

B.R.877J(7b)(RESTRICTED)

Part V (cont.)

COAST, PORTS, AND INLAND TOWNS

(B) PORTS (*cont.*)

(H.M. Naval Base, Singapore Island)

AUGUST 1944

INTER-SERVICE TOPOGRAPHICAL DEPARTMENT

PART V (cont.)

(B) PORTS (cont.)

H.M. NAVAL BASE, SINGAPORE ISLAND

Note: For Singapore, Commercial Port, and City, see B.R. 877 J, Vol. I, fascicle (7a).
For other ports of Malaya see B.R. 877 J, Vol. I, fascicle (7) (West coast), and
Vol. II, fascicle (12) (East coast).

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PART V (cont.)

(B) PORTS (cont.)

H.M. NAVAL BASE, SINGAPORE ISLAND

1°28'N, 103°50'E.

Chart: 2403 (Plan 70), 3834, 2585 (Plan 74) 2586
(Plan 75); F.0145, 0148, 0147, 0126, 0127, 0128,
019.Planes: 101-104; see also above under Charts.
Photographs: K.1-K.72.

DATE OF INFORMATION

In general, the Naval Base is described as it was when last in working order before the capitulation of Singapore (February 1942), but certain details of later date have been included (see p. 130, and 131).
No air photographic cover was available at the time of writing.

(A) PORT AND REPAIR FACILITIES

(1) General

Position and general description

The Singapore Naval Base is on the north shore of Singapore Island, and is approached from Singapore Strait eastward about the island via Johore Strait East. The sea distance from Singapore commercial port is about 36 miles; for channels, depths, etc., see below. Johore Causeway, linking the island with the mainland (and carrying the main road, railway, and water pipelines), prevents access from the western section of the Strait, except for small craft which can pass through the lock at its northern end (see p. 130, Approaches, etc., below).

The Naval Base occupies an area roughly in the shape of a half-crescent along the coast of the island from the Johore Causeway eastward for about 5 miles; the blunt eastern end is about 1½ miles wide, the western or causeway end tapering to a width of a few yards, sufficient to carry the access road and railway behind the shore. Within this area were, at the time of the capitulation—

A large dockyard, with (planned) total berthing of 8800 ft., and dredged docks alongside up to 30 ft.; a large graving dock; two floating docks, and repair and storage facilities of every description.

An extensive Armament Depot (nearly complete), with jetty.

A Torpedo Depot (under construction), with jetty, Senoko Oil-fuel Depot, comprising 30 tanks.

Suara W/T station.

Fleet Shore Accommodation, European residences, police quarters, coolie lines, etc.

The Base supplied its own light and power and had its own sewage scheme, but took water from two municipal sources. There is access to the area by two roads from Singapore city and it is also served by a metre-gauge branch from the main F.M.S.R. line across the island.

History of the Naval Base

The scheme for the development and construction of the Naval Base went through many vicissitudes since its first conception, when a very large scheme including several docks was envisaged.

It first appeared in Navy Estimates in 1923, when a scheme including one large graving dock was authorized. Consequent on a change of government work on the scheme was discontinued in 1924. In 1929 a revised plan—the "Truncated" Scheme—was worked out, which included only the essentials to enable the Base to be used for docking and repair of ships in peace-time, but both repairs and storage facilities were below what was considered necessary for war. In 1928 a contract for the construction of a base on these lines was arranged. In 1929 the govern-

ment then in office decided to slow the work down as much as possible.

In 1933 the "Truncated" Scheme was extended to include, amongst other items, provision for a Boon Defence Depot and increased accommodation for the Armament and Mining Depot. The "Truncated" scheme—known as the "July 1933 Development scheme"—were approved by the Treasury. It was intended to bring the dock into use by September 1937 and to complete the approved work by March 1940, by which date the Dockyard and other establishments would be capable of being used to a limited extent in war time.

In 1935, under the Naval Development Programme, the July 1933 Development Scheme was accelerated by one year so as to be completed by March 1939 and further sums were approved to cover many additional items.

At the time of the outbreak of war in the Far East (December 1941) much had been completed. In the Dockyard some sections of the quay walls were unfinished and various storehouses remained to be built, certain other dock and slipway facilities were still in embryo. The Torpedo Depot was about half complete and some of the magazines in the Armament Depot were still under construction. Various extensions to the European residential areas, to the coolie lines, and to the water supply, were in hand or contemplated. But the Base was in general so far complete that a very full use could be made of it.

Denials, and Japanese use of the Base, 1942-43:

The siege of Singapore Island began on the morning of Saturday, January 31st, 1942, when a gap was blown in the Johore Causeway, all our troops having been withdrawn from the mainland. Japanese landings were made in the night of February 8th-9th, and further landings on 9th-10th; Singapore capitulated on Sunday, February 15th. During this fortnight the Naval Base formed a sector of the front line, and was subjected to some bombing, and to shell and mortar fire from across the Strait; this, however, caused comparatively little damage. Some denials were carried out in the last days, but no thorough and systematic operations could be undertaken, for a variety of reasons; one was lack of time, as until a comparatively late date it was the official opinion that the island would not fall. Such details as have been reliably reported of denials are given under the relevant subject-headings, below.

After information has indicated that the Japanese are making considerable use of the Base, and are continuing work on some of the installations left unfinished in 1942. A report of mid-1943 indicates that no signs of damage were apparent at that date and the Base appeared to be in full working order. Such reports of Japanese repair and use of the

here that the chief range of workshops is along Workshop Road, behind West Wall and the graving dock (photographs K.28, K.29), that there is a subsidiary range along North Road, and that the two power stations supplying the Base area are (1) at the junction of North and Workshop Roads (photographs K.28), and (2) close behind the southeast corner of the Naval Stores Basin (photograph K.16).

Road and rail access

Road and rail layon in the dockyard area can be seen on *Plan* described under (14) *Road and rail access*, p. 147, below. In general, road service is excellent; rail service is by two main branches from North Road (one metre gauge), and by an extensive system of dockyard standard (4 ft. 8 1/2 in.) gauge lines serving the graving area and all wharves, workshops, transit sheds, storerooms, stacking grounds, etc.

Other installations

These comprise chiefly the various dockside sheds and the dockside living accommodation for officers, C.P.O.s, P.O.s, and ratings, and a variety of other buildings (chart depot, fire station, engine shed, pay and muster stations, etc.) eastward of the graving dock (photograph K.38). The layout of these may be seen on *Plan* 102.

Japanese use: In mid-1943 it was observed that the water ground near the chart depot was occupied by new buildings thought to be stores.

(ii) RESIDENTIAL AREA AND COOLIE LINES. (Photographs K.7-12, K.68-71.)

South and south-east of the Dockyard is an area of unbuilding ground given over to European residences and, south-westward of these, to extensive permanent coolie lines, beyond, to the southward, is the residence of the Admiral Superintendent. At the coolie line is the Asiatic Hospital. The layout of this area may be seen on *Plan* 101; the residences and coolie lines are described in (1) *Living accommodation*, etc. (i), p. 148, below. In the centre of the residential area is conspicuous on the left of photograph (K.17), and beside it one of the two reservoirs of the water-supply system to the Base area (see (12) *Water and sanitation*, p. 150, below).

(iii) CONTRACTOR'S AREA. (Photographs K.7-8, K.10-12, K.40-42.)

Between the graving dock (see (i) above) and the Sunset Sembarang, about 500 yds. north-west of it, is an area which was given over to the use of the contractor engaged in the building of the Base; here are a stone-crushing plant, a concrete-mixing plant, some storerooms, and various ancillary buildings, and beside these the contractor's wharf on the south-east side of the mouth of the Sunset Sembarang (photograph K.40-41). These installations have rail connection by a spur from the main Base metre-gauge access line.

The contractor's wharf is described in (7) *Quayside*, etc., pp. 134 and 136, below, and the shore line in (10) *Landing of men*, etc. (i), p. 139-140, below.

(iv) SUNSET SEMBARANG

The Sunset Sembarang originally ran westward of the permanent coolie lines and across the present site of Suara W.T. station (see (vi), below), beyond which it was spanned by a conspicuous steel bridge (photograph K.42) carrying the main Base access road and railway; there it flowed into Johore Strait about 100 yds. north-west of the present site of this section. On the development of the Base, the west end of its course was filled, from a point close westward to the mouth (Plan 101), its west end of this section through the New Cut from Suara W.T. station into the Sunset Senoko (see (vi), below); the filling was

continued to within about 700 yds. of the river mouth, and as the steel bridge was therefore rendered unnecessary, it was removed, the road and railway being rebuilt across the Sunset Sembarang (see (v), below) correctly shown on *Chart F. 619* at its point in position.

The lower portion of the Sunset Sembarang is thus no more than a tidal inlet about 700 yds. long (photographs K.7-8, K.10-12, K.42). Slipways for M.T.B.s and M.L.s (see (13) *B*), *Slipways*, p. 144, below) were under construction at its inner end, and for this purpose a temporary dam had been built between the Sunset Sembarang and K.28, reducing its effective length in 1941-2 to about 500 yds. Only the site for these slipways had been prepared. Further proposed works in this area included a long and low two further storerooms, Nos. 5 and 6, on the west bank of the creek (photograph K.40) shows progress on the site by November 1941, and the completion of a jetty on the west bank for the use of coastal transport, this had not been begun.

(v) FLEET SHORE ACCOMMODATION. (Photographs K.7, K.11, K.30, K.42-K.47.)

The buildings providing accommodation for officers and men of the fleet ashore occupied the whole of the area between the graving dock and close to the shore. These, and the various ancillary buildings in the area, are described in detail in (B) *Living accommodation*, etc. (1) (i), p. 149, below. On the north-west side of the hill, between it and the shore, is a large flat area which has been used to provide football, hockey, cricket and other recreation grounds; farther to westward, and on the shore, are the Inland tank and drying-drying beds which dispose of sewage from the Base (see (B) (2) *Sanitation*, p. 151, below), and a refuse destructor. The shore in the whole of this area is described in (10) *Landing of men*, etc. (i), p. 140, below.

Japanese use: In mid-1943 it was observed that all the Fleet Shore Accommodation, including the officers' club, was occupied.

(vi) SUNSET SENOKO. (Photograph K.31.)

The Sunset Senoko runs southward from the Sunset Sembarang, but (as noted in (v), above) the waters of the latter have been diverted into it by way the New Cut (see *Plan* 101). Its mouth is close to the Fleet Shore Accommodation area, has depths of only 1 ft. over the bar at L.W., within the depths increase and it is possible for tankships to anchor as far as the junction with the New Cut, or at times to ascend the New Cut itself and use the bridge carrying the main Base road and railway line.

(vii) SUARA W.T. STATION. (Photographs K.7, K.38, K.42.)

This station, with its three conspicuous 600-ft. masts and its three smaller masts of 180 ft., was west of the chief residential area and south of the Fleet Shore Accommodation; its enclosure was bounded on its western side by the New Cut (see (vi), above).

Dental and Japanese use: It is reported from several sources that before the capitulation, in February 1942, all the masts were brought down from the top by explosives, and the station completely destroyed or removed, the station completely destroyed, and the various spaces smashed. In November 1942 it was reported that the Japanese had a dental station on the same site; the station is reported to have been built in mid-1943 and found to be in complete working order, with all six masts in place.

(viii) SENOKO OIL-FUEL DEPOT. (Photograph K.52.)

On the opposite bank of the New Cut and between 2000 and 1000 yds. inland from the mouth of the Sunset Sembarang, the Oil-fuel Depot is a long line of the chain of storage installations for Admiralty fuel established across Singapore Island from Keppel

Harbour to the Naval Base (Plans H.3 and I.4, B). Here there were 38 tanks, storing a total of 488,000 tons of oil, and connected by pipeline with the other depots and with the Dockyard. This and the other installations are fully described in (12) (B), *Oil*, p. 141, below.

Dental: The Senoko Depot is reported to have been completely destroyed before the capitulation.

(ix) THE ARMAMENT DEPOT. (Photograph K.53-56.)

The Armament Depot, sometimes called 'Western Depot', or briefly the K.N.A.D., is constructed on the shore of the island (between the main Base and the Dockyard and the Johore Causeway, and to the west of the Sunset Senoko and Senoko Oil-fuel Depot). It occupies a strip of land some 3000 yds. long and averaging 1000 yds. in width between the main road and railway and the Strait of Johore. The numerous small hills in the area (Perapat, Atapp, Talab's Hill, Rimau, Keramat, etc.) see *Plan* 101 and *Chart F. 6128* average a little under 100 ft. in height (except for Keramat Hill, which rises to about 135 ft.), and have been utilized to good advantage in the construction of the various magazines of the depot.

Eighteen underground bomb-proof reinforced-concrete magazines, 120' x 30 ft., built into the hill-sides and having 25 ft. of earth cover, had been completed; a further ten were under construction (photographs K.58-59). One of these, No. 1, was constructed in the shallow valley of Talab's Hill (photograph K.54). No. 8 is on the northern side of Atapp Hill. Nos. 5-12 in the northern side of Perapat Hill, and Nos. 13-18 in the slopes of Rimau Hill. The remaining ten were being built into Keramat and Perapat Hills, and the hill to the southward of Talab's Hill.

The further equipment of the depot comprised surface magazines for shell stores; primer magazines; detonator stores; charge-case assembly shop with examining bank; laboratory area; with six ammunition stores (photographs K.57); numerous acid, paint, oil, rubber, timber and other miscellaneous stores; shell-painting and scraping shops; fire station, laundry, and first-aid room. The coolie lines in the depot (some permanent, some temporary buildings) lay on the southern slopes of Atapp Hill. One of the two were the temporary coolie lines. Various private houses and langgahs for officers and others were built or building on the southern slopes of Keramat and Perapat Hills overlooking the Base road, which bounds the depot area to southward (photograph K.54).

A jetty with a 600 ft. T-head (see (7) *Quayside*, etc., p. 138, below, and photographs K.53-56) was constructed on the shore northward of the Depot. This was planned, to be built on the shore north of Talab's Hill. The existing jetty had rail connection and was equipped with three cranes.

The depot is served by a system of bituminous-surfaced roads, with two connections from the main Base access road; the chief of these runs up Atapp Valley, west of Atapp Hill, and is about 12 in. wide. A branch from the metre-gauge access line to the Base also serves the depot (see (14) (B), p. 148, below).

For details of water supply and sanitation in the depot area, see (12) (B), p. 150, below. The waterfront is described in (10) *Landing of men*, etc. (i), p. 140, below.

Dental and Japanese use: It is reported that on evacuation all machine tools in the depot were destroyed; the magazines, however, except Nos. 7 and 8, and possibly No. 1, were not demolished or flooded. Ammunition, etc., was part removed or rendered useless, primers and detonators being taken away. The jetty was damaged or destroyed (see (7) *Quayside*, etc., p. 137). In November 1942 it was reported that the Japanese were working on the magazines left unfinished early in that year, and that all the others were in use.

(x) THE TORPEDO DEPOT. (Photographs K.60-64, K.72.)

The Torpedo Depot, sometimes called 'Woodlands Depot', lies immediately westward of the Armament Depot, a triangular site between the Strait of Johore and the main Base road and railway; the landward face of this area is about 800 yds. long, the waterfront about 700 yds. long.

The depot was not complete, work on it having been begun only in 1940. Fourteen stores, each 70 ft. square) were constructed, two near each end of the waterfront, and also the main office, electric substation, air-compressor house, garages, and various storerooms; a workshop block of about 220' x 130 ft., in six bays, had been begun (Plans 101 and photographs K.60-61). A pier with a 215 ft. front and one crane was about complete, and rail connection was laid, but no common had been made with the water pipeline. One (7) *Quayside*, etc., p. 137, below, and *Chart F. 6128* (K.60) Temporary office and coolie lines (photograph K.62) were erected in the south-east corner of the triangle.

Rail connection from the main Naval Base road (photographs K.62, K.64, K.72) was almost complete, and there was also access by a temporary road laid up Keramat Valley, between the Armament and Torpedo Depots. A rail link from the main Base access line had been planned but not laid, and in February 1942 the only rail access was by an extended spur along Keramat Hill, connecting the Armament Depot to about the level of the workshops in the Torpedo Depot.

The waterfront is described in (10) *Landing of men*, etc. (i), p. 140, below; water supply and sanitation in the depot in (12) *Water and sanitation*, p. 150, below.

(xi) RIMAU ESTUARY. (Photographs K.43, K.54, K.67.)

The 'Rimau Estuary' is the name given to the area on both sides of the main road south of the Armament Depot, where various permanent and temporary residences were built or building for officers and other staff employed in this neighbourhood (see (B) *Living accommodation*, etc. (1) (i), p. 149, below). A line of offices (photograph K.67) was also in course of construction; a bomb-proof office beside it (photograph K.68) is in the south of the area. The Rimau reservoir (photograph K.58), one of the two on the water supply system of the Naval Base area (see (12) *Water and sanitation*, p. 150, below).

(xii) SUNGEI CHANG—JOHORE CAUSEWAY. (Photographs K.61-62, K.65-66.)

The mouth of the Sungai Chang forms the western boundary east of the Torpedo Depot (photograph K.62); west of it the area occupied by the Base tapers to a narrow strip, just sufficient to carry the main Base road and railway in a shallow trench. The Strait and the rising ground behind, as far as the southern end of the Base area, are described in (photograph K.65).

A few yards west of the mouth of the Sungai Chang is the jetty, 530 ft. in length, of the Causeway. Behind the jetty, and connected with the Causeway by a short pier, is a second depot under construction on ground newly acquired close south of the jetty. (These depots are described in mid-1942 in (10) *Landing of men*, etc. (i), p. 140, below, and in (7) *Quayside*, etc., p. 137, below).

The jetty, which was built southward the R.F.A. *Rathemes*, used as an oiling link, was permanently moored close offshore, with a light approach jetty (photograph K.66) and a light buoy (photograph K.65) in (12) (B), p. 142, below. About a quarter of a mile beyond the jetty, the Johore Causeway joins the Base area, carrying the main road, rail, and water pipelines from the mainland to Singapore city.

(b) Mooring buoys

The following are indicated on Chart F 0128—
 Off Talbot's Hill, Armament Depot, 1 (Nos. 1-4),
 in about 7 fathoms.

Off Red House Landing, Fleet Shore Accommodation, 6, in about 31-54 fathoms. (Note: 3 only on Chart F 0015.)

Off mouth of Sungai Sembawang, 1, in about 5 fathoms.

Off Sembawang (Sektar) Pier: 6 (Nos. 15-17 and 21-25), in about 2-3 fathoms.

Close east of Sembawang Pier: 3 (Nos. 18-20), in about 3 fathoms.

In centre of Dockyard Reach, off the west end of North Wall, 1, in about 5½ fathoms.

(c) Enclosure of Naval Base area

The whole Naval Base is enclosed by a high steel paling fence (photograph K.64), which follows the outline of the Base area as shown on Plans 101 and 100B. Starting immediately west of Sembawang pier, it runs down the western side of Sembawang (Sektar) Road for a total distance of nearly 2 miles, with seven gates (Bouldier, Mata, St. Helena, Sembawang, Africa, entrance to Admiral's Residence, and Canberra) giving access into the Base (see Plan 101); of these, Sembawang Gate is at the eastern end of the main Base access road running to the Johore Causeway.

At a point about 80 yds. south of Canberra Gate the fence turns westward, and follows the Base boundary as shown on Plans 101 and 105, enclosing the residential area and cooie lines, Sauri W/T station, Smoker Oil-fuel Depot, and the Riman estate. Beyond Batu Riman reservoir the fence returns to meet the main Base road and railway, which it then follows westward as far as Woodlands Gate by the causeway.

In addition, there are inner fences enclosing the chief installations within the Base area, as follows:—

Dockyard

The Dockyard is surrounded by a steel paling fence, the course of which is indicated on Plan 102, parts of its course may be seen in photographs K.15, K.31, K.32, and K.33. The main Gate is at the south end of Workshop Road (photograph K.32), and there is another gate on Store Road between the residential area and the Dockyard.

Fleet Shore Accommodation

The Fleet Shore Accommodation and the nearby recreation grounds are enclosed by a chain-mail fence, in which the only gate is at the main road end of Drake Avenue.

Armament Depot

The Armament Depot is doubly enclosed; there is an outer fence, 8 ft. high and unbreakable, and within this a 10 ft. fence surrounds the explosives area and is continued along the whole extent of the waterfront (photograph K.57).

Torpedo Depot

A chain-mail fence surrounds the depot and is continued along the waterfront (photograph K.60).

(d) Location of offices (1942)

The Main Offices were in a large and prominent building close to the south-west corner of the dockyard area (photograph K.31; see also photograph K.8, K.10, K.12).

The Photo office was on the north-east corner of North Wall.

The Riman office (photograph K.67) was building, between Batu Riman reservoir and the main Base road; beside it, a bombproof office was completed.

The Main Office of the Armament Depot was about 150 yds. west of Attap Valley Road, in the centre of the depot (photograph K.54).

The office of the Torpedo Depot was on the southern side of the area, close to the main Base road. It was complete.

(7) Quayage, crannage and access to the quays

(a) General

In the Naval Base there were the following quays, piers, etc.:—

Dockyard—West Wall, North Wall, and the Naval Stores Basin, with a planned total berthing length of 8950 ft., of which about 5500 ft. were in effective use in January 1942.

Contractor's wharf: about 320 ft., with about 19 ft. depth.

Armament Depot: jetty 600 ft., with about 25 ft. depth.

Torpedo Depot: jetty 215½ ft., with about 17 ft. depth.

A.P.C. sailing pier, for tankers of about 300 ft., with 18 ft. depth.

Admiralty sailing berth alongside R.F.A. Rutilia, permanently moored close offshore, with an approach pier bearing oil masts.

The following are general notes on quayage, wharf crannage, and access to quays; details of these are given in (9) *Tabular Statement*, pp. 138-137 and of other crannage in (c), p. 138, below.

QUAYAGE—DOCKYARD

Construction

All quays are solid concrete wharf walls, partly built in open trench and partly by monoliths; the face is at a batter of 1:24. Culverts for surface drainage, 4½ ft. diameter, are taken to below L.W. level. Several flights of landing steps are included in the wharf faces. Rail and crane tracks are laid flush in the wharf surface. (Photographs K.15, K.19.)

State of completion, January 1942

At this date there remained to be completed: (1) a length of about 1275 ft. of the western half of North Wall; (2) part of the East Wall of the Naval Stores Basin. Of these two sections, that in North Wall, and a length of about 450 ft. of East Wall, were being built in concrete monolith form (photographs K.10-14). The constructive work was all but complete, but the earth dams in front of these two sections had not all been removed. (Photographs K.10-12, K.23, 24.) At North Wall the centre third of the dam was retained dry, the two outer thirds having been partly grabbed or surface-dredged in order to facilitate the removal of the pile core (photograph K.23, 24); the whole of this section of the wall was therefore still not available for service. At East Wall the dam had been removed to a depth of about 19 ft. in L.W., and some pile-drilling remained to be done before the required depth could be attained.

Subway and services

A subway, 4½ ft. high and 6 ft. wide, runs round all the dockyard wharves and the graving dock, at 23.3 ft. below the level of the wharf surface; this carries the fresh water and compressed air mains, and the electric cables. There are hand-operated valves at intervals for drainages.

The two oil mains (see (12) (i) *Oil*, p. 142, below) are not laid in the subway, but are carried on a benching behind the wharf walls.

Lighting units (cf. photograph K.19) are installed on the wharves at intervals of 125 ft., at 42 ft. back from the coping. For power supply by tug bores, etc., see (13) (c) *Repair facilities*, etc., (i), p. 146, below.

Denials and Japanese use: No specific details have been reported of damage to the wharf walls. Approach to them from seaward was obstructed by

Note: (1) Quay, etc., are named from east to west.
 (2) Figures otherwise stated, information relative to conditions in January 1942.

Height of tide in feet above chart datum: M.H.W. 5.10; M.T.W. 4.6; M.L.W. 3.6

NAVAL STORES BASIN (photographs K.13, 14)	Name	Depth from chart datum (ft.)	Length (ft.)	Width (ft.)	Height H at L.W. (ft.)	Capacity (tons)	Type	Access to wharf		Remarks
								By rail	By road	
South Wall (photographs K.61A, 14)	Store Wharf (see wall of Naval Stores Basin) (photograph K.13 B)	31	400	5	5	—	—	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.
		31	400	5	5	—	—	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.
Store Wharf (see wall of Naval Stores Basin) (photograph K.13 B)	Store Wharf (see wall of Naval Stores Basin) (photograph K.13 B)	17-20 Sloping in profile.	1750	40 (to sheds at rear)	5	1 at 40 ft. 1 at 60 ft. 2 at 60 ft.	Travelling crane, gantry.	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.
		17-20 Sloping in profile.	1750	40 (to sheds at rear)	5	1 at 40 ft. 1 at 60 ft. 2 at 60 ft.	Travelling crane, gantry.	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.
Store Wharf (see wall of Naval Stores Basin) (photograph K.13 B)	Store Wharf (see wall of Naval Stores Basin) (photograph K.13 B)	17-20 Sloping in profile.	1750	40 (to sheds at rear)	5	1 at 40 ft. 1 at 60 ft. 2 at 60 ft.	Travelling crane, gantry.	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.
		17-20 Sloping in profile.	1750	40 (to sheds at rear)	5	1 at 40 ft. 1 at 60 ft. 2 at 60 ft.	Travelling crane, gantry.	—	—	Construction. Solid concrete wharf wall. Foundations. Post and steel sheet pile. Fresh water and compressed air mains. Electric cables. Approach to wharf by 3 transit sheds (see note 1). What is loaded by 3 transit sheds (see note 1). Fresh water, compressed air mains, and electric cables. 2 flights of steps up to wharf.

(7) *Tabular Statement of quayage, crannage and access to quays*

Height of tide in feet above chart datum: M.H.W. 5.10; M.T.W. 4.6; M.L.W. 3.6

7) (b) Tabular Statement of quays, cranes and access to quays—cont.

[illegible]

the following vessels reported sunk in February 1942:

Dredger *Kaeniden* and attendant hoppers sunk at entrance to the Naval Stores Basin.
R.F.A. *Rathenia* scuttled and thereafter mined by depth-charges off S.W. corner of North Wall, in line with Workshop Road (Photograph K.27, 18).
Large steel lighter sunk off West Wall, between the 250-ton crane and dock entrance.
Various other vessels scuttled in the Base area; details and locations not reported.
A report of mid-1943 states that remains of damage were then apparent in the Naval Base.

WHARF CRANES—SUMMARY

Dockyard

One 250-ton electric cantilever, West Wall, (illustrated in a large number of photographs, notably K.26 and 27).
Two 30-ton electric travelling portals, southern end of West Wall. (Photographs K.27, K.33-35).
Two 20-ton electric travelling portals, on northern part of West Wall, and intended to be used also on the western half of North Wall.
One 10-ton, one 5-ton, two 3-ton electric travelling portals, eastern half of North Wall, and Naval Stores Basin. (Crane tracks not complete on East Wall).
In addition the following steam travelling crane standard (4 ft. 8½ in.) rail gauge, which could be used anywhere on any (completed) wharf—
One 10-ton, two 5-ton, three 3-ton. (See (c) *Other cranes*, p. 138, below.)

Notes: (1) The two 30-ton cranes and any yard crane could also be used on either side of the graving dock. (Photograph K.35).
(2) Power for electric cranes was taken from plug boxes.

Armament depot jetty

Two 25-ton travelling electric portals.
One 25-ton fixed electric portal.

Torpedo depot jetty

One 3-ton fixed electric portal.

Dentals and Japanese use: The following have been reliably reported—

250-ton crane, structure blown. After explosion the crane collapsed and fell into the sea.
Other cranes had their main supports on the landward side cut by gunshot charges, but only one fell into the sea. A crane on the western side of the graving dock (Common: Presumably one of the 30-ton cranes) was undamaged. Two other cranes could not be touched as there were defense posts close by.
An armament depot crane, cranes rendered unserviceable. (Another report: 'were demolished').
A report containing information of November 1942 states that there were then some seven (c) wharf cranes, of which four or five were moveable. In December of that year a Japanese-controlled newspaper claimed that many cranes at the Base were working.

ACCESS TO QUAYS (See Plans 101, 102)

Road

There is good road access to all the dockyard wharves which were complete; to Stores Wharf (Naval Stores Basin) from Stores Road, running behind the transit sheds (Photograph K.7, 18); to North Wall from North Road (Photograph K.21), and to West Wall from Workshop Road (Photograph K.26). There is also road access to the jetty at the Armament Depot, connecting with Attap Valley Road, a branch from the main Naval Base Road (see (14) *Access*, etc., p. 147, below). Road access to the jetty at the Torpedo Depot was unfinished in January 1942, but lorries could be run up.

For details of rail access, see (14) *Access*, etc., p. 147, below. In general, all the completed dockyard wharves were served by the dockyard standard (4 ft. 8½ in.) gauge tracks. West Wall, the eastern part of North Wall (Photograph K.19) and Stores Wharf were also served by metre-gauge lines connecting with the main Naval Base access line, as were also the jetties at the Armament Depot and at the Torpedo Depot. (See Plans 101, 102).

(c) Other cranes

Floating crane. (Photograph K.12)

Capacity: 150 tons at 90 ft.
100 tons at 125 ft.
Height: lift 110 ft. above water level at maximum radius.
Dimensions of pontoon: 176×78½ ft.
The crane was self-contained, with reciprocating steam engines to drive D.C. electric generators supplying power to work the crane and providing electric light; it was self-propelled, twin screw, speed 7 knots.

Denial and Japanese use: This crane was removed to Singapore in February 1942, and scuttled and capsized off the breakwater. A report of mid-1943 states that the Japanese were making much use in Singapore port of a large floating crane, it is presumed to be the crane from the Naval Base, salvaged.

Yard cranes

Steam, 4 ft. 8½ in. rail gauge—
One 10 tons.
Two 5 tons at 25 ft.
One 3 tons at 30 ft.
Two 3 tons at 22 ft.

Mobile cranes

One 5 tons.
Six 2½ tons.
One 2 tons.

The mobile crane repair shed is a few yards east of the engine shed and south of the boiler shop.

Dental: Four mobile cranes were removed from the Base but ditched between it and Singapore.

Overhead travelling cranes on gun ground
One 15 tons.
One 2½ tons.

Miscellaneous

For overhead travelling cranes in the various workshops see (13) (c) *Repair facilities* (5), p. 144; for travelling and wall cranes in transit sheds and storehouses, see (11) *Wharves*, etc., p. 140, below. The three 2-ton 'Smith's' overhead travelling crane, jib 32 ft., stored in the contractor's shed, at the mouth of the Sungai Semabang, and the contractor for the work on the wharf walls and dredging of a 10-ton crane on a mid-rail pontoon (see (9) *Harbour craft* (2), p. 139, below).

There was also a 3-ton crane on the torpedo test-ramping pontoon (see (9) (1) p. 139, below).

(8) Accommodation

(a) ALONGSIDE

Summary of available berthing lengths and depths—

Depth (ft. below chart datum)	Lengths (ft.)	Location	Remarks
30	total 2200 ft.	West Wall, South Wall, 1150 ft. approx.	Eastern half of North Wall only. Dredging un- derway, in- complete.
31	400	South Wall, Naval Stores Basin	

Depth (ft. below chart datum)	Lengths (ft.)	Location	Remarks
29-27	1750	Stores Wharf, Naval Stores Basin.	
25	000	Armament Depot Jetty	Demolished
23	approx.	East Wall, Naval Stores Basin, 1500 ft. approx. Contractor's Wharf, Singapore Submarine Base, 320 ft. approx.	Depths not indic- ate, see (10), above, and (7) (1) <i>Talbot</i> Statement, above.
18½		A.P.C. jetty.	Offing jetty only, for trans- fers to about 100 ft. approx.
17	215½	Torpedo depot jetty.	Approx. com- plete, Jan. 1942. 3 swim-ended barges 50 ft.×20 ft.×6 ft.; 2 16-ft. sounding boats; 2 18×20 ft. diving boats; and the following mill-stead pontoons— Blighty: with two submarine dredging machines; Kephel: 46-ton, 44 ft.×27 ft.×3 ft., with 10-ton crane; Seahawk: 40 ft.×25 ft.×5 ft.; Mandak: for oil compressors; St. James: for piling outfit.

(b) AT ANCHOR OR AT Buoys

See (8), p. 131, and (9) (3), p. 134. Johore Strait
East forms a well-sheltered anchorage, classified as
an 'A' anchorage, suitable for a large fleet.

(9) Harbour craft

Craft listed below were in use at the Naval Base shortly before the capitulation. The great majority will certainly have been removed or scuttled in February 1942, this list, however, is made as complete as possible in order to give an indication of the numbers and types of craft then found necessary for the proper functioning of the Base. Some, moreover, have probably been salvaged by the Japanese.

(a) TUGS

Dockyard:
St. Just: each 1200 h.p., normal displacement
St. Breck: approx. 770 tons.
also
Tribster: small tug of about 142 tons normal
displacement; unsuitable for wharf work;
see P.W.D. Singapore.

Armament Depot.

Lock Low steam, twin screw, 375 L.H.P.; also
one other on hire; a third (displacement, 500 h.p.)
was building at Singapore.
Messrs. Topham, Jones and Railton (wharf wall
contractors)
Bergmann (displacement, 220 B.H.P.)

Note:

A 450 h.p. tug was building at Hong Kong for the
use of S.N.S.C., Singapore.

(b) CARGO CRAFT, ETC.

Tandjong Baidi: 141 g.r.t., 108 ft. store carrier.
Apurwar store carrier from loan from R.A.F.
Approx. same size as *Tandjong Baidi*.
C.48: dumb coal lighters, wood, 100 tons.
C.49: dumb coal lighter, steel, 250 tons.
N.180: motor lighters.
N.A. 50, 60, 67, 68: 100-ton steel ammunition
lighters.
N.A. 69, 70: 200-ton steel ammunition lighters,
dumb, with diesel-driven derricks.
N.A. 71, 75: 200-ton steel ammunition lighters,
dumb.
N.A. 25: 200-ton pontoon lighter.
Several other lighters were on hire from the con-
tractor and other sources; and three 100-ton lighters,
one self-propelled, were building at Hong Kong.
Six large motor sampans were also on hire, and were
used for carrying stores.

(c) PASSENGER CRAFT, ETC.

C.450: steam launch, 60 ft. (S.N.S.C.).
Ketchik: petrol motor launch, 18½ ft. (S.C.E.).
Pindick: diesel launch, 30 ft. (Armament Depot);
Nos. 40208, 40207: torpedo-recovery launches,
35 ft.
Lavinia: diesel launch, 30½ ft. (Messrs. Topham,
Dyllis).
28½ ft. J. Jones & Railton;
and various motor-boats for use round the Dockyard
and elsewhere, to a total of about 25.

(d) DREDGER

Kuawar: bucket ladder dredger, on hire from
F.M.S. (Sunk in entrance to Naval Stores Basin
before the capitulation.)

(e) CONTRACTORS' EQUIPMENT

Messrs. Topham, Jones & Railton (dredging and
wharf walls contractors) had at the Basin, in addition
to the one and two launches on hire round the Dockyard
Cherbon: steel dumb hopper barges, 450 tons;
Lavard: 3 swim-ended barges 50 ft.×20 ft.×6 ft.;
2 16-ft. sounding boats;
2 18×20 ft. diving boats;
and the following mill-stead pontoons—
Blighty: with two submarine dredging machines;
Kephel: 46-ton, 44 ft.×27 ft.×3 ft., with 10-ton
crane;
Seahawk: 40 ft.×25 ft.×5 ft.;
Mandak: for oil compressors;
St. James: for piling outfit.

(f) WATERBOATS

Heather: self-propelled diesel-engined water-boats,
—capacity (each) 224 tons, on charter from
Messrs. Hammer & Co., Singapore.
Daisy: self-propelled diesel-engined water-boats, etc.
C.452: dumb water-carrier, 112 tons.
Various self-propelled waterboats were building at
Hong Kong.

(g) OIL LIGHTER

C.451: dumb lubricating-oil lighter, 50 tons.

(h) MISCELLANEOUS

There was at the Torpedo Depot a pontoon for
firing torpedoes test-ramping. It was fitted with
h.p. air compressor, generating set and salt-water
pump, all diesel driven; h.p. air cylinder and charging
cisterns, 3-ton hand crane, etc., Singapore.
Two torpedo tubes (21 in. and 18 in.) were intended
to be fitted but had not been delivered by February
1942.

(10) Landing of men, stores and vehicles by water transport

(Note: Landing facilities on both sides of the Johore
Strait outside the Naval Base are described in Part V (4), *The Coast, Area VIII*.
For landings on the Johore coast east of the cam-
penny, see *Area VIII* (1), *Landing Places* 124, etc.;
for landings on Singapore Island from
Tanjong Chua to the Base, see *Area VIII*
(1), *Landing Places* 5, 43-48.)

Men and stores

Assuming the wharves and jetties occupied, the
following points are suggested—

(a) DOCKYARD AREA. (Chart F.019, Plan 102)

Just outside the eastern limit of the Dockyard is
Semabang (Selebar) (Photograph K.6), a small
landing pier, suitable for men and for light stores.
(For description see (4) *The Coast*, p. 82, No. S.49
Landing Place.)

From this pier to the NE. corner of the Naval
Stores Basin ('Reoulen Fort') the shore is fairly
low; the foreshore is rather firm and sandy, and there
is a bathing beach opposite Beantien House. Offshore
depths deepen rapidly towards the basin entrance.

At the corner the shore is massy, forested by a flight of landing steps (Mata Steps).

From the Stores Basin to the dock entrance are the dockyard wharves, built at a uniform height of 5 ft. above H.W., with landings as follows:—

Naval Store Basin

East Wall 2 flights.

South Wall 1 flight.

Stores Wharf 3 flights.

North Wall, 6 flights (the second from the NW corner not available in January 1942; still faced by earthen dam; see (7) (d), p. 134).

West Wall 2 flights.

West side of dock entrance: 1 flight.

West side of the graving dock entrance a rubble-faced slope runs for about 350 ft. Across this a temporary

Defense slipway had been constructed in concrete, into upwards of a fathom of water; its gradient is not exactly known, but is believed to be comparatively steep. Towards L.W., coal is unloaded at this ramp by gangplank from the tugs.

Beyond, a muddy shore leads northward to the mouth of the Sungai Sembawang. There is some light scrub close behind the beach (Photographs K.12, 12b) behind which is an area given over to the contractor, where his stone-crushing plant was erected. Immediate offshore depths, not precisely charted, are probably very shallow, but deepen rapidly between 200 and 300 ft. off to the 30 ft. dredged and swept area at the graving dock. Men might be landed to this shore.

(b) SINGEI SEMBANG—SINGEI SENOKO. (Chart F.0126)

Sungei Sembawang

As indicated in (8) (iv), p. 132, the Sungai Sembawang is more no more than a tidal inlet, its waters having been diverted through the New Cut into the Sungai Senoko, and its bed from this diversion having been filled in to within 700 yds. of its mouth. The proposed slipways for M.T.B.s and M.L.s. (see (13) (b) Slipways, p. 144) were to be built at its south-western end, and for this purpose a temporary dam had been constructed across the creek (Photograph K.30), reducing its present effective length to about 500 yds.

The banks of the inlet are fairly low and muddy, partly scrub-covered (Photographs K.1, K.42, 42b). The contractor's wharf (see (7) Quayage, etc., p. 136) occupies part of the bank at the north-east corner. Depths within the creek are not charted but are certainly sufficient for small native craft. Men, and in case of necessity also light stores, might be landed here.

Fleet Shore Accommodation

The northern entrance point of the Sungai Sembawang is fronted by a wide drying beach from the point for about 400 yds. westward the shore is built up in a rubble slope. (Photographs K.11, 12.) The fore- and middle shoals and offshore depths are shallow; the 3-ft. mean line is about 250 yds. off shore.

Beyond the rubble-faced section, 3 small piers are shown on the chart; only the westernmost, Red House Landing, still exists. This is a house built over the water, having a small landing-pier in front, with roughly 6 ft. at L.W. Behind, Red House Road gives access to the Fleet Shore Accommodation area. (Pier visible at lower right-hand corner of photograph K.12, ground behind illustrated by photograph K.47.) Men and light stores could be landed here. Also, close off the Red House, there is a concrete slipway used for hauling up the boats of the Dockyard sailing club; men and light equipment could be landed to it.

West of Red House Landing (Photograph K.48) the beach is narrow and sandy, the shore behind rising a few feet only. Two landing piers, Red House and a seamen's landing pier, about 150 ft. long, with upwards of a fathom of water at its beach; this is also a landing pier for men and light stores. From this point westward for some 900 yds. the shore has been faced with a low rubble slope, having a narrow sandy beach

before it; the 1-fathom line averages 150 ft. offshore. The ground behind is flat and open. Towards H.W. this would probably provide a good landing area; its western end (Photographs K.49, 50), where the sewage disposal plant is erected, has road access from the main Naval Base road.

Sungei Senoko

Beyond is the shallow mouth of the Sungai Senoko (Chart F.0128; Photograph K.51); this has 1 ft. only over the bar at L.W., but depths within are charted as ranging from 3 to 12 ft., and tongalogs could ground as far as the junction with the New Cut, and at times the New Cut itself as far as the main road bridge. In case of need this means could be used to land men and stores from appropriate craft.

(c) SINGEI SENOKO—SINGEI CHINA. (Chart F.0126)

The mouth of the S. Senoko is marked by a small hill on its western side, rising to about 30 ft., faced by deep water close in, with the fence removed, but its whole length past the Armament and Torpedo Depots, as far as the Sungai China, the shore is built up with a fairly steep masonry slope (Photographs K.54, 55, K.60-62), and immediately behind this a 10 ft. unclimbable fence runs the entire distance in front of the Armament Depot; it is continuous with a 6 ft. chain-mail fence in front of the Torpedo Depot (Photographs K.57, K.60). There is generally deep water close in, with the fence removed, men and stores could be in case of necessity be landed to this point at most points, at or near H.W.

Landing-sets on the two piers in this section are noted in (7) (b), *Tabular Statement*, pp. 136-7

(d) SINGEI CHINA—CAUSEWAY

In this short section, about 900 yds. in length, the land behind the shore rises sharply to wooded heights of about 50-60 ft. (Photographs K.61, K.64, K.66) leaving only a narrow shelf, some feet higher than the shore, along which lie the main Base access road and rail; on the landward side of these runs the outer fence of the Naval Base. The width of the shelf from shore to fence is about 25 ft. Men might be landed to the shore and climb the slight bank to the road.

Men and stores could be landed to the A.P.C. jetty (see (7) (b), 137, and Photographs K.67, K.68, 68b) the former approach pier to *Rothschi* (see (7) (b) Light structures), or to the small wooden Customs jetty close beside the causeway. Except near the A.P.C. jetty there is deep water close inshore; but about 100 yds. west of the *Rothschi* pier there is under-water obstruction from the remains of a former pier.

Vehicles

In case the necessity should arise, vehicles might perhaps be landed to the Boom Defense pier close west of the graving dock, but as noted above, its gradient is believed to be steep, and probably too steep for this purpose. A second possible area is the shore between the Fleet Shore Accommodation and the Sungai Senoko, perhaps just near the sewage disposal plant, whence a road gives access to the main Base access road. (Photographs K.48-50).

(11) Warehouses and stacking space

(a) Warehouses

East of STORES BASIN

East Wall

Three transit sheds were planned, 500 ft. x 225 ft., in January 1942; only the southernmost has begun. It was almost completed. (Photograph K.133)

Stores

Transit sheds Nos. 1-3; each 500 ft. x 225 ft. Steel frames; walls and roofs galvanized corrugated iron; some sheeting single story; pitched roofs.

Floor load 3 cwt. per sq. ft.

Road hatches, to allow stores to be lifted through by the wharf cranes.

Each shed equipped with a 5-ton electric traveler.

Double sliding doors, taking lorries.

Road and rail connection; rail loading platforms in rear; road.

(Photographs K.13, 14)

Behind transit sheds 1-3.

Storehouses No. 1: 250 ft. x 210 ft.

Storehouses Nos. 2, 3: 300 ft. x 210 ft. each.

Reinforced concrete throughout; 3-story; flat roofs.

Floor load 3 cwt. per sq. ft., both floors (except for a patch on post foundation in the S.W. corner of No. 3, where 1 cwt. per sq. ft.).

Equipped with goods lifts, 2-ton electric, to second story; 1-ton electric wall cranes, and 1-ton electric pulley blocks.

Double sliding doors, taking lorries.

Road connection; rail connection incomplete; rail loading platforms in rear, with 1-ton wall cranes at each door for unloading wagons.

(Photographs K.17, 18)

Note: No. 1 storehouse was to be extended southwards to the full length of 500 ft., the foundations for this were ready.

Additional storehouses were planned as follows:—

No. 4A: behind No. 3.

No. 4B: between the chart depot and the engine shed, opposite the Main Office.

Nos. 5 and 6: between Meral Hill and the Sungai Sembawang.

DOCKYARD AREA

Miscellaneous smaller stores, for timber, lubricating oil, inflammable materials, etc.

SINGEI SEMBANG

Behind contractor's wharf

Contractor's shed, about 190 ft. x 120 ft.

Steel frame; single storey; good headroom.

Rail access (metre gauge).

ARMAMENT DEPOT AND TORPEDO DEPOT

Miscellaneous small sheds for acid, rubber, paint, timber, packages.

(b) Stacking space

Possible areas, listed from east to west, are:—

Behind East Wall, Naval Stores Basin (unless once occupied by new building). Group of sheds levelled, 1942. Coal was sometimes stacked at northern end, near Mata Steps. Road access. (Photographs K.13, 14)

Some open ground behind Mata Steps, Naval Stores Basin (Narrow area). Road and rail access. (Photographs K.13)

Open area behind storehouses Nos. 2 and 3, and to southward of No. 1. Road access; rail access to the latter area.

Variety of open spaces (clear of rail and crane tracks) between North and West Walls. All road and rail served.

Various open areas behind workshops lining West Wall, and under Mandali village, plate stacking ground, heavy storage ground; rail served.

Storage areas at head of King George VI dock, for propellers, shafts, test weights, lozops, anchors, etc. Rail and road served.

Open ground between Sungai Sembawang and dry dock; road served near dock, rail served on west (by spur to contractor's wharf). Some points used for coal dumps. (Photographs K.12, K.38, K.42)

Open ground on west bank of Sungai Sembawang (site proposed for storehouses Nos. 5 and 6). Road at higher level close behind, serving Fleet Shore Accommodation. (Area partly obstructed by

early work on storehouses.) (Photographs K.40, 41)

Recreation grounds and other open areas westward of Fleet Shore Accommodation on Meral Hill.

Part road served.

Few small areas in R.N.A.D., close to jetty; also in unoccupied areas of Torpedo Depot. Part road, mostly road served.

(12) Coal, oil and water

(a) Coal

Temporary dumps of coal maintained at various times.

(1) Behind Mata Steps, north end of East Wall, Naval Stores Basin.

(2) South of engineering, Block, Workshop Road.

(3) Beside Dock Road West, graving dock.

(4) Behind contractor's wharf, Sungai Sembawang (Photograph K.32).

(5) Between the chart depot and the engine shed, opposite the Main Office.

There is no coaling plant. For coal lighters, see (9) (b), p. 139.

(b) Oil

(1) ADMIRALTY INSTALLATIONS (see Plans 1034, 10)

There were four Admiralty surface installations on Singapore Island, widely dispersed (ranging between Keppel Harbour and the Naval Base), interconnected by a total storage for 1,328,000 tons, with three fuelling points in Keppel Harbour, at the Dockyard in the Naval Base, and at the bulk *Rothschi* which lay close offshore near the Johore Causeway. An underground installation (Bukit Gombak) was in course of construction, to provide additional storage. Details of the installations are as follows:—

Storage depots

(1) ST. PAULS

On the hillside above Blangah Bay, Keppel Harbour.

Storage: 1 tank of 12,000 tons capacity; 1 tank of 8,000 tons capacity. Total storage 20,000 tons.

Pumps: 2 steam, 100 tons per hour at 250 ft. per sq. inch. (The pumphouse is below M.T. Faber, beside Tekong Island Road.)

Connections: For connections to the fuelling point in Keppel Harbour see Part V (8), *Ports, Singapore*, p. 103.

To Normanton: a 10 in. diameter C.I. oil fuel main.

(2) ROBINSON

At Pulau Janglim, near Alexandra Barracks, 2½ miles north-westward of Mt. Faber.

Storage: 35 tanks, each 12,000 tons capacity; total storage 420,000 tons.

Pumps: As at Mt. Faber.

Connections: To Mt. Faber and Kranji: 10 in. diameter C.I. oil fuel main.

Interconnections within depot, 12 in. diameter.

(3) KRANJI

At Pulau Janglim, 4 miles SSW. of the southern end of Johore Causeway.

Storage: 35 tanks, each 12,000 tons capacity; total storage 420,000 tons.

Pumps: As at Mt. Faber.

Connections: To Robinson and Senoko: 10 in. diameter C.I. oil fuel main.

Interconnections within depot, 12 in. diameter.

(4) SENGOKO (4th Oil Fuel Depot)

At Naval Base (Photographs K.38, 39).

Storage: 30 tanks, each 12,000 tons capacity; total storage 480,000 tons.

the dock was more recently moored at the north end of West Wall. Its permanent position was under discussion.

Denials and Japanese use: Before the capitulation the dock was towed to Keppel Harbour and scuttled at King's Dock Jetty; charges exploded in the pump-room after the dock sank.

A Japanese broadcast of February 17th, 1943, mentioned the salvaging of the dock, and some confirmation is given by a report of mid-1943 which states that this jetty was then usually occupied by shipping, but the dock was not seen at the Naval Base at that date, and its present whereabouts is uncertain.

(b) Slipways

Three slipways of 320 ft. extreme length, for coastal motor craft, were planned at the inner end of the existing tidal portion of the Sungei Semang. Only the site had been prepared by 1942. There were no others in the Base.

(c) Repair Facilities

(i) GENERAL

The equipment of the Base in this respect was that of a first-class dockyard, the construction and equipping of the various workshops having been almost completed (though a few extensions were envisaged). The chief range of workshops is along Workshop Road (photograph K.12, K.28, 29, behind West Wall, within convenient reach of the graving dock and served by the 250-ton crane and by many spurs from the Dockyard standard-gauge rail system (see (14), *Auxes* (p. 148), and *Plan 102*). A range of rather less importance is found on and behind North Wall.

The workshops and their equipment as installed, services, compressed air, distilled water, and other services are described separately.

Denials and Japanese use: Denials carried out before the capitulation suffered from lack of time and lack of equipment, and have not been completely reported. Such details as are known are given below, with the workshop or service concerned. In general it appears that the Japanese have since carried out considerable repair work: a Japanese-compiled newspaper describing clearance and repairs at the Base in its issue of December 18th, 1942, mentioned the building (or rebuilding) of a number of large workshops round the Dockyard, and stated that "all machine tools have been remodelled after Japanese types". A report of November of the same year mentions the repairing of merchant-ships at the Dockyard, and in mid-1943 the Base appeared to be in full working order, no signs of damage being apparent.

(ii) DETAILS OF WORKSHOPS AND PLANT

West Wall

(Workshops, etc., described in a north-south order.)

A. No. 1 generating station, and annexes: see below (iii), *Electricity supply*, p. 148.

B. Joinsers' shop: single block of about 200 x 45 ft.

C. Constructive block: a large and prominent building about 420 ft. long, with width varying up to about 200 ft., comprising six departments:—

Plumbers' shop.

Moulding floor.

Ship shop: 2 bays, with 2 spurs from the dockyard standard-gauge tracks.

Smitery: 2 bays, with 2 spurs from the dockyard standard-gauge tracks.

Chain cable test house, with 1 spur from the dockyard standard-gauge tracks.

Ship fitters' shop: 2 bays, with 1 spur from the dockyard standard-gauge tracks.

Equipment: the chief plant is shown in the table below:

Department	Description	No.	Capacity, etc.
Ship shop	Hydraulic damping press	1	250 tons.
	Plate bending rolls	1	plates 40 ft. long x 2 in. thick.
	Plate bending and straightening rolls	1	plates 14 ft. x 1 1/2 in.
	Plate straightening rolls	1	plates 10 ft. wide x 2 in. thick.
	Plate bending and straightening machine	1	plates 10 ft. long.
	Edge planing machine	1	plates 40 ft. long.
	Large drilling machine	4	1 1/2 in. vertical, various.
	Radial drilling machines	14	8 in. to 24 in.
	Drill and ream	1	1 1/2 in. vertical.
	Oxy-acetylene flame-cutting machine	1	see (16) below.
	Electric welding plant	1	see (16) below.
Smitery	Bloom furnaces	2	84 x 44 ft. and 7 x 4 ft.
	Plate furnaces	1	24 1/2 x 8 ft.
	Angle furnace	1	10 x 6 ft.
	Annealing furnace for cables, etc.	1	5 tons; 30, 10, and 5 cwt.
	Arm furnaces	1	5 tons; 30, 10, and 5 cwt.
Chain cable test house	Testing machines	2	1-250 tons.
	Test house	1	1-50 tons.
Ship fitters' shop	42 in. break lathe	1	30 ft. between centres
	24 in. lathe	1	
	Combination turret lathe	1	
	125 in. lathe	1	
	104 in. lathe	1	
	84 in. lathe	1	
	64 in. lathe	1	
	Capstan lathe	1	
	Horizontal boring machine	1	To bore 24 in. diameter.
	Radial drills	1	19 to 7 ft. radius.
Shaping machines	Vertical drills	1	various.
	Shaping machines	2	
	Slotting machines	2	
	Milling machines	2	
	Planing machines	2	6 x 6 x 16 ft. and 8 x 3 x 3 ft.

Overhead cranes, Constructive Block:

2 x 25 tons.
1 x 15 tons.
1 x 10 tons.
3 x 5 tons.
1 x 3 tons.

Denials: No details are reported, but it is understood that some were effected, various machines being destroyed; but the denials were not so thorough as in the Engineering block. Overhead cranes were probably largely destroyed by explosives (in total, 40 per cent of those in the Base are reported destroyed), or damaged by their fall after their supports had been blown.

D. Air compressor house, building 100 x 50 ft., and Distilled water house, about 60 x 50 ft., annexed. (Photograph K.30.) See below, (iv) *Compressed air* and (vi) *Distilled water*.

E. Engineering block (prominent, the second-largest block on Workshop Road, about 340 x 270 ft., comprising six departments:—

Gun-mounting shop, with 1 spur from the dockyard standard-gauge tracks.

Turbine and heavy machine shop, with 1 spur each from the standard- and metre-gauge tracks.

General machine and fitting shop, with 1 spur from the standard-gauge tracks.

Lifting machine shop.

Copper-smith's shop.

Pattern-makers' shop.

Equipment: the chief plant was—

Description	No.	Capacity, etc.
36-48 in. double lathe	1	for shafts up to 88 ft.
24 in. lathe	1	36 ft. between centres.
Lathe, 18 in. to 104 in.	12	
44 in. lathe	1	
64 in. lathe	15	
Capstan and turret lathe	9	
Radial-drilling machine	7	24-8 ft. various sizes.
Large vertical drilling machine	1	
Vertical boring machine	1	
Horizontal boring machine	1	
Milling machines	5	22 in. to 8 in.
Shaping machines	5	20 x 6 ft. to 8 x 4 ft.
Planing machines	1	6 x 3 x 3 ft. various.
Slotting machines	4	24 in. to 8 in. various.
Welding machines	1	various.
Cold-chamber furnace	1	
Dynamic balancing machine	1	

A combined engine test shop and H.P. test boiler house is annexed.

Overhead cranes, Engineering Block:

2 x 60 tons.
2 x 15 tons.
1 x 10 tons.
1 x 5 tons.
and light hand-travellers.

Denials: It is reported that the equipment of the block was thoroughly destroyed.

F. Foundry: building about 175 x 150 ft., with 3 spurs from the dockyard standard-gauge tracks. (Photograph K.29.)

Equipment: the chief plant was—

Description	No.	Capacity, etc.
Cupolas	4	2 tons to 10 cwt.
Reverberatory furnace	4	4 tons to 360 lbs.
Tilting furnaces	4	160 lbs. to 1 ton.
Pot furnaces	1	for aluminium.
Ball-cast furnace	1	30 x 20 ft.
Drying oven	1	
Sand treating plant	1	

Overhead cranes, Foundry:

2 x 25 tons.
2 x 10 tons.

Denials: No definite information.

G. Boiler shop: building about 240 x 120 ft., with 2 spurs from the dockyard standard-gauge tracks, and one from the metre-gauge system. (Photograph K.28.)

Equipment: the chief plant was—

Description	No.	Capacity, etc.
Hydraulic damping press	1	150 tons.
Hydraulic riveting machine	1	
Large plate-bending rolls	1	12 ft. x 2 in.
Plate bending rolls	1	plates 6 ft. x 1 in. thick.
Plate levelling rolls	1	plates 8 ft. x 1 in. thick.
Plate furnace	1	20 ft. plates.
Planing machine	1	plates 8 ft. x 1 in. thick.
Rotary drill shearing machines	2	up to 1 ft. plate.
Rotary drill	1	1 in. plate.
Sawing machines	4	30 cwt. to 1 cwt.
Arm furnaces	1	8 x 3 ft.
Bloom furnace	1	18 x 24 ft.
Annealing furnace	1	134 x 54 ft.
Lathe	4	7 to 3 ft.
Lathe	2	2 of 6 in., 1 of 7 in.
Sawing machines	1	12 in.
Shaping machine	1	
Roll, flat, and rivet feeding machine	1	
Acetylene and electric welding plants	1	
Tube-treating, dressing, and cutting of machines	1	in small building annexed.

Overhead cranes, Boiler shop:

1 x 50 tons.
2 x 10 tons.

Denials: It is reported that the equipment of the boiler shop was thoroughly destroyed.

North Wall

(Workshops, etc., described in a west-east order.)

H. Electrical workshop: building about 200 x 100 ft., 5 bays, with a spur from the dockyard standard-gauge tracks. (Photograph K.25.)

Equipment: the chief plant was—

Description	No.	Capacity, etc.
36 in. lathe	1	8 ft. between centres
84 in. lathe	1	
64 in. lathe	2	
Grinding machines	9	(incl. 1 radial, 4 semi-turret)
Milling machines	3	various.
Shaping machine	1	
Slotting machine	1	
Tool grinding machine	1	
Tool grinding machine	1	
Vertical boring machine	1	42 in.
Intergrating plant	1	
Dynamometer	1	various.
Cold-cutting machines	1	
Small dynamic balancing machine	1	up to 2 cwt.

Overhead cranes, Electrical workshop:

1 x 15 tons.
2 x 2 tons.

Denials: No details are reported, but it is understood that some of the plant was destroyed; details here were less thorough than in the Engineering block.

J. Electrical equipment store: building about 120 x 50 ft., 4 bays.

K. *Sailmakers' and riggers' shop*: building of about 100 x 150 and 100 ft.

L. *Sawmill, log shed, and timber store*: building of about 300 x 120 ft., 8 bays, with 2 spurs from the dockyard standard-gauge tracks.

Equipment: the chief plant was—

Description	No.	Capacity, etc.
Horizontal log-hand saw	1	4 ft. saw, 4 ft. saw
Log float saw	1	4 ft. saw
Circular saw	1	60 in.
Planing machine	1	18 x 5 ft.
Machines for saw service	1	
Vertical hand-saw	1	

Dockyard cranes, Sawmill:

2 x 4 tons,
2 x 2 tons.

M. *Bathouse*: Prominent building on North Wall, at centre, about 200 x 150 ft., 3 bays, with 3 spurs from the dockyard standard-gauge tracks, and a boat-cum-lift in North Wall. (Photographs K.20, 21.)

Equipment: the chief plant was—

Description	No.	Capacity, etc.
Planing and thicknessing machine	1	
26 in. circular saw	1	to plane 23 x 9 in.
Band saw	1	
Vertical boring machine	1	to bore up to 3 in.
Moulding machine	1	
Punch and shears	1	
Lathe	1	
Slipping kiln	1	

Dockyard cranes, Bathhouse:

1 x 25 tons,
1 x 20 tons,
1 x 10 tons.

N. *Bathhouse*: The bathhouse was set on fire by enemy action, and is reported destroyed, with its contents.

O. *Sailmakers battery shed*: building about 160 x 90 ft., served by a combined meter- and standard-gauge spur.

(iii) ELECTRICITY SUPPLY

A. *Generating stations*
No. 1: northern end of Workshop Road, NW corner of Dockyard area. (Photographs K.12, K.28.)

No. 2: junction of Stores Road and South Road, south of No. 3 transit shed, Naval Stores Basin. (Photograph K.16.)

Plant

No. 1 Station:
Three 1000 kW. sets driven by 6 O. Fuller's six-cylinder two-stroke mechanical injection engines with normal full load output of 1500 H.P. at 300 r.p.m.
Two 220 kW. sets driven by eight-cylinder four-stroke mechanical injection engines.

No. 2 Station:

Three 1000 kW. sets as in No. 1 station.
Oil supply to the ready-use tanks at these stations was from storage tanks erected close beside them and fed from the dockyard oil mains, as described in (12) (b) (ii) (d), p. 142.

Generation: 5-phase at 50 cycles, 6000/6000 volts.
Oil, kerosene, compound filled bus-bar chambers, installed in an annex at each station and remotely operated from the respective control rooms.

B. Supply and distribution. (Plan 104)

Supply to substations was at 6000 volts; to workshops immediately near the plant, direct at 400 volts. Paper-insulated lead-covered armoured cables

were used throughout, either mounted on hangers in the subway road the wharves and dock (see (7) *Quarries*, etc. (a), p. 134), or laid direct in the ground.

Substations. The position, plant, and interconnection of all substations is shown on Plan 104. Of these the Dockyard area (*Plan 104*) was—

A. is on West Wall, close to the 250-ton crane.
B. is at the dock entrance, N.E. side.
C. and C2 stand one each side of the dock.
D. is on North Wall, beside the submarine battery shed.
E. is beside No. 2 generating station.
F. is outside the Dockyard.
G. is in the Armament Depot, beside Atter Valley Road, at Senoko, beside the main Base road.
H. at Senoko, is an annex to the transmitting station in the residential part of Admiralty Road East and Wellington Road.
I. in the code from south of the graving dock, is 100 yds. east of the junction of Dulhi and Canton Roads, Light Stern Commission, is on the west side, next to women's block F.
Transformers. Wound for 6000/400/230 volts, but insulated on the high voltage side for 6000 volts. As a precaution against possible damage by enemy action, etc., two similar transformers were installed in most substations, and for ease in replacement the number of different transformer sizes was restricted as far as possible.

Substation G. High voltage: hand-operated, compound filled bus-bar chambers; gear is hand operated: single bus-bars.
Medium voltage: of similar type.
Low voltage, for the supply of exterior lighting and minor loads: insulated, quick-act air break type incorporating high rupturing capacity fuses.

From the substations, distribution is at 400 volts. Workshops and other buildings were normally fed from the nearest substation, but in the case of the more important workshops a standby source of supply was provided by linking their 400-volt cables to the nearest building supplied from another substation.

There was also a supply at 400 volts to plugs and sockets installed at the dockside, along West and North Walls and Stores Wharf, for travelling cranes and welding motor-generators.

Ships in the graving dock and at West and North Walls obtained D.C. supply from 250 kW. motor-generators installed as follows—

No. 1 generating station:	2
Substation A:	2
" C1:	2
" C2:	2

(Note: Ships in the Naval Stores Basin were intended to be self-sufficient in this respect, and no such provision there was contemplated.)

A single 250 kW. motor-generator was also installed in the submarine battery shed.

The captains the dock and along West Wall and the caisson haulage motor received a constant current supply from two motor-generators in substation B. Each of these generators was of 160 kW. output at a constant current of 250 amperes, driven by a 400-volt 3-phase 80-horsepower slip-ring induction motor, and was capable of operating at caisson hauling motor and one captain at full load, or alternatively three captains at full load. There were three main cables from the generators, one feeding six captains round the dock and one caisson hauling motor, the second feeding the six captains on the West Wall and the other caisson hauling motor. Normally, each ring was supplied by one motor-generator, but the two could be connected in series to supply either ring, or one or both could supply the two rings in series.

C. Lighting

Units were installed approximately 125 ft. apart along the wharves, 42 ft. back from the wharves and elsewhere as necessary. (CL Photograph K.19.)

D. Alternative supply

The distribution system was so designed that damage to any part by enemy action would cause as

little interference as possible with its operation, and would allow of easy and rapid repair. An alternative supply, however, was available from the large floating dockyard, built 2000 ft. from generating plants, and from (a) (iii) (a), p. 143; this was connected by submarine cable running into substation D. This plant, however, was not designed for continuous full-load output for long periods. A proposed second cable had not yet been laid, and this supply, if used, would therefore have been restricted accordingly.

E. Interconnection with municipal supply

There was a temporary 6.6-kV. interconnection between substation B and the Thomson Road substation in the Singapore municipal supply (see *Part V (ii) Singapore*, (B) The Town (7), p. 119). Cables were laid two in-parallel along the roadside, Light Stern Commission, the Base at Canton Road (see *Semang Road*), and ran behind the code lines across the slopes to substation B.

Dentals and Japanese use: The following reports have been received on the power plant.
No. 1 station: engines, generators and buildings reported completely destroyed.

No. 2 station: reported undamaged to February 12th, 1942, except for a direct hit on the north wall of the building, but fuel pumps and spur valves were removed, and taken away from the Naval Base.

A second report, of high grading, gives the following details—

A sandbag full of petroleum was attached to the side of each dynamo; sand was put into the engine sumps. The explosions lifted the rods evenly off the powerhouses, and presumably wrecked the dynamo and other machines.

A third report, with information of November 1942, says that the two power plants had been repaired by the Japanese, and were in operation.

In addition, the following details are reported—

Substation D and Battery shed converters were destroyed.

Transformer on the incoming line from Singapore: windings and case damaged by enemy-gun fire.

Electrical stores removed or damaged.

(iv) ELECTRIC WELDING SETS

D.C. Petrol-driven generator on truck (believed 28 kW.).

D.C. Motor-generators, single-operator: 2.

D.C. Transformer motor-generators, 38 kW., ten-operator: 6.

D.C. Paraffine motor-generator sets, single-operator: 2.

A.C. Workshop sets: 5 (single-operator; 4 six-operator); 9.

A.C. For Tarpeds Depot: single-operator sets: 2.

(v) STEAMING AIR SERVICE

The air-compressor house is a building of 100 x 80 ft., standing on Workshop Road between the Constructive block and the Engineering block (Photograph K.30). It has the following equipment—

Two compressors of 2500 cu. ft. p.m. free air capacity.

Two compressors of 1000 cu. ft. p.m. free air capacity.

Four air reservoirs, 8 ft. diameter, 20 ft. high. The two larger compressors are driven by 6000 volt synchronous induction motors, 580 h.p., designed to run when required at 80 per cent full load output for long periods, and intended to be used as base load machinery. The smaller compressors are driven by 400 volt slip-ring induction motors, and are intended to start and stop automatically in order to maintain a predetermined pressure in the reservoirs.

From the reservoirs the air is led to an air main in the subway which extends round all wharves and the

graving dock (see (7) *Quarries*, etc. (a), p. 134); from this there are branches to the various workshops (to supply, for example, large air hammers in the Smithery and the Hot Shop) and to the various stores, the latter being fitted with multiple connections for standard air service lines.

A second compressor station, to be equipped with two further large compressors and two 8 ft. x 20 ft. reservoirs, was planned immediately west of the Boat-house, North Wall, but had not been erected; the machinery, however, had been delivered.

(vi) DISTILLED WATER

The distilling plant is housed in an extension to the Air-compressor house (see *Part V (ii) Singapore*, (B) The Town (7), p. 119); it was to comprise three distilling sets (each producing 70 tons of distilled water per 24 hours), and the water was to be stored in large tanks for tanks for distilled water to be provided on the roof of the air-compressor house (Photograph K.30); one was complete but not connected.

Two of the boilers were delivered but not installed, and the two distilling sets installed; one was later removed by sea elsewhere; the other was later operated with a temporary boiler.

(14) Road and rail access (Plans 101, 102)

(a) Road

The whole Base area is served by a single main road, with various branches. It runs from a point about 300 yds. south of the Johore Causeway close behind the shore as far as the Tarpeds Depot (Photograph K.62); here it crosses the Sengul Canal by a small bridge and makes a slight turn inland, to pass south of the Tarpeds and Armament Depots, of which it forms the southern boundary (Photographs K.64, K.72). A road branches right to the Kinross Offices and the Batu Kiman reservoir, and two roads branch left to serve the Armament Depot (Photograph K.54); various minor roads serve the Kiman residential area. Behind and beyond the Armament Depot the road runs parallel to the shore and about 1000 yds. inland, bridging the Sengul Sengk and the New Cut (Photograph K.71), and passing close to the northern side of Senoko Oil-field Depot and Sengk W.T. station which have access to the shore by a small access road. A short branch, to provide an alternative crossing of the New Cut, was part complete, but the bridge was unfinished. South of Merli Hill road, about 1850 yds. inland, and there are branches north-west to the refuse destructor on the shore, and north-east to the Port Shore Accommodation (Photograph K.42). From this area the road curves south-eastward to the Main Gate of the Dockyard. Immediately beyond Merli Hill it crosses the Sengk Sengk in Semangway by a concrete stone bridge, but the bridge has been wrecked, the road has been closed, and the bridge removed. To this point the metre-gauge access line to the Base (see (b) *Rail*, below) is laid along the south side of the road, but here it turns to the north at a level-crossing, the main water pipeline into the Base (see (b) *Water*, etc. p. 156), and the oil-field main connection (see (b) *Oil*, etc. p. 156) and the Sengk Sengk and Senoko with the Dockyard (see (12) (b), (d), p. 141), also lie alongside the road to about this point.

At Main Gate the road divides into three:—
(i) The main branch, which runs northward behind West Wall of the Dockyard, and is joined by North and Middle Roads (Photographs K.17, 20), which serve North Wall and the various installations behind it; this in turn give access to Stores Road (Photographs K.17, K.18), which serves Stores Wharf and runs back, southward, into the residential area to rejoin (i).

(ii) The central branch, called Admiralty Road East (Photograph K.31), is a direct continuation of

the main access road, and runs east and south-east through the residential area to the Base limit at Semakawang Gate; a network of branches serves the European residences nearby.

(ii) The southern branch (Canberra Road) photographs K/8, K/10, curves south-west and south-east from Main Gate to serve the area occupied by the permanent cooie lines, and beyond these the residence of the Admiral Superintendent; it reaches the Base limit at Canberra Gate.

Construction, etc.

The road is about 20 ft. wide and has a tarmac surface on a 9 in. granitic pitching. It was in excellent condition and required very little maintenance under heavy traffic.

Bridges

The three bridges are all combined road and rail bridges; they are described fully under (i) Road, as well as in Part III (B), Roads, Route 136, p. 275.

Connections

(1) At the causeway end the road joins the main Malayan trunk road, which runs southward across the island to Singapore (16 miles) and northward across the causeway up the western side of Malaya to the Siamese frontier (383 miles) and beyond. Across the island the road is particularly well engineered, about 40 ft. wide, and in general on a side for at least 2-way heavy traffic. (This route is described in detail in Part III (B), Roads, Route 1; for the southernmost section Johore Bahru—Singapore, see pp. 125-6, 140-1; see also Part V (B), Singapore, p. 111 and following.)

(2) To the east of the Base area the main road, and further south-west its branch Canberra Road, join Semakawang (Selat) Road, which forms the eastern boundary of the Naval Base and provides a secondary means of access to Singapore (134 miles), passing to the east of the municipal council area and reservoirs in the centre of the island. This road is about 20 ft. wide and was in good condition, but heavy traffic required more maintenance than the Naval Base road. (It is described in detail in Part III (B), Roads, Route 136, pp. 220-2, 275.)

(b) Rail

The Base is served by a single-track metre-gauge branch from the main F.M.S.R. Singapore—Siam line; the dockyard area is served by spurs from this line and by an extensive system of standard-gauge (4 ft. 8½ in.) track. The wider gauge for the main internal system was adopted as better suited to the requirements for heavy yard travelling cranes and large machinery trucks, including those for carrying the heaviest guns, also gun mountings, boilers, etc.

(i) METRE-GAUGE MAIN

The metre-gauge branch leaves the main line at Kranji sidings (134 miles from Singapore railway station), and after a short section (standard-gauge 4 ft. 8½ in.) track, the wider gauge for the main internal system was adopted as better suited to the requirements for heavy yard travelling cranes and large machinery trucks, including those for carrying the heaviest guns, also gun mountings, boilers, etc.

(ii) KRANJI SIDINGS

The metre-gauge branch leaves the main line at Kranji sidings (134 miles from Singapore railway station), and after a short section (standard-gauge 4 ft. 8½ in.) track, the wider gauge for the main internal system was adopted as better suited to the requirements for heavy yard travelling cranes and large machinery trucks, including those for carrying the heaviest guns, also gun mountings, boilers, etc.

Branches

There are the following branches, as shown on Plan 101 (ii):

(a) To *Armament Depot*. From the main Base line at an eastward-facing junction at N. 31 from Kranji sidings along the main service road to the depot, and along the shore, for nearly a mile to westward, and about 1/2 mile to eastward, over a mile of this coastal section is double track, and the jetty at the depot is also rail-served. Short spurs connect this system, well provided with short loops.

*For bridges on Singapore Island (river lines) see Part III (B), pp. 270-4.

serve all the installations in the depot, including all completed magazines.

(b) To *Contractor's wharf*. From about m. 41 from Kranji sidings to the contractor's wharf and stored at the mouth of the Sungai Semakawang.

(c) In *Dockyard*. The main service line as such may be taken to end at the sidings (photographs K/30) south of the graving dock, 5 miles from Kranji sidings. From here there are two extensions into the dockyard areas:

(i) North-eastward (curve 350 ft. radius) and along West Wall to within a few yards of its north-east corner. A spur loops back beside the graving dock and connects through the engine shed with line (ii).

(ii) Between Main Gate and the fire station, and north-eastward behind the workshops which back West Wall, with connection through the engine shed with line (i), and with spurs into the boiler and turbine shops thence by a very sharp curve east behind the boatsheds and to the eastern end of North Wall, whence a spur loops back into the submarine battery shed; thence two branches, one serving the whole length of Stores Wharf, and one (which is doubled) behind the transit sheds which back the wharf. (Photographs K/17-19.)

Sidings

(a) *Main line*
Kranji sidings (mile 21 from Kranji sidings: south of Armament Depot): loop about 1000 ft. on south side of line; rumped platform on south side.

Terminal sidings (mile 5 from Kranji sidings: south of graving dock; photograph K/30):

1 loop on north side of main line, about 1000 ft., with twin weightbelts.
2 loops on south side of main line, about 600 ft. each.

(b) *Armament Depot branch*.

1 loop, about 475 ft., approx. 200 yds. from junction.

2 loops, each about 400 ft., approx. 1200 yds. from junction.

Also, in the depot, numerous short loops and spurs, as shown on Plan 101.

(c) *In Dockyard*.

Line (i): West Wall.
Loop about 420 ft., at SW. end of wharf.

Line (ii):
Loop about 720 ft. at Plate Ground.

" " 380 ft. at North Wall.

" " 880 ft. behind transit sheds, Stores Wharf.

" " 320 ft. on Stores Wharf.

Permanent Way

Track and weight: Flat-bottomed, 80 lb. per yd. Maximum axle load: Briddles were designed to take the heaviest F.M.S.R. locomotives, with an axle load of 16 tons, (16½ in. sing. spurs at the Singapore batteries were unloaded from ship at the Naval Base and transported by rail to Singapore.)

Gradient: Maximum grade 1:100.

Curvature: A very sharp curve in the Dockyard south of the boatsheds (line ii) cannot be passed by main line curves on those sections which can be so passed is the 350 ft. radius curve on the dockyard line (ii), south of the graving dock.

In the Armament Depot all curves are of small radius, and suitable only for short wheel-base locomotives.

Bridges, etc.

(i) (miles from Kranji sidings). All are road-and-rail bridges.

Sungai Gintu (m. 11): 2 x 10 ft. spans, 12 in. x 15 in. R.C. beams on piles at 3 ft. centres; 49 ft. concrete deck.

Sungei Senoko (m. 34): 1 x 15 ft. span, 2 ft. thick R.C. slab.

New Cut (m. 44): 1 x 70 ft. through span, plate girder.

Note: Semakawang bridge (immediately beyond Merah Hill), shown on various maps and charts, has been removed, as this part of the river-bed has been filled.

Tunnels and no tunnels.

Level-crossings occur—
Near m. 21 (branch road to Batu Kiman reservoir),
Near m. 21 (branch road to Kiman Estate, south of railway line).

At mile 34 (branch to Armament Depot crossing main Base road).

At mile 37 (rail passes to north side of main road). At various points in the Dockyard and Armament Depot.

Facilities

Engine sheds: in Dockyard, east of graving dock (120 x 40 ft.), 2 lines (1 motor, 1 standard), inspection pits 92 ft. long x 33 ft. deep on each line.

In Armament Depot, for diesel locomotives, and electric tractors.

Water: at engine shed, Dockyard.

Turning facilities: nil, except triangular loops. There is one such loop on the metre-gauge lines, via the engine shed.

Locomotives and rolling-stock (1941/2)

Armament Depot:
3 78 h.p. diesel locomotives.

3 25-ton electric tractors.

36 3-unit mine trucks.

12 4-ton box trucks.

42 8-ton box trucks.

10 torpedo-transporting trailers.

Dockyard:

3 saddle-track locomotives (similar to that described below).

There were a few trucks, in poor condition. Rolling-stock of the F.M.S.R. was mainly used.

Contractor's stock (in store at S. Semakawang):
1 0-6-0 saddle-track locomotive. Cylinders 12 x 18 in. Weight 27½ tons. Coal-fired.

39 12½, 2½, 4½-pivoted all-steel air-dump cars.

(ii) DOCKYARD STANDARD-GAUGE (4 ft. 8½ in.) SYSTEM

System

An extensive standard-gauge system serves the whole dockyard area, including all wharves (so far as they were completed), all workshops and stocksheds, and both sides of the graving dock. The service is especially intricate and complete at West Wall, where two tracks run for the entire length on or close behind the wharf, with some 18 spurs serving almost every bay of the various workshops. No. 1 generating station, the foundry, and the boiler shop. In continuation, two tracks serve the eastern half of North Wall, two serve Stores Wharf, and two more at behind the transit sheds at the back of Stores Wharf. The system can best be studied from Plan 102 (and see photographs K/15, K/16, K/19).

The standard-gauge system is combined with the metre-gauge track (dockyard line (ii); see above) in a 3-rail layout at 4 points (see Plan 102):

(a) Between North and Middle Roads, behind the sawmill and timber store.

(b) Behind the transit sheds, Stores Wharf (one combined track for whole length of some 500 yds.).

(c) On Stores Wharf, in front of No. 1 transit shed (short siding off the metre-gauge line combined with one of the standard-gauge lines).

(d) Spur into submarine battery shed, North Wall: metre and standard combined.

On each wharf, and behind it, there are one standard-gauge line is combined with a travelling-crane track (photographs K/18, K/35).

All tracks on wharves, and all road crossings, are laid flush.

Facilities

Engine shed: East of graving dock, served by 2 lines, one standard, one metre. (For description, see under *Metre-gauge lines, above*).

Water: at engine shed.

Turning facilities: nil, except triangular loops. There are two such loops on the standard-gauge system, behind the main range of workshops.

Locomotives and rolling-stock

3 saddle-track locomotives.

2 13-ton trucks for transporting guns.

1 50-ton truck for use by a caulkery.

Other rolling-stock, various kinds.

(B) LIVING ACCOMMODATION AND SERVICES

(1) General

(a) Location, etc.

The chief residential area in the Naval Base is on the undulating ground south and east of the Dockyard, where most of the European residences and the largest Asiatic colony are situated (photographs K/7, K/10, K/12, K/42). These occupy almost all the area between Semakawang Road on the east and Suara W/T station on the west, beyond, to the southward, is the Admiral Superintendent's residence. There is a small residential area on the slopes overlooking the main road to southward of the Armament Depot (photograph K/54), and further cooie lines in the Torpedo and Armament Depots and eastward of Merah Hill, most of these were temporary buildings, or were in course of erection. The Fleet Stores Accommodation, a temporary building, is situated on the west bank of the Sungai Semakawang (photographs K/42-47); the dockyard police quarters are close to Main Gate, and there are temporary police quarters in the Armament and Torpedo Depots.

Roads serving these areas are all bituminous-surfaced, the main road being about 30 ft. wide, the subsidaries 12 to 16 ft.

The whole Base is served by an automatic telephone system, with exchanges behind the dockyard Main Office, at the Fleet Store Accommodation, and at the Armament Depot. Of these the first-named is hump-proof, the others splitter-proof.

Details of water supplies and of sanitation are given below (see (2), p. 150).

(b) Fleet Store Accommodation. (Photographs K/42-47.)

This occupies the whole of Merah Hill, close to the shore on the west side of the Sungai Semakawang; there was accommodation for numbers estimated at 1800 men in permanent buildings, and in (1941-2) an additional 500 in temporary attap-roofed barracks.

The hill is roughly elliptical in shape, on a north-east—south-west axis, and is fringed by Hawke Road, Cochrane Road and Drake Avenue. Access from the main Naval Base road, which cuts across the base of the ellipse, is by a gate at the end of Drake Avenue; the road is entered by a chain-mail fence. The various buildings in the area are ranged round the slight hill-slopes, roughly following the contour of the hill, and partly enclosing the flattish hill-top (about 50 ft. above datum), which has a thin tarmac surface and was used as parade ground.

On the north-east slope are the officers' quarters (photograph K/48) and the officers' club (photograph K/49). Behind these buildings are the Warrant

Officers' quarters and mess (a chabhouse was planned but not erected), also the C.P.O.s' quarters in a single 3-storey block, with space for a prospective additional block. Southwest is a central building of 3 blocks, single storey, containing a kitchen, seamen's mess, and recreation rooms for 200 seamen. Beside these are the P.O.s' quarters (single 3-storey block) and one single and two double 3-storey blocks, providing seamen's quarters A and B, C and D, and E (photographs K 43, K 44). Beyond the parade-ground on its south-west side, are the temporary barracks; these occupy part of the area earmarked for the future erection of 3 further blocks for seamen's quarters.

Various ancillary buildings include mess' quarters, for the staff and the Staff W/T station, storerooms, surgery, telephone exchange, and a toilet-house at the gate. On the northern slopes of the hill are a permanent and a temporary canteen, and a swimming bath (photograph K 47), which has automatic chlorination and an ultra-violet plant, with sprays. Between the hill and the sea is flat ground which has been used to provide tennis-courts, hockey, football, and cricket grounds.

(c) European residences were provided for about 550 (all areas) in the form of permanent and temporary bungalows and houses. (Photographs K 88, 89 show temporary houses.) The size was varied according to the rank of the proposed occupant. Permanent houses and bungalows are of brick and concrete construction, temporary ones mostly of timber.

These bungalows are built chiefly in the residential area south of the Dockyard; there is a colony of temporary bungalow to the east of the Naval Stores Basin. The Riman Estate is a further residential area on the hill slopes on both sides of the main road south of the Armament Depot.

The main route through the chief residential area is Admiralty Road East, a direct communication from Main Gate to Sembawang Road, of the chief access road to the Base (see above, A (14) Access, p. 147); this and its branches, and side-roads from Sembawang Road, serve all the bungalows in this area. Here there are also a canteen; a cinema (of about 400 seats); a football ground and a bowling green; and a swimming bath filled from the main, and emptied and refilled as required.

(d) Coolie lines

Including all areas in the Base, and with contractor's accommodation, there are coolie lines for some 10,000 Asiatics (this figure includes women and children) in permanent and temporary buildings (photographs K 71, 72).

The chief coolies are to the south of the Dockyard, between the European lines and the temporary Suva W/T station (photograph 8); here the majority of the buildings are of permanent type, but to east and west are some temporary lines. Road, running in a southerly direction from the Dockyard Main Gate to Sembawang Road, are at intervals of 1/2 mile in this area and the Asiatic Hospital close northward of it (photograph K 70); this has 4 wards of 18 beds each, and 2 wards each of 4 beds with dispensary, mortuary, and a cinema. (In this area are also 300 Asiatic shops, and a cinema. (Canberra) section 300-400.)

Further temporary lines are sited between Merah Hill and Singet Senoko, close northward of the main Base road. The coolie lines at the Armament Depot, and both permanent and temporary type, are built on the southern slopes of Attap Hill, and the temporary lines at the Torpedo Depot are at the easternmost corner, close to the main road (photograph K 72).

(2) Water and sanitation

(a) Water

General

The water supply of the Naval Base was delivered from the municipal sources at Gunung Palak (Johore) and on Singapore Island.

The Johore source comprises an impounding reservoir at Pontian Kechil (capacity at T.W.L. 2400 million gallons) and a second at Gunung Palak (capacity at T.W.L. 1200 million gallons). The supply from Pontian Kechil was pumped 34 miles to the Gunung Palak rapid gravity filters, and produces about 154 million gallons per day (total capacity 20 million gallons per day); from them the combined supply, after aeration and treatment with ammonium sulphate, chlorine, and additional lime, gravitated through pipelines, crossing the Johore Strait by the causeway, to North Hill reservoir in Singapore city. (The pipelines must have been cut when the causeway was blown on January 31, 1942.)

At the southern end of the causeway a branch main, 12 in. in diameter, feeds eastward into the Naval Base, and is laid along the 12-in. main on the Base to the Dockyard, also feeding to the Batu Riman equalizing reservoir (see *Reservoirs*, below) about 800 ft. distant. At the causeway end the main is the chief supply main for the whole Base area.

A subsidiary supply was also taken from the sources in Singapore Island by a 9-in. main, tapping the municipal 12-in. main in Sembawang (Seletar) Road at Africa Gate; this 9-in. main, laid for some distance along Durbin Road, feeds the Admiralty reservoir and water tower (see below) in the residential area south of the Dockyard.

[For further details of the Johore and island supplies to Singapore, see Part II, Reservoirs (7), and Part V (U), Singapore (8) (p. 129, 120).

Reservoirs

Batu Riman (or 'Woodlands') reservoir, south of main road and south-west of the Armament Depot. Capacity: 5,730,000 gallons. T.W.L. about 170 ft. above datum.

Reservoir south of Dockyard.

Capacity: Two sections, 438,000 gallons, and 138,000 gallons. Total 576,000 gallons. T.W.L. about 107 ft. above datum. The water tower beside this second reservoir has a capacity of about 100,000 gallons.

Distribution

The main, main along the Naval Base road is tapped close beyond Batu Riman reservoir to supply the Armament Depot; the ring main in the depot is 4 in. in diameter, and runs up Riman Valley Road to Keramat Hill, with a return down Attap Valley, and branches along the waterfront. Branch mains from this ring main are 8-, 6-, 4- and 3-in. diameters, and other installations, and the jetty.

It was planned to take a supply from the chief 12-in. main in an emergency to the Torpedo Depot, and to supply with the 9-in. ring main in the Armament Depot, subsidiary distribution being by mains of 6-, 4- and 3-in. diameters to the jetty and various installations. (No mains had been laid in the Torpedo Depot in January 1942.)

The chief 12-in. main is again tapped at 12,500 ft. from the reservoir to supply the Fleet Shore Accommodation, where two 6-in. mains, rising to the shore, serve the whole hill and all buildings, with numerous hydrants.

At about 15,000 ft. from Batu Riman reservoir the chief 12-in. main reaches the Dockyard at the level of the railway sidings and turns northward, supplying the graving dock and then encircling the wharves, where it is laid in the subway (see above, A (7) Wharves) by 12-, 14- and 12-in. (2) Water. A 12-in. branch from it is laid between Main Gate and the fire station northward behind the workshops at West Wall to Middle Road, along this road to the storerooms at Stores Wharf, and thence southward to meet the first main near the south-west corner of the Naval Stores Basin. From this junction a further 12-in. main returns to the reservoir in the residential area south of the Dockyard, which is in turn linked by

a 12-in. pipe to the original supply main at the railway sidings.

Subsidiary connections in the Dockyard, serving all installations, are 6- and 4-in., and hydrants are liberally installed: these have Admiralty standard No. 3 connecting. Mains serving the residential area to south and east of the Dockyard, and the coolie lines and Asiatic Hospital, are 9-, 6- and 4-in.

Booster stations. Fire-booster stations were as follows:—

Torpedo Depot: planned but not installed. **Armament Depot:** two, beside the main Naval Base road at south end of Riman Valley, about 220 yds. apart, each equipped with a pump of 1000 g.p.m. capacity, and a 12-in. main, 100 yds. long, for the use of the Armament Depot, pumping from the reservoir to the lower end of the Riman Valley reservoir; the other was for use in boosting the 12-in. main, or in pumping from the reservoir to the Dockyard.

Fleet Shore Accommodation: planned, beside main road, but pump not installed. **Dockyard:** two, one beside Main Gate, equipped with a pump of 1000 g.p.m. capacity; another beside the water tower south of the Dockyard, pumping to the tower at 400 g.p.m. (one pump) and boosting mains at 1000 g.p.m. (one pump).

Supply and consumption

The amount of water which could be drawn from the Naval Base was limited by the capacity of the 12-in. supply mains, which at the maximum recommended velocity of 3 ft. per sec. is 1,200,000 gallons per day; the amount which might be taken from the municipal mains in Seletar Road was restricted to 50,000 gallons per day; total, 1,250,000 gallons per day.

In 1941 supply reached an actual figure of 1,100,000 gallons per day, against an average daily consumption of 1,000,000 gallons, though the maximum peak consumption had reached the figure of 1,700,000 gallons.

Consumption figures include the amount diverted to the temporary temporary hatted camp near the main Base road south-east of the Armament Depot, which was supplied from the 12-in. main laid beside the road. In these conditions the demand was too great to allow Batu Riman reservoir to fall, and both the supply mains were taxed almost to capacity, the fire booster pumps being called into service to assist supply. To meet this demand, it had been approved to lay a second 12-in. main into the Base area from the pipeline crossing the causeway.

Note. Supplies from the two sources could be linked in an emergency to the Torpedo Depot, and in general to supply the European and Asiatic residential areas south of the Dockyard from the 9-in. main tapping the municipal (island) supply, leaving the rest of the Base to be supplied from the 12-in. main tapping the Johore source.

(b) Sanitation

The Naval Base has waste-borne sewerage, the sewers of 6-, 9-, 12-, 15- and 18-in. diameter. Sewers of 9- and 12-in. are of B.S. st.-galv. water; those above 12-in. diameter of B.S. steel S. and S. (concrete-lined); pumping mains are B.S. steel screwed (concrete-lined).

The chief sewer in the dockyard area is 12-in. diameter, increasing to 15 in. It runs from the south end of the Naval Stores Basin up Stores Road, along Middle Road and then southward behind the workshops backing West Wall to a point south of the graving dock; connections from the numerous Fleet,

European and Asiatic latrines and wash-places are 6-in. diameter. Pump-chamber A is near the junction of Stores Road and Middle Road, and chamber B behind West Wall, 2000 north-east of the foundry; each is equipped with two motor-driven pumps. A 15-in. sewer, increasing to 12 in. then 10 in., encircles the residential area south of the Dockyard, and joins the dockyard sewer at a point between the railway and the southern end of the graving dock.

From this junction an 18-in. sewer is laid westward, close to the railway line, past the south side of Merah Hill, where it is joined by the sewers serving the Fleet Shore Accommodation; these are 6-in., increasing to 8 in. Immediately beyond is pump-chamber C (two motor-driven pumps), whence a pump-chamber, rising to a 12-in. main, carries the sewage to an Imhoff tank and sludge-drying beds close to the shore a few yards eastward of the mouth of the Sungai Senoko across its mouth to the disposal point was not erected. The sewage disposal plant was overtaxed, and it had been proposed to duplicate the Imhoff tank.

Sewage from the Armament Depot is pumped from pump-chamber D (close northward of Attap Hill) two motor-driven pumps) through a direct main (9-in., steel screwed, concrete-lined) laid on the bed of the Sungai Senoko across its mouth to the disposal plant on its opposite bank. This main was also to carry the sewage from the Torpedo Depot and from the 'Stores Road' connections from the latter area were partly laid, up Attap Valley, pump-chamber E, which was to pump sewage from the Torpedo Depot, was almost finished, but no pump had been installed. Note: (1) A small septic tank and filter beside the Imhoff tank, Sembawang Road, served the bungalows to east of the Naval Stores Basin, but discharged into the 9-in. service main described above.

(2) Temporary coolie lines, beside the main Base road west of the Fleet Shore Accommodation, and south-west of the Asiatic Hospital had not been connected with the general reticulation, but were served by a night-soil bucket system. There is a refuse destructor close westward of the sewage disposal plant.

(3) Bakeries, cold storage, etc.

There were no bakeries.

A small ice-defrosting floor chamber is provided on North Wall, beside the warehouses.

It was planned to provide refrigerated storage in the form of a hall of No. 1000 tons (see above, A (14) Warehouses, etc., p. 141); no more than the foundations of this building were ready.

The main hall of No. 1000 tons, Co had a small branch establishment at the Sembawang Road (junction of Admiralty Road East and Sembawang Road), estimated capacity about 50 cu. ft.

Almost all the residences were supplied with domestic type refrigerators.

(4) Fire service

The whole area is liberally provided with hydrants; for a note on the fire service, see above, A (14) Warehouses, etc., p. 141.

Fire stations and engines were as follows:— Dockyard: 1 station to Main Gate; 3 fire engines; hose-drying tower 37 ft. high; sleeping and showering quarters.

Fleet Shore Accommodation: small fire station. Armament Depot: fire station off Attap Valley. Main Gate: Main Office beside the workshops. There were upwards of 20 trailer pumps in the Naval Base.

