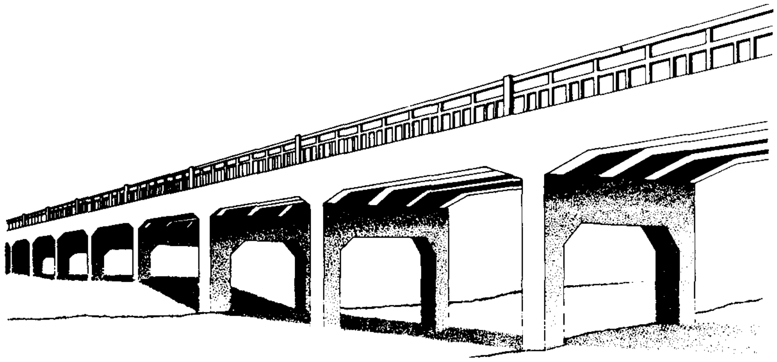


Man-Made Features

Chapter 2

URBAN AREAS

Urban-area intelligence is important in planning tactical and strategical operations, targeting for nuclear or air attack, and planning logistical support for operations. Knowledge of characteristics in urban areas may also be important in civil affairs, intelligence, and counterintelligence operations. Although information is frequently accessible, the amount of detail required necessitates a substantial collection effort.

The first aspect of urban intelligence includes geographic location, relative economic and political importance of urban areas in the national structure, and physical dimensions such as street shapes. The six street patterns are rectangular, radial, concentric, contour conforming, medieval irregular, and planned irregular (in the new residential suburbs of some countries).

The second aspect includes physical composition, vulnerability, accessibility, productive capacity, and military resources of individual urban areas. Urban areas are significant as military objectives or targets and as bases of operations. They may be one or a combination of power centers (political, economic, military); industrial production centers; service centers; transportation centers; population centers; service centers (distribution points for fuels, power, water, raw materials, food, manufactured goods); or cultural and scientific centers (seats of thought and learning, and focal points of modem technological developments).

Buildings can provide numerous concealed positions for the infantry. Armored vehicles can find isolated positions under archways or inside small industrial or commercial structures. Thick masonry, stone, or brick walls offer excellent protection from direct fire, and ceilings for individual fire. Cover and concealment can also be provided by the percentage of roof coverage. For detailed information, see FM 90-10.

Although an urban overlay is not a standard product, it is useful for military purposes. A subdivision can describe individual categories or break down a division to more specific items as required by the user, as long as the subdivisions are outlined in the legend. The division numbers in this manual are based on the DFAD system, in PS/ICE/200. The first number describes the division as residential or industrial, the second number indicates the type of construction material, and the third number is the type of structure. If this number or its subdivisions are not needed in particular overlays, the number will be followed by zeros.

The industrial category (code 100) consists of the area and facilities that include the buildings used by those establishments engaged in the extraction, processing, and production of intermediate and finished products or raw materials, The two plant types in industrial areas are heavy manufacturing and medium and light manufacturing. Heavy-manufacturing plants require distinctive structures, such as blast furnaces, that could be readily recognized, while medium and light plants are housed in general loft buildings from which machinery could be removed. The specific type of medium-or light-manufacturing plant is not usually apparent from the type of building.

The transportation category (code 200) consists of the area and facilities used in moving materials and people on land. Features include railroads, roads, road interchanges, bridges, bridge structures, and conduits.

The commercial/recreational category (code 300) consists of the area and buildings where the major business activities and recreational facilities comprise the congested commercial core of a city. It includes retail and wholesale establishments, financial institutions, office buildings, and hotels. Modem multistory office buildings are typical of commercial sections of large cities. More than one commercial area may exist, particularly in cities where a number of towns have merged. Recreational activities, such as amusement parks and stadiums, may also be present.

Residential areas of a city (code 400) consist of the area and associated buildings where civilians live. They include many types of dwelling structures. Buildings vary from one and two-story single family dwellings to multistory apartment houses and may be built of any materials available locally. Types and sizes of residential areas often indicate the number of people and the varying living standards throughout the city.

Communication facilities (code 500) transmit information from place to place. This category includes telephone, telegraph, and radio facilities, as well as other electronic features such as power line pylons and structures. These facilities include communication towers and buildings, as well as power transmission, observation, microwave, television, and radio towers.

The governmental and institutional category (code 600) consists of the area and facilities, primarily buildings, that constitute the seat of legal, administrative, or other governmental functions of a country or political subdivision. This category includes those buildings serving as public service institutions, such as universities, churches, and hospitals. Governmental and institutional areas may include buildings such as the capital; administrative centers such as ministries, departments, courts, legislative buildings, embassies, and police headquarters; educational, cultural, and scientific institutions such as schools, hospitals, universities, libraries, museums, theaters, research institutions and laboratories; and religious and historic structures such as churches, monuments, and shrines.

The military/civil category (code 700) consists of the area and facilities used by the air, naval, and ground forces for waging war, training, and transporting nonmilitary goods and personnel by sea and air. Military areas usually include transportation, billeting, storage, airfields, and administration facilities. Since these are of strategic and tactical importance, they require as accurate a description as possible for urban-area intelligence.

The storage category (code 800) consists of the area and facilities used for holding or handling liquids or gases, bulk solids, and finished products. Examples are cylindrical and spherical storage tanks; closed storage such as silos and grain bins; open storage such as vehicle, ship, and aircraft storage areas and storage mounds such as coal or minerals.

The landforms, vegetation, and miscellaneous features category (code 900) describes the surface landscape characteristics or natural scenery features such as levees, walls, and fences. It includes beaches, recreation areas, farms, wooded areas, swamps, and vacant land. Extensive open areas within the city may be valuable military assets, particularly if they have roads and railroad lines nearby as well as access to electric and water supply facilities. Open areas on the outskirts of cities arc the most immediately available land for military use. Features include snow or ice areas, vegetation such as orchards and vineyards, agricultural areas, and surface features such as embankments, fences, and cliffs.

TRANSPORTATION

Analysts preparing terrain studies must carefully evaluate all transportation facilities to determine their effect on proposed operations. Analysts may recommend destroying certain facilities or retaining them for future use. The entire transportation network must be considered in planning large-scale operations. An area with a dense transportation network, for example, is favorable for major offensives. Networks that are criss-crossed by canals and railroads and possess few roads will limit the use of wheeled vehicles and the maneuver of armor and motorized infantry.

The transportation facilities of an area consist of all highways, railways, and waterways over which troops or supplies can be moved. The importance of each area depends on the nature of the military operation involved. An army's ability to carry out its mission depends greatly on its transportation capabilities and facilities.

Highways

Features

Military interest in highway intelligence of a given area or country covers all physical characteristics of the existing road, track, and trail system. All associated structures and facilities necessary for movement and for protection of the routes, such as bridges, ferries, tunnels, and fords, are integral parts of the highway system. Planners must know where new routes will be needed to support an operation.

Road widths are given in meters. Measurements indicate the minimum width of the traveled way. Each road segment between intersections is assigned a width value, and that number is placed parallel to the road segment.

The severe abuse given to roads by large volumes of heavy traffic, important bridges, intersections, and narrow defiles makes them primary targets for enemy

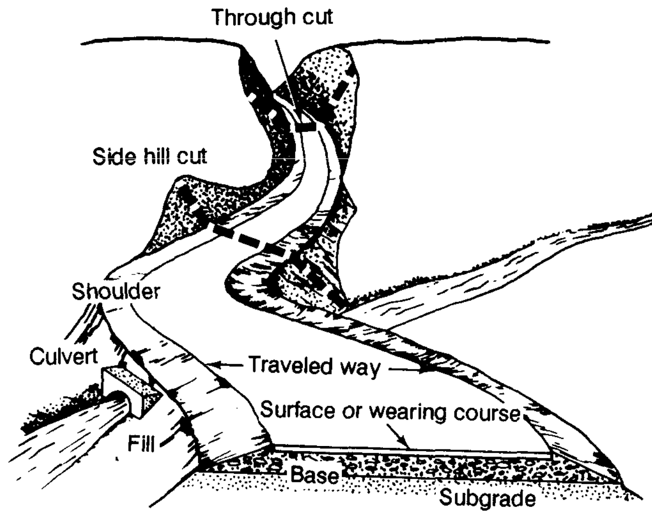


Figure 2-1. Parts of a road

bombardment. Planners must avoid maintaining unnecessary routes and must hold construction of new routes to a minimum.

Road Classification

Five road classifications are recognized on 1:50,000 scale topographic maps. They are all-weather, hard-surface dual/divided highway; all-weather, hard- surface highway; all-weather, loose-surface highway; fair-weather, loose-surface highway; and cart track.

All-weather, hard-surface, dual/divided highways normally have waterproof surfaces paved with concrete, bituminous surfacing, brick, or paving stone and are only slightly affected by precipitation or temperature changes. The route is never closed to traffic by weather conditions other than temporary snow or flood blockage. Photo interpretation keys include:

- Traveled portion of roadway is fairly straight.
- Even curves are present.
- Road width is uniform with easily seen parallel sides.
- Photo tint of mad surface is an even color and varies from dark gray to white.
- Absence of ruts or holes on traveled portion of the roadway.

All-weather, hard-surface highways have waterproof surfaces of concrete, bitumen, brick, or paving stone and are only slightly affected by rain, frost, thaw, and heat. They are passable throughout the year to a volume of traffic never appreciably less than its maximum dry-weather capacity. They are never closed by weather conditions other than temporary snow or flood blockage. Photo interpretation keys are similar to those for the dual or divided highway.

All-weather, loose-surface highways are not waterproof but are graded and drained and are considerably affectedly rain, frost, or thaw. They are constructed of crushed rock, water-bound macadam, grovel, broken stone and cinders, or smoothed earth with an oil coating. The roads are kept open in bad weather to a volume of traffic considerably less than its maximum dry-weather capacity. Traffic may be halted for short periods of time. Heavy use during adverse weather conditions may cause complete collapse. Photo interpretation keys include:

- Sharp or irregular curves are present.
- Roadway meanders to avoid steep slopes.
- Gravel or crushed rock appears a uniform light gray except for low spots that collect water and appear in dark tones.
- Ruts and stones give the roadway a mottled appearance.
- Roadway edges and shoulders are not clean, sharp lines; sometimes, they are very difficult to determine.

Fair-weather, loose-surface highways are constructed of natural or stabilized soil, sand clay, shell, cinders, or disintegrated granite or rock. They include logging roads, abandoned roads, and corduroy roads which become quickly impassable in bad weather. Photo interpretation keys are similar to those for the all-weather, loose-surface highway except for less visible maintenance and narrower road widths at stream crossings.

Cart tracks are natural traveled ways including caravan routes and winter roads. They are not wide enough to accommodate four-wheeled military vehicles. Photo interpretation keys include

- Irregular turns and bends.
- Traveled roadway width varies.
- Apparent lack of direction.
- Roadway detours around wet terrain.

Railroads

Railways are a highly desirable adjunct to extended military operations. Their capabilities are of primary concern and are the subject of continuing studies by personnel at the highest levels.

Railroads include all fixed property belonging to a line, such as land, permanent way, and facilities necessary for the movement of traffic and protection of the permanent way. They include bridges, tunnels, snowsheds, galleries, ferries, and other structures.

Commanders need information on physical characteristics to determine railway capacities and maintenance or rehabilitation requirements. Railway intelligence covers all physical characteristics of the existing system and all available information pertaining to development, construction, and maintenance. Physical characteristics describe the railroad and its critical features and component parts such as roadbed, ballast, track, rails, and horizontal and vertical alignment.

Identification Keys

Railroads have definite characteristics distinguishing them from roads and highways (see Figure 2-2). Railroads often follow rivers, to take advantage of the normal gradual gradient of the valley. They follow as straight a line as possible, while roads meander. Curves are usually long and smooth, while roads may have sharp, right-angle turns and T-shaped intersections.

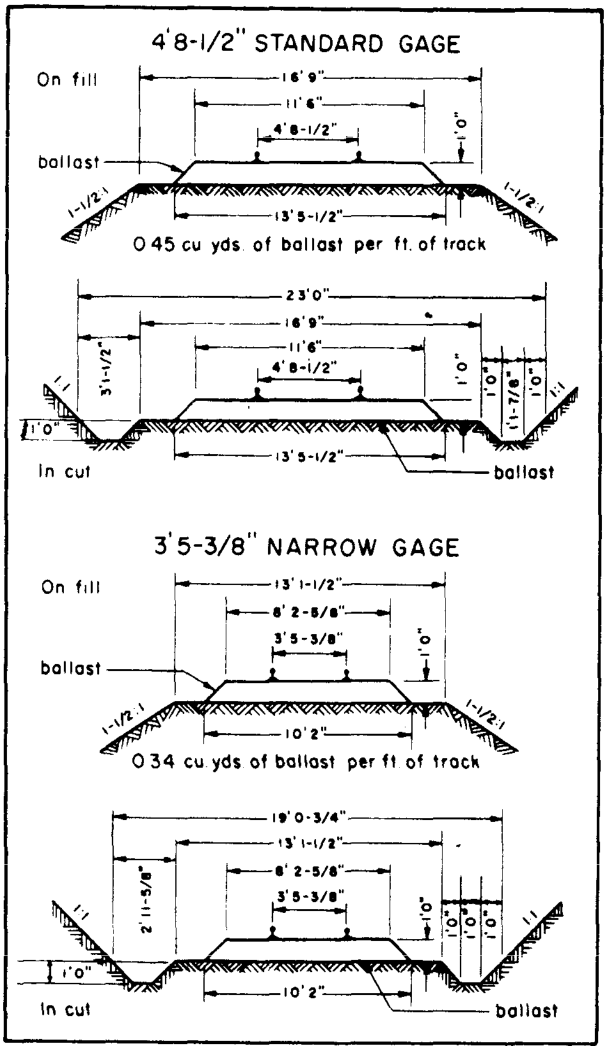


Figure 2-2. Diagram of standard- and narrow-gage roadbed cross section

Gradients are as level as possible and seldom exceed more than three or four percent, while roads often have steep grades. In order to keep gradients at a minimum, many cuts and fills exist along the right-of-way, especially in rolling or broken terrain, while roads run up and down hills with fewer cuts and fills.

Few houses are found along railways. Highways and railroads cross each other in such a manner that no interchange of traffic is possible. Grade crossings have distinct intersection angles, and overpasses and underpasses are obvious.

The gage of a railroad is the distance between the rails. Knowledge of railroad gages is useful to image interpreters for determining photo scales. Also, knowing that a change in gage may occur at an international border, the interpreter should look for transshipment stations. Railroad gages are classified as wide, standard, or narrow. Wide gages are 5 feet or wider. They are mostly used by Russian, Finnish, and Spanish lines. Standard gages are 4 feet, 8½ inches. They are used for main and branch lines in the United States and the rest of Europe. Narrow gages are less than standard. Their use is somewhat limited to and usually found in mountainous, industrial, logging, and coastal defense areas and in mines and supply dumps. In South and Central America, the one-meter gage is found in many places; however, many of the countries are now adopting the standard gage because they import US-made rolling stock. See Figure 2-2.

Fixed Installations

Classification (marshaling) yards are used to sort freight cars. They are identified by a large group of parallel tracks with a restricted (one-or two- track) entrance and exit called a choke point. Active classification yards include numerous freight cars and small switch engines. Two or more classification yards are frequently found next to each other, with their entrances through a choke point. If this choke point is higher than either classification yard, it is known as a hump. Also, one yard is often placed slightly higher than the neighboring yard to allow cars to coast out of one yard through the choke point into a previously selected track of the other yard.

Service yards are normally found in or near marshaling yards and can be identified by the presence of roundhouses, turntables, service facilities, and car repair shops. Roundhouses are used for light repair and storage of locomotives. The number of roof vents on top of the roundhouse indicates the capacity of the roundhouse. Turntables are used for turning the engines around. Service facilities include coal towers, water towers, and coal piles. Car-repair shops normally appear as long, low buildings straddling one or more tracks, with cars awaiting repairs on sidings adjacent to the buildings.

Freight or loading yards are identified by loading platforms, freight stations, warehouses, and access to other means of transportation. Special loading stations are identified by grain elevators, coal and ore bins, oil storage tanks, and livestock pens with loading ramps.

Passenger stations vary from small rural depots or suburban stations to large stations and terminals. Small stations usually do not have loading docks and may not have parking areas for automobiles or trucks. They are located close to a track, and shelters may cover waiting platforms if more than two tracks pass the station. Large stations are identified by a large number of tracks leading into or past a large building that houses waiting rooms, ticket offices, and other passenger facilities. The track or boarding area is normally covered.

Freight stations may be identified by loading docks along railroad tracks on one side of a building and loading docks along a road or street on the opposite side. Freight stations are small, single structures near passenger stations designed for the temporary storage of goods received. Warehouses may be away from fixed railroad installations, and more than one may be located in an area. Freight cars loading or unloading at a freight station aid in identification of the installation. See Figure 2-3.

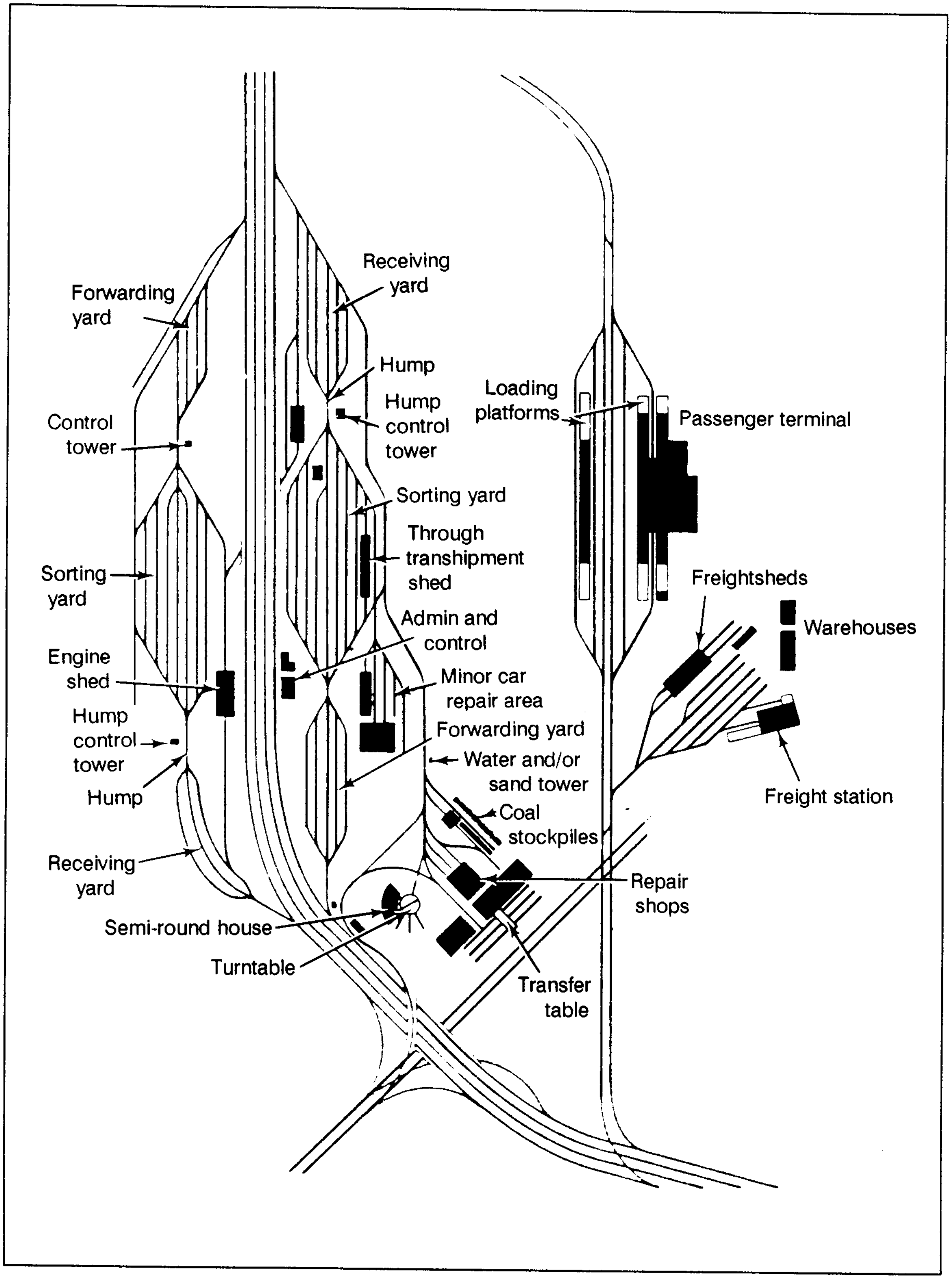


Figure 2-3. Fixed Installations

Rolling Stock

Locomotives. Locomotives vary greatly, from small switch engines 24 to 30 feet long m mainline passenger and freight locomotives 35 to 50 feet long. Locomotives longer than 50 feet are used for special purposes such as mountain climbing. Locomotives may be steam, electric, diesel, or diesel-electric. Steam locomotives are easily identified by smoke and stream around an operating locomotive, a smokestack, and a fuel tender attached just behind the locomotive. Electric locomotives have no fuel tender or smokestack and may be identified by overhead antennae if they receive their power from overhead lines. The lines may be evidenced by the shadows their support poles cast. Diesel locomotives lack a fuel tender and are usually identified by their streamlined appearance.

Freight cars. The boxcar is the most frequently found freight rolling stock, recognized by its rectanglar shape and little roof detail. The round-topped freight car differs only in its top. These cars average 40 to 45 feet in length in the US, 25 feet in Europe. Other freight cars are the gondola and hopper cars, which are used for coal, ore, and other bulky material or large freight that cannot be loaded into a boxcar. Shape and shadow aid in identification. Refrigerator, stock, and automobile cars are so close in appearance to boxcars that low-level obliques arc usually necessary to distinguish them. Cabooses, not always found on foreign railroads, appear as small cars attached to the end of freight trains, usually with a visible cupola.

Passenger cars. For identification purposes, the outstanding characteristic of passenger cars is their length, especially when compared with freight cars. They vary from 50 to 80 feet. Normally, it is not possible to distinguish a coach from a sleeping or dining car.

Special Equipment. Railroads have a variety of special equipment in their rolling stock. The railcar is a self-contained unit with its own power plant as well as space for passengers or mail and baggage or all three. Cranes, snowplows, and drop-center flatcars are sometimes present on rolling stock.

Railheads

Railheads are points of supply transfer from railroads to other transportation and are generally found in small towns or cities where sidings and storage space already exist. Characteristics of a railhead are spurs and sidings from a main line; a road net, including narrow gage railroads, leading away from the area; piles of materials stacked near the track trucks or wagons or both, either without order or organized into convoys or trains; and temporary dwellings, such as tents or Quonset huts, for housing troops guarding and handling supplies.

End Points

System. A railroad system is a network of railroads operated by a single management entity, government or corporate. System end points are the points where a railroad system begins, ends, or changes identification. There may be no system end points within many map sheets, but system end points will always coincide with route and segment end points.

Route. A route is the portion of a system providing through lines between selected points. Routes are usually specified by the system management, but it may often be convenient or appropriate for the analyst to select others. The route will be identified on the factor overlay by abbreviations of the two endpoints placed in parentheses. There may be no route end points within the area of a 1:50,000 factor overlay. Route end points always coincide with segment end points and may coincide with system end points. Kilometer distances are always measured from route end points.

Segment. A segment is the portion of a route characterized by uniform load-bearing, traffic capacity, and operating characteristics. Analysts will number segments sequentially along a route within a map sheet, starting at the segment nearest the zero kilometer point. End points of segments are defined by nodes along the route, at which anyone of the following conditions occurs:

- A change in the number of tracks (points where passing tracks or sidings start or end do not constitute nodes).
- A change in the gage of the track.
- A route or system terminal.
- The point where the route crosses the neat line of the factor overlay.
- A terminal or junction where traffic may be diverted onto another route.
- A change in the type of construction such that the load-bearing capacity, speed or traffic capacity is altered.
- A point where electrification starts, ends, or changes method of power transfer.
- A point where a change in traffic control methods occurs, such as international boundary crossings.

Number of Tracks

Analysts indicate the number of tracks for single- and double-track lines by the number of ticks used with the gage symbol. Routes with three or more tracks are symbolized by the double-track symbol supplemented by a *T* and a number, which indicates the actual number of tracks. Lines operated by different systems that closely parallel each other or share a common right-of-way are in juxtaposition (side by side) and are indicated by separate symbols. Symbols for such lines will be sufficiently displaced from the centerline to make it clear that two distinct lines exist.

Bridges

Features

Structures and crossings on highways or railways include bridges, culverts, tunnels, galleries, ferries, and fords. For the purpose of terrain intelligence, they also include cableways, tramways, and other features that may reduce or interrupt the traffic flow on a transportation route. Bridges and culverts are the structures most frequently encountered; however, any feature that may present a potential obstacle is significant in a military operation. See Figure 2-4.

Any type of structure or crossing on a transportation route is an important portion of the route regardless of the mode of transportation. Maps, charts, photographs, and other sources contain valuable information that analysts should exploit.

Highway and railway bridges and tunnels are vulnerable points on a line of communications. Information about prevention, destruction, or repair of a bridge may be the key to an effective defense or the successful penetration of an enemy

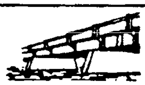
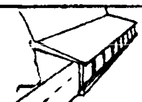
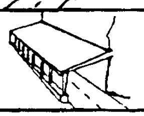
Structure Type / Span Type	Photo Indication	Photo Tone/Color/texture	Probable Material Type
Bridge  SUSPENSION BRIDGE	Towers Shadow outline of towers and suspension cables. Texture of tower surfaces.	Color: green, red, black Tone: dark gray	Steel reinforced concrete
 TRUSS	Presence of superstructure cross hatch pattern of span members. detail visible from shadow detail.	Color: white, gray, red, silver Tone: light to dark gray Texture: rivet pattern	Steel
 SLAB	Absence of superstructure Type of guard rails: (1) Angular (2) Rounded, smooth	Beam, girder, and slab bridge design preclude identification of construction material from vertical aerial photography. When possible the analyst should obtain low oblique photography of these types of bridges.	
 BEAM	Absence of superstructure Type of guard rails: (1) Angular (2) Rounded, smooth, length		
 GIRDER	Absence of superstructure Type guard rails: (1) Angular (2) Rounded, smooth, length, shadow detail		
 ARCH (closed spandrel)	Shadow detail: massive structure	Color: white, red Tone: gray, light gray Texture: rough Joint patterns	Masonry structures are massive and usually old. Reinforced concrete spans are smaller.
 ARCH (open spandrel)	Shadow detail: open structure, smooth, rounded span members	Color: white to light gray Tone: gray to light gray Texture: smooth	Smooth rounded span Members: reinforced concrete Angular span members: steel
Snowshed 	Location: Mountainous areas Length	Color: light gray to white Tone: light gray Texture: smooth	Difficult to determine from vertical photo. Long structures (100m) are probably reinforced concrete.
Gallery 	Location: limited to Mountain sides and valleys. Rock and landslide indications in area.	Roof materials not indicative of material.	Recent construction: reinforced concrete. Old structure: wood

Figure 2-4. Structure construction type identification from vertical aerial photography

area. A bridge seized intact has great value in offensive operations, since even a small bridge eases troop movement over a river or stream.

A bridge includes the substructure and superstructure. The substructure comprises the foundation and supporting elements of a bridge; the superstructure is the assembly that rests on the substructure and spans the gaps between ground supports.

Bridge superstructures take many forms, ranging from short trestle spans built into wooden stringers to large multiple cantilever spans of several thousand feet. Most have two basic components, the main supporting members and a floor or deck system. The primary exception is the concrete slab design, in which the supporting member also serves as the floor. The superstructure used depends on the loads to be carried, required span lengths, time available for erection, availability of

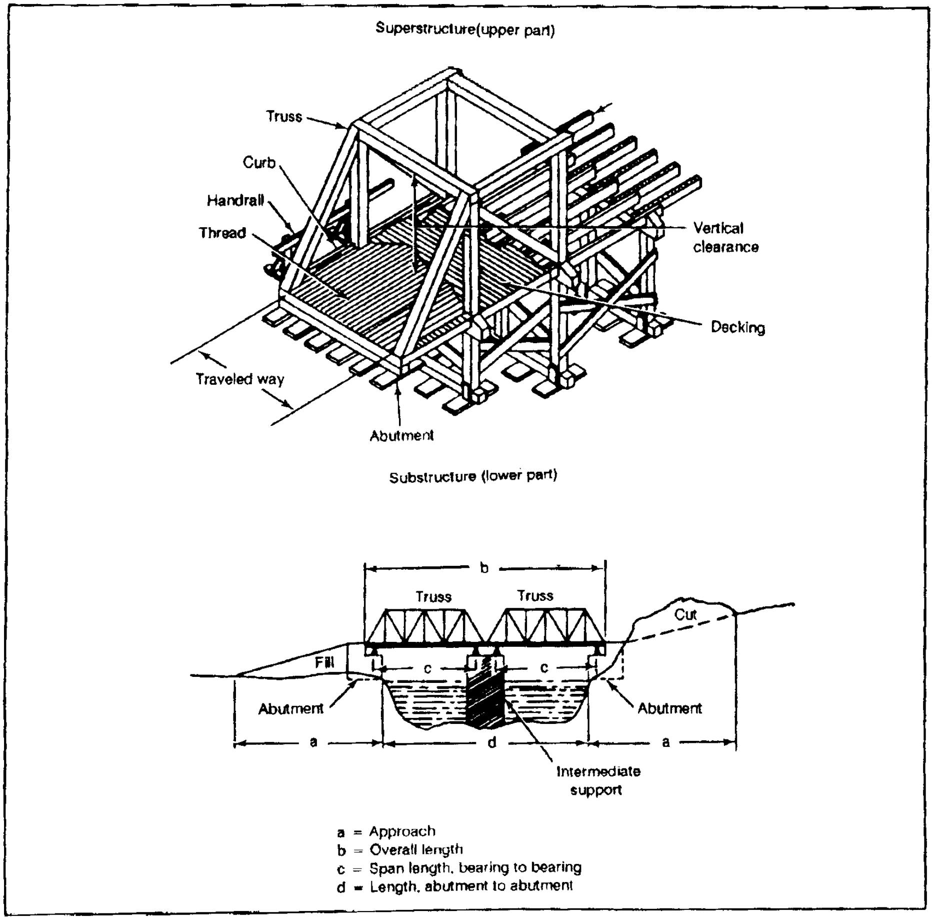


Figure 2-5. Bridge mensuration requirements

construction materials, manpower and equipment, and characteristics of the site. See Figure 2-5.

Based on their superstructures, bridges may be either fixed or movable. The five major categories of fixed bridges are beam, slab, girder, truss, and arch bridges. These types may occur alone or in combination. Movable bridges have at least one span that can be moved from its normal position to allow passage of vessels. The four general types of movable bridges are swing, lift, bascule, and retractile.

The load capacity is the most critical factor of abridge. The most reliable capacity data comes from the standard design loadings by which most countries design their bridges. Usually a country has a number of standard design loadings for different capacity classes. Standard design loadings may be expressed by a letter, number, or symbol.

Bridge Reporting

The data base includes all-on route bridges that can be identified and measured on aerial photography or derived from updated collateral sources. Structures less than 6 meters long are culverts; all others are treated as bridges. This cut-off length is flexible according to the prevalence of bridging in the study area.

All bridges present a potential restriction to traffic, and all items reflected in the collection checklist are important. Some of the basic requirements for information on any type of bridge are--

- Location, or kilometer stations from origin of section. The nearest kilometer should be given unless close spacing requires use of the nearest 0.1 kilometer for separate identifications.
- Obstacle crossed. Analysts must list the name of the stream when they know it. Other possible entries include gorge, railroad, and canal.
- Universal transverse mercator (UTM) coordinates to six places and geographic coordinates to the nearest second.
- Overall length, to the nearest meter. This should generally be the sum of the span lengths, but it should not include approaches.
- Roadway width to the nearest 0.1 meters of that portion of the deck over which vehicles normally run, excluding sidewalks, curves, parapets, truss superstructure, and so forth. Width is measured between the inside faces of the curbs.
- Horizontal clearance, or the limiting width to the nearest 0.1 meter at a point 30 centimeters above the edge of the roadway. This normally includes widths of curbs and sidewalks but excludes parapets and trusses. The horizontal clearance on a truss bridge is measured from a point 4 feet above the roadway.
- Vertical clearance, or the minimum distance between the roadway and any obstruction immediately over the roadway, to the nearest 0.1 meter. The letter *u*, for unlimited clearance, indicates no obstruction.
- Military load classification (MLC). This number indicates the carrying capacity of the bridge, including classifications for single- and double-flow traffic. The symbol to show the MLC is a circle with the bridge information on the inside. The load classification is on the top of the circle. In those instances where dual classifications for wheeled and tracked

vehicles exist, both classifications are shown. See TM 5-312 for further information. See the NATO bridge symbol on Figure 2-6.

- Spans. Both the number and length of spans need to be determined. Lengths are given to the nearest 0.1 meter and represent the distance between supports, or centers of bearing. The bridge classification is measured fron center to center of supports and is based on the weakest span.
- Span construction. The construction material and type will be identified.
- Bypasses. Bypasses are local detours along a specified route that enable traffic to avoid an obstruction. They are classified as easy, difficult, or impossible according to the ease of access to the bridge bypass. See Figure 2-6.

Culverts

Culverts are grouped into four main categories of pipe, box, arch, and rail girder spans. Pipe culverts are the most common. They are usually concrete, but corrugated metal and cast iron are also used. The pipes have different shapes and range from 12 inches to several feet in diameter. Box culverts are used to a great extent in modem construction. They are rectangular in cross section and usually concrete. A large box culvert is similar to a slab bridge. Arch culverts were used frequently in the past but are rarely constructed now. They are concrete, masonry, brick, or timber. Rail girder spans are found on lightly built railways or, in an emergency, on any line. The rails are laid side by side and keyed head to base and may be used for spans of 3 meters or less.

Tunnels, Galleries, and Snowsheds

Features on a transportation route where it would be relatively easy to block traffic or that affect the traffic capacity of the road are critical. Such features include

BRIDGE RECONNAISSANCE REPORT
For use of this form, see FM 5-36, the proponent agency is TRADOC.

DATE: 23 MAR 90
SIGNATURE: [illegible]
TO: (Headquarters ordering reconnaissance) CDR EUCOM ATTN: G2
FROM: (Name, grade, and unit of officer or NCO making reconnaissance) GARY C. SEEBAUM, 1LT 18th ENGR
MAPS (Country, scale and sheet number or name) BELGIUM 1:50,000 LIEGE
DATE/TIME GROUP (Of signature) 23 MAR 1440Z

ESSENTIAL BRIDGE INFORMATION								ADDITIONAL BRIDGE INFORMATION (Add columns as needed) ((Military load class, overall length, roadway width, vertical clearance, bridge by-pass)					
		CLEARANCE		SPANS									
SERIAL NO.	LOCATION	HORIZONTAL	UNDER-BRIDGE	NUMBER	TYPE OF CONSTRUCTION	TYPE OF CONSTRUCTION MATERIAL	LENGTH AND CONDITION	MILITARY LOAD CLASSIFICATION	OVERALL LENGTH	TRAVELLED WIDTH	OVERHEAD CLEARANCE	BY-PASS POTENTIAL	REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	JA 388167	52	16.0		2	a	18.2 w	35 / 50; 35 / 50					
					2	a	35.0 w						
					2	a	22.0		146	52	∞	DIFFICULT	
2	JA 335414	∞	22.0	6	4	aK	9.2 w	30; 30	60	4.0	∞	IMPOSSIBLE	
3	JA 365218	6.2	4.1	1	1	a	33 w	80 / 100; 60 / 80	33	6.2	4.8	EASY	

DA FORM 1249 PREVIOUS EDITION OF THIS FORM IS OBSOLETE.

Figure 2-6. Bridge Reconnaissance Report

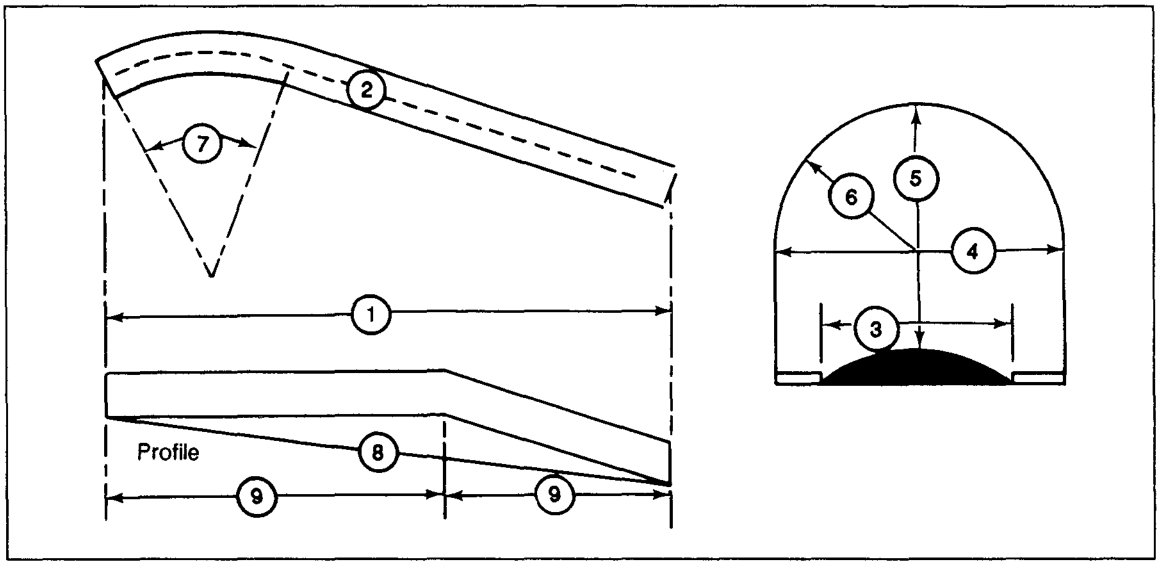


Figure 2-7. Dimensions required for tunnels

LEDGEND
1. Portal-to-portal length of tunnel
2.. Center line distance of tunnel
3. Effective width of the traveled way, curb to curb
4. Horizontal clearance (minimum width of the tunnel bore measured at least four feet above the traveled way)
5. Overhead clearance (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)
6. Rise of tunnel arch (radius of curved portion)
7. Radius of curvature of the traveled way either measured or estimated
8. Gradient (percentage of rise of the traveled way between portals)
9. Change in gradient within the tunnel (percentage of rise each way from break of grade)

tunnels, snowsheds, and galleries. These obstructions can prevent access to vehicles with certain physical dimensions. Reductions in traveled-way widths, such as narrow streets in built-up areas, drainage ditches, and embarkments, can also limit vehicular movement. This is an important aspect of transportation intelligence.

Tunnels

A tunnel is an underground section of the route that has been bored or made by cut-and-cover for a route passage. It consists of the bore or bores, portals, and possibly a liner. Tunnel bores are commonly semicircular, elliptical, horseshoe, or square with arched ceiling. Bores may be lined with brick, masonry, or concrete, or they may be unlined. Some very long tunnels on steam-operated railroad lines are artificially ventilated by blowers at the portals or in ventilating shafts above the bore. Alignment of tunnels may be straight or curved. See Figure 2-7.

Galleries and Snowsheds

Built in rugged, mountainous terrain, these protective structures are not as common as bridges or tunnels. Galleries offer protection against snow and rock avalanches. They may be cut into the side of a cliff and have a natural overhang, or the cover may be a concrete slab, either of which guides the avalanche across the track or road. One side of a gallery is usually open. Snowsheds offer protection against snow accumulations and slides on exposed sections of the permanent way.

Ferries

Ferries or ferry boats convey traffic and cargo across a river to another water barrier. These vessels vary widely in physical appearance and capacity depending on the depth, width, and current of the stream and on the characteristics of traffic to be moved. Propulsion of ferries may be by oars, cable and pulleys, poles, or stream current such as trail and flying ferries, or by steam, gasoline, or diesel engines. Construction of ferry boats varies widely from expedient rafts to ocean-going vessels.

The capacity of a ferry boat is usually expressed in tons and total number of passengers and is sometimes assigned an MLC number. When more than one ferry is employed for a given site, report the capacity of each.

Climatic conditions have a marked effect on ferry conditions. 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 operations is important.

A ferry site is the place where ferries convey traffic and cargo. Ferry slips or piers are generally provided on the shorn to permit easy loading. The slips may vary from simple log piers to elaborate terminal buildings. A common characteristic of ferry slips is a floating or adjustable approach ramp that accommodates variations in ferry deck level. Analysts must consider the limiting characteristics of ferry sites, such as the width of the water barrier from bank to bank, the distance and time traveled by the ferry boat from one side to the other, and the water depth at each ferry slip.

Approach routes to ferry sites have an important bearing on ferry use. Analysts should report the condition of the approaches, including the load-bearing capacity of landing facilities.

Fords

A ford is a location in a water barrier where the current, bottom, and approaches permit the passage of personnel or vehicles and other equipment, where little or no swimming is required, where they cross under their own or assisted propulsion, and where their wheels or tracks remain in contact with the bottom.

Fords are classified according to their crossing potential, or trafficability, for foot or wheeled and tracked vehicles. Fordable depths for vehicular traffic can be increased by suitable waterproofing or, in the case of modem tanks, by adding deep-water fording kits that permit fording depths up to 4.3 meters.

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

Bottom conditions are determined by checking the stability and composition of the bed. The composition of the stream bottom determines its trafficability. 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, or timber or wooden planking.

Climatic conditions such as seasonal floods, excessive dry seasons, freezing, and other extremes of weather materially affect stream foldability. The velocity of the current and the presence of debris also affect the condition and passability of a ford.

Current estimates are swift (more than 1.5 meters per second), moderate (1 to 1.5 meters per second), and slow (less than 1 meter per second).

Low-water Bridges

Low-warm bridges consist of two or more intermediate supports with concrete decking and are located wholly within ravines or gullies. **During** high-water periods, they may easily be confused with paved fords, as both are completely submerged. **Because** of corresponding military load limitations, analysts must properly identify low-water bridges and paved fords.

Cableways and Tramways

Cableways, tramways, and so forth are not usually major factors in a military operarion; however, they may be encountered in rugged mountainous regions and beach areas or used as connections between two primary supply routes. In some cases they may extend for several miles and be the best available method for moving supplies.

Pipelines

Pipelines that **carry** petroleum and natural gas represent an important mode of transportation. White rail, water, and road transport are used extensively for transporting fluids and gases, the overland movement of petroleum and refined products is performed most economically and expeditiously by pipeline. Crude-oil pipelines are used only to transport crude oil, while many refried-product pipelines carry more than one product. These products are sent through the pipelines in tenders, or batches, to keep the amount of mixing to a minimum. Because of their most vital link in an industrialized country's energy supply system, coal and ore are also carried in pipelines as slurry.

Components

Pipes are used in long-distance pipelines and in many local lines. They are composed of welded steel with diameters varying from 15 centimeters to more than 1 meter, depending upon the economies of the line's construction. The pipe may be laid either underground or above grorrnd **and** may extend cross-country or follow the alignment of roads and railroads. When a pipeline must cross a stream, the pipes are usually laid along the stream bottom. Where streams are **swift** or where beds may shift rapidly, either the pipe is attached to existing bridges **or special** pipeline suspension bridges are built. Siphon crossings are used where necessary,

When an increase or decrease of pressure is required, regulating features such as pumps or compressors are used. Pumping stations are used for liquid fuels and compressor stations for gas. They are similar in appearance except for the cooling towers present at compressor stations.

Valves, manifolds, and meters are integral parts of any pipeline system and are located at frequent intervals along the pipeline and at terminals. Valves protruding from the ground are often the only indicators of a pipeline alignment.

Terminal Facilities

Refinery terminals consist of numerous tanks for the separate storage of crude oil and refined products. Facility size and type depends on whether the refinery is located near the source of supply or consuming center, Refined-product dispensing terminals contain a variety of products for final distribution.

Natural gas is generally stored in bulk, below the ground, and under high-pressure, Large underground gas storage pools, usually caves or quarries near consuming centers, are often used to store gas for seasonal or emergency needs. Above ground, natural gas is stored mostly under pressure in spherical tanks, but large telescoping tanks are sometimes used for low-pressure storage. Natural-gas receiving terminals are located at the producing field and contain facilities for conditioning the gas for pipeline transmission. Natural-gas dispensing terminals are located at

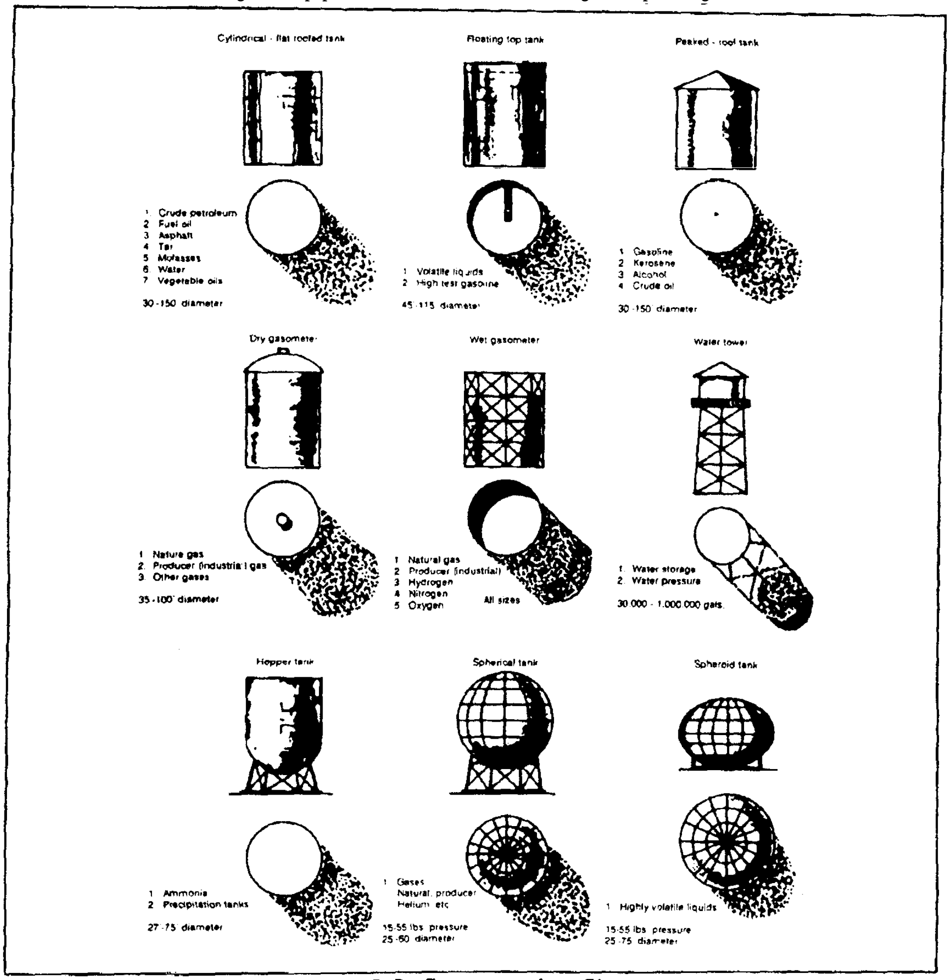


Figure 2-8. Storage tanks - Shapes

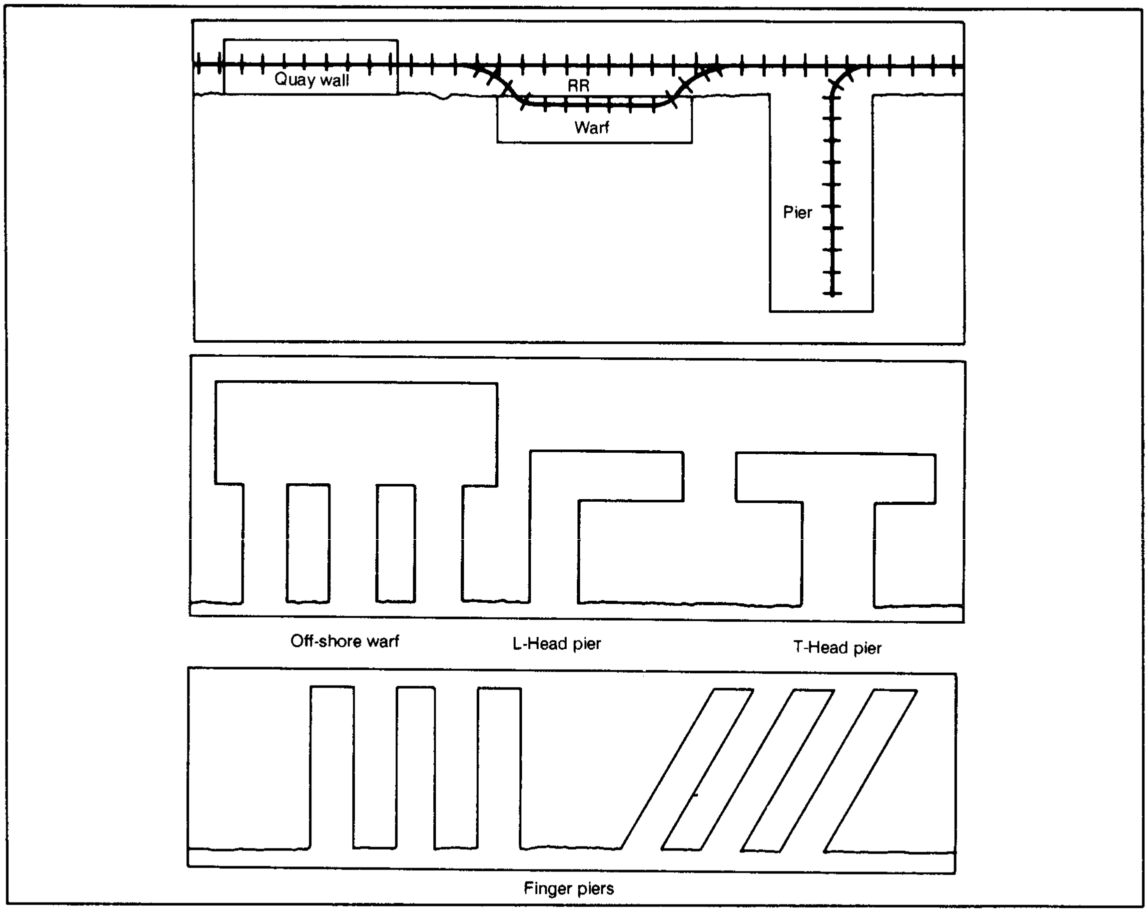


Figure 2-9. Berthing facilities

consuming centers and include dispatching and metering facilities and sufficient storage facilities to meet peak demands.

Storage tanks, found in varying numbers at all petroleum installations, are easily recognized. Volatile products such as gasoline and kerosene are generally stored in floating roof tanks. These tanks have roofs that float on the liquid to reduce space in which vapor might form. Nonvolatile products such as fuel oils and crude oil are stored in fixed-roof tanks. Petroleum gases are generally liquefied and stored under pressure in spherical tanks or in horizontal cylindrical tanks. The number and variety of tanks in a storage installation indicate the quantity and types of product stored. Areas of great extent and capacity are called tank farms. See Figure 2-8.

PORTS AND HARBORS

Information about ports, naval bases, and shipyard facilities is essential for estimating capacities, vulnerability, and other items of military significance.

Ports

Ports are settlements with installations for handling waterborne shipping. Principal port facilities are berthing space, storage space, cargo-handling equipment, cargo transshipment facilities, and vessel-servicing facilities. Ports are classified on an areawide rather than a worldwide basis, and a principal port in a small

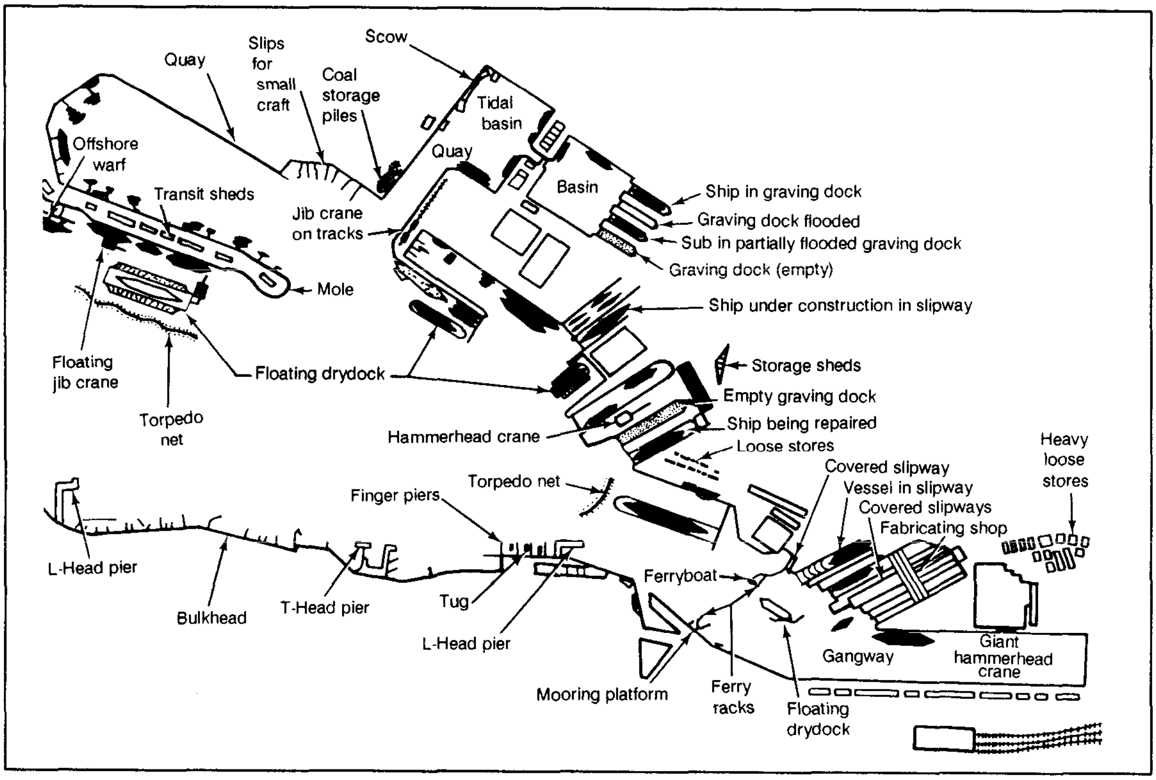


Figure 2-10. Annotated overlay of a European harbor (Kiel, Germany)

maritime nation may be equivalent to a much lesser port in the more extensive port system of another country. In wartime, principal and secondary ports and bases are prime targets for destruction, and the relative importance of minor ports increases. See Figure 2-9.

Ports may have various structures affording berthing space or may be anyplace a vessel may be made fast. These structures include piers, moles, and wharves or quays. Perhaps the most important difference between these structures is that piers are supported by pilings driven into the harbor bottom, while moles are of solid construction. In addition, wharves and quays are parallel with the shoreline, while piers and moles are perpendicular to it.

Harbors

Harbors are areas where the anchorage and shore are protected from the sea and storms by natural or man-made barriers. Areas that do not have this protection but are still suitable for vessel anchorage are open anchorages or roadsteads. A good harbor must have deep water, adequate protection from storms, enough space to accommodate large numbers of vessels, and a shoreline that can be developed as a port and as a site for industry. Harbors may be situated on the sea, estuaries, or inland lakes and rivers and may easily be recognized by abundant waterborne traffic and port facilities. See Figure 2-10.

Relatively few strategically located natural harbors are large enough or safe enough to be valuable to shipping. Many of the important harbors of the world are man-made. Most harbors have some or all of the more common artificial protective structures. A breakwater is a massive stone or masonry structure extending across or at an angle to the entrance to the harbor. A jetty is the name applied to a breakwater that connects with the shore. A mole is a jetty that is wide enough to allow construction of a roadway along the top. A sea wall is a structure built along the coastline to prevent the sea from eroding the land.

Within the harbor itself are various types of buoys used as navigational aids. In addition, lighthouses, mooring buoys, and dolphins are often present. Mooring buoys are huge buoys located in the harbor so that vessels may tie up without dropping anchor. Only when a harbor has been developed for transacting business between ship and shore does it become part of a port. Dolphins are groups of pilings driven into the harbor bottom for the same purpose.

Dolphins usually consist of a cluster of piles lashed together at the top. They are located off shore and are used singly for mooring into or hauling out of a berth and in a series for mooring a ship alongside. Dolphin moorings conserve space in the stream and are used either for idle berthing or for loading cargo from lighters. Dolphins are often associated with a wharf either as a protective device at wharf corners or as a means of increasing the length of berthing space provided by a wharf face.

A dock, also called a slip or berth, is the water adjacent to a mole, pier, or wharf when that water area is narrow and affords berthing space. Basins are broad and expansive, artificially enclosed bodies of water that form a harbor or part of a harbor. They may be tidal basins in which water is subject to tidal influences, or controlled-level basins in which the water level is maintained irrespective of tidal change. Controlled-level basins are either wet docks or half-tide basins. A wet dock is enclosed by a gate, caisson, or lock. It may be filled by naturally impounding water at each high tide or at spring tides only. Pumping plants may be provided for initial filling or for elevations of the water above that achieved by natural impounding. The half-tide basin has gates at each end and is used in much the same manner as a large leek to increase the enormous amount of water required to raise the water level. It cannot be used at all states of the tide.

Harbor works, including protective works, are structures designed to provide shelter, control water flow, and regulate erosion for improvement of the navigability of a harbor. The principal structures are breakwaters, jetties, groins, sea walls, bulkheads, dikes, locks, and moles. Harbor works do not include port facilities that are designed specifically for transfer of cargo and the servicing ships.

Depths are important in such port topics as harbor, entrance, anchorage, wharves, and dry docks. They are computed in terms of established reference planes that are based on but do not necessarily coincide with tidal levels. The particular reference plane on which depths on a hydrographic chart are based is called chart data and is defined on the chart. Precise data is established for most ports and is a basis for soundings. Analysts should clearly indicate the reference plane when reporting depths.

The navigable waterways through the approach, the entrance to the harbor, and the harbor itself frequently determine the size of the ships (draft, length, beam, height above water) that can be accommodated in the port. Analysts should describe in detail any thruway with controlling dimensions that limit the size of ships which can traverse it. Reports on the experiences of ships with critical dimensions that have entered are most helpful.

Cranes (Cargo-handling Equipment)

Cargo berthing space may be recognized by the presence of heavy handling equipment located on piers or wharves. However, very small ports may not have any such equipment, requiring vessels to supply and use their own. Port cargo-handling equipment includes various hoists for handling general cargo and special equipment for other cargo.

A gantry crane is a traveling crane on rails that consists of a hoist on a heavy cross girder supported at two points. Hoisting is performed by a trolley or crab that moves transversely along the bridge. Gantry cranes occasionally serve as a base for a jib crane, the latter being mounted on and capable of transverse movement along the bridge member. They are used extensively in shipyards for hull erection and in various industrial yards and shops for heavy lifting. They are almost always electrically operated. Depending on use, they may range up to 250 tons capacity. Hoisting capacity is constant regardless of the position of the crab or trolley on the bridge.

A cantilever crane consists of a base or tower structure on which is mounted a counterbalanced horizontal arm or jib. A trolley that can be racked along rails on the cantilevered jib carries the hoisting sheaves. The trolley does not carry the hoisting mechanism but merely serves to support the fall, and its transverse movement is controlled by a system of sheaves and ropes. Cantilever cranes are most commonly found in shipyards, although they may be used for cargo handling in special instances where a large working radius is required. They are normally electrically powered and range up to 250 tons or more in capacity. Capacities should be reported at maximum and minimum radius. One type of cantilever crane is the hammerhead. These cranes are supported at one point, about which the mechanism can turn. The hoisting end is balanced by a cab or counterweight. The entire machine may be mounted on rails for movement along the pier or wharf.

A jib crane consists of the primary arm on which is mounted a shorter arm, or jib, extending at an angle. At the end of the jib are sheaves through which run the fall from which the load is suspended. The fall is raised and lowered by a hoisting mechanism built into the crane. Jib cranes are frequently mounted on gantry, bridge, or trestle bases, where they are capable of transverse movement. Because of their versatility, they are the most common cranes and have a wide range of uses. They include wharf cranes for handling general cargo and many cranes used in shipyards. They are usually electrically powered and range in capacity from 3 to 5 tons. Other jib cranes may range up to 100 tons or more. Analysts customarily report the capacity at minimum working radius and at maximum radius. They must also indicate the maximum height of lift above the wharf deck for wharf cranes.

A floating crane is almost any crane mounted on pontoons or barges. The float may range from a simple wooden barge to an elaborately constructed steel hull with built-in balancing tanks and pumps. Large floating cranes, usually steam powered, are commonly used in harbor construction, salvage operations, or transfer of heavy cargo to and from ships. Capacity may exceed 400 tons. Small floating cranes, driven by internal combustion engines or operated manually, are used for many lifting tasks. The operating dimensions are reported similarly to those for shore cranes, except that reach beyond the pontoon is substituted for radius. Dimensions of the pontoon include length, beam, draft forward, and draft aft.

A derrick consists of a vertical mast supporting a pivoting jib or boom. The mast may be stayed by cable or beams anchored to the ground, with the fall running through sheaves at the end of the jib. Large derricks are used for miscellaneous heavy-lifting tasks and run on steam, gasoline, diesel, or electricity. Small derricks are used for simple cargo handling and are operated manually or are driven by gasoline or diesel engines. Derricks and shearlegs are normally the simplest and least expensive cranes. Depending on size and type, capacity may range from 1 to 40 tons. The jib of a derrick functions similarly to that of a jib crane, and operating dimension should be reported the same way.

A shear-leg crane is a fixed hoisting device with a leaning tripod supporting the system of pulleys and cables. Heavy shear legs may range up to 150 tons capacity. In hoisting and lifting motions, the operating dimensions are comparable to those of the jib crane.

A locomotive crane may be recognized easily, because it is mounted on a special railroad flat car. A revolving elevated crane is mounted on a high, derrick-like structure that moves along rails. An overhead crane differs from a gantry crane in that the supporting mechanisms do not move as they do on the gantry. A bridge crane is constructed so that the crane may travel beyond each supporting leg.

Anchorage

Much of the anchorage data can best be shown on large-scale charts and plans. All available operational information should be reported, including anchorage designations and berth assignments by local authorities, normal anchoring practices, and ship experiences.

Fixed moorings may consist of anchored buoys or mooring posts. They are provided in harbors where space restrictions prohibit free-swinging anchorage, where the number of accommodations is limited, and when they provide a more secure berth than a ship’s own anchors can provide.

Mooring buoys can provide several berth types, including free-swinging (one buoy), ship’s head secured to buoy; bow and stem (one buoy), ship secured ahead by own anchors and astern to bollards ashore; bow and stem (two buoy), ship secured to buoys ahead and astern. Buoys may be held by a single anchor, but two or more anchors laid at varying angles are generally used for greater holding capacity and more precise positioning of the buoy. When more than one anchor is used, each may connect independently with the buoy secured by a pendant chain. Mooring buoys, particularly those used by naval craft, may befitted with submarine cable connections for telephone, electricity, and water. The holding capacity of the buoy is important information.

Ships may lie infixed moorings without buoys in a variety of ways. The simplest method, that of mooring with one or both anchors ahead and stem lines to bollards ashore, is used where wharf facilities are limited, and is commonly used in Mediterranean ports.

Harbors are usually subject to sea and swell, and navigation and port operations are consequently affected. Duration and seasonal variation in sea and swell conditions are important factors to analysts, as are specific effects on lighterage and boat work on anchoring and mooring and on movement into and about the harbor.

Wharves

The majority of landing structures are either piers or wharves. Piers project into the water at an angle with the shoreline. Berthage is usually available on both sides of the pier and at the head as well, if the structure is wide enough. Variations of the simple straight pier are the T-head pier and the L-head pier. These piers are commonly used to transfer bulk petroleum, and berthage is generally confined to the pier head.

Wharves form the pivot point for port operations, and detailed information concerning them is necessary to evaluate a port's capabilities. Generally, wharves include all landing structures, even piers. Specifically, a wharf is a structure that parallels the shoreline and provides berthage at its face only. A wharf's design is determined largely by its intended usc and by local conditions and engineering practice. Variations in names of landing structures cause considerable confusion, and analysts should be careful to use the proper term. The term *dock* is properly used in northwestern European countries to designate a water area; in the US, however, it is applied generally but erroneously to any and all types of landing structures. The pier structure is commonly called a jetty in British and other foreign ports, and all marginal structures are *quays*. Improper classification will often be embodied in the proper name of a wharf, but the reporting officer should not arbitrarily change the name. In describing the structure, however, the analyst should correctly indicate the wharf type.

The wharf type may be marginal, quay, or offshore. The marginal wharf and quay are both built parallel to and against the shore and differ only in construction type. The marginal wharf is constructed of open piling, while the quay is a solid wall of masonry or other material. The offshore wharf is a structure of open piling built parallel to but in an insular position off the shoreline. It may be connected with the shore by one or more approaches or gangways or pipelines. A variation of the offshore wharf commonly used in the Far East is the pontoon wharf, which consists of pontoons of various construction moored in a fixed position offshore and connected with the shore by one or more adjustable gangways. This type is used where the water level fluctuates considerably.

Two special wharf types are the mooring platform and the breasting platform, The mooring platform is a small offshore wharf with a square platform or deck. It provides berthage for a ship but is too small for cargo transfer. Mooring platforms commonly are provided in groups of two or more, and ships are berthed across the faces. One or more of a group of mooring platforms are generally connected with the shore by a narrow approach or trestle, and platforms may be connected by catwalks. The breasting platform is a small platform structure projecting from the face of the wharf bulkhead. Breasting platforms are usually provided in groups of two or more, and ships are berthed across the heads. See Figure 2-11.

An offshore pipeline berth is connected to the shore solely by a submarine or floating pipeline, which permits cargo transfer directly to storage installations on shore.

In a terminal buoy system, the terminal buoy looks similar to the standard mooring buoy but is substantially larger. It is positioned offshore in deep water with three or more chains attached to heavy anchors. The terminal buoy has a revolving platform or swivel to which the tanker is secured as are the floating hose lines for cargo, bunker oil, and fresh water. When the buoy's flexible hoses are coupled to the ship's system, this permits ship and hose lines to swing together a full 360 degrees with the wind or sea. Product transfer proceeds through submarine pipelines connecting the buoy and ashore installation.

Wharf construction and materials vary greatly; however, most structures are either open or solid construction. Open construction is used for marginal wharves, offshore wharves, and most piers. In its simplest and least permanent form, it consists of open-spaced wooden piling supporting a wooden deck. Variations designed to contribute to the strength and permanence of the open structures are

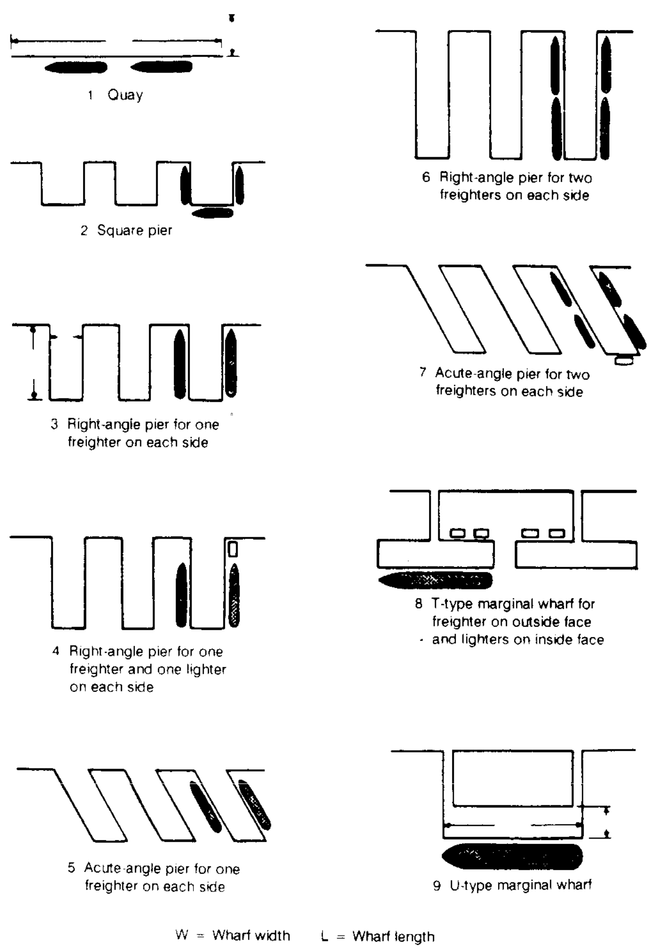


Figure 2-11. Types of wharf layout

numerous. Substructures may consist of steel or precast concrete piling. The superstructure or decking may vary from wooden joints and flooring to concrete and steel construction with an asphalt or other paved surface.

Solid construction is used in quays (and occasionally in piers) and consists of a solid backfill against a retaining wall and covered with a surfaced decking. Quay walls may be a simple facing of interlocking sheet steel pinning, a monolithic concrete wall, or a masonry structure built of stone or precast concrete blocks. Many quays abroad consist of large concrete caissons sunk in line to forma wall, then filled with concrete or rubble and capped with a reinforced concrete deck.

Wharves require several basic dimensions; careful measurement and precise identification of reference points is essential. Measurement may be in either feet or meters, since conversion tables are available.

The length of one side of a pier may differ from that of the other, and both should be reported. The side of a pier or the face of a wharf may be irregular or stepped, and a dimension should be reported for each segment. Usable berthing space may or may not coincide with the overall length; shoals or other obstructions may decrease the usable length of a wharf.

The width of a marginal wharf may be difficult to determine, since the inner limit may not be defined. In such cases, the measurement points should be clearly identified. Width of apron is not to be confused with width of wharf. The apron is the working part of the wharf deck at shipside; it terminates at the transit shed or other obstruction.

The type and condition of the deck surface has an important bearing on the usability of a wharf. Analysts should indicate the layout of wharf railroad tracks with respect to the wharf deck. They should be particularly careful when reporting berthing capabilities of a wharf. Special or unusual berthing conditions include the breasting of ships off the wharf by means of pontoon, the presence of surge or swell that might require special mooring precautions, and draft limitations.

Harbor Craft

The operation of most ports requires a fleet of various harbor crafts. Although in large ports the composition of the fleet may undergo frequent changes, information about types, general numbers, and operating characteristics of harbor craft is essential.

Tugs are generally seagoing or harbor. Analysts should list the horsepower, power type, operating range of seagoing salvage tugs, and special equipment such as salvage or fire-fighting equipment. When no tugs are present, launches are important. They may be grouped by horsepower and power type.

Lighters may be broken down by size and type (self-propelled and dumb); in large ports their numbers may be given in round figures. Information requirements include such details as capacity, construction, power type, and specialized lighters for handling ammunition.

Harbor-dredging operations use dredges, hopper barges, and rock breakers. Dredges vary in type and mechanism, depending on the nature of the bottom sediments to be worked. Hopper barges are self-propelled or dumb barges fitted with self-emptying hoppers. They haul material recovered by dredges. Rock breakers, as the name implies, are used in special cases when loosening of rock from the harbor floor is required.

Shipyards

Completeup-to-date information is required on shipyard facilities and on all firms capable of making marine repairs but lacking dry-dock facilities. Valuable information is contained in maps, yard plans, individual facility plans, shop layouts, photographs of yard facilities, and docking manuals. Each shipyard should be positively identified by position within a city or port, with references to outstanding landmarks on watefront, rivers, and tributaries.

The principal types of dry-dock facilities are the graving dock, floating dry dock, and marine railway. The three gate types provided for graving docks are leaf gates, flap gates, and sliding caissons. Leaf gates are hinged swinging gates that fold back into recesses in the walls of the entrance when the dock is open. Flap gates arc hinged at the bottom and lowered outward to a horizontal position in the approach to the dock. The sliding caisson rolls or slides on a track on the dock sill.

Ship construction and conversion are not treated in detail in port studies dealing with terrain intelligence; however, information about the physical facilities used in construction and repair are valuable to the intelligence analyst. This information includes the types of structural, engineering, electrical, and miscellaneous shops in which various shipbuilding and ship repair processes are performed; the types of ships constructed and the largest of each type constructed to date; whether repairs can be made without dry docking by means of caisson; the yard’s reputation for speed in accomplishing repair work; and the general capabilities of the yard as to hull, engineering, and electrical repairs.

Naval Bases

Natural features required of a good naval-base site include a harbor with deep-water approaches; protected and spacious deep-water anchorages; positions capable of being easily defended; sufficient land for expansion; elevation of approximately 1.5 to 3 meters above mean high water at the waterfront; suitable ground for the foundation of dry docks, buildings, and heavy equipment; and an ample supply of safe, freshwater. Local labor, materials, and transportation must be adequate to support the operation. Secondary stations of the shore establishment are necessary to fleet operation.

Although they will vary in both size and relative importance, certain functional components are common to given types of naval bases. Submarine bases will almost always contain a torpedo shop, battery repair shop, electrical battery-charging equipment, and high-pressure air-charging equipment. Medical components of a large activity may contain, in addition to the normal medical and dental equipment, specialized equipment and resuscitating gear for divers. Analysts should indicate whether or not a particular component is included among the base installations.

Landings

Landings may be structures that are usable for landing, although primarily designed to serve some other function, or they may be beaches in the harbor on which landings are possible. Landings assume particular importance when a port becomes unusable by damaged or sunken vessels and when they must serve as the supplemental or principal medium of transfer between ship and shore. These structures include breakwaters, sea walls, bulkheads, seaplane ramps, and beaching hardstands. In wall-type structures, the length, depth alongside as referred to chart data, height of the top above chart data, and batter of face wall are significant. For all structures, analysts should identify the construction type, condition of the sea and current alongside, and clearance facilities.

Airfields

Air facilities are the military and civilian installations upon which a nation's air operations depend. The fundamental air facilities are airfields, seaplane stations, and heliports. Each has its own facilities such as runways, hangars, fuel systems, maintenance ships, and crash, fire, and service equipment. At some small foreign airfields, many functions may be combined in one or two centrally located buildings.

A. Airfields:

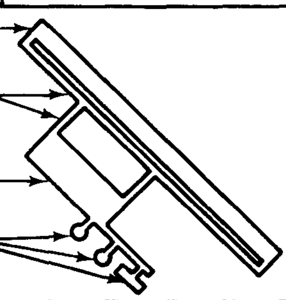
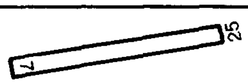
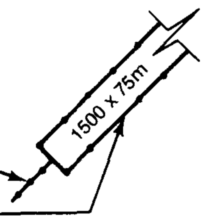
No.	Feature	Symbol	Specifications
1.	Runways		Outline runways to scale.
2.	Taxiways		Outline taxiways connecting runways. aprons, and hardstands to scale.
3.	Aprons		Outline aprons to scale.
4.	Hardstands		Outline hardstands to scale.
5.	Airfield perimeter		Draw a boundary line representing the airfield perimeter.
6.	Structures		Outline all structures. Number each and list in the Data Table.
7.	Airfield name-elevation	Columbus - 200m	Place name and elevation just outside the perimeter symbol.
8.	Runway azimuth		Place the runway azimuth at the end of the runway outline (within or just outside).
9.	Runway length and width		Place length and width designations inside, or just outside runway outline.
10.	Approach lighting		Show locations along line drawn to scale (length).
11.	Runways lights		Show locations by dot symbols along the lateral boundary of the runway.

Figure 2-12. Symbol specifications for airfields and heliports

B. Heliports:

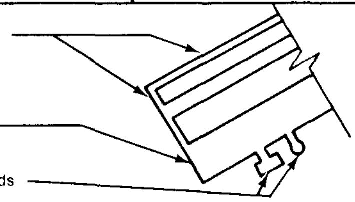
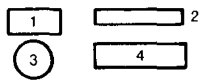
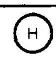
No.	Feature	Symbol	Specifications
1.	Landing area - runways		Draw outline of the landing area or runway to scale.
2.	Taxiways		Outline taxiways connecting runways/ landing areas, aprons, and hardstands to scale.
3.	Aprons		Outline aprons to scale.
4.	Hardstands		Outline hardstands to scale.
5.	Heliport perimeter		Draw a boundary line representing the heliport perimeter.
6.	Structures•		Outline all structures. Number each, and list in Data Table.
7.	Heliport name/(No.) elevation	Columbus - 200m H-1	Place name (No.) and elevation just outside the perimeter symbol.
8.	Helipad (without facilities)		Circle .4" dia. Letter .3" high

Figure 2-12 continued. Symbol specifications for airfields and heliports

The most advantageous location for an airfield is an area free from natural and cultural impediments to operations. An elevated rather than low area is preferred because of-the absence of terrain obstructions and generally more favorable local weather conditions. Low areas are frequently exposed to adverse wind conditions, fog, and occasional flooding. Another important factor in airfield location is its intended use. Major civil airfields will almost always be located near the cities they serve. Major military installations, which normally require more land because of their vast complex of fixed facilities, are more often constructed some distance away from large cities. See Figure 2-12.

Auxiliary airfields are normally located near major operational or training bases. Often these facilities are on caretaker status during part of the year when their additional capacity is not needed.

A helipad is an area specifically designated and marked for helicopter landings and takeoffs. The surface of the pad may be natural, temporary, or permanent. A helistop refers to a helipad with little or no facilities and is used for on- and off-loading of cargo or passengers.

An airfield runway is a flat landing surface with a true or magnetic heading, normally taking advantage of prevailing winds. The number of runways or runs may vary from one to several, which are usually oriented in different directions. Some airfields have parallel runways (two runways with the same headings - not to be confused with a parallel taxiway). Runways are the most significant features of an airfield, and detailed information concerning them, taxiways, and parking areas is essential to properly evaluate the airfield's capabilities. The length, width, load-bearing capabilities, and pavement condition directly influence the type and amount of traffic an airfield can accommodate.

Taxiways are access paths to parking aprons, hangar aprons, and handstands or revetments. A parallel taxiway parallels the runway but is usually narrower. Under emergency conditions it may be used as a runway, but it should not be reported as a runway. Link taxiways connect the runways with other taxiways, parking and hangar aprons, or revetments. A perimeter taxiway usually starts at one end of the runway and ends at the other, and is normally oval. Loop taxiways are normally located at or on both ends of the runway, forming a loop. The alert taxiway is located at the end of the runway with clear access to the runway for a scramble by fighter interceptors.

Runways, taxiways, aprons, and revetment surfaces may be permanent, temporary, or natural. Permanent surfaces such as concrete or asphalt have distinct edges and ends, while temporary surfaces such as mixed-in-place madam or oiled earth have ragged and uneven edges and ends. Permanently surfaced runways are easily discernible and may have jet barriers or arrester gear. Jet barriers are located on the overrun, whereas the arrester gear is normally flush with the runway and located approximately 500 meters from the end of the runway. This 500 meters is usable runway and should not be confused with an overrun.

Measuring permanent or temporary surfaced runways should not be difficult. The major difficulties are locating and arriving at the measurements of natural surface marked with painted barrels, reeks, or broken white lines. Runway lengths and surfaces vary according to the use or intended use of the airfield.

The weight- or load-bearing capacity of a runway, taxiway, or apron is a determining factor in its capability to accept aircraft without damage to the aircraft or the facility. The engineering factors involved in determining weight-bearing capacity are complicated; however, other sources for this information are route manuals, air information publications, airfield managers, and engineering documents. If these sources are not available, information about the type and weight of aircraft (partially or fully loaded) operating out of a given airfield will enable the analyst to estimate the weight-bearing capacity of the runway.