

CHAPTER 6 URGENT PLAN

1. Basis of the Beach Conservation Plan

This urgent plan was made to propose means of conservation of the present beautiful coral sand beach and to cope with the progressing beach erosion. The urgent countermeasures and locations were planned mainly based on the coastal engineering aspects as follows.

(1) Artificial Sand Nourishment

By providing sand to the eroded beach, the lost beach could be artificially recovered and thus counteract the progressing erosion. In this project, the sand nourishment is planned as the minimum required width and length to protect the existing structures along the coastline from collapse and to protect property from scouring due to wave actions. This would conserve the beach space for international tourism.

(2) Facilities for Reduction of the Longshore Sediment Movement

The series of groins are planned to reduce the incoming wave height, to change the wave direction, and to weaken the current velocity. At the same time, the longshore sediment transport induced by wave and current will be trapped there. Consequently, in order to stop the progress of beach erosion to adjacent areas and stop the retreat of the shoreline, T-shaped groins are the most suitable facility considering the rough sea conditions of Kuta Beach and straight groins are designed as the most suitable facility for the relatively shallow and moderate sea conditions at Sanur Beach and Nusa Dua Beach.

2. Urgent Plan

(1) Urgent Plan for Kuta Beach

The basic concept of the Kuta beach conservation plan is to recover the lost beach by sand nourishment and maintain it. The countermeasures necessary for the beach conservation are planned as follow.

1) Sand Nourishment

Nourished area : From 300 m (near Pertamina Cottages) to
3,000 m North (near Kuta Sea View
Cottages) of the Airport.
Beach length = 2,700 m
Beach width : Average 50 m
Slope of foreshore: About 1/17
Sand volume : 783,000 m³

2) Maintenance of the Nourished Beach

The basic concept of the beach conservation is to divide the whole stretch of the beach into a series of sections and to stabilize the beach within each section. Each section will thus be comprised of a stable pocket-beach.

Groins will be used as maintenance facilities because the sections should be separated from each other and the longshore sand drift should be enclosed within the sections.

4 sets of headlands using T-shaped groins are necessary to stabilize the filled sand and reduce the wave impact by forming pocket beaches between these headlands.

One small groin is planned to maintain the filled sand at the northern end of the sandfill area.

The location and scale are shown in Fig. 6-2-1.

(2) Urgent Plan for Nusa Dua Beach

In order to reduce the erosion, and to maintain this beach in good condition for conservation and touristic use, the sand nourishment and countermeasures are planned as follows.

1) Sand Nourishment

Nourished area : From groin No. 3 (near Culb Med Hotel) to
Nusa Besar
Beach length = 2,350 m
Beach width : Average 50 m
Slope of foreshore: Average 1/7
Sand volume : 229,000 m³

2) Maintenance of the Beach

The basic concept of beach conservation at Nusa Dua beach is that the whole reach of the beach will be divided into a series of sections and the beach will be stabilized within each section.

At Division III, extension of the U-shaped offshore breakwater is necessary to stop the sediment movement through the gap of the reef and to obstruct the refracted waves coming in from the reef gap. A pocket beach is expected to form between groins No.2 and No.3. Extension of the existing groin No.3 is planned to retain the filled sand.

3) Modification of Existing Offshore Breaker

The height of the existing offshore breakwater is planned to be reduced to the mean sea water level, just like the existing U-shaped breakwater, judging from the wave diffraction diagram and the condition of wave concentration coming in through the reef gap.

The locations and dimensions are shown in Fig. 6-3-1.

(3) Urgent Plan for Sanur Beach

The basic concept of the beach conservation plan is to recover and develop the lost beach by nourishment up to 50 m of beach width and maintain it by a series of headlands. The countermeasures necessary for beach conservation are planned as follows.

1) Sand Nourishment

- Nourished area : ① From the Bali Beach Hotel Pier to 700 m North
Beach length = 700 m
- ② From 1,700 m (near Sindhu Hotel) to 5,700 m South (near Sanur Beach Hotel) of the Bali Beach Hotel Pier
Beach length = 4,000 m
- Beach width : Average 30 m
- Slope of foreshore: About 1/7
- Sand volume : 448,000 m³

2) Maintenance of Nourished Sand

In Division I, 3 sets of headlands are planned to form a stable shoreline against the incoming wave direction. In Division II, 3 sets of groins are necessary to stabilize the filled sand.

In Division III, L-shaped groins and straight groins are planned to prevent the filled sand from falling to the reef gap.

A submerged offshore breakwater at the coral reef gap is necessary to stabilize the filled sand and reduce the wave impact against the beach near Kesuma Sari Inn.

The locations and dimensions are shown in Fig. 6-4-1.

(4) Urgent Plan for Tanah Lot

The existing conservation plan using concrete blocks around the island is suitable in order to protect the island from erosion by waves.

The locations and dimensions are shown in Fig. 6-5-1.

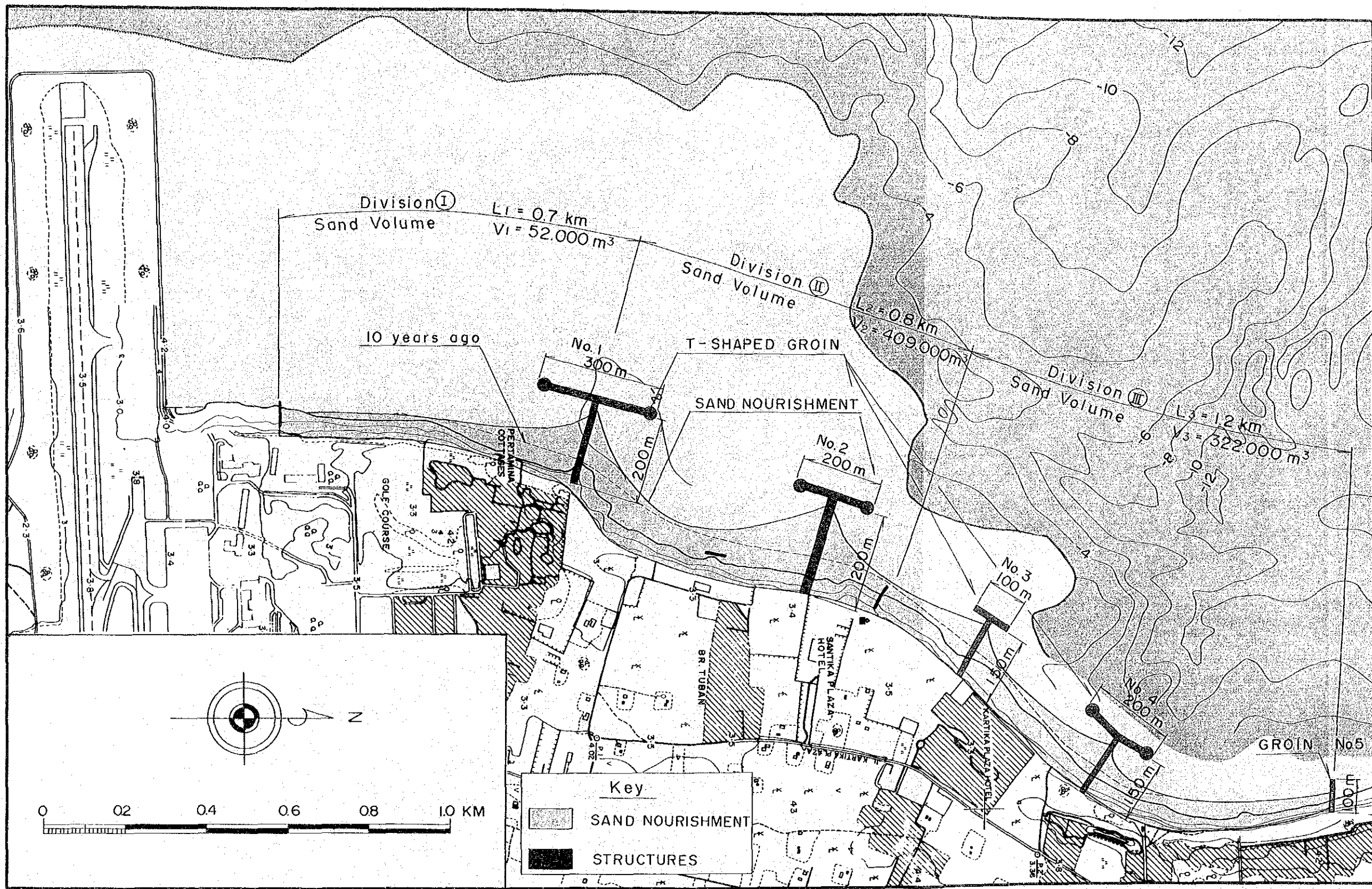


Fig. 6-2-1 Urgent Plan for Kuta Beach

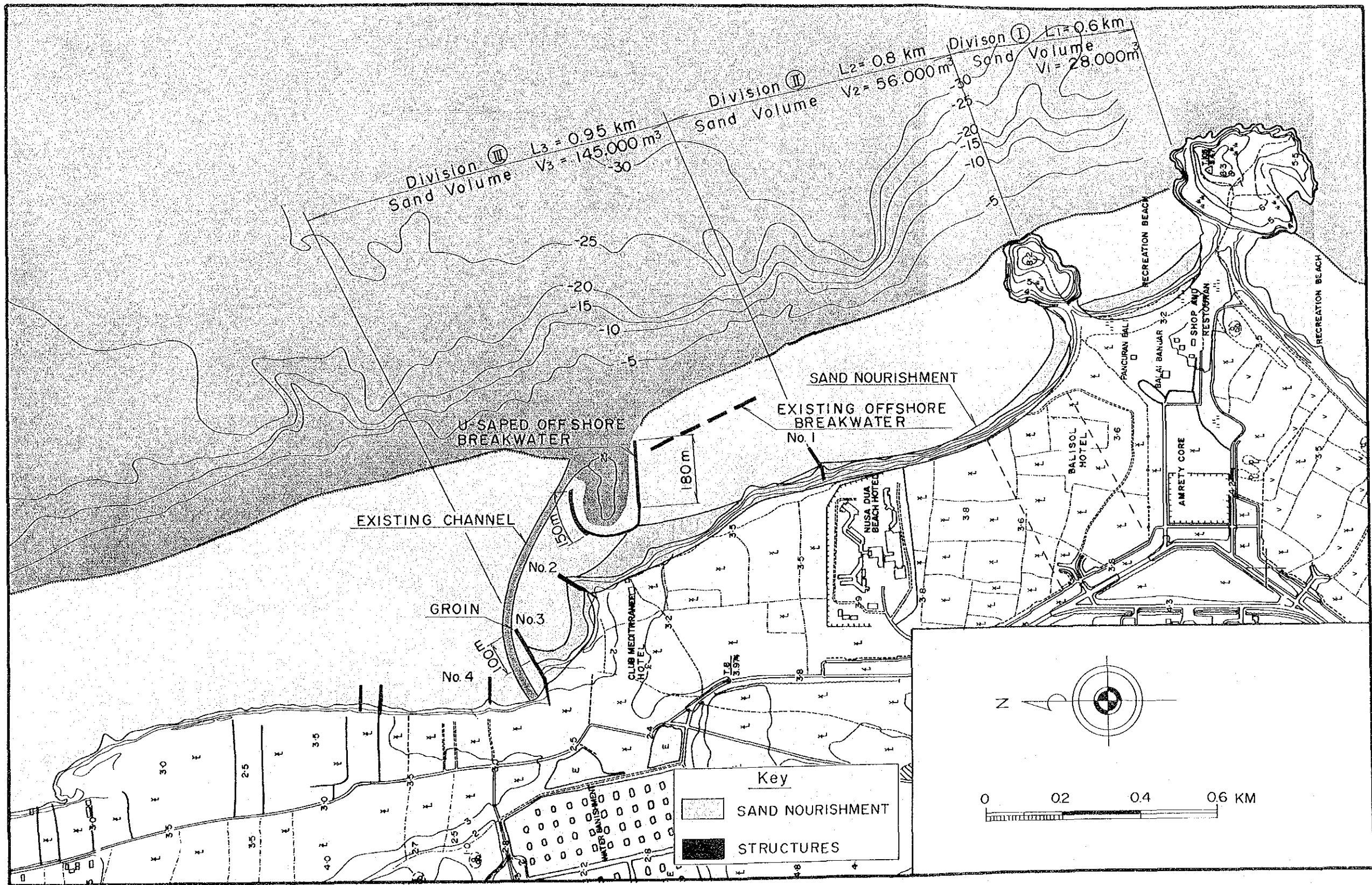


Fig. 6-3-1 Urgent Plan for Nusa Dua Beach

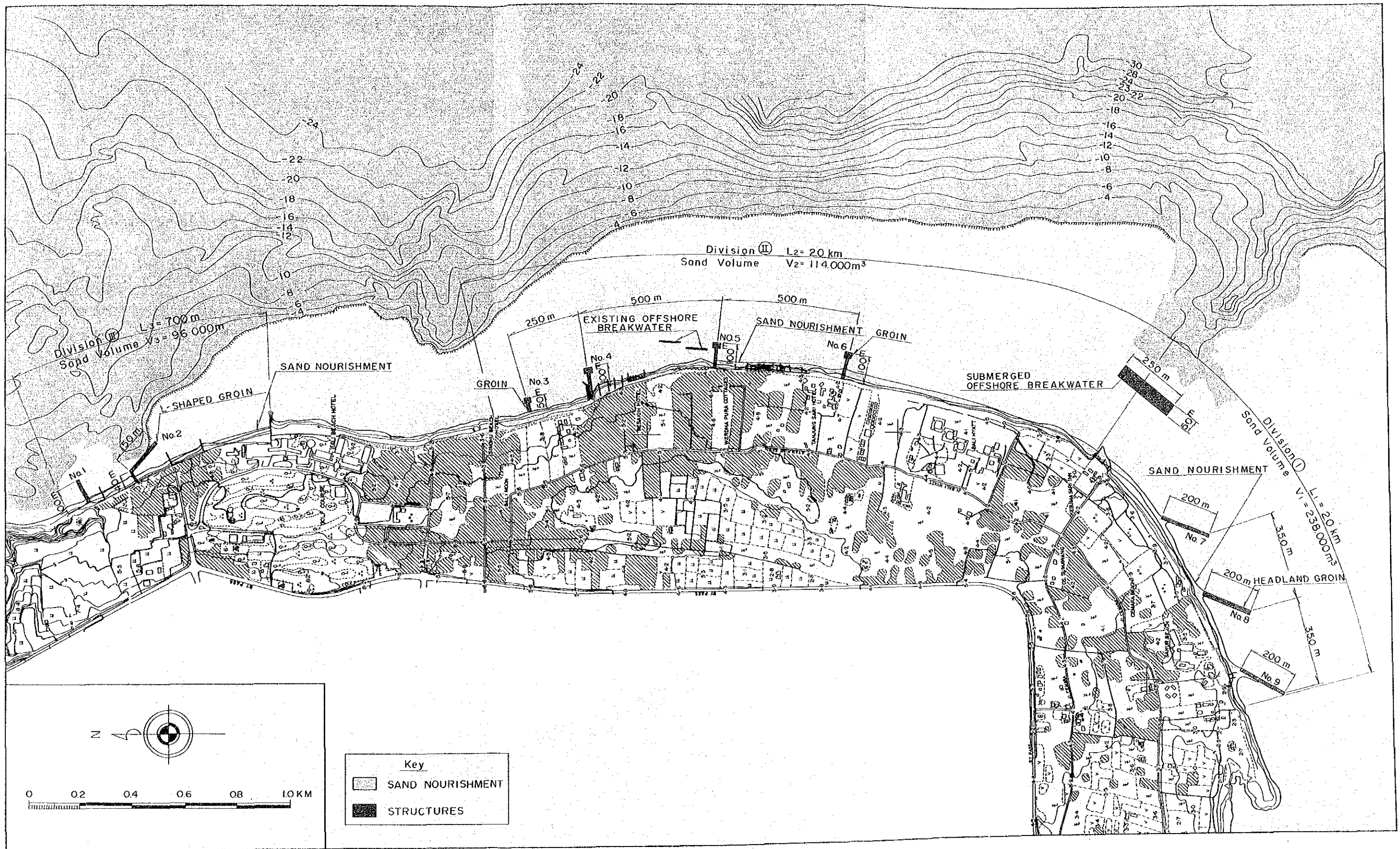
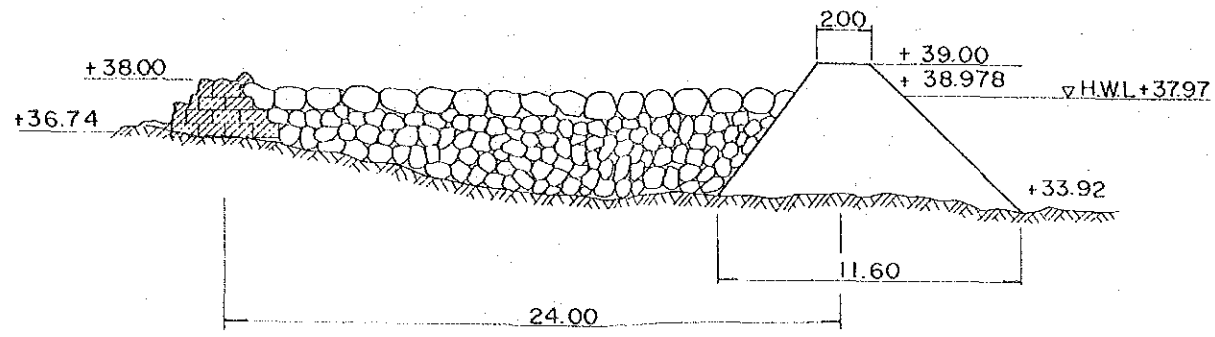
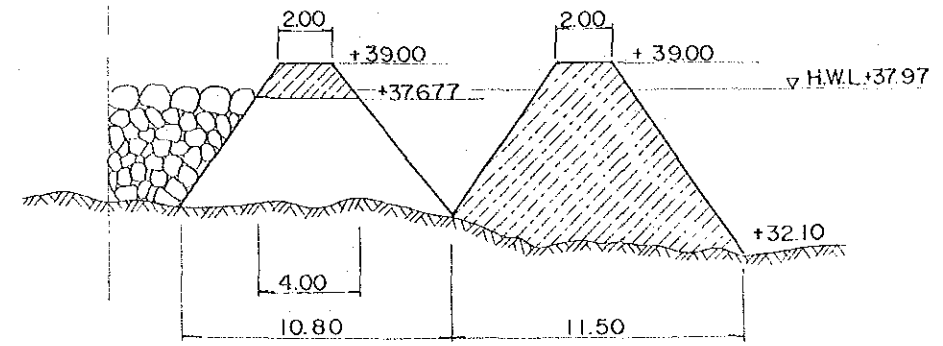


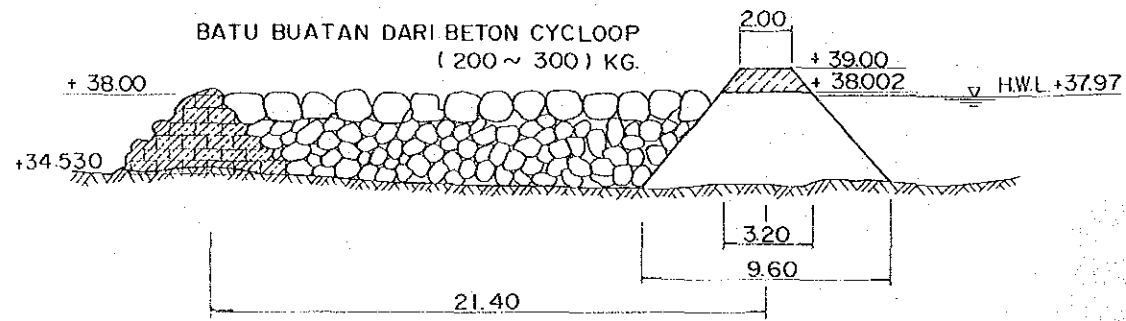
Fig. 6-4-1 Urgent Plan for Sanur Beach



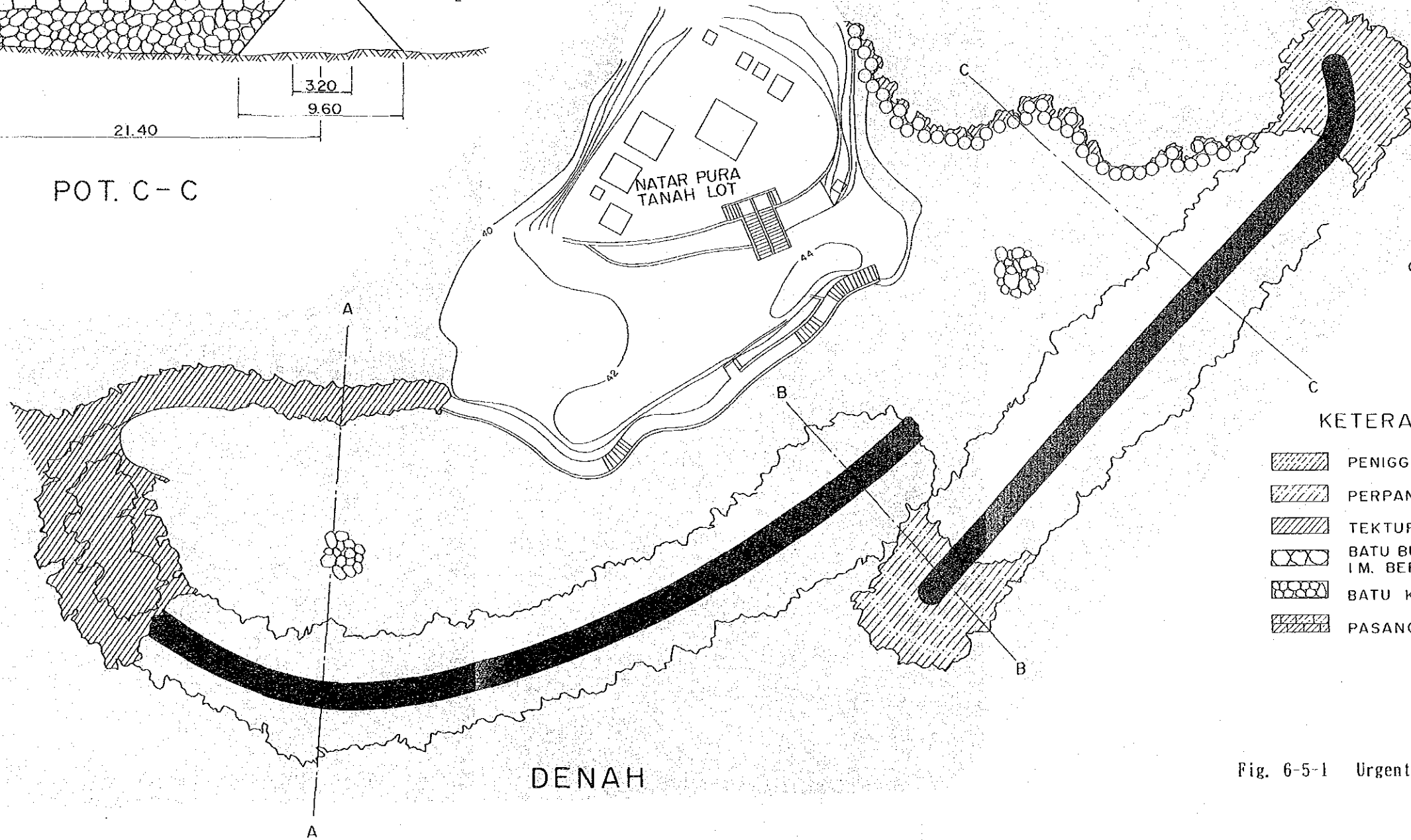
POT. A-A



POT. B-B



POT. C-C



DENAH

KETERANGAN







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-  PERPANJANGAN TETRAPOD
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-  BATU KALL BERAT 100 K.G.
-  PASANGAN BUIS BETON DICOR CYCLOOP

Fig. 6-5-1 Urgent Plan for Tanah Lot

CHAPTER 7 DESIGN, CONSTRUCTION

1. Facility Design

The typical sections of structures and sand nourishment at each beach are shown in Fig. 7-1-6-1 through 7-1-6-6.

2. Construction Plan

(1) Execution Plan

This project must be completed urgently and all the works are planned to be completed in the three-year period by using construction machinery.

1) Urgent Bali Beach Conservation Project

The main erosion prevention works are summarized below.

Groin	:	2,940 meters
Offshore Breakwater	:	330 meters
Submerged Offshore Breakwater	:	12,500 cubic meters
Beach Sand Nourishment	:	1,460,000 cubic meters
Demolition	:	363 meters

The process of the beach sand nourishment for the Bali Beach Conservation Project is illustrated in Fig. 7-2-4-1.

2) Kuta Beach

The main erosion prevention works at Kuta beach are as follows:

Groin	:	1,600 meters
Beach Sand Nourishment	:	783,000 cubic meters
Demolition	:	70 meters

3) Nusa Dua Beach

The main erosion prevention works at Nusa Dua beach are as

follows:

Groin	:	100 meters
Offshore Breakwater	:	330 meters
Beach Sand Nourishment	:	229,000 cubic meters
Demolition	:	213 meters

4) Sanur Beach

The main erosion prevention works at Sanur beach are as follows:

Groin	:	1,240 meters
Submerged Offshore Breakwater	:	12,500 cubic meters
Beach Sand Nourishment	:	448,000 cubic meters
Demolition	:	80 meters

(2) Construction Schedule

The construction time schedule is given in Fig. 7-2-5-1.

3. Cost Estimate

(1) Summary of the Cost Estimate

The project cost is estimated at Rp. 71,445,456,000 except for price escalation, consisting of Rp. 16,937,809,000 of local currency portion and Yen 4,431,516,000 of foreign currency portion at 1988 prices.

(2) Maintenance Cost

The maintenance cost for the Urgent Bali Beach Conservation Project is estimated as Rp. 700,000,000 per year after completion.

4. Three-Contract Method

The three-contract method is an alternative plan which has been devised considering that this Project consists of three beaches, particularly assuming that the works at each beach are carried out separately and independently.

The total construction period of the two methods is almost equal. However, the construction period of Nusa Dua and Sanur Beaches under the three-contract method is shorter than under the one-contract method, especially at Nusa Dua Beach. Therefore, in view of the construction period, the three-contract method is better than the one-contract method.

From the point of view of the project cost, the one-contract method is better than the three-contract method. (Table 7-5-2-1)

From the point of view of the construction equipment and plants, the three-contract method uses much more equipment and plants than the one-contract method. There is no harm in increasing the numbers of equipment and plants, but this would disturb the tourists on the beach during the construction period.

Therefore, a smaller number of equipment and plants is better and wiser.

From the point of view of the engineering services, certainly the one-contract method is better than the three-contract method, because of the easy control of the supervision works and the lower cost.

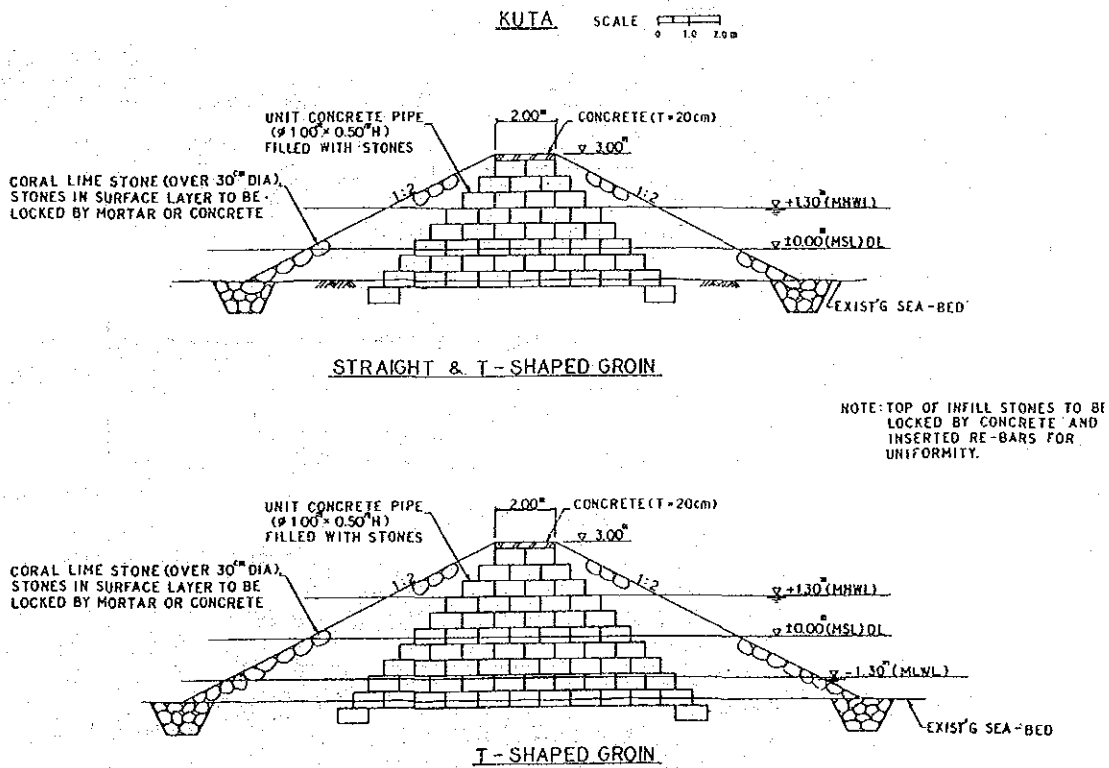
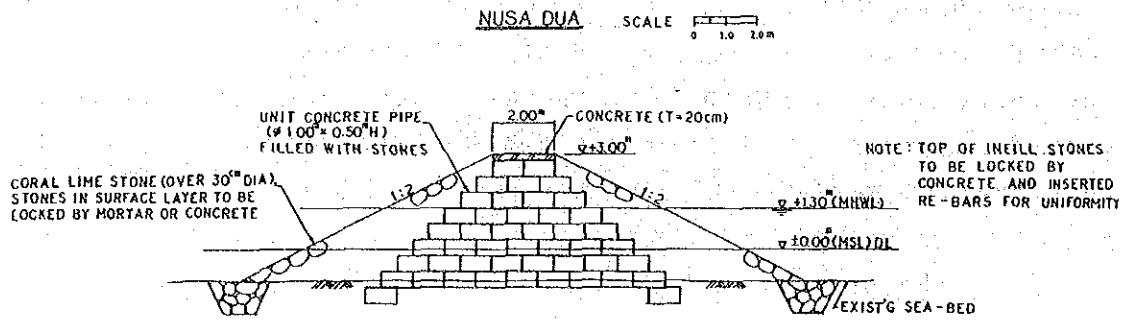
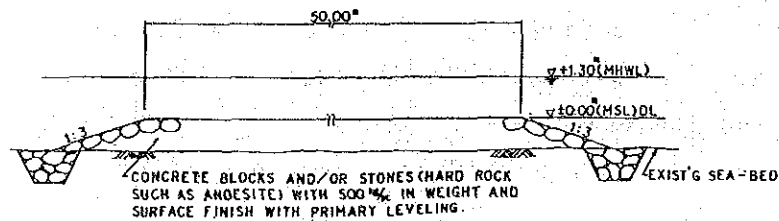


Fig. 7-1-6-1 Preliminary Design (Structures, Kuta)

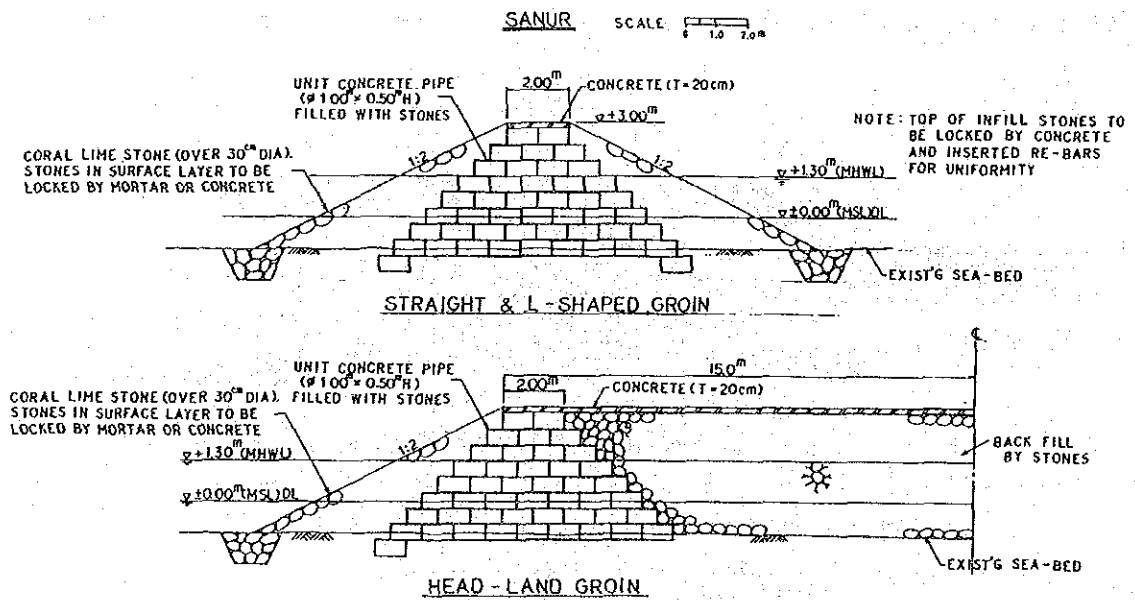


EXTENSION OF STRAIGHT GROIN

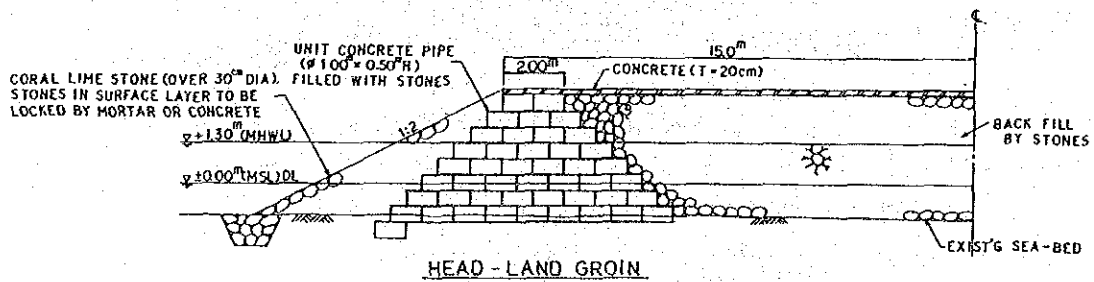


SUBMERGED OFF-SHORE BREAKWATER

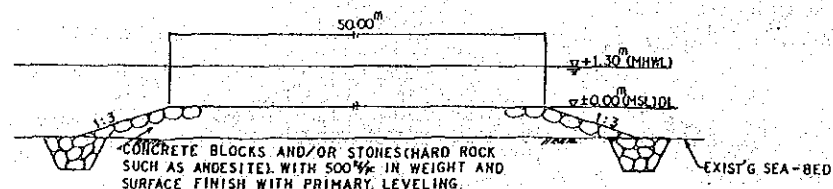
Fig. 7-1-6-2 Preliminary Design (Structures, Nusa Dua)



STRAIGHT & L-SHAPED GROIN



HEAD-LAND GROIN



SUBMERGED OFF-SHORE BREAKWATER

Fig. 7-1-6-3 Preliminary Design (Structures, Sanur)

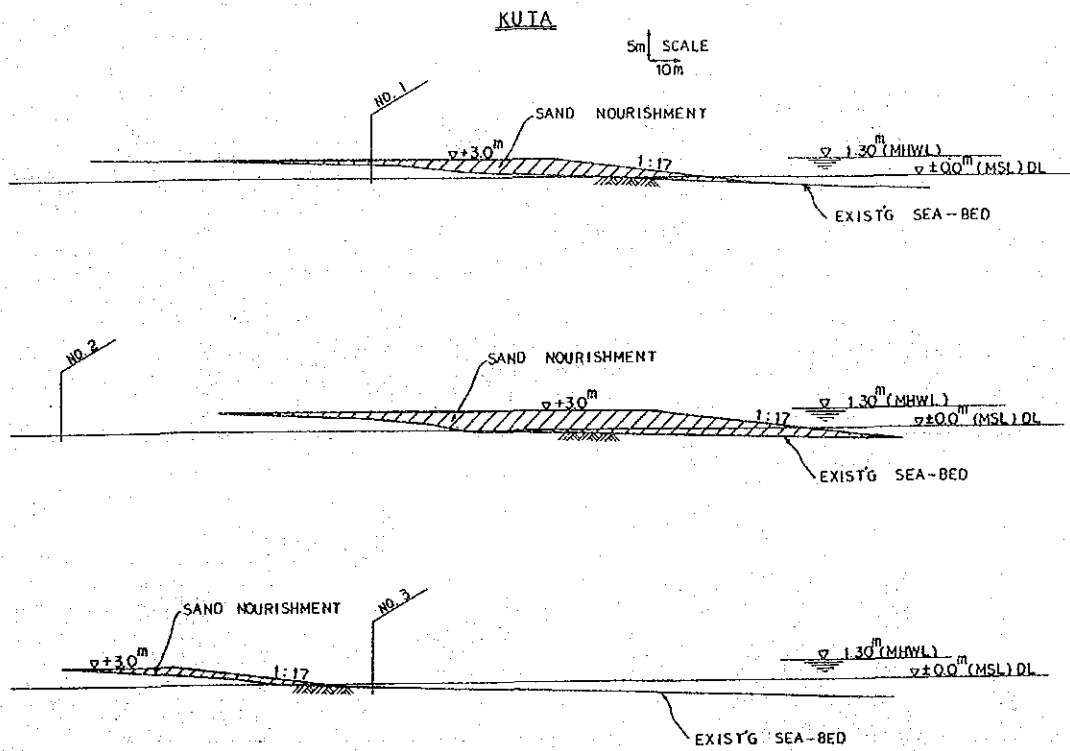


Fig. 7-1-6-4 Preliminary Design (Nourishment, Kuta)

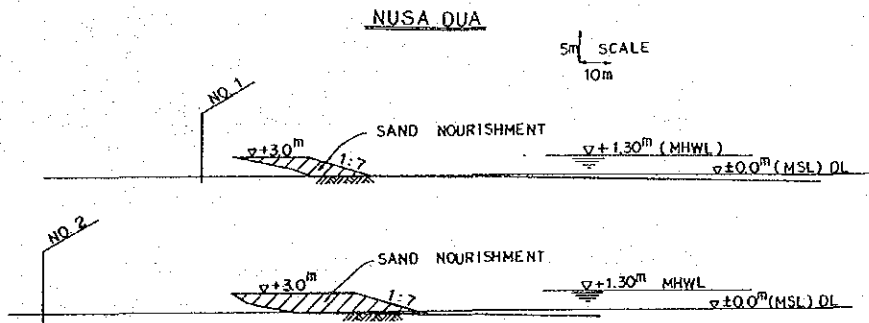


Fig. 7-1-6-5 Preliminary Design (Nourishment, Nusa Dua)

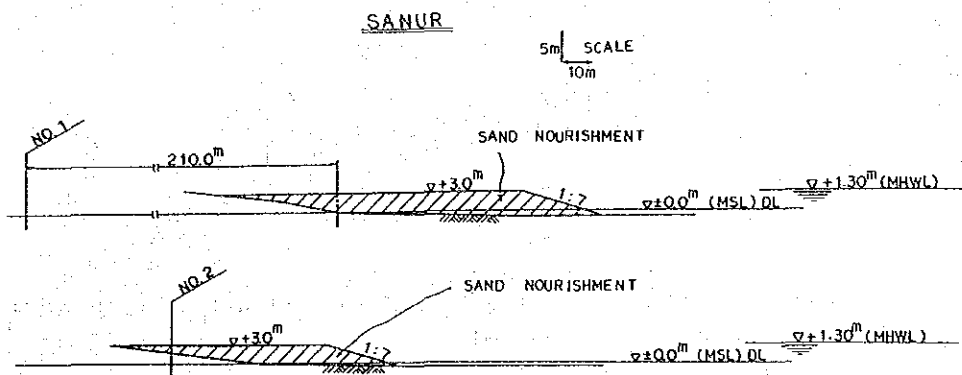


Fig. 7-1-6-6 Preliminary Design (Nourishment, Sanur)

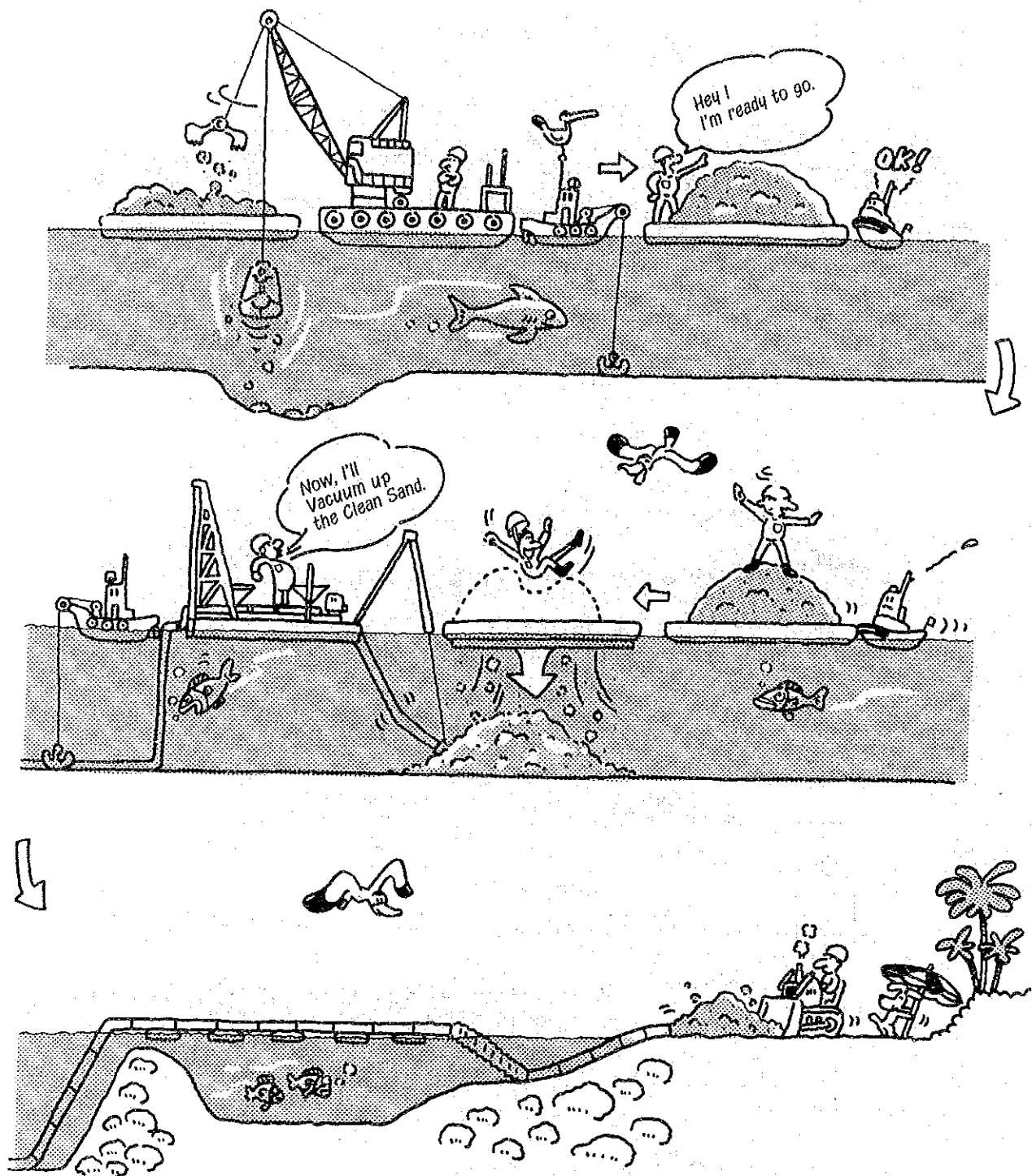


Fig. 7-2-4-1 Illustration of the Beach Sand Nourishment

Name of Place and Description	Period																							
	1991/1992			1992/1993			1993/1994			1994/1995														
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1. Preparatory Works	Quantity																							
Temporary Access Road	L.S																							
Temporary Facilities & Buildings	L.S																							
2. Kuta Beach																								
Groin	1.600 m																							
No. 5	100 m																							
No. 4	350 m																							
No. 3	250 m																							
No. 2	400 m																							
No. 1	500 m																							
Beach Sand Nourishment	788.000 m ³																							
No. 5 L = 600 m	149.000 m ³																							
No. 4 L = 400 m	99.000 m ³																							
No. 3 L = 300 m	74.000 m ³																							
No. 2 L = 800 m	402.000 m ³																							
No. 1 L = 750 m	52.000 m ³																							
Demolish	70 m																							
Groin	70 m																							
3. Nusa Dua Beach																								
Groin	100 m																							
No. 1	100 m																							
Offshore Breakwater	330 m																							
No. 1	330 m																							
Beach Sand Nourishment	229.000 m ³																							
No. 1 L = 350 m	28.000 m ³																							
No. 2 L = 800 m	56.000 m ³																							
No. 3 L = 700 m	107.000 m ³																							
No. 4 L = 250 m	38.000 m ³																							
Demolition	213 m																							
Offshore Groin 4 NOS	213 m																							

Fig. 7-2-5-1 Construction Schedule (One-Contract Method)

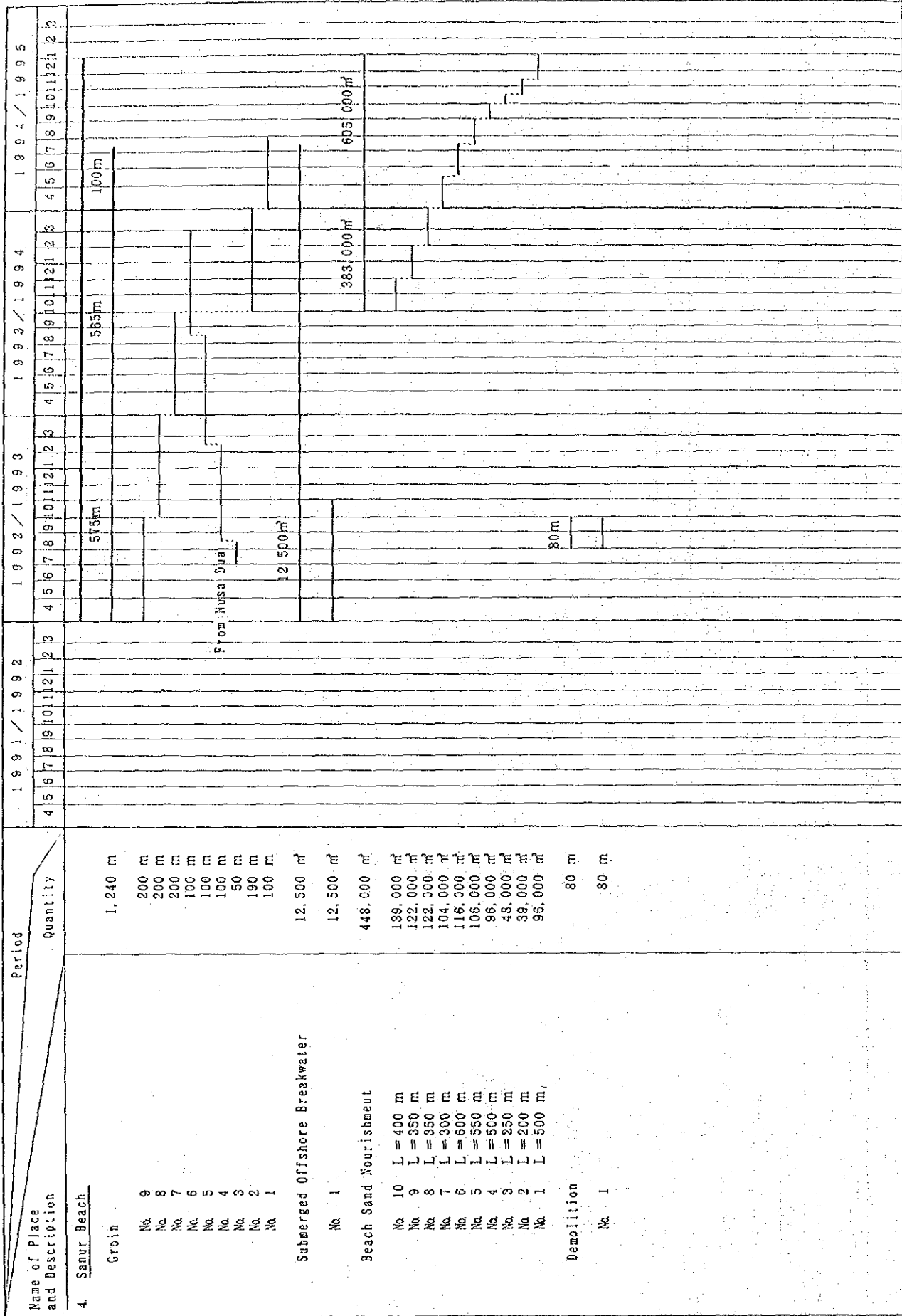


Fig. 7-2-5-1 Construction Schedule (One-Contract Method)

Table 7-5-2-1 Comparison of Project Costs

Unit × 10³ Rp
× 10³ Yen 1988 prices

Description	One Contract Method				Three package Method				(2)/(1) (%)
	Cost				Total				
	L.C. (Rp)	F.C. (Yen)	(1) Total (Rp)		L.C. (Rp)	F.C. (Yen)	(2) Total (Rp)		
1. Land compensation	600.000	—	600.000		600.000	—	600.000		100.0
2. Civil works									
a. Preparatory works	11,814,765	3,379,185	53,378,741		14,619,338	3,944,846	63,140,943		118.3
b. Groins	446,300	22,600	724,280		553,000	22,600	830,980		114.7
c. Offshore breakwater	7,529,798	876,515	18,310,933		8,289,312	702,987	16,936,052		92.5
d. Submerged offshore breakwater	273,062	44,253	817,374		1,126,364	32,865	1,530,604		187.3
e. Beach sand nourishment	516,700	126,350	2,070,805		702,350	106,497	2,012,263		97.2
f. Demolition	3,030,960	2,299,500	31,314,810		3,921,423	3,070,419	41,687,576		133.1
g. Miscellaneous	11,945	6,167	87,799		20,889	5,678	90,728		103.3
Subtotal	6,000	3,800	52,740		6,000	3,800	52,740		100.0
3. Government administration	12,414,765	3,379,185	53,978,741		15,219,338	3,944,846	63,740,943		118.1
4. Engineering services	248,295	67,584	1,079,578		304,387	78,897	1,274,818		118.1
Subtotal	900,348	406,723	5,903,041		1,029,725	462,846	6,722,731		113.9
5. Physical contingency	13,563,408	3,853,492	60,961,360		16,553,450	4,486,589	71,738,492		117.7
Subtotal	1,944,511	578,024	9,054,206		2,483,019	672,987	10,760,769		118.8
6. VAT	15,507,919	4,431,516	70,015,566		19,036,469	5,159,576	82,499,261		117.8
Subtotal	1,429,890	—	1,429,890		1,750,224	—	1,750,224		122.4
GRAND TOTAL	16,937,809	4,431,516	71,445,456		20,786,693	5,159,576	84,249,485		117.9

CHAPTER 8 ECONOMIC ANALYSIS

1. General

The results of this assessment clarify the viability of this Project. The investment is very efficient, and the execution of this project is strongly recommended.

2. Identification of Economic Benefit

The economic benefit accruing to the beach conservation project is defined as the difference in the tourism industry's earnings between the "with the project" and the "without the project" cases.

3. Estimation of Economic Benefit

Four steps are taken to estimate the economic benefit;

- Forecast of foreign tourist arrivals.
- Estimation of the magnitude of reduction in tourist arrivals.
- Estimation of average expenditure by tourists.
- Actual calculation of economic benefit.

4. Estimation of Economic Cost

Two kinds of contract methods are considered: the one-contract method and the three-contract method.

The economic cost of the project is defined as the sum of all materials' real production costs. Thus transfer items such as taxes and duties are excluded from the nominal prices of the materials.

5. Economic Viability of the Project

The economic viability of the Project is examined by two kinds of indicators. First is the level of investment efficiency, which is measured by the following indicators;

- internal rate of return (IRR)
- benefit-cost ratio (B/C)
- net present value (NPV)

The results are shown in Table 8-5-1. The table shows the superiority of the one-contract method over the three-contract method.

Table 8-5-1 Summary of Economic Analysis

Contract	Beach	Total Economic Cost	Total Economic Benefit	EIRR (%)	B/C (discount rate=12%)	NPV (discount rate=12%)	Labour Opportunity (person * years)
One-Contract Method	Kuta	41,860	189,200	21.0	1.70	13,131	
	Nusa Dua	10,363	121,509	43.2	4.43	15,897	
	Sanur	31,451	268,033	33.4	3.09	30,628	
	Three Beaches as a Whole	83,673	578,741	29.5	2.57	59,656	
Three-Contract Method	Kuta	40,752	189,200	22.4	1.78	14,050	4,222
	Nusa Dua	13,541	121,509	31.5	3.03	13,462	520
	Sanur	33,454	268,033	33.9	2.98	30,051	2,637
	Three Beaches as a Whole	87,746	578,741	28.9	2.45	57,563	7,379

Note: 1. The project life is 20 years after the completion of the construction works.

2. The opportunity cost of capital is set at 12%.

Sensitivity analysis is carried out on the superior method (the one-contract method) to evaluate the risks associated with changes in the economic cost and benefit streams. (Table 8-5-2)

Table 8-5-2 Sensitivity Analysis for the Project

Cases	IRR (%)	B/C	NPV (Rp. mn)
<u>Kuta</u>			
Cost up by 20%	17.6	1.41	9,364
Benefit down by 20%	16.9	1.40	6,738
Cost up & Benefit down by 20%	13.9	1.13	2,971
Two Year Delay	17.0	1.40	7,011
<u>Nusa Dua</u>			
Cost up by 20%	38.3	3.69	14,971
Benefit down by 20%	37.2	3.55	11,792
Cost up & Benefit down by 20%	32.7	2.96	10,866
Two Year Delay	37.5	3.62	12,557
<u>Sanur</u>			
Cost up by 20%	29.1	2.58	27,697
Benefit down by 20%	28.2	2.47	21,572
Cost up & Benefit down by 20%	24.3	2.06	18,641
Two Year Delay	28.9	2.54	26,485
<u>Three Beaches as whole</u>			
Cost up by 20%	25.4	2.14	52,033
Benefit down by 20%	24.6	2.05	40,102
Cost up & Benefit down by 20%	20.9	1.71	32,478
Two Year Delay	25.2	2.10	50,850

Note: B/C and NPV are measured at a 12% discount rate.

CHAPTER 9 ADMINISTRATION

1. Recommendations

Why should coastal works be carried out by public bodies? Coastal areas suffer from sea disasters such as coastal erosion, high tides, tsunami and hurricanes. It is very difficult to construct countermeasure facilities using private finances because there is no guarantee that all the people concerned will participate. Considering the prevention of coastal erosion, there are many cases when privately constructed facilities have an adverse effect on adjacent coastal stretches due to blockage of the longshore sediment transport. All the people concerned are definitely unable to join in such projects due to financial and other reasons. In the case of flood mitigation works, no benefit is expected if all the people concerned do not participate. With regard to roads, if the network is not long enough, they are not really effective.

Levying charges is very difficult for these works, because the individual benefit is not well specified. That is the reason that river, coast and road works should be handled by the government through public financing.

So far as coastal areas are concerned, they must be well administered in order to protect these areas from disasters and to maintain a good environment. Preparation of laws and regulations is urgently necessary. The administrator must be designated by law and administer all aspects of the coastal area.

The main roles of the administrator are:

- 1) To collect data on topography, transition of shoreline position, waves and longshore current,
- 2) To protect coastal areas from disasters such as coastal erosion, high tides, tsunami and hurricanes,
- 3) To maintain coastal facilities in good condition, and
- 4) To restrict actions which may adversely effect these areas.

2. Proposed organization for Project Implementation and Operation and Maintenance

Since this project is very big scale and should be completed within three years, the organization and number of staff members shall be large. It is recommended to set a head office and three site offices at the job sites, Kuta, Nusa Dua and Sanur. The proposed administrative sections at the head office are planning, construction, logistics and finance, and administration. The site offices shall supervise the construction. The proposed organization chart is shown in Fig. 9-4-1.

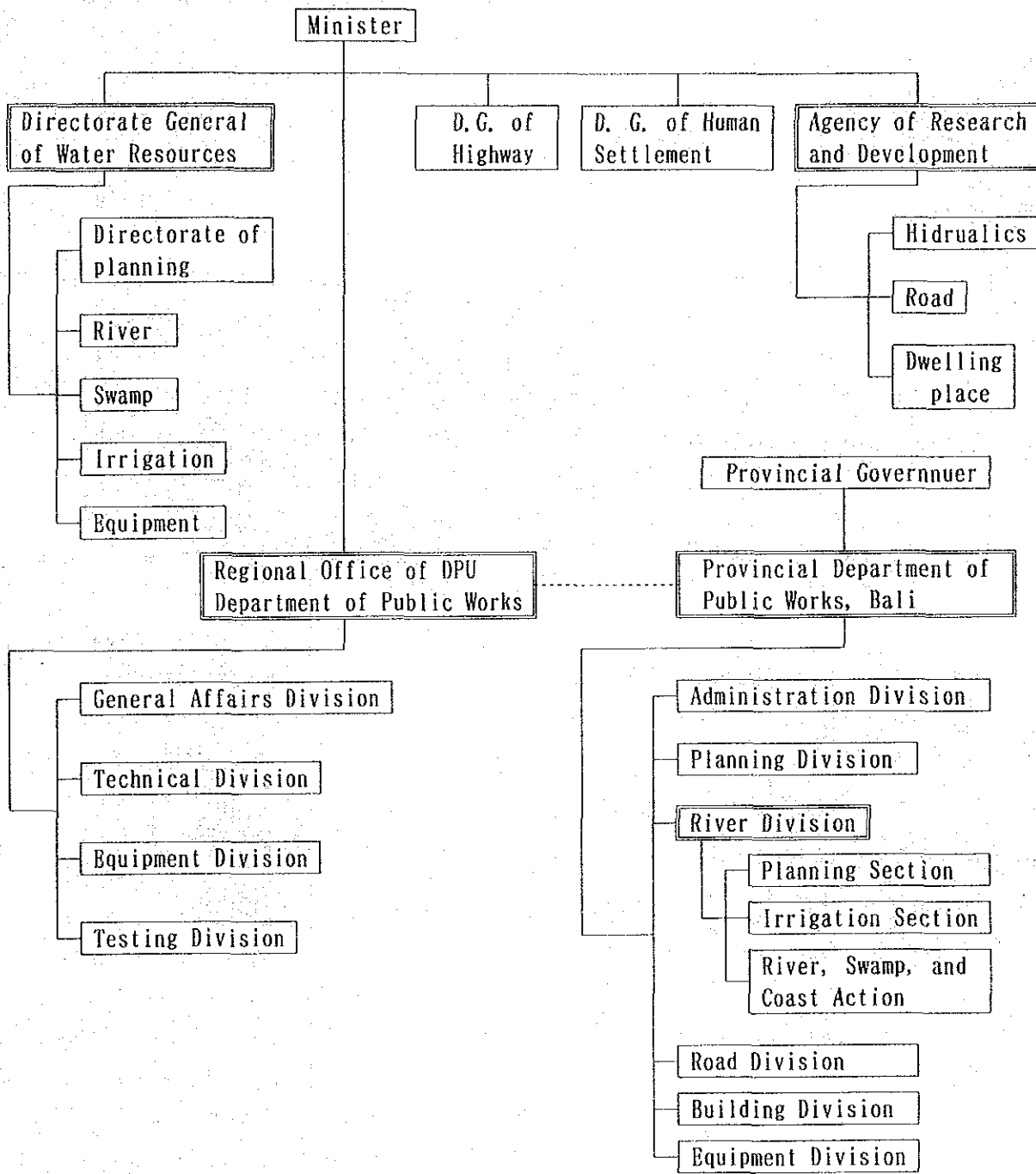


Fig. 9-1-1 Organization of Department of Public Works (Schmatic Figure)

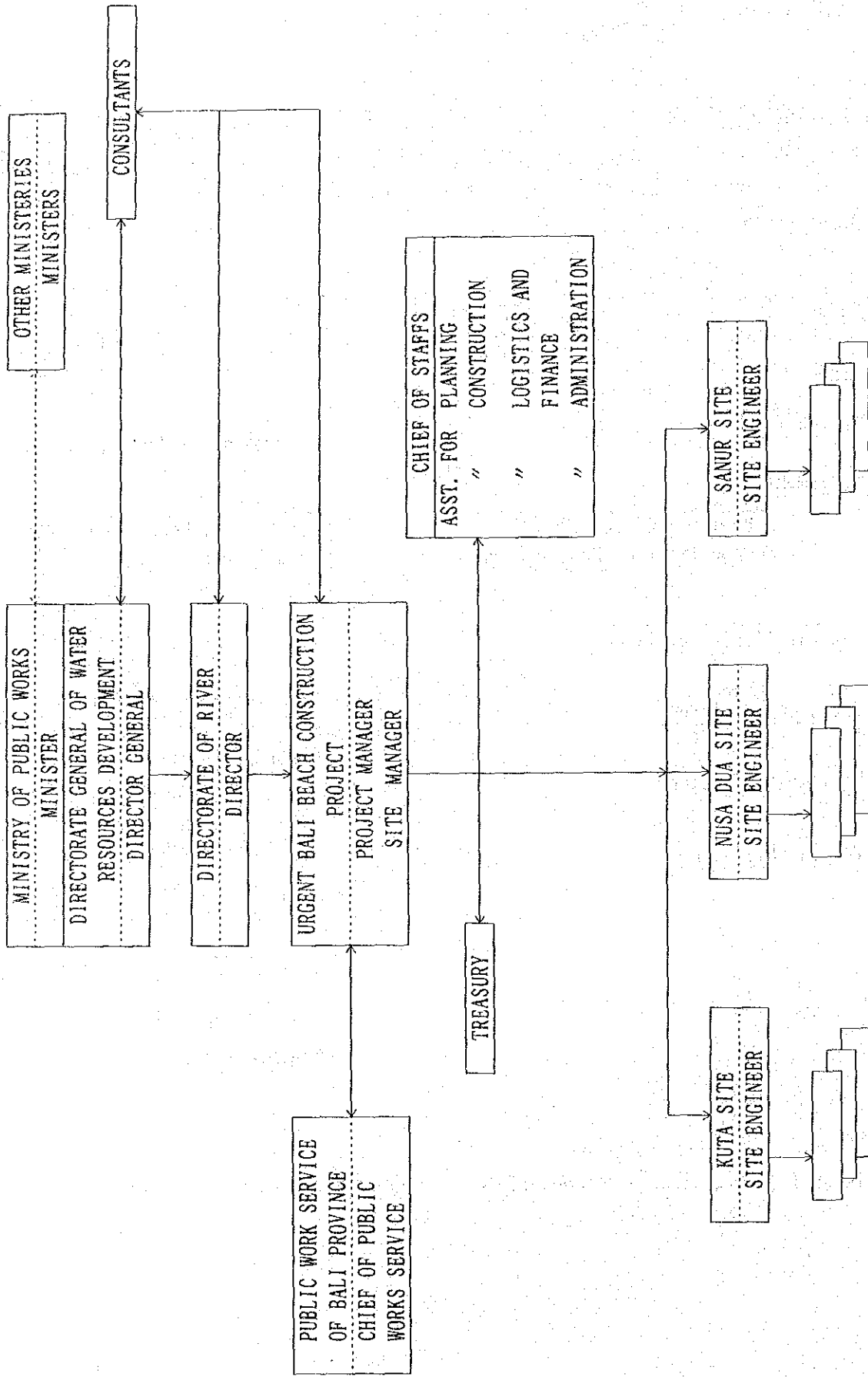


Fig. 9-4-1 Organization Chart for Implementation of the Project

CHAPTER 10 ENVIRONMENTAL IMPACT STUDY

1. Study Results

(1) Marine Ecology

The species of flora and fauna at the four study areas observed by the field reconnaissance are common, and do not include any endangered species.

It is obvious that the plants and the wildlife will be affected by the project. Nevertheless, the concerned areas are quite limited, and the birds and the wild animals can easily move to adjacent area in their habitat without difficulty.

Therefore, it can be concluded that the implementation of the project will not affect the ecology at the site significantly.

(2) Landscape

Landscape change by the implementation of the project can be studied by the photo-montage method, as shown in Fig. 10-1-2-1.

1) Kuta

The landscape at present is composed of sea, trees, artificial facilities such as groins, walls, cottages, etc., which give the impression of artificiality and dirt (Ref. to Photo 10-1, 10-3, at Pertamina Cottages).

Beach with sand nourishment, which will cover the artificial and dirty facilities will give a more natural and beautiful view (Ref. to Photo 10-2, 10-4).

Therefore, it can be concluded that the implementation of the project will improve the environment.

2) Nusa Dua

The landscape at present is composed of sea, sand and erosion protection facilities such as groins, offshore breakwaters, and the U-shaped breakwater, mainly, which gives the visual impression of variety (Ref. to Photo 10-5 at Club Med).

A beach with sand nourishment, which will cover up the sand-bags,

can provide a more natural view, and extension of the U-shaped breakwater will not add significant pressure on the present view (Photo 10-6).

Therefore, it can be concluded that the implementation of the project will provide a better environment.

3) Sanur

The landscape at present is composed of sea, sand and erosion protection facilities, mainly, which give the impression of poverty (Ref. to Photo 10-7 at Werdha Pura).

Sand nourishment and groin extension will create a richer beach (Photo 10-8).

Thus, it can be concluded that the implementation of the project will provide a better environment.

4) Tanah Lot

In line with the planning and design by D.P.U., the placing of concrete blocks and reinforcement of the rock cliff by mortar are now in the final stage.

The landscape after completion of the above project will be better with colour and shape considered carefully.

The above analysis refers to typical sections of the four study areas, but the same conclusions can be drawn for the entire areas of the four beaches.

That is, the environment of the typical beaches of south Bali will be greatly improved by the increase of beach width, the improvement of the present erosion protection facilities and the establishment of new appropriate erosion protection facilities.

It is hoped that many tourists from throughout the world will continue to come to Bali, the most favored place in mysterious Indonesia, and the contribution of tourism to the national economy is greatly appreciated.

(3) Sea Water Quality

The implementation of the project may affect the marine ecology due to the existence of the facilities and the slower sea-water

current. However, the work is in a rather limited area, the term of the work is short, and the open spaces between facilities still seems wide enough to provide sufficient sea-water current.

Therefore, the project may not present only serious problems concerning in sea-water quality.

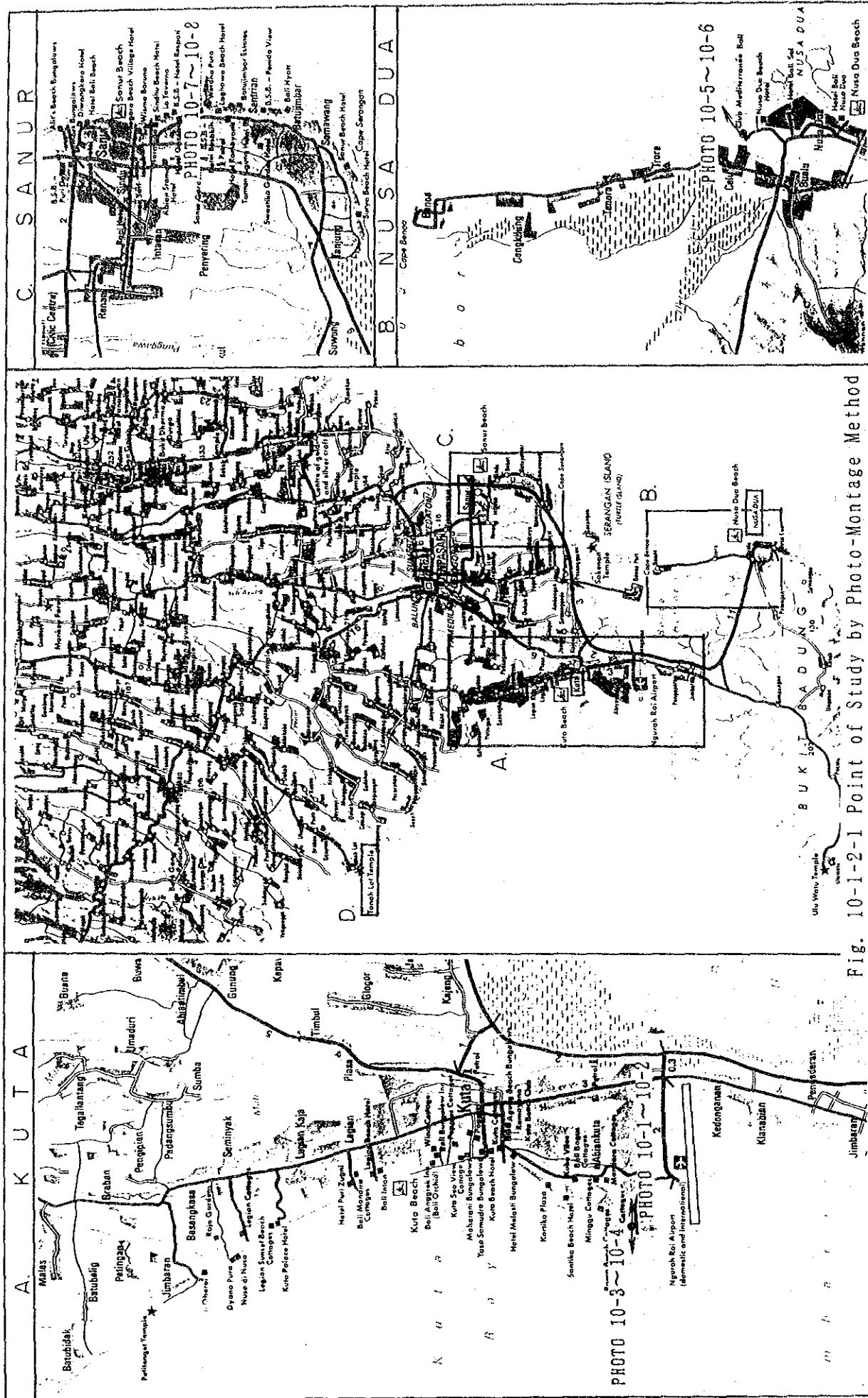


Fig. 10-1-2-1 Point of Study by Photo-Montage Method



Photo. 10-1 Landscape at Present at Pertamina Cottages (1)

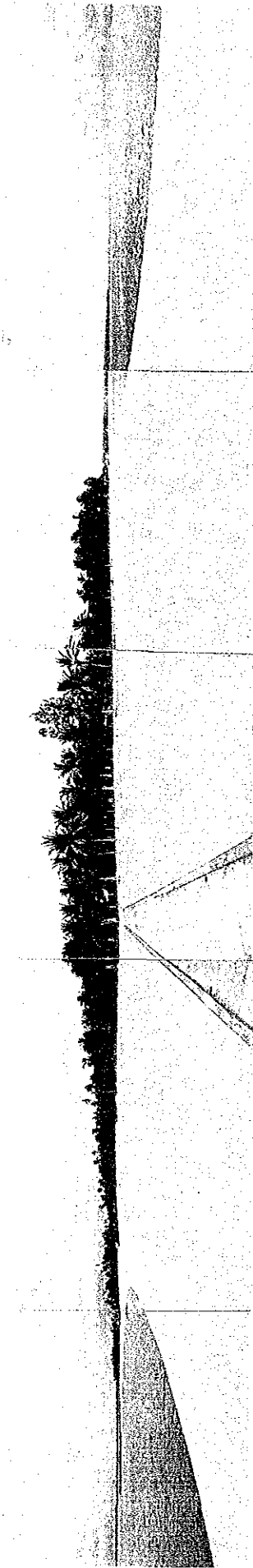


Photo. 10-2 Landscape after Development at Pertamina Cottages (1)



Photo. 10-3 Landscape at Present at Pertamina Cottages (2)

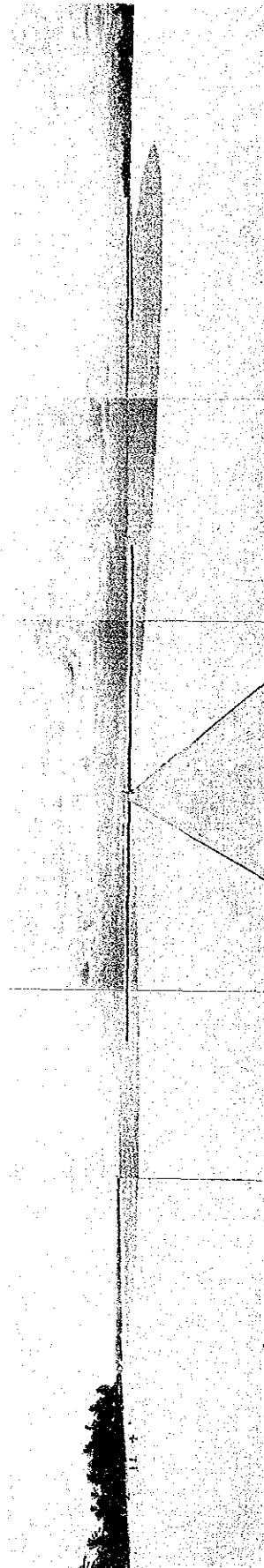


Photo. 10-4 Landscape after Development at Pertamina Cottages (2)

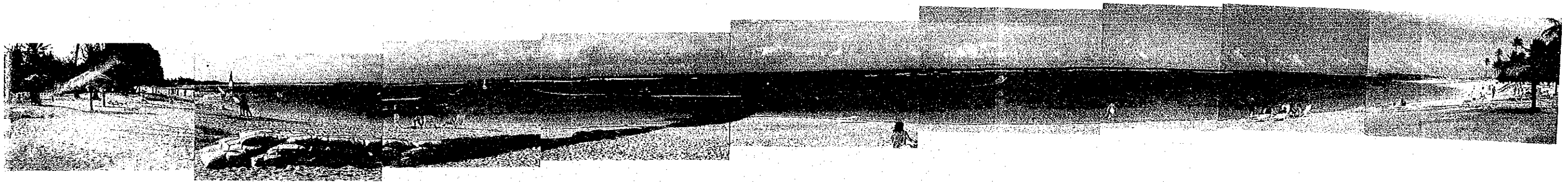


Photo. 10-5 Landscape at Present at Club Med.

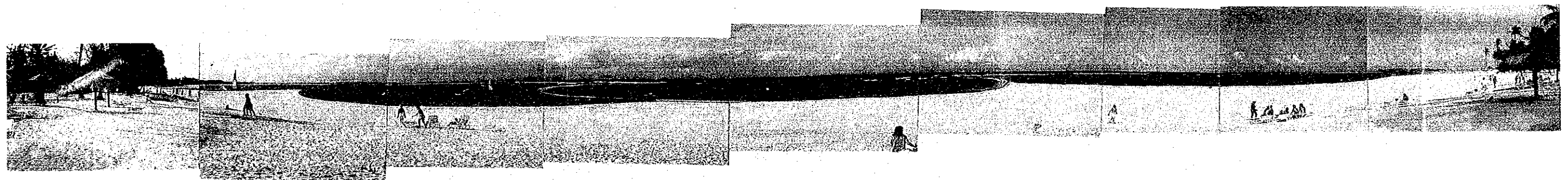


Photo. 10-6 Landscape after Development at Club Med.

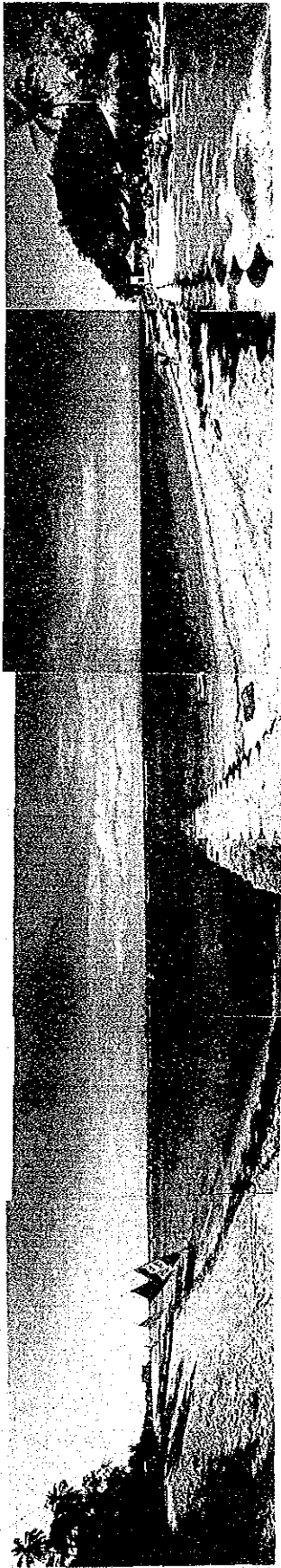


Photo. 10-7 Landscape at Present at Werdha Pura

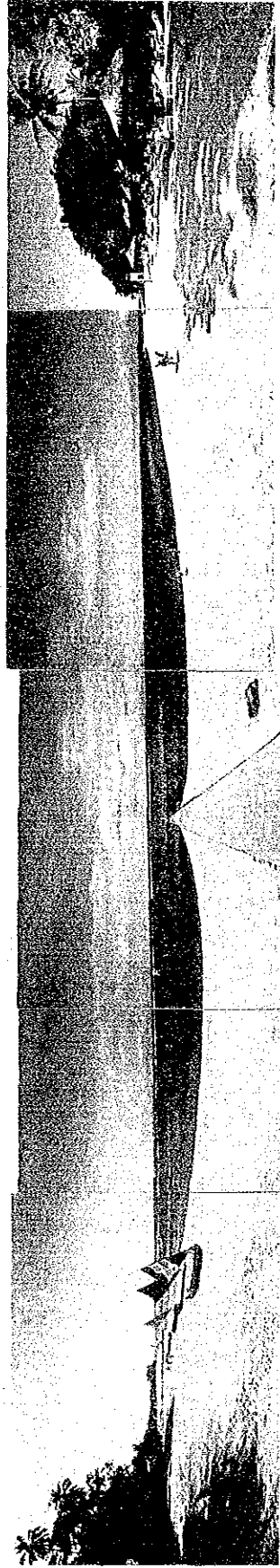


Photo. 10-8 Landscape after Development at Werdha Pura

CHAPTER 11. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

(1) National Policy

1) Coastal erosion has advanced throughout Indonesia recently, and shore protection is now one of the main public policy issues to be successfully addressed.

2) Since the second five-year plan, 'Repelita 2', the government has noted the role of tourism in national and regional economic growth. The government also recognizes the value of tourism as an earner of foreign exchange and a labour intensive service industry. Hence, the government is promoting the development of potential tourist areas by providing basic infrastructures and general services.

(2) Necessity of the Urgent Bali Beach Conservation Project

1) The project shall be implemented from the viewpoints of disaster prevention and economic development in accordance with the national policies. The project contributes to the protection of the assets and the conservation of the safety and security of the residents living there.

2) Bali's beaches are the main attraction for tourists going to Bali Island, and the beaches have been developed as international tourism points.

However, unfortunately, the magnitude of the coastal erosion has increased recently, that is, the shore line has been retreating, and the beach sand has been lost. The resources for tourism have been decreased and the environment is deteriorating.

Therefore, countermeasures to the erosion are needed on an urgent basis.

3) The beaches of Bali have also been used as a charming domestic resort for the Indonesian people traditionally. The demand of domestic tourists seems likely to increase in the future following the gradual increase in personal income.

Efforts shall also be made to cater to 'day-trip' or 'short-stay' domestic tourists by the provision of comfortable beaches.

(3) Goals of the Project

1) The target year

The target year of the project is set as 1995, as early as possible, considering the present condition of the proceeding erosion.

2) Conservation areas

The urgent conservation areas are determined appraising the following items: the magnitude of erosion, beach use, the present hinterland use, land use plans, and the profitability of the project.

(4) Urgent Plan

In this project, the sand nourishment is planned as the minimum required width and length to protect the existing structures along the coastline from collapse and to protect property from scouring due to wave actions. Sand fill will be protected by artificial structures such as groins.

The urgent plan for the three beaches is summarized as follows.

1) Kuta beach

The basic concept of the Kuta beach conservation plan is to recover the lost beach by sand nourishment up to a minimum width of 50 m, and to maintain the beach by a series of headlands.

— Sand nourishment

Location : from Pertamina Cottages to Kuta Sea View Cottages

Scale : beach length, 2.7 km
beach width, average 50 m

Sand volume: 783,000 m³

— Groins

4 sets of headlands using T-shaped groins are planned to stabilize the filled sand and to form pocket beaches between these headlands by reducing the wave impact. 1 small groin is planned to maintain the filled sand at the northern end of the sand nourished area.

2) Nusa Dua beach

In order to reduce the erosion and to maintain this beach in good condition for conservation and touristic use, the sand nourishment and countermeasures are planned as follows.

— Sand nourishment

Location : from Club Med. Hotel to Nusa Besar

Scale : beach length, 2.35 km
beach width, average 50 m

Sand volume: 229,000 m³

— Extension of existing facilities

Extensions of the existing U-shaped offshore breakwater and of the existing groin are planned.

— Modification of existing offshore breakwater

The height of the existing offshore breakwater will be lowered to mean sea water level, the same level as the existing U-shaped breakwater.

3) Sanur beach

The basic concept of the beach conservation plan is to recover and develop the lost beach by nourishment up to 50 m of Beach width and to maintain it by a series of headlands.

— Sand nourishment

Location : (1) ..from Bali Beach Hotel Pier to 700 m North
(2) ..from Sindhu Hotel to Sanur Beach Hotel

Scale : (1) ..beach length, 0.7 km
beach width, average 30 m
(2) ..beach length, 4 km
beach width, average 30 m

Sand volume: (1) .. 96,000 m³
(2) ..352,000 m³

- Groins

(1) ..In the northern area, an L-shaped groin and a straight groin are planned.

(2) ..In the southern area, 3 sets of headlands are planned.

In the middle area, 3 sets of groins are planned to stabilize the filled sand.

- Submerged offshore breakwater

A submerged offshore breakwater is planned at the coral reef gap to reduce the wave impact against the beach and to stabilize the filled sand.

4) Tanah Lot

The existing conservation plan using armor stones and concrete blocks around the island is suitable in order to protect the island from erosion by waves.

(5) Construction

1) Work Schedule

The formalities of this project from the preparation of the general agreement between the Indonesian Government and the donor government through the completion of the urgent construction works are planned as follows.

2) Project Cost

Project cost is estimated at Rp. 71, 445, 456, 000, consisting of Rp. 16, 937, 809, 000 of local currency portion and Yen 4, 431, 516, 000 of foreign currency portion at 1988 prices based on a one-contract method.

(6) Economic Analysis

The economic analysis examines the economic viability of the project based on the economic benefit and the economic cost of the project from the viewpoint of its contribution to the national economy. The analysis identifies the primary benefit of the project as the difference in tourist revenues under the "with the project" and the "without the project" cases.

The viability is checked by the Internal Rate of Return (IRR), the benefit cost ratio (B/C) and the Net Present value (NPV). The IRR of the project is 29.5% under the one-contract method. All the calculated economic indices show unusually high values, proving that the investment is highly efficient, and of great value to the national economy.

Furthermore, the sensitivity analysis proves that the investment is viable, even when the costs increase 20% and the benefits decrease 20% simultaneously.

I T E M	1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.	6th yr.	7th yr.
IP	—						
General Agreement		↓					
Loan Agreement		↓					
Consultant Tender & Evaluation		↓					
Consultant Contract Negotiations		↓					
Award of Consultant Contract		↓					
Detailed Design			—				
P.Q. of Contractor			—				
Tender of Contractor				—			
Tender of Evaluation & Negotiations				—			
Award of Contract					—		
Construction						—	

Fig. 11-1-1 Work Schedule for Project Implementation

2. Recommendations

The following recommendations are proposed concerning various matters which were noticed while conducting the Study.

(1) The beaches of the study areas are seriously eroded and this project should be started as soon as possible.

1) According to the Interview Survey of the tourists at Kuta Beach, 80% of them were unsatisfied or disappointed due to the narrow beach width and beach erosion. Once the worldwide reputation of Bali Beach is lost, it will be difficult to recover.

2) The delay of implementation will cause a further loss of sand and consequently additional cost would be required.

3) The IRR is very high, so this project is very feasible from the economic point of view.

(2) Determination of the urgent conservation project, fund raising plan, detailed design and construction should be carried out based on this study.

(3) At present, there is no one organization which comprehensively administrates and operates the coastal area. So, there are some difficulties with the protection and conservation of the coastal area as a whole.

The coastal area must be well administered in order to protect the area from disasters and to maintain a good environment.

Preparation of law/regulation is urgently necessary. An administrator must be designated by law to administer all aspects of the coastal area.

The main roles of the administrator shall be as follows.

1) To collect the basic data such as oceanography, hydraugraphy and topography.

2) To protect the coastal area from disasters such as coastal

erosion, high tide, tsunami and hurricane.

- 3) To maintain the coastal facilities in good condition.
- 4) To restrict actions which may adversely affect the area.

(4) Since this project is of a very large scale and should be completed within three years, numbers of staff members shall be very large and the organization shall be managed effectively.

The staff members, especially the engineers, must be well trained and experienced because this project is the first large-scale coastal erosion prevention project to be carried out by the Government of Indonesia.

(5) An operation and maintenance office shall be necessary after the completion of the project works.

The role of operation and maintenance office is to maintain the beach, and the main items are as follows.

- 1) To control coral mining and sand removal from the beach.
- 2) To restrict actions which may adversely affect the beach.
- 3) To carry out topographical surveys along the beach and on the reef every year.
- 4) To nourish supplemental sand if necessary.

(6) The reef mining is not desirable, because the wave height on the reef would increase much more than without reef mining.

(7) The execution of the project works should be executed based upon the proposed work schedule in order to complete the construction of the facilities within three years.

(8) The construction works of the project should be executed in such a way that the regular tourist activities are not disturbed.

(9) The construction works of the project should be implemented considering the protection of the excellent natural condition and the conservation of traditional, historical and cultural resources in the project areas.



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