7.52	9.49	11.94	7	8	11
Truck, tank, water, 2½ ton, 6x6, 1,000 gal, M222	7.05	8.98	11.30	6	8	10
Truck, tractor, 2½ ton, 6x6, M48	5.92	—	—	6	—	—
Truck, tractor, 2½ ton, 6x6, M221	6.05	—	—	5	—	—
Truck, tractor, 2½ ton, 6x6, M275	5.80	—	—	5	—	—
Truck, tractor, 5 ton, 6x6, M52 and M52A1	9.72	—	—	8	—	—
Truck, tractor, 5 ton, 4x2 federal model 45M2	4.90	—	—	4	—	—
Truck, tractor, 5 ton, 4x2, International-Harvester model L–201	5.11	—	—	5	—	—
Truck, tractor, 5 ton, 4x2, International-Harvester model R–202	5.12	—	—	5	—	—
Truck, tractor, 10 ton, 6x6, M123, M123C	16.12	—	—	14	—	—
Truck, tractor, 10 ton, 8x8, XM191	17.18	—	—	15	—	—
Truck, tractor, 12 ton, 6x6, M26A1	24.45	—	—	28	—	—

Table IV–3.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Truck, tractor, 25 ton, M523E2	20.49	—	—	18	—	—
Truck, tractor, 15 ton, 8x8, XM194E1	24.08	—	—	20	—	—
Truck, tractor, 15 ton, 8x8, XM194E2 & E3	24.22	—	—	21	—	—
Truck, tractor, 15 ton, 8x8, XM194E4	26.30	—	—	23	—	—
Truck, tractor, wrecker, 5 ton, 6x6, M246	16.42	22.42	24.60	15	20	23
Truck, van, expansible, 2½ ton, 6x6, M292	—	12.52	12.52	—	11	11
Truck, van, expansible, 5 ton, 6x6, M291	12.75	15.25	20.25	11	14	19
Truck, van, shop, 2½ ton, M109, M109C and M109D	7.62	10.29	11.37	7	9	10
Truck, van, shop, 2½ ton, M220, M220C and M220D	7.54	10.22	11.29	7	9	10
Truck, wrecker, crane, 2½ ton, 6x6, M108	7.06	9.06	10.25	6	9	11
Truck, wrecker, crane, 2½ ton, 6x6, XM519	7.41	8.91	8.91	6	8	8
Truck, wrecker, light, 2½ ton, 6x6, M60	11.98	21.73	13.90	11	12	13
Truck, wrecker, medium, 5 ton, 6x6, M62	17.01	20.51	23.01	16	21	23
Truck, wrecker, medium, 5 ton, M543A2	17.33	17.33	17.33	17	17	17
Truck, wrecker, 10 ton, 4x4, XM553 (GOER)	19.42	23.93	23.93	17	22	22
Truck, wrecker, 20 ton, 4x4, XM554 (GOER)	28.80	33.33	33.33			
10′ span	.....	.....	.....	39	43	43
Spans over 50′	.....	.....	.....	24	28	28

Table IV–4. Towed Vehicles

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
a. Artillery.						
Gun, antiaircraft artillery, towed, 75mm weapons system, M51	—	9.64	9.64	—	8	8
Gun, antiaircraft artillery, towed, 90mm, M2, mount 90mm, M2	—	16.15	16.15	—	16	16
Gun, antiaircraft artillery, towed, 90mm, M118	—	4.15	4.15	—	5	5
Gun, antiaircraft artillery, towed, 20mm, M1 with mount 120mm, M1 & M1A1	—	30.75	30.75	—	38	38
Gun, field artillery, towed, 4.5 inch	—	6.70	6.70	—	9	9
Gun, field artillery, towed, 155mm, M59	—	13.85	13.85	—	14	14
Gun, field artillery, towed, 8 inch, tlr mount M1A1 (wagon transport M1A1)	—	26.32	26.32	—	24	24
Howitzer, light, towed, 105mm, M101 or M101A1	—	2.49	2.49	—	4	4
Howitzer, medium, towed, 155mm, M114 and M114A1	—	6.44	6.44	—	9	9
Howitzer, medium, towed, 155mm, auxiliary propelled, M123A1	—	6.75	6.75	—	9	9
Howitzer, heavy, towed, 8 inch, M115	—	14.80	14.80	—	15	15
Howitzer, heavy, towed, 240mm, M1 wagon transport M2A1	—	23.86	23.86	—	21	21
Howitzer, heavy, towed, 240mm, M1 or gun field artillery, towed, 8 inch, M2 on carriage transport, wagon M3A1	—	25.55	25.55	—	21	21
b. Trailers.						
Trailer, ammunition, 1½ ton, 2 whl, M332	1.40	2.90	2.90	2	4	4
Trailer, ammunition, 2 ton, 2 whl, M10	1.40	3.40	3.40	2	5	5
Trailer, ammunition, 4 ton, 2 whl, M21 (Oneida, Trailmobile)	2.65	6.65	6.65	4	9	9
Trailer, ammunition, 8 ton, 4 whl, M23	5.00	13.00	13.00	5	11	11

Table IV–4.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Trailer, basic utility, pole type, 2½ ton, 2 whl	1.20	3.70	3.70	2	5	5
Trailer, bolster, 2½ ton, 2 whl	1.10	3.60	3.60	2	5	5
Trailer, bolster, pole handling, 3½ ton, 2 whl, M271 and M271A1	1.21	4.71	4.71	2	7	7
Trailer, bolster, 4 whl, special tandem 7 to 14 ton (4 DT), Eidel Mfg Co	3.60	17.60	17.60	4	21	21
Trailer, bomb, 2 ton, 4 whl M143 and M143A1	3.20	5.20	5.20	3	5	5
Trailer, bomb, 2½ ton, 3 whl M5 (Oneida)	1.60	4.10	4.10	2	5	5
Trailer, cable reel, 3½ ton, 2 whl, M310 (Signal Corps Model K–37–B)	1.26	4.76	4.76	1	7	7
Trailer, cargo, 1½ ton, 2 whl, M104, M104A1 and M104A2	1.36	2.86	4.11	2	4	6
Trailer, cargo, 1½ ton, 2 whl, M105, M105A1 and M105A2	1.32	2.82	3.57	2	4	6
Trailer, clamshell bucket, 3 ton, Gramma Model M–16	1.22	4.12	4.12	2	5	5
Trailer, firefighting pumper, Sabre Model TT 2000	4.85	—	—	6	—	—
Trailer, flat bed, 7 ton, LaCrosse Model CTP7F:						
FSN 2330–255–9190	5.67	12.67	19.67	7	15	24
FSN 2330–255–9091	5.67	12.67	12.67	6	15	15
Trailer, flat bed, 4 whl, special tandem, 10 ton, for crane-shovel attachment	5.58	15.58	15.58	6	17	17
Trailer, flat bed, 10 ton, 4 dual midship wheels, FSN 2330–377–0389	5.63	15.63	15.63	6	18	18
Trailer, flat bed, 10 ton, 4 whl, M345, FSN 2330–200–1737	5.63	15.63	18.63	6	18	20
Trailer, flat bed, Guided Missile M261	3.85	5.47	5.47	4	5	5
Trailer, low bed, 8 ton, Fontaine Model T8–105	4.83	12.83	12.83	4	12	12
Trailer, low bed, 8 ton, Fruehauf Model CPT–8 Special	4.76	12.50	12.50	4	12	12
Trailer, low bed, 8 ton, Jahn Model LKS–408	3.80	11.80	11.80	4	12	12
Trailer, low bed, 8 ton, Hobbs Model F–1386	4.89	12.89	12.89	4	13	13
Trailer, low bed, 8 ton, LaCrosse Model DF 4C–8F	4.83	12.83	12.83	4	14	14
Trailer, low bed, 60 ton, Rogers Model D–60–DS–5	17.00	—	77.00	13	—	110
Trailer, low bed, 60 ton, Rogers Model DW–60–LS–6	14.06	—	79.06	10	—	123
Trailer, low bed, 60 ton, Rogers Model D–60–DS–7	16.35	—	76.35	12	—	117
Trailer, low bed, 60 ton, Steel Products, Model Great Dane	15.58	—	75.58	10	—	130
Trailer, low bed, antenna mtd, M260 and M260A1	2.57	4.95	4.95	2	4	4
Trailer, low bed, Guided Missile, 7 ton, 4 whl, XM529	7.22	13.80	13.80	6	12	12
Trailer, tank, 6 ton, 1,500 gal, VIC Model 72 FSN 2330–294–6302	5.10	—	11.10	4	—	10
Trailer, tank, water, 1½ ton, 2 whl, 400 gal, M106, M106A1, M106A2, M107, M107A1, M107A2 and M149	1.18	2.84	2.84	2	4	4
Trailer, transporter, 45 ton, 12 whl, M9	10.08	—	55.08	8	—	82
Trailer, van, shop, folding sides, 1½ ton, 2 whl, M448	1.48	2.98	3.73	2	4	6
Trailer, van, launching control, M262	3.40	6.20	6.20	4	6	6
Trailer, van, radar tracking control, M258	3.53	5.98	5.98	3	5	5
Trailer, van, director station, M259	3.53	5.98	5.98	3	5	5
Trailer, van, fire control, 2 ton, 4 whl, M244	3.56	6.04	6.04	4	6	6
Transporter, liquid rolling wheel	1.07	4.27	4.27	1	6	6
Transporter, liquid rolling wheel (2 in. tandem)	2.14	8.42	8.42	2	7	7
Transporter, liquid rolling wheel (3 in. tandem)	3.21	12.63	12.63	2	10	10
Transporter, liquid rolling wheel (4 in. tandem)	4.28	16.83	16.83	3	12	12
c. Semitrailers.						
Semitrailer, LOX, 9 ton, 2 whl	8.82	17.82	17.82	7	16	16
Semitrailer, low bed, crane, 7 ton, M6	3.91	—	12.41	3	—	11
Semitrailer, low bed, wrecker, 12 ton, 4 whl, M270 and M270A1	8.75	20.75	28.75	8	17	24
Semitrailer, low bed, wrecker, 12 ton, 4 whl, M269 and M269A1	7.10	19.10	27.10	6	17	23
Semitrailer, low bed, 15 ton, 4 whl, M172	7.75	—	22.75	6	—	19
Semitrailer, low bed, 25 ton, 4 whl, M172A1	7.43	32.43	37.43	7	29	36

Table IV-4.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Semitrailer, maintenance weapon, mechanical unit M457	—	6.92	6.92	—	6	6
Semitrailer, maintenance weapon, electrical unit M458	—	7.20	7.20	—	6	6
Semitrailer, maintenance weapon, connecting unit M459	—	7.20	7.20	—	6	6
Semitrailer, mobile sawmill, Corinth Machinery Co Model, Saw Mobile No. 58	—	19.15	19.15	—	18	18
Semitrailer, repair parts, shopvan, 6 ton, 4 whl, semitrailer chassis M295A1	—	8.6	8.6	—	11	11
Semitrailer, stake and platform, 5 ton, 2 whl, Olson Model 516	3.32	8.32	10.32	3	8	10
Semitrailer, stake, 6 ton, 2 whl, M118 and M118A1	3.55	9.55	11.65	4	8	11
Semitrailer, stake, 12 ton, 4 whl, M127, M127A1 and M127A1C	7.20	19.20	25.20	8	23	30
Semitrailer, stake, 12 ton, 4 whl, M127A2C	7.02	19.02	25.02	7	22	29
Semitrailer, tank, alcohol, 300 gal, 2 whl, M388	4.15	12.15	12.15	5	13	13
Semitrailer, tank, 6 ton, 1,500 gal, dual whls, Little Ford Model Jan-T-505	4.0	—	10.0	4	9	9
Semitrailer, tank, 6 ton, 1,500 gal, dual whl, Columbian Steel Tank M1944	3.3	—	9.55	3	8	8
Semitrailer, tank, gasoline, 6 ton, 2 whl, 2,000 gal, M30, Progress Model ST62M	3.38	—	9.48	3	—	9
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131, M131A1, and M131A2	7.42	17.23	22.69	7	16	21
Semitrailer, tank, fuel servicing, 2 whl, 2,000 gal, Type F-28, Heil Co	4.00	—	10.00	4	—	9
Semitrailer, tank, water, 2,000 gal, 2 whl, M586	3.21	—	11.51	4	—	14
Semitrailer, tank transporter, 40 ton, 8 whl, M15	21.19	61.19	61.19	15	53	53
Semitrailer, tank transporter, 45 ton, 8 whl, M15A1	21.18	66.18	66.18	16	59	59
Semitrailer, tank transporter, 50 ton, 8 whl, M15A2	21.30	71.30	71.30	16	78	78
Semitrailer, van, cargo, 12 ton, 4 whl, M128A1 and M128A1C	7.74	19.74	25.74	7	18	23
Semitrailer, van, cargo, 12 ton, 4 whl, M128A2C	7.70	19.70	25.70	8	23	30
Semitrailer, van, cargo, 6 ton, 2 whl, M118 and M118A1	3.57	9.57	11.67	5	9	11
Semitrailer, van, cargo, 6 ton, 2 whl, M119 and M119A1	3.59	9.59	11.69	5	9	11
Semitrailer, van, electronic, 3 ton, 2 whl, M348A1 and M348A2	4.32	7.32	9.32	5	10	11
Semitrailer, van, electronic, 6 ton, 2 whl, M348A2C, M348A2F and M348A2G	4.38	9.38	10.38	5	10	11
Semitrailer, van, electronic, 6 ton, 2 whl, M373A2C	4.85	9.58	10.85	5	10	11
Semitrailer, van, refrigerator, 7½ ton, 2 whl, M349 and M349A	4.30	—	11.80	5	—	13
Semitrailer, van, shop, 6 ton, 2 whl, M146 and M146C	3.66	9.66	11.76	4	9	10
Semitrailer, van, supply, 12 ton, 4 whl, M129A1 and M129A1C	8.01	20.01	26.01	7	18	23
Semitrailer, van, supply, 12 ton, 4 whl, M129A2C	7.80	19.80	25.80	8	23	30

Table IV-5. Construction Equipment

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Bin, aggregate loading, trl mtd, GED, 30 ton, Iowa Model 30-T	5.93	—	—	5	—	—
Bin, aggregate loading, trl mtd, GED, 30 ton, Universal Model PB-20	5.86	—	—	5	—	—
Bin, aggregate loading, trl mtd, GED, 30 ton, Pioneer Model 220	8.57	—	—	7	—	—
Compressor, air, GED, trk mtd, 80 CFM, Clark Model HO-6-5C1 FSN 4310-555-1634	—	9.25	9.25	—	8	8

Table IV–5.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Compressor, air, rotary, DED, whl mtd, 315 CFM, Ingersoll-Rand Model DR 315, FSN 4310–270–3332	—	4.04	4.04	—	4	4
Compressor, air, DED, trl mtd, 315 CFM, LeRoi Model 315D2–C	—	4.36	4.36	—	4	4
Compressor, air, GED, whl mtd, 600 CFM, Ingersoll-Rand Model DR–600	—	5.59	5.59	—	6	6
Compressor, reciprocating, DED, 500 CFM, whl mtd, Worthington Model Blue Brute 500	—	5.68	5.68	—	6	6
Compressor, reciprocating, power driven, 80 CFM, 5,000 psi, trk mtd, M45 chassis, Joy Model 8–HGC3–MS–1	—	9.21	9.21	—	8	8
Compressor, reciprocating, power driven, 80 CFM, 5,000 psi, trk mtd, M45 chassis, Joy Model 80–HGC2–MS–1	—	9.21	9.21	—	8	8
Compressor, reciprocating, power driven, GED, 80 CFM, 5,000 psi, trk mtd, M45 chassis, Clark Model HO–6–5G	—	9.25	9.25	—	8	8
Compressor, reciprocating, power driven, 210 CFM, Davy Model 210-WDS, FSN 4310–272–8128	—	7.92	7.92	—	7	7
Compressor, power driven, GED, 210 CFM, 100 psi, trk mtd, Joy Model RPA–210 GD3–MS–1	—	7.35	7.35	—	6	6
Compressor, reciprocating, power driven, 210 CFM, 100 psi, trk mtd, LeRoi Model 210–G2	—	8.04	8.04	—	7	7
Compressor, reciprocating, air, GED, trk mtd, 210 CFM, 100 psi, LeRoi Model 210G1	—	7.65	7.65	—	7	7
Compressor, rotary, power driven, GED, 210 CFM, 100 psi, trk mtd, M45 chassis, Harris Model J–210	—	7.53	7.53	—	7	7
Compressor, rotary, power driven, whl mtd, 600 CFM, 100 psi, Ingersoll-Rand Model DR 600 WTRZD	—	5.62	5.62	—	6	6
Conversion-storage-charging unit, carbon-dioxide, Cardox Model FE 34365	—	16.40	16.40	—	16	16
Conversion unit, carbon-dioxide, semitrailer mtd, Girdler Model 131–4910	—	19.33	19.33	—	17	17
Conveyor, belt, whl mtd, electric, 300 tons per hour, 50 foot, Barber-Green Model PG–70, FSN 3910–790–2175	—	—	4.82	—	—	6
Cooling tower, liquid, semitrailer mtd, Badger Model CT–1, FSN 3655–606–0820	—	—	8.22	—	—	7
Crane-shovel, basic unit, crawler mtd, GED, 10 ton, ¾ cu yd, American Hoist Model 375–BC	—	18.7	18.7	—	14	14
Crane-shovel, basic unit, crawler mtd, DED, 40 ton, 2 cu yd, Baldwin-Lima-Hamilton Model 802	—	66.25	66.25	—	—	—
Spans under 20 feet	—	—	—	—	153	153
Spans over 20 feet	—	—	—	—	81	81
Crane-shovel, basic unit, crawler mtd, GED, 10 ton, ¾ cu yd, Baldwin-Lima-Hamilton Model 34	—	16.58	16.58	—	22	22
Crane-shovel, basic unit, crawler mtd, DED, 40 ton, 2 cu yd, Bucyrus-Erie Model 51–B	—	66.00	66.00	—	—	—
Spans under 20 feet	—	—	—	—	134	134
Spans over 20 feet	—	—	—	—	79	79
Crane-shovel, basic unit, crawler mtd, GED, 5 ton, ¾ cu yd, Bucyrus-Erie Model 22–B	—	19.17	19.17	—	19	19
Crane-shovel, basic unit, crawler mtd, GED, 10 ton, ¾ cu yd, Byers Model 83	—	19.8	19.8	—	19	19
Crane-shovel, basic unit, crawler mtd, DED, 40 ton, 2 cu yd, Harnischfeger Model 855–BG	—	40.38	40.38	—	56	56
Crane-shovel, basic unit, crawler mtd, DED, 40 ton, 2 cu yd, Harnischfeger Model 855–BG3	—	50.51	50.51	—	58	58

Table IV–6.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Crane-shovel, basic unit, crawler mtd, DED, 35 ton, 2 cu yd, Harnischfeger Model 855–B	—	53.2	53.2	—	—	—
Spans under 20 feet	—	—	—	—	72	72
Spans over 20 feet	—	—	—	—	56	56
Crane-shovel, basic unit, crawler mtd, GED, 40 ton, 2 cu yd, Wtzd to 65°F, Harnischfeger Model 855–BG–2	—	48.16	48.16	—	—	—
Spans under 20 feet	—	—	—	—	58	58
Spans over 20 feet	—	—	—	—	50	50
Crane-shovel, basic unit, crawler mtd, GED, 5 ton, ½ cu yd, Insley Model E–12	—	12.00	12.00	—	11	11
Crane-shovel, basic unit, crawler mtd, DED, 40 ton, 2 cu yd, Manitowoc Model 3000–B	—	58.50	58.50	—	—	—
Spans under 20 feet	—	—	—	—	101	101
Spans over 20 feet	—	—	—	—	69	69
Crane-shovel, basic unit, crawler mtd, 10 ton, ¾ cu yd, Thew Model TL–25K	—	16.0	16.0	—	15	15
Crane-shovel, basic unit, crawler mtd, DED, 35 ton, 2 cu yd, Thew Model L–820 and L–820–J	—	50.35	50.35	—	55	55
Crane-shovel, basic unit, crawler mtd, GED, 10 ton, ¾ cu yd, Unit Model 1020–YD	—	17.5	17.5	—	16	16
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Baldwin-Lima-Hamilton Model 34–T	—	28.25	28.25	—	27	27
Crane-shovel, basic unit, trk mtd, 10 ton, Bay City Model 150M	—	18.92	18.92	—	18	18
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Garwood Model M–20–B	—	28.25	28.25	—	34	34
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Garwood Model M–20–A(F)	—	28.05	28.05	—	34	34
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Koehring Model 304	—	27.6	27.6	—	32	32
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Link Belt Model HC–70	—	28.25	28.25	—	25	25
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Quick-Way Model M202, FSN 3810–820–0698	—	25.39	25.39	—	25	25
Crane-shovel, basic unit, trk mtd, DED, 20 ton, ¾ cu yd, Quick-Way Model M–200	—	23.5	23.5	—	25	25
Crane-shovel, basic unit, trk mtd, GED, 3 ton, ⅜ cu yd, Quick-Way Model N383AB	—	9.15	9.15	—	8	8
Crane-shovel, basic unit, trk mtd, GED, 3 ton, ⅜ cu yd, Schield Bantam Model ABM–53	—	9.27	9.27	—	8	8
Crane-shovel, basic unit, trk mtd, GED, 20 ton, ¾ cu yd, Thew Model MC–416	—	26.55	26.55	—	28	28
Crane-shovel, basic unit, trk mtd, GED, 10 ton, ½ cu yd, Thew Model MC–254	—	19.87	19.87	—	20	20
Crane-shovel, basic unit, trk mtd, GED, 10 ton, ½ cu yd, Thew Model E–6610	—	18.05	18.05	—	18	18
Crane-shovel, basic unit, trk mtd, GED, Unit Model 1220–CE	—	26.25	26.25	—	31	31
Crane-shovel, basic unit, trk mtd, GED, 10 ton, ½ cu yd, Wayne Crane Model 40	—	19.20	19.20	—	19	19
Crane-shovel, basic unit, whl mtd, DED, 20 ton, ¾ cu yd, rough terrain	—	28.50	28.50	—	30	30
Crane, ½ cu yd, 7 ton, air droppable, self-propelled, 4x4, whl mtd, Garwood and Koerhing Model 7	—	8.12	8.12	—	8	8
Crane, whl mtd, DED, 5 ton, ⅜ cu yd, air transportable, rough terrain	—	14.68	14.68	—	15	15
Crusher, jaw, diesel and electric, 75 TPH, Eagle Model 5157	—	36.7	36.7	—	37	37

Table IV–5.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Crusher, jaw, GED, whl mtd, 4 whl, 15 TPH, Iowa Model AB–1424SP–15T	—	7.25	7.25	—	8	8
Crusher, jaw, GED, crawler mtd, 200–400 TPH, 4 in size, Iowa Model 2–A	—	16.45	16.45	—	15	15
Crusher, roll, diesel and electric, 75 TPH, whl mtd, Eagle Model 5230B	—	30.72	30.72	—	27	27
Crushing and screening unit, GED, whl mtd, 6 whl 40 to 140 TPH, Pioneer Model 42–VA	—	28.2	28.2	—	25	25
Crushing and screening unit, GED, crawler mtd, 100 to 190 TPH, Pioneer Model 54–VA	—	38.54	38.54	—	58	58
Crushing and screening unit, GED, crawler mtd, 100 to 190 TPH, Iowa Model 2–A	—	17.15	17.15	—	15	15
Crushing, screening, and washing unit, DED, whl mtd, 6 whl, 40 to 250 TPH, Iowa Model DJ–50	—	31.94	31.94	—	26	26
Crushing, screening, and washing unit, DED, whl mtd, 40 to 250 TPH, Pioneer Model 33R Triplex	—	31.3	31.3	—	39	39
Crushing, screening, and washing unit, DED, whl mtd, 6 whl, 40 to 250 TPH, Universal Model 1830–CWL	—	32.62	32.62	—	45	45
Dehydrator, sand, tlr mtd, Pioneer Model 1833	—	3.42	3.42	—	6	6
Dehydrator, sand, tlr mtd, Universal Model 20PW	—	3.73	3.73	—	6	6
Dehydrator, sand, tlr mtd, Pioneer Model 2220 SDE	—	7.56	Y 7.56	—	7	7
Dehydrator, sand, tlr mtd, Pioneer Model P–300W	—	9.35	9.35	—	9	9
Dehydrator, sand, 120 to 150 TPH, Iowa Model 5022E	—	8.75	8.75	—	7	7
Distributor, bituminous material, tank type, GED, trk mtd, 800 gal, Etnyre Model MIL–D32	11.20	15.20	15.20	10	15	15
Distributor, bituminous material, tank type, GED, trk mtd, 800 gal, General Steel Tank Model SDC	11.72	15.72	15.72	10	15	15
Distributor, bituminous marerial, tank type, GED, trk mtd, 800 gal, Etnyre Model MXRE D–30	11.70	15.20	15.20	10	15	15
Distributor, bituminous material, tank type, 1,250 gal, ETNYRE Model MX Style RE	10.69	—	15.1	10	—	14
Distributor, water, tank type, GED, trk mtd, 1,000 gal, force feed, Municipal Model WD–1000	10.05	14.22	14.22	9	13	13
Distributor, water, tank type, trk mtd, 1,000 gal, VIC Model M73A	10.35	14.52	14.52	9	03	13
Distributor, water, tank type, trk mtd, 1,000 gal, force feed, MacLeod Model W–IM3	00.31	13.31	13.31	9	14	14
Distributor, water, tank type, trk mtd, 1,000 gal, force feed, MacLeod Model W–IM5	10.30	14.47	14.47	9	14	14
Distributor, water, tank type, trk mtd, 1,000 gal, force feed, Butler Model 6743	10.30	14.47	14.47	9	14	14
Distributor, water, tank type, trk mtd, 1,000 gal, ROSCO Model MOE	10.00	14.17	14.17	9	03	13
Distributor, water, tank type, trk mtd, 1,000 gal, ROSCO Model MME	9.60	13.77	13.77	8	12	12
Ditching machine, DED, whl mtd, ladder type, Unit Rig & Equip Model 4262	—	18.0	18.0	—	19	19
Drier aggregate, GED, tlr mtd, 2 whl, 10 to 25 TPH, Barber Greene Model 830	—	5.13	5.13	—	9	9
Drier aggregate, DED, tlr mtd, 80 to 120 TPH, Barber Greene Model 837	—	18.1	18.1	—	17	17
Dust collecting machine, paving materials, DED, 22,000 CFM semitlr mtd, Barber Greene Model 857	—	10.31	10.31	—	11	11
Generating and charging plant, carbon dioxide, semitlr mtd, Girdler Model 32–4027, FSN 3655–390–8562	—	24.50	24.50	26	26	26

Table IV–5.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Generating and charging plant, carbon dioxide, semitlr mtd, Girdler Model 32–4176, FSN 3655–554–4558	—	24.0	24.0	23	23	23
Generating and charging plant, hydrogen-carbon dioxide, semitlr mtd, Electric Heating Equipment Model H2–CO2, FSN 3655–288–2993	—	24.47	24.47	—	23	23
Generating and charging plant, oxygen-nitrogen, semitlr mtd, Air Products Model A2	—	15.0	15.0	—	17	17
Generator, carbon dioxide, semitlr mtd, Electric Girdler Model 32–4027	—	24.01	24.00	—	25	25
Graduation control unit, aggregate tlr mtd, Barber Greene Model 866	—	15.28	15.28	—	12	12
Grader, road, motorized, DED, Austin-Western Model 99–H	—	10.7	10.7	—	9	9
Grader, road, motorized, DED, Caterpillar Model 12	—	12.5	12.5	—	10	10
Grader, road, motorized, DED, Caterpillar Model 212	—	7.46	7.46	—	6	6
Grader, road, motorized, Gallion Model 118	—	12.70	12.70	—	10	10
Grader, road, motorized, DED, Huber-Warco Model 4D	—	12.59	12.59	—	11	11
Grader, road, motorized, DED, LeTourneau-Westinghouse Model 220	—	7.98	7.98	—	7	7
Grader, road, motorized, Riddell Model 4D–100	—	12.41	12.41	—	10	10
Grader, road, towed, Adams Model 124S	—	5.98	5.93	—	5	5
Heater, bitumen, GED, tlr mtd, steam, Williams Bros Model SG–52TA	3.13	—	—	5	—	—
Loader, scoop type GED, 1½ cu yd, Clark Model 85–AM	7.35	—	10.35	9	—	14
Loader, scoop type DED, 2½ cu yd, 4 whl, Hough Model H–90M, ESN 3805–803–2672	14.20	—	18.2	15	—	30
Loader, scoop type, DED, 4 whl, 2½ cu yd, Clark Model 175A–M23	14.41	—	19.00	16	—	22
Loader, bucket type, DED, crawler, mtd, Haiss Model 77–PC	11.5	—	—	12	—	—
Loader, belt type, GED, crawler, self-propelled, 10 to 20 cu yd per min, Barber Greene Model 538B	7.84	—	—	11	—	—
Mixer, bituminous material DED, 110–200 TPH, tlr mtd, Barber Greene Model 848	15.70	—	—	16	—	—
Mixer, concrete, tlr mtd, Construction Model 16–S	3.00	—	—	3	—	—
Mixer, concrete, tlr mtd, liquid cooled, 16 cu ft, Gallion Model 16S–SCE	3.65	—	—	4	—	—
Mixer, concrete, tlr mtd, Ransome Model 14SU	3.00	—	—	3	—	—
Mixer, rotary tiller, DED, self-propelled, Seaman Model TP–84M	5.74	—	—	5	—	—
Paving, machine, bituminous material, GED, Barber Greene Model 879–A	12.12	—	—	21	—	—
Paving, machine, bituminous material, GED, Barber Greene Model 879–B	11.25	—	—	14	—	—
Power unit gasoline, whl mtd, Minneapolis-Moline Model 1210–12A	7.19	—	—	8	—	—
Roller, motorized, Buffalo-Springfield Model KT–24B, FSN 3895–187–2645	8.75	—	—	10	—	—
Roller, motorized, GED, 3 whl, 9 ton, Buffalo-Springfield Model KX–16–C2	6.30	—	—	—	—	—
Roller, motorized, Buffalo-Springfield Model KT–16B, FSN 3895–194–8536	6.00	—	—	7	—	—
Roller, motorized, GED, 5 to 8 ton, Gallion Model 3T9G	10.76	—	—	12	—	—
Roller, motorized, GED, 5 to 8 ton, Gallion Model T–5G	5.90	—	—	6	—	—
Roller, motorized, road, Gallion Model T–8G, FSN 3895–290–4993	8.84	—	—	11		—
Roller, motorized, DED, 8 to 12 ton, Gallion Model Chief	10.02	—	—	11	—	—
Roller, motorized, GED, 10 to 20 ton, Gallion Model Chief CG	10.60	—	—	13	—	—
Roller, motorized, GED, 3 whl, 10 ton, Gallion Model Chief Rollo-Matic	10.83	—	—	13	—	—
Roller, towed pneu tire, 4 whl, 7 ton, Shovel Supply Model RT–100CE	6.95	—	—	10	—	—
Roller, towed, pneu tire, 7½ ton, Grace Model Wltr	7.25	—	—	10	—	—
Rooter, towed, Southwest Model RH–3	6.62	—	—	10	—	—
Rooter, towed, LeTourneau Model LW–H–3	3.82	—	—	6	—	—
Saw Mill, circular, DED, tlr mtd, Jackson Lumber Harvester Model RMS	4.80	—	—	7	—	—

Table IV–5.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Scraper, earthmoving, towed 7.2 cu yd, Heil Model OC–9 FSN 3805–378–9805	7.70	14.70	14.70	7	14	14
Scraper, earthmoving, towed 7.5 cu yd, Be-Ge Model 6595 FSN 3805–554–5051	7.06	14.06	14.06	6	14	14
Scraper, earthmoving, towed 7.5 cu yd, Murry Model AR88M, FSN 3805–683–9126	4.9	13.81	13.81	4	15	15
Scraper, earthmoving, towed 12 cu yd, Woolrich Model OS–122–A, FSN 3805–691–6161	12.10	27.10	27.10	9	37	37
Scraper, earthmoving, towed 12 cu yd, LeTourneau-Westinghouse Model LPO 3805–351–9542	9.75	21.75	21.75	8	26	26
Scraper, earthmoving, towed 13.5 cu yd, Southwest Welding Model S–152, FSN 3805–691–6132	12.00	28.00	28.00	9	37	37
Scraper, earthmoving, towed 18 cu yd, Curtiss-Wright Model CWT–18–M	15.45	40.45	40.45	16	77	77
Scrubber and washer, aggregate, Iowa Model 720	—	17.69	17.69	—	16	16
Scrubber and washer, aggregate, GED, whl mtd, 80 to 120 TPH, Pioneer Model Log Washer	—	23.6	23.6	—	21	21
Snow, removal unit, GED, rotary, trk mtd, 7½ ton, 4x4, KLAUR Model TU–3	—	11.32	11.32	—	10	10
Snowplow, trk mtd, Wausau Model M–1123, mtd on Oskosh Model WT2206	—	16.10	16.10	—	23	23
Tank, storage, liquid, argon-nitrogen-oxygen, semitlr mtd, Cambridge Model 217–30	—	—	—	7	—	16
Tractor, wheeled, Industrial, Case Model LA1, FSN 2420–190–0347	—	6.25	6.25	—	8	8
Tractor, whl, Industrial DED Caterpillar Model DW–20M, FSN 2420–200–1297	—	24.82	24.82	—	34	34
Tractor, whl, Industrial DED LeTourneau-Westinghouse Model Super C TournaTractor	—	16.24	16.24	—	19	19
Tractor, whl, Industrial DED LeTourneau-Westinghouse Model Super C Tournadozer	—	17.30	17.30	—	19	19
Tractor, whl, Industrial, MRS Model 72AGT	—	7.88	7.88	—	9	9
Tractor, whl, DED, MRS Model 100, FSN 2420–792–6163	—	—	—	—	8	8
Tractor, whl, Industrial, MRS Model 125	—	10.75	10.75	—	10	10
Tractor, whl, Industrial DED, air transportable, MRS Model 150 AGT	—	7.87	7.87	—	8	8
Tractor, whl, Industrial DED, air transportable, MRS Model 150	—	17.65	17.65	—	21	21
Tractor, whl, Industrial, DED, MRS Model 190	—	15.39	15.39	—	17	17
Tractor, whl, Industrial, DED, Westphall Model SWD 300	—	21.20	21.20	—	33	33
Tractor, full tracked, low speed DED, Allis-Chalmers Model HD6M	—	8.00	8.00	—	8	8
Tractor, full tracked, low speed DED, Caterpillar Model 933	—	7.99	7.99	—	9	9
Tractor, full tracked, low speed DED, 44 in min ga, Caterpillar Model D–4	—	7.0	7.0	—	9	9
Tractor, full tracked, low speed DED, 60 in min ga, Caterpillar Model D–4, FSN 2410–190–0196	—	7.27	7.27	—	8	8
Tractor, full tracked, low speed DED, 60 in min ga, Caterpillar Model D–4, FSN 2410–190–0020	—	7.50	7.50	—	9	9
Tractor, full tracked, low speed DED, 60 in min ga, Caterpillar Model D–4, FSN 2410–190–0217	—	7.98	7.98	—	10	10
Tractor, full tracked, low speed DED, 56 in min ga, Caterpillar Model D–6, FSN 2410–190–0049	—	16.31	16.31	—	21	21
Tractor, full tracked, low speed DED, 74 in min ga, Caterpillar Model D–6, FSN 2410–185–0855	—	9.79	9.79	—	10	10

Table IV–5.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Tractor, full tracked, low speed DED, w/angle-dozer, cable PCU, winch, Caterpillar Model D–7, FSN 2410–191–0536	—	16.25	16.25	—	19	19
Tractor, full tracked, low speed DED, 74 in min ga, Caterpillar Model D–7:						
FSN 2410–191–0532	—	12.76	12.76	—	13	13
FSN 2410–190–0339	—	16.25	16.25	—	17	17
FSN 2410–191–0537	—	16.65	16.65	—	18	18
FSN 2410–277–1280	—	17.83	17.83	—	20	20
FSN 2410–233–5746	—	17.83	17.83	—	20	20
FSN 2410–233–5749	—	16.25	16.25	—	18	18
Tractor, full tracked, low speed DED, 74 in min ga, Caterpillar Model D–7, with crane, center revolving, Trackson Model CDT, FSN 2410–234–4603	—	16.62	16.62	—	19	19
Tractor, full tracked, low speed DED, 74 in min ga, Caterpillar Model D–8:						
FSN 2410–223–1216	—	18.10	18.10	—	20	20
FSN 2410–618–3139	—	21.25	21.25	—	26	26
FSN 2410–268–8229	—	20.80	20.80	—	22	22
FSN 2410–267–6888	—	21.77	21.77	—	22	22
FSN 2410–233–5750	—	21.00	21.00	—	27	27
FSN 2410–233–1210	—	23.56	23.56	—	33	33
FSN 2410–223–1214	—	23.37	23.37	—	30	30
FSN 2410–233–5752	—	21.80	21.80	—	27	27
FSN 2410–542–4882	—	22.05	22.05	—	30	30
Tractor, full tracked, low speed DED, 60 in min ga, International Harvester Model TD–9, FSN 2410–190–0211	—	5.3	5.3	—	6	6
Tractor, full tracked, low speed DED, 74 in min ga, International Harvester Model TD–18–182, FSN 2410–541–7655	—	19.82	19.82	—	25	25
Tractor, full tracked, low speed DED, International Harvester Model TD–20–200:						
FSN 2410–542–2498	—	18.67	18.67	—	25	25
FSN 2410–542–2499	—	18.70	18.70	—	24	24
Tractor, full tracked, low speed DED, 78 in min ga, International Harvester Model TD–24–241, FSN 2410–542–2337	—	27.66	27.66	—	32	32
Tractor, full tracked, low speed DED, 78 in min ga, with bulldozer and backrip, scarifier, PCU, International Harvester Model TD–24–241, FSN 2410–542–2338	—	27.09	27.09	—	31	31
Trailer, dump, 11 cu yd, 4 whl, pneu tire, hopper dump, MRS Model 110AWG	7.22	22.22	22.22	6	22	22
Trailer-tractor, dump, DED, Euclid Model 89W, with Model 71 FDT tractor, FSN 3805–261–5830	17.90	37.90	37.90	13	31	31
Water purification unit, van, 1500 GPH, Met-Pro Model 1500–2600	—	9.51	9.51	—	8	8
Water purification unit, van, 3000 GPH, Met-Pro Model 3000–2700	—	10.71	10.71	—	9	9
Water purification unit, tlr mtd, 600 GPH, Met-Pro Model 600–2500	—	2.91	2.91	—	5	5

Table IV–6. Missile and Fire Distribution System

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
a. Pershing.						
Carrier, missile equipment, full tracked, XM474E2	5.95	—	—	5	—	—
Communications pack, mtd on carrier XM474E2	—	8.89	8.89	—	8	8
Erector-Launcher, mtd on carrier XM474E2	—	9.72	9.72	—	9	9
Power station and programer mtd on carrier XM474E2	—	10.91	10.91	—	10	10
Warhead, pallet and warhead handling gear, mtd on XM474E2	—	8.16	8.16	—	8	8
Facilities distribution, mtd on tlr, 1½ ton, 2 whl, M105A2	—	2.54	2.54	—	4	4
Generator, 45 KW, mounted on tlr, 2 whl, 3½ ton, XM353	—	3.78	3.78	—	6	6
b. Sergeant.						
Launching station, 4 whl, semitlr mtd, guided missile XM504	—	8.5	8.5	—	7	7
Combined with truck, tractor, 5 ton, 6x6, M52	—	18.22	18.22	—	14	14
Transport trailer, 4 whl, 6 ton, XM527 w/2 forebodies	—	5.11	5.11	—	4	4
Transport trailer, 4 whl, 5 ton, XM527 w/missile motor, fin and guidance	—	7.74	7.74	—	6	6
Semitrailer, motor-guidance transport	—	7.75	7.75	—	7	7
Combined with truck, tractor, 2½ ton, 6x6, M48, M221, M275	—	13.80	13.80	—	10	10
Test station, organizational, maintenance, AN/MSM–35	—	7.75	7.75	—	6	6
Combined with truck tractor, 2½ ton, 6x6, M275	—	13.55	13.55	—	10	10
Test station, field maintenance AN/MSM–36	—	7.75	7.75	—	6	6
Combined with truck tractor, 2½ ton, 6x6, M275	—	13.55	13.55	—	10	10
c. Little John.						
Handling unit, rocket, trk mtd, 318MM, M572	6.75	9.25	9.25	6	8	8
d. Honest John.						
Handling unit, 762mm rocket, tlr mtd, M405 and M405A1	4.31	7.31	7.31	5	7	7
Heating and tiedown unit, 762mm rocket, trk mtd, M78 and M78A1	12.43	15.39	15.39	10	14	14
Kit, 762mm rocket, XM78E1, M55 trk dual rear whl, cargo body with winch	12.31	18.92	18.92	10	17	17
Launcher, 762mm rocket, trk mtd, M289	20.90	23.80	23.80	19	22	22
Launcher, 762mm rocket, trk mtd, M386	17.12	20.08	20.08	16	19	19
Trailer, rocket transporter, 762mm rocket, M329A1 and M329A2	2.50	5.50	5.50	3	7	7
e. Hawk.						
Loader-transporter guided missile, XM501E1, XM501E2 and XM501	2.77	4.75	4.75	3	5	5
Generator, 45 KW, mtd on chassis, tlr M200A1	—	4.25	4.25	—	5	5
Radar set, pulse acquisition, tlr mtd, AN/MPQ–35	—	3.97	3.97	—	6	6
f. Nike-Ajax.						
Antenna-receiver-transmitter group, tgt tracking, tlr mtd (tlr, low-bed antenna mtd M260)	—	5.47	5.47	—	5	5
Director station, guided missile, tlr mtd, AN/MSA–7 and AN/MSA–17	—	6.32	6.32	—	6	6
Electronic shop, tlr mtd, M304 and M304A1	—	6.59	6.59	—	6	6
Launching control group, tlr mtd, OA–867/MSE–2	—	6.00	6.00	—	6	6
Tracking station, guided missile, tlr mtd, AN/MPA–4	—	6.18	6.18	—	5	5
g. Nike-Hercules.						
Antenna-receiver-transmitter group, missile tracking, OA–1340/MPA, OA–1487/MPA and OA–1487A/MPA, tlr mtd, (antenna tlr M406)	—	6.36	6.36	—	6	6
Director station, guided missile, tlr mtd, AN/MSA–19	—	6.79	6.79	—	6	6
Electronic shop, tlr mtd, M304 and M304A1	—	6.57	6.57	—	6	6

Table IV–6.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Launching control group, guided missile, tlr mtd, AN/MSW–4	—	5.19	5.19	—	6	6
Tracking station, guided missile, tlr mtd, AN/MPA–5	—	6.42	6.42	—	5	5
Test equipment, electronic shop, field maint, tlr mtd, AN/MPM–44, XM383	—	6 50	6.50	—	6	6
Test equipment, electronic shop, field maint, tlr mtd, AN/MPM–46, XM382	—	6.50	6.50	—	6	6

Table IV–7. Combination Vehicles

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Truck, cargo, ¾ ton, 4x4, M37:						
Trailer, cargo, ¼ ton, 2 whl, M100	3.24	4.24	4.24	3	4	4
Trailer, cargo, ¾ ton, 2 whl, M101	3.63	5.13	5.76	3	5	5
Truck, cargo, 2½ ton, M35:						
Trailer, cargo, 1½ ton, 2 whl, M105	7.77	11.77	15.02	6	9	12
Trailer, tank, water, 400 gal, M106	7.58	11.75	14.25	6	9	12
Howitzer, light, towed, 105mm, M101	8.93	11.43	13.93	7	9	11
Trailer, cargo, 1½ ton, 2 whl, M104	7.64	11.64	15.39	7	10	12
Trailer, basic utility, pole type, 2½ ton, 2 whl	7.64	12.64	15.14	6	10	12
Truck, cargo, 2½ ton, 6x6, M36:						
Compressor, air, tlr mtd, 4 whl, DED, 315 CFM	13.84	16.34	18.84	10	12	15
Conveyor, belt, whl mtd, 300 TPH, Barber Greene Model PG–70	11.06	13.56	16.06	8	10	12
Truck, cargo, 2½ ton, 6x6, M211:						
Trailer, cargo, 1½ ton, 2 whl, M104	7.99	12.17	15.92	7	10	13
Trailer, cargo, 1½ ton, 2 whl, M105	8.12	12.29	15.55	7	10	12
Trailer, tank water, 400 gal, 1½ ton, 2 whl, M106	7.93	12.28	14.78	7	10	11
Trailer, basic utility, pole type, 2½ ton, 2 whl	7.99	13.17	15.67	7	10	12
Semitrailer, van, cargo, 6 ton, 2 whl, M118 with dolly converter, 2 whl, 6 ton, M197	11.84	20.51	25.12	10	17	20
Truck, cargo, 5 ton, 6x6, M41:						
Trailer, cargo, 1½ ton, M104	11.12	17.79	21.54	10	15	18
Dryer, aggregate, 80–150 TPH, tlr mtd, Barber Greene Model 833	31.62	—	39.29	24	—	30
Trailer, ammunition, 8 ton, 4 whl, M23, w/limber, carriage M5	15.86	29.03	31.53	11	22	25
Mixer, bituminous material, 110–200 TPH, tlr mtd, Barber Greene Model 848	23.42	—	35.19	19	—	30
Truck, cargo, 5 ton, 6x6, M54:						
Dryer, aggregate, 80–150 TPH, tlr mtd, Barber Greene Model 833	31.67	—	41.84	24	—	32
Howitzer, heavy, towed, 8 inch, M115	24.97	—	35.14	20	—	29
Mixer, bituminous material, 110–200 TPH, tlr mtd, Barber Greene Model 848	23.47	—	27.74	19	—	32
Semitrailer, tank, gasoline, 5,000 gal, 4 whl, M131A1 w/tlr converter M198A1	18.83	38.82	44.31	16	27	37
Trailer, cargo, 1½ ton, 2 whl, M104	11.17	17.84	24.09	9	15	20
Truck, cargo, 5 ton, 6x6 M55:						
Howitzer, heavy towed, 8 inch, M115	27.03	32.03	37.03	21	25	30

Table IV–7.—Continued

Vehicle description	Weight (Short tons)			Class		
		Loaded			Loaded	
	E	C	H	E	C	H
Truck, cargo, 10 ton, 6x6, M125:						
Mixer, bituminous material, 110–200 TPH, tlr mtd, Barber Greene Model 848	29.12	—	48.22	23	—	41
Howitzer, heavy, towed, 8 inch, M115	30.60	40.40	46.60	24	32	36
Trailer, ammunition, 8 ton, 4 whl, M23, w/limber, carriage M5	21.74	—	44.74	17	—	37
Truck, dump, 5 ton, 6x6, M51:						
Bin, aggregate loading, tlr mtd, 30 ton, Universal Model PB–20	17.19	—	17.19	12	—	12
Mixer, bituminous material, 110–200 TPH, tlr mtd, Barber Greene Model 848	24.83	—	39.11	20	—	33
Trailer, basic utility, pole type, 2½ ton, 2 whl	12.53	20.21	25.21	10	17	21
Truck, tractor, 2½ ton, 6x6, M221:						
Semitrailer, van, cargo, 6 ton, 2 whl, M119 and M119A1	9.82	15.82	17.92	8	14	16
Truck, tractor, 2½ ton, 6x6, M275:						
Semitrailer, stake and platform, 5 ton, 2 whl, Olsen Model 516	9.12	14.12	16.62	8	12	15
Truck, tractor, 5 ton, 6x6, M52:						
Codling tower, semitrailer mtd, 4 sec, 2400 GPM	—	17.3	17.3	—	13	13
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131	16.93	26.74	32.20	13	22	28
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131C	16.58	27.77	33.86	13	24	30
Semitrailer, van, cargo, 12 ton, 4 whl, M127	16.25	28.25	34.25	12	25	31
Semitrailer, low bed, 15 ton, 4 whl, M172	16.78	—	31.78	12	—	25
Semitrailer, low bed, 25 ton, 4 whl, M172A1	16.78	—	41.78	12	—	35
Semitrailer, low bed, wrecker, 12 ton, 4 whl, M270	18.25	30.25	38.25	13	23	30
Semitrailer, tank, alcohol, 3,000 gal, 2 whl, M338	13.21	21.19	21.19	10	18	18
Semitrailer, stake, 12 ton, 4 whl, M127A1	15.68	27.78	33.78	12	23	29
Semitrailer, mobile, sawmill, Sawmobile Model 58	—	28.87	28.87	—	22	22
Truck, tractor, 10 ton, 6x6, M123:						
Semitrailer, tank transporter, 50 ton, 8 whl, M15A2	33.20	—	89.83	21	—	72
Semitrailer, tank transporter, 45 ton, 8 whl, M15A1	35.66	—	80.66	24	—	65
Truck, tractor, 10 ton, 6x6, M123:						
Semitrailer, tank transporter, 45 ton, 8 whl, M15	35.66	—	75.66	24	—	60
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131	21.90	31.71	37.17	17	26	31
Semitrailer, low bed, wrecker, 12 ton, 4 whl, M269	21.57	33.57	41.57	16	26	33
Semitrailer, low bed, 25 ton, 4 whl, M172A1	22.63	47.63	52.63	17	37	42
Truck, tractor, 12 ton, 6x6, M26:						
Trailer, low bed, 60 ton, Rogers Model D–60–DS	41.45	—	101.45	30	—	108
Semitrailer, tank transporter, 45 ton, 8 whl, M15A1	45.64	—	90.64	32	—	73
Semitrailer, tank transporter, 40 ton, 8 whl, M15	45.64	—	85.64	32	—	68
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131	31.88	41.69	47.15	25	33	37
Truck, tractor, wrecker, 5 ton, 6x6, M246:						
Dryer, aggregate, 80–120 TPN, tlr mtd, Barber Greene Model 833	—	—	43.66	—	—	35
Trailer, ammunition, 8 ton, 4 whl, M23, w/limber, carriage M5	22.35	—	38.53	18	—	32
Mixer, bituminous material, 110–200 TPH, tlr mtd, Barber Greene Model 848	29.91	—	42.19	24	—	35
Semitrailer, tank, gasoline, 12 ton, 4 whl, 5,000 gal, M131	23.85	33.66	39.12	19	28	33
Semitrailer, low bed, 12 ton, 4 whl, M270A1	25.17	37.17	37.17	19	28	28
Tractor, full tracked, high speed, 13 ton, M5:						
Howitzer, medium, towed, 155mm, M114	—	21.61	21.61	—	18	18
Gun, antiaircraft, artillery, towed, 90mm, M118	—	19.32	19.32	—	16	16
Tractor, full tracked, high speed, 18 ton, M4:						
Howitzer, heavy, towed, 8 inch, M115	—	30.50	30.50	—	25	25
Gun, antiaircraft, artillery, towed, 90mm, M2, mount 90mm, M2	—	30.95	30.95	—	27	7

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By Order of the Secretary of the Army:

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Chief of Staff.

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NG: State AG (3); Units—same as Active Army.

USAR: Units—same as Active Army.

For explanation of abbreviations used, see AR 320–50.

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