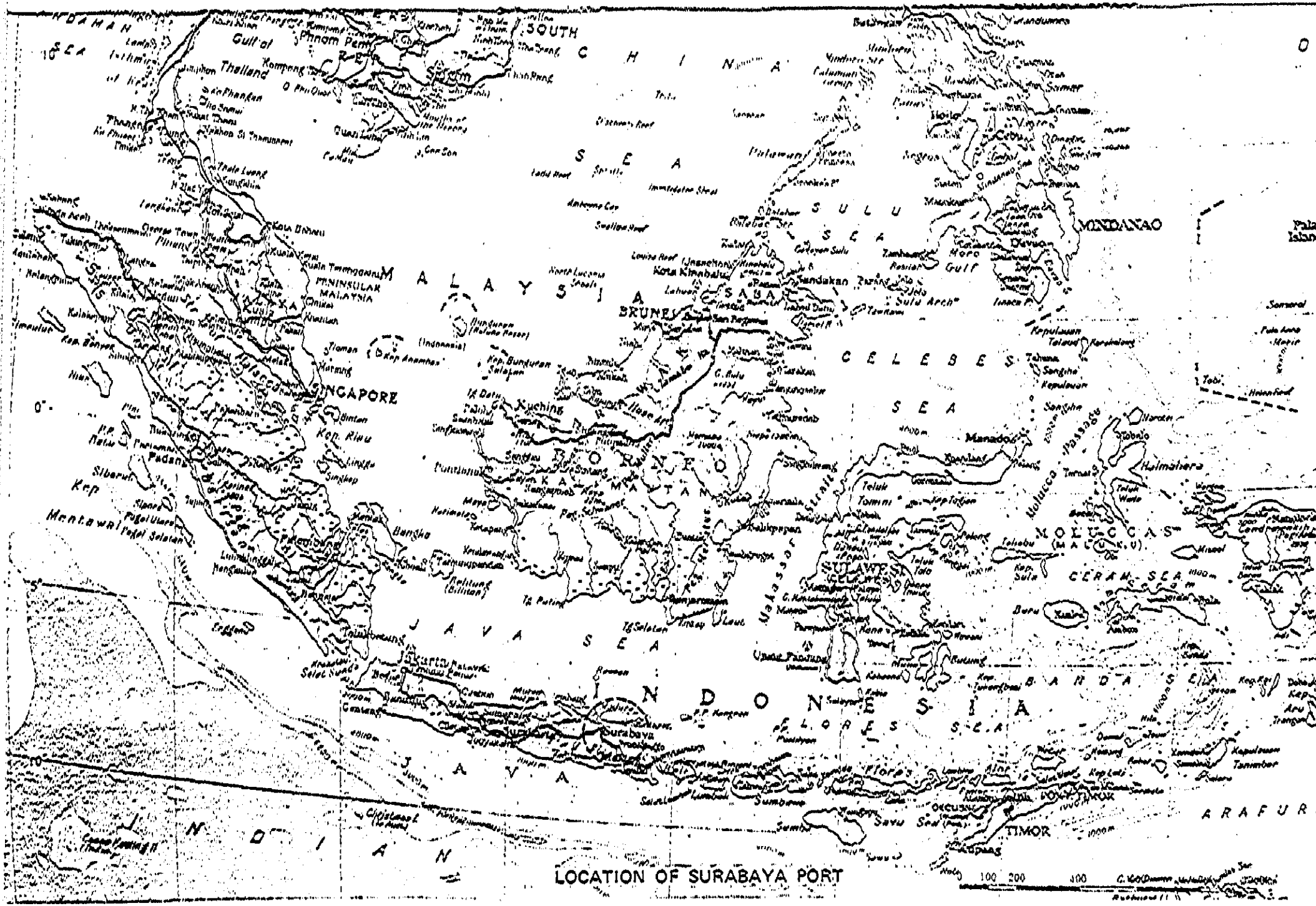
REPUBLIC OF INDONESIA

STUDY REPORT ON THE REMOVAL OF SUNKEN VESSELS

MARCH 1980

JAPAN INTERNATION COOPERATION AGENCY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Manado
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Passage
M O L U C C A S
(MALUKU)
CERAM SEA
SULAWESI
(CELEBES)
Kuching
SARAWAK
B O R N E O
KALIMANTAN
Pontianak
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Makassar
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J A V A S E A
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Flores
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Denpasar
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Lampung
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Billiton
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Siberut
Nias
Aceh
Andaman
Sea
I N D I A N
O C E A N
LOCATION OF SURABAYA PORT

PREFACE

In response to the request of the Republic of Indonesia, the Government of Japan has decided to carry out the survey as part of her overseas technical cooperation program aiming at transferring the technologies of the removal of sunken vessels both planning and execution, and the Japan International Cooperation Agency (JICA) conducted the survey.

JICA organized a steering committee headed by Mr. Yasuhiro Hosokawa, Ship Bureau, Ministry of Transport and a Survey Team comprising engineers of the Japan Shipbuilding Technology Center, and dispatched the team to the Republic of Indonesia to carry out the field survey.

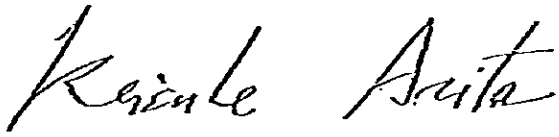
After returning from the field survey, the Team analyzed and examined the information and data obtained in Indonesia, discussed those matters with the Indonesian authorities concerned, and has completed the final report for submission to the Government of the Republic of Indonesia.

I hope this report will prove to be useful for the development of technology regarding the removal of sunken vessels in Indonesia, and contribute to the promotion of friendly relations between our two countries.

I would like to express my heartfelt appreciation to the Government and the people concerned of Indonesia for their close cooperation and assistance extended to the survey team.

Sincerely yours,

March, 1980



Keisuke Arita,
President,
Japan International Cooperation Agency
Tokyo, Japan

Scope of Work

The survey was conducted to transfer the implementation and drafting techniques of the basic plan regarding sunken vessels in Indonesia to the Directorate General of Sea Communications in Indonesia.

In implementing the survey, the main points of the cope of work have been decided as follows;

(1) Survey for the present state of Surabaya Port

(2) Drafting the standards to decide the priority order for the removal work of sunken vessels

(3) Deciding the priority for the removal work of sunken vessels

(4) Survey on the removal method of sunken vessels

(5) Survey on the general implementation standards for the salvage work

(6) Survey on the manpower training for the salvage work

(7) Survey on the procurement of machines and equipment for the salvage works

According to above "Scope of Work," the study on the removal of sunken vessels in the Republic of Indonesia has been carried out, setting an example on Surabaya Port.

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INDEX OF PLAN

SUMMARY

S-1 Current State and Problems in the Waters of the Republic of Indonesia

S-1-1 Environment of the Passages in Indonesian Waters from the Viewpoint of Natural and Geographical Conditions

The Republic of Indonesia is the largest archipelageon nation in the world, being situated in vast zones centered on the equator. Consequently, importance of the maritime traffic is very big, but it is short of natural good harbours, while most major ports are river ones.

In major ports, it is very hard to maintain sufficient depth as the port, which marks a characteristic of the river ports in general. Additionaly, in the port of Indonesia, as the location of floatings is largely moved by changes in the terrain arround coast line caused by a huge quantity of mud/sand from rivers and affect of strong tide and current, navigators have to make strict watch on the surface of the water when entering into and leaving the port, regarding it as the most dangerous.

Furthermore, there are still so many zones in the Indonesian waters where sweeping operation has not finished yet, and is left a number of sunken vessels as they are in the passages and the inside of harbours.

Putting in order of the current state of main ports, it is prescribed as in the table S-1.

In the above environment of the passages, problems to safety navigation for ships entering into and leaving the port and psychological apprehension of navigators are immeasurable, which inevitably leads to a possible factor to cause sea accidents.

Table S-2 indicates a tabulation of the maritime accidents, in which the cases of sinking and stranding are inclined to increase year by year. Therefore, it is an urgent task to improve environment of the passages, laying stress on removal of the sunken vessels.

From the above, it can be said that effects should be made to accelerate improvement of the passage and harbour environment necessary for safety navigation and to restore confidence of navigation environment, which are the bases for developing the country as oceanic nation.

S-1-2 Position of Removal of the Sunken Vessels in the policies of The Republic of Indonesia

Transport Sector is expected to attain more than 10 percent growth per annual, of which domestic maritime transport expected 10 percent, while overseas are 5 percent

respectively, complying with the policies of regional development and of immigration set in the 3rd Five-year Development Plan (PELITA III)

So, the estimate to be performed at the end of the above plan is shown in Table S-2, and to this end, it is indispensably requested to secure safety navigator to cope with the increased volume of maritime freight and number of ships in commission.

But, improvement of environment of the passage, corresponding to growth in maritime transport sector, is impeded by the sunken vessels which become more or less the bottleneck to proceed it. As the situation above was reperceived by person concerned in Indonesia, removal works have borne fruit of 16 sunken vessels with 4,600 tons during the Second Five-year Development Plan (1974/75–1978/79), which, however, is not sufficient enough to contribute to improvement of the existing condition in the ports of Indonesia.

So, the matter has come to what it stands partly due to low level of salvage technics combined with restraint of natural conditions and the like.

S-1-3 Current State of Salvaging Sunken Vessels in the water of the Republic of Indonesia

The Government of the Republic of Indonesia has carried out removal operations of the sunken vessels during the 1st and 2nd Five-year Development Plans (PELITA I and II) the volume of which is shown in Tables S-3 and S-4 respectively, and has planned to salvage them during the 3rd Five-year Development Plan (PLITA III) as indicated in Table S-5.

Comparing the planned figures with the performed results throughout the periods of PELITA I to PELITA III, as seen in Table S-6, it is pointed out that the former has been getting bigger year by year, on the contrary the latter getting smaller yearly.

S-1-4 Current State of the Salvage Industry in Indonesia

The Salvage companies authorised by and registered for the Directorate General of Sea Communication are indicated in List 1-5-7. Of these companies, substantially only 4 companies have had the performed experience of salvaging operation to award the orders from the Government. These 4 companies are presumed to have operation capacities of around 10,000 tons per year in total, but their existing salvage technique, machines and equipment are not satisfactory to fully meet the current state in the country, in taking account of volume of the sunken vessels to be salvaged in the water of the Republic of Indonesia.

List S-1 Environment of passages in major ports in Indonesia

No. Ports	Type	Function	Estimated Depth/m		Estimated total of wrecks
			in Road	at Quay	
1. Surabaya Area	B	F	12	2-8	49
2. Teluk Bayur Area	B	II		7.5	14
3. Bangka Strait Area					22
4. Musi River Area	Rv	F		5-6	15
5. Tanjung Priok Area	B	F		4-9	1
6. Tarakan Area	Rd	F	3-14	5	3
7. Cilacap Area	Rv	F	7	4-7	16
8. Balikpapan Area	Rd	F		9	8
9. Ujung Pandang Area	B	F	16	8-10	1
10. Belawan Area	Rv	F		7	32
11. Semarang Area	Rd	F	5-7	2.5-5.5	3
Total					164

Abbreviation

Rd = Road
Rv = River
B = Basin/bay
II = Interisland trade
F = Foreign trade

List S-2 Estimated Trade Capacity at the End of the Third Five-Year Development Plan

Kind of vessel	Hull (DWT)	Cargo (T)
Local		
Loacl Vessels	165,900	2,986,200
Inter island	357,500	7,865,600
Traditional vessels	68,800	1,719,000
Pioneer vessels	19,500	78,000
Foreign trade	593,000	7,526,000
Ocean going vessels		

List S-3 Actual Removal in PELITA I

PELITA I (1969–1974) RE: WRECK REMOVAL

	Plan			Actual Data		
Location	Period	Object	Approx. Scrap (ton)	Period	Object	Approx. Scrap (ton)
Jakarta	69/70	3 wreck	3,270	69/70	3 wreck	3,270
	70/71	2 wreck	900	70/71	2 wreck	900
	71/72	6 wreck	2,000	71/72	6 wreck	2,000
	72/73	30 wreck	1,062	72/73	30 wreck	1,062
	73/74	Floating Dock	900	73/74	Floating Dock	900
Surabaya	69/70	Floating Dock	750	69/70	Floating Dock	750
	70/71	Floating Dock	450	70/71	Floating Dock	450
	71/72	Floating Dock	1,350	71/72	Floating Dock	1,350
	72/73	wreck	1,400	72/73	Wreck	1,400
	73/74	Floating dock + wreck	2,250	73/74	Floating dock + wreck	2,250
Palembang	69/70	Wreck (LST II)	400	69/70	Wreck (LST II)	400
	70/71	Wreck (LST II)	1,600	70/70	Wreck (LST II)	1,600
Cilacap	69/70	Wreck		69/70	Wreck	
	70/71	Continuation	2,000	71/72	Continuation	2,500
Belawan	71/72	Dredger	431	71/72	Dredger	431
	72/73	Continuation	–	72/73	Continuation	–
Balikpapan	72/73	2 Barge	65	72/73	2 Barge	65
		1 Oil pipe			1 Oil pipe	
		1 Pontoon			1 Pontoon	
Total			18,828			19,328

List S-4 Actual Removal in PELITA II

PELITA II (1974–1979) RE: WRECK REMOVAL

	Plan			Actual Data		
Location	Period	Object	Approx. Scrap (ton)	Period	Object	Approx. Scrap (ton)
Jakarta	74/75	16 wreck	4,800	74/75	11 wreck	450
Surabaya	75/76	3 wreck	5,550	75/76	2 wreck	670
	76/77	3 wreck	3,510	76/77	2 wreck	890
	77/78	31 wreck	4,810	77/78	1 wreck	630
	78/79	35 wreck (including wooden wrecks at Jakarta)	2,530	78/79	18 wreck (including 17 wooden wrecks at Jakarta)	2,000
Total			21, 200			4,640

Remarks: 1. One Wreck/Matsukura No. 44 out of 18 wrecks during period 78/79 of ACTUAL DATA is still under-operation by P.T. Indonesian Salvage as of December, 1979.

2. Total removed weight tons of scrap during PELITA I & II (1969–1979) are estimated 23,968 tons.

List S-5 Planned Removal in PELITA III

First period (1979–1980) of PELITA III — RE: WRECK REMOVAL

The first priority of the wreck removal and mine field cleaning at the channel and the anchorage area at Surabaya Port

Location	Object/Matsukura No.	Estimate scrap (ton)	Remarks
I. Western Channel	1. Passenger Ship/7	1,100	*Under operation by P.T. Yalagada
	2. Naval Training Ship/4	4,400	
	3. Cargo Ship/4	2,000	*Partly removed (±1,400 ton) during 1972/73
	4. Passenger Shpi/2	900	
	5. Cargo Ship/6	1,775	
	6. Semi Cargo Ship/5	3,300	
II. Eastern Channel	1. Mini Field Cleaning	–	*Under procedure
	2. Wreck of Steel Ship/73	290	
	3. Passenger Ship/72	900	
III. Anchorage Area	1. Cargo Ship/46	5,250	*Partly removed (±335 ton) during 1976/77
	2. Cargo Ship/41	1,500	
	3. Cargo Ship/43	1,415	
	4. Cargo Ship/52	1,200	
	5. Cargo Ship/53	2,200	
	6. Cargo Ship/48	1,700	
	7. Tanker/50	4,500	
	8. Cargo Ship/47	4,000	
Total	16 Wrecks	36,430	

Remarks: Only the Removal Operation of Item 1. Passenger Ship/7 at Western Channel was conducted during this period and is still under-operation by P.T. YALAGADA as of December, 1979.

List S-6 Comparison between the planning and the result of salvage

Name of the planning	Planned Salvage (A)	Performed Salvage (B)	(B)/(A)
PELITA I (69/70–73/74)	18,828 tons	19,328 tons	102.7%
PELITA II (74/75–78/79)	21,200 tons	4,640 tons	22.1%
PELITA III (79/80)	36,430 tons	1,100 tons	3.0%

S-2 Fundamental scheme of the removal of sunken vessels (setting an example on Surabaya Port).

S-2-1 General situation of Surabaya Port

Surabaya Port (or Tanjung Perak which means Cape Silver) is, in line with Jakarta (or Tanjung Priok), one of the most important ports in Indonesia, located in East Java at Lat 7°–12'S. and Long. 112°–44'E. From the viewpoint of the geographical features, Surabaya Port as the model port in this study is situated in the interior of the narrow strait which is formed as against Madura Island. Therefore, the port is eventually considered similar to a river port and a typical port. The west channel of the port, which is an incoming and outgoing passage, is very narrow for the navigation. The sunken vessels existing therein are the obstacle for the passage to be kept broad and deep. A ship of deep draught must discharge the ballast for averting the danger at the time of entering and leaving the port. She also has to proceed only at the high tide or has to alleviate the full load. The light buoy is so much susceptible to movement, as is the case in the other ports, that the experience and the sixth sense of navigator are depended upon. The situation is, therefore, quite dangerous to those who have little experience in the navigation. Under the circumstances, the existence of the sunken vessels has come up to be a big obstacle for the development of the port. The removal of the sunken vessels also encounters difficulty on account of the reduced visibility in water caused by the strong current stream and drifting sand. The investigation and the activities of the removal are further hampered by the meteorological factors in addition to the technical troubles including that of the submarine operations.

1) Anchorage

a) The anchorage for sea-pilot is north of No. 5 Buoy (approximately 06°–52'–30"S., 112°–44'–45"E.)

b) Quarantine anchorage in port is at the water basin in front of Djamrud Utara wharf. There exist a lot of sunken vessels and obstacles, and so the utmost care must be taken.

The speed of current is so quick that it reaches 2.5 knot at its heighest. The bottom of water is mud and the anchor clings fairly well.

2) Perilous areas

The areas in the vicinity of Surabaya Port, which have or have not been swept are reported.
(reference: Daera Randjau (mine area), Indonesian Navy edition). A mine

exploded in the year 1975 on open sea off the Padan Port, Sumatra Island. The mine is still powerful after the lapse of the lengthy time.

3) Channel and the manner of maneuvering

a) The lighthouse at Karang Djamuang is a good target for the ships to proceed to west channel. The ship confirms its position by the direction of the lighthouse and the distance measured by radar. She also confirms the position of outer light buoy (6°–37.5'S., 112°–44'E.) or No. 1 light buoy (6°–47'S., 112°–44.5'E.) and, proceeding to the south, it reaches No. 5 buoy.

Tg. Modoeng (Madura Island), Ug. Pangka etc. are seldom echoed on the radar because of the low sea-level, and of the specific geographical situation even though the radars are set at both headlands.

b) One of the most perilous passages in the west channel is that of between No. 5 buoy and No. 2 buoy for the length of about 100m which is free from underwater obstacles and sunken vessels.

Another is the passage between No. 9 buoy and No. 11 buoy. The ship proceeds watching the light at Jamuang and Sembilangan (at north-west end of Madura Island) and avoiding the other vessels.

c) As regards the passage from No. 6 buoy to Surabaya Road, the navigatable channel is comparatively broad and it is easy to confirm the ship's position by the distance from both shores and by the lighthouse. However, care must be given to small fishing vessels and fishing trellies.

4) The largest type of ship

a) The largest type of ship which can pass through the west channel and enter the Surabaya Port is of the draught 9.5m and length 210m.

b) The largest type of vessel which used to pass through is that of D/W 65,000 tons and of the length 224m. She passed in April, 1974 at the maximum draught 10.02m.

S-2-2 Natural Condition

(1) Meteorological phenomenon

The weather outside west channel of Surabaya is as follows: In the south-east monsoon season, the sea breeze starts to blow, drawing a little toward north, at about noon and cease in the evening. The land breeze starts from the south at about the time of sunset. Mostly, it is quite calm and hazy in the morning. In the north-west monsoon season, sea breeze usually blows strongly from west-north-west or from north-west in the morning. The wind of this direction blows during the day time, but it changes, as time goes by, to the weak south-west land breeze. The monsoon season in the area is from December to March next year. The volume of rain affects mostly the operation of removal of sunken vessels due to the fact that rain adds to the invisibility of water.

(2) Tidal current

1) The tide at the anchorage is featured with a typical semi-diurnal current. In general, the slack is short in case the current velocity is big and is long in case the velocity is minor. The current near the shore is quicker by 1–1.5 hours than that in the midst of the anchorage at the time of the turn of the current, but it is not in conformity with the tide. Due to the influence by the south-east monsoon, the westward current is, on an average, stronger than the eastward current in the anchorage.

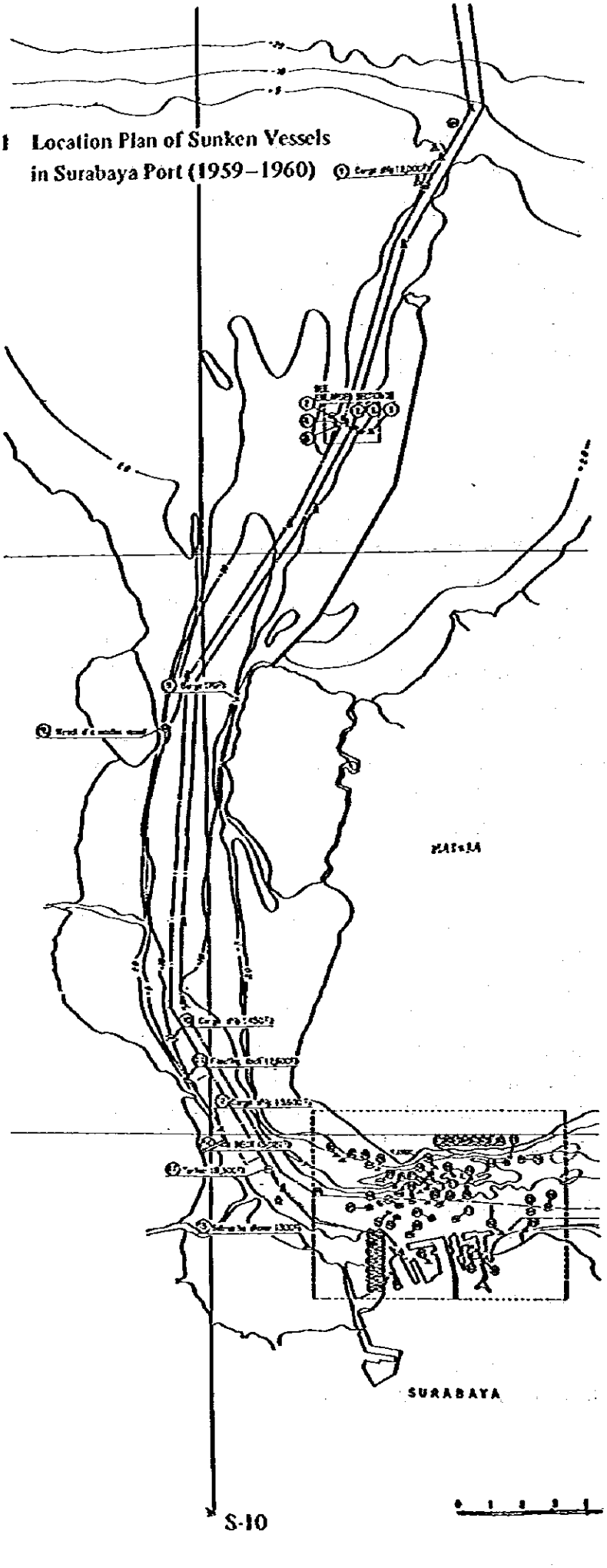
2) The tide and current in the west channel and in the outer area are figured out from the above-mentioned tide table by adding and subtracting the ratio of the height of tide and the difference of the time of tide. The outline is as follows: The current in the west channel is the tidal current. The south-east monsoon puts aside the sea-water from the funnel-shaped east channel, strengthening the northward stream and weakening the southward stream in the west channel. There are remarkable semi-diurnal current in the west channel at large and the current runs northward and southward each twice a day. At the time of the new full moon, the northward current reaches the heighest velocity 2.5 knots after about 1 hour 15 minutes from meridian transit of the moon. In the meantime, the southward current reaches its heighest after about 7 hours 30 minutes from the meridian transit. The current velocity is about 1 knot at the time of the first quarter and last quarter of the moon.

S2-3 Activities in Surabaya Port

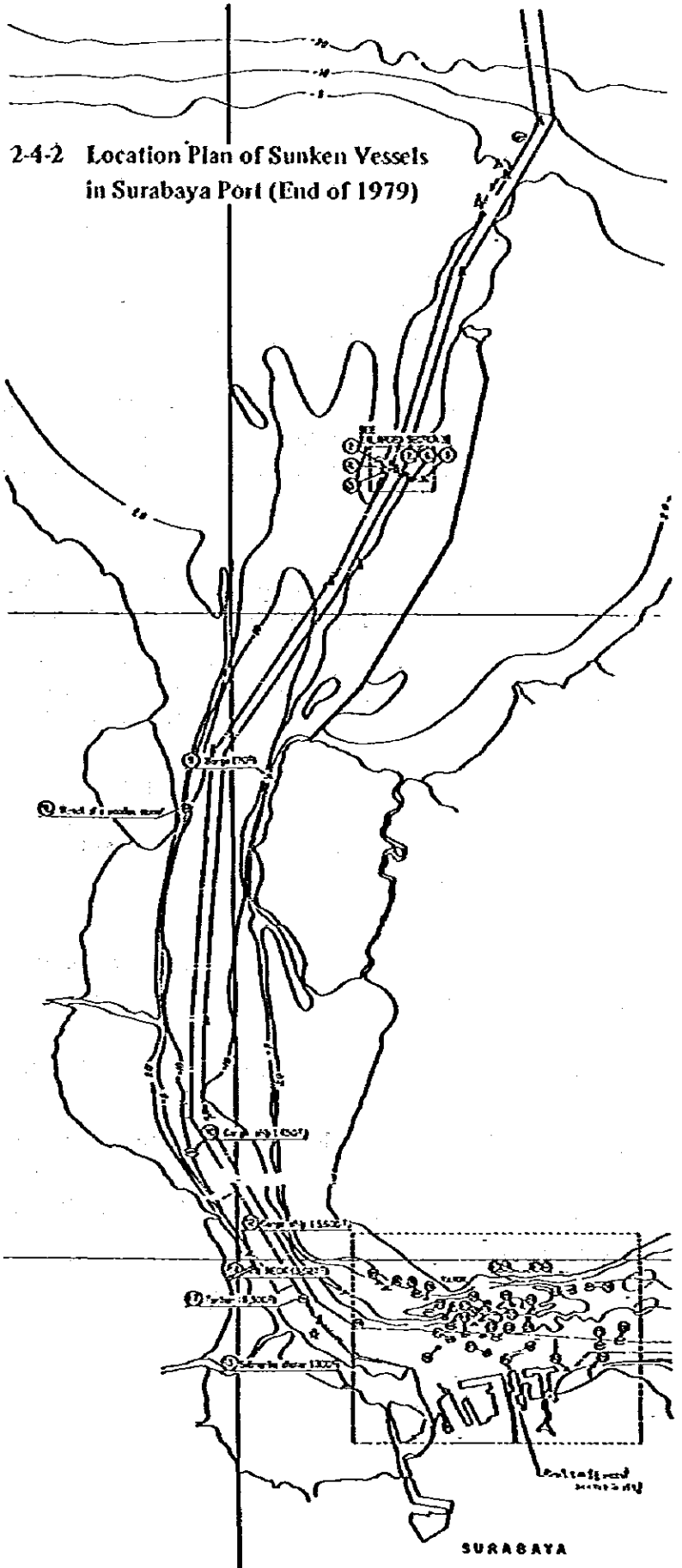
(1) Number of ships

The number of ships, arriving and leaving Surabaya Port, of DWT 250 tons and more has increased from 3,600 in the year 1971 to 5,000 or more in recent years.

Plan 2-4-1 Location Plan of Sunken Vessels in Surabaya Port (1959–1960)



Plan 2-4-2 Location Plan of Sunken Vessels in Surabaya Port (End of 1979)



(2) Cargoes

Both foreign and domestic trade increased proportionately.

S-2-4 The Distribution of Sunken Vessels in Surabaya Port

The distribution as studied in the year 1959 - 1960 is as per plan 2-4-1 (Matsukura Report). DMS removed 29 vessels in 20 years from 1960 to 1979 and also removed a part of the stem (about 5% of whole) of the sunken vessel No.4 as well as one third of the vessel No. 43.

List S-7 The change in number of sunken vessels in Surabaya Port as time elapsed

Item / Year	Number of vessel	Aggregate gross tonnage assumed	Estimated scrap to be produced
1959–1960 by Matsukura	74	114,969	40,659 M/T
End of 1979	45	88,584	31,205

We have heard at the occasion of the recent investigation from those who are interested in Surabaya Port to the effect that

(1) The Matsukura Report has not covered the whole sunken vessels in Surabaya Port.

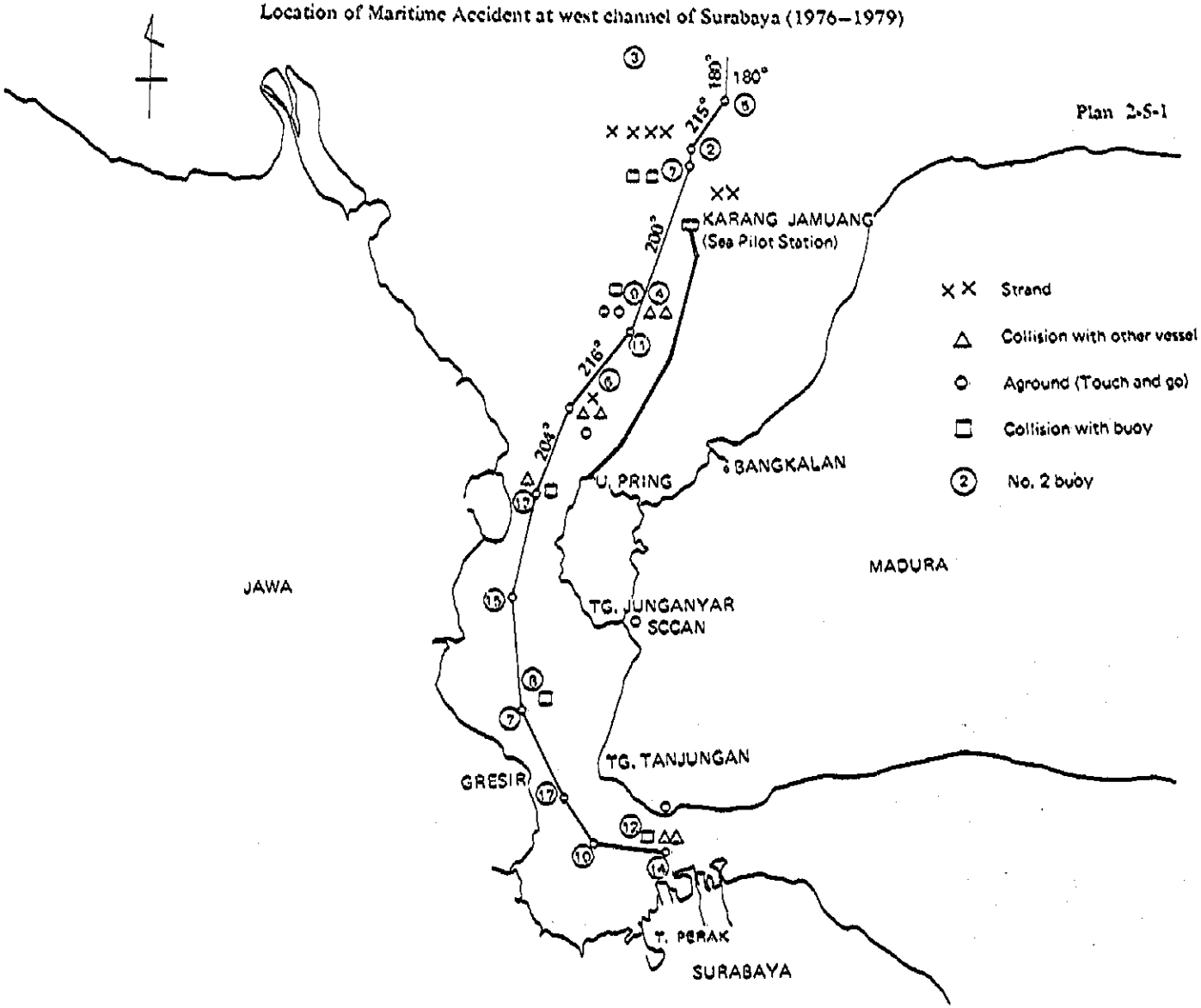
(2) Some of the old sunken vessels still remain untouched in the west side of the channel.

(3) Many vessels sank after the issue of the Matsukura Report. Some of them has been removed already.

S-2-5 Maritime Accident

Most maritime accidents happened in the vicinity of the buoies No.2 - No.4 in the west channel. In this connection, every equipment aiding navigation is provided including buoy etc. and the pilots versed with the situation have been employed. The weather and sea condition are comparatively calm in the region. Nevertheless, the accident occurred frequently. consequently, we conclude that those accidents have apparently been caused by the fact that the existence of sunken vessels is hardly perceived by the navigators and that the sunken vessels narrowed the navigatable channel extremely.

Location of Maritime Accident at west channel of Surabaya (1976–1979)



S-2-6 The development Plan of Surabaya Port

In view of the development of the contenarization, the administration of Surabaya Port is contemplating the construction of the wharf, exclusively used for the containers, of the length of about 1,500 m by way of filling in the shallows at west side of the present commercial port. The administration is going to have a feasibility study from economic and technical points of view as from the year 1980 to 1985. Further, the idea of constructing new passage is proposed. The passage will be provided at the location stretching from No.6 buoy in the west channel to open sea, by dredging the shallows at west of the spot of sunken vessel.

S-2-7 The Priority for Removal of Sunken Vessels in Surabaya Port

S-2-7-1 Sunken Vessels in West Channel

West channel is the only one that is important passage for vessels entering into or leaving Surabaya but is in unfavorable circumstance for navigation due to scattered sunken vessels reducing the breadth of passage which is originally narrow.

Especially the breadth of navigable course indicated on plan 2-5-1 is narrow and need to remove all of sunken vessels in order to assure safety navigation.

The sunken vessels located around the No.5 bouy set at the northern end of West Channel should be given priority for removal because it is the changing point of navigation and in the unfavorable sea condition compared with inner area of the channel.

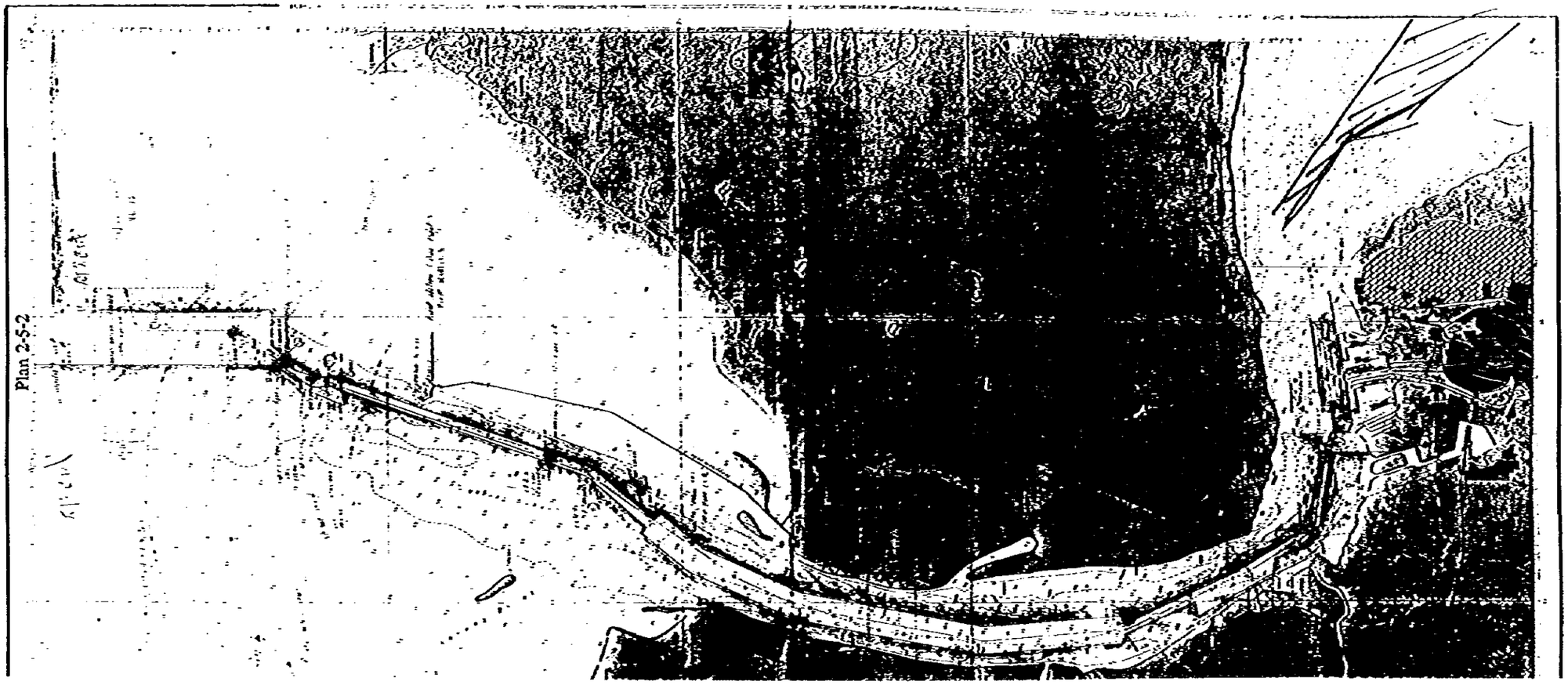
And while the sunken vessels around the No.4 bouy should be removed with priority because these sunken vessels have reduced the width of the navigational course remarkably.

S-2-7-2 Sunken vessels around the anchorage of Surabaya Port

The anchorage of Surabaya Port must secure ample sea because of veering due to change of the current and the wind direction. Then, anchoring in such area, it is needed for vessels to be held safely.

Accordingly as for sunken vessels shown on plan 2-5-2, all of sunken vessels in anchorage should be removed at least and it is desirable to remove the sunken vessels in the circumferential area as much as possible.

Especially, sunken vessels in the western area of the anchorage which is congested with anchoring and cruising vessels should be given priorty to be removed.


Plan 2-5-2

S-3 General Consideration of the Priority for Removal of Sunken Vessels

As for the necessity and the determination of priority for removal of sunken vessels from viewpoint of securing the safety navigation, the final decision should be given by examining the degree of interferance with safety navigation caused by sunken vessels after investigated in detail georogical, natural characteristics, actual traffic state in the waters in question. In above articles it has been stipulated that all of sunken vessels are basically objects of removal but the priortity should be concluded according to the degree of interferance, namely it is on the premise that the countermeasure to get rid of or reduce interferance of safety navigation is only to remove the sunken vessels without devising another countermove.

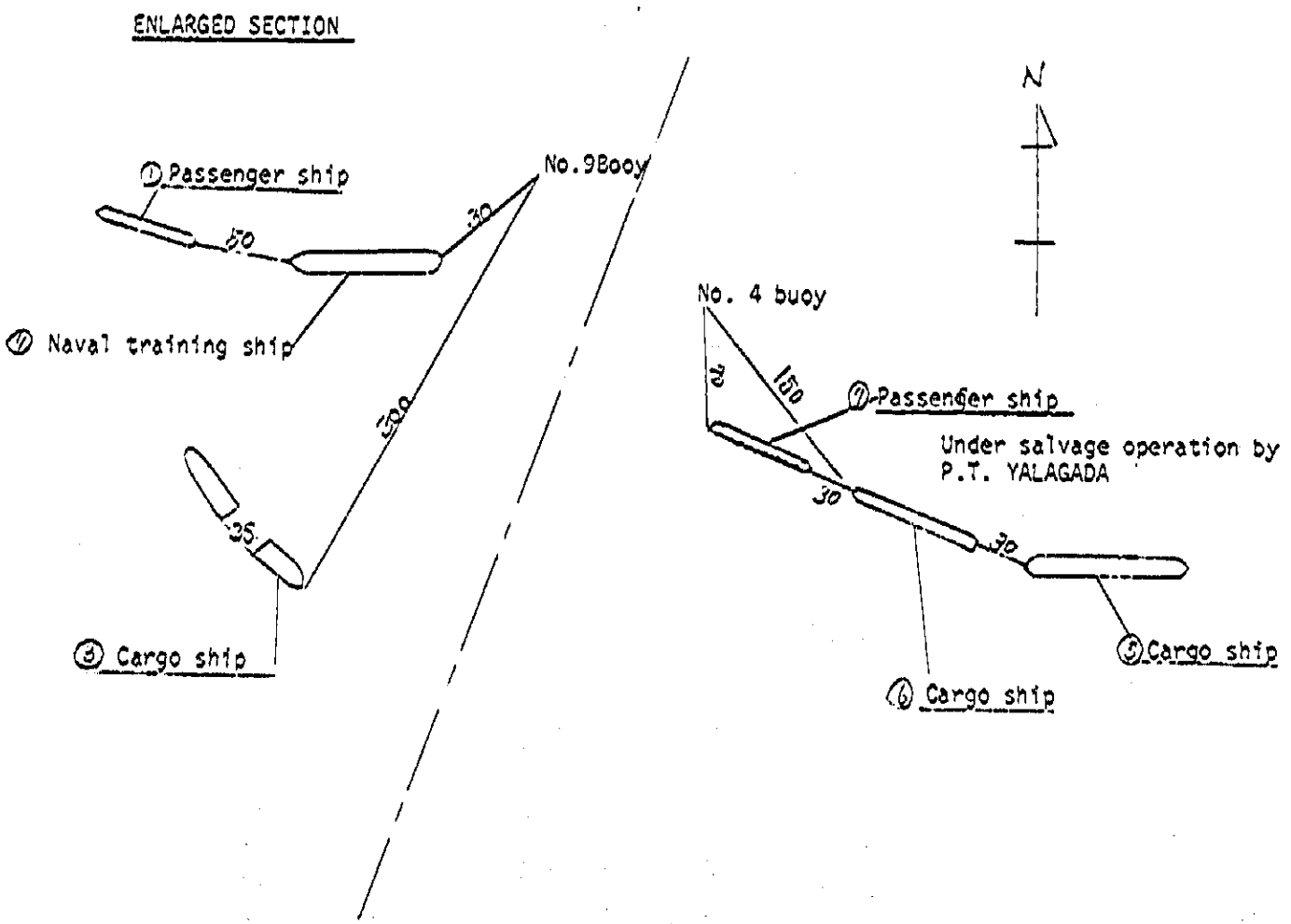
But it is more realistic to examine countermeasures in order to exclude the interferance, it is of exclude or mitigate of interruption including removal. It is conceivable that if it is possible to exclude or mitigate the interference without removal of sunken vessels, the priority of removal would become low relatively because of alternative countermeasure. By this reason the basis will be the investigation of all countermeasures on the occasion of the necessity of removal and decision of the priority.

Furthermore, sunken vessel which has been decided to be removed after examined through above mentioned procedure must be put into removal operation at an early opportunity. But in case that removal operation could not be carried out due to some affairs, at least in order to secure safety navigation following treatments will be required in the period needed for beginning the removal operation.

(1) Installation of marker buoy or others which indicate clearly the position of sunken vessels.

(2) Offer of informations concerning sunken vessels and waters around sunken vessels to navigators by the means of chart or notice to mariners.

(3) Installation of navigational aids.


ENLARGED SECTION
① Passenger ship
No.9Booy
170
30
⑪ Naval training ship
300
35
③ Cargo ship
N
No. 4 buoy
150
① Passenger ship
Under salvage operation by
P.T. YALAGADA
30
30
⑤ Cargo ship
⑥ Cargo ship

S-4 The Study on the Method and the Cost for Removal Operation

S-4-1 Surveyed Results of each Sunken Vessel

(3) Results of each sunken vessel

1) No. 4 sunken vessel

	Date of survey:	From November 20, 1979 to November 23, 1979
a)	Name:	Seven Provincien
b)	Kind of vessel:	Naval training ship
c)	Type of vessel:	Flat deck type
d)	Main dimension:	L X B X D = 86.4 M X 14.2 M X 9.5 M
e)	Displacement tonnage:	Estimated 2,000 Tons
f)	Kind of main engine and horsepower:	Reciprocating engine Estimated 3,000 HP
g)	General arrangement and structure:	See in attached drawings
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-52'-43" S 112°-42'-18" E
k)	Distance from the port:	Abt. 18 miles from Surabaya Port
l)	Ship's head:	W
m)	List and trim:	Nil
n)	Buried condition:	See in attached drawings
o)	Condition of hull:	Piled sandy mud
p)	Corroded condition:	The wooden deck floor was swept away, the steel deck was covered by oysters and sea weeds, and there were many holes on it due to corrosion. The shell plating out of the mud was covered by shells (oysters) & sea weeds which were sticked 10 to 15 cm thick.
q)	Sounding around the vessel:	At the bow: 16.8 M At the midship (p): 10.3 M At the midship (s): 17.0 M At the stern: 14.3 M (Measured at 11:15 – 12:30 hrs November 22, 1979)
r)	Sea bed:	Sandy clayey mud and flat
s)	Visibility:	0.2 – 0.3 M
t)	Tidal difference:	High tide: 2.8 M, Low tide: 0.2 M Difference: 2.6 M

u) Direction & velocity or tidal current: Max. 1.9 knot (November 22)

v) Damaged condition & others:

i) Part of the bridge walls remained still, but the rest was swept away.

ii) The wooden deck floor was removed and swept away, in which there were many corroded holes all over, only the beams being left in general.

iii) Regarding the fore mast, it's gone except the rest remaining one meter above the deck.

iv) The funnel was gone.

v) The anchors and the anchor chains were missing.

vi) The rudder and the propeller were missing.

vii) A part of the stern was cut and removed by. (Yalagada, one of Indonesian salvage companies removed it according to the information.)

viii) On 27 CM cannon was left on the bow deck.

ix) Sandy mud deposited inboard up to the upper deck all over the vessel.

x) Scraps recollectable are estimated 1,850 tons.

2) No. 3 Sunken vessel

	Date of survey:	November 25, 1979 to November 27, 1979
a)	Name:	Not known
b)	Kind of vessel:	Cargo ship
c)	Type of vessel:	Three island type
d)	Main dimensions:	L X B X D = 102 M X 14.5 M X 8.3 M
e)	Gross tonnage:	Estimated 3,500 tons
f)	Kind of main engine and horsepower:	Reciprocating engine Estimated 1,700 horsepower
g)	General arrangement and structure:	See in the attached drawing
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-50" S 112°-42'-20" E
k)	Distance from the port:	Abt. 18 miles from Surabaya Port
l)	Bearing of bow:	SE
m)	List & trim:	3° to the starboard of the bow 2° to the port of the stern 2° to bow (at the bow section) 3° to the stern (at the stern)
n)	Buried condition:	See in the attached drewings
o)	Condition of hull:	Sandy mud was deposited.
p)	Corroded condition state:	The deck was corroded much, out of which the beams were exposed here and there.

The shell plating was sticked by oysters and sea weeds. It must have much corroded.

q) Sounding around the vessel:
At the bow: 17.7 M
At the midship (p): 11.2 M
At the midship (s): 10.2 M
At the stern: 18.2 M
(measured at 10:10 – 11:30 hours on November 27, '79)

r) Sea bed: Sandy clayey mud and flat

s) Visibility: 0.3 M

t) Tidal difference: High tide: 2.2 M, low tide: 0.5 M
Difference in tide: 1.7 M (as of November 27, 1979)

u) Direction & velocity of current: Southerly and northerly current
Max. 1.9 knots

v) Damaged condition & others:

i) Part of the bridge walls was remained, but most of the others were swept away.

ii) Near the sections of one meter high above the deck the main and fore masts were chopped of. Part of them was spread outboard.

iii) Windlasses remained as they were, while winches were swept away.

iv) Anchor chains & chains: Nil

v) Rudder and propeller: Remained

vi) Some openings of the shell plating were artificially openned, to be sure. (1 M X 1 M)

vii) It was presumed that the vessel was exploded to sink, separating the midship roughly into the bow and the stern in 35 meters. (Refer in the attached drawings.)

viii) Sandy mud piled inboard up to the upper deck all over the vessel.

ix) The bisivility varies a little corresponding to the tide conditions, but the sea water was so turbid that it couldn't be recognized. In addition, it was very difficult to carry out the diving work due to the rapid velocity of tidal current.

x) Estimated volume of scraps: 1,700 tons

3) No. 2 sunken vessel
Date of survey: From November 23, 1979 to November 24, 1979

a) Name: Not known

b) Kind of vessel: Passenger ship

c) Type of vessel: Shelter deck type

d) Main dimensions: L X B X D = 56 M X 8 M X 5 M

e)	Gross tonnage:	Estimated 700 tons
f)	Kind of main engine and horsepower:	Estimated reciprocating engine, 400 HP
g)	General arrangement & structure:	See in the attached drawings.
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-40" S 112°-42'-15" E
k)	Distance from the port:	18 miles from Surabaya Port
l)	Ship's head:	ENE
m)	List & trim:	90° to the starboard
n)	Buried condition:	See in the attached drawing-
o)	Condition of hull:	Muddy sand is piled.
p)	Corroded condition:	The deck was corroded seriously. The deck was swept away, only to beams beeing left. The shell plating was considered to be covered by oysters and sea weeds.
q)	Sounding around the vessel:	At the bow: 10.9 M At the midship (p): 11.3 M At the midship (s): 6.8 M At the stern: 12.7 M (as of November 24, '79)
r)	Sea bed:	Sandy mud was piled inboard up to the sea bed. (See in the attached drawing.)
s)	Visibility	0.3 – 0.5 M
	Estimated scraps:	370 tons

4) No. 6 Sunken vessel

	Date of survey:	From November 29, 1979 to December 4, 1979
a)	Name:	Not known
b)	Kind of vessel:	Cargo ship
c)	Type of vessel:	Flat deck
d)	Main dimensions:	L X B X D = 87.6 M X 9.8 M X 7.7 M
e)	Gross tonnage:	Estimated 2,000 tons
f)	Kind of main engine and horsepower:	Estimated reciprocating engine 1,000 HP
g)	General arrangement & structure:	See in the attached drawing.
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-50" S 112°-42'-40" E

k) Distance from the port: 18 sea miles from Surabaya Port

l) Ship's head: WNW

m) List & trim: 1° to the starboard
0° to the horizontal slanting

n) Buried condition: See in the drawing.

o) Condition of hull: Sandy mud was piled up.

p) Corroded condition: The deck and the shell Plate were covered by oysters & sea weeds in seriously corroded conditions.

q) Sounding around the vessel: At the bow: 14.5 M
At the midship (p): 9.2 M
At the midship (s): 8.0 M
At the stern: 9.2 M
(Measured 1100 – 1200 hrs Dec. 3, '79)

r) Sea bed: Sandy clayey mud & flat.

s) Visibility: 0.2 – 0.3 M

t) Tidal difference: High tide: 2.1 M, Low tide: 0.2 M
Difference: 1.9 M (as of Dec. 3)

u) Direction & velocity of tidal current: Southerly & northerly current
Max. 1.9 knots

v) Damaged condition & others:

i) 1.5 M from the fore partition wall of the engine room to the bow cracks were traversed horizontally, 0.7 M at maximum wide.

ii) These cracks were traversed from the shell plating to the bottom.

iii) 12 M from the stern to the bow, the deck was cracked in 2 meters wide, traversing side to side, and buried at this section.

iv) Like the other sunken vessels the deck was eroded much, only some beams being left.

v) Part of the bridge except the surrounded walls was almost swept away.

vi) It is presumed that the windlass remained, but the winches were swept away.

vii) Chain anchors and chains were gone, while a rudder and a propeller remained as they are

viii) About 2 meters below the deck on the shell plating there were several artificial openings (0.5 M X 0.5 M each) here and there.

ix) The sandy mud inboard was piled up to 2 meters below the deck in the No. 1 & 2 hold, and up the deck in the engine room and No. 3 hold.

x) Due to the poor visibility and rapidness of tidal current, so the diving working hour was very much restricted. (This could be explained as the same in the survey of No. 2, 3, 4 sunken vessels.)

w) Estimated scraps: 900 tons

5) No. 5 Sunken vessel

	Date of survey:	From December 5, 1979 to December 9, 1979
a)	Name:	Not known
b)	Kind of vessel:	Cargo vessel
c)	Type of vessel:	Flat deck
d)	Main dimensions:	L X B X D = 106.5 M N 12.0 M X 9.5 M
e)	Gross tonnage:	Estimated 4,000 tons
f)	Kind of main engine and horsepower:	Estimated recirporeating engine with 2,500 HP
g)	General arrangement & Structure:	See in the attached drawing.
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-50" S 112°-42'-52" E
k)	Distance from the port:	About 18 miles from Surabaya Port
l)	Ship's head:	E
m)	List & trim:	40° to the starbord
n)	Buried Condition:	See in the attached drawing.
o)	Condition of hull:	Not known
p)	Corroded condition:	Due to oysters and sea weeds, the deck was seriously corroded. The shell plating out of the mud level was covered by oysters and sea weeds.
q)	Sounding around the vessel:	At the bow: 9.5 M At the midship (p): 6.0 M At the midship (s): 6.0 M At the sterm: 15.0 M (As of December 7, 1979)
r)	Sea bed:	Sandy clayey mud and flat
s)	Visibility:	0.2 – 0.3 M (with flashlight)
t)	Tidal difference:	High tide: 1.6 M, Low tide: 0.2 M Difference: 1.4 M (Dec. 7, '79)
u)	Direction & velocity of tidal current:	Southerly & northerly current Max. of 1.1 knots

v) Damaged condition & others:

i) Nearabout the midship, the hull was almost buried.

ii) Oysters and sea weeds covered all over the ship in 10 – 15 cm or so thick.

iii) A rudder and a propeller remained as they were.

Regarding the above sunken vessel, the sea conditions were so bad that divers couldn't suvey thoroughly and introduced a brief outline of the survey.

(4) Observational method and result of the climate and the sea conditions

1) Observational method of the climate and the sea conditions

a)	The climate:	By observation
b)	Temperature:	It was measured 1.0 – 1.5 meters high above the ground under the shade in favourably ventilated conditions.
c)	Wind direction:	A magnetic compass in the "BOGA" was used to measure by observation.
d)	Wind force:	Judging from the wind scale of "BEAUFORT SCALE", it was measured by observation.
e)	Wave:	Like the wind force, it was measured by observation.
f)	Swell:	Like the wind force, it was measured by observation.
g)	Water temperature:	By catching sea water in the bucket, it was measured by a sticktype thermometer.
h)	Current direction:	With the help of a magnetic compass in the "BOGA", it was measured by observation.
i)	Velocity of current: (Current velocity)	A mooden stick was cast from the upper to the down current for the distance of 10 meters alongside the "BOGA" and a time lap was calculated. This was repeated three times and a mean value was calculated out of the three.

S-4-2 Examination of Removal Method

S-4-2-1 Selection of Removal Method

It is common that the method is to cut the full into several sections, to list, and shift them for the removal.

Although there are many ways to cut, the following are considered to be the most common in Japan.

1) Underwater oxy-arc cutting
2) Underwater gas cutting
3) Underwater blast cutting

Regarding the last method, it was commonly combined either the first or the second method to employ depending upon the salvage engineer's selection. Therefore, there introduced the first and the second methods to refer in the following.

S-4-2-2 Weight Calculation of Sunken Vessels

No. of Sunken Vessels	2	3	4	6
Weight (Ton)	370	1700	1850	900

S-4-2-3 Examinations for Cutting Method & Cutting Position

Cutting partition for each sunken vessel

1) Two diver's boats are used, each manning four divers or two squads for the cutting work.

2) By arranging two divers' boats one, at the bow and other at the stern, the hull is cut simultaniously both from the bow and the stern.

3) In order to remove oysters and sea weeds as well as rust, an air scrapper and a small quantity of dynamite are jointly used.

4) The working hours are four hours per day (depending on the tide table) and the length of a cutting block should be 7 meters per pair of divers (one diver & one assistant).

5) Each sunken vessel should be cut from inside to outside.

(2) Cutting plan

After surveying the sunken vessels, the examinations are made for hull structures and the part to be cut. In this case, the following should be borne in mind.

1) Confirmation for the location of partitions

It is very important to confirm the exact location of a partition (bulkhead) before implementing the cutting & removal work. Once it is confirmed and recorded in the drawing, the cutting location is decided to implement the work.

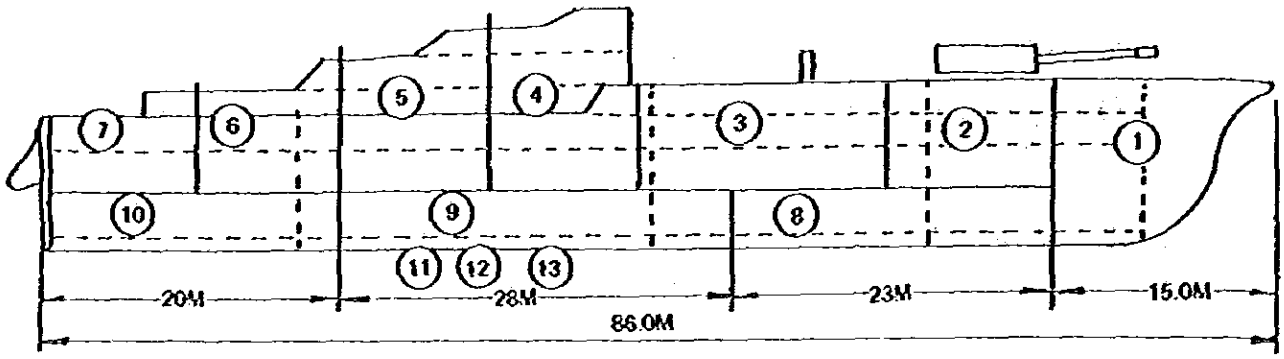
2) The engine room should be considered as one block when the cutting position is determined as there are many machines and equipment in it. However, when it is lifted by a crane, it can be dismounted per each machines respectively in case the weight is too heavy.

3) It should be planned to make use of any cargo hatch for cutting, simply because the cutting length can be reduced much, and the work can be curtailed the work.

(3) Cutting partition for each sunken vessel

1) In case that 200-ton capacity floating crane is mobilized the weight of one block should be of 150 – 160 tons.

a) Cutting partition for No. 4 sunken vessel



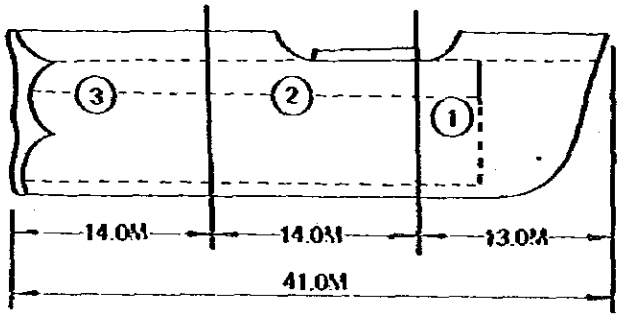
Weight distribution of each block

1	160 tons	2	150 tons	3	180 tons
4	170 tons	5	170 tons	6	150 tons
7	150 tons	8	100 tons	9	150 tons
10	100 tons	11	100 tons	12	130 tons
13	130 tons				

Total: 1,850 tons for thirteen blocks

b) Cutting distribution of No. 3 sunken vessel

i) The bow



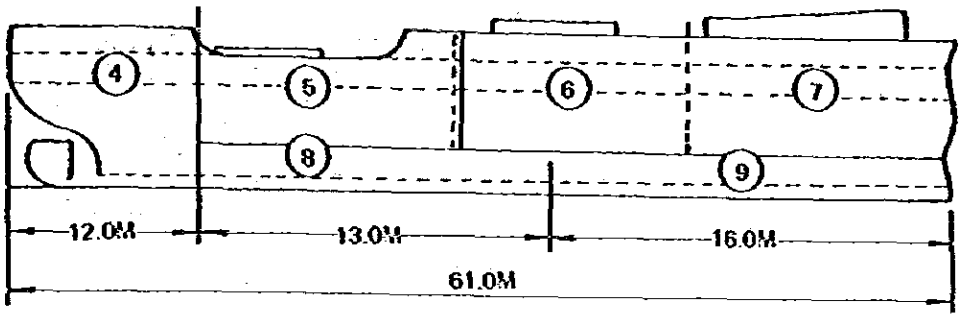
Weight distribution of each block

1	170 tons	2	160 tons	3	170 tons

Total: 500 tons for three blocks

ii) The stern

4 160 tons	5 170 tons	6 170 tons
7 170 tons	8 160 tons	9 150 tons



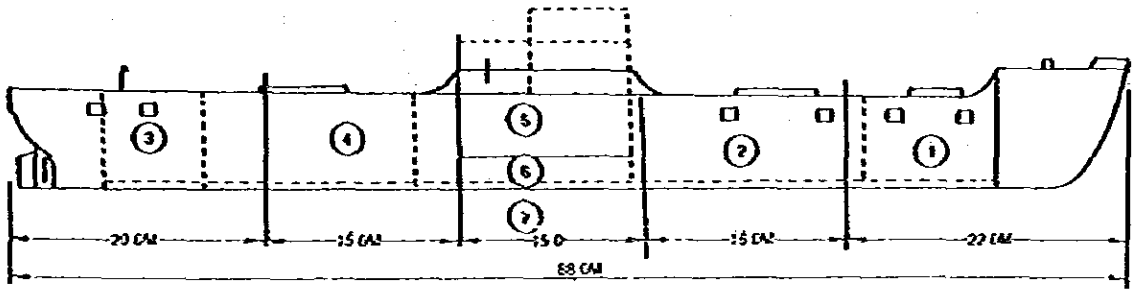
10 120 tons (machinery) 11 100 tons (machinery)

Total: 1,700 tons for eleven blocks

c) Cutting distribution for No. 2 sunken vessel

The total weight of this sunken vessel (370 tons) is rather light, so she'll be refloated by the 500 ton floating crane as a whole. Otherwise the vessel is divided into the midship, the engine room, and an engine, each one of which is considered less than 100 tons. It will cost more if lighted one by one by the 200-ton floating crane.

d) Cutting partition for No. 6 sunken vessel

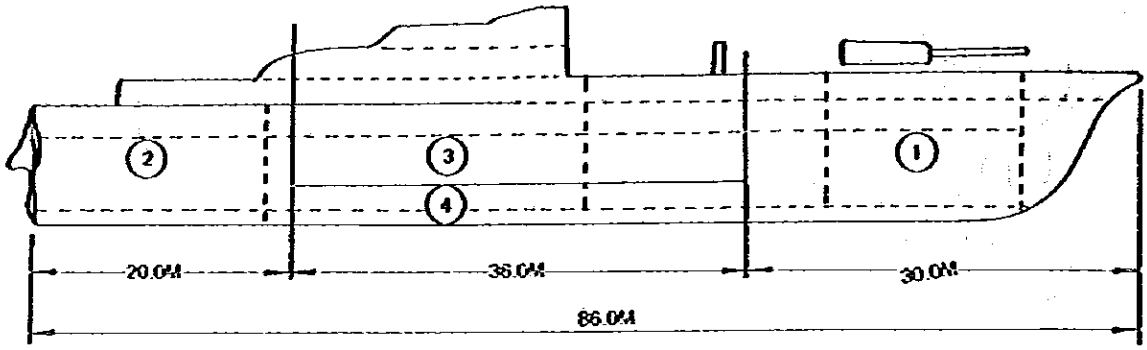


1 160 tons	2 140 tons	3 140 tons
4 150 tons	5 110 tons	6 100 tons
7 100 tons		

Total: 900 tons for seven blocks

2) Removal operation 500-ton floating crane
Each block should weigh 450 to 470 tons.

a) Cutting partition for No. 4 sunken vessel



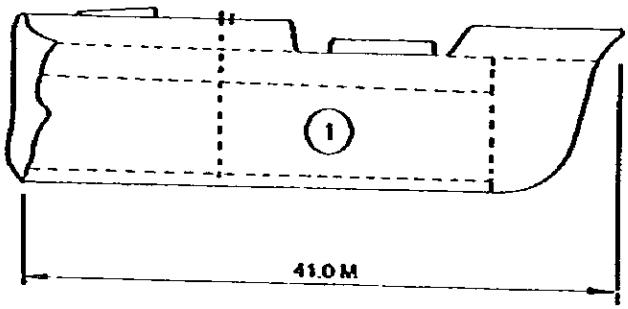
Weight distribution for each block;

1 410 tons	2 400 tons	3 430 tons
4 420 tons	5 190 tons	

Total: 1,850 tons for five blocks

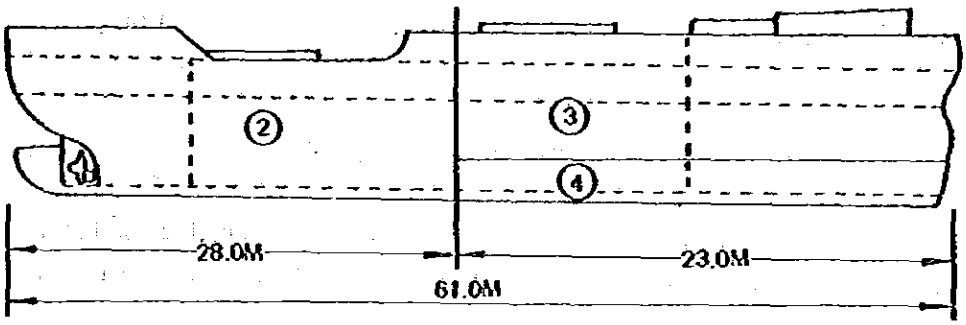
b) Cutting partition for No. 3 sunken vessel

i) Fore section



Weight distribution for each block;
1 500 tons

ii) After section



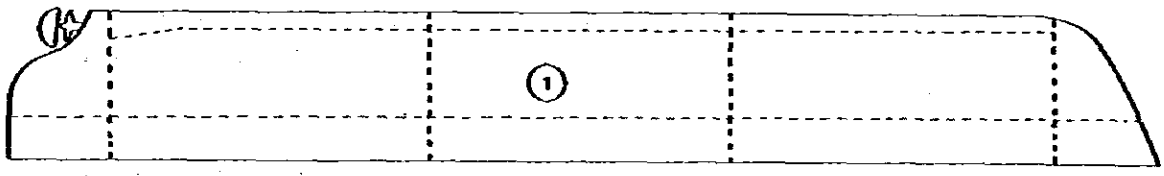
Weight distribution for each block;

2 420 tons 3 340 tons 4 440 tons

Total: 1,700 tons for four blocks

c) Cutting partition for No. 2 sunken vessel

The sunken vessel weighes 370 tons as a whole, so that she'll be refloated by lifting as one block.

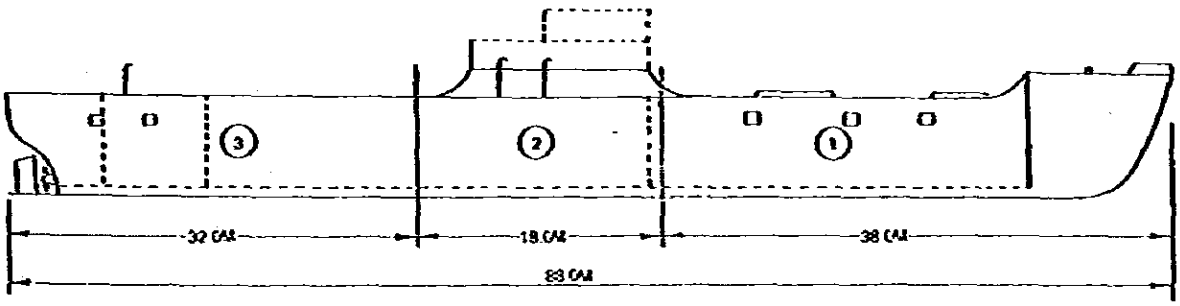


d) Cutting partition for No. 6 sunken vessel

Weight distribution for each block;

1 300 tons 2 300 tons 3 300 tons

Total: 900 tons for three blocks.



(4) Comparison of a cut block by either 200 ton or 500 ton floating crane

Sunken vessel ⟶	No. 4	No. 2	No. 3	No. 6
200 ton floating crane	13 blocks	–	11 blocks	7 blocks
500 ton floating crane	5 blocks	1 block	4 blocks	3 blocks

Note 1 Cut length of sunken vessel
The cutting operation is made from inside the vessel.

(1) The cutting of the double bottom is made firstly by cutting the inner bottom plate (Tank top plate), secondly by removing each floor in the bottom, and then by cutting bottom plate.

(2) The cut lengths of shell plate, deck, bottom plate are figured out on the table, at the time of the initial study of the hull structure, by the use of the scale.

Note 2 The weight of the block is that of the block itself added to the mud suction power. In this connection, the following steps are taken to reduce this power.

(1) When the bottom of the hull is lifted, the sea water is to be introduced by lifting up one side of the block, in between the bottom of the hull and the mud.

(2) A room can be secured between hull bottom and mud when the sling wires are installed.

(3) The dynamite is frequently used for removing the rot of the outer plate causing the vibration. The vibration works faborably reducing the mud suction power. The mud suction power is strong and weights, in some instance, almost 10 times as heavy as vessel itself. Therefore, it is very important to reduce the mud suction power.

Note 3 No mention is made concerning the charge of the floating crane to be towed. This is because the estimate is on the basis that the floating crane is available in Surabaya port.

Detailed comparative costing table by the capacity of floating crane and cutting method

Item \ Sunken Vessel			No. 4	No. 3	No. 6	No. 2
200 ton floating crane	Number of cut block		13	11	7	
	Cut length (M)		±430	±460	±310	
	Under water oxy-arc cutting	Period (day)	110	117	115	
		No. of mobilization (man, day)	3080	3276	3220	
		Cost (R.P.)	570,531,500	549,186,000	517,882,750	
	Under water gas cutting	Period (day)	124	133	125	
		No. of mobilization (man, day)	3472	3724	3500	
		Cost (R.P.)	641,138,300	624,264,300	567,602,200	

Item \ Sunken Vessel			No. 4	No. 3	No. 6	No. 2
500 ton floating crane	Number of cut block		5	4	3	1
	Cut length (M)		±270	±190	±114	0
	Under water oxy-arc cutting	Period (day)	75	84	84	47
		No. of mobilization (man, day)	2100	2352	2352	1316
		Cost (R.P.)	421,938,000	445,585,250	404,855,000	209,156,750
	Under water gas cutting	Period (day)	84	91	90	
		No. of mobilization (man, day)	2352	2548	2520	
		Cost (R.P.)	465,969,900	483,313,600	448,569,000	

Detailed comparative costing by the capacity of floating crane and cutting method

Item		Sunken vessel	No. 4	No. 3	No. 6	No. 2
200 ton floating crane	Under water oxy-arc cutting	Vessel expenses	77.38%	76.07%	74.56%	
		Personnel expenses	3.47	3.83	3.99	
		Equipment expenses	7.91	8.70	10.06	
		Consumable expenses	1.30	1.37	1.31	
		Site expenses	0.85	0.94	0.98	
		General expenses	9.09	9.09	9.09	
	Under water gas cutting	Vessel expenses	74.36%	72.88%	72.12%	
		Personnel expenses	3.48	3.83	3.96	
		Equipment expenses	10.94	11.90	12.54	
		Consumable expenses	1.30	1.38	1.33	
		Site expenses	0.83	0.91	0.96	
		General expenses	9.09	9.09	9.09	

Item		Sunken vessel	No. 4	No. 3	No. 6	No. 2
500 ton floating crane	Under water oxy-arc cutting	Vessel expenses	78.24%	77.66%	76.34%	74.84%
		Personnel expenses	3.20	3.39	3.73	4.04
		Equipment expenses	7.14	7.61	8.44	8.55
		Consumable expenses	1.46	1.36	1.42	2.40
		Site expenses	0.87	0.89	0.98	1.08
		General expenses	9.09	9.09	9.09	9.09
	Under water gas cutting	Vessel expenses	75.34%	74.97%	72.01%	
		Personnel expenses	3.24	3.39	3.61	
		Equipment expenses	9.97	10.40	13.03	
		Consumable expenses	1.50	1.35	1.34	
		Site expenses	0.85	0.87	0.93	
		General expenses	9.09	9.09	9.09	

S-5 Most Adequate Method and Expenses

S-5-1 Provision of Machines and Equipments

(1) General equipments

General equipments like diving apparatus, underwater cutting equipment, mud removal apparatus, diving pontoon etc. are the indispensable equipments for the removal of vessels and, different from the big equipment like floating crane, are not so much expensive that the improvement and arrangement thereof at an early stage are recommended. DMS is supposed to utilize the equipments including diving apparatus used this time by the Japanese Team and to have the Indonesian private companies versed with the equipments.

(2) Survey boat

The aim of employing the survey boat is to catch the detailed information about the sunken vessel and to map up the basic plan. In Indonesia, DMS owns the equipments for survey, but does not own survey boat. It is said that several hundreds of vessels are sunk in Indonesian waters. The situation of the vessels is only clarified in the "Matsukura Report" which was drafted 20 years ago. Since then, no up-to-date report has been prepared. The survey boat can be used not only for the purpose of survey but also for tug of, say, floating crane. Its operation extends to the incipient work necessary to the vessel to sink, blocking the oil pollution, having access to the situation of vessel and performing the facile type of salvage.

Therefore, the survey boat is very helpful.

(3) Floating crane

The floating cranes in Indonesia are three in number. One is operated by PT. Yalagada, 5 years of age and of lifting capacity 170 tons. Another two are of lifting capacity 140 tons each. The three floaters are all aged and workable only within the port area of JAKARTA and SURABAY. It is unable for them to be towed to other places. There are still many vessels sunk in Indonesian waters. As the existing floating cranes are getting aged year after year, it is considered that new floaters are better be procured although the foreign flag floating crane may be employed for the time being. Floating crane can serve multi-purposely, not only for the removal of the sunken vessels. In the case of the new procurement, thorough study must be made concerning fund, maintenance, capacity etc. As regards the capacity, the most appropriate figure will be 500 tons or the like.

List 5-2-13 For reference: Outline of desirable Survey Boat

1.	Gross tonnage	200 – 300 tons
2.	Type	Tug type
3.	Navigation area	Indonesian waters
4.	Main engine	Diesel 2,000 HP
5.	Propulsion	Port nozzle twin screw
6.	Accommodation	For 20 persons to dwell
7.	Cargo gear	3 tons derrick
8.	Mooring	Feasible to moor at 4 points
9.	Navigation equipment	Radar etc.
10.	Communication system	VHF etc.
11.	Recompression apparatus	Small recompression tank Provided
12.	Towing gear	1 type
13.	Survey equipment	Side scan sonar Portable echo sounder Portable current meter
14.	Others	Under-water cutting apparatus Pumps

S-5-2 Most Adequate Method of Removal Operation and Cost Analysis

(1) Most Adequate Method

The method of removal of sunken vessels should be determined taking into account the aggregate cost and the vaule of the vessel removed.

Usually the refloating method, by which a vessel shall be removed as one whole substance, is examined visualizing the vessel's operation once again. Even when it has been made clear that this operation is infeasible and value of the vessel is only that of the scrap, the refloating method still remains to be the subject of examination because of the curtailed period of operation and of the reduced cost. In this occasion, there exists a problem of risk which can not be ignored from the point of view of the completion of operation. The removal operation is usually conducted based upon the fixed amount of charge.

So, the salvor will not dare to undertake the operation on the fixed amount unless the possibility of removal is made quite definite. Because, if he fails, everything goes on to his shoulers for his responsibility. Any preliminary arrangements for the removal operation, employing a lot of equipments and salvage personnels, arranging for quite a long period, might become nullified once a storm may act positively weighing the risk involved. In that case the term of contract is principally "No Cure, No Pay". If he succeeds, he earns much more than the cost he bears. It has been made clear by the survey performed in Surabaya port that the sunken vessels on the list of the Indonesian Authorities have slept beneath the sea neary 40 years.

The vessels are so heavily rotted, rusted and deteriorated that very few vessels will be removed by refloating method. Therefore, only cutting and lifting method will be adopted. The specific features of the cutting and lifting method are:

1) Techincally speaking, the weight of the basic operation is great.
2) A lot of equipments are dispensed with.
3) Salvor's risk is minor.
4) By introducing a piece-work payment system, even minor company of little fund can undertake the operation.

The Indonesian salvors performed and experienced the salvage (not the removal) of the sunken vessels, operated by the refloating method or practiced the lift of the vessel employing two salvage boats. They are thus skilful in adaptation to the requirements of the case, and, under the circumstances, the cutting and lifting method is, we believe, employed by them without any technical trouble.

Hence, we conclude that the best choice is not other than the cutting and lifting method.

(2) Expense

When the adoption of the operation method is decided, the relevant expense is forcedly figured out. The total sum is, as mentioned in 5-1, the aggegate of expense of equipments, personnels, supplies and of the administration. Another assortment of the expense shall be made according to the operation as follows:

1) preliminary survey
2) preatrangement
3) removal of mud/sand
4) cutting
5) operation of floating crane
6) withdrawal

Above 3), 4) and 5) are the major items of expenditure. As regards the removal of mud/sand and the cutting operation, we described in chapter 4 (model case) and in 5 to the effect that there exists an improved manner of operation which can be introduced to the manner currently adopted in Indonesia. The manner thus introduced shall be the most efficient manner of the operation. As regards the floating crane, the charter of floating crane of big capacity from Singapore, Japan and other South-East Asian areas is feasible.

However, the charge of bringing the floating crane longway to Indonesia is so expensive that the employment of the Indonesian domestic floating crane is most advisable.

S-6 Expected Effects

S-6-1 Improvement of Safety Navigation

Removal of sunken vessels in the waters of Indonesia is necessary for improvement of safety navigation as mentioned already, and so expected effect by removal of sunken vessels is to prevent outbreaks of maritime accidents caused by sunken vessels.

Maritime accidents occurs from various causes as follows; weather and sea condition, state of ship performance and facilities, and their maintenance, breadth and bend of passage, navigation aids, traffic of vessels, knowledge and technique of navigator, and etc. which interact, directly or indirectly. Accordingly in order to prevent maritime accidents from happening, it will be necessary to improve every cause and to work out counter-measures against them from the sysnthetic viewpoint.

Removal of sunken vessel is one of such countermeasures as that in which only economic evaluation in qualitative can be made and no economic evaluation in quantative is to be made because of lock of data and time limination. Improvement of navigational circumstances have great weight with general policy for prevention of maritime accidents and there is no need to dwell upon that removal of sunken vessels will contribute extensively to prevention of maritime accidents. Namely, the removal of sunken vessels in passages and anchorages leads to increase in breadth of passage and width of anchorage, and to improvement of bend of passage, and durthermore results in dissolution of passing and meeting with each other, or of psychological apprehension of navigator. It can be said that removal of sunken vessels has significant meaning for safety navigation in Indonesian waters.

S-6-2 Dissolution of the bottleneck for port improvement

The second effect by removal operation of sunken vessels is dissolution of the bottleneck for port improvement. Removal of sunken vessels will be expected to have following immediate effects on navigation of vessel.

(1) There would be not waiting time to enter into or leave the port because of larger capacity of traffic by gaining in width of passage.

(2) It will become possible to reduce the range of the guidance by sea pilot.

(3) It can be possible for vessels to enter into or leave the port easily, additionally at night.

Besides, completion of removal of sunken vessels could make dredging easy, of which smooth operation would lead to increase in depth and breadth of passage.

For instance, in Western Channel of Surabaya port the navigational depth and width of passage have been maintained by dredging more than 2 million m^3 mud and sand annualy, which has been impeded by sunken vessels distributed in those area. Therefore, dredging operation would be promoted smoothly upon completion of removal of sunken vessels. Consequently, large sized vessels half loaded or waiting for high tide so as to enter into or leave the port could have their shipping movement at any time.

That is to say, as mentioned above, it is expected to reduce transportation cost by dissolution of the bottlenecks and by acceleration of port improvement.

S-6-3 Spreading Effect

Removal of sunken vessels brings not only such direct benefits to navigators as improvement of safety navigation but also some derivative ones.

The first of them is the recovery of steel scrap.

For example, Japan had removed many sunken vessels during 1950S. At the beginning, Japan had planned to solve the problem of shipping shortage with removal by defloating of sunken vessels which had been obstacles to navigation inner and outer harbor. Then, removal operation of sunken vessels in more than 30 m depth has been carried out for the purpose of recovery of steel scrap, even though those vessels were not so direct stumbling blocks to safety navigation. In those days Japan was in postwar rehabilitation period and not well provided with such modern facilities for steel manufacture as large sized blast furnace yet in spite of vigorous demand for steel. The recovered steel scrap from sunken vessels were utilized as rerolling or melting. Accordingly price level of scrap exceeded cost for removal operation of sunken vessels, which has been smoothly carried out on commercial base in many cases.

Following is examined from a viewpoint of such experience as above.

It is the present state that steel can be supplied sufficiently, of which price is relatively low because of world-wide spread of steel manufacturing method. There are thirty steel manufacturers in Indonesia and they have capacity to supply one million ton of bar and angle per year. On the other hand, sunken vessels are buried in mud, which makes increment in cost for removal operation.

Subsequently, the recovery of steel scrap as a resource of iron would be unprofitable in Indonesia. But removal of sunken vessels is expected to have a fair part in recovery of steel scrap, considering that steel scrap has an inclination to be short supplied in Indonesia.

The second is that opportunity of employing would be found.

The removal operation of sunken vessels requires some labor, and still more, in the process of breakdown into small pieces of recovered scrap a considerable amount of labor is indispensable. So, it is more effective to get opportunity of employment in the consecutive processes; removal operation of sunken vessels – disposal of scrap – recovery of steel scrap to be manufactured. Accordingly it is necessary to formulate each plan on the premise that removed vessels should be dumped to the point where the price of scrap could be estimated high.

Besides, all staffs including divers who have much experience in actual removal operation of sunken vessels will be expected to contribute to emergent rescue in maritime accidents or to implementation of ocean development projects.

S-6-4 Investment of Expenditure

To pay the consideration prevention of outbreaks of maritime accidents by the removal of sunken vessels would bring benefits to navigators and furthermore have excessive public significance as well as other plans to prevent traffic accidents from happening have. So, removal operation requires enormous expenditure, and the leading role for handling of the operation should be naturally taken by the Government so as to maintain public order and welfare. The Government should take initiative in promoting the provision of intra-structure. And there is no doubt that the Government's administration would play major role.

Basically important points of administrative management are as follows.

(1) To give the priority to the investment of expenditure for safety countermeasure.

Needless to say, the expenditure is necessary for promotion of any countermeasure. It is one of the most important administrative methods for the Government to invest the necessary and enough fund in the measure of prevention against maritime accidents. Accordingly it is considered to be necessary to take financial action with courageous decision to remove the sunken vessels which are obstacles to navigation.

(2) To install the countermeasure in early opportunity

Past countermeasures for safety have begun to be taken in the occurrence of maritime accidents, which has been sustained by the so called "Empirical Rule". It is quite necessary to take the initiative to promote the countermeasure, always looking for ahead in future.

7 GENERAL RECOMMENDATION

S-7-1 Summary

Expressing briefly the history of salvage operation in Indonesia, since the year 1960, when the International Salvage Association (ISA) was active, till the year 1965, the removal of sunken vessels has been carried out mainly around wharf and anchorage in such major ports as Jakarta, Surabaya.

Project for removal of sunken vessels is not only unobtrusive but also of little appeal to the public, in spite of importance, in comparison with such projects as construction of roads, airports, ports, etc. In this context, it is the current state that the project is partially left as it is with the policy to control nonessential expenditures for Government which is now seeking for re-establishment of the national budget.

Problem of safety navigation has become highlighted again, as numbers of ships entering and freight remakably increased for four years commencing 1972 to 1975 in the Surabaya port, for example, and ships enlarged reflecting expansion of economic development and of foreign trade.

From the viewpoint of safety navigation, navigator could easily identify location of the sunken vessel at the time of sinking because a part of the sunken vessel appeared above the surface of water. But, now, as years rolled by every part of hull sank into water because upperstructure above the surface corroded to breakdown or bottom of vessel was buried in mud of sea-bed.

For navigator, therefore, it is almost impossible to perceive by the eye the location of sunken vessels. As the affect of sunken vessels on the safety navigation has become more vicious than at the beginning, recently considerable numbers of maritime accidents caused by sunken vessels have been reported and psychological apprehension for navigator has been increased.

Touching upon actual state for carrying out salvage operation of the sunken vessels, it is current state that upperstructure of the hull collapsed and scattered into the sea due to corrosion, both inside and outside of the each sunken vessel were piled up with a large quantity of mud, and accordingly most sunken vessels subsided and dipped in the sea-bed. For this reason, in salvage operation it is needed to get rid of mud inside and outside sunken vessels as the first step. Then, the method of salvage could be limited to cutting and lifting because main parts of the hull to which sea creatures such as oyster attached seem to be too decayed and fragile to be refloated as a whole due to corrosion.

In formulating salvage plan and implementing the operation, the largest constraint factor in the natural conditions is extremely low water visibility in Indonesian waters, so diving operation is to nearly grope about in the water. Consequently, it is very hard for supervisor of the operation to accurately grasp real situation of the site in water, to say nothing of difficulty in carrying out diving and psychological apprehension for diver. If the water visibility is sufficiently high, necessary facts and information could be easily transmitted by hydro-photographing, water-TV camera, etc., thereby multiple studies could be made, as the waters are comparatively shallow. On the contrary, as the above method could not be applied to the waters, acceleration of the operation on survey and removal of sunken vessels is impeded even in not so deep water for diving. Challenge to the mud/sand in water induces to a leading factor to increment of difficulty in planning and costs for removal.

Paying consideration to the above problems, the following is a summarized result of the survey we have made this time.

7-2 Intent of Government of the Republic of Indonesia

The government of the Republic of Indonesia, firmly recognizing the importance of project for removal of sunken vessels to secure safety navigation in promotion of economic development, places high priority on it in the Third Five-year Economic Development Plan commencing 1979/1980 following 1st and Second Five-year Economic Development ones.

For efficient and effective operation of the project, the government has requested the government of Japan to extend technical cooperation on transfer of technology to formulate a basic plan for removal of sunken vessels and to implement its plan.

Historically, the Government of the Republic of Indonesia had initially had a Japanese salvage company make diving survey to identify locations of the sunken vessels in 1959 – 1960, then let joint ventured company remove 53 sunken vessels in 6 main ports. In 1965, the private salvage company was set up to take over operational machines and equipments from the joint ventured company, thereafter the Government has kept the consistent stance to let the national salvage company carry out the operation. The Government is not only expected to hold existing policy hereafter, but also has the intention to tackle this project from the medium and longer term viewpoint, having a plan to procure machines and equipments to be made use of and to educate and train personnel required for efficient operation of the project.

7-3 Management and Operational System

The Government of the Republic of Indonesia, in accelerating to salvage sunken vessels in tremendous numbers being unparalleled in other countries, took the first step to set up the Interdep committee in 1960 composed of all departments in charge of administration of sunken vessels by issuance of the Presidential Decree No. 333 dated Dec. 20, 1960, then promoted contracting to implement the operation by inviting foreign salvage companies, set up and reinforced the private salvage company in the country and established a new administrative body exclusively in charge of removal of sunken vessels. At present, Directorate General of Sea Communications, having taken over the competency of the above body, is authorized to give permission of establishing company within purview of salvage and under-water-work services, to regulate to offer tender and to place order only to the registered companies authorized.

Directorate General of Sea Communications, introduces, too, permission system for respective salvage operation, so that administrative management system is considered to be more completely provided than any other oceanic countries.

However, there are some problems in respect of its operation. First of all, supervisory authorities concerned does not have detailed record on the salvage operation in the past as well as surveyed data on actual state of the sunken vessels. These record are absolutely necessary in order that data obtained by colossal sum of cost expenditured may be reflected in coming plan of salvage operation or that bottlenecks may be elucidated to operate forthcoming salvage more effectively. In case of deciding the priority given to sunken vessels in the salvage operations, further coordination is needed among the concerned.

In Japan, when the World War II ended, main ports and fairways were almost blocked on account of the sunken vessels including warships in many places around the sea waters of Japan. On top of that, mines and torpedoes were scattered all around the seaways and, therefore, the navigation of the vessels were very dangerous. Under the circumstances, the Government of Japan or the Ministry of Transport stepped into the clearance of the fairways.

(1) Clearance of fairway

The Maritime Safety Agency, the Ministry of Transport, surveyed the main ports and straits with a result that Osaka port, Kobe port and Shimonoseki strait were designated as to be cleared in the first priority, and contracted with the salvage companies for the removal of the sunken vessels.

For this purpose, insurance companies and shipowners in possession of the sunken vessels were requested to sell the scraps to the scrap dealers.

(2) The clearance of the other ports and straits was carried out on the commercial basis and the sunken vessels were cleared one after another based on the contract between the salvage companies and the insurance companies etc. As regards the warships, the Ministry of Finance appears as an owner and sold by bid the sunken vessels to the salvors who in turn sold the scrap to the iron manufacturers to cover the cost. The obstacles were thus cleared and the safety navigation was brought about. It took several years from the beginning.

(3) The Government of Japan sold the scrap to the salvors at the reasonably low price, and no other favorable steps were taken by the Government to the salvors. The salvors were financed by the commercial bank based on the removal contract. They raised money, by selling the scraps, for the vessel and equipments needful for the operation.

7-4 Policy and System

Expenditure for salvage operation is a sort of investment for provision of infrastructure, so that it is needless to say that necessity is to raise efficiency of investment (cost).

Directorate General of Sea Communications not only stands in a position of placing order, but also should pay attention to nurturing sound private salvage companies in order to perform steadily salvage operations.

In this connection, although four leading private companies are dependent upon highly order awarded from the government, it is of necessity for the Directorate General of Sea Communications to place stably orders of salvage operation and to level off the volume of order by which the companies could be able to modernize the machines and equipments, to secure required personnel and to improve the efficiency of operation. To this end, to make efforts to secure sufficient source of revenue for this operation is essential.

As witnessed in the articles of cost analysis, in the Republic of Indonesia modernization in machines and equipments is earnestly desired, in particular what is short of among them is a kind of ship such as floating crane with big capacity, etc.. If each of these machines and equipments is owned or chartered by an individual company alone, rate of operation would be lowered, and reduced efficiency will ensure. Therefore, to avoid overlapping huge investment, it is desirable that these machines and equipments owned by the government should be in common use or those jointly owned by companies concerned should be collectively utilized. And if ship are chartered from foreign countries, which is one of the most effective ways, the Government should study and examine such method of placing orders as the chartered ship in one navigation should be consecutively in use for removal of several sunken vessels.

Furthermore, as to machines and equipments imported efforts should be actively made to exempt them from customs duties in so far as these are not made by domestic producers and as no competitors appears in the country. In addition, it is desirable that supply system of materials should be consolidated so as to realize the on-the-spot supply.

7-5 Provision and Supply Plan for Machines and Equipments

Although views on the plan has been indicated in the preceding Article on the assumption that the above could apply elastically on step-by-step basis in the situation of financial stringency, it is desirable to consider future effective provision and supply plan for machines and equipments if determined to proceed removal operation of a numerous number of sunken vessels as shown in the Article 1-2, with the medium and long term prospect.

As, in Chapter 6, the detailed examination had been made, here is shown the typical machines and equipments as follows:

Vessel	Specification	Price (CIF in Jakarta) US $
1. Floating Crane (self propelled type) 2000 PS	Hoisting capacity 500 ton	approximately 13.5 million
2. Salvage Tug/Survey vessel	Gross Tons approximately 390 T Engine 1000 BHP x 2 sets	Approximately 4.5 million
3. Salvage Support Vessel	Gross Ton approximately 110 T Engine 250 BHP x 1 set	approximately 2.0 million

The required amount for provision of the above is approximately US$20 million, for procurement of which necessary budget should be secured. The comparison between in present state and in future state when new machines and equipments are supplied has been already made in chapter 4.

7-6 Education and Training of Salvage Personnel

In the Directorate General of Sea Communications of the Republic of Indonesia, there are 8 divers in charge of the preliminary survey on sunken vessels who, having diving license at 2nd class of U.S. Navy, are considered to have no difficulty in their diving techniques to dive in 20 meters of water. As most of diving personnel at the master level in the salvage companies once had training in Japan, European countries, etc., they are sufficiently qualified to handle salvage operation by means of training newly employed personnel. In addition, as the plan is being put forward as to further provision of the facilities in training institutes which covers up to advanced diving techniques, it is expected that both quality and quantity of divers can be improved when the above plan is completed and put into operation.

For the divers in the Directorate General of Sea Communications, the following works should be performed for themselves, even if actual operation of salvage will be done by private salvage companies; (i) identification of the location of sunken vessels left alone in major ports, (ii) preliminary survey on their actual states, (iii) technical survey to carry out salvage operations, and (iv) inspection after the salvage. Particularily, the survey mentioned above (iii) is aiming at obtaining fundamental data to examine the method of and to estimate cost for salvage operation, and the result of survey might affect accuracy in calculation of the cost, namely, it makes difference between budget appropriated and actual cost at times according to its result. Therefore, as referred to in Chapter 5, the diving survey should be carried out on the basis of the most adequate method of salvage taken in the past, grasping the detailed points like the cutting part, and then reflecting the result in the coming operation. For this purpose, the divers in the Directorate, in our opinion, should always attend actual operation of salvage for which the government placed order.

8 PROPOSAL

This study on planning the removal of sunken vessels as stated in the preface has been made for the purpose of formulating a basic plan on the removal of sunken vessels in the Republic of Indonesia, and of transferring its technology to the Directorate General of Sea Communication to implement the plan. As to the transference of technology of removing the sunken vessels, the technology varies according to such conditions as of type and scale of the sunken vessel, situation of sinking, etc. and, salvage operation itself should be handled on case by case basis because it is largely affected by natural conditions, etc. of the site. So that, there are so many factors specific to this technology which differ from unified on pertaining to commodities producing industries. This study team, therefore, from Japan, modeled after several sunken vessels located around Buoy No. 4 in west channel of Surabaya Port as the example, has made the diving survey by having brought divers with a plenty of experiences as well as by having transported machinery and equipment from Japan. Then the team has researched and examined into the most adequate method and cost, required machines and equipments, etc., taking account of the actual conditions in the area.

There are various views of the sunken vessels, but it had better touch upon its reality here. There prevails a nearly established recognition among owners/operators of ships that a large number of sunken vessels are left as these are in the main ports in the Republic of Indonesia, for the reason of which they are inclined to hesitate introducing newly produced ships with a colossal sum of investment because of the sunken vessels being obstacles to safety navigation. In promoting economic development in the Republic of Indonesia, though further provision and modernization of ports is obviously the basic one among other things in infrastructure, as a precondition of realizing the above, it is necessary to improve safety navigation and restore navigators' confidence. To this end, though there are such alternative plans as provision of navigational aids, dredging new passage, etc., what is more essential is to carry out quick removal of all sunken vessels in the passages and anchorages which is prerequisite for developing the modern ports.

Heretofore, examination on item by item basis has been made. In summing up, we propose that the following points be emphasized.

8-1 Medium and Long Planning

From the viewpoint of securing safety navigation; it is necessary to formulate medium and long term plan on removal of sunken vessels to grasp the whole picture of the sunken vessels, for which at first step, survey of the actual state is needed in the main ports. Sunken vessels between Bouy No. 4 – No. 5 and No. 9, West Channel, port of Surabaya on which preliminary survey has been made as the model case, should be promptly removed,

collectively judged from all factors such as status of maritime accidents, etc.. The same could be pointed out in the inner harbour and anchorage.

From the viewpoint of removal operation; main structure as deck of every vessels sunken on which diving survey has already been made in this study corroded because of the lapse of more than 30 years after sunken, and both inside and outside of sunken vessel are being piled up with a great quantity of mud/sand owing to strong current forward North and South in a cycle of alternately half day at the site. In addition, fine red clay floating up in the water from the bottom makes visibility extremly poor, whereby making salvage operation more difficult. It is presumed that the same situation is found in sunken vessels in other ports. In order to safely and smoothly perform the salvage operation in such unfavorable conditions, the following should be fully considered in formulating the operation plan; (i) to select favorable time, last operation should be done in rainy season, (ii) to examine working hours & day upon completion of tidal chart, (iii) to study operation method suitable for the site and (iv) to adopt the mother ship with dwelling facilities for working personnel to step up the rationalization of mobility to the site, by which safety in operation and improvement of efficiency could be secured. And in performing the operation it is essential to promote the adoption of (1) discharger of mud/sand, (ii) under-water oxy-arc cutter and (iii) diving apparatus with telephone, as well as to secure safety in the operation by (i) improving mooring method, (ii) use of guide rope, (iii) managing diving, etc..

8-2 Personnel and Machines and Equipments in Salvage Operation

As to personnel for diving operation, present educational training centered on diving and existing divers are considered to be sufficient. In the long run for salvage and underwater engineering, a commercial diving center is urgently needed.

As current machines and equipments are poor and mean, it is essential to further provide such ships in kind as survey boat movable and manageable within the water basin, floating crane, tag boat, etc. for the realization of which necessary budget resources should be secured. Additionally, it is desirable to promote the spread of discharger of mud/sand, underwater oxy-arc cutting apparatus and diving apparatus with telephone.

Furthermore, in introduction of a sort of large sized ship(s), appropriate consideration should be paid to invitation of supervisors during the period required for mastering its operation and maneuvering technics.

8-3 Regulation and Rule

At present, in order to remove the vessels which have been already sunken now in Indonesian waters, regulations and rules are mostly completed already. But regarding to new maritime accident, as there are many cases in which the newly sunken vessels can not be removed promptly according to current regulations and rules, it may be necessary to adopt new regulation and rules which depend upon international regulation or covention.

8-4 Salvage Fleet

With regard to the role that the Government should take in order to accelerate the wreck removal operation, it has been already mentioned in chapter 7-4.

And considering the actual situation in Indonesia, one of alternatives to improve removal operation is that the Government should support the salvage fleet as initial investment.

1. Present Situation in Indonesian Waters andthe Subjects to be studied

1-1 Natural Environment and the Subjects to be studied

1-1-1 General View of the Sate of the Nation

Indonesia is the largest archipelago nation in the world of 13,677 islands including large ones and small ones. It is situated in between lat. 6°N and lat. 11°S with the equator at its center. The longest distance from north to south is about 1,900 km. The Sabang island at the north of Sumatra is situated in the west end, and Merauke of West Irian is situated in the east end. The distance between the east and west is about 5,000 and odd km. In this vast area are there, from west — Sumatra, Java, Kalimantan, Sulawesi, West Irian etc. The territory covers 1,900,000 km^2 and is 5.2 times as large as Japan. The width from east to west is almost same as that of the mainland of U.S.A. They have three kinds of standard time — west, center and east. The population is about 153,000,000.

The Indonesian people are composed of many tribes. They have their own languages, manners and customs different from each other. However, the standardized Indonesian language rules.

The religion is complex embracing Islamite (87.5%), Christian (7.5%), Hindu, Buddhist, Confucian etc. (5%). Therefore, the harmonious uniformity in diversity is the foundation of the unified nation. They have 5 principles (Pancasila) for the foundation, namely — Belief in the one Supreme God, Just and Civilised Humanity, The Unity of Indonesia, Democracy Wisely led by the Wisdom of Deliberations among Representatione, Social Justic for the whole of the People of Indonesia. Garuda Pancasila is the symbol of varieties but united. The Indoneisan People is united by the five principles "Pancasila."

1-1-2 Geographical Features

Indonesia Archipelago is one of the typical volcanic regions in the world, and stretches to east through Sumatra, Java, Nusa Tenggara, Maluku and West Irian. In Indonesia the 2 belts are joining, namely the Circum Pacific Mobile belt and Alpide belt. The Islands of Indonesia mostly consist of mountains and the coast lines are much frilled inward and outward. There are a lot of bays which mostly do not go deep into the land. As seen in the north shore of Sumatra and Java, most shores are so plain and water is so shallow that good harbour seldom exists. Further, one of the characteristic features is that the very fine yellow earth produced by volcano was carried by the stream of river into the sea. The earth so carried turned to an alluvial on the coast and causes severe invisibility in the sea water for several miles from the coast line. The condition is much worsened in the rainy season. On the other hand, the south coast of Sumatra and Java is much higher than the sea surface and washed by the strong waves from the Indian Ocean constantly. Therefore, though the water

is deep enough, the bay is mostly not suitable as a harbour.

There exists no modern artificial port in Indonesia. Most of the ports are located at the river mouth.

The rivers are featured with many tributaries. They flow through the meandering passage via vast alluvial covered by forest at end of the river or via developed fields into the sea carrying lots of turbid red water. As a result, the land or the alluvial at the mouth of the river extends itself toward the sea changing the line of the coast. The mouth of river is usually choked with the mud or sand to some extent. Indonesian waters are, as seen above, blocked by many islands, reefs and sandbanks. The incoming vessels carefully follow the natural fairway, but the situation of harbours and fairways are always subject to change caused by mud and sand carried by the water of river. Therefore, maintenance dredging is indispensable in the major ports and channels in order to secure the normal functions.

1-1-3 Meteorological Phenomena

In general, it is hot, humid and rainy in Indonesia. Due to tropical weather under the equator, it is hot all around the year. There exists, nearly in all parts of the region where monsoon blows, the change of the weather or the alternation of rainy and dry seasons. The tropical cyclone is given birth to on the sea south of Java, Nusa Tenggara, but it seldom attacks Indonesia directly. The islands of Indonesia are, as mentioned above, mostly covered with mountains and the coast is much frilled inward and outward. As a result, although no big difference in weather is observed in different districts, some specific features of the weather are nevertheless observed in a particular region.

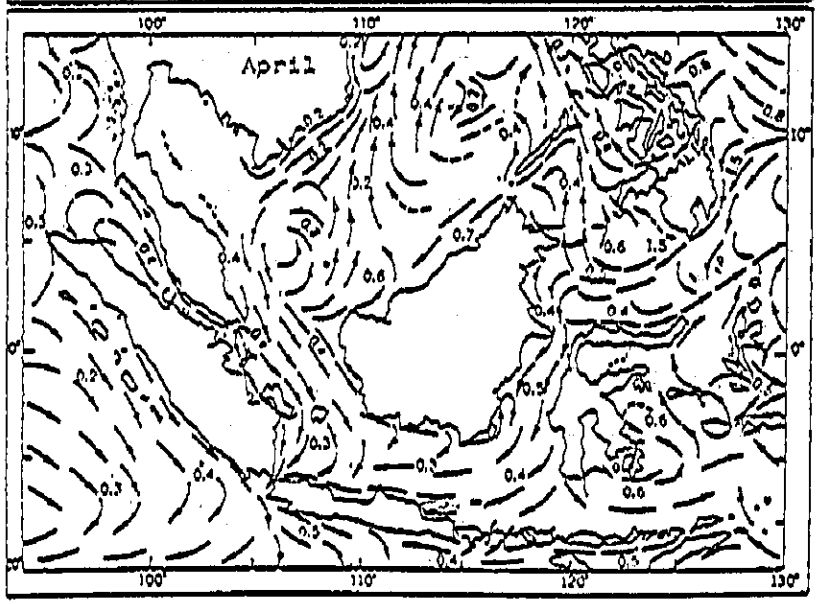
In addition to the change of the inland climate, the existence of the mountain works against the normal flow of the monsoon bringing about a serious change to the climate on the coast. The phenomena is marked when mountain blocks the movement of monsoon. There comes a temporary squall in particular regions, but it seldom blows strongly. The squall is comparatively frequent and is accompanied by thunder and rain. The land-and-sea wind often blows in the vicinity of coast and, at the time of turn of monsoon, the force of the wind is far stronger than the ordinary wind. Anyway, it is impossible to explain the wind at particular spot to the full extent on account of the intricate geographical features of Indonesia.

1-1-4 Ocean Current and Tidal Current

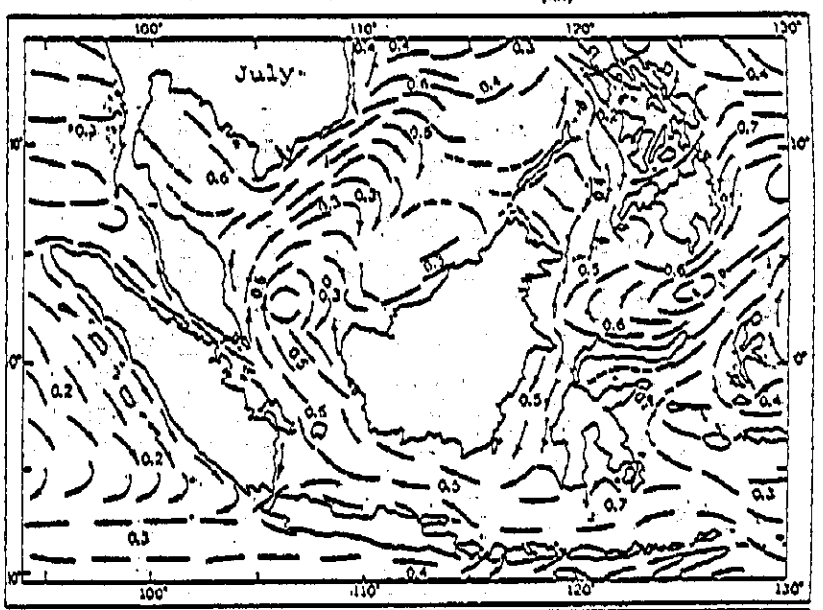
The ocean current is the drift current caused by monsoon, and so the current retrogresses as monsoon takes turn. The plan (1-1-1) shows the situation of the usual ocean current in the Indonesian waters in January, April, July and October. As same with the drift current in the other regions, the ocean current changes the direction considerably. The

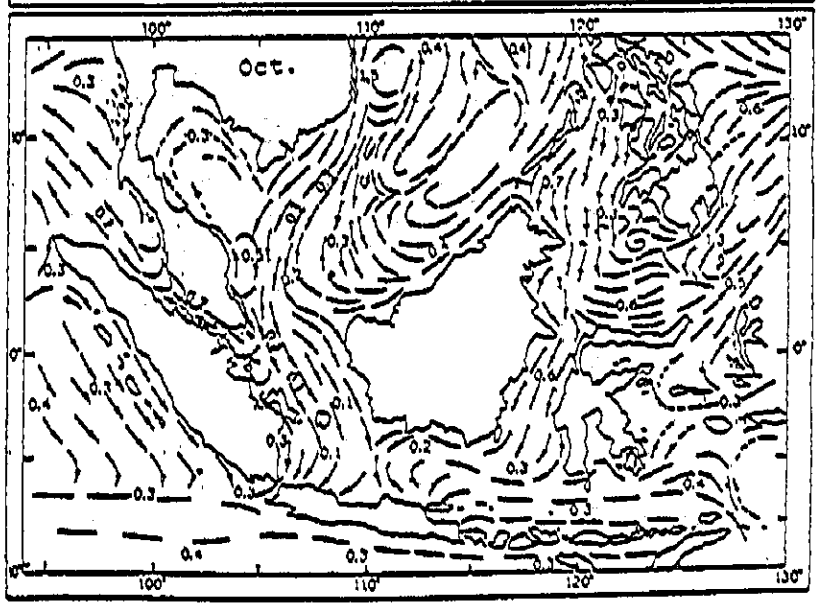
Plan 1-1-1

Ocean current (kn)



Ocean current (kn)





Source: Japan Maritime Agency

change takes place not only according to the direction or the force of wind but also directed to other quarters or to the direction opposite to the drift current caused by monsoon. As regards the tidal current, its force is comparatively weak in the open sea, only strengthening or weakening the ocean current caused by monsoon. However, its speed is fairly rapid in the straits between the islands or in the narrow waterways and it cannot be ignored. Further, it brings about an intricate change in a port employing additionally the force of the river stream running into the port. The geographical and the meteorological features in conjunction with each other causes strong wind and rough waves hampering the manuever of the vessels. Sometimes fierce rain reduces the visibility as in a fog and, in that instance, it is very difficult to find a few establishments on the land and a navigational aids causing a diseaster at sea.

1-1-5 Passage Studied from the Viewpoint of Natural and Geographical Condition

Summing up from the above description, most of the Indonsian principal ports are, with a few exception, the river ports. The river ports are usually so shallow that the vessels have to proceed the deepest fairway, but as shown in list (1-1-1).

List (1-1-1)

Maximum Draft at Main Passage/Port

Name of passage/port	Standard draft set by Harbour master/pilot
Belawan passage	9.0
Surabaya west channel	9.5
Palenbang-Musi river, Outer Bar	7.0
Benoa Channel	–
Samarinda – M. Pegah Outer Bar	–

Source: Japan Advisery Team

The movement of mud and sand in the river port is remarkable because of the nature of the river, giving birth to the intricate condition of the bed of water. The buoy in the river route is susceptible to movement as mud and sand move, and sometimes it moves to a great extent. Furthermore, the light of navigation buoy might be put out or the light of the lighthouse by chance works irregularly. While, in the case of the ordinary port, the utmost care is given to the another vessel in the head-on or the crossing situation, the utmost care, in the case of the river port, must be given to the bottom of water. On the top of that, the existence of the sunken vessels causes great embarrassment and anxiety at the time of arriving and leaving the port both technically and psychologically.

1-2 Distribution of the Sunken Vessels

An outline of distribution of the sunken vessel has become clear for the first time by the survey on the sunken vessels in the west ports of the Republic of Indonesia made by "Matsukura Shoten KK," a Japanese salvage company in 1950-60. The said company made survey in 11 major ports in the plan 1-2-I, the result of which is well known to the persons concerned as called "Matsukura Report," even at the present time.

List 1-2-I

Place surveyed	Sunken Vessels	Total tonage estimated	Estimated scrap M/T
1. JAKARTA (Tg. Priok)	30	23,048	6,488
2. SEMARANG	3	2,550	775.3
3. SURABAYA (Tg. Perak)	74	114,969	40,659
4. CILACAP	30	15,079	5,009
5. TELUK LAMPUNG	14	2,579	907
6. TELUK BAYUR	12	17,223	7,411
7. SABANG	7	2,780	783
8. BELAWAN	32	7,380	2,784
9. PALEMBANG	37	26,659	13,418
10. BALIKPAPAN	26	26,306	11,338
11. UJUNG PANDANG	16	9,003	3,116
Total	281	247,578	92,688.3

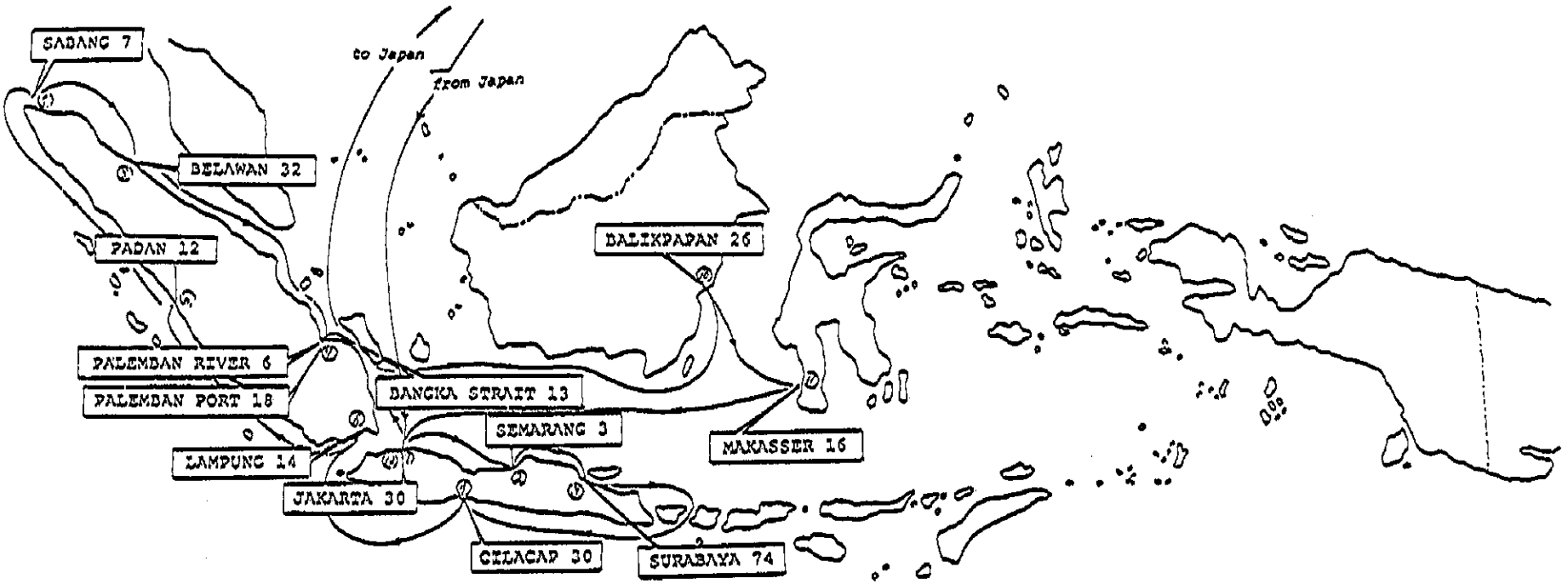
Source: Matsukura Report

As shown in the above table, the report states that 281 vessels were sunken, but this does not include all the figures in all ports in the country inasmuch as the number being as of 1960. Every year, a large number of maritime accidents have been reported, and accordingly the number of sunken Vessels has steadily increased.

The following list 1-2-2 indicates the number of maritime accidents reported to KPLP (i.e. the paragraph of" maritime accidents of 1-5). Number of the vessels sunken during 5 years, commencing 1974 to 1978, was 188, which obviously, surpasses the number of

Plan 1-2-1 Abstract survey report of the sunken vessels conducted by Matsukura Shoten KK., in 1959–1960.

Total number of identified sunken vessels is 281.



Remark: The number of the Vessels has been changed due to the removal operation in some locations.

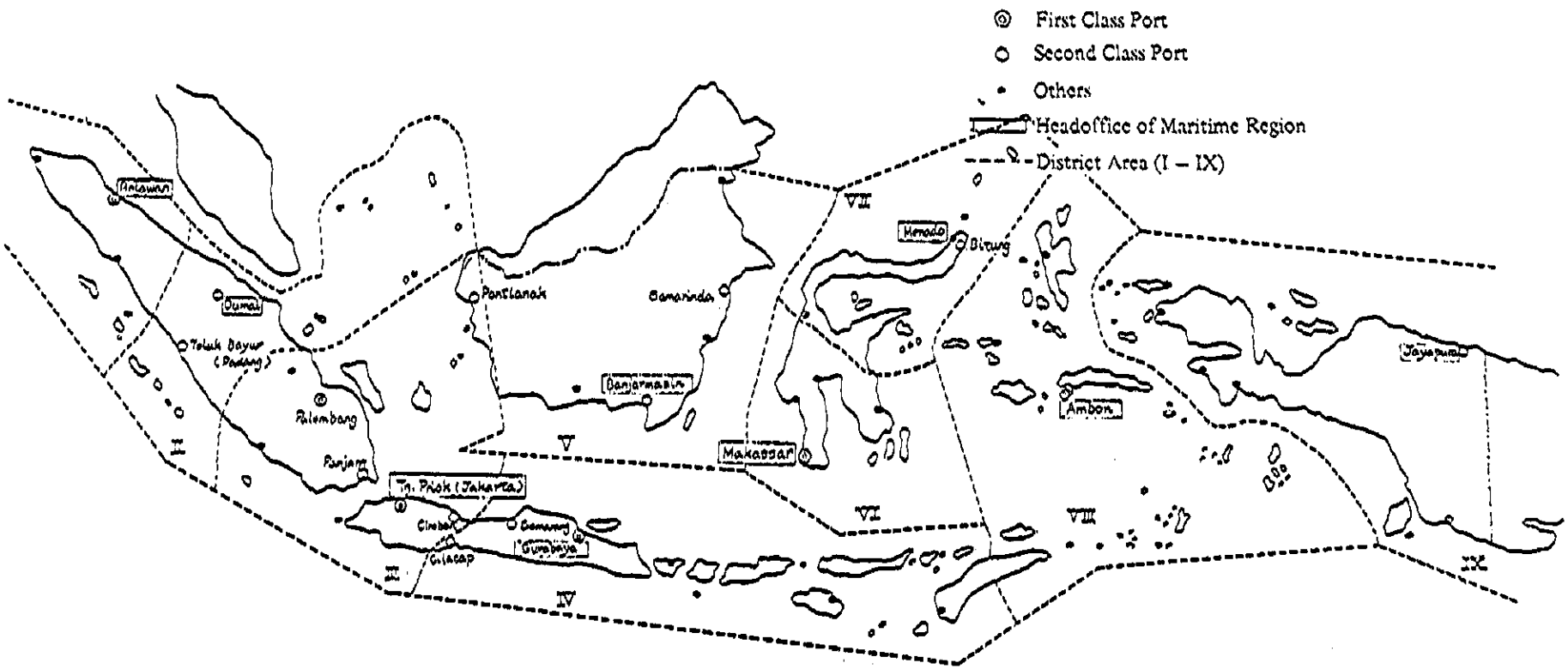
Recapitulation of Marine Accidents in Indonesia
Year: 1974 to 1978

List I-2-2

No. Type of Accidents	YEAR					Total
	1974	1975	1976	1977	1978	
1. Human						
– Dead	146	87	109	68	60	470
– Survived	402	702	346	611	428	2489
– Missing	93	273	76	65	452	959
– Dropped	–	–	–	–	14	14
	641	1062	531	744	954	3932
2. Ship						
– Sunken	24	30	41	39	54	188
– Stranded	20	21	42	23	47	153
– Collision	5	9	11	11	37	73
– Fire	–	–	–	2	21	23
– Engine trouble	13	15	11	11	19	69
– Missing	–	–	–	2	9	11
– Capsized	–	–	–	–	4	4
– Hull trouble	–	–	–	–	12	12
– Other distress	–	–	–	–	38	38
	62	75	105	88	244	571

Source: Japan Adivisery Team

Plan 1-4-1 Name of Major Ports and Maritime Region



Source: Surabaya Port Authority

removed vessels (see paragraph of 1-5). The above is limited number of sunken vessels only reported to the KPLP, so that its actual number is deemed to be larger than the above. As seen above, a large number of sunken vessels still exist in the Indonesian waters. The sinking and stranding of the vessels increased year after year. The cause of maritime acident has not been made clear but the existance of the sunken vessels has probably caused maritime accident to some extent as mentioned above.

: "KPLP" Indonesian Coast Guard.

1-3 Plan for removal of the Sunken vessels based on the Third Five-year Development Plan.

(1) Particulars in the past and future direction of the Development Plans. The Republic of Indonesia has continuously carried out the comprehensive development plans in which national development instituted in the general rules of the national policy, should be proceeded on the basis of five principles of the states.

The national development started with the First Five-year Development Plan in April of 1969 (Pelita I). During the period, the government made efforts to get away from the financial difficulties in fixing the target to expand and reinforce agricultural sector and the infrastructure related to that sector in order to attain self-supporting of foodstuff. Based on the performed results in the First Five-year plan above, the Second plan was put into operation, with emphasis placing on the further development of agriculture sector, as did in the First one, while setting up the target of industrialization in the light industry to increment employment opportunities.

(2) Maritime transport and Removal of the sunken vessels in the Five-year plans.

In the Third Five years Development Plan, fairness in development is set as the important target through the 8 ways of gavernment programmes.

One of these items suggests the fairness in geographical distribution of development in every local area, which is aiming at dispersing the rural development efforts into all areas in the country, and Promoting development in local villages, instead of the development efforts having made to concentrate on Java up to that time.

In particular, special consideration has been made to the local areas featured with lack of productivity, excessive population or depopulation. Rural development in these areas is given the priority, for political, economic and cultural development.

One of big factors playing significant roles/in the development is the increase in distribution of population, consequently a measure was adopted to immigrate from excessive population areas to the areas of depopulation and lack of productivity.

Based on the above guidelines and policies for the development plan, it is pointed out that transport sector plays an important role in attaining the target set in the plan as well as in unifying the nation.

In the Second Five-year Development Plan, the importance was attached to rehabilitation of the facilities, improvement of efficiency and establishment of transport system in the transport sector.

Ferry boats were introduced to improve service in river traffic, while more port facilities such as inner harbour, etc., were installed to smooth restore and improve coastal shipping service, by which safety navigation service including sea telecommunication, etc., has been improved. These merits are shared by both domestic and foreign vessels.

As seen in the above, sea transport opened the way even to isolated areas, and was made available for immigration, pilgrimages, tourists, etc. to some extent.

However, in the Third Five-year Development Plan, annual rate of the economic growth is fixed at 6.5% as the target, for which it is expected for the transport sector to attain more than 10% of the growth. Breaking down the details of the growth grate in the sector, the target rate of coastal shipping transport is 10%, while overseas shipping 5% (PERITA III). Need-less to say, to enhance the effeciency by making good use of the existing facilities, the next step is that emphasis should be laid on development and restoration of the infrastructure.

As seen in the next paragraph, it is indispensible requested that safety navigation facilities and port facilities should be further provided as the sea borne freight and number of ships in commission are increasing. In this connection, the affect of existance of the sunken vessels is rather bigger, blocking the way to secure safety navigation.

1-4 Present Situation of Port Utilization and Development Plans

1-4-1 Present Situation of Port Utilization

The Republic of Indonesia is a Maritime States with a vast boundary, where most major cities have grown on the coastlines. Management of the Directorate General of Sea Communications is divided into nine rigions and each region has a regional headquarter as representative of the Directorate General of Sea Communications.

The following table shows the number and classification of harbour in each region.

Number and Classification of Harbours in Each Region

List 1-4-1

class / region	1 class	2 class	3 class	4 class	5 class	others	Total
I	1	0	3	2	4	19	29
II	0	2	2	3	6	26	39
III	2	3	3	3	4	31	46
IV	1	2	3	7	5	25	43
V	0	2	2	3	6	11	24
VI	1	0	1	1	0	16	19
VII	o	1	1	2	0	25	29
VIII	0	1	1	0	1	23	26
IX	0	1	1	2	2	8	14
Total	5	12	17	23	28	184	269

(The above classes are sorted by the class of harbour management office, and others implies that harbours do not have the harbour management office.)

The Plan 1-4-1 indicates each retion and location of the major harbours, by which it is found that various size of ports are distributed all over the country, centering around Java.

The Republic of Indonesia is composed of numerous islands in large and small sizes, and its growth of maritime transport goes back to the olden days. Maritime transport in the

country is in an undisputable position as the cheif support in comparison with land and air transportation.

List 1-4-2 PELITA II Variation of Hull and Cargo at sea-trade

Kind of Vessel	1974/1975		1977/1978	
	Hull (DWT)	Cargo (T)	Hull (DWT)	Cargo (T)
1. Domestic trade				
Local vessels	110,000	938,000	140,000	1,832,000
Inter-island vessels	220,000	2,755,000	310,000	3,635,000
Traditional vessels	26,000	50,000	42,900	96,800
2. Ocean going vessels	478,000	–	490,800	–

Source: PELITA III, D.P. 1978

List 1-4-3 PELITA III *Total port facilities at the end of development plan*

Length of wharf	M	35.246
Warehouse	M^2	683.250
Cargo handling area	M^2	800.019
Fork – lift	unit	351
Mobile crane	unit	96

Data: BUKU III RAPAT KERJA DEPHUB 1979
HALAMAN 140

As both domestic and foreign trades are expanding, the route for coast-wise and oceanic sailing have recently opened and the traffic has increased. In addition, as the rural development is promoted, the immigration policy is encouraged and the foreign trade is expanded, the importance of the maritime transport is increasing, as mentioned in the above paragraph.

List 1-4-2 shows a change in the volume of the maritime traffic during the Second Five-year Development Plan. In the list, the volume of the overseas maritime traffic is mainly attributable to services from and to Japan, Europe North America, etc. Increase in volume of maritime traffic and in number of the ships in commission naturally bring about number of the ships entered into. Therefore, to receive the increased ships, port facilities such as inner harbours, cargo handling machines, etc., should be proportionately equipped.

List 1-4-3 manifests all port facilities in the country at the end of the Second Five-year Development Plan. Tonnage capacity by the above facilities totals 24.58 million ton.

During the Second Five-year Plan, reinforced port facilities, dredging in the passages and ports have been made with 45 million m^3 of mud/sand.

But, the dredging is only to maintain the existing passage, and consequently it is now impossible to expand width and depth of the passages and anchorages corresponding to increased utilization of harbours, due to existence of the sunken vessels.

1-4-2 Program of Arrangement of Harbourrs

The estimated volume of maritime traffic at the end of the Third Five-year Development Plan is shown in List 1-4-4. For the purpose of realizing the estimate, it is needed to supplement new ships and to replace old and uneconomical ships by new ones, number of which are indicated in List 1-4-5. At the same time the necessity is pointed out for improving the capacities of various facilities related to maritime transport, and the enforcement of port facilities, dreding operations and reinforcement of dredging boats are being contemplated (see List 1-4-6 and 1-4-7).

Based on the above planning, there are a number of projects, extending all over the country, as indicated in Plan 1-4-2 and List 1-4-8, for the purpose of developing, further providing and improving harbours.

List 1-4-4 PELITA III Estimated trade capacity at the end of the development plan

Kind of vessel	Hull (DWT)	Cargo (T)
1. Domestic trade:		
– Local vessels	165.900	2.986.200
– Inter island vessels	357.500	7.865.600
– Traditional vessels	68.800	1.719.000
– Perintis (Pioneer vessels)	19.500	78.000
2. Foreign trade:		
Ocean going vessels	593.000	7.526.000

Data: Feasibility study PT. MALAIRCO HAL. 37 dan 39
KHUSUS KAPAL-KAPAL NASIONAL

List 1-4-5 PELITA III Plan for new build and replacement vessels during the Third Five-year development plan

Kind of vessel	New build	Replacement
1. Domestic sea trade		
Inter island vessels	5,800 DWT	110,500 DWT
Local vessels	45,000 DWT	17,500 DWT
Traditional vessels	26,000 BRT	10,000 BRT
2. Foreign trade		
Ocean going vessel	235,883 DWT	193,317 DWT
Log carrier	104,000 DWT	

Source: PELITA III D.P. 1978

List 1-4-6 PELITA III Plan for port facilities

Whaft	m	6,670
Warehouse	m^2	83,160
Open storage area	m^2	60,304
Fork-lift	unit	160
Mobil crane	unit	35

Source: PELITA III D.P. 1978

List 1-4-7 PELITA III Plan for dredging amount and dredging facility

Maintenance dredging	94,450,000 m^3
Project dreding	33,500,000 m^3
Dredger and auxiliary equipment	18 units

Source: PELITA III D.P. 1978

However, while it is needless to say about the necessity of improving dredging projects and of reinforcing dredging boats in acceleration of projects for port development, the existence of the sunken vessels is a big impediment factor, as already mentioned above. The above circumstances have been admitted by the person concerned in the country, as the proof of which 16 sunken vessels with 4,640 tons have been removed during the poriod of the Second Five-year Development Plan.

Owing to low level of salvage techniques, unfavable natural conditions, etc., in addition to a lot of the sunken vessels distributed over the country, salvaging operation have not obtained a fair results. So, the present situation in the Indonesian waters is the almost same as before, while necessity of removal of sunken vessels is being advocated.

Plan 1-4-2 Projects in Indonesian Ports

(include under plan)

List 1-4-8 Projects at Indonesian Port

Number at appendix chart	Name of port	Rank of port	Project	Coorperation	Present condition
1	Ulee Lheue	3	-	Indonesia	-
2	Belawan	1	Commercial port and oil berth	ADB. West Germany	Tender: West Germany
3	Sibolga	3	-	-	-
4	Dumai	1	Oil berth	-	-
5	Teluk Tarusan	-	-	West Germany	F.S. Feasibility Study
6	Jarbi	3	-	-	-
7	Bengkulu	3	-	Holland	F.S.
8	Palembang	1	Industrial port	-	-
9	Tanjung Priok	1	Container terminal	The World bank	Completed
10	Cirebon	2	Commercial	West Germany	-
11	Cilacap	3	Commercial port and oil berth	Australia	-
12	Semarang	2	Commercial port	Japan	JICA + OECF
13	Surabaya	1	-	ADB	-
14	Pontianak	3	Commercial port	-	-
15	Banjarmasin	2	Commercial port	JAPAN	JICA + OECF
16	Balikpapan	2	Oil berth	JAPAN	Completed F.S. (There is idea of commercial port)
17	Samarinda	2	-	-	-
18	Tarakan	4	Oil berth	-	-
19	Ujung Pandang	1	Commercial port	-	-
20	Bitung	2	Commercial port	JAPAN	-
21	Ternate	4	-	-	-
22	Arbon	2	Commercial port	Indonesia	-
23	Sorong	3	Commercial port	JAPAN	Plan for F.S.
24	Jayapura	2	-	-	-

Source: Japan Advisary Team

1-5 System for Management and Dispositions of Sunken Vessels in the Water of Indonesia

1-5-1 Administrative Organization

The followings are administative organizations in charge of management and operation of the maritime affairs in the Republic of Indonesia;

(1) Central government offices

Organizational chart in the Department of Transport Communications and Touriom (Department Perhubungan) is shown as in the Plan of 1-5-1. In the Department, Directorate Genral of Sea Communications (Direktorat Jenderal Perhubungan Laut) governs charge of the administration related to sea transportation. The job carried out by the Directorate General is compared to that in Japan where she job is separately administered by Maritime Transport Bureau, Ship Bureau, Harbour Bureau, Personnel Bureau of the Ministry of Transportation, and also by Maritime Safety Agency as the extra-ministorial board.

Intra-organizations of the Directorate General of Sea Communications can be indicated like the Plan of 1-5-1. Directorate of Maritime Services (Direktorat Jasa Maritime) controls among others the affairs concerning removal the sunken vessels and ship repairs.

(2) Local offices of the Directorate General of Sea Communications

Perform smoothly the administration of the Directorate General of Sea Communications, the whole water zone in the country is divided into nine regions as mentioned in the afore said paragraph, headquarters (Kantor Wilaya) of which are set up in the central city in each region.

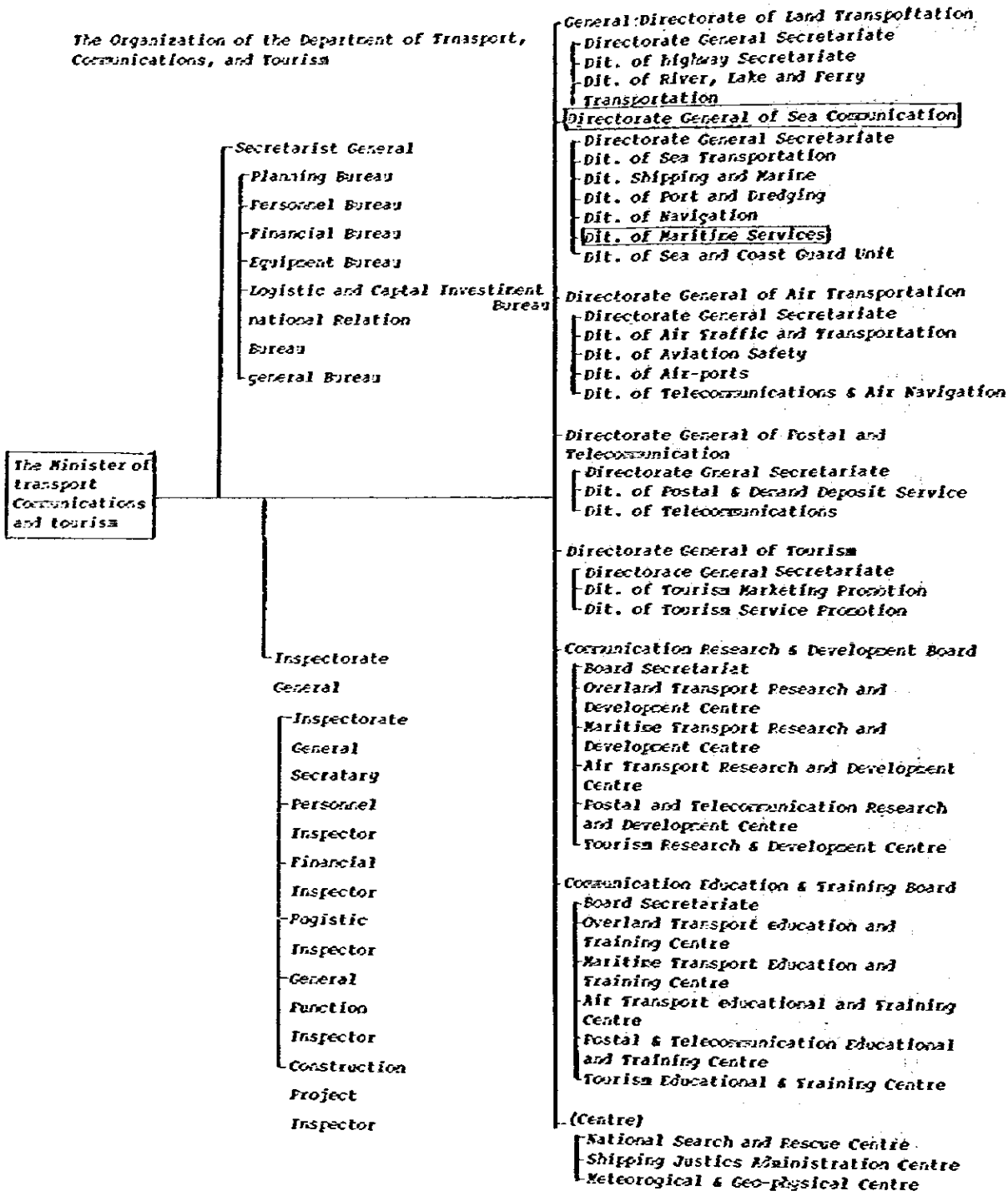
Intra-organization of the above headquarters has following five field divisions besides, of the administration office; Maritime Transportation, Harbour Dredging, Navigation, Maritime Services, Department of Coastguard and Rescue. Each Maritime administration headquarters has subordinate organizations under their control in the major ports as follows.

1) Port administrator

A port administrator who aims at administrating port & harbours in general, takes charge of general administration regarding the basic facility like moorings, and functional facilities, such as cargo handling machines & equipments, warehouse facility, etc. and general clerical works for ships & ports & harbours. The port administrator numbers 84 thoughout the country, being classified 1st to 5th classes.

Plan 1-5-1

The Organization of the Department of Transport, Communications, and Tourism



Source: Japan advisery Team

2) Harbour master

A harbour master, who aims at securing the navigational safety in ports and harbours, conducts the varsons functions, including traffic control for ships in the ports, handling of dangerous goods, placement of personnel, an establishment of the standards regarding the safety control for ships, inspections for the vessels and related matters. Likewise the port administration, it has 267 harbour masters throughout the country, being classified 1st to 5th classes.

3) Local navigation office

The office is to maintain and manage channel marks, being equipped with ships like marklaying boat, channel marks equipment, storage for them, etc. The office, which are of 1st and 2nd classes are located in 19 places.

4) Coastguard office (KPLP)

It handles maritime accidents, possessing patrol boats, etc. There are 18 established with 1st (KKR) and 2nd (SKR) classes.

These inferior offices are divided in to some classes mentioned above judged from function/equipment, economy, the degree of importance in terms of administration and policy, etc. of the harbour respectively.

1-5-2 System for handling sunken vessels

As mentioned above, Directorate of Maritime Services, Directorate General of Sea Communications is in charge of handling sunken vessels.

(1) Sunken vessels for a long time

Proposal for removal of sunken vessels is made by the port manager to submit the request of removal to the maritime service division of its regional headquarter. Then, the division confers with the Directorate of Maritime Services, Directorete General of Sea Communications.

In this conference, persons concerned such as from port manager's office, port management office, Navigation office, coastguard office, etc. are invited to attend and to explain all the details. After formulating plan for removal by Diroctorate of Maritime Services based on the conference above, it reaches the stage of implementation.

In implementing it, preliminary survey, tender by private companies, placing order, etc. will be made, which is indicated in the next poragraph.

(2) Newly sunken vessels

In case a ship on sail encounters maritime accident, search and rescue work will be made in the following order.

1) When received the news of sea accident at communication station or/and patrol boat, it is transmitted to its regional headquarter and the port manager's office.

2) Through both offices above, it is informed to the search and rescue division, then orders for sailing of patrol boat is given.

3) At the same time of the above 2), the news is transmitted to the Directorate General of Sea Communication and Navy, too, according to the scale of the accident, ship and boat, airplane, etc. will be further reinforced. In case unavoidable circumstances obliged the ship to sink in spite of these search and rescue works performed, after care of the accident is left to the hand of the Directorate of Maritime Services.

In this case the Directorate of Maritime Services gives three months moratorium to the ship owner to remove the sunken vessel, giving recommendation of the removal once a month. After the moratorium, the Directorate of Maritime Services carrys out the removal if it is judged for the owner to abandon its ownership as well as to have no capability of, intention and will for its removal. If so, its process of handling is same as (1) above. Actually, it is said that most of ship owners are impossible to bear cost for salvaging by insurance because they seldom insure their coastal and traditional vessels under Indonesian flag.

1-5-3 Current state of salvaging sunken vessels in the waters of the republic of Indonesia

(1) Performance of removal of sunken vessels in the past (PELITA I, II).

Program for removal of sunken vessels was included in the Five-year Development Plan (Rencana Pembangunan Lima Tahun), commencing in 1969 which has been formulated and implemented every five years, the first one being called as PELITA I, begining 1969 to 1974, while the second one as PELITA II, starting 1974 to 1979.

1) Planning and the performance of removal of sunken vessels during PELITA I (1969-1974).

As seen in the Table 1, during PELITA I, planned tonnage to salvage sunken vessels was 18,828 tons in total in Jakarta, surabaya, Palembang, Cilacap, Belawan, Balikpapan, etc. while the actually performed tonnage was 19,328 tons, which exceeds the planned.

2) Planning and the performance of removal of sunken vessels during PELITA II (1975-1979).

As indicated in the List 1-5-3, although the planned figure was 21,200 tons in Jakarta and Surabaya during the period, only 4,640 tons, equivalent to 22% of its planning, has been actually removed.

As of December, 1979, PT. INSAL (in fact, jointly with their two companies; PT. Yalagada and PT. Salvage Antasena) is now engaged in removal operation of No.44 sunken vessel in the Surabaya port, which is given the number by the Matsukura Report. Through the period of PELITA I and II, (1969-1979), total tonnage of removal of the sunken vessels was 22,968 tons.

(2) Existing and future plan of removal of the sunken vessels (during PELITA III)

As shown in the List 1-5-4, though the planned figure was 36,430 tons in total for the removal of sunken vessels in 1979/1980, the first year of PELITA III, at present, only one operation is going on to remove a passenger ship of the Matsukura No. 7 at the western channel of Surabaya which is estimated 1,100 tons because of the failure in acquiring the necessary budgetary appropriate. Apart from this, the plan being drafted as to operation of mine field cleaning in the estern channel of Surabaya. In the second year of the PELITA III (1980/1981), as expressed in the List 1-5-5, the drafted plan shows that removal operation will reach 10,475 tons in total in Surabaya, Jakarta, Cilacap and Balikpapan.

(3) The tendency in removal operation of sunken vessels in the Republic of Indonesia

During the PELITA I, of 19,328 tons in total of the sunken vessel has been removed exceeding the planned tonnages, exceeding the planned figure in weight, while only a quarter of the planned tonnages equivalanet to 4,640 tons, has been removed during PELITA II. In the first year of the PELITA III (1979/1980), as much as 36,430 tons in total of the sunken vessels was planned be salvaged, the figure being double that of Five-years period so far planned, but in fact only a sunken vessel of 1,100 tons is now under operation. The recent tendency, in the removal operation of sunken vessels in Indonesia, is that while the planning or the request for the salvage increases, the tonnage actually removed is sharply decreasing.

PELITA I (1969-1974)

RE: WRECK REMOVAL

List I-5-2

	PLAN			ACTUAL DATA		
LOCATION	PERIOD	OBJECT	APPROX. SCRAP (TON)	PERIOD	OBJECT	APPROX. SCRAP (TON)
JAKARTA	69/70 70/71 71/72 72/73 73/74	3 WRECK 2 WRECK 6 WRECK 30 WRECK FLOATING DOCK	3,270 900 2,000 1,062 900	69/70 70/71 71/72 72/73 73/74	3 WRECK 2 WRECK 6 WRECK 30 WRECK FLOATING DOCK	3,270 900 2,000 1,062 900
SURABAYA	69/70 70/71 71/72 72/73 73/74	FLOATING DOCK FLOATING DOCK FLOATING DOCK WRECK FLOATING DOCK+WRECK	750 450 1,350 1,400 2,250	69/70 70/71 71/72 72/73 73/74	FLOATING DOCK FLOATING DOCK FLOATING DOCK WRECK FLOATING DOCK+WRECK	750 450 1,350 1,400 2,250
PALEMBANG	69/70 70/74	WRECK (LST II) WRECK (LST II)	400 1,600	69/70 70/70	WRECK (LST II) WRECK (LST II)	400 1,600
CILACAP	69/70 70/71	WRECK CONTINUATION	2,000	69/70 71/72	WRECK CONTINUATION	2,500
BELAWAN	71/72 72/73	DREDGER CONTINUATION	431 -	71/72 72/73	DREDGER CONTINUATION	431 -
BALIKPAPAN	72/73	2 BARGE 1 OIL PIPE 1 PONTOON	65	72/73	2 BARGE 1 OIL PIPE 1 PONTOON	65
TOTAL			18,628			19,328

Source: D.M.S.

SECOND PERIOD (1980 - 1981) of PELITA III

RE: WRECK REMOVAL

List I-5-5

LOCATION	OBJECT/MATSUKURA NO.	ESTIMATE SCRAP (TON)	PRIORITY
I. SURABAYA	1. Cargo Ship/3	2,000	FIRST
	2. Cargo Ship/6	1,775	FIRST
	3. Naval Training Ship/4	4,400	FIRST
	4. Mine Field Cleaning	-	FIRST
II. JAKARTA	1. One Wreck in EDAM is/and	300	FIRST
	2. Five Woodea Ship in SUNDA KELAPA	-	FIRST
	3. Wooden ships and abstacles in Kalibaru	-	FIRST
III. CILACAP	1. Wreck named SIPORA		FIRST
	2. Eight Wreck		SECOND
IV. BALIKPAPAN	1. Tanker FLAVIANO	2,000	SECOND
TOTAL	18 Wrecks	10,475 + 2	

Source: D.M.S

Remark: a : - wooden ships

PELITA II (1975 - 1979) RE: WRECK REMOVAL

List F-5-3

	PLAN			ACTUAL DATA		
LOCATION	PERIOD	OBJECT	APPROX. SCRAP (TON)	PERIOD	OBJECT	APPROX. SCRAP (TON)
JAKARTA	74/75	16 WRECK	4,800	74/75	11 WRECK	450
SURABAYA	75/76	3 WRECK	5,550	75/76	2 WRECK	670
	76/77	3 WRECK	3,510	76/77	2 WRECK	890
	77/78	31 WRECK	4,810	77/78	1 WRECK	630
	78/79	35 WRECK (INCLUDING WOODEN WRECKS AT JAKARTA)	2,530	78/79	18 WRECK (INCLUDING 17 WOODEN WRECKS AT JAKARTA)	2,000
TOTAL			21,200			4,640

Source: DMS

REMARKS: 1. One Wreck/Matsukura No.44 out of 18 wrecks during period 78/79 of ACTUAL DATA is still under-operation by P.T. Indonesian Salvage as of December, 1979.

2. Total removed weight tons of scrap during PELITA I & II (1969 - 1979) are estimated 25,668 tons.

FIRST PERIOD (1979 - 1980) of PELITA III RE: WRECK REMOVAL

The first priority of the wreck removal and mine field cleaning at the channel and the anchorage area at Surabaya Port

List I-5-4

LOCATION	OBJECT/MATSUKURA NO.	ESTIMATE SCRAP (TON)	REMARKS
I. Western Channel	1. Passenger Ship/7	1,100	* UNDER OPERATION BY P.T. YALAGADA
	2. Naval Training Ship/4	4,400	
	3. Cargo Ship/3	2,000	* PARTLY REMOVED (±1,400 TON) DURING 1972/73
	4. Passenger Ship/2	900	
	5. Cargo Ship/6	1,775	
	6. Semi Cargo Ship/5	3,300	
II. Eastern Channel	1. Mine Field Cleaning	-	* UNDER PROCEDURE
	2. Wreck of Steel Ship/73	290	
	3. Passenger Ship/72	900	
III. Anchorage Area	1. Cargo Ship/46	5,250	
	2. Cargo Ship/41	1,500	* PARTLY REMOVED (±335 TON) DURING 1976/77
	3. Cargo Ship/43	1,415	
	4. Cargo Ship/52	1,200	
	5. Cargo Ship/53	2,200	
	6. Cargo Ship/48	1,700	
	7. Tanker/50	4,500	
	8. Cargo Ship/47	4,000	
TOTAL	16 WRECKS	36,430	

Source: D.M.S.

REMARKS: Only the Removal Operation of Item 1. Passenger Ship/7 at Western Channel was conducted during this period and is still under-operation by P.T. YALAGADA as of December, 1979.

Comparison between the Planning and
the Result of Salvage

List 1-5-6

Names of the planning	Planned salvage (A)	Performed salvage (B)	(B)/(A)
PELITA I (69/74)	18,828 ton	19,328 tons	102.7 %
PELITA II (74/79)	21,200 ton	4,640 tons	22.3 %
PELITA III (79/80)	36,430 ton	1,100 tons	3.0 %

1-5-4 Requested budget during the period of PELITA III

Four companies have experienced in the removal operation; they are PT. Yalagada, PT. Insal, PT. Antasena and PT. Bayu (see the List 1-5-7), having 29 divers in total.

In view of results performed in the past, of the existing machinery and equipments and of the personnel of salvage operation in Indonesia, the estimated capacity per annum of the four companies is considered to be about 10,000 tons or 4 vessels.

However, the plan of salvage operation in 1979/1980 includes 16 vessels in number and 36,430 tons in weight and the budget is requested. The above is too excessive for them to carry out judged from the capacity of the companies.

Resistered Salvage/Under Water Work Company List

List 1-5-7

Company Name	Representative	Address	Staff		Date of Established	Capital (Million) Rupiah		Main Work
			Employer	Diver		Base	Deposit	
1. PT. VALAGADA	RUSDAN SAIDI	Jl. Pintu Besar Selatan No.93 JAKARTA-BARAT	58	12	1964	10	2	removal
2. PT. INSAL	SOEKARDONO	Jl. M. AGUS SALIM No. 52A JAKARTA-PUSAT	23	6	1958	0.5	0.5	removal
3. PT. BAYU SAMODRA SAKTI	ANWAR	Pintu Gelora 9, komplek Lapangan Tembak Senayan JAKARTA	38	3	1974	5	5	removal
4. PT. SALVAGE ANTASENA	SOEKANDAR	Jl. Kramat Raya No.27 Lantai II JAKARTA-PUSAT	69	8	1966	0.25	0.25	removal
5. PT. KOMARITIM	ODO SOEHADA	Five Pillars Office Park Jl. Letjen Mt. Haryono 58 JAKARTA-SELATAN	254	11	1974	415	0.083	oil work
6. PT. KARYA ASIH AGUNG	ANWAR N.S.	Jl. Kramat VIII No.12 JAKARTA-PUSAT	32	12	1973	50	10	small ship removal
7. PT. CALMARINE	BASUKI	Jl. Melawai VII No.4 Blok M. Kebayoran-Baru	38	15	1971	94.5	94.5	oil work
8. PT. KALIRAYA SARI	USMAN ADMADJAJA	Panca Building Jl. K.H. Hasjim Asyhari No.4 JAKARTA-PUSAT	42	4	1975	50	10	oil work
9. PT. ANUGRAH TIRTA	WALEAN	Jl. Dayak No.29 Tanjug Priok	22	8	1979	25	6	harbour work
10. PT. INDOSAL INTI	SIDO PAROMO	Jl.Kebantenan Raya 48 Cilincing JAKARTA-UTARA	23	15	1979	25	7.5	harbour work
11. PT. TOSAN GALIN	SOEWADJI	Jl. Kwini II No.6 JAKARTA-PUSAT	16	3	1975	2	1	oil work
12. PT. BAHARI CAK RAWALA	R.L SOEMANTRI	Jl. Cempaka Putih Timur 91 JAKARTA-PUSAT	51	11	Data not available			harbour construction
13. PT. LLIENT		Jl. Melawai VIII No.2 Kebayoran Baru JAKARTA			1974	inactive		
14. P.T. YALA PRANGKASA RAYA		Jl. Sultan Hasanuddin No.12 Blok M 3 Kebayoran Baru KAKARTA			1974	inactive		
15. P.T. EMDECE		Jl. Prof. M. Yamin No. 46 JAKARTA			1977	inactive		

DATA 1979 — DATA 1978

Source: D.M.S.

1-6 Present Situation of the Salvage Operation in Indonesia

1-6-1 An Outline of the Development

In the waters of the Republic of Indonesia under the influence of the World War II extended to, a large number of vessels were left sunken even in post war days. Immediately after the end of the war, the country became a independent nation as the republic.

The primary object for restoration after the war was directed to the other various problems to be solved faced urgently. It was only around 1960 that the question of the sunken vessels began to attract the attention of those concerned therewith.

Tracing the origin of the matter, the trigger for the removal operation was pulled by the Matsukura Shoten KK., a Japanese company, who was invited by the government of the Republic of Indonesisa for the survey. That opened the curtain to remove the sunken vessels.

Based on the survey, the presidential decree was issued in 1960, and the expert committee was set up in order to propel removal of the sunken vessels. The committee instantly started the salvage operation of the sunken vessels in major ports such as Surabaya. These vessels not only deteriorate functions of port, but also become the obstacles to the navigation, and under the circumstances, the committee concluded the contract in 1960, with the International Salvage Association (I.S.A), of Hong Kong, to remove the sunken vessels in the waters of the Republic of Indonesia.

The said company (ISA) has carried out salvage works as shown in the following table in concern with the joint-ventured company in Indonesia from 1960 to 1964. Fifty-three vessels in the major 6 ports were removed.

List 1-6-1

Name of port	Number of salvaged sunken vessels	dock	Year of operation
1. JAKARTA(Tg. Priok)	1	-	1960
	17	-	1961
	1	-	1962
2. SURABAYA(Tg. Perak)	7		1961
	6		1962
	-	1	1962
	2		1963
	1		1964
3. MEDAN(BELAWAN)	1		1961
4. SEMARANG	1		1962
5. PALEM BANG	1		1964
6. UJUNG PANDANG	14		1961
Total	52	1	

Source: D.M.S.

As nationalism has come to the fore, the laws and regulations on the salvage have been revised. As a result, the company (ISA) evacuated from Indonesia and handed over the contractual right and machinery and equipment for salvage operation to the Indonesian company called INSAL in 1965. Since then, the salvage operation of the sunken vessels has been continuously carried out by the private companies of Indonesia. the office which once started as the expert committee, is the predecessor of the present Directorate of Maritime Services (DMS) as an subordinate office of the Directorate General of Sea Communications.

The DMS, since 1969, has been active in formulating plannings on the salvage operations which were incorporated into the Five-year Development Plan or in, commissioning contracts or in providing guidance and permission to the private companies and so forth.

1-6-2 Actual state of the salvaging industry in the Republic of Indonesia

PT. INSAL was the first salvaging company set up in the country, a joint-ventured company with the ISA (International Salvage Association based in Hong Kong). Then in 1960s, 2 salvage companies came into existance while in 1970s, small and medium sized salvage companies have been established, the outline of which is shown in the next table. All the companies mentioned above got the permission from the Directorate General of Sea Communications.

It is the principle in Indonesia that salvaging operation cam only be carried out by Indonesian salvage companies after having oftoined the permission for each work from the Directorate General of Sea Comunications in the Republic of Indonesia, the details of which are prescribed in the Ordinance of the Directorate General of Nomor, DJM 23/2/10, Tentang; Penyelenggaraan dan Pengusahaan Salvage dan Pekerjaan Bawa-h Air. By this ordinance, the salvage companies are classified in 3 ranks according to its scale, equipment, personnel etc. The main items for this criteria are indicated in the following table.

List 1-6-2

Item / Rank	Scrap produced by the sunken vessels/year	Capital (more than)	Salvage boats	Capacity of floating cranes (t)	Diving capability (m)	Personnel
A	more than 5,000 ton	R.P. 750,000,000	ocean going salvage boat	200 ~	40 ~	salvage expert diver in deep water explosive
B	Up to 5,000 ton	R.P. 400,000,000	salvage tug boat	200 ~	~ 40	engineer diver explosive
C	Up to 1,000 ton	100,000,000	not stipulated	~ 100	~ 20	diver

Four companies as PT. Yalagada, PT. Insal, PT. Antasena and PT. Bayu Samodra Sakti among the salvage companies in the Republic of Indonesia, have obtained the order of salvage operations from the Government of Indoneisa. Main business activites for these four companies are the salvage operations ordered by the government, but the order of the government is as few as, 1 or 2 yearly in terms of number. Presently, PT. Insal is salvaging the sunken vessel of Matsukura No.44, in cooperation with PT. Antasena, while PT. Yalagada is salvaging Matsukura No.7.

PT. Bayu Samodra Sakti was engaged in the removal operation in Tarakan under the contract of the civilian basis. In the meantime, the Indoensian operates who undertake the operation jointly with foreign firms are as per List 1-6-3.

Daftar Pekosahaan Salvage Dan Pekarjaan Bawah Air

Yang Telah Mendapatkan Izin Usaha Dari Direktorat Jenderal Perhubungan Laut Dan Derjasamanya Dengan Pihak Asing

List 1-6-3

No.	Perusahaan	Mulai PT Berdiri Sesuai Akte	Izin Usaha	Keterangan Kerjasama
1.	PT. YALAGADA Jl. Pintu Besar Selatan No. 93, JAKARTA-BARAT. Tilp. 272042	Akte Notaris: SOETRONO PRAWIROATMODJO No. 22 Tgl. 15 Oktober 1964 Di. Jakarta	No. DJM 23/3/5-B Tgl. 31 Desember 1976	1. FUKADA SALVAGE CO., LTD. 1-9-1, Kanda Nishiki-cho Tenri Building Chiyoda-Ku Tokyo – Japan 2. SMIT INTERNATIONAL 2014, International Plaza Anson Road, Singapore 2.
2.	PT. INSAL Jl. M. AGUS SALIM No.52A JAKARTA-PUSAT. Tilp 352350 – 351006	Akte Notaris: FLIZA PONDANG No.61 Tgl. 14 Februari 1958 Di. Jakarta.	No. DJM 20/4/4-B Tgl. 24 Augustus 1978	1. SELCO / SINGAPORE No. 1, Jl. Samulun Jurong Singapore 22.
3.	PT. BAYU SAMODRA SAKTI Jln. M.T. Haryono 58 Tilp: 776576-776577 Jakarta	Akte Notaris: KHAIRIL BANRI No. 41 Tgl. 26 Januari 1974 Di. Jakarta.	No. DJM 20/1/19-B Tgl. 17 Juni 1978	1. Under procedure NIPPON SALVAGE CO., LTD. 1-2-1 Marunouchi, Chiyoda-Ku Tokyo, Japan 2. PT. KOMARITIM dengan PT. BAYU SAMODRA SAKTI
4.	PT. KOMARITIM Jln. M.T. Haryono 58 Tilp: 776576-776577 Jakarta	Akte Notaris: F.J. MAKATI No. 17 Tgl. 20 Nopember 1974 Di. Jakarta.	No. DJM 20/1/5-B Tgl. 12 Januari 1978	COMEX / PERANCIS B.P. 143. TRAVERSE DE LASOUDE 13275 Marseilles Cedex 2. COMEX/SINGAPORE, Room 41, Thon Tech Building 15 Skott Road, Singapore
5.	PT SALVAGE ANTASENA Jln. Kramat Raya No. 27 Tilp: 349298 Jakarta	Akte Notaris: ADLAN YULIZAR No. 64 Tgl. 25 Februari 1966 Di. Jakarta.	No. DJM 23/3/1-B Tgl. 3 Desember 1976	1. MR. DAVID BARNETT Jln. Banjarsansari III/8 Cipete, Jakarta.
6.	EMDECE P.T. Jl. Prof. Moch. Yamin No. 46 Jakarta	FRJT MAWATI No.8 Tgl. 8-4-1567	No. DJM 23/2/108 Tgl. 8-10-1076	CALDIVE U.S.A. California Dalam Bentuk Joint Venture Dengan Nama Perusahaan: P.T. CALMARINE No. AKTE Notaris: FRJT MAWATI No.17 P.T. CALMARINE Arthaloka Building 9th Floor Jl Yenderal No. 2 - Jakarta 587305 (Direct) 587611 / EXT. 290
7.	PT. TOSAN CALIH Jl. Senen Raya No. 44 SANGGA BUANA BUILDING Jakarta Pusat. Tilp. 363436	Akte Notaris: J.F.B. TUMBELAKA SINJAL Nomor : 23 Tanggal : 13-6-1979 Di. : Jakarta	No. DJM 23/1/4/79 Tgl. 15-10-1979	HYDROSAPACE INTERNATIONAL South East Asia Pte. Ltd. Suite 1001, Far East Shopping Centre 545 Orchard Road, Singapore 9 Telp. 2352697 ; 2352608 Telex. 23640

Note:

1. Perusahaan salvage Nasional ini telah lulus prakwalifikasi tahun 1978.
2. Izin Usaha tersebut diatas merupakan perpanjangan dari Izin Usaha sebelumnya.
3. Urutan nomor tersebut diatas sekaligus merupakan skala kemampuan.

Source: D.M.S.

2. FUNDAMENTAL SCHEME OF THE REMOVAL OF SUNKEN VESSELS (SETING AN EXAMPLE ON SURABAYA PORT).

2-1 General Situation of Surabaya Port

Surabaya Port (or Tanjung Perak which means Cape Silver) is, in line with Jakarta (or Tanjung Priok), one of the most important ports in Indonesia, located in East Java at Lat 7°–12'S. and Long. 112°–44'E. From the viewpoint of the geographical features, Surabaya Port as the model port in this study is situated in the interior of the narrow strait which is formed as against Madura Island. Therefore, the port is eventually considered similar to a river port and a typical port. The west channel of the port, which is an incoming and outgoing passage, is very narrow for the navigation. The sunken vessels existing therein are the obstacle for the passage to be kept broad and deep. A ship of deep draught must discharge the ballast for averting the danger at the time of entering and leaving the port. She also has to proceed only at the high tide or has to alleviate the full load. The light buoy is so much susceptible to movement, as is the case in the other ports, that the experience and the sixth sense of navigator are depended upon. The situation is, therefore, quite dangerous to those who have little experience in the navigation. Under the circumstances, the existence of the sunken vessels has come up to be a big obstacle for the development of the port. The removal of the sunken vessels also encounters difficulty on account of the reduced visibility in water caused by the strong current stream and drifting sand. The investigation and the activities of the removal are further hampered by the meteorological factors in addition to the technical troubles including that of the submarine operations. The summarized features of Surabaya Port for the owner's and operator's information are as follows:

The state of affairs in Surabaya Port

(1) Outline

1)	Location	7°–12'S. 112°–44'E.
2)	Time adopted	GMT (+) 7 h – 00 m
3)	Chart	Indonesian edition No. 97 English edition No. 921

(2) Navigation

1) Telegram for arriving at a port
To be cabled before the arrival to the Surabaya Agent in respect of:

a) ETA
b) Quantity in ton of cargo to be unloaded.
c) Number of gang to be employed.
d) Health of crew
e) Quantity in ton of oil and water to be supplied

2) Pilot

a) Pilots are always necessitated for ships with measurements 250m^3 or more. There are two kinds of pilot, one being sea-pilot and another one being harbour-pilot.

b) The notice of requesting the pilot is to be made through ship's agent 24 hours before the arrival or 6 hours before the leaving.

c) The pilot at the west channel is always stationed at Karang Jamuang and gets on board at a spot near buoy No. 5

d) Communication with pilot station at Karang Jamuang is possible by VHF.

e) On the occasion of rough weather, pilot cannot reach the afore-mentioned spot because of the inferior capacity of the pilot boat. The ship is requested to proceed to Karang Jamuang or the vicinity.

f) As regards the east channel, pilot goes by barge from Surabaya Port to the entrance of east channel and gets aboard the ship there. However, as the water depth is only 2.5m, the ocean-going ships are unable to enter. Only the small vessels like the sailing ships in inland sea are able to proceed.

g) The working hour of the pilot is, as from the year 1975, 24 hours a day in principle, but the hour is not practically observed. Actually, from sunrise to sunset as for the arriving ship and, concerning the leaving ship, no pilot likely gets on board at midnight.

h) Sea-pilot takes turns at inner roads with harbour-pilot who undertakes the operation of reaching and leaving the pier.

3) Anchorage

a) The anchorage for sea-pilot is north of No. 5 Buoy (approximately 06°–52'–30"S., 112°–44'–45"E.)

b) Quarantine anchorage in port is at the water basin in front of Djamrud Utara wharf. There exist a lot of sunken vessels and obstacles, and so the utmost care must be taken.

The speed of current is so quick that it reaches 2.5 knot at its heighest. The bottom of water is mud and the anchor clings fairly well.

4) Perilous areas

The areas in the vicinity of Surabaya Port, which have or have not been swept are reported.

(reference: Daerah Randjau (mine area), Indonesian Navy edition). A mine exploded in the year 1975 on open sea off the Padang Port, Sumatra Island. The mine is still powerful after the lapse of the lengthy time.

5) Channel and the manner of maneuvering

a) The lighthouse at Karang Djamuang is a good target for the ships to proceed to west channel. The ship confirms its position by the direction of the lighthouse and the distance measured by radar. She also confirms the position of outer light buoy (6°–37.5'S., 112°–44'E.) or No. 1 light buoy (6°–47'S., 112°–44.5'E) and, proceeding to the south, it reaches No. 5 buoy.

Tg. Modoeng (Madura Island), Ug. Pangka etc. are seldom echoed on the radar because of the low sea-level, and of the specific geographical situation even though the radars are set at both headlands.

b) One of the most perilous passages in the west channel is that of between No. 5 buoy and No. 2 buoy for the length of about 100m which is free from underwater obstacles and sunken vessels.

Another is the passage between No. 9 buoy and No. 11 buoy. The ship proceeds watching the light at Jamuang and Sembilangan (at north-west end of Madura Island) and avoiding the other vessels.

c) As regards the passage from No. 6 buoy to Surabaya Road, the navigatable channel is comparatively broad and it is easy to confirm the ship's position by the distance from both shores and by the lighthouse. However, care must be given to small fishing vessels and fishing trellis.

d) It is usually the case with features in Indonesia that the charted visibility of the navigatable aids like lighthouse is reduced or light is put out or the location of light buoy moves about.

6) The largest type of ship

a) The largest type of ship which can pass through the west channel and enter the Surabaya Port is of the draught 9.5m and length 210m.

b) The largest type of vessel which used to pass through is that of D/W 65,000 tons and of the length 224m. She passed in April, 1974 at the maximum draught 10.02m.

c) As the depth of water varies, enquiry must be made beforehand to the port authorities of Surabaya in case a ship of the draught more than 9m is employed.

d) When requested, the port administration shall provide the tug boat up to the buoies No. 5 – No. 4 for the assistance of the vessels which suffer from navigation due to the deep draught.

2-2 Natural Condition

We describe the meteorological and oceanic phenomena in connection with the planning of the removal of sunken vessels in Surabaya and the vicinity.

(1) Meteorological phenomenon

The weather at Surabaya Port (Tanjung Perak) is calm all year round as per list 2-2-1. No stormy days are recorded at all. The weather outside west channel of Surabaya is as follows: In the south-east monsoon season, the sea breeze starts to blow, drawing a little toward north, at about noon and cease in the evening. The land breeze starts from the south at about the time of sunset. Mostly, it is quite calm and hazy in the morning. In the north-west monsoon season, sea breeze usually blows strongly from west-north-west or from north-west in the morning. The wind of this direction blows during the day time, but it changes, as time goes by, to the weak south-west land breeze. The monsoon season in the area is from December to March next year. The volume of rain affects mostly the operation of removal of sunken vessels due to the fact that rain adds to the invisibility of water.

The visibility revealed this time in port and at the operation site is as inferior as under 0.3m because the research has been made at the beginning of the rainy season. The visibility will get worse amid the muddy stream from the river. The swift turbid current stirs up the bottom earth and causes the invisibility of water.

(2) Tidal current

1) Tide table of ports is edited and obtainable. The outline is as follows: The tide at the anchorage is featured with a typical semi-diurnal current. Generally speaking, the slack is short in case the current velocity is big and is long in case the velocity is minor. The current near the shore is quicker by 1 — 1.5 hours than that in the midst of the anchorage at the time of the turn of the current, but it is not in conformity with the tide. Due to the influence by the south-east monsoon, the westward current is, on an average, stronger than the eastward current in the anchorage.

2) The tide and current in the west channel and in the outer area are figured out from the above-mentioned tide table by adding and subtracting the ratio of the height of tide and the difference of the time of tide. The outline is as follows: The current in the west channel is the tidal current. The south-east monsoon puts aside the sea-water from the funnel-shaped east channel, strengthening the northward stream and weakening the southward stream in the west channel. There are remarkable semi-diurnal current in the west channel at large and the

PLACE—TANJUNG PERAK. (SURABAYA). 7° 13′ S., 112° 43′ E. Height above Mean Sea Level—3 m (10 ft)

WMO No. 96933 Climatic Table compiled from 7 to 30 Years' Observations, 1936 to 1965

List 2-2-1.

Month	Pressure at M.S.L. Mean	Air temperature: Mean daily max.	Mean daily min.	Highest in each month	Lowest in each month	Relative humidity: ◆	Minimum	Cloud No. of days clear at: 0800	1400	Rain: Average fall	No. of days with 1 mm or more	Wind direction ◆: Percentage of observations from N	NE	E	SE	S	SW	W	NW	Calm	Wind direction ◆: Percentage of observations from N	NE	E	SE	S	SW	W	NW	Calm	Mean wind speed ◆	⊕	No. of days with gale	No. of days with dust fog	No. of days with thunderstorms
	mb	°C	°C	°C	°C	%	%	Oktas		mm																					Knots				
January	1009	31	24	34	21*	84	40	3	2	290	17	18	3	1	1	2	10	36	25	4									8	7	0	0	13
February	1010	31	24	34	20	85	40	3	1	267	18	19	0	1	1	3	8	28	34	6									7	5	0	0	9
March	1009	31	24	33	22	85	42	6	2	246	15	11	3	4	5	8	10	24	21	14									6	5	0	1	9
April	1010	31	24	33	21	84	41	8	6	203	9	6	12	26	16	8	6	5	3	18									5	4	0	1	6
May	1009	31	24	33	20	82	36	9	9	122	9	4	8	28	18	7	6	5	5	19									5	4	0	1	4
June	1009	30	23	32	19	79	31	14	17	74	5	2	6	43	22	6	6	6	2	7									6	4	0	0	4
July	1010	30	22	32	17	76	30	13	17	20	5	●	3	43	20	9	10	6	2	7									6	4	0	1	0
August	1011	30	22	33	17	73	26	17	20	3	3	●	2	56	19	6	7	3	1	6									7	4	0	0	0
September	1010	31	22	36	18	73	22	20	21	3	1	3	3	48	15	4	9	6	2	10									7	4	0	0	1
October	1010	32	23	36	20	73	19	17	16	40	4	4	5	44	13	2	13	10	2	7									6	2	0	0	11
November	1010	33	24	35	21	76	23	8	6	92	11	10	8	27	9	12	9	6	4	15									6	3	0	0	8
December	1009	32	24	36	21	81	23	3	2	291	16	10	3	5	1	4	12	34	17	13									7	4	0	0	12
Means	1010	31	23	—*	—**	79	—	—	—	—	—	7	5	27	12	6	9	14	10	10	—	—	—	—	—	—	—	—	6	2	—	—	—
Totals	—	—	—	—	—	—	—	121	119	1651	113	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	4	74
Extreme Values	—	—	—	36†	17††	—	19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
No. of years' observations		30										7																	7	7	20	20	20

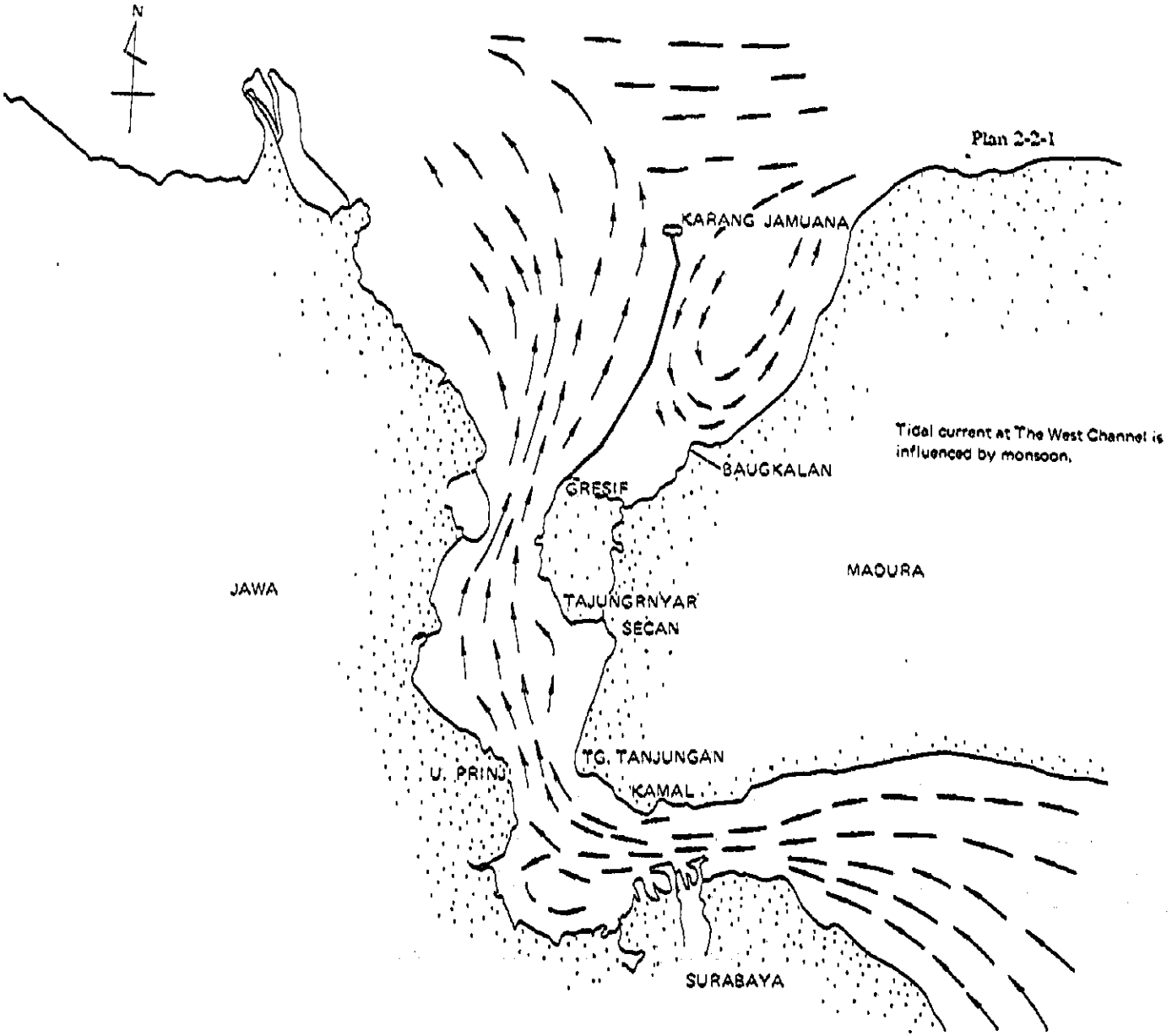
*Mean of highest each year.
**Mean of lowest each year.

†Highest recorded temperature.
††Lowest recorded temperature.

●Rare.
◆ All observations.
⊕% frequency of wind > 17 knots.

Source: Official data at MET. O. Bracknell.

current runs northward and southward each twice a day. At the time of the new/full moon, the northward current reaches the heighest velocity 2.5 knots after about 1 hour 15 minutes from meridian transit of the moon. In the meantime, the southward current reaches its heighest after about 7 hours 30 minutes from the meridian transit. The current velocity is about 1 knot at the time of the first quarter and last quarter of the moon. The direction of the westward current is supposed to be as shown in plan 2-2-1.


N
Plan 2-2-1
KARANG JAMUANA
Tidal current at The West Channel is influenced by monsoon.
BANGKALAN
GRESIK
JAWA
MADURA
TAJUNGRNYAR
SECAN
TG. TANJUNGAN
U. PRINJ
KAMAL
SURABAYA

2-3 Activities in Surabaya Port

(1) Number of ships

The number of ships, arriving and leaving Surabaya Port, of DWT 250 tons and more has increased, as seen in list 2-3-1, from 3,600 in the year 1971 to 5,000 or more in recent years.

(2) Cargo

The quantity of the cargo handled is shown in list 2-3-2. The figure in the year 1979 has been doubled as from that in 1971. Both foreign and domestic trade increased proportionately.

(3) Number of ships arrived and cargo handled

The ships arriving and leaving Surabara are both of foreign and domestic trade. The cargoes are not loaded at nor destined to only one port. Meanwhile, a large ship may be half-loaded due to the restriction by the depth of water. Under the circumstances like this, the indication is not easily figured out, but the relation between the number of arrived ships and the quantity of cargoes handled is as per list 2-3-3. The list speaks that the size of the ship employed has become bigger and bigger during the lapse of time (in 1975 and 1976, the number of employed ship decreased) inasmuch as the volume of cargo per bottom has increased.

(4) Arriving and leaving ships assorted by flag

Three fourth of all the ships are of the Indonesian flag as indicated in list 2-3-4. However, foreign flag ships are always seen there, as the port is opened for the world.

(5) Installations in the port

As seen in list 2-3-5, all kinds of installations are equipped with. The tug boats are provided. Fresh water and bunker are ready to be supplied and the temporary repair of the ship is feasible.

(6) Condition of the channel

1) The chart tells that the port is lengthy from east to west, but the east of Menara is used as a naval port.

The commercial port is located in western part and occupies about half the whole

port area. The water depth is reported to be 12 – 18m, but several points in the vicinity of the wharf are as shallow as about 7m. Further, there exists one sunken rock in the anchorage,

It is said that the commercial port has a capacity of embracing about 25 vessels of around 10,000 DWT each, but actually as many as 40 ships, large or small, entered the port. In the case of the congestion, however, some vessels have to wait outside the port.

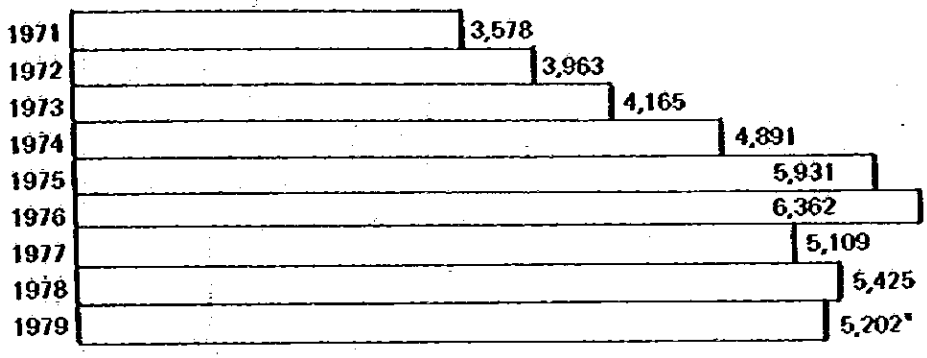
2) The small-sized (under 250 DWT) domestic sailing boats and the fishing sailing boats as small as canoe very often cross the west channel although no crossing passage is provided therein. The wind may blow to the unfavorable direction causing the hazardous situation where the sailing boat may collide with the big steamer.

3) The ferry boat shuttling between Surabaya and Madura Island crosses the anchorage in the midst thereof (or east end of the commercial port).

4) The east channel has not yet been cleared so that there may still remain the mines and sunken vessels. No dredging has been made in recent years with a result that the water depth is only 2.5m. No vessels other than the small sailing boat can proceed the channel.

List 2-3-1 Number of inward/outward vessels at Surabaya (1971 -- 1979)

List 2-3-1



Number of vessels in 1979 is obtained by multiplying two times of the actual number from January to June 1979.

List 2-3-2 Quantity of Cargo handled at Surabaya

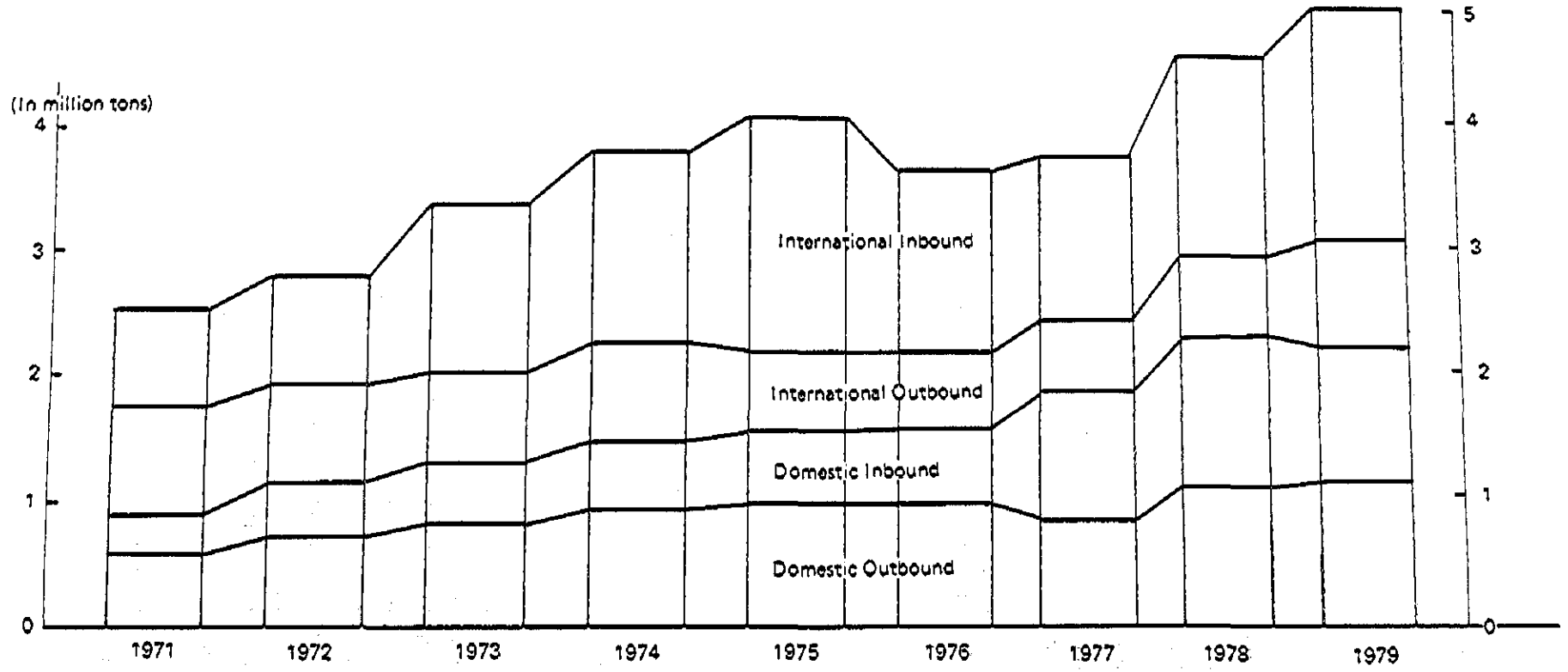
(IN TONS)

Year	Sum Total	Foreign Trade			Domestic Trade		
		Total	Export	Import	Total	Shipment	Receipt
1971	2,490,444	1,538,014	848,706	689,308	952,430	606,637	346,793
1972	2,691,215	1,596,915	720,637	876,278	1,094,300	723,289	371,011
1973	3,240,903	1,975,816	694,928	1,280,888	1,265,087	860,163	404,924
1974	3,731,410	2,342,986	851,260	1,491,726	1,388,424	937,004	451,420
1975	3,922,908	2,371,837	608,283	1,763,554	1,551,071	941,414	609,657
1976	3,647,761	2,048,990	585,993	1,463,006	1,598,762	946,028	652,734
1977	3,726,370	1,897,221	552,128	1,345,093	1,829,149	1,032,329	796,820
1978	4,552,259	2,120,445	636,252	1,484,193	2,431,814	1,236,885	1,194,929
1979	4,867,960	2,500,520	889,576	1,610,944	2,367,438	1,120,222	1,247,216

* Quantity of cargo in 1979 is obtained by multiplying two times of the actual quantity from January to June 1979.

Quantity of cargo handled at Surabaya

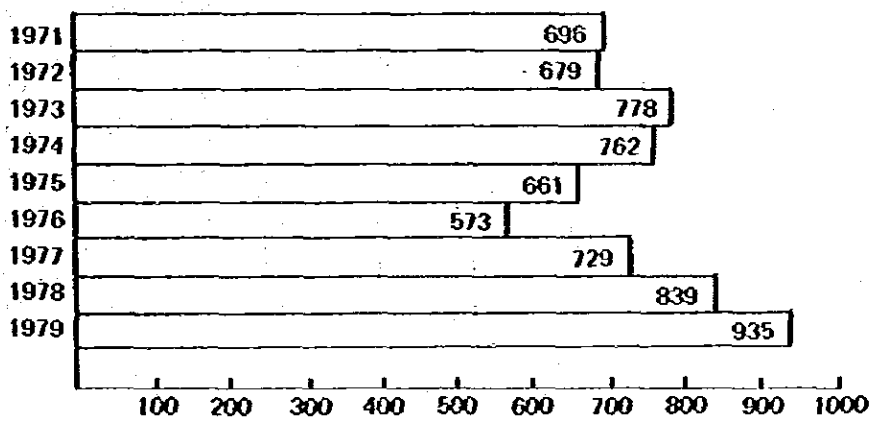
Plan 2-3-1



List 2-3-3 Relation of quantity of cargo and vessels arrived

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979
Quantity of cargo (A) ton	2,490,444	2,691,215	3,240,903	3,731,410	3,922,908	3,647,761	3,726,370	4,552,259	4,867,960
Number of vessels (B)	3,578	3,963	4,165	4,891	5,931	6,362	5,109	5,425	5,202
(A)/(B)	696	679	778	762	661	573	729	839	935

including domestic cargo and vessels



List 2-3-4 Number of inward/outward vessel classified in Nationality and Year 1971 – to 1979

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total	3,578	3,963	4,165	4,891	5,931	6,362	5,109	5,425	5,202
1. Indonesia	2,611	2,850	3,019	3,612	4,434	4,977	3,814	4,103	4,018
2. Panama	185	249	289	370	359	294	316	309	230
3. Japan	172	144	124	100	125	134	130	147	106
4. Liberia	154	203	168	207	233	209	240	264	324
5. Singapore	88	85	98	154	249	204	191	170	152
6. Netherlands	83	72	60	37	30	30	38	33	42
7. U.S.A.	71	61	85	63	155	158	54	52	18
8. Greece	52	40	36	46	58	40	–	–	–
9. Republic of Germany	37	29	16	20	31	42	42	61	44
10. Norway	28	91	110	59	35	41	36	25	32
11. Somaliland	22	24	43	45	10	6	–	–	–
12. Denmark	22	27	26	26	34	28	21	20	12
13. United Kingdom	15	24	30	44	50	43	41	36	22
14. Yugoslavia	–	4	4	4	9	7	5	6	2
15. Republic of Korea	7	14	5	11	30	48	39	44	40
16. India	6	8	15	7	7	19	21	16	8
17. Poland	4	10	8	15	14	14	14	12	10
18. Taiwan	1	4	6	6	12	16	6	9	18
19. Cyprus	–	2	3	20	7	6	1	3	2
20. Philippines	–	6	4	6	7	13	12	14	20
21. Thailand	–	–	1	15	4	5	2	1	2
22. Malaysia	–	–	6	9	2	–	1	2	0
23. U.S.S.R.	7	2	2	3	6	2	4	2	2
24. Pakistan	–	3	1	4	–	–	–	–	–
25. Others	13	11	6	8	30	26	81	96	96

port facilities

I. WHARVES

A. Concrete	length (m)	depth (m)
1. Jamrud Utara	900	8.60
2. Jamrud Barat	210	8.20
3. Jamrud Selatan	800	7.90
4. Perak	140	7.50
5. Berlian Utara	140	7.50
6. Berlian Timur	780	8.40
7. Berlian Barat	750	9.30
8. Nilam Timur	900	8.20
– for coal	100	8.50
– for fertilizer	75	8.50
– for wheat	140	8.50
9. Kalimas		
– for ferry	130	3.50
– for coaster	1,055	3.50
– for sailing vessels	1,720	1.50
B. OIL YETTY	16	8
C. Wooden	nil	nil

II. WATER AREA Total: 1,964,000 m²

III. BASIN

	area (m²)	depth (m)
Outer basin	1,180,000	12
Inner basin	784,000	9.60

IV. LAND AREA 6,450,000 m²

V. BREAKWATER 830 m

VI. TRANSIT SHEDS

Location	Number	area (m²)	capacity
Jamrud Utara	9	27,067	54,134 tons
Jamrud Barat	1	2,629	5,258 "
Jamrud Selatan	8	19,675	39,350 "
Perak	1	2,429	4,858 "
Berlian Timur	3	14,454	28,980 "
Berlian Barat	4	17,085	34,170 "
Nilam Timur	5	30,895	61,780 "

VII. WAREHOUSES (P.A. Property)

Location	Number	area (m²)	capacity
Jamrud Tengah	8	11,479	22,958 tons
Perak	2	4,643	9,286 "
Kalimas	4	13,093	26,186 "
Taman Jayengrono	12	15,838	31,676 "

VIII. OPENSTORAGE

Location	area (m²)	capacity
Inner harbour	46,530	139,590 tons
Outer harbour	76,900	230,700 "
Air base	202,000	606,000 "

IX. FORKLIFTS (PA Property)

Capacity	Number	Condition
1.5 t	2	30%
2.5 t	80	new
5 t	10	new

X. MOBILE CRANES

Capacity	Number	Condition
3 t	2	30%
25 t	2 (electric)	new
15 t	8 (electric)	new
15 t	2 (hydraulic)	new

XI. TRAILERS

Capacity	Number	Condition
20 t	3	new

XII. TOWING TRACTORS

Capacity	Number	Condition
3 t	1	new

XIII. FLOATING CRANES

Capacity	Number	Condition
50 t	1	70%

XIV. PILOT BOATS

Capacity	Number	Condition
250 HP	2	90%
150 HP	2	60%
250 HP	2	new

XV. TUG BOATS

Capacity	Number	Condition
800 HP	2	80%
1500 HP	2	new

XVI. MOORING BOATS

Capacity	Number	Condition
36 HP	2	80%

XVII. BARGES

Capacity	Number	Condition
300 t	1	90%

XVIII. WATER-BARGES

Capacity	Number	Condition
PA.4 - 500 T	–	50%
PA.5 - 200 T	–	60%
Bengawan - 285 T	–	80%

XIX. GRAVING DOCKS

Capacity	Number	Condition
20,000 T	1	new

XX. FLOATING DOCKS

Capacity	Number	Condition
2,500 TLC	2	new

XXI. COAL CRANES

Capacity	Number	Condition
5 T	1	40%

2-4 The distribution of Sunken Vessels in Surabaya Port

The distribution as studied in the year 1959 – 1960 is as per plan 2-4-1 (Matsukura Report). DMS removed 29 vessels in 20 years from 1960 to 1979 and also removed a part of the stern (about 5% of whole) of the sunken vessel No. 4 as well as one third of the vessel No. 43. The following list has been made out of the Matsukura Report which tells that 40% in number of vessels has been removed. However, only 23% of the vessels has been removed if the calculation is based not on the number of vessels but on the gross tonnage (the assumed figure) and the scrap DWT.

It has been revealed that many small vessels under 100 DWT were removed, but most of the large vessels have still been left as they are.

List 2-4-1 The change in number of sunken vessels in Surabaya Port as time elapsed

Item / Year	Number of vessel	Aggregate gross tonnage assumed	Estimated scrap to be produced
1959–1960 by Matsukura	74	114,969	40,659 M/T
End of 1979	45	88,584	31,205

We have heard at the occasion of the recent investigation from those who are interested in Surabaya Port to the effect that

(1) The Matsukura Report has not covered the whole sunken vessels in Surabaya Port.

(2) Some of the old sunken vessels still remain untouched in the west side of the channel.

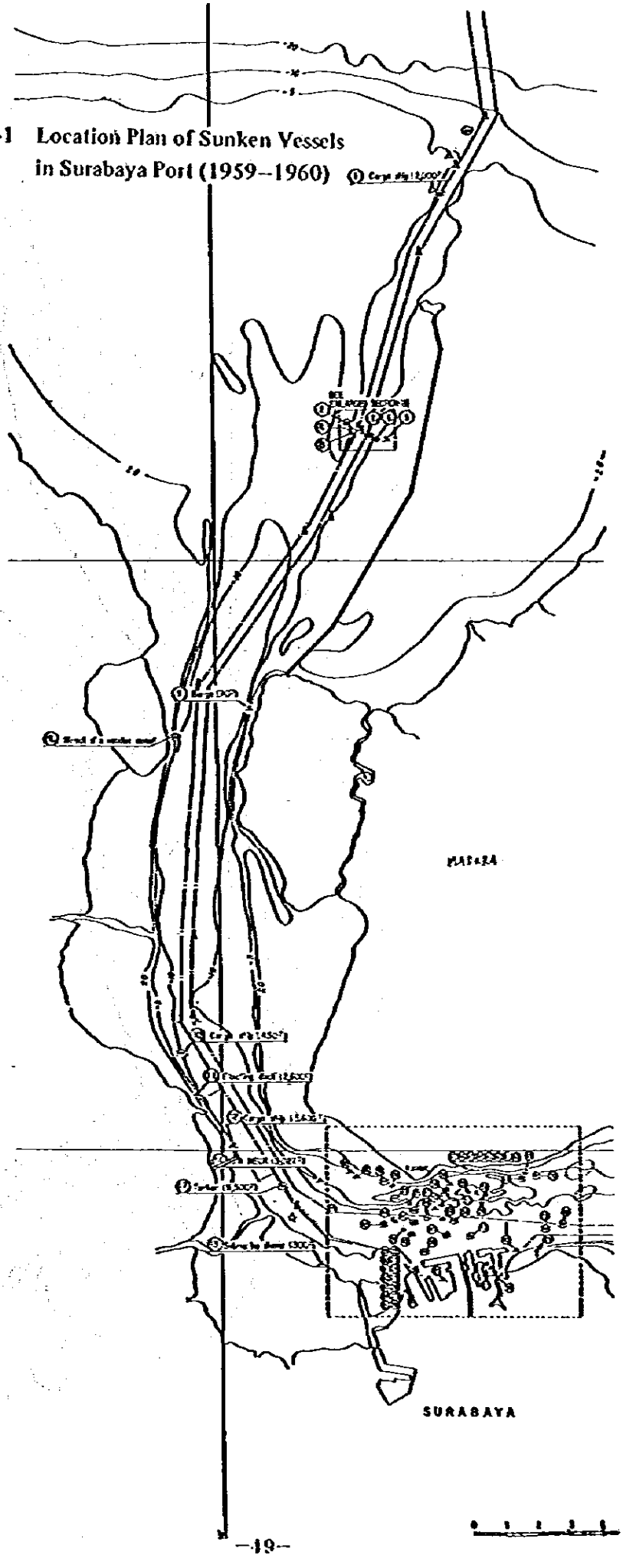
(3) Many vessels sank after the issue of the Matsukura Report, some of them has been removed already.

However, there is no alternative but to resort to the Matsukura Report for the purpose of mapping out the up-to-date distribution of the sunken vessels. The plan 2-4-2 has been summed up from the Matsukura Report for the indication of the distribution of sunken vessels in Surabaya Port.

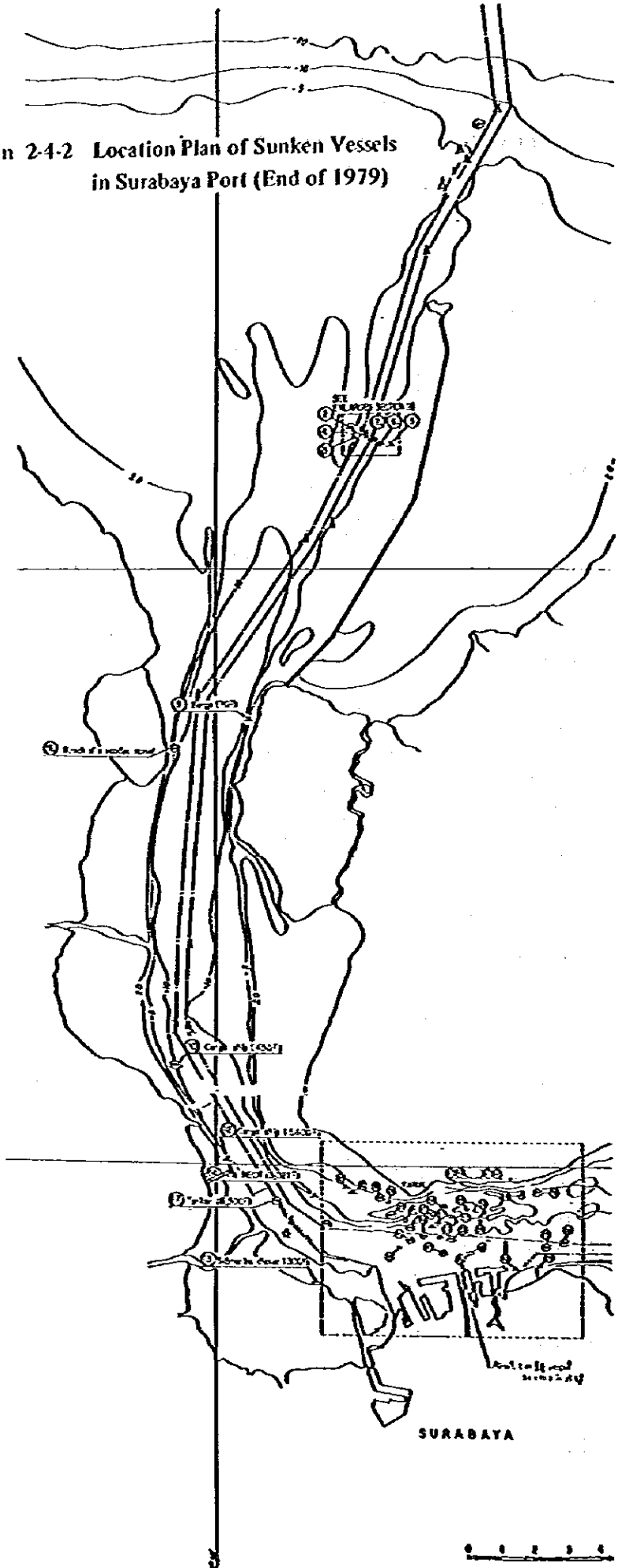
As regards the east part of Surabaya Port (naval port and east channel), some sunken vessels, which have neither surveyed or swept, are marked in the chart and actual situation is not known at present.

It is, therefore, considered that they have been buried deeper into sea-bed for a long period.

Plan 2-4-1 Location Plan of Sunken Vessels in Surabaya Port (1959–1960)



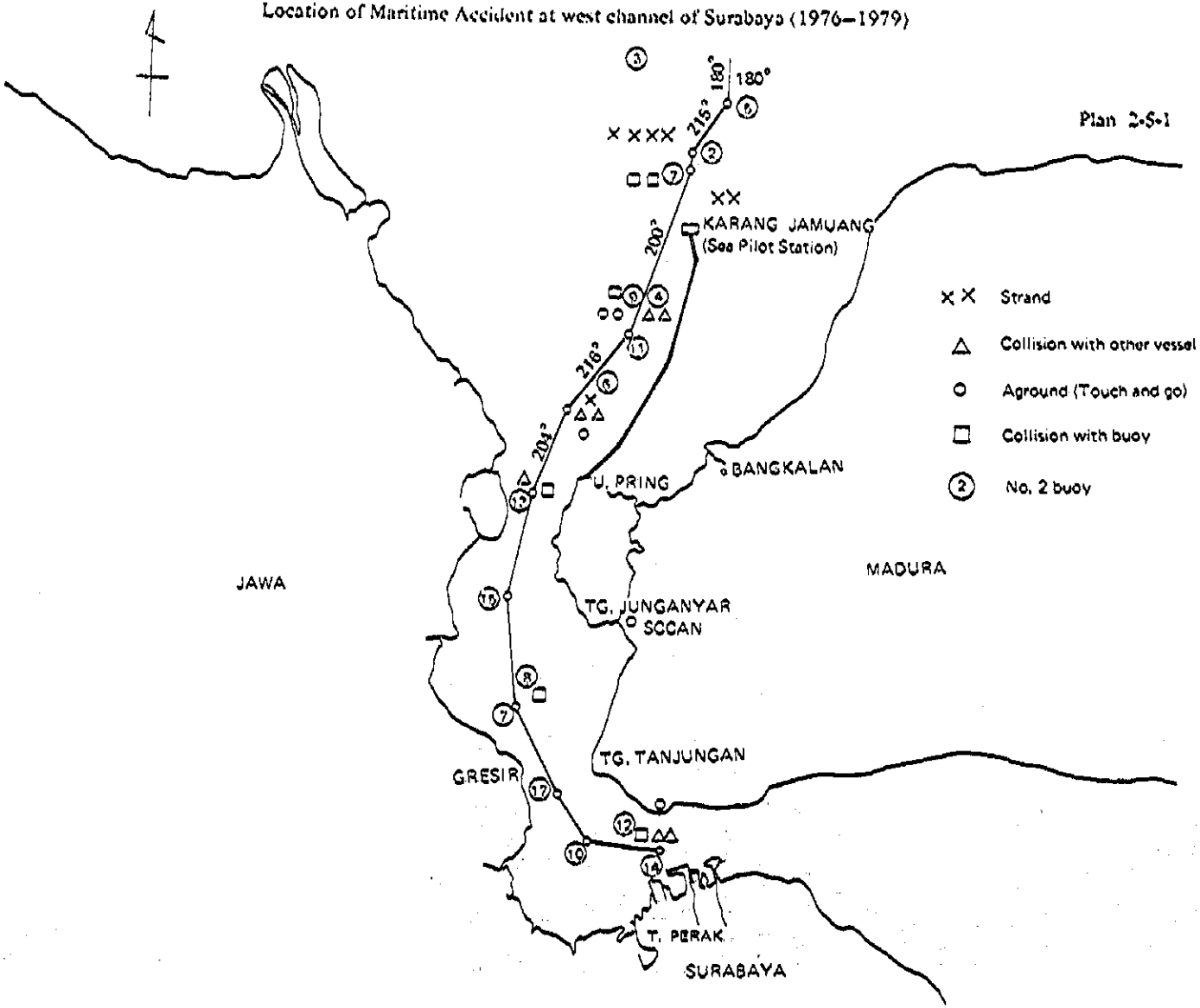
Plan 2-4-2 Location Plan of Sunken Vessels in Surabaya Port (End of 1979)



2-5 Maritime Accidents

We have studied the location where maritime accidents took place on the basis of the Report of Maritime Accidents in Surabaya Port (as from January 1976 to August 1979) prepared by the regional headquater of Sea Communication at Surabaya. The Report indicates the figures of accident in respect of open sea and of inside the port (plan 2-5-1). The cause of the accident is classified into 1 stranding 2 collision with other vessel 3 grounding 4 collision with buoy and 5 others. The distribution thereof is as per the list 2-5-1. As is gathered therefrom, most accidents happened in the vicinity of the buoies No. 2 – No. 4 in the west channel. In this connection, every equipment aiding navigation is provided including buoy etc. and the pilots versed with the situation have been employed. The weather and sea condition are compratively calm in the region. Nevertheless, the accident occurred frequently. Consequently, we conclude that those accidents have apparently been caused by the fact that the existence of sunken vessels is hardly perceived by the navigators and that the sunken vessels narrowed the navigatable channel extremely. In the meantime, the accidents in the vicinity of inside the port area, as seen in list 2-5-2, mostly caused by the collision with other vessel. The factors giving birth to the situation may be that the anchorage is not wide enough, or that the vessels, large or small, are jammed and yet no passage is provided for incoming and outgoing vessels separately, or that the capacity of the berth is limited, or that the tug boat to be employed at the time of arriving and leaving the wharf or other aiding equipments might be insufficient and etc. It is difficult to find the reasons definitely, but we can at least point out that the narrowness of the channel, where water area is wide enough considering from physical geography, was caused by the sunken vessels.

Location of Maritime Accident at west channel of Surabaya (1976–1979)



List 2-5-1 Maritime Accident at west channel or in vicinity of Surabaya

Condition / Location	Stranded	Collision with other vessel	Aground (Touch and go)	Collision with buoy	Others	Total
1. Buoy No. 2	4			2	1	7
2. No. 3					2	2
3. No. 4		2				2
4. No. 5					1	1
5. No. 6	1	2	1		1	5
6. No. 7					3	3
7. No. 8				1		1
8. No. 9			2	1		3
9. No. 10					1	1
10. No. 11					1	1
11. No. 12		2		1		3
12. No. 13		1		1		2
13. No.17		1				1
14. Pilot Station	2				2	4
15. Other places	3	2	1		8	14
Total	10	10	4	6	20	50

Other places: On passage, outside of east passage, westside of channel etc.
Condition Others: Sunk, engine trouble, flooding, fire, etc.

List 2-5-2 Maritime Accident at inner harbour

Condition / Location	Stranded	Collision with other vessel	Aground (Touch and go)	Collision with buoy	Others	Total
1. Rede Delabuhan		17			10	27
2. Rede Gresik					4	4
3. Jamrub Utara		1			1	2
4. Jamrub Barat		1				1
5. Jamrud Selatan		2			2	4
6. Jamrud		4			2	6
7. Gudan	1	6			2	9
8. Berlian Utara					1	1
9. Berlian Barat					1	1
10. Berlian Timur					2	2
11. Kalimas	1	11			5	17
12. Nilam Timur		2			3	5
13. Oil Jetty (in vicinity)					1	1
Total	2	44	0	0	34	80

Condition Others: Sunk, engine trouble, flooding, fire, etc.

2-6 The Development Plan of Surabaya Port

In view of the development of the contenarization, the administration of Surabaya Port is contemplating the construction of the wharf, exclusively used for the containers, of the length of about 1,500m by way of filling in the shallows at west side of the present commercial port. The administration is going to have a feasibility study from economic and technical points of view as from the year 1980 to 1985. Further, the idea of constructing new passage is proposed. The passage will be provided at the location stretching from No. 6 buoy in the west channel to open sea, by dredging the shallows at west of the spot of sunken vessel. According to the plan, the water depth is 11m and the navigation area is 200m in width. The quantity of earth and sand to be dredged is roughly estimated 40,000,000 tons.

As a lot of earth and sand drift, the maintainance dredging of the considerable volume even after the completion of construction is indispensable necessitating the extraordinary expenditure. It is said that the movement of earth and sand at the bottom of the west channel gets stiller as it approaches the trainning wall (breakwater) and gets wilder as it approaches the west end of the channel. It should be considerable matters whether to take the aforementioned idea of new passage or to remove the sunken vessels, which narrowed the water passage, for the purpose of deepening and broadening the channel and enabling the large vessels to proceed without any trouble.

As regard the east channel, it is hardly availed at present. However, the clearance and dredging of the channel is now under study and, upon completion, the navigation of large vessels to and from South side of Jawa and Australia will shorten the navigating time and be said to bring about the big economic efficiency.

2-7 The Priority for Removal of Sunken Vessels in Surabaya Port

2-7-1 Sunken vessels in West Channel

West channel is the only one that is important passage for vessels entering into or leaving Surabaya but is in unfavorable circumstance for navigation due to scattered sunken vessels reducing the breadth of passage which is originally narrow.

Especially the breadth of navigable course indicated on plan 2-5-1 is narrow and need to remove all of sunken vessels in order to assure safety navigation.

The sunken vessels located around the No. 5 buoy set at the northern end of West Channel should be given priority for removal because it is the changing point of navigation and in the unfavorable sea condition compared with inner area of the channel.

And while the sunken vessels around the No. 4 buoy should be removed with priority because these sunken vessels have reduced the width of the navigational passage remarkably.

2-7-2 Sunken vessels around anchorage of Surabaya Port

The anchorage of Surabaya Port must secure enough area because of veering due to change of the current and the wind direction. Then, anchoring in such area, it is needed for vessels to be held safely.

Accordingly as for sunken vessels shown on plan 2-7-1, all of sunken vessels in anchorage should be removed at least and it is desirable to remove the sunken vessels in the circumferential area as much as possible.

Especially, sunken vessels in the western area of the anchorage which is congested with anchoring and cruising vessels should be given priority to be removed.

Plan 2-5-2

3. GENERAL CONSIDERATION OF THE PRIORITY FOR REMOVAL OF SUNKEN VESSELS

3-1 *Outline*

In case of decision of the priority to remove sunken vessels, there are so many factors to examine like secure of safety navigation, and extension of port function, removal cost, and difficulty in removal operation. It should be first prior to another to examine the factor to secure the safe and smooth navigation.

As for another factors, after the priority for removal is determined from the viewpoint of security of safety navigation, synthetic priority should be given with analysis on each factor.

Therefore in this article the fundamental consideration for the necessity and the priority of removal of sunken vessels will be described.

3-2 Investigation Items in Decision of the Necessity of the Priority for Removal of Sunken Vessels

3-2-1 The position and the depth in waters of sunken vessels

Grasp the accurate position and the depth of sunken vessels from the standard water level.

3-2-2 Actual circumstance of traffic around sunken vessels

Investigated in the waters around sunken vessels as main principal (LXBXD, type, full draft, and etc.), navigational apparatus used type, in measuring vessel's position, method of locating vessels, navigational course (distribution of courses and of wakes), traffic volume by types of vessels, states of passing and crossing, and etc., it is necessary to be examined that the waters around sunken vessels are corresponding to passage or anchorage, and that what influence the sunken vessels have on traffic in nearby waters.

3-2-3 Circumstances in the sea area around sunken vessels

Especially investigate the following items regarding the navigational circumstances in the sea area around sunken vessels.

(1) Geological condition in the sea area

Width, length, water depth, and views in such navigable area as open sea, inland sea, the strait, the channel, and the harbour

Topography of sea bed state of obstacles to the traffic other than sunken vessels

(2) Natural condition in the sea area, weather and sea condition

(3) Navigational aids or land mark for navigation

Installed place, interval, reliability, and any other items of navigational aids, land marks, and etc.

(4) The state of the occurrence of maritime accidents

Date & time of occurrence, place, kind, distribution, cause, and principal of vessel met with maritime accident.

(5) Regulations with regard to sea traffic.

(6) Opinions of personnel concerned

It should be done as widely as possible to assemble opinions of personnel concerned who utilize the sea area in question.

3-3 Necessity and Determination of the Priority for Removal of Sunken Vessels

3-3-1 The necessity of removal

Based on the result of investigation by 3-2, and considering the state of utilization in traffic in the area of the sunken vessels which should be removed according to the following classifications.

(1) Anchorage

All of the sunken vessels in anchorage should be removed. The area of anchorage should have full water depth, desirable sea bed for holding the vessel tightly by anchoring, ample surplus in width for stretching chain and the veering due to tide, current, and wind for this reason, obstacles like sunken vessels should be removed despite of those water depth at the sea area utilized as anchorage.

(2) Any sunken vessel in the water passage as follows should be removed. It is essential to secure the depth ("a proper depth") including maximum draft of navigating vessels and under-water-keel-clearance.

All sunken vessels which are in lower depth than above should be put into removal operation.

1) Sunken vessels in the passage which cause the extreme change of course or force so many times to change the course in short distance or interval

Generally, taking into consideration the weather and sea conditions geographical ones, owners/operators select the navigational course in which the vessels could cruise more safely and more smoothly than in any other courses. So all the sunken vessels which force difficulty in navigation on owners/operators, should be removed in case that desirable selection of course is impeded and that the change of course is forced to the extremity or so frequently in short distance or interval.

2) Sunken vessels which reduced the breadth of passage

It is needed for safety navigation to keep some navigable breadth, which is dependent on so complexed factors as weather and sea conditions, water depth, size of vessel, volume of traffic and others. But generally the navigation breadth in the harbour needs one or two times the vessel's length, so in order to secure the safety navigation, it should be done to remove the sunken vessels located within the range.

3) Others

It is necessary to examine in detail to remove or not the sunken vessels other than 1) or 2) by investigating the occurrence situation of maritime accidents and through confirming the opinion of personnel relating to maritime affairs. Especially, sunken vessels which have caused maritime accidents are most dangerous obstacles to safety navigation, and by interviewing maritime personnel, some valuable informations could be acquired regarding the sunken vessels which is some effective in navigation.

3-4 Determination of the Priority for Removal

The priority of removal should be concluded fundamentally from the viewpoint of the necessity to remove, namely the extent of obstacle of sunken vessels to sea traffic. But in actual case, there are various extents of obstacle, and it had better be on case by case basis to compare the extent each other. Accordingly, hereafter only the fundamental consideration to decide the priority could be stipulated.

3-4-1 The priority owing to circumstances in sea area

There are various kinds of sea area as narrow channel, and inner harbour restricted to navigating by natural condition or obstacles without sunken vessels, as sea area where freely navigating or anchoring can be done because comparatively wide, and so on. But fundamentally the priority for removal should be given to sunken vessels in navigable sea areas which have been restricted by sunken vessels. In this case, it is necessary to examine relative priority between such areas by grasping enough the actual traffic of the vessels.

In general, the first priority should be given to the sunken vessels located in the harbour where there is much traffic and in narrow channel where the passage is restricted.

3-4-2 The priority in anchorage or passage

It should be judged from actual state of traffic and of traffic volume to which the anchorage or the passage the priority would be given. For instance, the passage would be prior to the anchorage if the anchorage area sufficient enough for the traffic could be found so as to keep the function of harbour.

3-4-3 The priority due to water depth of sunken vessels

As described already, all of sunken vessels should be removed despite of water depth in case of anchorage and the sunken vessels should also be put into removal operation if placed in lower depth than the total depth ("a proper depth") of the maximum draft added to under-water-keel-clearance, in case of passage.

It is easy to confirm obstacles above water surface but is difficult to certify the position of sunken vessels below the surface, which are dangerous. Consequently, removal operation should begin on the sunken vessels below water level in a manner that those placed closer to sea level are removed prior to those placed less close to it.

3-4-4 The priority of removal in anchorage

The priority should be decided by factors like utilization of anchorage, topography

of sea bed, tide, current, and quality of sea bed.

The priority should be given to sunken vessels which considerably confine the width of anchoring area, or which make valueless the anchorage that is otherwise valuable, or which are on the way to the port.

3-4-5 The priority of removal in passage

It is necessary to conclude the priority through comparative examination of the extents of obstacles in individual case because of the diversity of obstacles like interrupting the choice of desirable course for safety navigation, reducing the breadth of passage, and so on. It also needs to remove obstacles like sunken vessels in the waters where it is difficult to operate the vessels because of large variable of vessel, difficulty in locating vessel, low water depth, or side water effects. Operational characteristic of vessel must be thoroughly considered in decision of the priority.

As a conclusion the priority should be decided after examining the following items collectively.

(1) As for sunken vessels which interrupt desirable navigational safety traffics, examine the degree of influences by an angle of changing the course, and the frequency of the change.

(2) As for sunken vessels which have reduced the navigational width, examine the degree of interference.

(3) Examine the wind and tidal current, the measurable degrees of difficulty and error for positioning the vessel, the influences of shallow water and side water effects the situation of the vicinity of sunken vessels.

3-5 Conclusion

As for the necessity and the determination of priority for removal of sunken vessels from viewpoint of securing the safety navigation, the final decision should be given by examining the degree of interference with safety navigation caused by sunken vessels after investigated in detail geological, natural characteristics, actual traffic state in the waters in question. In above articles it has been stipulated that all of sunken vessels are basically objects of removal but the priority should be concluded according to the degree of interference, namely it is on the premise that the countermeasure to get rid of or reduce interference with safety navigation is only to remove the sunken vessels without devising another countermove.

But it is more realistic to examine countermeasures including removal in order to exclude or mitigate the interference. It is conceivable that if it is possible to exclude or mitigate the interference without removal of sunken vessels, the priority of removal would become low relatively because of alternative countermeasure. By this reason the basis will be the investigation of all countermeasures on the occasion of the necessity of removal and decision of the priority.

Furthermore, sunken vessels which have been decided to be removed after examined above mentioned procedure must be put into removal operation at an early opportunity. But in case that removal operation could not be carried out due to some affairs, at least, in order to secure safety navigation, following treatments will be required before the removal operation.

(1) Installation of marker buoy or others which indicate clearly the position of sunken vessels.

(2) Offer of informations concerning sunken vessels and waters around sunken vessels to navigators by means of chart or notice to mariners.

(3) Installation of navigational aids

4. THE STUDY ON THE METHOD AND THE COST FOR THE REMOVAL OPERATION

4-1 The Survey On Sunken Vessels

4-1-1 Method of Survey

In implementing this survey, the following plan for the divers' team was arranged on the data regarding the general meteorological and sea conditions, the navigation charts, and the like in the districts of Tanjungperak and Surabaya.

(1) Personnel

Salvage master	1 man
Salvage engineer	1 man
Diver	2 men
Mechanic	1 man
Tender	2 men
Total	7 men

(2) Main particulars

Generator (75 KVA)	1 unit
Compressor (150 kg/cm^2)	1 unit
Sand pump (Electric 4" dia)	1 unit
Underwater electric cutting machine (500A)	1 unit
Diving apparatus (Kirby morgan)	3 sets
Consumable items (Wire rope, etc.)	1 set

(3) Survey boat

The Indonesian side shall be responsible for the survey boat. And we chartered the "BOGA" that had been registered in Indonesia, for this purpose as an ideal one.

(4) Loading and installation of equipments

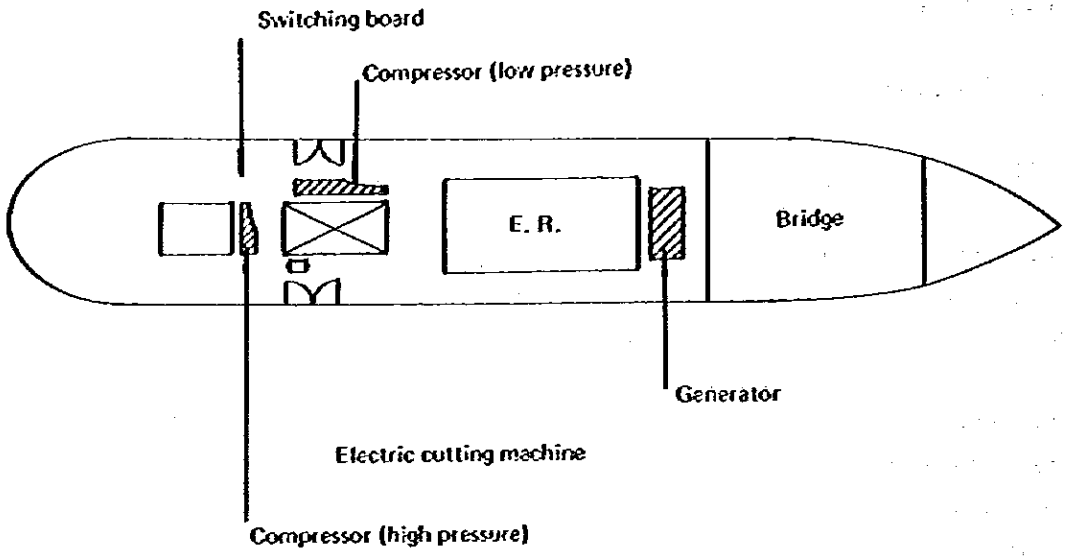
1) Go alongside the survey ship.

2) Loaded machines and equipment, and consumable goods with the helps of fork-lifts and truck cranes.

3) Install loaded equipment as shown in Plan 4-1-1.

4) Arrange them free for operating a generator, switching boards, and compressors.

Plan 4-1-1



(5) Inspection & tests of machines & equipment

1) Inspections for the connections of the generator & the switching board.

2) Operated the generator and all other machines one by one to see them in normal operation or not.

3) Inspected all the machines in the full speed of operation to examine the allowable capacity of electricity.

4) Inspected all the diving apparatuses in low pressured compressor.

5) Checked all the diving masks.

6) Provided a diver's steps due to the high deck of the survey boat.

7) Loaded 2 small anchors, one at the bow and one the stern of the survey boat (150 kg X 1 pc, 50 kg X 1 pc) "BOGA", whose anchors are not sufficient enough to hold the stationary position corresponding to the max. sea current of two knots in the vicinity of No. 4 navigating buoy as prescribed in the table of tidal current & tide. (In order to moor the "BOGA" in the middle of the tidal current of two knots, the anchor was comparatively smaller than what she ought to equip with.

(6) On-the-site Mooring

1) Upon completing the preparations for the survey, the survey team got onboard and sailed to the site.

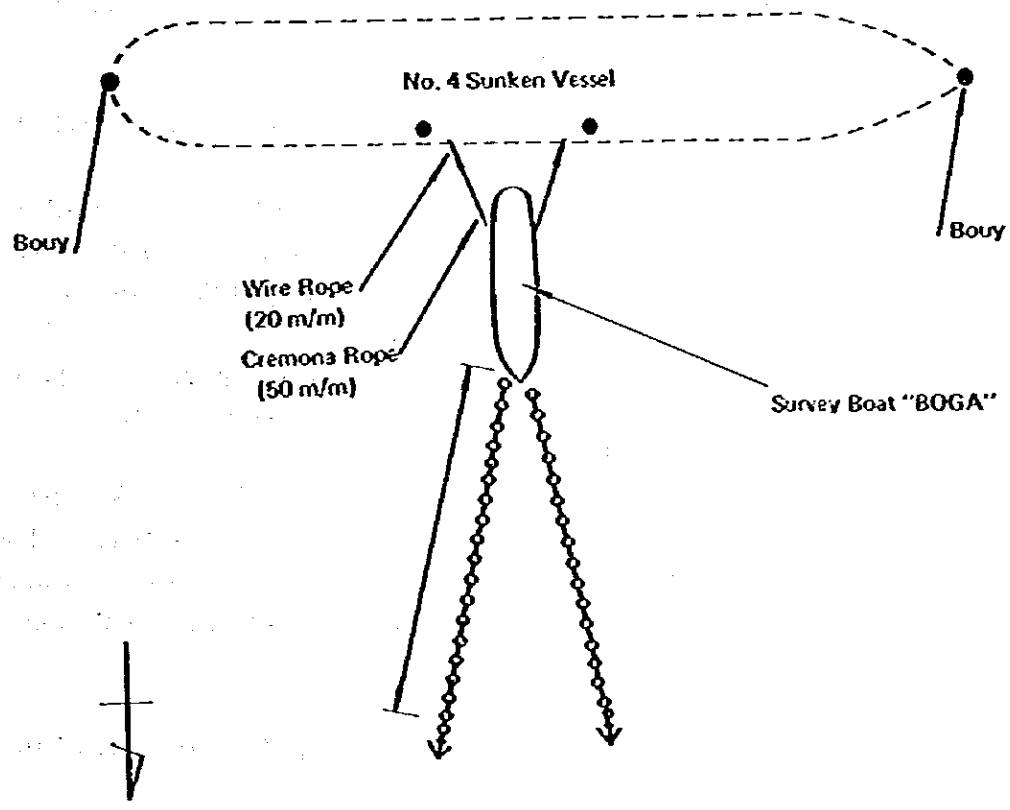
2) Regarding the mooring method, the survey team thoroughly discussed it with the captain of the "BOGA" and arranged her so as not to contact the sunken vessel.

3) Upon arriving at the site, disembarked a small boat, loaded a mooring buoy (50 kg) for the sunken vessel and two mooring wire ropes (20 m/m X 20 M), boarded divers, and approached herself to the sunken vessel.

4) Being confirmed No. 4 sunken vessel by the divers, fixed the mooring buoy one each at the bow and stem end of the vessel. And arranged the mooring wire ropes of the "BOGA".

5) In case the "BOGA" was to be moored, it was advisable to moor at the southern side of the sunken vessel in consideration to the tidal current, but she was obliged to be at the northern side as there were some other sunken vessels nearabout.

Plan 4-1-2



a) As shown in Plan 4-I-2, two anchors were dropped down from the "BOGA" the chain of which being extended to the position of 20 meters closer to the sunken vessel, schackled the mooring wires and the mooring buoys of the "BOGA", and tightened them with a winch.

(7) *Survey of sunken vessels*

Upon completing the first survey of No. 4 sunken vessel, a series of surveys were conducted to No. 2, 3, 6, and 5. The results of No. 4 sunken vessel were as follows:

1) Sunken Position

In case that a part of the sunken vessel is exposed out of the water surface, it was measured on the vessel with a sextant to go after 2 to 3 objects and measure an angle between them, and recorded with a semicircular protractor.

At the site the position was known to us owing to the information and the data gathered from the various sources, so that it was measured 2 positioned bearings with the compass of the "BOGA", to make sure where the sunken vessel is located.

2) Survey regarding main particulars of the sunken vessel

In general, the survey of the sunken vessel is conducted on the basis of a general arrangement drawing, and a structural arrangement drawing, which shows a type of ship, main particular dimensions, & others. The sunken vessel, however, was sunk about 30 years ago, leaving us nothing clear about what happened on her, so that the survey was conducted in the following.

a) Prepared a CREMONA rope (12 m/m X 130 M) with a mark every 1 meter.

b) Installed the end of the measuring rope at the bow and the other at the stern, and tightened it from the small boat. When it was fully tightened, divers measured the actual dimension of the vessel at the stern.

c) Regarding the width of the sunken vessel, measuring ropes were provided at the middle, the bow, and the stern respectively to find it out.

d) The above measuring method may cause different dimensions corresponding to the reflections of the sea conditions. The underwater visibility, however, was very bad (0.2 – 0.3 M only, so that the measuring rope was an ideal to employ, for it acted as a guide rope for the divers to measure the dimensions of the vessel under the groping conditions.

e) Divers measured the dimensions of the poop deck, the cargo hatch, and others with a guide rope.

f) Divers measured the dimensions of the vessel and the location and the dimension of the bridge, the cargo hatches, and others.

g) Divers measured the dimensions of the measuring rope which was horizontally extended, and the exposed part of the vessel's bottom regarding the depth.

3) Gross tonnage and displacement

Gross tonnage and displacement are of vital importance to calculate the scale and the weight of the vessel. The main particulars of the sunken vessel were, however, assumed regarding the D.M.S., the drawings, and other important data, in the following since she was sunken about 30 years ago and not available to obtain anything certain:

4) Kind of main engine and horse power

The main engine room was buried under the piled sandy mud and assumed what she ought to be judging from the same type of vessel at the time of the last World War II.

5) Fuel

Since about thirty years had passed, the fuel oil in the sunken vessel must have leaked out of the air pipes, sounding pipes, and others by now.

6) Cargo

Due to the deposited mud inboard, cargoes were not located inside.

7) Ship head

Ships head was surveyed with a magnetic compass on the small boat respectively.

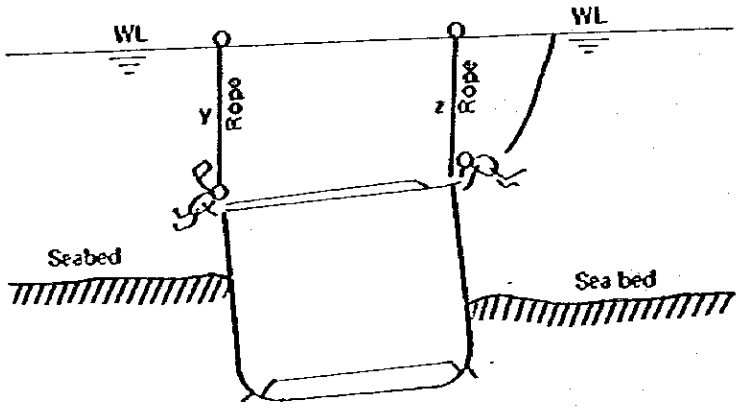
8) Lost

a) Horizontal List

The employed method was to calculate the depths of the starboard and the portside under the sea surface and to measure the breadth between the two.

2 to 3 positions were measured to measure the slanted degree of an angle.

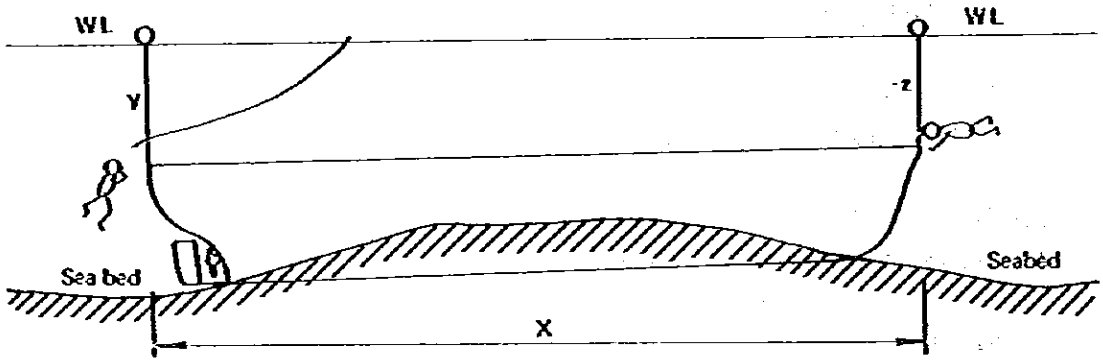
Plan 4-1-3(A)



b) Trim

The calculation was conducted to measure the depth from the bow and the stern in consideration of the length of the vessel.

Plan 4-1-3(B)

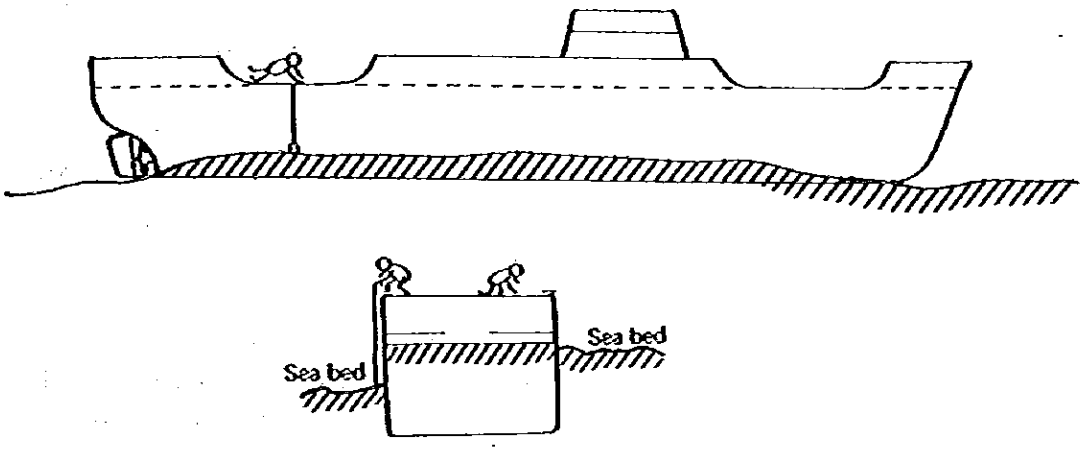


9) Buried Condition

In order to measure the sunken condition of the vessel, the buried depth was calculated from the main and the higher deck to the surface of the deposited mud.

a) Diving with a ruling scale along the shell plating, divers measured the length of the vessel.

Plan 4-1-4



b) The surveyed area is ranged from the bow to the stern, the starboard to the port. In all, it covers the whole circumference. This survey is very important to decide the plan for the removal of the sunken vessel. That is why it is necessary to survey in details.

c) Regarding the volume of the piled sandy mud inside the board, divers originated from the main deck as a base to survey, measured it in hulls, engine rooms, bridges, and others, and found it almost filled up to the deck as she was. As the result of the survey, there found deposited mud being covered almost all the inboard owing to the reflections of the tidal current.

d) The sunken situation of the vessel represented a form incurred by the rapid tidal current, namely, sandy mud was digged deep at the bow and the stern, while it was piled high at the midship.

10) Corroded Condition

a) The hull that was exposed to the water out of the mud, was flourishly covered with shells and sea weeds of 10 to 15 cm thick.

b) By removing the shells, divers examined the degree of steel corrosion and measured the thickness of the shell plating, and noticed that many layers of rusted steel with shells were peeled out, and that the plating was 8 – 10

m/m in thickness.

c) The deck was totally damaged all over, only to leave the beams as they were.

11) Sounding of the water near the sunken vessel

A sounding lead was casted to measure the depth of the water in the vicinity of the sunken vessel.

12) Sea bed

Divers collected sandy mud in the vicinity of the sunken vessel and analyzed it closely, and found that the nature of sea bed consists of sandy clayey mud.

Note: In general, a sounding lead coated grease, is casted underwater, to which mud is sticked for the collection. Hence, the nature of the sea bed is judged from the result of an analysis.

13) Temperature

The surface water was measured by a thermometer every one hour and found it in the range of 31°C – 32°C. In the tropical zone, nothing bad can be affected to the diving work at the site. The sea temperature was taken only to help us use as the supplemental data.

On the contrary, temperature tends to fluctuate on account of the climate, tidal currents, and others in the temperate and frigid zones, so that it is essential to keep recording the temperature throughout year.

When it comes to planning the working schedule, it'll play an important role in executing this type of work. Besides, the underwater temperature varies corresponding to the degree of the sounding, so that in case that the depth is more than about 30 meters deep, it is advisable to measure three different places.

14) Visibility

The color of the sea water at the site stays always dark brown as the turbid water flows into the site. That was why the underwater visibility was 0.2 – 0.3 M when a flashlamp was lighted on.

Regarding the measuring method, a diver puts one of the hand in front of his eyes, moving it back and forth, and measured the distance with a scale.

15) Tidal current

a) A tidal direction & current meter with an automatic recording type, is employed to measure in general, but a graph on tidal direction and current was made on the basis of a tide table in Surabaya Port (as of 1979) surveyed by the Republic of Indonesia.

b) On the basis of the graph on tidal direction and current, the time difference was measured regarding the tidal current in the vicinity of No. 4 navigating buoy and judged the above data quite sufficient to use for the survey of the sunken vessel.

c) As a reference, a wooden stick was cast on the sea water and a time lap was measured in a fixed distance where it flowed, and the velocity of the current per hour was calculated which was compared with the data in the table of tidal current. As a result, the velocity of the tidal current was same as shown in the table.
Compared with the tide table, the time gained 30 minutes as a difference.

d) Regarding the tidal current corresponding to the depth of the sea, divers found no difference in either the surface or the underwater.

4-1-2 Results of the Survey

(1) Present state in Surabaya Port

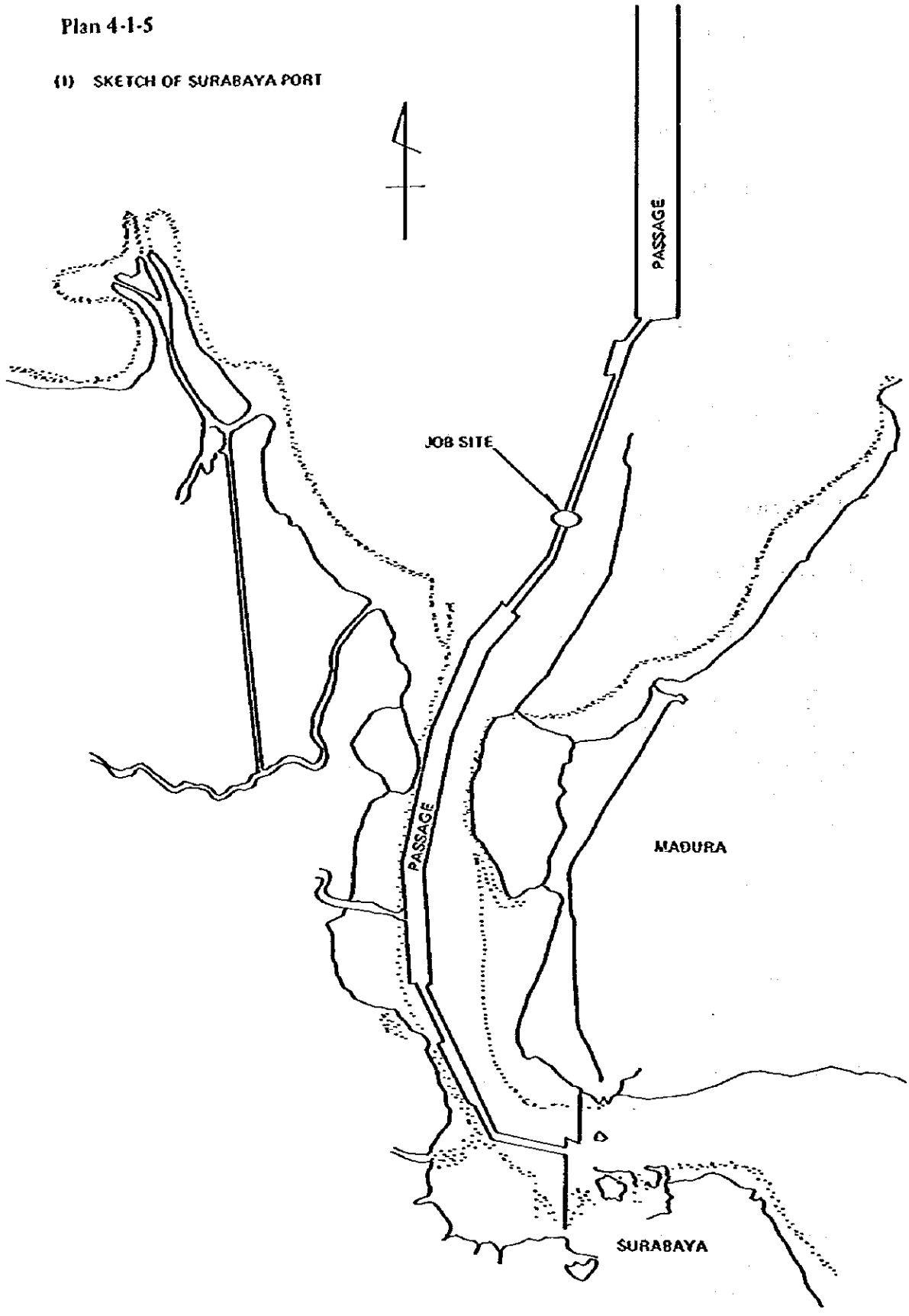
(2) Present state of sunken vessels

(3) Results of each sunken vessel

(4) Observation methods and results of climatic and sea conditions

Plan 4-1-5

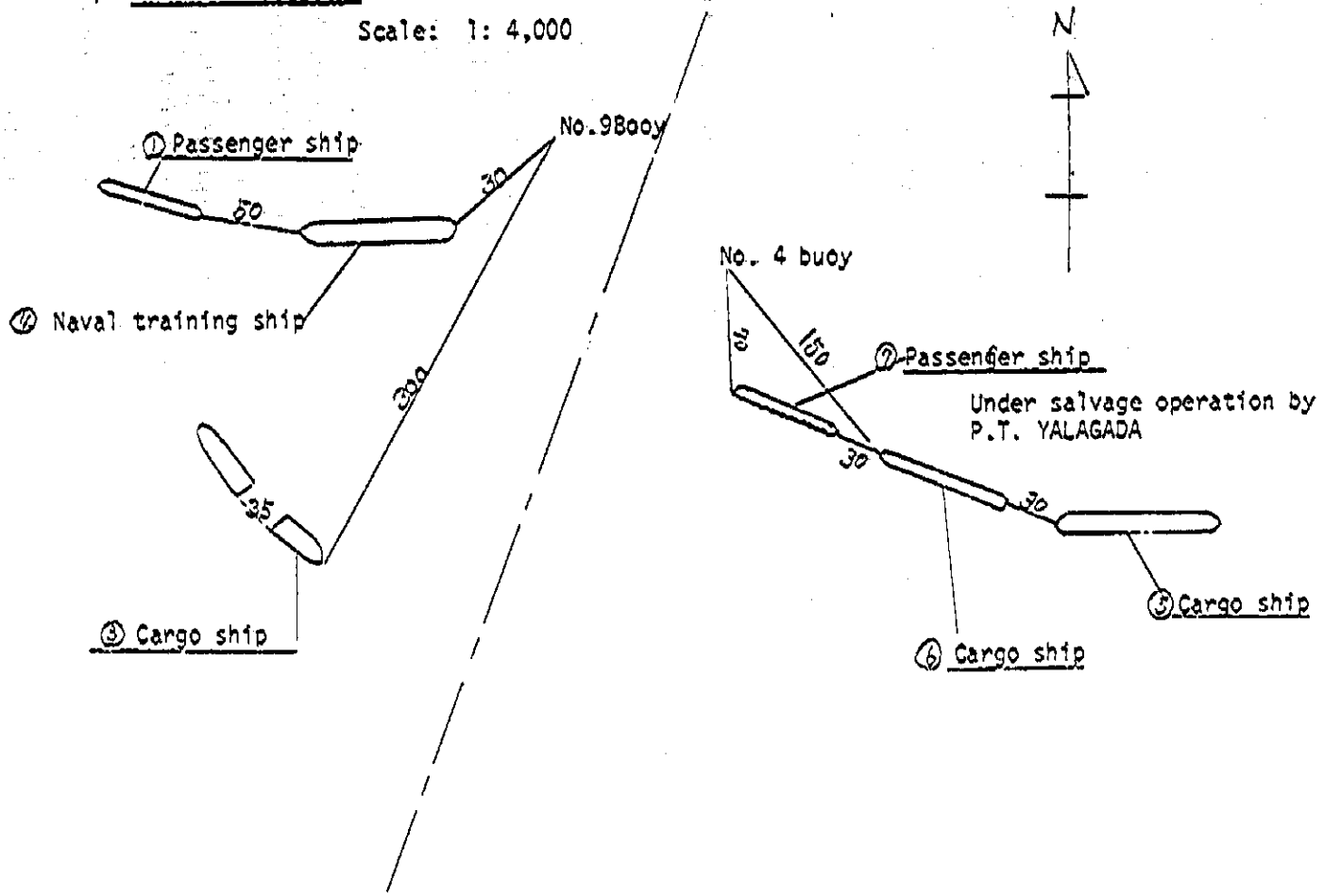
(1) SKETCH OF SURABAYA PORT



Plan 4-1-6

2) ENLARGED SECTION

Scale: 1: 4,000



(3) Results of each sunken vessel

1)	No. 4 sunken vessel Date of survey:	From November 20, 1979 to November 23, 1979
a)	Name:	Seven Provincien
b)	Kind of vessel:	Naval training ship
c)	Type of vessel:	Flat deck type
d)	Main dimension:	L X B X D = 86.4 M X 14.2 M X 9.5 M
e)	Displacement tonnage:	Estimated 2,000 Tons
f)	Kind of main engine and horsepower:	Reciprocating engine Estimated 3,000 HP
g)	General arrangement and structure:	See in attached drawings
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-52'-43" S 112°-42'-18" E
k)	Distance from the port:	Abt. 18 miles from Surabaya Port
l)	Ship's head:	W
m)	List and trim:	Nil
n)	Buried condition:	See in attached drawings
o)	Condition of hull:	Piled sandy mud
p)	Corroded condition:	The wooden deck floor was swept away, the steel deck was covered by oysters and sea weeds, and there were many holes on it due to corrosion. The shell plating out of the mud was covered by shells (oysters) & sea weeds which were sticked 10 to 15 cm thick.
q)	Sounding around the vessel:	At the bow: 16.8 M At the midship (p): 10.3 M At the midship (s): 17.0 M At the stern: 14.3 M (Measured at 11:15 – 12:30 hrs November 22, 1979)
r)	Sea bed:	Sandy clayey mud and flat
s)	Visibility:	0.2 – 0.3 M
t)	Tidal difference:	High tide: 2.8 M, Low tide: 0.2 M Difference: 2.6 M
u)	Direction & velocity or tidal current:	Max. 1.9 knot (November 22)
v)	Damaged condition & others:	

i) Part of the bridge walls remained still, but the rest was swept away.

ii) The wooden deck floor was removed and swept away, in which there were many corroded holes all over, only the beams being left in general.
iii) Regarding the fore mast, it's gone except the rest remaining one meter above the deck.
iv) The funnel was gone.
v) The anchors and the anchor chains were missing.
vi) The rudder and the propeller were missing.
vii) A part of the stern was cut and removed by. (Yalagada, one of Indonesian salvage companies removed it according to the information.)
viii) On 27 CM cannon was left on the bow deck.
ix) Sandy mud deposited inboard up to the upper deck all over the vessel.
x) Scraps recollectable are estimated 1,850 tons.

2) No. 3 Sunken vessel

	Date of survey:	November 25, 1979 to November 27, 1979
a)	Name:	Not known
b)	Kind of vessel:	Cargo ship
c)	Type of vessel:	Three island type
d)	Main dimensions:	L X B X D = 102 M X 14.5 M X 8.3 M
e)	Gross tonnage:	Estimated 3,500 tons
f)	Kind of main engine and horsepower:	Reciprocating engine Estimated 1,700 horsepower
g)	General arrangement and structure:	See in the attached drawing
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-50" S 112°-42'-20" E
k)	Distance from the port:	Abt. 18 miles from Surabaya Port
l)	Bearing of bow:	SE
m)	List & trim:	3° to the starboard of the bow 2° to the port of the stern 2° to bow (at the bow section) 3° to the stern (at the stern)
n)	Buried condition:	See in the attached drawings
o)	Condition of hull:	Sandy mud was deposited.
p)	Corroded condition state:	The deck was corroded much, out of which the beams were exposed here and there. The shell plating was sticked by oysters and sea weeds. It must have much corroded.
q)	Sounding around the vessel:	At the bow: 17.7 M At the midship (p): 11.2 M

At the midship (s): 10.2 M
At the stern: 18.2 M
(measured at 10:10 – 11:30 hours on November 27, '79)

r) Sea bed: Sandy clayey mud and flat

s) Visibility: 0.3 M

t) Tidal difference: High tide: 2.2 M, low tide: 0.5 M
Difference in tide: 1.7 M (as of November 27, 1979)

u) Direction & velocity of current: Southerly and northerly current
Max. 1.9 knots

v) Damaged condition & others:

i) Part of the bridge walls was remained, but most of the others were swept away.

ii) Near the sections of one meter high above the deck the main and fore masts were chopped of. Part of them was spread outboard.

iii) Windlasses remained as they were, while winches were swept away.

iv) Anchor chains & chains: Nil

v) Rudder and propeller: Remained

vi) Some openings of the shell plating were artificially openned, to be sure. (1 M X 1 M)

vii) It was presumed that the vessel was exploded to sink, separating the midship roughly into the bow and the stern in 35 meters. (Refer in the attached drawings.)

viii) Sandy mud piled inboard up to the upper deck all over the vessel.

ix) The visivility varies a little corresponding to the tide conditions, but the sea water was so turbid that it couldn't be recognized. In addition, it was very difficult to carry out the diving work due to the rapid velocity of tidal current.

x) Estimated volume of scraps: 1,700 tons

3) No. 2 sunken vessel

Date of survey: From November 23, 1979 to November 24, 1979

a) Name: Not known

b) Kind of vessel: Passenger ship

c) Type of vessel: Shelter deck type

d) Main dimensions: L X B X D = 56 M X 8 M X 5 M

e) Gross tonnage: Reciprocating engine, estimated 400 H.P.

f) Kind of main engine and horsepower: 400 HP

g) General arrangement & structure: See in the attached drawings.

h) Sunken date: Not known

i) Cause of accident: Not known

j)	Position:	06°-57'-40" S 112°-42'-15" E
k)	Distance from the port:	18 miles from Surabaya Port
l)	Ship's head:	ENE
m)	List & trim:	90° to the starboard
n)	Buried condition:	See in the attached drawing.
o)	Condition of hull:	Muddy sand is piled.
p)	Corroded condition:	The deck was corroded seriously. The deck was swept away, only to beams beeing left. The shell plating was considered to be covered by oysters and sea weeds.
q)	Sounding around the vessel:	At the bow: 10.9 M At the midship (p): 11.3 M At the midship (s): 6.8 M At the stern: 12.7 M (as of November 24, '79)
r)	Sea bed:	Sandy mud was piled inboard up to the sea bed. (See in the attached drawing.)
s)	Visibility	0.3 – 0.5 M
	Estimated scraps:	370 tons

4) No. 6 Sunken vessel

	Date of survey:	From November 29, 1979 to December 4, 1979
a)	Name:	Not known
b)	Kind of vessel:	Cargo ship
c)	Type of vessel:	Flat deck
d)	Main dimensions:	L X B X D = 87.6 M X 9.8 M X 7.7 M
e)	Gross tonnage:	Estimated 2,000 tons
f)	Kind of main engine and horsepower:	Estimated Reciprocating engine 1,000 HP
g)	General arrangement & structure:	See in the attached drawing.
h)	Sunken date:	Not known
i)	Cause of accident:	Not known
j)	Position:	06°-57'-50" S 112°-42'-40" E
k)	Distance from the port:	18 sea miles from Surabaya Port
l)	Ship's head:	WNW
m)	List & trim:	1° to the starboard 0° to the horizontal slanting
n)	Buried condition:	See in the drawing.
o)	Condition of hull:	Sandy mud was piled up.

p) Corroded condition: The deck and the shell plate were covered by oysters & sea weeds in seriously corroded conditions.

q) Sounding around the vessel: At the bow: 14.5 M
At the midship (p): 9.2 M
At the midship (s): 8.0 M
At the stern: 9.2 M
(Measured 1100 – 1200 hrs Dec. 3, '79)

r) Sea bed: Sandy clayey mud & flat.

s) Visibility: 0.2 – 0.3 M

t) Tidal difference: High tide: 2.1 M, Low tide: 0.2 M
Difference: 1.9 M (as of Dec. 3)

u) Direction & velocity of tidal current: Southerly & northerly current
Max. 1.9 knots

v) Damaged condition & others:

i) 1.5 M from the fore partition wall of the engine room to the bow cracks were traversed horizontally, 0.7 M at maximum wide.

ii) These cracks were traversed from the shell plating to the bottom.

iii) 12 M from the stern to the bow, the deck was cracked in 2 meters wide, traversing side to side, and buried at this section.

iv) Like the other sunken vessels the deck was eroded much, only some beams being left.

v) Part of the bridge except the surrounded walls was almost swept away.

vi) It is presumed that the windlass remained, but the winches were swept away.

vii) Chain anchors and chains were gone, while a rudder and a propeller remained as they are

viii) About 2 meters below the deck on the shell plating there were several artificial openings (0.5 M X 0.5 M each) here and there.

ix) The sandy mud inboard was piled up to 2 meters below the deck in the No. 1 & 2 hold, and up the deck in the engine room and No. 3 hold.

x) Due to the poor visibility and rapidness of tidal current, so the diving working hour was very much restricted. (This could be explained as the same in the survey of No. 2, 3, 4 sunken vessels.)

w) Estimated scraps: 900 tons

5) No. 5 Sunken vessel

Date of survey: From December 5, 1979 to December 9, 1979

a) Name: Not known

b) Kind of vessel: Cargo vessel

c) Type of vessel: Flat deck

d) Main dimensions: L X B X D = 106.5 M N 12.0 M X 9.5 M

e) Gross tonnage: Estimated 4,000 tons

f) Kind of main engine and horsepower: Estimated reciprocating engine 2,500 HP

g) General arrangement & Structure: See in the attached drawing.

h) Sunken date: Not known

i) Cause of accident: Not known

j) Position: 06°-57'-50" S
112°-42'-52" E

k) Distance from the port: About 18 miles from Surabaya Port

l) Ship's head: E

m) List & trim: 40° to the starbord

n) Buried Condition: See in the attached drawing.

o) Condition of hull: Not known

p) Corroded condition: Due to oysters and sea weeds, the deck was seriously corroded. The shell plating out of the mud level was covered by oysters and sea weeds.

q) Sounding around the vessel: At the bow: 9.5 M
At the midship (p): 6.0 M
At the midship (s): 6.0 M
At the sterm: 15.0 M
(As of December 7, 1979)

r) Sea bed: Sandy clayey mud and flat

s) Visibility: 0.2 – 0.3 M (with flashlight)

t) Tidal difference: High tide: 1.6 M, Low tide: 0.2 M
Difference: 1.4 M (Dec. 7, '79)

u) Direction & velocity of tidal current: Southerly & northerly current
Max. of 1.1 knots

v) Damaged condition & others:

i) Nearabout the midship, the hull was almost buried.

ii) Oysters and sea weeds covered all over the ship in 10 – 15 cm or so thick.

iii) A rudder and a propeller remained as they were.

Regarding the above sunken vessel, the sea conditions were so bad that divers couldn't suvey thoroughly and introduced a brief outline of the survey.

(4) Observational method and result of the climate and the sea conditions

1) Observational method of the climate and the sea conditions

a) The climate: By observation

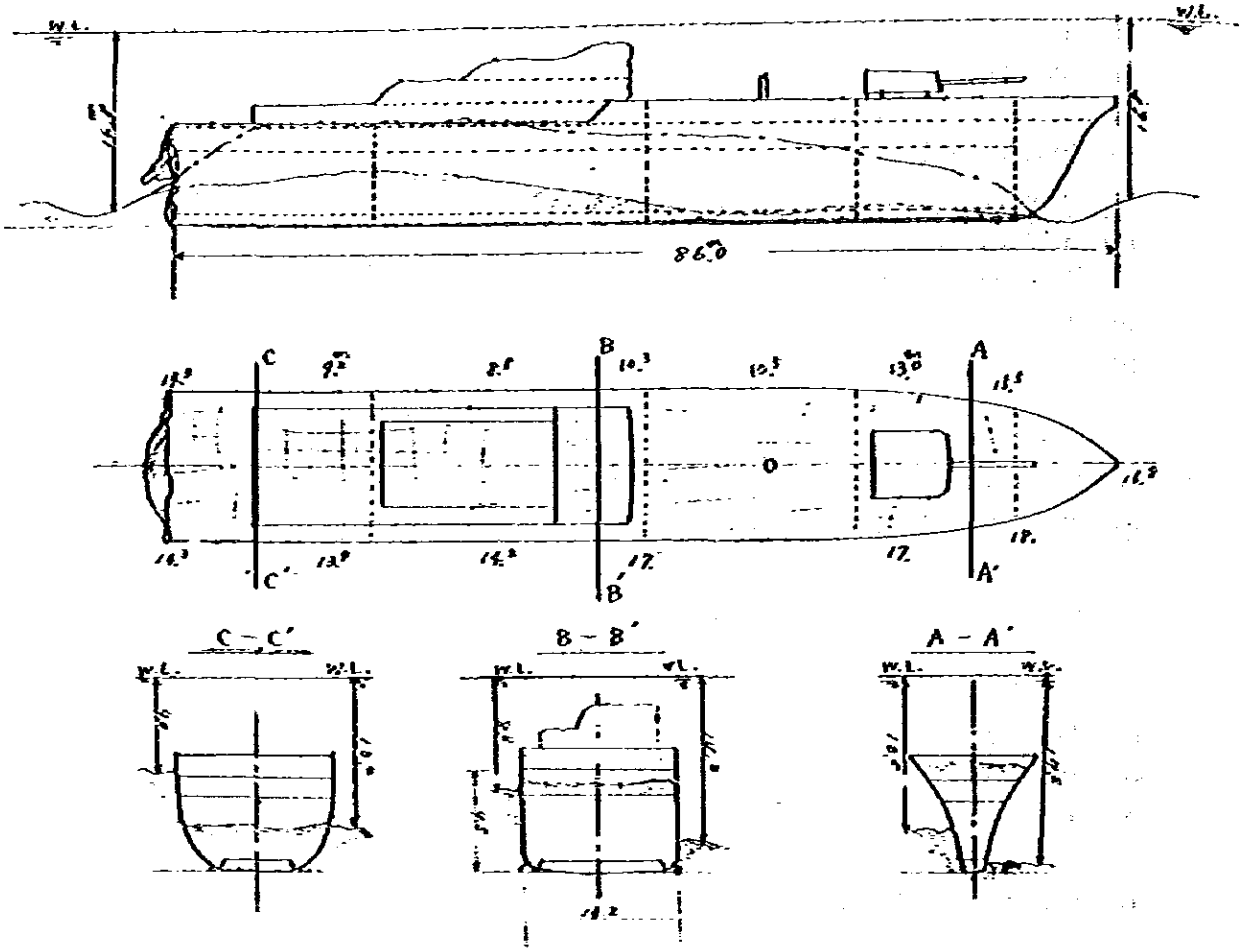
b) Temperature: It was measured 1.0 – 1.5 meters high above the ground under the shade in favourably ventilated conditions.

c) Wind direction: A magnetic compass in the "BOGA" was

No. 4 (S/S SEVEN PROVINCIEN)

S.B SIDE
P. SIDE

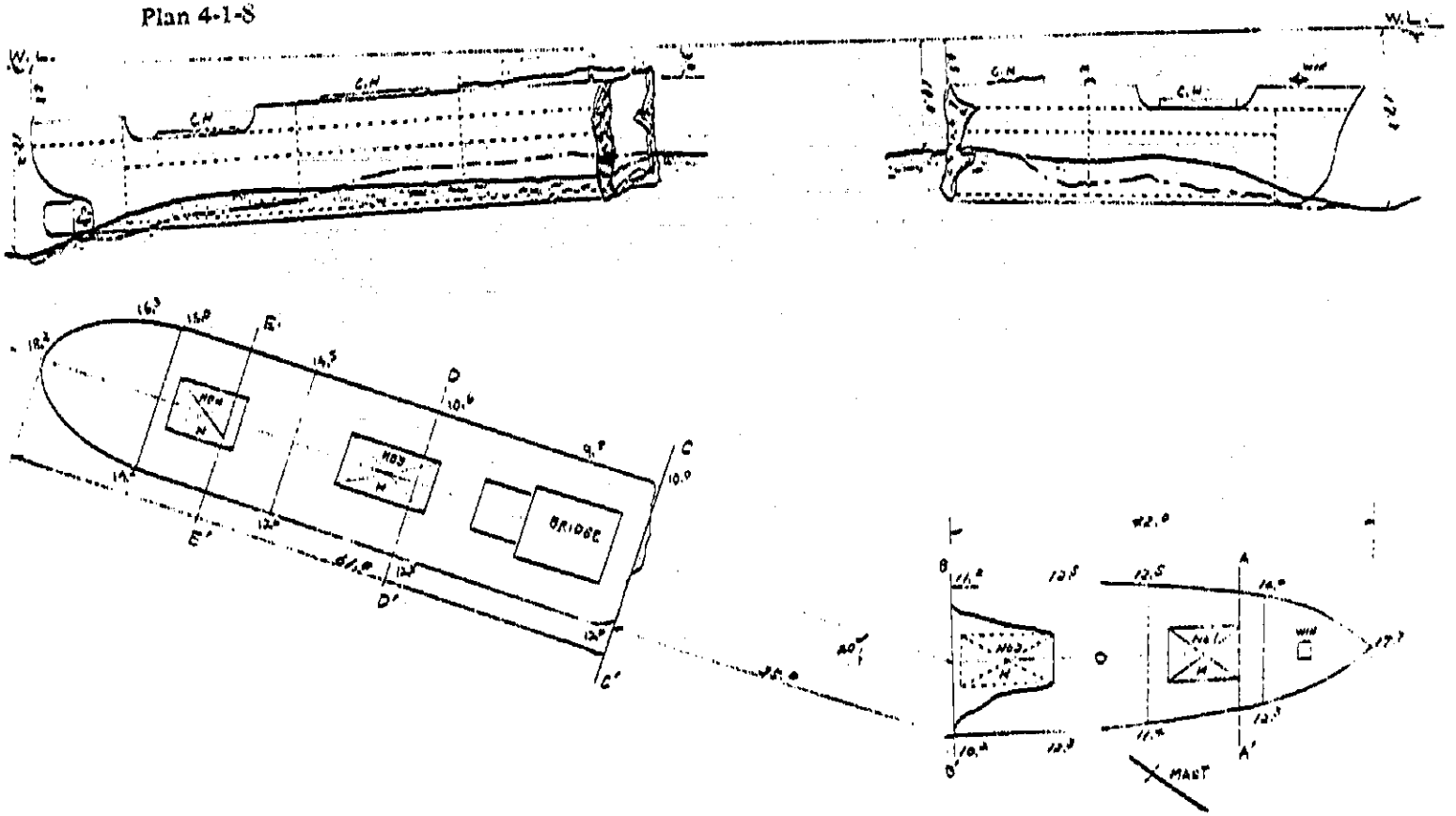
Plan 4-1-7



Plan 4-1-8

No. 3 SUNKEN VESSEL

S.B SIDE
P. SIDE

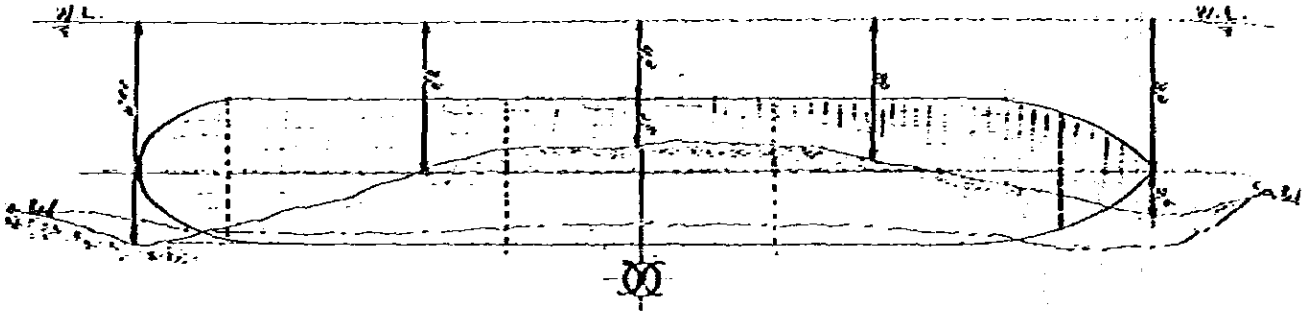


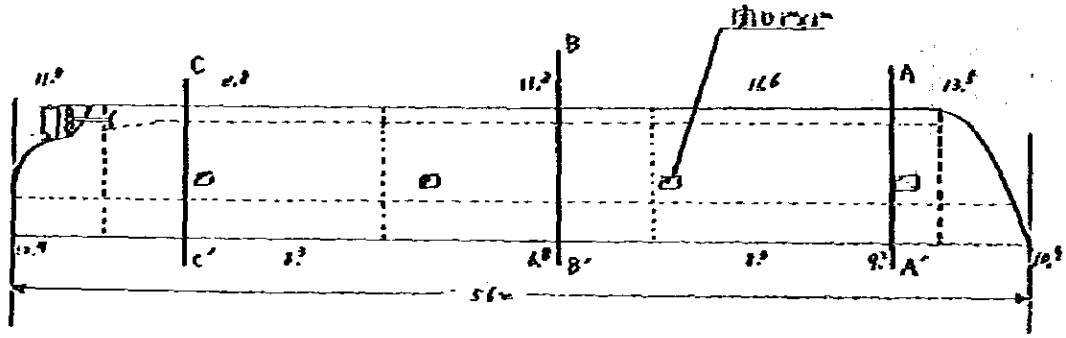
No. 2 SUNKEN VESSEL

S.B. SIDE

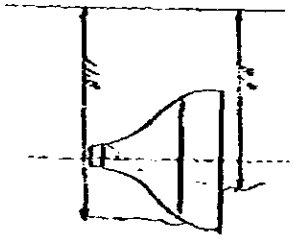
P. SIDE

Plan 4-1-9

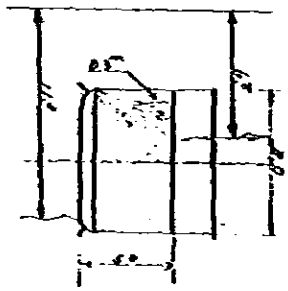




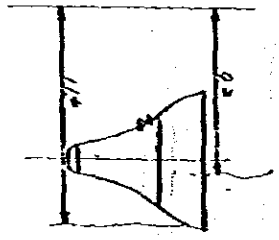
C - C'

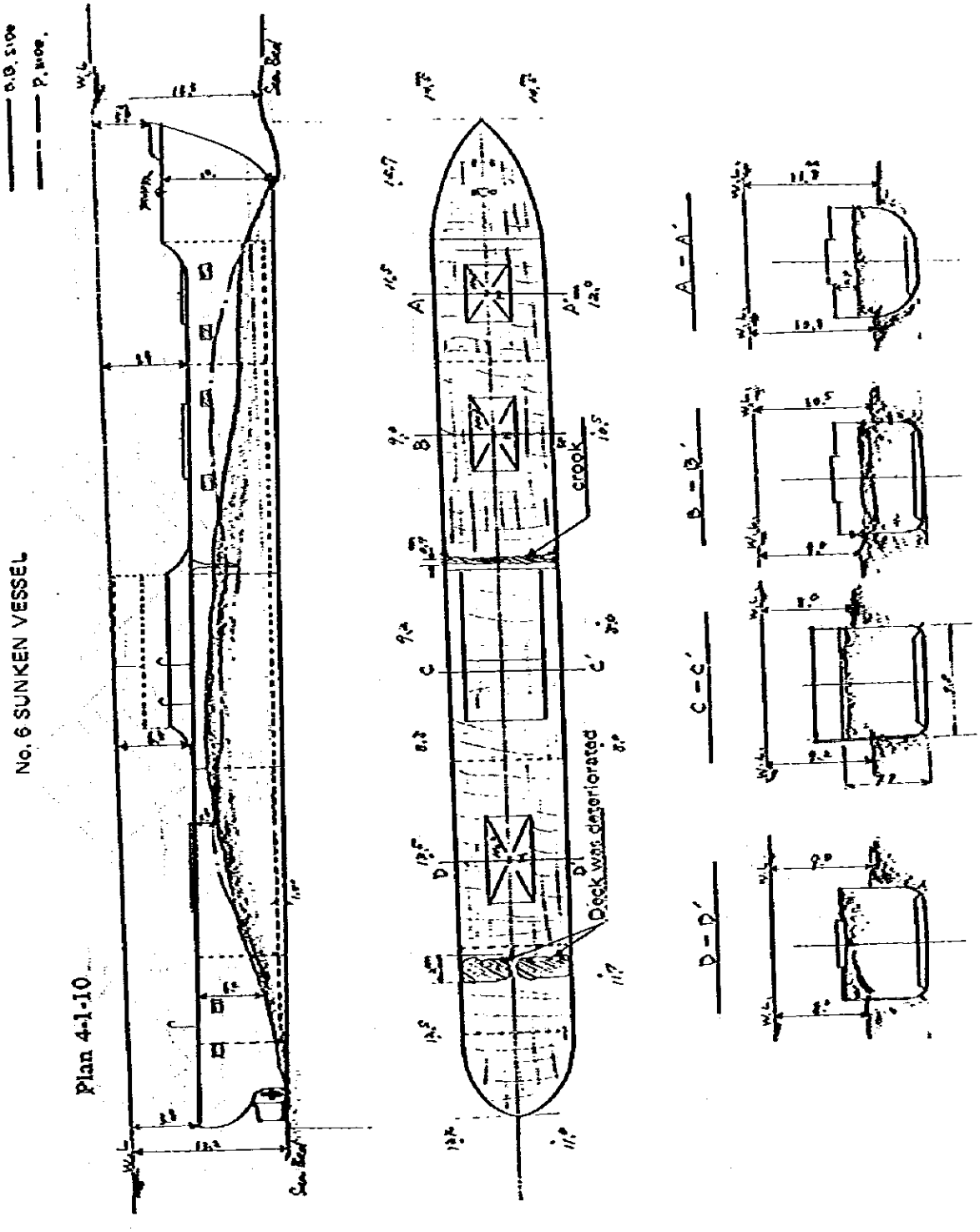


B - B'



A - A'



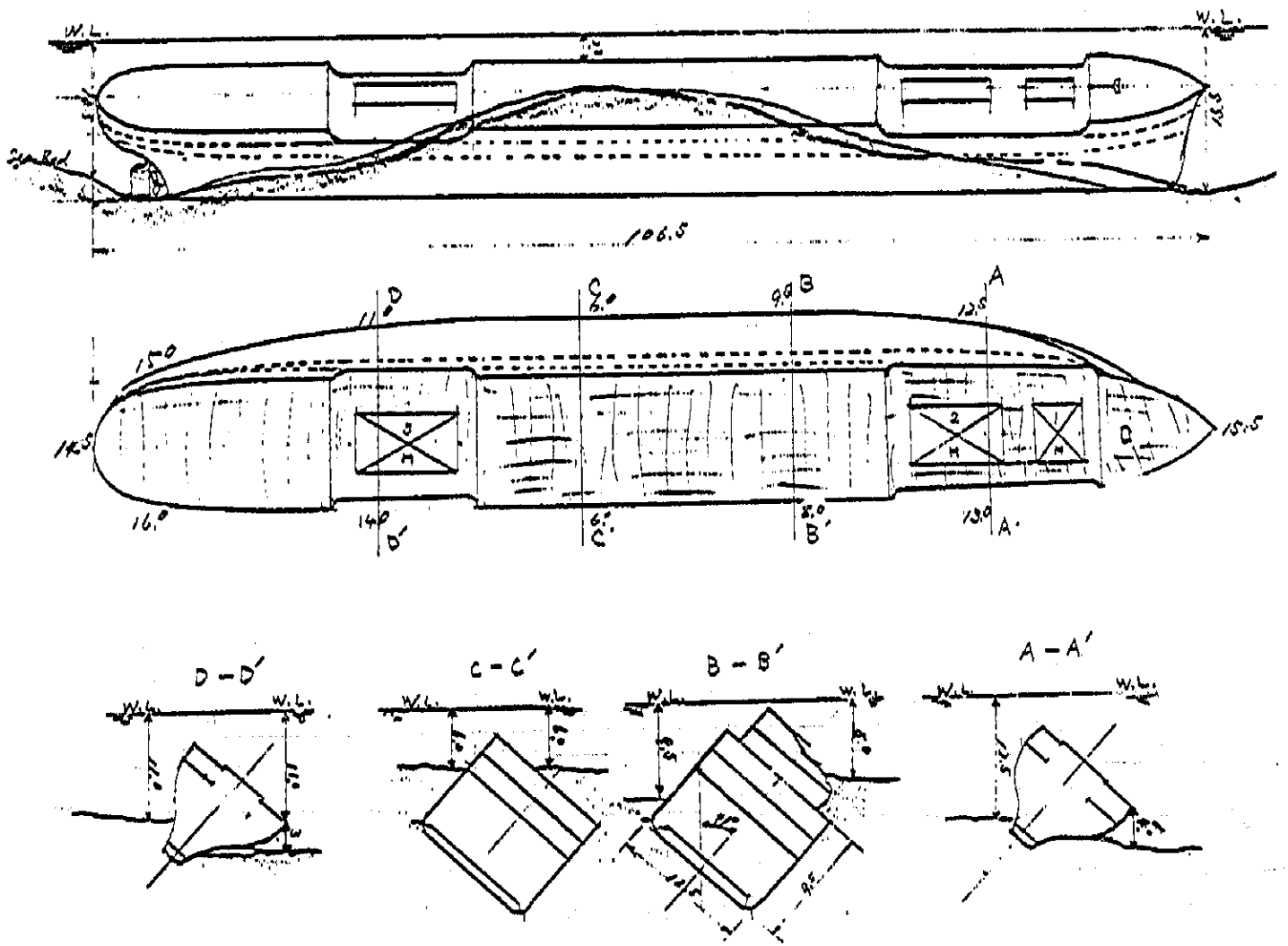

No. 6 SUNKEN VESSEL
Plan 4-1-10
crook
Deck was deteriorated
A - A'
B - B'
C - C'
D - D'

No. 5 SUNKEN VESSEL

S.S. side

P. side

Plan 4-1-11



d) Wind force:	used to measure by observation. Judging from the wind scale of "BEAUFORT SCALE", it was measured by observation.
e) Wave:	Like the wind force, it was measured by observation.
f) Swell:	Like the wind force, it was measured by observation.
g) Water temperature:	By catching sea water in the bucket, it was measured by a sticktype thermometer.
h) Current direction:	With the help of a magnetic compass in the "BOGA", it was measured by observation.
i) Velocity of current:	A mooden stick was cast from the upper to the down current for the distance of 10 meters alongside the "BOGA" and a time lap was calculated. This was repeated three times and a mean value was calculated out of the three.

(5) Problems

As the results of close examinations for the data and information collected about Surabaya Port and its surroundings prior to the actual field survey, it was estimated to require the preparations efficient enough to conduct the survey in the following, so that the team has prepared them more than necessary and conducted the field survey.

1) Allowable diving time limit corresponding to the tidal current

2) The degree of operation in the turbid sea water

3) Inboard survey for sunken vessels

The above items are explained respectively as follows;

1) Allowable diving time limit corresponding to the tidal current

The diving corresponding to the velocity of tidal current is, in general, allowed within 0. – 0.8 knots. On the basis of the said standard, the tidal current table was made and the survey was conducted.

During the period of low tide, the diving operation was engaged for two hours

at the stationary period of tidal current, while it was obliged to operate for only one hour and half due to the comparatively short stationary period of tidal current during the period of spring tide.

2) The degree of operation in the turbid sea water

The underwater visibility in the western navigational channel of Surabaya Port was so bad as the team operated, namely almost zero meter in sight, barely 0.3 meter when the flash light was switched on. Under such a circumstance, the diving survey method was oblighed to change the original plan partially.

As for a solvable measure, no recording was made underwater, so that a diver employed an inter-communication system between a diver and an onboard crew to record the underwater information. In addition, a diver's guide rope was fixed to a sunken vessel so as to identify the position of a diver in operation.

3) At the in-advance preparation for the survey, the survey plan was scheduled to remove sandy mud by sand suction pumps if not much in depositing inboard and the survey work was implemented, but it was obliged to give it up on account of the large volume of sandy mud piled up inboard.

As an alternative plan, the following survey can be devised out;

a) Cargoes are available inboard the hull or not and its state.

b) Kind and structure of main engine in the engine room

c) Degree of damages and its state in the inboard

Although the plan was devised out to go by any one of the openings on the shell plating, the degree of laid mud was so much that it couldn't actually implemented and oblighed to give it up.

4) Others

a) Regarding the light to be employed in actual operation, the survey team prepared a hand flash light (dry cell battery type) and electric underwater light, and conducted the diving operations thoroughly under such a turbid sea water conditions.

b) In order to countermeasure the tidal current, the team prepared the diving units of an acqualung type and a Kirbby Morgan type. In case of the rapid

tidal current, the acqualung diving unit was used for the confirmation on the position of a sunken vessel and for the mooring operation, etc, while a Kirbby Morgan type with communication was utilized mainly for the detailed survey, which made the team easy to operate.

c) An underwater oxy-arc cutting machine was prepared to serve at any time.

4-1-3 Others

SAFETY AND EMERGENCY MEASURES AT THE SITE

Safety Measure

(1) All the members who took care of themselves in daily life, engaged the work at the most healthy condition.

(2) After and before the commencement of the work that had to be reminded of, each of the members took notice of and reviewed what he had to do.

(3) All the members in working uniform, hat, and safety shoes, engaged their duties properly.

(4) An inspection and arrangement were conducted as a rule on machines and equipment, which were in good order.

(5) The divers who had the most careful attention about their health, adjusted themselves before diving.

(6) Prior to the commencement of the diving work, all checking works were conducted on whether air was full or not in an air bomb, and the diving unit was in good functions or not.

(7) At any time of working at sea, a safety watcher kept on watching the divers in work.

(8) In an emergency, life gackets were available on board.

(9) In order to secure the safety for the divers, no work was conducted at the time of the tidal current of 0.8 knots.

(10) A communication unit was prepared for an emergency, a stand-by boat was arranged at site, and ready to mobilize in an emergency.

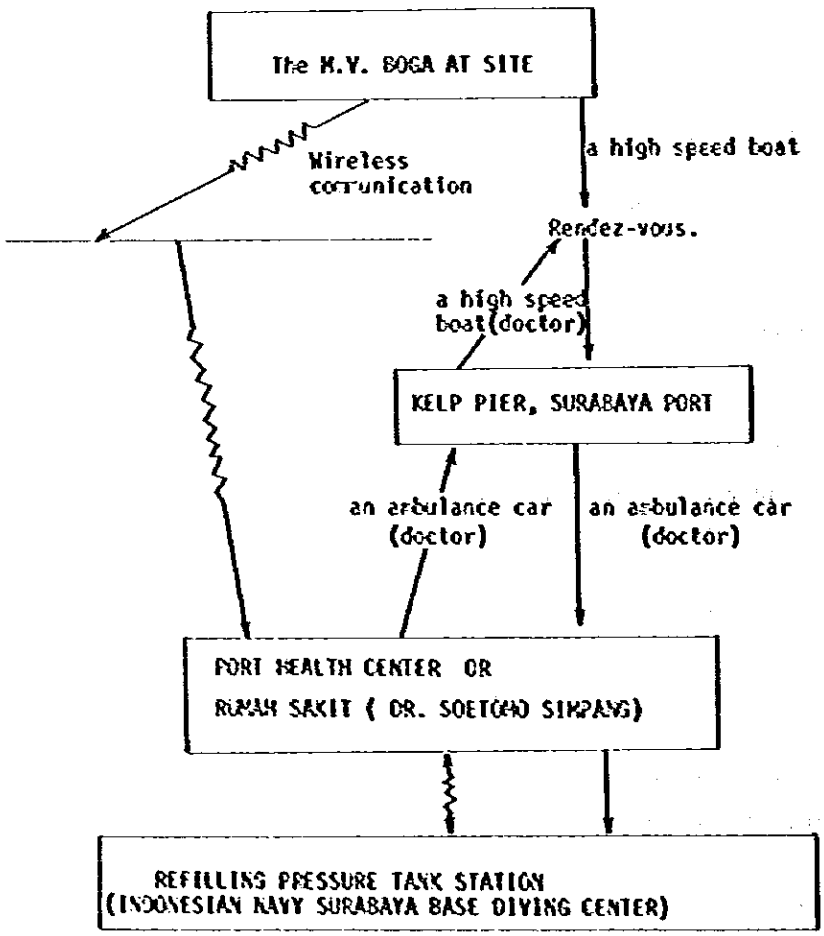
(11) In an emergency, the following measures were arranged at site. (See plan 4-1-12)

(12) A safety controller at sea was arranged and kept watching.

(13) In order to moor the "Boga" so as to hold the position against the tidal current, the most careful precaution was devised out, namely, the examinations and the analyses for anchors, anchor chains, mooring wires, and on the top of the above, the stand-by equipment to be loaded on board.

(14) In operations of the generator, the compressors, and the like, main items on the machines and equipment, were inspected then and there, kept watching various important gauges, i.e. pressure gauges, safety valves, and so on, to check and evaluate the quality of air sent to the divers in underwater operations.

Plan 4-1-12



4-2 Examination for Removal Method

4-2-1 Selection of removal method

It is considered that the removal method can be largely classified into two in the following;

(1) Refloating method as a whole

(2) Cutting & removal method

(1) Refloating method as a while

As a result of the survey, the sunken vessels (No. 4, 2, 3, 6, and 5) in the vicinity of No. 4 buoy, were sunk at the time of the World War II, having past about 30 years. It was quite clear that the hulls were so much corroded, particularly, flown wooden decks, seriously corroded steel decks in common, many artificial openings on the shell platings in general, and so many other factors that the vertical strength of the deck should not be in function any more, much less close to zero as such an effect. There left the beams and the shell plating which were inter-supported each other and which kept them in the form of the vessels.

On the other hand, there was no denying that sandy mud was deposited inbord and piled up to the deck. In the light of the above, it was technically impossible to introduce the refloating method for the removal of the sunken vessels, so that we have referred to the cutting and removal method in the following.

(2) Cutting and removal method

It is common that the method is to cut the hull into several sections, to lift, and shift them for the removal.

Although there are many ways to cut, the followings are considered to be the most common in Japan.

1) Underwater oxy-arc cutting

2) Underwater gas cutting

3) Underwater blast cutting
Regarding the last method, it was commonly combined either the first or the second method to employ depending upon the salvage engineer's selection.

Therefore, there introduced the first and the second methods to refer in the following.

4-2-2 Weight Calculation of Sunken Vessels

(1) Calculation method

Although there are some methods to calculate hull weight, and weight distribution, BILES method is introduced to the above.

The characteristic of the Biles method is, different from the other methods, that the one is developed for the removal of the sunken vessels.

1) The calculation is made as per each block based on the cubic meter of the hull. For the calculation, it is convenient to collect beforehand some of the results of the calculation made in the part regarding the old vessels.

2) The method is advantageous in figuring out the weight of each block which is the most important factor in dealing with the vessels sunken or afloat. This is because of the fact that method contains the calculation formula for the weight curve used in the distribution of weight. In view of the above, the Biles method is adopted in Japan for the removal operation of the sunken vessels.

(2) Formula for weight calculation.

1) The basis of the calculation is the cubic meter of the hull and the weight is divided into three as follows;

   a) hull steel weight

   b) out-fitting weight

   c) engine weight

2) Details of the weight

   a) The hull weight is the total weight of: bottom structure, shell plate structure, each deck plate, deck housing, engine casing, bulkhead, shaft tunnel, stem, and stern frame, rudder, etc.

   b) Out-fitting weight
   This is the total weight of the followings, deck machinery, anchor, mooring

equipments, mast and derrick, etc.

c) Engine weight

This is the total of: main engine, boiler, condenser, shaft, screw, funnel, auxiliary machine, electric and piping, etc.

3) Hull weight

The hull steel weight is figured out by hull cubic meter (L X B X D) multiplied by the weight coefficient.

Weight coefficient (K)

Kind of ship	K
Passenger Vessel	0.18 ~ 0.22
Passenger & Cargo Vessel	0.13 ~ 0.19
Cargo Vessel (three island)	0.13 ~ 0.18
Shelter D.$\frac{K}{}$ Vessel	0.13 ~ 0.16
Tarker	0.16 ~ 0.23
Tug Boat	0.18 ~ 0.24
Fishing Boat	0.17 ~ 0.27

"remarks" : not including deck machines, out-fitting etc.

a) Hull weight (Wh)

Wh = K X L X B X D

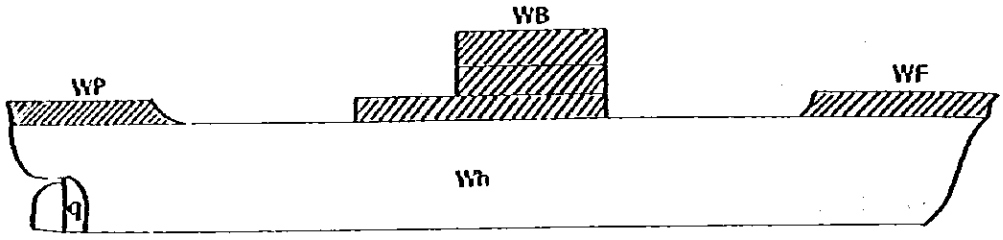
K: coefficient
L: length (m)
B: Breadth (m)
D: Depth (m)

b) Upper structure weight (Who)

Who = WP + WB + WF

WP = KP X B X l
WB = KB X B X l X d
WF = KF X B X l

WP = weight of poop deck
WB = weight of bridge deck
WF = weight of F'cle deck
KP = 0.27 ~
KB = 0.08 ~
KF = 0.18 ~
d = the hight between decks
l = length of upper structure
B = Breadth



As shown above, the weight of the hull plate up to the main or upper deck and the weight of the upper structure are to be figured out.

c) Out-fitting weight (Wf)

$Wf = Cf \times L \times (B + D)$

Cf = cofficient
L = length
B = Breadth
D = Depth

d) Engine weight (Wm)

$Wm = Cm \times HP$

Cm = Coefficient
HP = IHP

Cm

kind of main engine	Cm
reciprocating engine	0.13 ~ 0.18
turbin	0.14 ~ 0.16
deisel engins	0.11 ~ 0.14

The engine weight varies by its kind, power, location in the engine room etc, but is mostly proportionate to its power.

e) Total weight (WH)

$WH = Wh + Who + Wf + Wm$

f) *Distribution of weight*

The distribution of weight of the length and direction of the vessel is indicated in the weight curv chart.

The curv is used for the cutting of the sunken vessel and then the weight of each block is figured out.

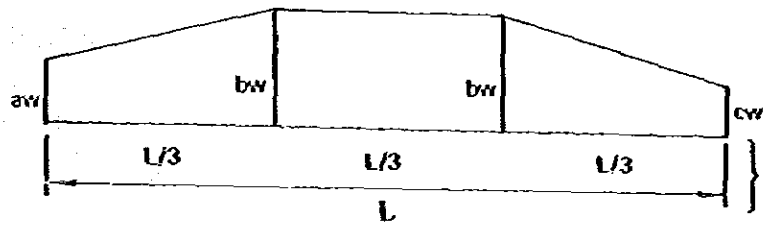
$$Wh = K \times L \times B \times D$$

$$\frac{aw}{L} = a \times Wh \times \frac{1}{L}$$

$$\frac{bw}{L} \quad b \times Wh \times \frac{1}{L}$$

$$\frac{cw}{L} = c \times Wh \times \frac{1}{L}$$

a = coefficent
b = coefficent
c = coefficent
L = length



Kind of Vessel	a	b	c
Slim Vessel	0.653	1.195	0.566
Fat Vessel	0.706	1.174	0.596

Above is the basic explanation, but in case of calculating the weight of sunken vessels in Surabaya, the co-efficient was ditermined by the results of diving survey and actual experience in Japan as follows;

K: 0.11
KP: 0.27
KR: 0.08
KF: 0.18
Cm: 0.13
Cf: 0.12

As for the weight calculation of a vessel, the weight of inboard mud was excluded for the removal of a vessel. The weight of each vessel was estimated in consideration of the above. So, the estimated weights mean clean scrap only.

(3) Estimated hull weight of each sunken vessel

1) Estimated hull weight of No. 4 sunken vessel

a) Hull weight

Wh = K X L X B X D
= 0.11 X 105 X 14.2 X 9.5
= 1,560 tons

K = 0.11 (Originaly, K is 0.13 ~ 0.18, but we introduced 0.11 by the results of survey and actual experiances in Japan.)

b) Upper structure weight

Who ≒ 20 tons

It was estimated from the degree of corrosion regarding the decks and its walls.

c) Fitting weight

As most of the fittings were swept away, the remained equipments were a cannon, mooring units, and part of the inboard equipment. Therefore, it was estimated 40 tons.

d) Engine weight

Wm = Cm X HP
= 0.13 X 3,000
= 390 tons

Cm = 0.13

e) Total weight

Wl = Wh + Who + Wf + Wm
= 1,560 + 20 + 40 + 390
= 2,010 tons

PT. Yalagada cut and removed the stern section of a sunken vessel in 1974. The estimated cut-out blocks were about 160 tons.

= 2,010 – 160

= 1,850 tons (Remaining scrap weight)

1) The distribution of the hull weight

Wh = K X L X B X D

= 0.11 X 105 X 14.2 X 9.5

= 1,560 tons

$$\frac{aw}{L} = a \times Wh \times \frac{1}{L}$$

$$= 0.653 \times 1{,}560 \times \frac{1}{105}$$

$$\doteqdot 9.7$$

$$\frac{bw}{L} = b \times Wh \times \frac{1}{L}$$

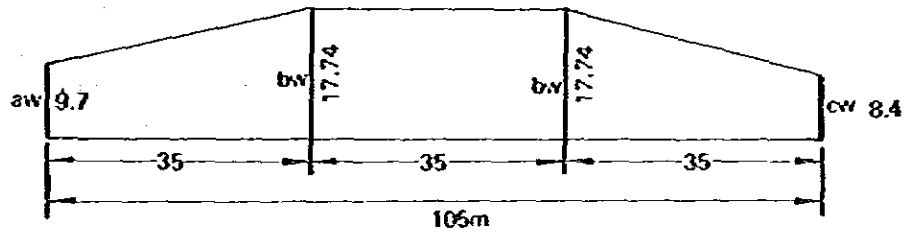
$$= 1.195 \times 1{,}560 \times \frac{1}{105}$$

$$\doteqdot 17.75$$

$$\frac{cw}{L} = c \times Wh \times \frac{1}{L}$$

$$= 0.566 \times 1{,}560 \times \frac{1}{105}$$

$$\doteqdot 8.4$$



2) Estimated weight of No. 3 sunken vessel

a) Hull weight

Wh = K X L X B X D

= 0.11 X 102 X 14.5 X 8.3

= 1,350 tons

K = 0.11
L = 102 M
B = 14.5 M
D = 8.3 M

b) Upper structure weight

WF = KF X B X l
= 0.18 X 14.5 X 10
= 26 tons

KF = 0.18
l = Length of F'cle
B = Bredth

WB = KB X B X l X d
= 0.08 X 14.5 X 62 X 2.3
≒ 165 tons

KB = 0.08
l = length of bridge
d = hight between decks

WP = KP X B X l
= 0.27 X 14.5 X 12
= 47 tons

KP = 0.27

Who = WF + WB + WP
= 26 + 165 + 47
= 238 tons

This should be reduced 25% due to the of decks & shell plate swept away.

Who = 238 X 0.75
= 180 tons

c) Engine weight

Wm = Cm X HP
= 0.13 X 1,700
= 220 tons

Cm = 0.13

d) Estimated loss weight due to the explosion

In front of the bridge, the vessel was blasted into two, so that part of the bridge and the shell plating were flown off. This lost weight was estimated by the weight curve.

Lost weight of bridge: 20 tons

Lost weight of decks & shell plating: 40 tons

Total: About 60 tons

e) Fitting weight

Most of the fittings were swept off except windlasses and part of the equipments, so the fitting weight was estimated as follows;

Wf = 10 tons

f) Total weight

WH = Wh + Wf + Who + Wm – (lost weight)
= 1,350 + 10 + 180 + 220 – 60
= 1,700 tons

g) Distribution of hull weight

$Wh = K \times L \times B \times D$

$= 0.11 \times 102 \times 14.5 \times 8.3$

$= 1{,}350$ tons

$$\frac{aw}{L} = a \times Wh \times \frac{1}{L}$$

$$= 0.653 \times 1{,}350 \times \frac{1}{102}$$

$= 8.64$

$$\frac{bw}{L} = b \times Wh \times \frac{1}{L}$$

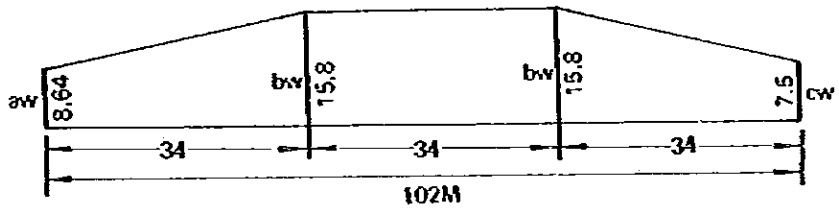
$$= 1.195 \times 1{,}350 \times \frac{1}{102}$$

$= 15.8$

$$\frac{cw}{L} = c \times Wh \times \frac{1}{L}$$

$$= 0.566 \times 1{,}350 \times \frac{1}{102}$$

$= 7.5$



3) Estimated weight of No. 6 sunken vessel

a) Hull weight

$Wh = K \times L \times B \times D$

$= 0.11 \times 87.5 \times 9.8 \times 7.7$

$\doteqdot 730$ tons

K = 0.11

L = 87.6 M B = 9.8 M

D = 7.7 M

b) Upper structure weight

$WF = KF \times B \times l$

$\doteqdot 0.18 \times 9.8 \times 10$

$= 18$ tons

KF = 0.18

l = 10 M

$WB = KB \times l \times B \times d$

$= 0.08 \times 13 \times 9.8 \times 2.3$

$= 23$ tons

KB = 0.08

d = 2.3 M

B = 9.8 M l = 13 M

$Who = WF + WB$

$= 18 + 23$

$= 41$ tons

Supposed that the reduced weight should be 20% due to the corrosion of decks and shell plating.

Who = 41 X 0.8

= 33 tons

c) Fitting weight

The remaining weight was estimated 10 tons for the decks and other fittings.

d) Engine weight

Wm = Cm X HP

= 0.13 X 1,000

= 130 tons

e) Total weight (WH)

WH = Wh + Who + Wf + Wm

= 730 + 33 + 10 + 130

= 903

≒ 900 tons

f) Hull weight

Wh = K X L X B X D

= 730 tons

$$\frac{aw}{L} = a \times Wh \times \frac{1}{L}$$

$$= 0.653 \times 730 \times \frac{1}{87.6}$$

$$= 5.44$$

$$\frac{bw}{L} = b \times Wh \times \frac{1}{L}$$

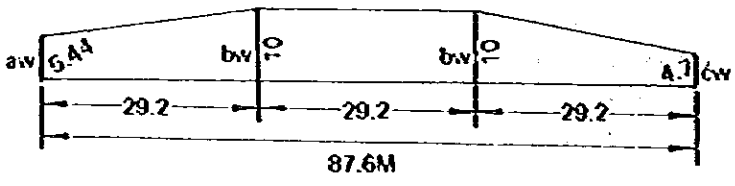
$$= 1.195 \times 730 \times \frac{1}{87.6}$$

$$= 10$$

$$\frac{cw}{L} = c \times Wh \times \frac{1}{L}$$

$$= 0.566 \times 730 \times \frac{1}{87.6}$$

$$= 4.7$$



4) No. 2 sunken vessel

a) Shell plating weight

Wh = K X L X B X D
= 0.11 X 56 X 8 X 5
≒ 24.6
= 250 tons

K = 0.11
L = 56 M
B = 8 M
D = 5 M

b) Upper structure weight

WB = KB X l X B X d
= 0.08 X 56 X 8 X 23
= 82 tons

KB = 0.08

Supposed that the reduced weight should be 25% due to the corrosion of decks and shell plating,

WB = 82 X 0.75
= 61.5
≒ 62 tons

c) Fitting weight

Almost all the fittings were swept off. However, supposed part of the inboard machines & equipment should remain,

d) Engine weight

Wm = Cm X HP
= 0.13 X 400
= 52 tons

e) Total weight

WH = Wh + Who + Wm + Wf
= 250 + 62 + 52 + 5
= 369
≒ 370 tons

5) No. 5 sunken vessel

Regarding the above vessel, no calculation could be made since the survey wasn't completed.

4-2-3 Mud removal work method of the in- & out-board

(1) Work method

1) Air-lift work method

a) It is a unit which combined an air-supply steel pipe with a rubber hose.

b) A compressor is in function to supply air into the steel pipe.

c) Supplied air passes the steel pipe and hose and refloat up to the water surface by smelling to itself. That is, the mud removal work was implemented by utilizing the hydraulic difference of pressure among the refloating air power, and air in-& out-lets.

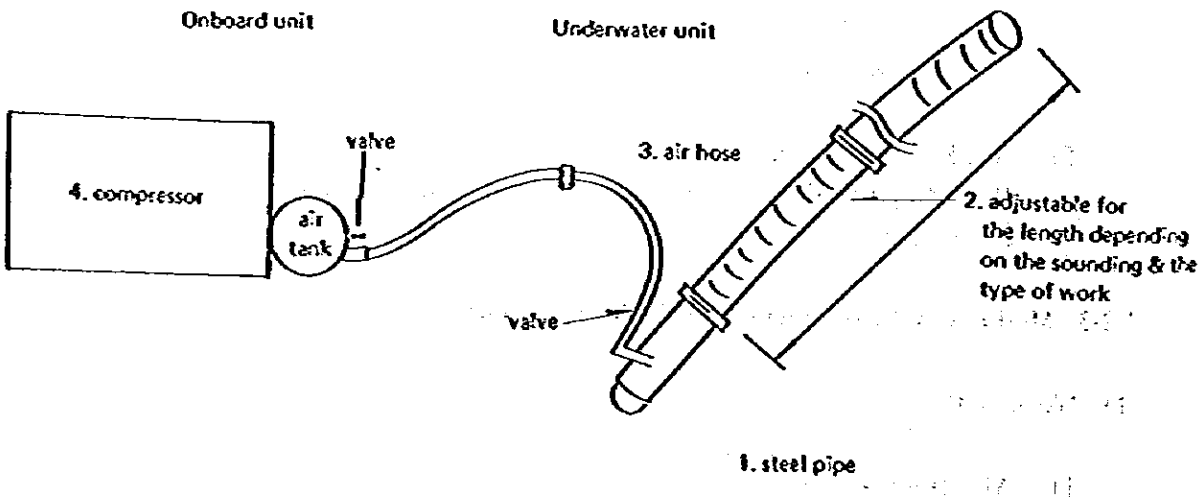
d) If the depth is less than 10 meters, the efficiency of the mud removal tends to go down due to the reduced difference of pressure. This is one of the disadvantage.

e) The main machines and equipment are as follows;

i)	steel pipe	(4 – 8 inches in diameters with less than one meter long)
ii)	hose (corrogated type)	Its length is decided depending on the underwater depth. The dimension should be matched with the steel pipe.
iii)	air hose	(one inch in diameter)
iv)	compressor	(8 M^3/min – 10 M^3/min as the outlet capacity)

f) The air-lift work is very easy to operate, the equipment of which is very light and easy to transport, so that this method is commonly used in actual operation.

Plan 4-2-1



2) Sand pump

a) There are two types of sand pump, namely, for the under water and for the on-land.

b) A sand pump (underwater) should be brought to the place where mud is to be removed and be operated by hand.

c) An on-land sand pump is installed either on board or on land, and a suction and a delivery hose, and are mounted thereon. It is very easy for a diver to manupulate the hose so as to deliver muddy water out of the water surface.

d) This method differs from that of the air lift in that the efficient doesn't devaluate even if the water sounding should be less than 10 meters deep. In case the diameters are same, volume of the discharged mud by this method is much more than that by air-lift because of the excellent lifting.

(2) Outboard mud removal work

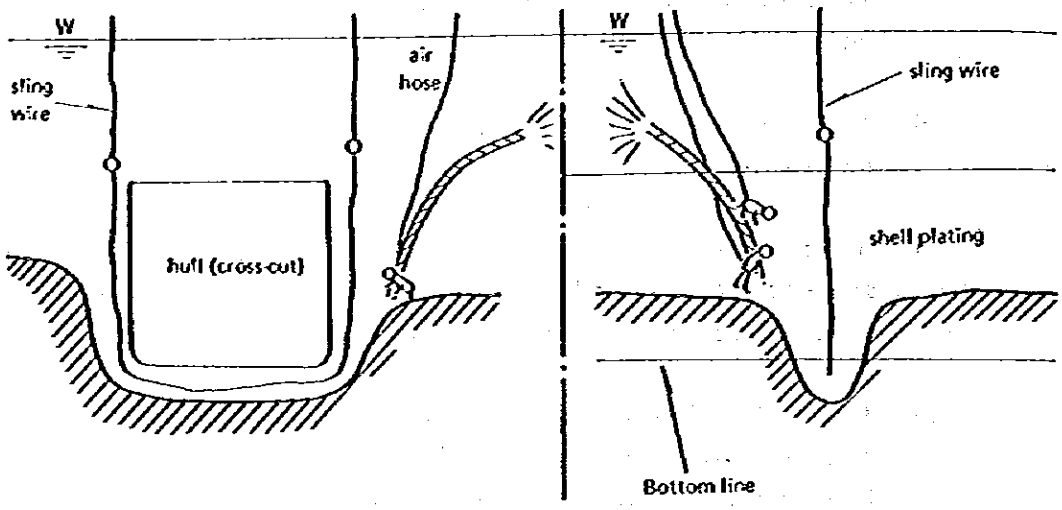
1) Removal work at the cutting section

a) Mud removal work at the time of cutting in parallel to the bow-to-stern line. In case that the vertical cutting is necessary for the shell plating, there may arise a case which requires the mud removal relying on the buried conditions of the hull. Judging from the volume of mud, the air-lift and the sand pump are used for the less quantity of mud, but if more, it is more efficient to employ a grab dredger.

b) Mud removal at the time of cutting the hull horizontally. Both the air-lift and the sand pump are combined to operate in this case.

2) Mud removal at the time of lifting the hull by sling wire. In case that the cut hull is refloated by sling wire, which is put under the hull bottom and lift by the floating crane. In order to lay a sling wire under the hull bottom, a diver manupulate the air-lift at the shell plating to remove mud up to the hull bottom, and then to the underneath till the other side of the shell plating.

Plan 4-2-2



(3) Inboard mud removal work

Each sunken vessel has almost full of sandy clayey mud inboard. Most of the work is to remove mud out of the inboard. Regarding the method, it is conducted in the same way as in the case of the afore-mentioned outboard removal work.

1) Removal work at the cut-off section
It is common to cut the hull at the inboard side as a cutting method in both underwater gas cutting and underwater oxy-arc cutting. Therefore, it is quite necessary to remove mud inboard as much as possible for the hull cutting.

2) Mud removal to reduce the hull weight

a) In case that mud is left inboard, it is very difficult to calculate the weight and to fail it lifting up, so it should be careful to clean thoroughly.

b) At the time of lifting, mud should be removed by either slanting the block, or using the air-lift and the sand pump.

4-2-4 Study for cutting method & cutting plan

(1) Cutting method

1) Two diver's boats are used, each manning four divers or two squads for the cutting work.

2) By arranging two divers' boats one, at the bow and other at the stern, the hull is cut simultaniously both from the bow and the stern.

3) In order to remove oysters and sea weeds as well as rust, an air scrapper and a small quantity of dynamite are jointly used.

4) The working hours are four hours per day (depending on the tide table) and the length of a cutting block should be 7 meters per pair of divers (one diver & one assistant).

5) Each sunken vessel should be cut from inside to outside.

(2) Cutting plan

After surveying the sunken vessels, the examinations are made for hull structures and the part to be cut. In this case, the followings should be borne in mind.

1) Confirmation for the location of partitions

It is very important to confirm the exact location of a partition (bulkhead) before implementing the cutting & removal work. Once it is confirmed and recorded in the drawing, the cutting location is decided to implement the work.

2) The engine room should be considered as one block when the cutting position is determined as there are many machines and equipment in it. However, when it is lifted by a crane, it can be dismounted per each machines respectively in case the weight is too heavy.

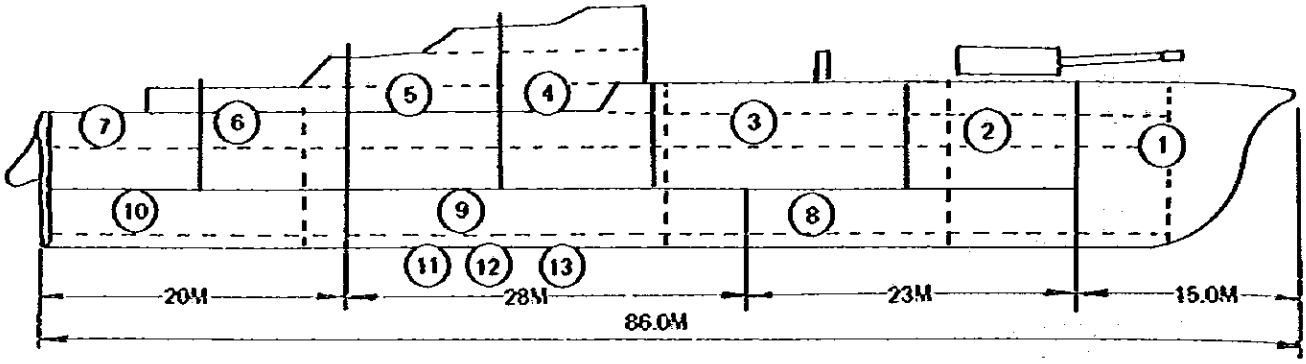
3) It should be planned to make use of any cargo hatch for cutting, simply because the cutting length can be reduced much, and the work can be curtailed the work.

(3) Cutting partition for each sunken vessel

1) In case that 200-ton capacity floating crane is mobilized the weight of one block should be of 150 – 160 tons.

a) Cutting partition for No. 4 sunken vessel

Plan 4-2-3



Weight distribution of each block

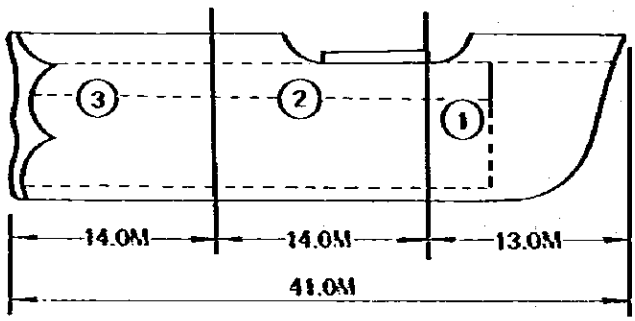
1	160 tons	2	150 tons	3	180 tons
4	170 tons	5	170 tons	6	150 tons
7	150 tons	8	100 tons	9	150 tons
10	100 tons	11	100 tons	12	130 tons
13	130 tons				

Total: 1,850 tons for thirteen blocks

b) Cutting distribution of No. 3 sunken vessel

i) The bow

Plan 4-2-4



Weight distribution of each block

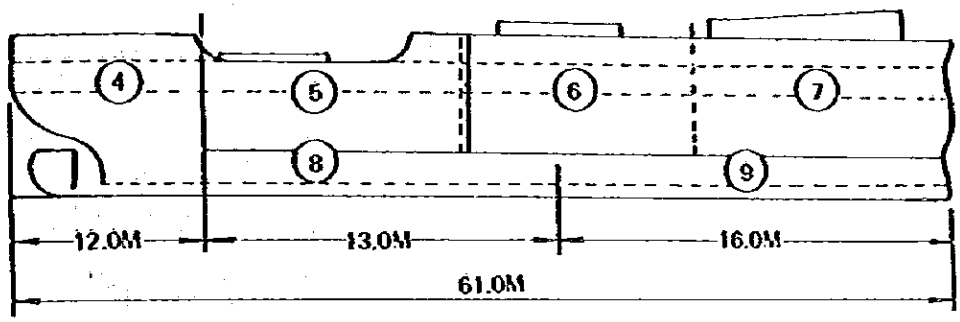
1	170 tons	2	160 tons	3	170 tons

Total: 500 tons for three blocks

ii) The stern

4 160 tons	5 170 tons	6 170 tons
7 170 tons	8 160 tons	9 150 tons

Plan 4-2-4



10 120 tons (machinary) 11 100 tons (machinery)

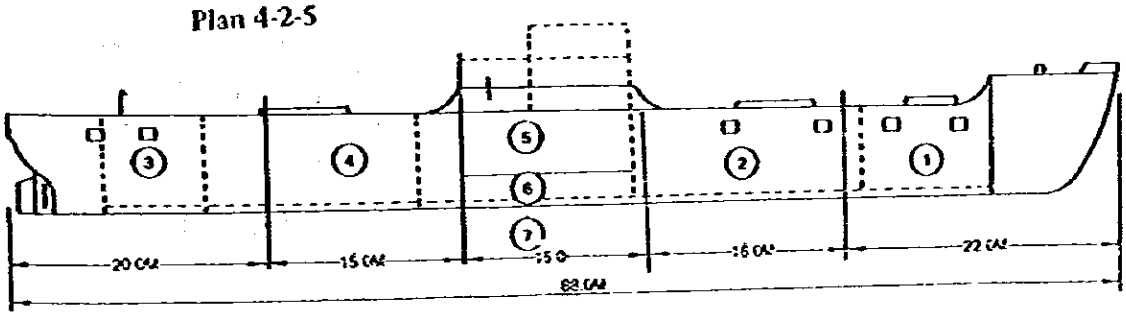
Total: 1,700 tons for eleven blocks

c) Cutting distribution for No. 2 sunken vessel

The total weight of this sunken vessel (370 tons) is rather light, so she'll be refloated by the 500 ton floating crane as a whole. Otherwise the vessel is divided into the midship, the engine room, and an engine, each one of which is considered less than 100 tons. It will cost more if lighted one by one by the 200-ton floating crane.

d) Cutting partition for No. 6 sunken vessel

Plan 4-2-5



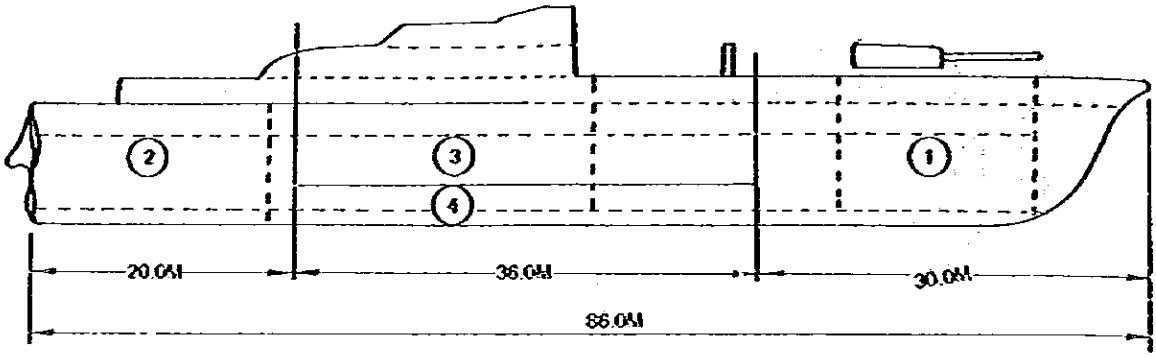
1 160 tons	2 140 tons	3 140 tons
4 150 tons	5 110 tons	6 100 tons
7 100 tons		

Total: 900 tons for seven blocks

2) Removal operation 500-ton floating crane
Each block should weigh 450 to 470 tons.

a) Cutting partition for No. 4 sunken vessel

Plan 4-2-6



Weight distribution for each block;

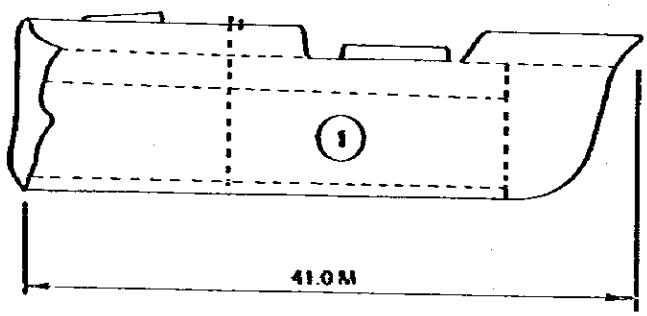
1 410 tons	2 400 tons	3 430 tons
4 420 tons	5 190 tons	

Total: 1,850 tons for five blocks

b) Cutting partition for No. 3 sunken vessel

i) Fore section

Plan 4-2-7

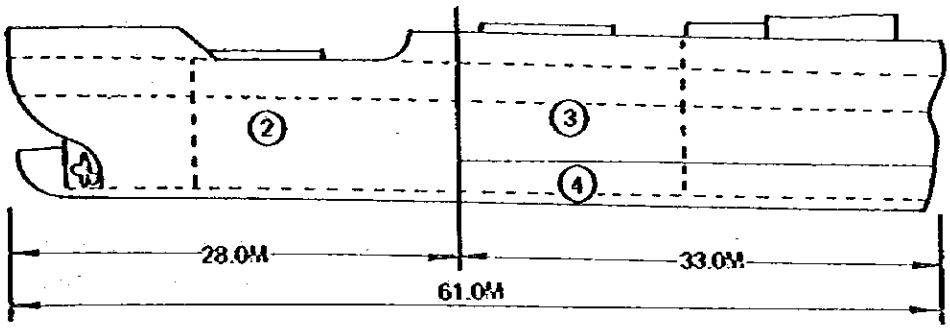


Weight distribution for each block;

1 500 tons

ii) After section

Plan 4-2-7



Weight distribution for each block;

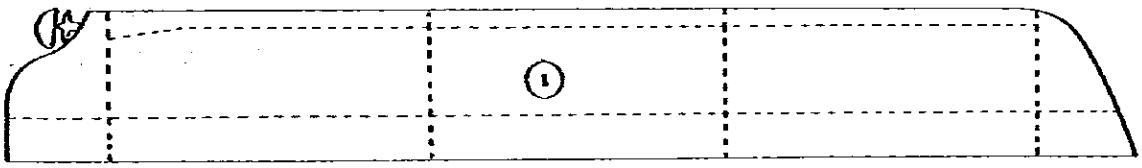
2 420 tons 3 340 tons 4 440 tons

Total: 1,700 tons for four blocks

c) Cutting partition for No. 2 sunken vessel

The sunken vessel weighs 370 tons as a whole, so that she'll be refloated by lifting as one block.

Plan 4-2-8



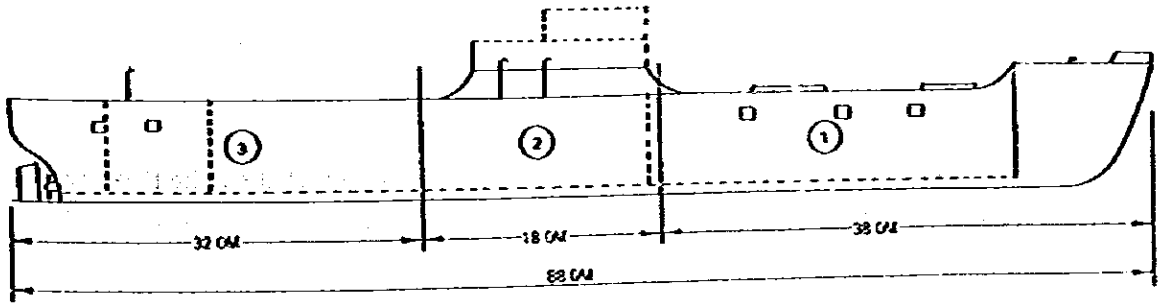
d) Cutting partition for No. 6 sunken vessel

Weight distribution for each block;

1 300 tons 2 300 tons 3 300 tons

Total: 900 tons for three blocks.

Plan 4-2-9



(4) Comparison of a cut block by either 200 ton or 500 ton floating crane

Sunken vessel ⟶	No. 4	No. 2	No. 3	No. 6
200 ton floating crane	13 blocks	--	11 blocks	7 blocks
500 ton floating crane	5 blocks	1 block	4 blocks	3 blocks

Note 1 Cut length of sunken vessel
The cutting operation is made from inside the vessel.

(1) The cutting of the double bottom is made firstly by cutting the inner bottom plate (Tank top plate), secondly by removing each floor in the bottom, and then by cutting bottom plate.

(2) The cut lengths of shell plate, deck, bottom plate are figured out on the table, at the time of the initial study of the hull structure, by the use of the scale.

Note 2 The weight of the block is that of the block itself added to the mud suction power. In this connection, the following steps are taken to reduce this power.

(1) When the bottom of the hull is lifted, the sea water is to be introduced by lifting up one side of the block, in between the bottom of the hull and the mud.

(2) A room can be secured between hull bottom and mud when the sling wires are installed.

(3) The dynamite is frequently used for removing the rot of the outer plate causing the vibration. The vibration works faborably reducing the mud suction power. The mud suction power is strong and weights, in some instance, almost 10 times as heavy as vessel itself. Therefore, it is very important to reduce the mud suction power.

Note 3 No mention is made concerning the charge of the floating crane to be towed. This is because the estimate is on the basis that the floating trane is available in Surabaya port.

4-2-5 Installation of hooks for lifting

After cutting the hull into blocks, they are lifted and transported by the floating crane. The installation method of hooks is roughly divided into two;

1. To bundle the hull
2. To open holes and install sling wires in them

(1) Installation method of a sling wire for the hull bottom
After divers removed mud and drilled, a sling wire should be fixed, the gists of which are as follows;

a) After making a hole, a diver puts a slim wire rope (8m/m – 18 m/m) which is combined to a wire (25 – 30 m/m). Then, the slim wire is rolled up by a winch on board so as to slip the wire rope into the hole.

b) As soon as the preparation is completed, the floating crane is mobilized to the site to roll up the fat wire rope by a winch of the floating crane. By rolling it up, another sling wire rope is bundled the hull, and so on. In the same manner, one by one a sling wire rope is tied up the hull ready for lifting.

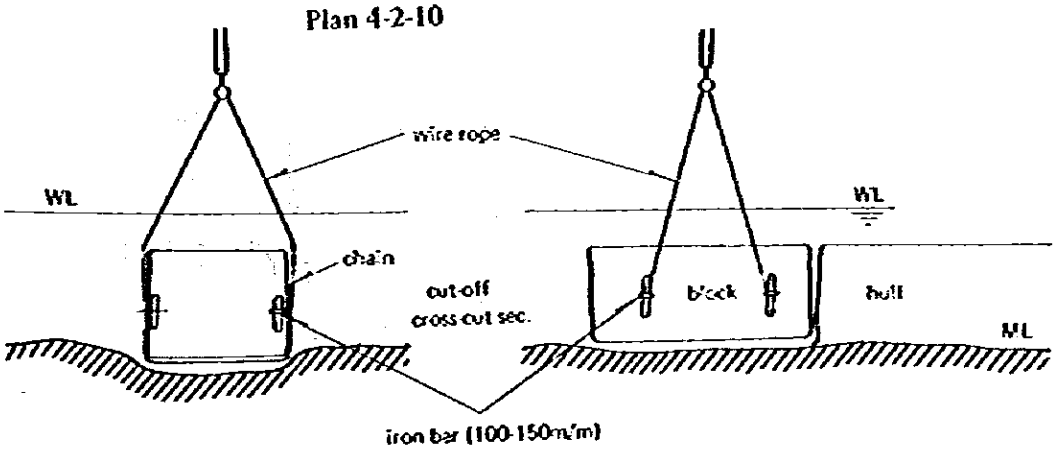
(2) Installation method of a sling wire for the shell plating
In case that one block consisting of cut-off shell plating and decks, are lifted out of the surface, there are two ways to conduct;

a) By making lifting holes on the shell plating, sling wire ropes being hung by the floating crane, are put into the holes, while divers set steel bars one each (150 – 200 m/m in diameter 1.5 – 2 M long) to the dovels from the inboard.

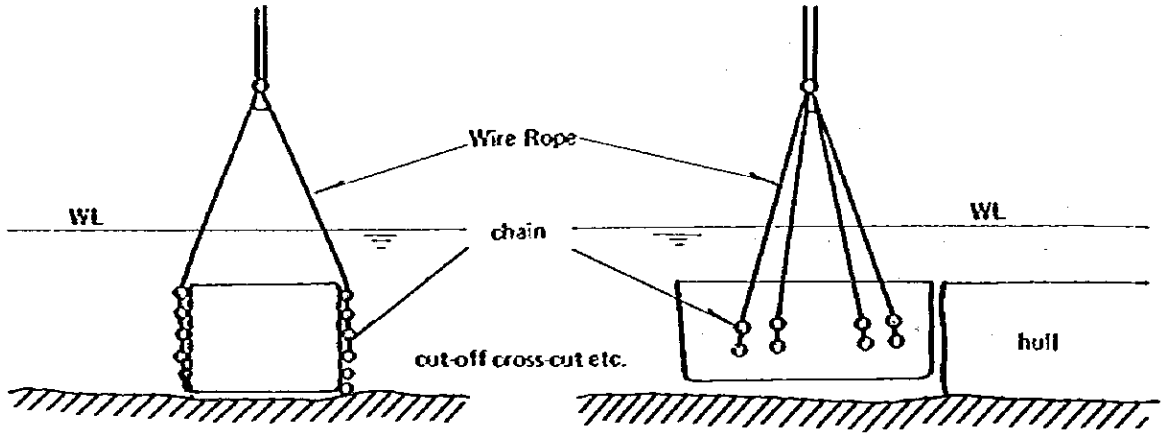
b) After completing the setting of sling wires are rolled up a little to see the balance of a block and also to check the conditions of setting the bars. (see plan 4-2-10.)

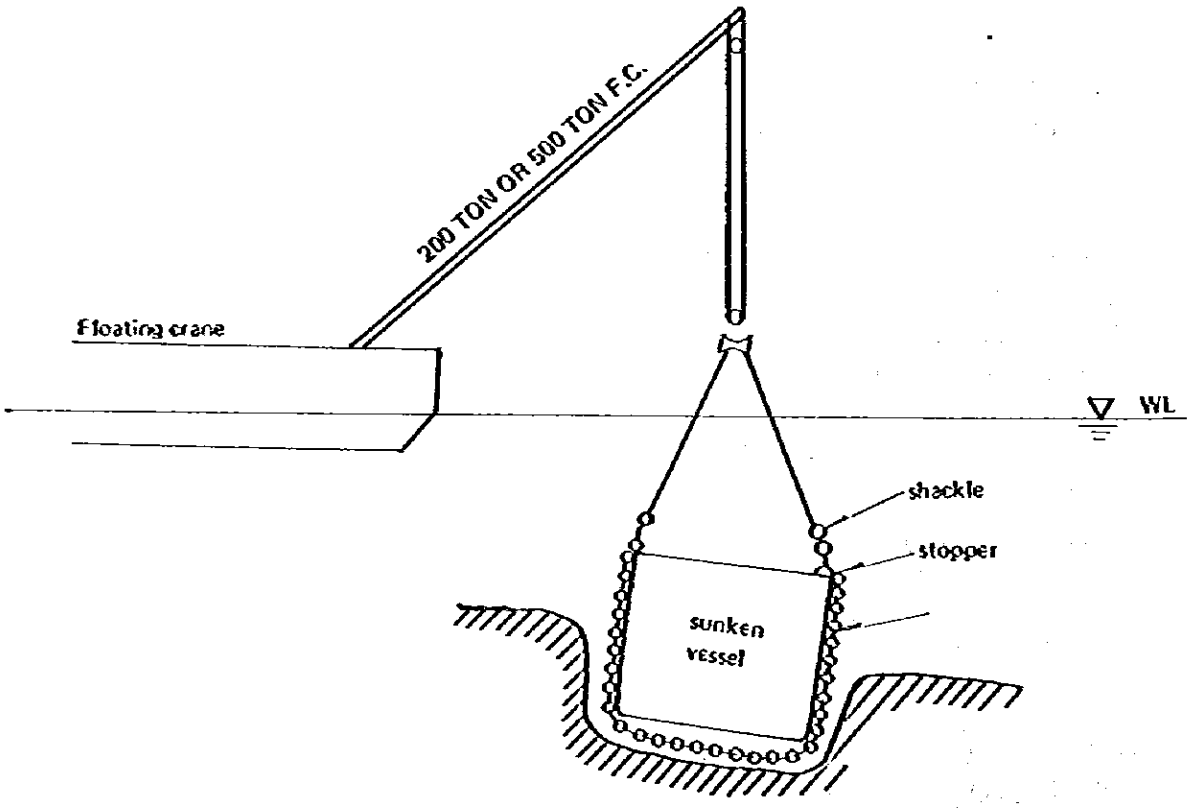
c) To open two holes at one position, two sets each on the shell plating, eight holes in total on both shell plating. A sling wire rope is hung by the floating crane, and set it into the holes as shown in the illustrated pictures hereafter. (see plan 4-2-11, 12). The above methods are employed to fix sling wire ropes, lift a block, and transport to the designated location.

Plan 4-2-10

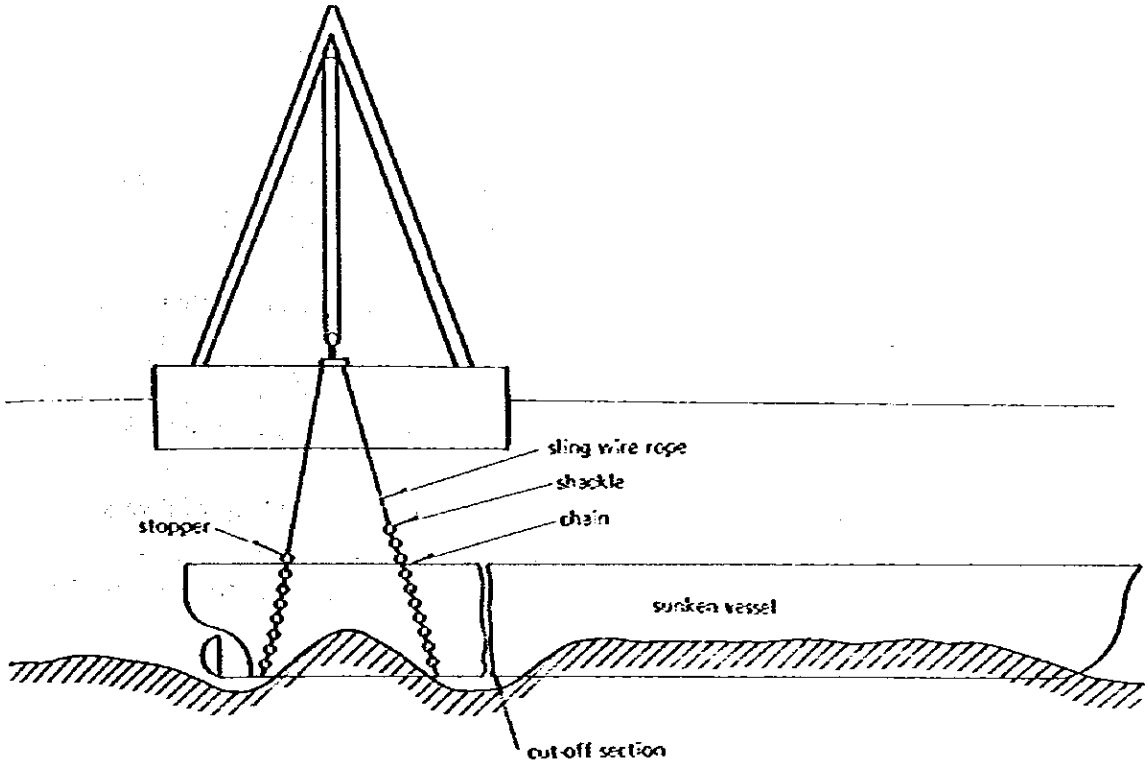


Plan 4-2-11


Wire Rope
WL
chain
WL
cut-off cross-cut etc.
hull


200 TON OR 500 TON F.C.
Floating crane
WL
shackle
stopper
sunken
vessel

Plan 4-2-12


sling wire rope
shackle
chain
stopper
sunken vessel
cut-off section

4-2-6 To lift, to transport, and to deposit

(1) To lift

1) A floating crane is mobilized by the tug boat to the site.

2) Uppon its arrival, the floating crane drops her anchor expanding the chain and approaches herself to the sunken vessel with the help of the tug boat.

3) Unload a small boat and load the fore mooring wire rope of the floating crane to moor the buoy.

4) By rolling up the mooring winch, the floating crane approaches the sunken vessel.

5) Hand down a sling wire rope and fix it to the block with the help of divers.

6) After fixing the sling wire rope to the block, put the rope onto the main hook, have it up and lift the block.

(2) To transport

1) After lifting the cut-off block, the tug boat tows the floating crane from the stern, and mobilizes her to the scrap yard in Karang Djamuang Island off three mile from the site.

2) In case that two floating cranes at the state of lifting the block are towed by the tug boat to the designated scrap yard, there are many problems, such as, the method of inter-communications, coordinated works with the tug boat, and so on, which require the captains' experiences and techniques to collaborate with one another, so that it is much better to avoid this method if the scrap yard is too far from the site.

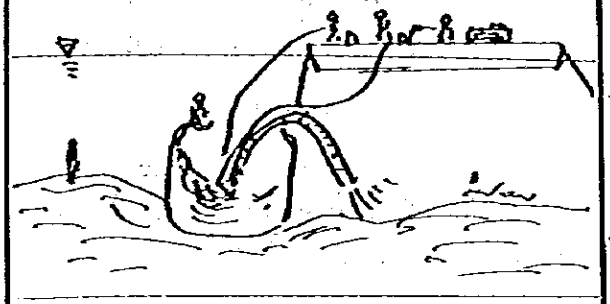
(3) To deposit

When the floating crane arrives at the scrap yard, drops her anchor, releases the towing wire rope, lifts the block gently out of the surface without letting it touch the sea bed, and then commences to deposit it to the scrap yard.

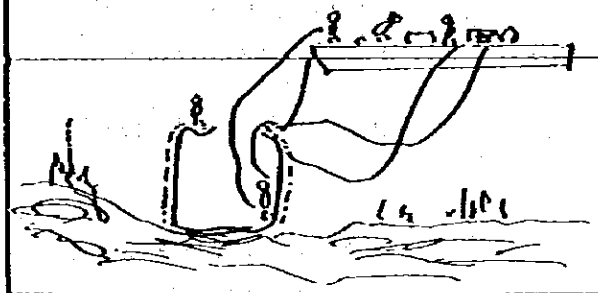
After depositing, divers start to release the sling wire rope. In case of having bundled the block, be careful for the sling wire stopes so as not to spoil them since they were laid underneath the block. (see plan 4-2-13).

Plan 4-2-13

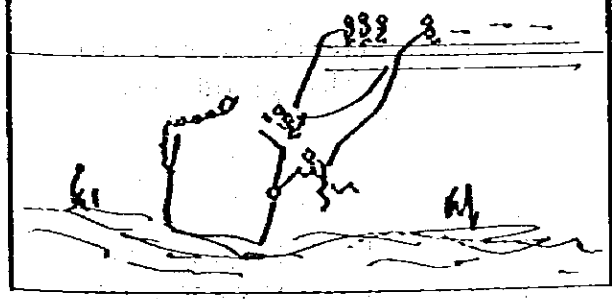
(1) Mud removal work



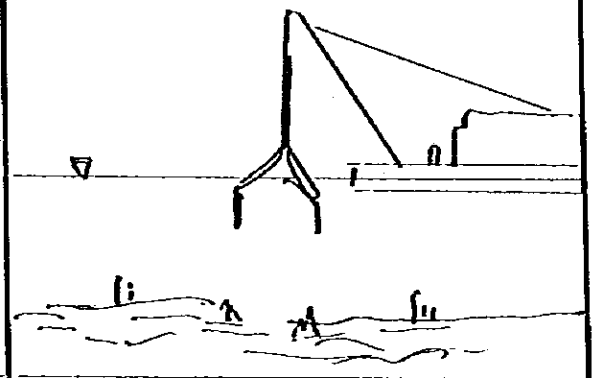
(2) Underwater cutting work



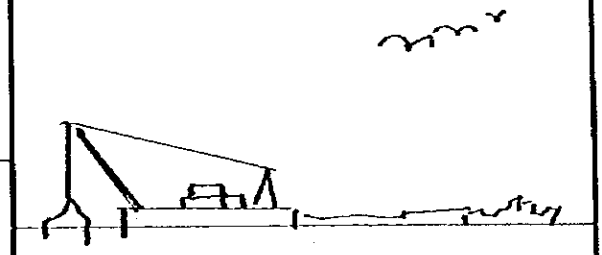
(3) Installation work of sling wire re rope



(4) Lifting work of sunken vessel



(5) Towing operation (site to scrap yard)



(6) Depositing work of scraps