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NATIONAL INTELLIGENCE SURVEY

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Transportation and Telecommunications

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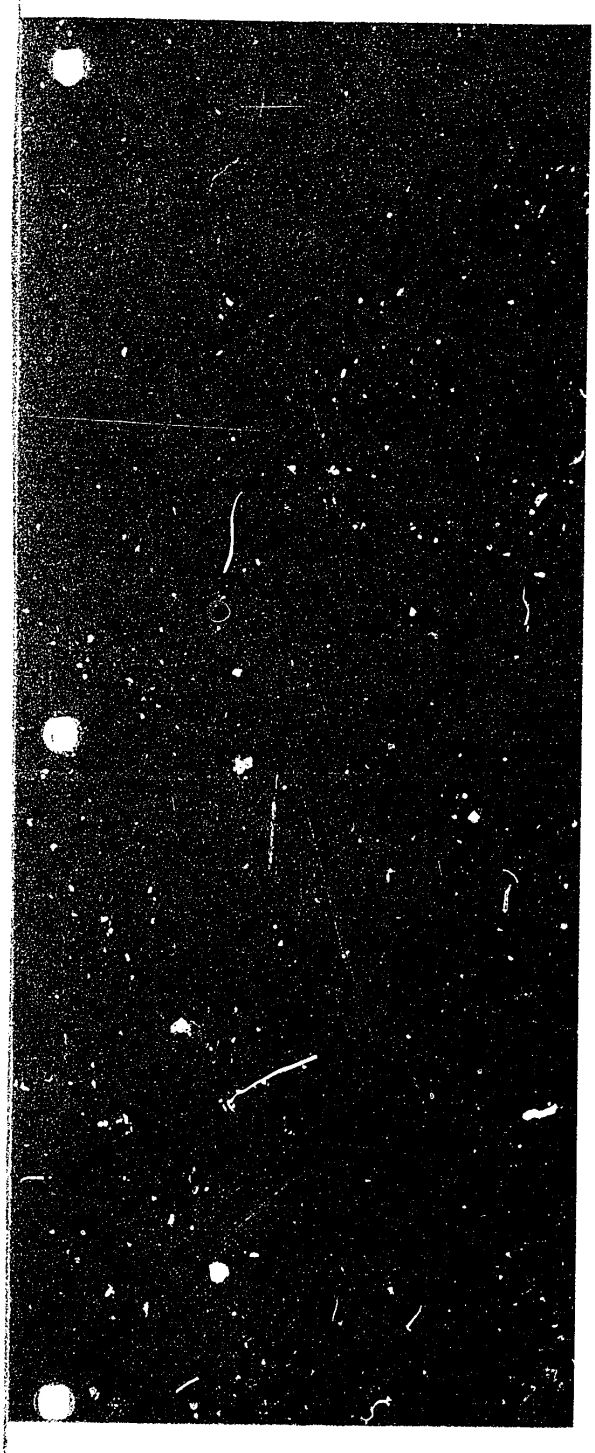

Thailand

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Transportation and Telecommunications

A. Appraisal (C)

The transportation and telecommunication (telecom) systems of Thailand, though sparse and inadequate in the outlying areas, have been greatly improved, particularly in the Bangkok area.

Bangkok, the capital and hub of both transportation and communications, is the most significant port and the site of the country's principal naval base, has the only international airfield, and is the nerve center of communications. Facilities are densest in the delta area around Bangkok, where the intricate waterway network is supplemented by railroads and an improved and increasing net of highways. Away from the capital, however, transportation routes generally consist of a single road or railroad, and these in turn are fed by earth or gravel roads, tracks, trails, and waterways; lateral routes between the arteries are relatively few.

Sattahip, the other major port, has deep-draft berthing facilities and is an important naval base. The port is under military control and was constructed primarily to handle military supplies, but some of the deep-draft facilities are now open to commercial use. The port has good highway connections but no railroad clearing the port.

Until the 20th century Thailand depended almost entirely on inland waterways and trails for transportation. Railroads were introduced around the turn of the century to supplement the waterways and have since been a continuing stimulant to Thai economic development and national unity, especially in the Khorat Plateau, the peninsula, and the northwest. Because railroads became a profitable government monopoly, the government took little interest in promoting highway development; roads were built mainly as feeders to rail and waterway systems. This official attitude began to change only after World War II as the Communist threat to Southeast Asia was recognized. Thailand aligned itself with the Western powers, became a member of the Southeast Asia Treaty Organization (SEATO), and in the early 1950's began major transportation and telecom development programs with extensive U.S. financial and technical assistance and additional aid from the World Bank, SEATO, and other sources. The aim of these programs has been to build modern networks capable of supporting rapid movement and effective communication to all areas of the country and to sustain an adequate logistic base for SEATO on the Asian mainland.

Much progress has been achieved under successive economic development plans, especially in highway and airfield construction and rail and telecom system improvement. The rail lines and the primary highway system are considered adequate for present traffic requirements.

Terrain and weather present problems to construction and maintenance of land routes in large areas, especially in the heavily populated and farmed central plain, where monsoonal rains annually flood the labyrinthian waterways and canals of the Mae Nam Chao Phraya system. As a result, inland waterways are the most important mode of transportation in this area. In the country as a whole, as a result of rapid development in the past few years, highways are considered the most important mode, with rail second and inland waterways third. Civil air is small and is significant only in the transport of high priority traffic. The only pipeline is in the port of Bangkok.

The merchant marine is very small, and Thailand must rely heavily on foreign vessels to haul foreign commerce and aid. The port system is inadequate for the thriving economy. Although wharfage completed at Sattahip has enabled the United States to divert military shipments away from Bangkok, thereby reducing congestion at that port, additional deep-draft maritime facilities are urgently needed. Airfields are well dispersed over the country, some being located in each region. Greatly improved in the past several years, the half-dozen largest fields are excellent. The telecom system is still unable to meet the requirements of the economy, but facilities serving the military and government agencies are generally adequate. Open-wire lines supplemented by high-frequency radio circuits provide the primary communications. Telephone service has been improved during the past

several years, but three-fourths of all instruments are located in the Bangkok area. International service is by radio and a communication satellite earth station.

The government owns and operates the telecom system, the rail lines, the ports, most airfields, 18 of the 22 ships of the merchant marine, a majority of the steel-hulled barges, and the two principal highway transport firms. In addition, the government controls the airlines; it owns one, holds 70% of the stock in another, and has a financial interest in and close working relations with a third. Construction and maintenance of national and provincial highways are the responsibility of the Ministry of National Development. Control of inland waterway transportation and waterway maintenance is the responsibility of the Department of Transportation, under the Ministry of Communications. Almost all administration of transportation and telecom systems is by the Ministry of Communications, but certain aspects of radio and television are under the Ministries of Defense, Education, and Interior. Land connections exist with all contiguous countries, but only those with Malaysia and Laos are significant; an open-wire line extends into Malaysia.

Overall, the transportation and telecom systems of Thailand compare well with those of other countries of Southeast Asia. Inferior to those of Malaysia, the systems are better than those of Burma and much superior to those of Laos and Cambodia. Development of the Thai systems continues to be pushed aggressively and with skilled foreign assistance.

B. Strategic mobility (C)

The rail lines and the primary highway system are considered adequate and are capable of supporting sustained military operations from the major ports of Bangkok and Sattahip to northern, eastern, and southern centers of distribution; certain airfield facilities have been improved to the point that they were capable of supporting U.S. Air Force operations against North Vietnam; and military communication links are largely reliable. Major deficiencies in the system are an inadequate port system, the lack of feeder roads serving the rail lines and arterial highways, and inadequate telecommunications in the outlying areas.

The major ports of Bangkok and Sattahip are adaptable to military use. Naval bases at both of the ports are able to provide berthing, repair, and logistic support for naval ships. The major ports and several minor ports provide easy access to most coastal areas of the country. Inland waterways which can be used for logistical support are located in Thailand's central plains, in the northeast, and in the south. Waterways are significant in both current and potential military operations. They provide a line of communication from Bangkok as far north as Nakhon Sawan. In conjunction with coastal waterways, this route can extend through barge movement from the military port at Sattahip to points as much as 245 miles inland. In the northeast, tributaries of the Mekong will probably become more significant as the insurgent threat increases in that area. The shallow-draft craft that operate along these streams could support either insurgent or counterinsurgent forces. Vulnerability of the ports and waterways is generally moderate. Particularly vulnerable factors include the up-river location of the port of Bangkok and the many locks which control waterway shipping. Aspects of low vulnerability are the many scattered smaller ports and the extensive interconnections of the waterway system.

Of Thailand's oceangoing merchant fleet (22 ships of 1,000 g.r.t. and over totaling 114,009 d.w.t.), at least 21 ships (13 dry cargo, 8 tanker) of 112,325 d.w.t. have military-support potential. The dry-cargo ships have a moderate potential for short-haul (up to 48 hours steaming) in nearseas operations. These ships have a military lift and supply transport potential of 61,642 cargo d.w.t.; their self-loading and unloading capability is enhanced by three of the units having large hatches (more than 50 feet in length), and one having both large hatches and heavy-lift booms (40 tons or more). The eight tankers have an estimated capacity of about 260,500 barrels (U.S.) of petroleum and could provide a moderate military-support capability. Twelve dry-cargo ships and five tankers are government owned and, if accessible at the time of emergency, their use for military support would be assured.

The complete control of all aviation facilities by the government, its ownership of TAC, its majority interest in TAI, and its close working relationship with Air Siam insure ready availability of all civil aviation resources, including equipment facilities, and employed Thai nationals. It is probable that most of the Thai pilots have at some time in their careers also been members of either the RTAF or the Thai security police force. The civil aircraft and the skilled crews would form a valuable reserve airlift force in the event of a national emergency.

Of the 176 usable airfields, 47 have permanent-surfaced runways; of these eight are military, seven are joint military/civil, and 32 are civil. Military airfield capabilities have been substantially improved in recent years. Many of the small airfields are located

along the borders and are used to support Border Police.

The military operates its own telecom networks. Military communications are provided mainly by microwave and high-frequency radio. A comprehensive U.S.-installed microwave network functions as part of the Integrated Wideband Communications System, which supports counterinsurgency forces in Southeast Asia. The Royal Thai Air Force communication network, one of the most modern in the country, utilizes very-high-frequency FM equipment. This system can be connected into the public telephone network in Bangkok. In addition, a backup high-frequency radio network links all air force stations. The army, with headquarters in the capital, has a 1,000-line automatic exchange. The Thai State Police, in conjunction with the Border Patrol Police, operate an interregional radio teleprinter system, as well as numerous fixed and mobile stations.

C. Railroads (C)

The Royal State Railway (RSR) holds a position of primary importance in the economy of Thailand and is adequate for present traffic requirements. The RSR has a distinct advantage in long-distance and large-volume transportation; however, highway competition is increasing as modern roads are built, and waterways offer competition in bulk freight in the areas they serve.

All rail lines (except for a few plantation lines) are owned and operated by the RSR, an autonomous agency of the government under the authority of the Ministry of Communications. The formulation of policies and the supervision of the general affairs are entrusted to the Board of Commissioners, consisting of a chairman and six members. The RSR general manager is appointed by the Board and is an ex officio member of the Board.

The network consists of 2,339 route miles of meter-gage (3′3⅜″) lines; all lines are single track, with the exception of the 56-mile double-track section between Bangkok and Phachi. There is no electrification. Bangkok is the focal point of the system. Four main lines radiate north, northeast, east, and south from Bangkok to serve the large administrative and commercial centers and to provide international connections with Cambodia and West Malaysia. International train service to Cambodia was resumed in 1970, while service to West Malaysia continues to be limited by the interchange of equipment due to coupler incompatibility. Some cars have been equipped with special couplers and are reserved for this service. The RSR carries most of the international traffic of landlocked Laos. Details of the principal railroad routes are given in Figure 1.

The rail lines traverse fairly level terrain. The network has a maximum grade of 3.6% and a minimum radius of curvature of 394 feet, but most sections have ruling grades of 1% or less and curves of more than 1,000 feet in radius. The track structure is of typical meter-gage construction, and main-line track is generally in good condition. Standard T-section rails weighing 50, 60, 70, and 80 pounds per yard are in use. Under the improvement program 50- and 60-pound rails are being replaced with 70- and 80-pound rails. Although hardwood ties are predominant, there is an increasing use of concrete ties. Crushed stone ballast, 6 to 12 inches deep, is used throughout the system. All rail and rail fastenings are imported, principally from Japan.

As of the close of FY1972 the 2,696 bridges on the network totaled 192,730 feet in length, or 1.52% of the total length of running track. Principal bridges are predominantly of the steel through-truss type (Figure 2) with spans ranging from 50 to 394 feet in length. Most short bridges are of the steel deck-girder type. The six tunnels total 8,055 feet in length. All structures are in good condition.

Train movements are controlled by the absolute-block system; with the exception of some color-light signals in the Bangkok area, all fixed signals are semaphores. Communications are by telegraph, telephone, teleprinter, and radio.

The principal locomotive fuels are wood, diesel oil, and fuel oil. Wood is obtained locally, but diesel oil and fuel oil must be imported, principally from Indonesia and Malaysia. An adequate supply of water is generally available but is untreated.

Adverse climate, terrain, and shortages of skilled labor and maintenance equipment constitute major construction and maintenance problems. Much of the soil becomes unstable when wet, making it difficult to establish and maintain a firm roadbed. Very heavy rainfall (generally in December and January in peninsular Thailand, and from mid-May to October throughout the country) causes considerable damage to roadbeds and structures. Most of the roadbed across the plains is embanked to minimize the effects of flooding.

Under the third 5-year development plan, 1972-76, the RSR is to continue the rehabilitation and modernization of physical properties in order to increase capacity to meet future traffic demands, improve operating efficiency, and decrease operating cost. The principal features of the project are

FIGURE 1. Principal railroad routes (C)

TERMINALS; ROUTE MILES	PHYSICAL CHARACTERISTICS	OPERATIONS	REMARKS
Bangkok to Chiang Mai..... 466 miles via Phachi and Uttaradit.	Meter gage (3′3⅜″), 410 miles single track. Passing track: maximum interval 11.8 miles, minimum length 656 ft. Maximum grade 2.5%; minimum radius of curvature 656 ft. Maximum axleload 16.5 tons; track structure fair to good. Structures: 358 bridges totaling 29,396 ft.; 19 bridges over 250 ft. in length, the longest of which is 989 ft. and is located at Lampang. There are 4 tunnels totaling 6,543 ft.; the longest is 4,468 ft. and is located east of Ban Tha Chomphu.	Mostly steam operated with some diesels. Manual block train operation; all fixed signals are semaphores. Average train speeds, excluding stops, 25 m.p.h. for passenger trains and 22 m.p.h. for freight. Traffic occasionally hampered by damage to roadbeds and structures during the heavy rainfall of the southwest monsoon (mid-May to October). Principal traffic is bulk raw and semimanufactured goods.	Four of the six tunnels are located on this line; all are north of Uttaradit. The first 56 miles between Bangkok and Phachi is double track. To minimize the effect of flooding the roadbed across the plains is embanked. There are some color-light signals in the Bangkok area.
Bangkok to Khlong Lek..... 160 miles.	Meter gage (3′3⅜″), single track. Passing track: maximum interval 20 miles, minimum length 984 ft. Maximum grade going and coming is 1%. Maximum axleload 11.5 tons; track structure fair to good. Structures: 318 bridges totaling 18,655 ft., 3 over 250 ft. long. The longest bridge, located 0.7 mile southwest of Yothaka, is 690 ft. long.	....*do*.....	International connection made with Cambodian railroad system. Freight traffic is light as the line is principally used for commuter traffic in the Bangkok area.
Bangkok to Padang Besa..... 614 miles via Nong Pla Duk, Khao Chum Thong, and Hat Yai.	Meter gage (3′3⅜″), single track. Passing track: maximum interval 12.4 miles, minimum length 590 ft. Maximum grade going 1% and coming 2%. Maximum axleload 16.5 tons; track structure fair to good. Structures: 919 bridges totaling 70,006 ft., 24 over 250 ft. long. The longest bridge, located 3.5 miles west of Bang Su, is 1,468 ft. long. The 774-ft. Ron Phibun tunnel, 6.9 miles west of Khao Chum Thong, is the only tunnel.	....*do*.....	International connection made with the Malaysian railroad system on the west coast leading south to Kuala Lumpur.
Phachi to Warin Chamrap..... 301 miles via Nakhon Ratchasima, Lam Chi, and Sisaket.	Meter gage (3′3⅜″), single track. Passing track: maximum interval, Phachi to Nakhon Ratchasima 6.2 miles, and Nakhon Ratchasima to Warin Chamrap 13 miles; minimum length, Phachi to Nakhon Ratchasima 984 ft., and Nakhon Ratchasima to Warin Chamrap 1,150 ft. Maximum grade, going 2.4% and coming 2.0%. Maximum axleload 16.5 tons; track structure fair to good. Structures: 238 bridges totaling 14,863 ft.; 5 bridges over 250 ft. in length, the longest, at Chakkarat, is 491 ft.	....*do*.....	Maximum grade going and coming is between Kaeng Khoi and Nakhon Ratchasima. Principal freight commodities are rice, livestock, and timber.

Nakhon Ratchasima to Nong Khai... 223 miles.	Meter gage (3′3⅜″), single track. Passing track: maximum interval 11.8 miles; minimum length 1,480 ft. Maximum grade going and coming 0.8%; minimum radius of curvature 984 ft. Maximum axleload 11.5 tons; track structure fair to good. Structures: 156 bridges totaling 9,698 ft., 3 of which are over 250 ft. in length. The longest bridge on the line, 16.5 miles north of Khon Kaen, is 458 ft.	....do.....	The terrain is level and grades and curves are moderate. This line is the principal means of access to the sea for Laos.
Hat Yai to Sungai Kolok..... 133 miles.	Meter gage (3′3⅜″), single track. Passing track: maximum interval 9.9 miles; minimum length unknown. Maximum grade is 1.5%, direction unknown. Maximum axleload 11.5 tons; track structure fair to good. Structures: 214 bridges totaling 20,714 ft., 14 of which are over 250 ft. long. The longest bridge, 14.7 miles northwest of Marubo, is 771 ft.	....do.....	International connection made with the Malaysian railroad system in the east coast area leading southward to Singapore.

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FIGURE 2. Rail-highway bridge over the Mae Nam Chao Phraya, 3.5 miles west of Bang Su. This 1,468-foot structure is the longest bridge on the RSR. (C)

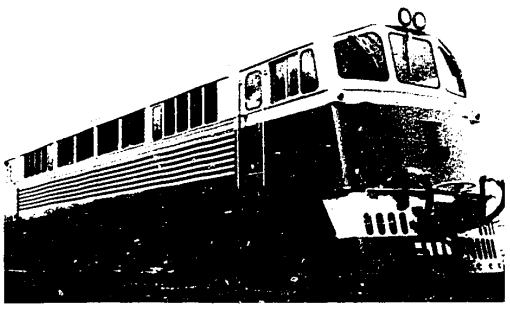

FIGURE 3. General Electric diesel-electric locomotive built for the RSR (C)

acquiring diesel locomotives and rolling stock, strengthening track and bridges, remodeling yards, constructing or extending sidings, and installing signaling and telecom equipment.

The construction of new lines, including the Bang Su–Khlong Tan loop line which was a part of the 1967-71 5-year plan, was postponed to future programs. Many surveys for new line construction have been carried out since 1970, including the 155-mile Den Chai–Chiang Rai line where both engineering and economic surveys were completed and submitted to the National Economic Development Board. However, because of the high cost of investment and low priority of this project, the Board considers that it should be treated as a reserve project. Other projects include the 70-mile line from Chachoengsao to the port of Sattahip.

Traffic on the RSR flows between Bangkok and the interior; there is some local traffic between stations. Principal commodities carried on the network are clinker and marl, rice products, petroleum products, lumber, and cement. Traffic statistics for 1971 were as follows:

Freight (short tons)	5,354,000
Short-ton-miles	1,534,200,000
Passengers	51,952,000
Passenger-miles	2,741,480,000

Most of the passengers carried are commuters in the Bangkok area. In 1972 passenger traffic continued the upward trend of recent years, accounting for 51.3% of the operating revenue; freight accounted for 44.5%. The RSR continues to operate at a profit; the operating ratio in 1972 was 88.68%.

The 1972 RSR inventory consisted of 226 steam locomotives, 191 diesel locomotives (Figure 3), 45 diesel railcar sets, 9,186 freight cars, and 936 passenger cars. Thailand is completely dependent on imports for motive power and rolling stock. Primary suppliers of equipment are the United States and Japan. The Makkasan shops in Bangkok, the principal workshops, can assemble rolling stock and perform major overhauls on all equipment. The Nakhon Ratchasima and Thung Song shops make medium repairs, and all other shops make only light repairs. The equipment is in good condition and is adequate in quantity.

The RSR had 33,976 employees (22,499 permanent and 11,477 temporary) in September 1972. The general level of efficiency is fairly high, but there is a shortage of trained personnel at all levels. The two methods of training are on-the-job training and 3 years of formal training at the Railway Technical School, which offers courses in mechanical engineering and operations. This technical institute was established in 1940, and as of late 1971 it graduated a total of 2,383 students, with about 300 students still under instruction.

D. Highways (C)

Highway transport is of major importance in the national economy of Thailand. Highways are not only important as short-haul feeders to the railroads and waterways, but with the trunk-line network radiating from Bangkok to all provinces nearly completed, highway transport has increased rapidly in the past few years. Highway transportation has increased significantly as a result of Thailand's rapid economic growth for the 1962-72 period. This increase is largely due to the progress of the second National Economic and Social Development Plan (1967-71), which emphasized the rehabilitation or construction of the national and provincial highway network. This situation reflects the government's positive road policy and attitudes toward the increasing importance of

highways. However, in order to meet the overall needs of the economy, considerable improvement and extension of the feeder road system will be required to provide minimal road access to areas not served by the primary or secondary highway networks.

As with all other transportation modes in Thailand, the focal point for the highway network is Bangkok. The chief arteries over which most highway tonnage and through traffic move are four trunk routes radiating from Bangkok. The most important route runs nearly the north-south length of the country from the Thailand-Burma-Laos tripoint to the Malaysia border; north of Bangkok the route is designated Route 1 and from Bangkok to the Malaysian border it is Route 4 (Figure 4). The Sara Buri-Nong Khai highway, Route 2 (Figure 5), is the major route from the central plain to the Khorat Plateau and north to the Mekong river and Vientiane, Laos. The fourth trunk route, Route 3, leads southeast from Bangkok, paralleling the shore of the Gulf of Thailand, to Trat, from which a branch continues to Khlong Yai at the Cambodia border.

FIGURE 4. National Highway Route 4. Highway extends along the Isthmus of Kra between Bangkok and the Malaysia border. (C)

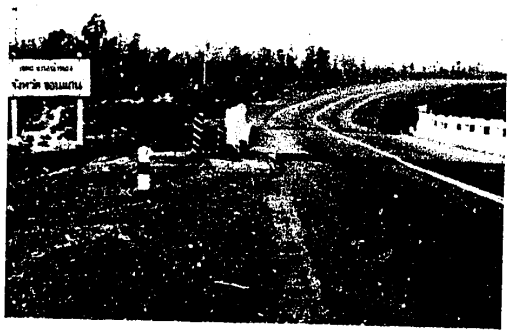

FIGURE 5. National Highway Route 2, between Khon Kaen and Udon Thani (U/OU)

International connections are made with all countries contiguous to Thailand: Two with Burma, four with Laos, three with Cambodia, and three with Malaysia. Three of the connections with Laos are by ferries across the Mekong at Nong Khai, Nakhon Phanom, and Mukdahan. Additional border connections with Laos are possible whenever vehicle ferries are available for crossing the Mekong at Bung Kan, Kene Thao (Laos), and Chiang Khong.

The Thai road system density of 0.083 mile of road per square mile of area compares favorably with that of neighboring Burma (0.059:1), Laos (0.03:1), and Cambodia (0.045:1) but is less than the ratio of West Malaysia (0.018:1).

The Royal Thai Highway Department, under the Ministry of National Development, is responsible for the 16,550-mile official highway system, which is made up of 6,850 miles of national primary highways, 5,900 miles of national secondary highways, and 3,800 miles of provincial highways. About 7,100 miles (42%) of the highways are surfaced with bituminous or bituminous-surface treatment; 4,066 miles (24%) are gravel, crushed stone, or laterite; and 5,362 miles (33%) are earth. In addition to the official system, there is a small but growing mileage of local roads under the Ministry of Interior and other government agencies. Details of selected principal highway routes are given in Figure 6.

Although there is no specified standard code for the design of highways and bridges in Thailand, the Department of Highways has adopted the official specifications of the American Association of State Highways. Surface widths range from 18 to 23 feet on primary highways and 13 to 23 feet on the secondary. The primary highways support two-way traffic, but about 70% of the secondary highways are too narrow for anything but one-way travel. About 67% of the national primary highways and 50% of the national secondary highways are in good condition. Provincial highways are generally too narrow for efficient two-way passage and are in poor condition. Shoulders on new roads consist of compacted crushed stone or gravel and vary from 3 to 10 feet in width. Many of the older roads have no shoulders, but where shoulders exist widths range up to 10 feet. Surfaced roads generally have bases of laterite covered with a 4- to 8-inch layer of rolled aggregate bound with earth or surface treated with bituminous material. First-class highways are generally constructed with a 6- to 8-inch

FIGURE 6. Selected principal highway routes (C)

ORIGIN AND DESTINATION	DISTANCE	SURFACE TYPE	SURFACE WIDTH	SHOULDER WIDTH	REMARKS
	Miles		*Feet*		
Bangkok to Burma border via Chiang Rai	644.4				Several major bridges with lengths ranging from 230 to 1,538 ft. Bottlenecks include narrow bridges, some sharp curves, a ford near the Burma border, and steep grades. Subject to flooding in the northern section during the rainy season
Mile 0 to 17.6	17.6	Concrete	40	6	
Mile 17.6 to 77.3	59.7	Asphalt concrete	22	5–8	
Mile 77.3 to 219.5	142.2	Intermediate bituminous	20–40	3–8	
Mile 219.5 to 329.5	110.0	Asphalt concrete	20–22	7–8	
Mile 329.5 to 334.8	5.3	Bituminous surface	20	6	
Mile 334.8 to 603.7	268.9	Asphalt concrete	20–22	7–8	
Mile 603.7 to 644.4	40.7	Intermediate bituminous/improved earth	17–38	5–6	
Sara Buri to Nong Khai	331.9				Three major bridges with lengths ranging from 279 to 434 ft. Most bridges are narrow. During the rainy season some stretches may become impassable.
Mile 0 to 255.4	255.4	Asphalt concrete	23	5–8	
Mile 255.4 to 331.9	76.5	Bituminous surface	20	5–8	
Bangkok to Khlong Yai	313.0				Several major bridges with lengths ranging from 252 to 1,087 ft. Some winding stretches with sharp curves in the mountainous area.
Mile 0 to 49.2	49.2	*na*	*na*	*na*	
Mile 49.2 to 97.0	47.8	Intermediate bituminous	21–27	6	
Mile 97.0 to 110.6	13.6	Intermediate bituminous/gravel	18	0–3	
Mile 110.6 to 263.7	153.1	Intermediate bituminous	18–32	3–6	
Mile 263.7 to 297.8	34.1	Asphalt concrete	18	0–6	
Mile 297.8 to 313.0	15.2	*na*	*na*	*na*	
Bangkok to Malaysia border	825				Several major bridges with lengths ranging from 230 to 595 ft. Some sharp curves.
Mile 0 to 363	363	Intermediate bituminous	20–22	0–8	
Mile 363 to 394	31	Asphalt concrete	19	0–6	
Mile 394 to 825	431	Intermediate bituminous	17–21	0–6	
Khlong Ngae to Narathiwat via Pattani	123	Asphalt concrete	20	0–7	Two narrow bridges.
Pattani to Malaysia border near Betong	127.7				Bottlenecks include narrow bridges, sharp curves, and steep grades.
Mile 0 to 123.7	123.7	Intermediate bituminous	12–16	1–4	
Mile 123.7 to 127.7	4.0	Asphalt concrete	16	1–4	
Nong Khae to Cambodia border near Poipet	125.9	Intermediate bituminous	19–22	3–9	No known bottlenecks. One major bridge 394 ft. long.
Ban Phai to Laos border via Ubon Ratchathani	202.0	Asphalt concrete	20	6–8	Several major bridges with lengths ranging from 250 to 1,618 ft.

na Data not available.

base course and 2 inches of bituminous concrete. In most cases, principal roads have long straight stretches; curves are gradual and grades moderate throughout the central plain and the Khorat Plateau from the lowlands to the south and west and on segments of Route 4 in southern Thailand.

The development of transportation and telecom facilities during the previous 5-year plans was geared to the completion of the main transportation and telecom systems. Most of the targets set forth in the two previous development plans had been achieved.

The highway system has a total of 5,095 bridges 20 feet or greater in length. Reinforced-concrete slab with reinforced-concrete pile piers predominate on the main roads, but many narrow timber structures remain in service, mostly on secondary roads. Most bridges are of the deck type and have unlimited vertical clearances. Reinforced-concrete bridges of recent construction generally have load capacities of 36 tons or more; older concrete and steel bridges generally have load capacities of 13 tons. Ferries are not common, but powered ferries are in use on the Mekong between Nong Khai and Laos, and at Phra Pradaeng, west of Bangkok, and Songkhla in the far south. Paved-ramp landing facilities at the Nong Khai ferry crossing permit operations in all seasons despite the fairly strong currents and water level variations of up to 40 feet on the Mekong. Several low-capacity ferries operate in the far south, and on the Mekong at Nakhon Phanom and Mukdahan. There are many fords on the low-type roads but none is improved; streams are fordable only in the dry season (generally from early November through mid-March). There are no known tunnels on the highway system.

The Maintenance Division of the Highway Department directs the overall maintenance activities of 12 field division offices that in turn direct 60 field districts. The district offices furnish personnel and equipment for maintenance work on highways within their own boundaries. The budget of the Highway Department favors new construction and upgrading rather than maintenance; the rapid pace of construction of national highways suggests that maintenance will continue to be poor on provincial highways.

Weather and terrain cause problems in construction and maintenance. The topography of Thailand varies significantly from region to region. The heavy rainfall during the southwest monsoon (mid-May through September) provides most of the annual precipitation over most of the country. The immediate effects are the overflowing of drainage systems, flooding, the undermining and eroding of roads, and the interruption of vehicle operation and road work. The rainy season also affects the construction of embankments, except when rock is the material involved; the building of earth fill and the laying of base and surface courses can be done only during 7 months of the year.

Availability of material suitable for base-course and subgrade construction is one of the most critical highway construction problems. Local soils generally are used—primarily laterite, which is found throughout most of the country. The output of crushed stone is inadequate; quarries must be developed for each road project and worked with portable crushers. In the delta area, crushed stone must be hauled long distances, but sand and gravel are usually obtainable.

Concrete road surfaces are found only in the Bangkok area. Elsewhere, cement concrete is used as a basic material only for bridges and culverts. Domestically produced cement and bituminous materials are in good supply. Good grades of lumber, including plywood for concrete form work and timber for bridges, are available from domestic sources. Some reinforcing steel is produced locally, but most, including special steel for prestressed-concrete structures, must be imported.

Construction and maintenance equipment is imported, practically all types being on hand in the Bangkok area; principal sources of supply are the United States, Japan, the United Kingdom, West Germany, France, and Australia. Spare parts are also available locally.

During the last decade highway transport has been quite extensive. The total length of paved road has more than tripled and vehicle registration has increased from about 50,000 in 1965 to more than 400,000 in 1971. More recent and major accomplishments in the highway transport system have taken place during the second 5-year plan, 1967-71. A total of 5,453 miles of highways were constructed or rehabilitated, of which 3,582 miles were national highways and 1,871 miles were provincial highways.

The third 5-year plan, 1972-76, will carry on the transportation policies of the previous plans. Highway development will continue to have a very high priority; however, the emphasis will be on provincial highways and village roads.

An engineering and feasibility study is being made of a proposed rail-highway bridge across the Mekong at Nong Khai, opposite Vientiane, Laos, on which an agreement for joint construction was signed between the Thailand and Laos Governments in April 1967. However, because of cost this will at first be limited to

highway traffic with provisions to accommodate rail traffic in the future.

The monsoonal climate and the terrain features that cause the main problems for highway construction and maintenance are also the chief traffic interruption factors. Over much of the provincial and village road network, traffic comes to a virtual standstill during part of the rainy season. Many roads become muddy and soft and some become impassable. In mountainous areas the rains precipitate landslides, cause washouts, and fell trees, all of which obstruct highway traffic. Fords become impassable, and ferry operations are hampered. During the dry season, dust from low-quality roads reduces visibility. Some areas are subject to early morning fog that limits visibility. In the hills and mountains are many sharp curves and steep grades. In a military tactical situation, during the monsoons the bridges would play an important role in route trafficability. In the flatlands, bypass construction would be more difficult than replacing destroyed bridges because of the flooded terrain on both sides of the roads. Since most bridge sites are short, they can be spanned with tactical bridging.

The two principal transport firms, the Express Transportation Organization (ETO) and the Transport Co., Ltd., are government owned. ETO operates a public trucking service with about 1,000 trucks, some of which are privately owned but operated under the supervision and control of the organization, subcontracting the transport of heavy equipment (usually over 10 tons) to the Trailer Transport Co. In 1968 the ETO handled a total of 2.3 million tons of freight. The Transport Co., Ltd., provides bus service on 12 major routes. Other truck and bus owners operate only small fleets or single vehicles; transport statistics are not maintained.

Seasonal traffic volume on the highways is influenced by a number of factors, such as the availability of alternative modes of transport and the seasonal effects of weather. Traffic reaches its peak during the early part of the dry season, when the delivery of agricultural products to the Bangkok area occurs. Principal types of goods moved are building materials, rice, corn, timber, petroleum, and fruit.

In 1971, trucks and buses comprised about 40% of the total motor vehicle traffic. Buses normally carry as much cargo as they do passengers, and trucks often carry a few passengers in addition to freight. The volume of traffic in the vicinity of Bangkok is about 20 times the average traffic of rural areas; each of the main routes into Bangkok carries over 7,000 vehicles per day. The volume of traffic within a radius of 100 miles from Bangkok is about 2,400 vehicles daily; within 100 to 200 miles it is 1,500; and within 200 to 300 miles the volume of traffic decreases sharply and averages only 200 to 300 vehicles per day. Highway transport has grown so rapidly in the past decade that it has become the country's most important mode.

Human porters and beasts of burden are important; in the outlying regions they are the primary and often only means of transport. In the central plain and the southeast, water buffalo and, to a lesser extent, oxen are used; in the Khorat Plateau, oxen are most important; in the mountains of the north, porters and pack trains, mainly of cattle but also of ponies and mules, are the most common means of transport; and in peninsular Thailand, oxen, water buffaloes, and elephants are used.

As of January 1973, there were 947,000 registered motor vehicles in Thailand, consisting of 282,600 passenger cars, 183,200 trucks and buses, and 481,200 motorcycles and motor bicycles. Trucks have capacities of about 5 to 7 tons. Vehicle maintenance is improving but is still poor, consiting mainly of keeping vehicles on the road and meeting the elastic licensing requirements. Except for expensive diesel-powered vehicles, the mechanical condition of all but the newest privately owned vehicles is generally poor. As of 1972, 12 motor vehicle assembly plants were producing about 6,500 passenger cars and 5,400 trucks annually. The plants can produce some components but cannot manufacture complete vehicles. In 1970, imports included a total of 22,982 passenger cars and 30,300 trucks and buses supplied by 10 countries; 90% of the imports came from Japan.

E. Inland waterways (C)

Inland waterways are a minor but important part of Thailand's transport system. The country has about 2,485 miles of principal waterways navigable at high water, of which about 2,400 miles have navigable depths of 3 feet or more throughout the year. Of the latter, 1,320 miles are on central and north-central waterways, 725 miles are in the northeast (including the Mekong), and 355 miles are on southern rivers. In addition, about 11,700 miles of minor tributaries and canals navigable by shallow-draft native craft considerably increase the total mileage. Long-haul commercial barges operate over 1,250 miles of the system, accounting for an estimated 620 million ton-miles of transport annually. Two-thirds of that figure is accrued in hauling foodstuffs, about 30% in building material, and the remainder primarily in fuel and fertilizer. Thai waterways also carry more than half the annual crops of timber, which is assembled

into rafts for floating from forest to sawmills in the Bangkok area. An enormous amount of local commerce is also carried on the waterways, especially in the central delta, but no records of this traffic are maintained.

The significance of the waterways varies among regions. Central Thailand has the most concentrated system. Seven principal rivers drain southward through the prosperous delta land, emptying into the Gulf of Thailand through four estuaries. An elaborate network of interconnecting canals serves virtually every population center in this region. The Lam Nam Chi-Mae Nam Mun river system in northeast Thailand provides the principal drainage of the Khorat Plateau but is only sectionally navigable. The most important international waterway is the Mekong, which forms most of the border with Laos. In southern Thailand, rivers flow generally eastward across the Malay Peninsula into the Gulf of Thailand, but a few drain westward into the Andaman Sea. One of these rivers, the Pakchan, forms the Thailand-Burma border for a distance of 62 miles. Data on principal inland waterways are given in Figure 7.

Most principal waterways are open to craft drawing up to 4 feet. The most important waterway is the Mae Nam Chao Phraya, which is navigable for about 35 miles by oceangoing vessels and for an additional 210 miles by craft drawing 6 feet. It is fed by three major streams, the Mae Nam Ping, the Mae Nam Nan, and the Mae Nam Yom, which is a tributary of the Mae Nam Nan. Of these streams, the Mae Nam Nan is the most significant, providing safe draft of 3 feet or more perennially for 174 miles to Uttaradit; the other two streams provide limited navigation for craft of 1.6-foot draft. Branching from the Mae Nam Chao Phraya in the vicinity of Chainat are the Mae Nam Nakhon Chai Si, a 190-mile distributary, and the Mae Nam Noi, which rejoins 84 miles downstream; both are used as alternate routes when extreme high and low water conditions restrict navigation on the main stream. Four major canals also connect the Mae Nam Nakhon Chai Si with the Mae Nam Noi and the Mae Nam Chao Phraya. The 66-mile Mae Nam Lop Buri, diverging from the Mae Nam Chao Phraya near Lop Buri and rejoining the main waterway near Phra Nakhon Si Ayutthaya, and its Mae Nam Pa Sak tributary provide a navigable route to Sara Buri for craft drawing up to 4 feet. Two rivers, not part of the Mae Nam Chao Phraya system, provide navigation into the eastern and western parts of the central delta. The Mae Nam Mae Klong to the west is navigable at high tide by 8-foot-draft vessels to Rat Buri, and by 3-foot-draft craft at all times to Kanchanaburi, 100 miles upstream. To the east, the Mae Nam Bang Pakong is navigable at high tides to Chachoengsao by craft drawing 7 feet. Both streams are connected with the Mae Nam Chao Phraya system by navigable canals. In eastern Thailand the Mae Nam Mun and its Lam Nam Chi tributary provide safe drafts of 3 feet to Chakkarat and Thawat Buri, respectively, but through navigation to the Mekong is not possible because of stone sills on the Mae Nam Mun near its confluence with the Mekong. The Mekong provides seasonal navigation sectionally along the Thailand-Laos border for local short-haul transport and communications by craft of 4-foot draft. In southern Thailand 11 rivers empty into the Gulf of Thailand. These waterways are characterized by sandbars at their estuaries and good navigation for short distances in their lower reaches for craft drawing 4 feet.

The principal causes of traffic interruption or reduction are extreme water levels, silting, and navigational hazards. Silting is a problem primarily in the central rivers. Navigation hazards are more widespread and include fishtraps, free-floating timber rafts, long tows of barges, and craft operating at night without lights. Also, safety responsibility is so fragmented among government agencies that channel and overhead clearance standards are not maintained. On the Mekong, rapids, gorges, and underwater hazards seasonally interrupt traffic at points throughout its length bordering Thailand.

Inland waterway structures consist of locks, dams, bridges, tidal gates, and a few navigation aids. Most of the 54 locks are in the central plains area, and, except for the larger lock at Chainat, they have narrow 20-foot gates opening into wider basins. Navigation aids are erected by barge operators or local people and are crude and inadequate. No night navigation aids exist.

In addition to the primary commercial port of Bangkok, port facilities exist at every population center served by a principal waterway. Although most inland ports have no public piers or mechanical handling equipment, about 20 upriver ports are large enough to accommodate significant amounts of cargo (the most important are Phra Nakhon Si Ayutthaya, Nakhon Sawan, and Chachoengsao). Wharfage consists mainly of offshore wooden piers and improved earthen riverbank, where cargo is landed manually across wooden ramps.

About 16,500 of the 25,000 craft registered in Thailand are nonmotorized and have a total carrying capacity of about 450,000 short tons. Nearly half are the 25- to 50-ton rice barges of wood construction (Figure 8), although steel barges are becoming more common. The two most common types of self-

FIGURE 7. Principal inland waterway routes (C)

ORIGIN AND DESTINATION; ROUTE MILES	PHYSICAL CHARACTERISTICS	OPERATIONS	REMARKS
Bangkok–Uttaradit..... 374 route miles via the Mae Nam Chao Phraya system. Several branching river segments and interconnecting canals serve Bangkok and a large area of north-central Thailand.	Depth 3 to 25 ft., width 30 to 1,700 ft. Numerous locks, all with 20-ft.-wide entrances. Natural streams, improved streams, and canals. Depth 20.7 ft. on Mae Nam Chao Phraya seaward approach to Bangkok.	Oceangoing freighters, barges, and smaller native craft navigate the Mae Nam Chao Phraya to the port of Bangkok, the hub of the elaborate waterway system and the foreign trade center of Thailand. North of Bangkok, extensive waterway commerce is dominated mainly by shallow-draft native craft.	Principal commercial waterway system of Thailand. Connects most smaller inland ports with Bangkok.
Ban Kum–Chiang Saen..... Several stretches totaling 1,913 route miles via the Mekong in northeastern Thailand along the border with Laos.	Depth 1 to 4 ft., width 46 to 124 ft. Natural stream with swift currents in many sections.	Navigable season in southeast, mid-November to mid-July; elsewhere, open to navigation all year. Traffic 10- to 20-ton craft carrying cargoes of rice, fish, and construction materials.	Navigable segments of stream generally separated by unnavigable segments with swift currents and by rapids.

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FIGURE 8. Empty wooden rice barges, known as *Rua Kao*, being towed by engine-amidship type craft, which also carries passengers (U/OU)

propelled craft are the inboard engine-amidship type and the long-shaft outboard. The former, which have diesel engines ranging from 40 to 140 horsepower, are more powerful and are used either as passenger carriers or as towboats for trains of up to 15 barges. There are an estimated 2,300 craft of this type. The remaining registered motorized craft are long-shaft outboards, nearly all having engines ranging from 1 to 20 horsepower. Most watercraft of less than 5-ton capacity are unregistered, but it is estimated their total number is several times that of the registered fleet. Motorization of the small-craft fleet is increasing, the most common type of craft being a long-shaft outboard known as the "shrimp-tail" (Figure 9). This craft draws less than 12 inches of water and can carry 1,000 to 2,000 pounds. Fleet capacity is considered adequate to meet peak demands under existing conditions. Over 90% of the craft operate on the waterways in the central plain and delta.

Control of inland waterway transportation and waterway maintenance is a responsibility of the Department of Transportation, which is under the Ministry of Communications. Barge transportation is primarily a family enterprise, 91% of the barges being owned either by their operators or individual merchants. The Suphan Transport Co. has the largest company-owned fleet of craft, and the government owns the largest number of steel-hulled barges. The major operating problems stem from delays in port resulting from transfer of cargo ownership and from the lack of maintenance of inland waterway channels.

In 1972, an inland waterway improvement project was begun with a goal of obtaining rapid and safe waterway transportation in central Thailand. In the past, waterway development generally has been only incidental to irrigation or hydroelectric projects. However, where navigation is important, an effort is usually made to provide bypass locks around newly constructed dams. In northeast Thailand, where most dam projects are located, local navigation has benefited from reduced seasonal variations in water levels. The Royal Thai Irrigation Department is increasing its waterway maintenance effort in the central delta region and has imported modern dredging equipment for use in that area. Improvements to inland port facilities are planned, and new cargo warehouses have been constructed.

F. Ports (C)

Thailand has two major and 16 minor ports; both of the major ports and 11 of the 16 minor ports are on the Gulf of Thailand coast, and the remaining five minor

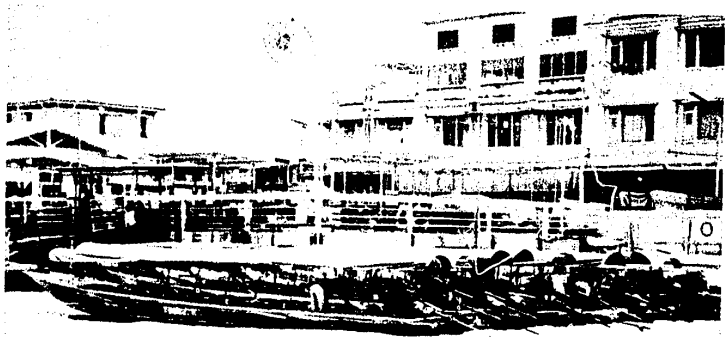


FIGURE 9. Long-shaft outboard "shrimp-tail" type craft at Bangkok (U/OU)

ports are scattered along the coastline of the Strait of Malacca. Because of the shallow depths within coastal indentations and offshore approaches, the coasts themselves are generally unsuitable for port development. As a result, most Thai maritime ports are river ports, but their development has been hampered by sand and mud bars that accumulate at the river mouths. The monsoon winds seriously affect operations in many of the ports—from November to mid-March, lighterage operations at a number of the east coast ports may be interrupted by heavy seas; and from mid-May through September, winds and heavy seas interrupt operations on the Malaccan coast and along the north shore of the Gulf of Thailand.

Of the 18 ports, 13 are river ports and one (Si Racha) is an offshore-pipeline facility. Only three have berthing facilities for oceangoing vessels; the others are lighter terminals that have meager facilities and limited capabilities for handling cargo. They serve as outlets for raw materials and forest products from the hinterland and as distribution centers for imports. The Port Authority of Thailand, part of the Ministry of Communications, operates the port of Bangkok. Operations at Sattahip are under military control. Elsewhere, port activities are conducted by the Thai Maritime Navigation Company, Ltd., a government-owned autonomous organization whose Board of Directors is appointed by the Thai Council of Ministers; and the Thai Maritime Company, Ltd., a 70% government-owned company. Bangkok and Sattahip are adaptable to military use, but the upriver location of Bangkok makes it highly vulnerable to blockage.

There has been some new construction in recent years, but additional deep-draft berthing facilities are urgently needed. Wharfage completed at Sattahip has enabled the United States to divert military shipments away from Bangkok, thereby reducing congestion at the latter port. A survey has been conducted for additional commercial development at Sattahip. Construction of 1,250 feet of additional shallow-draft wharfage and four to six new deep-draft berths at Bangkok is scheduled to begin shortly. Thailand has conducted feasibility surveys of sites suited for construction of additional deep-draft ports. The Ministry of Communications has proposed development of Phuket into a deepwater port and naval base on the Strait of Malacca. The government had earlier approved a site on the Gulf of Thailand, near Si Racha, for the construction of a new port to supplement the facilities at Bangkok. Existing maritime facilities at Si Racha are the petroleum terminal, which has two offshore-pipeline berths for large ocean-type tankers and one alongside berth for a small ocean-type tanker.

The major port of Bangkok (Figure 10) is also the commercial hub of the country and the site of the country's principal naval base. The harbor area comprises an 18-mile stretch of the Mae Nam Chao Phraya beginning 17 miles above the river mouth (Figure 11). Because of heavy silting, maintenance of depths in the entrance channel and harbor requires a major, continual dredging effort.

Sattahip, the other major port, is the country's other important naval base. It is located in an excellent, well-sheltered coastal harbor. The base provides operational and logistic support to naval operating forces. Deep-draft berthing facilities have been constructed by the United States to handle military shipping requirements (Figure 12); however, some of the deep-draft facilities were opened to commercial use in 1971.

Eleven of the minor ports have small craft-repair facilities. Details of the major ports are given in Figure 13.

G. Merchant marine (C)

Merchant shipping is of considerable significance to Thailand as economic development of the country depends on international seaborne trade. Heavy reliance is placed on shipping for essential consumer and capital goods imports and for the carriage of export commodities. Despite this importance of shipping, Thai-flag ships carried only about 450,000 tons of the nation's total seaborne trade of 16.6 million tons in 1970. Thailand currently spends almost US$300 million annually in freight payments to foreign shipping.

In January 1973 the merchant fleet consisted of 22 ships of 1,000 gross register tons (g.r.t.) and over, totaling 77,924 g.r.t. or 114,009 deadweight tons (d.w.t.), as follows:

Type	Number	G.R.T.	D.W.T.
Dry cargo	13	49,197	73,383
Tanker	8	27,185	38,942
Cement carrier	1	1,542	1,684
Total	22	77,924	114,009

Though fairly modern, Thai-flag ships are characteristically small and slow. Seven tankers, two dry-cargo ships, and one cement carrier are less than 10 years old; 10 dry-cargo ships are 10 to 19 years old; and one dry-cargo ship and one tanker are over 20 years old. With the exception of a 16,520-d.w.t. tanker, the units range from 1,684 to 7,700 d.w.t. All of the ships are

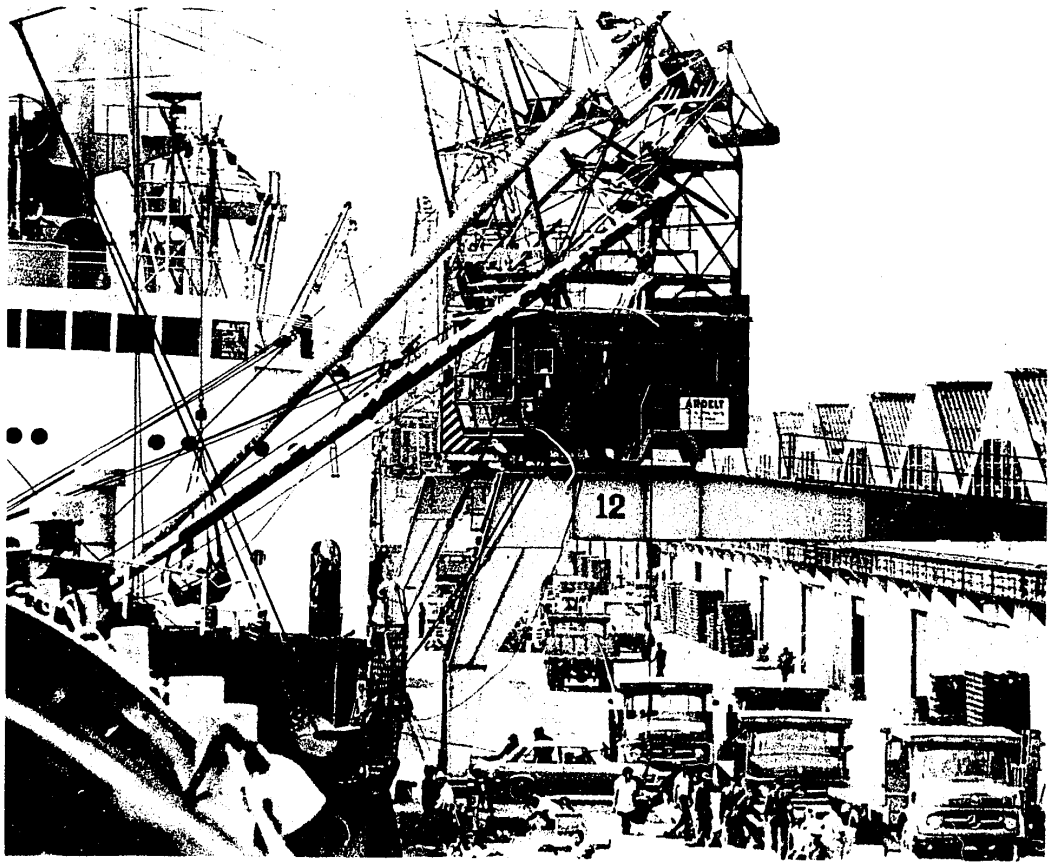


FIGURE 10. Cargo handling at Bangkok's Khlong Toei wharf (C)

diesel powered. Nineteen ships have normal operating speeds of 10 to 12 knots; three have speeds of 14 knots.

Both government and private beneficial owners (entities which take the profit or loss from operations) control ships of the Thai merchant fleet. The government owns 18 ships totaling 83,467 d.w.t. which are operated by the following government companies: Thai Maritime Navigation Co., Ltd. (TMN), with seven ships totaling 35,151 d.w.t.; Thai Petroleum Transports Co., Ltd. (TPT), five ships totaling 12,000 d.w.t.; Thai International Maritime Enterprises, Ltd. (TIME), three ships totaling 22,493 d.w.t.; Thai Mercantile Marine, Ltd. (TMM), two ships totaling 12,229 d.w.t.; and Jalaprathan Cement Co., Ltd., one ship of 1,684 d.w.t. Four privately owned shipping companies each operate one ship. Foreign ownership in the merchant fleet and domestic ownership of foreign-flag ships are precluded by Thai law.

The merchant fleet operates primarily in scheduled (liner) service between Thailand and Far Eastern countries and the United States. TIME, TMM, and TMN are members of the Japan-Thailand Freight Conference, and TMN is also a member of the Thailand-U.S. Pacific Coast and Thailand-U.S. Atlantic Coast Conferences. Ships of the fleet also operate to Northern Europe, Mexico, West Indies, South America, and Africa.

Principal exports carried by the fleet are rice, corn, rubber, and tin. Principal imports carried are machinery, petroleum and related products, food products, and iron and steel.

Direct government aid to shipping has been provided through a series of 5-year plans supporting progressive fleet development. During the 1964-71 period the fleet was increased from five ships totaling 11,910 d.w.t. to 22 ships of 101,600 d.w.t. In 1971 the government approved and allocated the equivalent of

FIGURE 11. Bangkok, New Harbor. Khlong Toei wharf, the port's most important general-cargo facility for deep-draft ships, left center; Shell Oil Co. of Thailand terminal, left foreground; moorings for ocean-type vessels in river. (C)

FIGURE 12. Sattahip, deepwater general-cargo and petroleum berthing facilities (C)

US$38.5 million under the third 5-year plan (1972-76) for the acquisition of eight cargo ships aggregating 76,500 d.w.t. for employment on the European and Japanese shipping routes. Five 10,500-d.w.t. ships were to be constructed in foreign shipyards, and three 8,000-d.w.t. units were to be purchased secondhand. As of November 1972, no new ship orders had been placed for Thai account. In early 1973 four secondhand ships were acquired and consisted of two 62,000-d.w.t. tankers purchased by Thai Ocean Transportation Co. (TOTC), a new shipping line formed for carrying imported crude oil to Thailand's oil refineries, and two 7,300-d.w.t. dry-cargo ships purchased by TMN.

Thailand has no capability for the construction of oceangoing ships and is presently limited to construction of steel vessels up to 500 g.r.t. at two shipyards in Bangkok.

FIGURE 13. Major ports (C)

NAME; LOCATION; ESTIMATED MILITARY PORT CAPACITY*	ACTIVITIES	HARBOR	BERTHS
Bangkok 13°45′N., 100°31′E.; extends along Mae Nam Chao Phraya, 17 to 35 miles above mouth. 12,250	Handles 30% to 90% of all Thai foreign trade and serves as port of entry for Laos. It is the site of the principal Thai naval base and ship-repair center. Principal shipments are rice, rubber, corn, and tin. Receipts consist primarily of construction materials, petroleum, machinery, and electrical equipment. Naval base provides operational, administrative, logistic, and ship-repair support for the fleet. Training, ordnance, medical, meteorological, and hydrographic components are also provided. Two shipyards. The Royal Thai Navy Dockyard is equipped with 2 graving docks, the larger is 472 ft. long; 1 floating drydock with a lifting capacity of 100 tons; and 1 marine railway with a hauling capacity of about 40 tons. Facilities at the Bangkok Dock Co., Ltd., include 2 graving docks, the larger is 374 ft. long; 3 marine railways for handling craft up to 40 tons; and 1 covered buildingway for ships up to 500 tons. About 50 small privately owned yards are available for construction and repair of small local craft.	River harbor along 18-mile section of Mae Nam Chao Phraya, with widths of 600 to 1,700 ft. and midstream depths of 24 to 30 ft. Two major areas are New Harbor, a 3.5-mile-long stretch in S. part, and Upper Harbor, an 11-mile-long stretch in N. part. Approach from Gulf of Thailand and across Bangkok Bar via an 11-mile-long channel dredged to a controlling depth of 20.7 ft. Tidal rises at Bangkok Bar are MHHW 10.3 ft., MLLW 3.3 ft.	Alongside—For 12 standard and 1 small ocean-type cargo vessels, 1 standard and 3 small coaster-type cargo vessels, 14 lighters, 3 standard and 2 small ocean-type tankers, 1 river-type tank barge, 4 ocean-type minesweepers, and 1 motor torpedo boat. Anchorage—Unlimited for vessels of all sizes in Gulf of Thailand S. of harbor. Area is exposed but the holding ground is good Mooring—For at least 7 standard ocean-type cargo vessels in river adjacent to the deep-water wharves of New Harbor.
Sattahip 12°40′N., 100°54′E.; on N. shore of Gulf of Thailand, about 80 miles SSE. of Bangkok. 5,715	Naval base operated by the U.S. Army Support Command providing operational and logistic support to U.S. forces and the Thai fleet. New deep-draft berthing facilities provide limited commercial service; however, the port has no rail line. The principal port function is to supply U.S. air units operating from U-Tapao airbase, located only 10 miles away, and from 7 other airbases in Thailand.	Natural coastal harbor with water area of about 1 sq. mile, protected by mainland and 2 islands lying to S. Port entered from S. via 650-ft.-wide dredged channel with controlling depth of 25 ft.; also entered from W. via 500-ft.-wide channel with controlling depth of 20 ft. Tidal rises are 10.1 ft. at extreme high water, 6.5 ft. at MHW, and 2.3 ft. at MLW.	Alongside—For 7 large ocean-type cargo vessels, 1 large ocean-type and 1 standard coaster-type tanker, 1 frigate (*Mitscher* class), 1 escort vessel (*Buckley* class), 1 ocean-type minesweeper, 1 motor torpedo boat, and 2 LST's. Anchorage—Unlimited free-swinging anchorage for vessels of all sizes in Gulf of Thailand about 2 miles W. of the wharf area. The area has depths in excess of 40 ft. and a holding ground of sand and shells; however, it is exposed and considered unsafe during the southwest monsoon (May through September). Limited anchorage is available for small craft in the harbor area in depths of 10 to 24 ft.

*The estimated military port capacity is the maximum amount of general cargo—expressed in long tons—that can be unloaded onto the wharves and cleared from the wharf aprons during a period of one 24-hour day (20 effective cargo-working hours). The estimate is based on the static cargo-transfer facilities of the port existing at the time the estimate is prepared and is designed for comparison rather than for operational purposes; it cannot be projected beyond a single day by straight multiplication.

In addition to ships of 1,000 g.r.t. and over, there are at least 25 domestic merchant ships of 194 to 832 g.r.t., aggregating about 13,400 d.w.t. These ships are utilized primarily in coastal trade, which is restricted insofar as possible for transport by domestic-flag ships. The fishing fleet consists of more than 35,000 small craft (including over 5,000 motorized units) which operate in nearby coastal waters. The fishing fleet also includes three oceangoing trawlers, each of 100 to 499 g.r.t.

Jurisdiction over maritime laws, decrees, and regulations is exercised jointly by the Ministry of Communications and the Ministry of Economic Affairs.

Government maritime policy advocates a viable, modern merchant fleet capable of carrying a larger share of the nation's total seaborne trade in order to conserve foreign exchange and to lessen Thailand's dependence on foreign shipping. In December 1972 the government adopted a maritime policy which restricts the use of foreign shipping for the transport of domestic cargoes. In 1971 Japan's exports to Thailand amounted to US$450 million, compared with Thai exports to Japan of $230 million. Of the Thai cargo imports of about 1.7 million tons carried by conference ships, 57.8% was carried by Japanese-flag ships, 27% by third-nation ships, and only 15.2% by Thai-flag ships. To counter this chronic trade imbalance and to carry a larger share of these imports, the government has been pressing the Japan-Thailand Freight Conference for an increase in the number of sailings for its three Thai member lines, TIME, TMM, and TMN.

Although there are sufficient numbers of Thai seamen to man domestic-flag ships, a shortage of maritime officers necessitates the employment of foreign nationals in key officer billets. Under law, three-fourths of the crew must be of national origin. Compared with European standards, Thai maritime wages are low; however, certain fringe benefits complement the modest wage schedule.

There are no maritime training schools in the country and none are contemplated. Maritime officers are trained at the naval school or at foreign maritime schools; seamen are trained aboard domestic merchant ships.

H. Civil air (C)

Civil aviation provides fast and reliable transport throughout Thailand as well as accruing much-needed foreign currencies. The country is served by two international air carriers—Thai Airways International, Ltd. (TAI), the national flag carrier, and Air Siam (Varan Air-Siam Co., Ltd.)—and one domestic air carrier, the Thai Airways Co., Ltd. (TAC).

The government has assisted in the development of both TAI and TAC; it owns TAC and currently holds 70% of the stock of TAI. The government maintains tight control over civil aviation activities under its jurisdiction. Civil aviation is controlled by the Ministry of Communications, acting through the Department of Aviation (DOA) which, in addition to the Royal Thai Air Force (RTAF), monitors all civil aviation activity. There is no official restriction on ownership of aircraft by private individuals; however, in practice no private registration permits are granted by the Ministry, which effectively curtails private aviation in the country. General aviation is restricted to charter and taxi operations. DOA is responsible for most civil air matters such as the issuance of operator licenses, aircraft registration, and the maintenance and operation of most of the airfields and air facilities. The issuance of airworthiness certificates, determination of medical standards, and the management of certain airports are the responsibility of the RTAF. The Directorate of Civil Aviation, RTAF, acts as a coordinating agency between civil and military aviation authorities, provides training and testing for pilots, meteorologists, and RTAF air-traffic controllers, and operates control towers and approach control facilities at RTAF bases. There has been some discussion regarding the establishment of an "Airport Authority," patterned after a Port Authority, which would be an independent body able to conduct and supervise airport operations and/or responsibilities now being undertaken jointly by DOA and RTAF. However, the proposed reform is still in the planning stage.

The domestic air carrier, Thai Airways Company, Ltd., provides air service to 20 domestic cities, in addition to Vientiane, Laos, and Pinang, Malaysia. TAC also engages in air-charter services on a limited basis with its airfleet consisting of nine Hawker Siddeley 748 series 207 (Figure 14) and five aging DC-3 transport aircraft. TAC employs 456 persons, of whom 36 are pilots.

International services are provided by Thai Airways International, a joint company in which TAC owns 70% and the Scandinavian Airlines System (SAS) owns 30%. SAS supplies technical and administrative assistance, a number of flight personnel, and specialized equipment. Currently, 25 SAS transport pilots are stationed in Bangkok to assist TAI with its international services. The TAI fleet consists of five DC-8-30 and one DC-8-62.

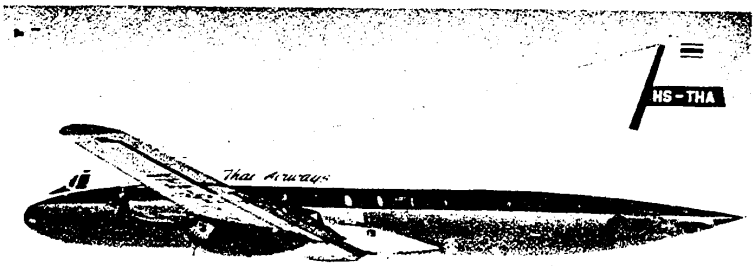


FIGURE 14. Hawker Siddeley 748 used by the Thai Airways Co. (U/OU)

TAI has improved its financial base over the years and has slowly evolved from a strictly regional air carrier into a full-fledged international carrier. It provides air service between Bangkok and Hong Kong, Manila, Taipei, Osaka and Tokyo, Saigon, Dacca, Rangoon, Calcutta, Kathmandu, Delhi, Copenhagen, Singapore, Sydney, Djakarta and Denpasar, Kuala Lumpur and Pinang, London, and Frankfurt. This successful expansion has resulted from a pooling arrangement between TAI, Cathay Pacific Airways, and the airlines of Malaysia and Singapore. Under the terms of this agreement Cathay Pacific was allotted a commanding position on routes north of Hong Kong, and the Malaysian and Singapore air carriers were given advantage on routes south of Bangkok. TAI was apportioned preference on the route between Bangkok and Hong Kong. This arrangement has been profitable for TAI, which has been able to expand into the international field. In 1971, it became an intercontinental airline by extending its air network to both Europe and Australia. TAI employs a total of 2,600 persons, of whom approximately 86 are pilots.

The country's third air carrier is Air Siam, which was organized in 1965 by Prince Varanand, a former captain for TAI and a cousin of the King of Thailand. Air Siam provides both passenger and cargo service between Bangkok, Hong Kong, and Tokyo. Its financial condition has fluctuated wildly since its inception because of poor financing and planning. In 1972 the airline was forced to cease its twice-weekly round trip on the route from Bangkok to Los Angeles via Hong Kong, Tokyo, and Honolulu. Air Siam's management was changed and a severe retrenchment program was initiated. Employees were reduced to a total of 150, and employment of many foreign consultants and technicians was terminated. New financing was attracted and Air Siam managed to keep a BAC-111 (Figure 15) and three DC-4 transports operating between Bangkok and Hong Kong with a leased Boeing 707 flying between Bangkok and Tokyo. Air Siam also operates one Boeing 747 on lease from Air Lingus until May 1975. Recent statistics indicate that Air Siam is now enjoying a recovery, especially from revenue gained from the Hong Kong-Bangkok route.

In addition to the major commercial operators, the Thai Department of Aviation operates one DC-3 and six small aircraft of the Cessna, Piper, and Beechcraft variety. A number of other lighter aircraft and helicopters are operated by several government agencies and private and foreign contractors on a variety of missions such as agricultural, air charter, and courier flights.

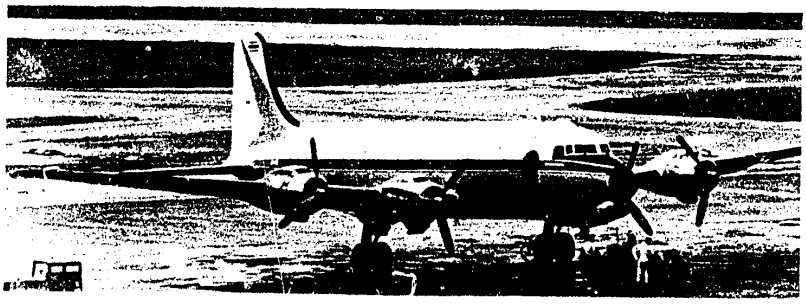


FIGURE 15. BAC-111 aircraft used by Air Siam (U/OU)

An estimated 4,300 persons are engaged in civil aviation activities in Thailand. These include personnel employed by the scheduled airlines, DOA, DCA, and those engaged in maintenance, air-traffic control, administration, security, training, communications, and electronics. Included in the overall strength figure are at least 250 civil pilots of all types, some 100 licensed flight-crew personnel (engineers, navigators, and radio operators), and about 800 skilled maintenance technicians.

Pilot and aircrew training is conducted at the [redacted] Aviation Training Center located in Bangkok. In 1971 the government contracted for a DC-8 flight simulator to improve pilot training and reduce the cost of training; prior to that time all TAI pilots were sent to Sweden for advanced flight simulator training. Other aviation courses at the Center include communications, meteorology, aircraft and engine maintenance, air-traffic control, and radio maintenance. SAS gives extensive training to TAI flight and technical personnel. TAC engages primarily in on-the-job training, but following the purchase of the Hawker Siddeley 748's some pilots and technicians were sent to the United Kingdom for training by the manufacturer. In addition, the RTAF Flying Club, organized to train pilots for the RTAF, has graduated a number of pilot candidates for the civilian airlines and operators. The club staff is composed of RTAF personnel on active duty assignments.

The only major maintenance facility is the Thai Airways Maintenance Company (THAIAM) located at the Bangkok International Airport. The company was formed in 1967 to upgrade aircraft maintenance. The government has ruled that all government aviation organizations which utilize contract maintenance must use the facilities of THAIAM. This ruling provides much business for THAIAM via the Ministry of Agriculture, Royal Thai Navy, and the Police Aviation Division. Another increase in THAIAM business developed in 1972 when the board of TAI voted to assign all maintenance of that airline to THAIAM. This additional work will bring both advantages and disadvantages for a maintenance division that in the past has been capable only of performing maintenance on DC-3 transports. Although THAIAM will ultimately be capable of performing airframe and engine maintenance and overhaul on all major aircraft in the country, all of TAC's HS-748's are sent to the United Kingdom for scheduled repairs. SAS will probably continue to perform maintenance on TAI's DC-8 aircraft, and it probably will be some time before THAIAM gains the capability to repair and overhaul modern jet transports.

Thailand is a member of the International Civil Aviation Organization, and Air Siam is a member of the International Air Transport Association. Thailand has civil air agreements or informal arrangements with 30 countries, including the U.S.S.R.

Through the terms of these agreements and arrangements Bangkok is served by 31 foreign carriers: Aeroflot (U.S.S.R.), KLM—Royal Dutch Airlines, Garuda, Singapore Airlines, Philippine Airlines, Pan American World Airways, Scandinavian Airlines System, Japan Air Lines, Alitalia, Olympic Airways, Lufthansa Airlines, Air France, Sabena—Belgian Airlines, Swissair, U.T.A.—UNION DE TRANSPORTS AERIENS, Qantas, Trans World Airlines, British Overseas Airways Corporation, Air India, Air Ceylon, British Airways, Cathay Pacific, China Airlines, Burma Airways Corporation, Malaysian Airlines System, Korean Airlines, Pakistan International Airlines, Royal Nepal Airlines, Air Cambodge, Air Vietnam, and Royal Air Lao.

I. Airfields[1] (C)

The air facilities system of Thailand consists of 227 airfields and former airfield sites, of which 176 are usable, and three heliports. Of the usable airfields, 47 have permanent-surfaced runways; 32 of these are civil, seven are joint military-civil, and eight are military. The remaining usable airfields consist of 42 airfields with runways over 2,000 feet and 87 with runways less than 2,000 feet in length. Airfields are fairly evenly distributed throughout the country. Most of the civil airfields are located near the larger communities. Five of the major airfields are located within a 120-mile radius of Bangkok. Many of the small airfields are located along the borders and are used in support of the Border Police. Air facilities are adequate for current civil needs, and recent constructions have substantially improved the military airfield capabilities. Details of 12 important airfields are given in Figure 16.

Bangkok International is the finest international airfield in Southeast Asia and is host to many international air carriers. Aircraft up to C-141-type use its parallel concrete runways, the longest of which is 10,500 feet.

Six of the main military bases house USAF tactical units. The largest of these is U-Tapao, which has an 11,500-foot concrete runway. The base supports a

[1]For detailed information on the air facilities in Thailand see Volume 25, *Airfields and Seaplane Stations Of the World*, published by the Defense Mapping Agency, Aerospace Center (DMAAC), for the Defense Intelligence Agency.

FIGURE 16. Selected airfields (C)

NAME AND LOCATION	LONGEST RUNWAY: SURFACE; DIMENSIONS; ELEVATION ABOVE SEA LEVEL	ESWL*	LARGEST AIRCRAFT NORMALLY SUPPORTED	REMARKS
	Feet	*Pounds*		
Bangkok International..... 13°55′N., 100°37′E.	Concrete..... 10,500 x 197 12	65,100	C–141.....	Joint. International airfield. Aviation and jet fuel available in aboveground tanks. Hq. Royal Thai Air Force (RTAF).
Chiang Mai..... 18°46′N., 98°58′E.	Concrete..... 7,000 x 125 1,063	59,393	C–124.....	Joint. RTAF tactical fighter squadron. Aviation and jet fuel available in semi-buried tanks.
Hat Yai..... 6°56′N., 100°24′E.	Asphalt..... 10,000 x 148 90	33,000	DC–6.....	Civil. Aviation and jet fuel available in underground tanks.
Koke Kathiem..... 14°53′N., 100°40′E.	Asphalt..... 7,333 x 98 98	35,500	C–130.....	Joint. RTAF tactical fighter squadron. Aviation and jet fuel available in aboveground tanks.
Korat..... 14°56′N., 102°05′E.	Concrete..... 9,845 x 148 729	65,100	C–141.....	Military. USAF fighter bombers. Aviation and jet fuel available in aboveground tanks.
Nakhon Phanom West..... 17°23′N., 104°39′E.	Asphalt..... 8,000 x 150 584	35,500	C–130.....	Military. RTAF and USAF supply groups. Aviation and jet fuel available in aboveground tanks.
Nam Phong..... 16°39′N., 102°58′E.	Concrete..... 10,000 x 150 787	65,100	C–141.....	Military. USMC fighter wing. Aviation and jet fuel available.
Phitsanulok..... 16°47′N., 100°17′E.	Asphalt..... 6,000 x 150 166	35,500	C–130.....	Joint. TAI and RTAF. Aviation and jet fuel available in underground tanks.
Takhli..... 15°17′N., 100°18′E.	Concrete..... 9,855 x 148 107	65,100	C–141.....	Military. RTAF, USAF fighter bombers. Aviation and jet fuel available in aboveground tanks.
Ubon..... 15°15′N., 104°26′E.	Concrete..... 9,000 x 125 405	65,100	....*do*.....	Joint. RTAF, USAF fighter bombers. Aviation and jet fuel available in aboveground and underground tanks.
Udorn..... 17°22′N., 102°48′E.	Concrete..... 10,000 x 125 584	65,100	....*do*.....	*Do.*
U-Tapao..... 12°41′N., 101°01′E.	Concrete..... 11,500 x 200 59	105,590	B–52.....	Military. USAF B–52 and KC–135 units. Aviation and jet fuel available in aboveground tanks.

*Equivalent Single-Wheel Loading: Capacity of an airfield runway to sustain the weight of any multiple-wheel landing-gear aircraft in terms of the single-wheel equivalent.

squadron of B-52 bombers and KC-135 tankers. The large military bases of Korat, Takhli, Ubon, and Udorn support fighter-bomber units of the USAF Tactical Air Command. Nakhon Phanom West, which has an 8,000-foot asphalt runway, can accommodate C-130-type aircraft and is used to support tactical operations. Nam Phong, which has a 10,000-foot concrete runway, is currently supporting a USMC fighter wing. Six of the seven joint military-civil airfields have hard-surfaced runways over 5,000 feet long and are capable of sustained operations of medium transports.

The civil airfields serving the larger communities with light transports have laterite or asphalt-surfaced runways 3,000 to 4,000 feet in length. They are used mainly by Thai Airways, Air America, Continental Air Service, and the Border Police and have few supporting facilities.

Except for Bangkok International, which is managed by the Royal Thai Air Force, airfield operations and maintenance are the responsibility of the Department of Aviation under the Ministry of Communications. Maintenance of airfields occupied by USAF units is performed by U.S. Seabees with equipment furnished by the United States. U.S.

Seabees have, on numerous occasions, performed airfield maintenance on joint military-civil airfields. Unpaved airfields are normally maintained by native labor. A new airfield at Tak is under construction by Thailand Department of Aviation and when completed will have a 5,000-foot permanent-surfaced runway.

The potential for expansion of military airfields is excellent, as most of them are located in flat areas; however, extensive artificial drainage is required to insure continuity of operations during the rainy season.

J. Telecommunications (C)

Thailand has one of the better developed telecommunications systems in Southeast Asia. Several domestic civil networks, including recently installed microwave facilities and independent military networks, are sufficiently extensive to satisfy government and military requirements. Service to the general public, however, is extremely limited and is restricted by the lack of coverage beyond main trunk lines. A program to improve civil communications is underway, principally involving further expansion of microwave networks. International communications are mainly by a satellite station which provides links to points in Asia, Europe, and the United States.

The Ministry of Communications is the primary authority over civil telecommunications, controlling the Posts and Telegraph Department and the Telephone Organization of Thailand, the two main public service carriers. Television and radiobroadcast facilities are under the jurisdiction of the Ministries of Communications, Defense, Education, and Interior. Special-purpose systems are maintained by indigenous military activities and numerous civil agencies, such as the Royal State Railway and the Departments of Transport, Mines, and Police. Nongovernment facilities are operated primarily by airline and construction enterprises. Government policy generally prohibits formation of privately owned communication systems except in the case of companies operating under government contract.

Domestic telephone and telegraph networks radiate from Bangkok. The system is composed principally of microwave cable and radio relay, supplemented by open-wire lines and high-frequency radio links. Open-wire lines are employed principally by the railroads. Radio networks are operated for civil aeronautical and mining communications. Public high-frequency radio generally functions to augment other systems and often is the only means of communication in remote areas. Lack of a central control over radio frequency usage and the resultant spectrum congestion, particularly in the high-frequency radio band, seriously hampers the effectiveness of radio as either a prime or alternate means of communication. Open-wire lines, cables, or radio-relay links generally parallel the main transportation routes.

Significant advancements in domestic telecommunications have been realized as part of the overall plan to upgrade the system. Foremost among these accomplishments is partial completion of a high-capacity microwave radio-relay network. This system represents the foundation for civil communications and connects most provincial capitals to Bangkok. Terminal and exchange equipment usually are installed in the local post offices. Most of the exchanges in the smaller urban areas are manually operated; equipment generally is obsolete and is in a poor state of repair. Recent improvements include installation of 13 automatic telephone exchanges, expanding the network by almost 100,000 lines. These additions have greatly increased the reliability of service in the Bangkok area, which accounts for over three-fourths of the country's telephones. Another 24 automatic telephone exchanges are planned for installation in the provinces under the provisions of the current development plan. As of January 1972, over 200,000 telephones were in use throughout the country, of which 90% were connected to automatic exchanges.

Other civil facilities are oriented toward specific communications needs. Most open-wire lines belong to the state railroad and are used primarily for traffic control; transmission capacity generally is limited to less than six voice-channels. The railroads handle some public telegraph traffic and lease a few trunks to the Ministry of Communications. In addition to open-wire lines, railroads also maintain a radio-relay system. Circuit capacity of most cable and relay links is adequate to meet anticipated railroad telecom requirements. Aeronautical Radio of Siam, Ltd., operates a radio network linking the Don Muang International Airport, Bangkok International, and smaller commercial airports throughout the country. The Department of Mines owns an independent radio system covering the peninsular area.

More than 100 AM broadcast stations are in operation. One of these, known as the Voice of Free Asia, is one of the most powerful A. stations in Southeast Asia, with an output of 1,000 kilowatts. This transmitter was installed by the United States near Sara Buri, about 50 miles northeast of Bangkok, to assist the government in countering Communist

propaganda. Other high-powered transmitters operated by the government are in the 100-kilowatt and 50-kilowatt output range. Additional AM transmitters planned for installation are to be operated by the military in the far north and the southern border areas to combat Communist propaganda.

FM broadcasting is limited to Bangkok, Chiang Mai, Nakhon Ratchasima, and Surat Thani. In early 1973, Bangkok had three main TV stations, including one color transmitter, and other main TV stations were at Chiang Mai, Hat Yai, Khon Kaen, Lampang, Nakhon Ratchasima, and Sara Buri. Additional main TV stations and repeater stations are planned. More than 3 million radiobroadcast receivers and over 650,000 TV receivers were in use.

International telecom services are provided primarily by a communications satellite station at Si Racha. The facility has direct-radio circuits, via the Indian Ocean satellite, to France, Italy, Singapore, Spain, the United Kingdom, and West Germany. Direct circuits also are available, via the Pacific Ocean Satellite, to Australia, Guam, Hawaii, Japan, the Philippines, the People's Republic of China, and the U.S. mainland. Backup radiocommunications extend to most world centers from an international high-frequency radio transmitter at Lak Si and a receiver site at Nonthaburi. Radio traffic also is transmitted from Phuket and Hat Yai to Pinang, Malaysia. A radio-relay link connects from Nong Khai to Vientiane, Laos, and a low-capacity telegraph line links Aranyaprathet to Poipet, Cambodia, affording a connection to Phnom Penh. U.S. military forces are linked to South Vietnam by tropospheric-scatter radio-relay terminals at Khao Khieo and near Ubon Ratchathani, in addition to a submarine cable which extends to Sattahip.

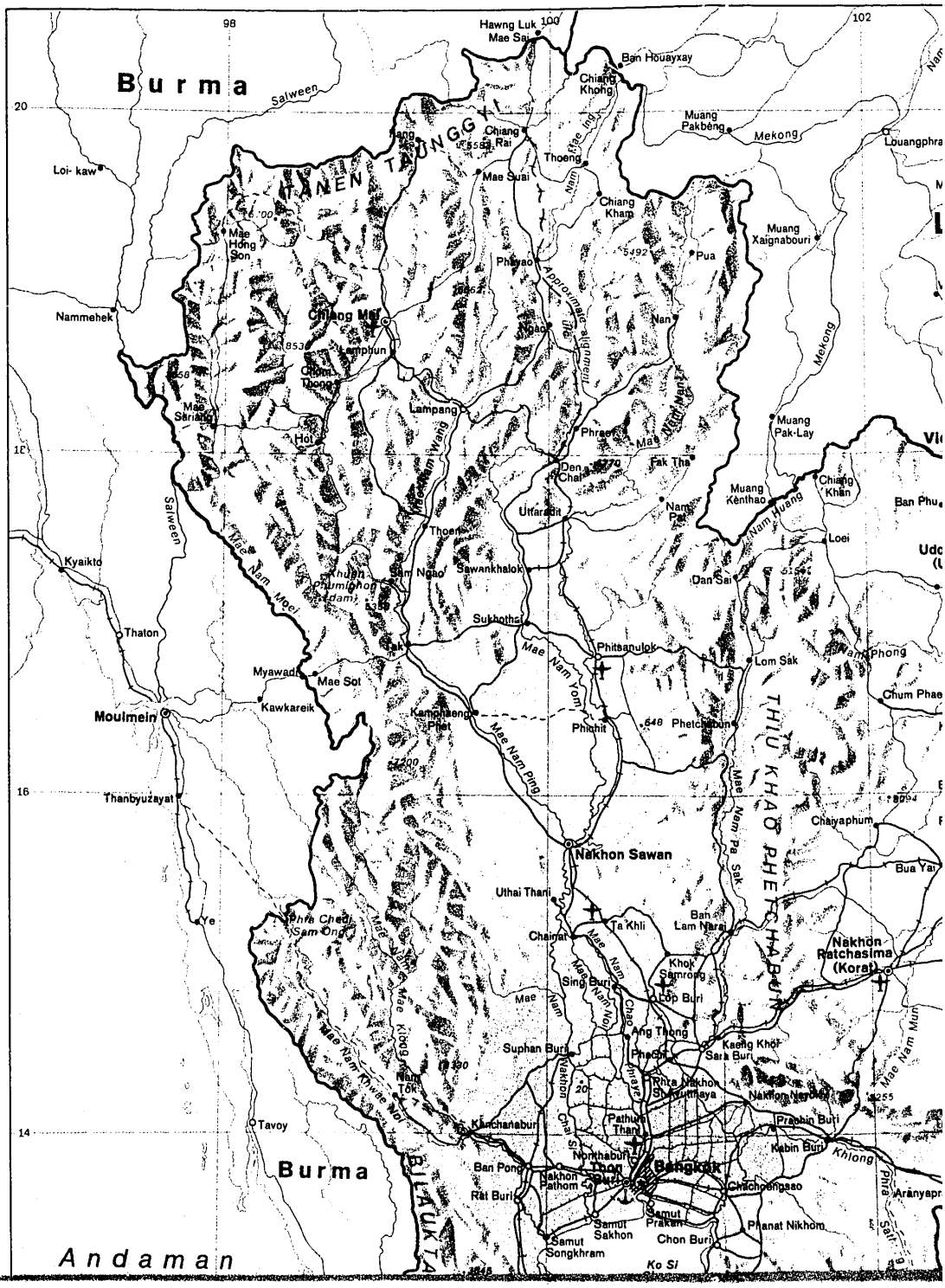
The modest telecommunications equipment industry mainly produces radio and TV broadcast receivers and some telephone handsets and telephone and telegraph accessories. Most other telecom equipment, many components, and supplements to domestically produced end-items are imported. Principal sources of imports are Japan and the United States. Most military equipment in use is of U.S. origin. There is no significant research and development activity. Adequate training is provided primarily by the Telecommunications Training Test and Development Center located near Bangkok. Established as an International Telecommunications Union and sponsored by the U.N. Development Program/Special Fund Component, the facility provides a wide range of telecom training, including basic and advanced engineering.

Telecom facilities in Thailand, as in most developing countries, are vulnerable to disruption. The low capacity of many intercity trunklines and the channelized distribution of the trunkline network generally limit the option for alternate routing. Furthermore, there has been little effort to establish physical security at fixed facilities. Climate and topography also cause numerous problems. The main factors are high humidity, which necessitates tropicalization of equipment, and the high atmospheric noise level found in the tropics, which reduces the range and usefulness of radio. Mountainous terrain and jungle often hinder installation of wire lines.

Development of the telecom system is being undertaken according to a comprehensive plan. The aim is to extend facilities to a large section of the country, which does not have adequate communications, and to substantially increase coverage in service areas. The primary work is centered on expanding the microwave network, which is partly completed. The total effort involves installation of 18 spur routes which are to link outlying areas to the existing trunk system. In addition, 24 automatic telephone exchanges are to be installed in provincial areas and is scheduled for completion in 1974. Plans also provide for building of additional exchanges through 1977. In service areas, modernization is to be accomplished between 1973 and 1975 in order to facilitate connections to the system. Automatic dialing is to be introduced in the provinces in 1975, with scheduled completion in 1977. The system in the Bangkok area is to be expanded considerably, and plans call for doubling the number of subscribers by 1977. Within the next decade, the overall goal is to establish a nationwide system by extending telecom facilities to most of the rural areas.

Places and features referred to in this General Survey

	COORDINATES			COORDINATES	
	° 'N.	° 'E.		° 'N.	° 'E.
Alor Setar, Malaysia	6 07	100 22	Nakhon Pathom	13 49	100 03
Andaman Sea (*sea*)	10 00	95 00	Nakhon Phanom	17 24	104 47
Aranyaprathet	13 41	102 30	Nakhon Ratchasima (*admd*)	15 00	102 10
Ban Bang Chak	13 37	100 33	Nakhon Ratchasima	14 58	102 07
Ban Bang Na	13 40	100 38	Nakhon Sawan	15 41	100 07
Ban Don Muang	13 55	100 36	Nakhon Si Thammarat	8 26	99 58
Bangkok	13 45	100 31	Nam Pung, Khuan (*dam*)	16 58	103 59
Bang Pakong, Mae Nam (*strm*)	13 27	100 57	Nan, Mae Nam (*strm*)	15 42	100 09
Bang Su (*rstn*)	13 48	100 33	Narathiwat	6 26	101 50
Ban Laem Chabang	13 05	100 53	Noi, Mae Nam (*strm*)	14 22	100 25
Ban Laem Narai	15 12	101 08	Nong Khai	17 52	102 44

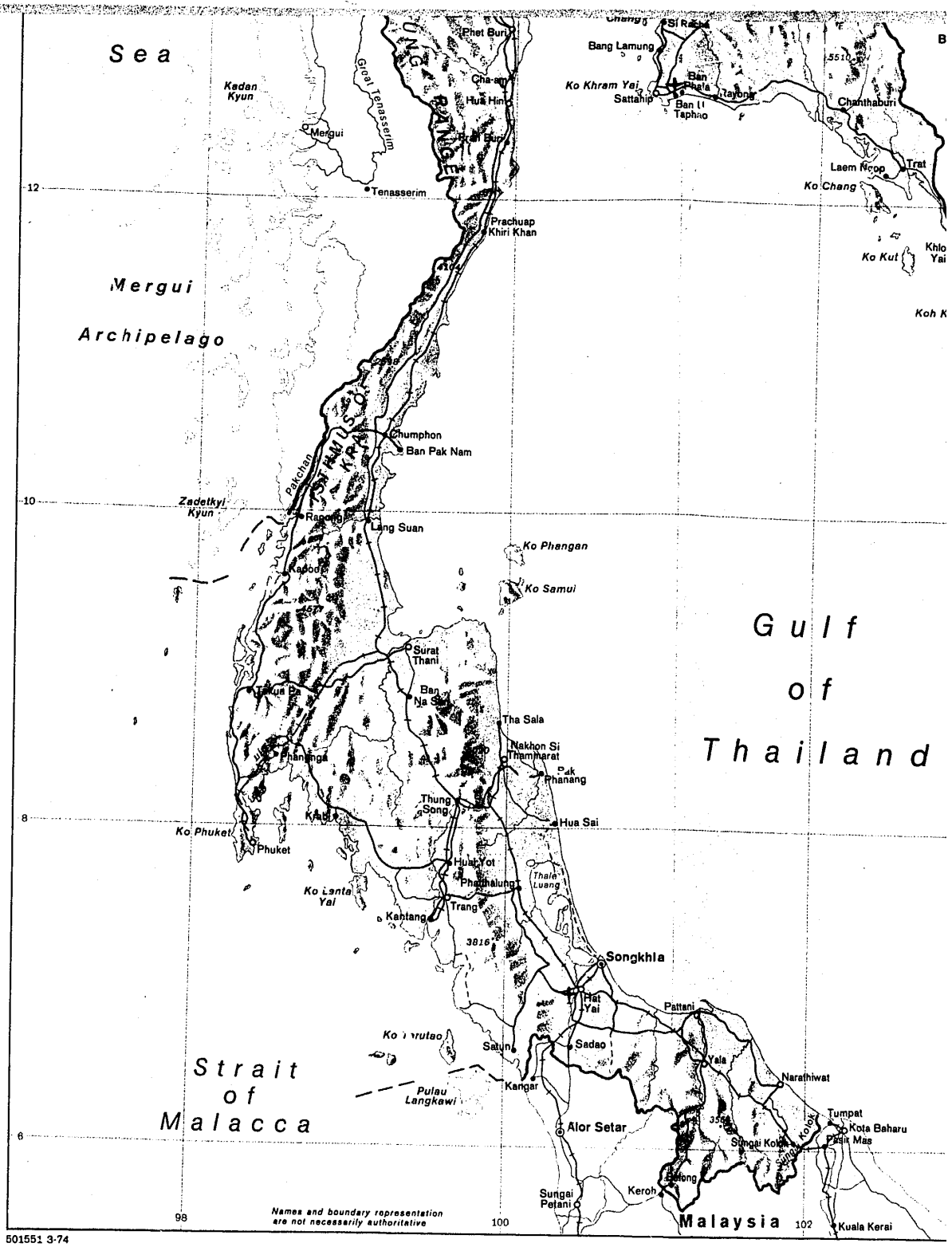


NATES	
°	'E.
100	03
104	47
102	10
102	07
100	07
99	58
103	59
100	09
101	50
100	25
102	44

Bannang Sata	6 16	101 16
Ban Pak Nam	10 26	99 15
Ban Phala	12 40	101 02
Ban Tha Chalaep	12 32	102 04
Ban Tha Luang	14 33	100 46
Ban Tha Phra	16 21	102 48
Bua Yai (*rstn*)	15 35	102 26
Bung Kan	18 23	103 37
Chachoengsao	13 42	101 05
Chainat	15 11	100 08
Chakkarat	15 00	102 16
Chanthaburi	12 36	102 09
Chao Phraya, Mae Nam (*strm*)	13 32	100 36
Chi, Lam Nam (*strm*)	15 11	104 43
Chiang Khong	20 17	100 24
Chiang Mai	18 47	98 59
Chiang Rai	19 54	99 50
Chok Chai	14 44	102 10
Chum Phae	16 32	102 06
Chumphon	10 30	99 10
Den Chai (*rstn*)	17 59	100 03
Det Udom	14 54	105 05
Dom Noi, Lam (*strm*)	15 17	105 28
Fang	19 55	99 13
Hat Yai	7 01	100 28
Hawng Luk, Burma	20 28	99 56
Hua Hin	12 34	99 58
Kabin Buri	13 59	101 43
Kaeng Khoi (*rstn*)	14 35	101 01
Kanchanaburi	14 01	99 32
Kantang	7 25	99 31
Kawkareik, Burma	16 33	98 14
Khieo, K'hao (*mtn*)	14 28	101 52
Khlong Toei	13 43	100 34
Khlong Yai	11 46	102 54
Khon Kaen	16 26	102 50
Khorat Plateau (*plateau*)	15 30	102 50
Klet Kaeo, Chong (*marine channel*)	12 45	100 51
Klet Kaeo, Ko (*isl*)	12 46	100 51
Kolok, Sungai (*strm*)	6 15	102 05
Krabi	8 04	98 55
Kra, Isthmus of	10 20	99 00
Krathing, Khao (*mtn*)	13 11	99 43
Krathing, Khao (*hill*)	12 43	100 56
Kuala Kerai, Malaysia	5 32	102 12
Laem Chabang, Khao (*hill*)	13 05	100 53
Laem Ngop	12 10	102 26
Lak Si (*rstn*)	13 53	100 35
Lampang	18 18	99 31
Lang Suan	9 57	99 04
Loei	17 29	101 35
Lom Sak	16 47	101 15
Lop Buri	14 48	100 37
Lop Buri, Mae Nam (*strm*)	14 22	100 35
Mae Hong Son	19 16	97 56
Mae Klong, Mae Nam (*strm*)	13 21	100 00
Mae Mo (*rstn*)	18 16	99 43
Mae Sariang	18 10	97 56
Mae Sot	16 43	98 34
Makkasan (*rstn*)	13 45	100 33
Malacca, Strait of	2 30	101 02
Malay Peninsula (*peninsula*)	6 00	102 00
Mekong (*strm*)	16 15	105 00
Moei, Mae Nam (*strm*)	17 50	97 42
Muang Kènthao, Laos	17 44	101 25
Muang Vangviang, Laos	18 56	102 27
Mukdahan	16 32	104 43
Mun, Mae Nam (*strm*)	15 19	105 30
Nakhon Chai Si, Mae Nam (*strm*)	13 30	100 16
Nong Pla Duk (*rstn*)	13 49	99 55
Nonthaburi	13 50	100 29
Pakchan (*strm*)	9 58	98 35
Pak Phanang	8 21	100 12
Pakxé, Laos	15 07	105 47
Pa Sak, Mae Nam (*strm*)	14 21	100 35
Pattani	6 52	101 16
Phachi	14 27	100 43
Phitsanulok	16 50	100 15
Phong, Nam (*strm*)	16 23	102 56
Phrae	18 09	100 08
Phra Khanong	13 42	100 36
Phra Nakhon Si Ayutthaya	14 21	100 33
Phuket	7 53	98 24
Phuket, Ko (*isl*)	8 00	98 20
Phumiphon, Khuan (*dam*)	17 15	98 58
Pinang, Malaysia	5 25	100 20
Ping, Mae Nam (*strm*)	15 42	100 09
Prachuap Khiri Khan	11 49	99 48
Pran Buri	12 23	99 55
Ranong	9 58	98 38
Rat Buri	13 32	99 48
Sakon Nakhon	17 10	104 09
Salween River	17 30	97 40
Samut Prakan	13 36	100 36
Samut Sakhon	13 32	100 17
Samut Songkhram	13 24	100 00
Sara Buri	14 32	100 55
Sattahip	12 40	100 54
Satun	6 37	100 04
Savannakhét, Laos	16 33	104 45
Si Racha	13 10	100 56
Sisophon, Cambodia	13 35	102 59
Songkhla	7 12	100 36
Sungai Kolok	6 02	101 58
Suphan Buri	14 28	100 07
Surat Thani	9 08	99 19
Tak	16 52	99 08
Ta Khli	15 15	100 21
Takua Pa	8 53	98 21
Thawat Buri	16 07	103 50
Thon Buri	13 43	100 29
Thung Song	8 09	99 41
Trat	12 14	102 30
Ubon Ratana (Nam Phong), Khuan (*dam*)	16 46	102 57
Ubon Ratchanthani	15 14	104 54
Udon Thani	17 26	102 46
Uttaradit	17 38	100 06
Vientiane, Laos	17 58	102 36
Warin Chamrap	15 12	104 53
Xénô, Laos	16 41	105 01
Yom, Mae Nam (*strm*)	15 52	100 16

Selected airfields

Bangkok International	13 55	100 37
Ban Ta Khli	15 17	100 18
Chiang Mai	18 46	98 58
Chieng Khrua	17 17	104 06
Koke Kathiem	14 53	100 40
Korat	14 56	102 05
Muang Lampang	18 16	99 30
Muang Ubon	15 15	104 52
Nakhon Phanom West	17 23	104 39
Nam Phong	16 39	102 58
Phitsanulok	16 47	100 17
Udorn	17 23	102 48
U-Tapao	12 41	101 01



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Terrain and Transportation Figure 17