

International Conference on

**ENGINEERING
FOR
OCEAN &
OFFSHORE
STRUCTURES**

AND

**COASTAL
ENGINEERING
DEVELOPMENT**

**18 – 20 December 2001
SINGAPORE**

Official Support Organisations

- PSA Corporation Limited, Singapore
- PACON International, USA
- Technical University of Lisbon, Portugal
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Table of Contents

Author/Paper	Page
Keynote Papers	
Preliminary parametric study of longitudinal motions of moored vessels under seiches at Porto Harbour <i>R C de Barros</i>	1
Energy saved desalination 10,000t/d in vertical shaft in Geo-Dome for Compressed Air Energy Storage (CAES) <i>M Hayashi, Y Jiang, M Sakurada, F Itou and M Sato</i>	12
Uncertainty in predictions of oil spill trajectories <i>C G Soares and P Sebastião</i>	20
Technical Papers	
Critical buckling load for raker pile by physical approximation model approach <i>S Chakraborty</i>	28
Characteristic aspects concerning Black Sea Coast erosion activity <i>A Chirică, C Cornel, D Pacale and G Caraivan</i>	38
Generating breaking waves with Gaussian wave packets <i>T Do, G T Leonart and V Rouillard</i>	46
Substructure on-line dynamic response test on gravity offshore structure based on saturated sand subjected to ice and earthquake loads <i>M Hyodo, N Yoshimoto, Y Yamane, T Fujii, K Kamesaki and Y Yamauchi</i>	54
Historical succession for water environment on the tidal flat located in urban coastal zone <i>Y Ishii, K Murakami, K Taki and H Tatsumoto</i>	62
Mitigation of liquefaction-induced uplift of underground structure by using sheet pile wall <i>S Isoda, N Nakai, R Orense and I Towhata</i>	70
An Evaluation method for stability of coastal structure – Ground system subjected to wave force <i>S Kawamura, S Miura and S Yokohama</i>	78
Port of Koper Infrastructure in the function of logistics processes <i>M Lipičnik and J Požar</i>	86

Author/Paper	Page
Laboratory model testing and calibration of suction pile installation in sand <i>T Preber, S Bang, S Boyle, Y Cho, J Gould and K Park</i>	91
Problem of two exterior Griffith cracks opened by heated wedge in a strip whose edges are normal to crack axis <i>M Saraj</i>	99
Hydrodynamic lift force on oscillating cylinders in a uniform flow <i>M Shafieefar</i>	108
Numerical simulation of nearshore currents and beach changes on the Genaveh Coast <i>M Shafieefar and A R Khoddam</i>	115
A control framework for a remotely operated vehicle <i>J B Sousa, S L Fraga, A Martins and F L Pereira</i>	123
Coastal engineering problems in Indonesia <i>Syamsudin, Yati Muliati and F Riandini</i>	131
First and second order wave forces – a critical study <i>A Umar and T K Datta</i>	138
The use of geocontainers for the Southern Islands reclamation project <i>J Wei, K C Chua, K Q Ho, W H Ho, S K Cheng, M K Seng, T W Yee and R S C Cheah</i>	146
Installation of offshore jack-up rig in stratified soil layers <i>D Y Yu, F M Mustapa and F M Syed</i>	157
Index of Authors	v

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ISBN: 981-04-2515-5

COASTAL ENGINEERING PROBLEMS IN INDONESIA

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Abstract

There are many coastal engineering problems in Indonesia among others are coastal erosion and river mouth closing. Until 2000 Research Institute for Water Researches Development has been investigated about 68 location of coastal erosion problems and 31 location of river mouth closing. Erosion problems have been classified into five classifications and river mouth closing into two classifications. Coastal protection structure to countermeasure of the problems consists of seawalls, groins, jetties, revetments, and sea dikes. This paper will explain the number and percentage of every classification of erosion and river mouth problems based on the dominant causing factor and the most of the coastal protection structure have been used.

Keywords : erosion, river mouth closing, coastal protection structure

1. Introduction

Indonesia is an archipelagic country with their sea and ocean about two third of total area; consist of about 13,000 islands and 81,000 km of coastline. There are many costal engineering problem in Indonesia among others are coastal erosion and river mouth closing. From the research carried out by Research Institute for Water Researches Development (RIWRD) until 2000, have been investigated about 68 location of coastal erosion problem and 31 location of river mouth closing.

With limited budget, countermeasures of the problems particularly by Ministry of Public Works were carried out at important location appropriate with priority. In this paper will be presented classification of erosion and river mouth problems based on the dominant causing factor and the most of the coastal protection structure have been used.

2. Classification of Problems and Countermeasures

Report of Beach and River Mouth Problem by RIWRD (1992) explained about coastal erosion process, coastal abrasion, closing and shoaling of river mouth. Classifications of erosion problems based on causing factors are :

- Classification 1 : Effect of perpendicular structure
- Classification 2 : Mining of beach and river material
- Classification 3 : Short cutting of river mouth
- Classification 4 : Effect of the weather
- Classification 5 : Effect of destroyed mangrove forest
- Classification 6 : Effect of dam construction at river upstream

Classification 1 : Effect of perpendicular structure

As a consequence of wave action, there is known a phenomena of longshore sediment transport at beach. If perpendicular structure such as jetty, groin or breakwater available at the beach, it will disturb sediment transport process and cause sedimentation at updrift of structure, while erosion at downdrift. Besides that perpendicular structure will change current and wave patterns around the structure. Sand bypassing is the best way to encounter the problem, but in Indonesia, sand bypassing is not so often used.

Classification 2 : Mining beach and river material

Beach materials consist of sand and clay. Beach sand consists of sand from river and sand from breaking coral. River and coral sand are being used for construction of the structure. As Indonesia since 1970 the development is rapidly increased, the need of sand material also increased. Sand mining, both from river or beach will affect stability of the beach. For coral beach, coral mining will decrease sediment supply to the beach and then cause equilibrium change.

Classification 3 : Short cutting of river mouth

Short cutting of river mouth usually is carried out to countermeasures flood problem at downstream area of the hinter land. The processes caused instability of beach and around old river mouth because of decreasing sediment supply to river mouth. Countermeasures should be carry out at the beach near the former river mouth.

Classification 4 : Effect of the weather

Weather effect include of rainy and dry climate, seasonal wind and wave. That effect will change formation of rock and stone; that is weathering processes. Because of the weathering processes strength of rock or stone will decrease, and not strong enough against wave attack, then occurred abrasion processes. Two of beach location namely Tanah Lot and Uluwatu at Bali Island have been eroded due to the weather and wave attack.

Classification 5 : Effect of destroyed mangrove forest

Mangrove forests usually grow up at clay or silt coast and consider as the natural coastal protection. Those forest will dissipated wave energy, so suspended sediment may be deposited at beach land. Besides that, mangrove forest will increase stabilization of beach by activities of microbiology. In order to increase fishpond production, all of mangrove trees area was cut. As consequences dissipated wave energy will be decreased; the bottom material will be stir up by wave action caused erosion at the coast. Some of the locations eroded in this classification are Labuhan Maringgai - Lampung, Karawang beach - West Java, Indramayu beach - West Java and West Kalimantan beach.

Classification 6 : Effect of dam constructed at river upstream

Construction of dam at river upstream will be decreased sediment supply to river downstream. As a consequence, stability change occurred around the river mouth. Erosion processes as an effect of construction of dam have not investigated yet, because of far location of dam and need much time to make an identification of this process.

Meanwhile, river mouth closing is caused by disable of river discharge to flush sediment at river mouth, especially in dry season. At present, due to increasing of water demand for irrigation, industries and drinking water, river discharge in dry season is decrease. Very often there is no river discharge flowing into river mouth. Besides river mouth closing, this condition also caused in salinity intrusion into the river. River mouth closing classified into :

- 1). First classification is river mouth closing that causing inundation of the lower land.
In this classification, river mouth closing at dry season formed the sand bar. At rainy season, this sand bar block river flow toward sea, caused rising water level. If this rising of water level higher than top elevation of riverbank, water will overtopped riverbank and caused in inundation of the lower area.
- 2). Second classification is river mouth closing that caused difficulties for fishermen boat enter and out of the river. Similar with first classification, in this classification sandbar formation caused difficulties for fishermen boat.

3. Number of Coastal Engineering Problems and Countermeasures

Figure 1 shows the locations of coastal engineering problem in Indonesian and their classifications. From the data, the numbers of the erosion problem are 68 locations; have been classified as follows :

- Classification 1 : 8 locations = 12 %
- Classification 2 : 47 locations = 69 %
- Classification 3 : 5 locations = 7 %
- Classification 4 : 3 locations = 5 %
- Classification 5 : 5 locations = 7 %
- Classification 6 : 0 locations = 0 %

From the data concluded that the classification 2 is the most erosion problem in Indonesia. This problem is due to the development in Indonesia, in which have been increased since 1970. As for the development, they need material; one of sources is from the beach and the river

The number of river mouth problem which have been identified are 31 locations, classified into :

- Classification 1 : 12 locations = 46 %
- Classification 2 : 19 locations = 54 %

Countermeasures to prevent beach erosion and river mouth closing were carried out by made sea wall, groin, jetty, sea dike and revetment with the total length about 69,244 m, consists of :

- Sea wall : 47,516 m = 69 %
- Jetty and groin : 13,124 m = 18 %
- Sea dike : 5,824 m = 9 %
- Revetment : 2,780 m = 4 %

The data shows that sea wall is the most of structure have been used, as sea wall is a structure give the direct function to protect the beach and relatively easy to make.

4. Case Study

Following will be explained the example case of coastal engineering problem and it's countermeasures.

4.1 Sanur Beach

Sanur beach along \pm 4 km, is beautiful tourism beach with coral flat at nearshore and white sand at beach face located southwest ward of Bali Island. Coral flat is a resource of white coral sand. Hotel, cottage, and other facilities were built near the coast line. Tsuchiya (1975) explained that coral mining activity from 1965 to 1970 is the main causes of beach erosion at Sanur Beach; caused damage to the structures and buildings that located near the shore. Countermeasure of beach erosion was carried out by stopping coral mining and constructing coastal protection structure to protect beach. Most of the structure was built by hotel's owner. Although those structure disturbed the view of beach but it succeed to protect beach by prevent erosion. At present, modification of coastal protection structure is being done. Artificial nourishment has been introduced to make the beach wider. Figure 2 shown situation of Sanur beach. In the figure shows the location of coral mining and the part of the beach were eroded.

4.2 Kuta Beach

Kuta beach is another beach located at Bali Island too. Like Sanur beach, Kuta beach is tourism beach with beautiful view; located at the west ward of Bali Island. Erosion at Kuta beach mainly caused by construction of airport runway along 800 m in 1968 and consider as the first classification of coastal erosion. From the data, the beach has been retreated about 130 m from the former coastline at the location of about 1200 m from the runway. Similar to Sanur Beach, at present modification of coastal protection is being constructed. Figure 3 shown beach situation of Kuta and the run way.

4.3 Karawang Beach

Karawang beach located at northward of West Java, is one of muddy beach completed with mangrove forest. Mangrove forest functioned as a natural coastal protection as they dissipate the

wave energy. Usually the wave in the mangrove forest is lower. Due to fish pond production, those mangrove trees are cut down. Cutting of trees will increase wave energy to the beach. That's the reason why erosion process occurred at this beach. Mud sediment stirred up by wave action and current brought it in the form of suspended sediment. Measurement result shows that erosion reaches to 500 m. Coastal protection has been constructed by the public, most of them are fishermen with the so-called **village** technology, using local material such as bamboo and plastic bag. Maintenance should be carried out periodically as the material is not strong enough against the weather. For example, the bamboo will break within one to one and a half years. Figure 4 shows the situation of Karawang beach.

4.4 Dadap River Mouth

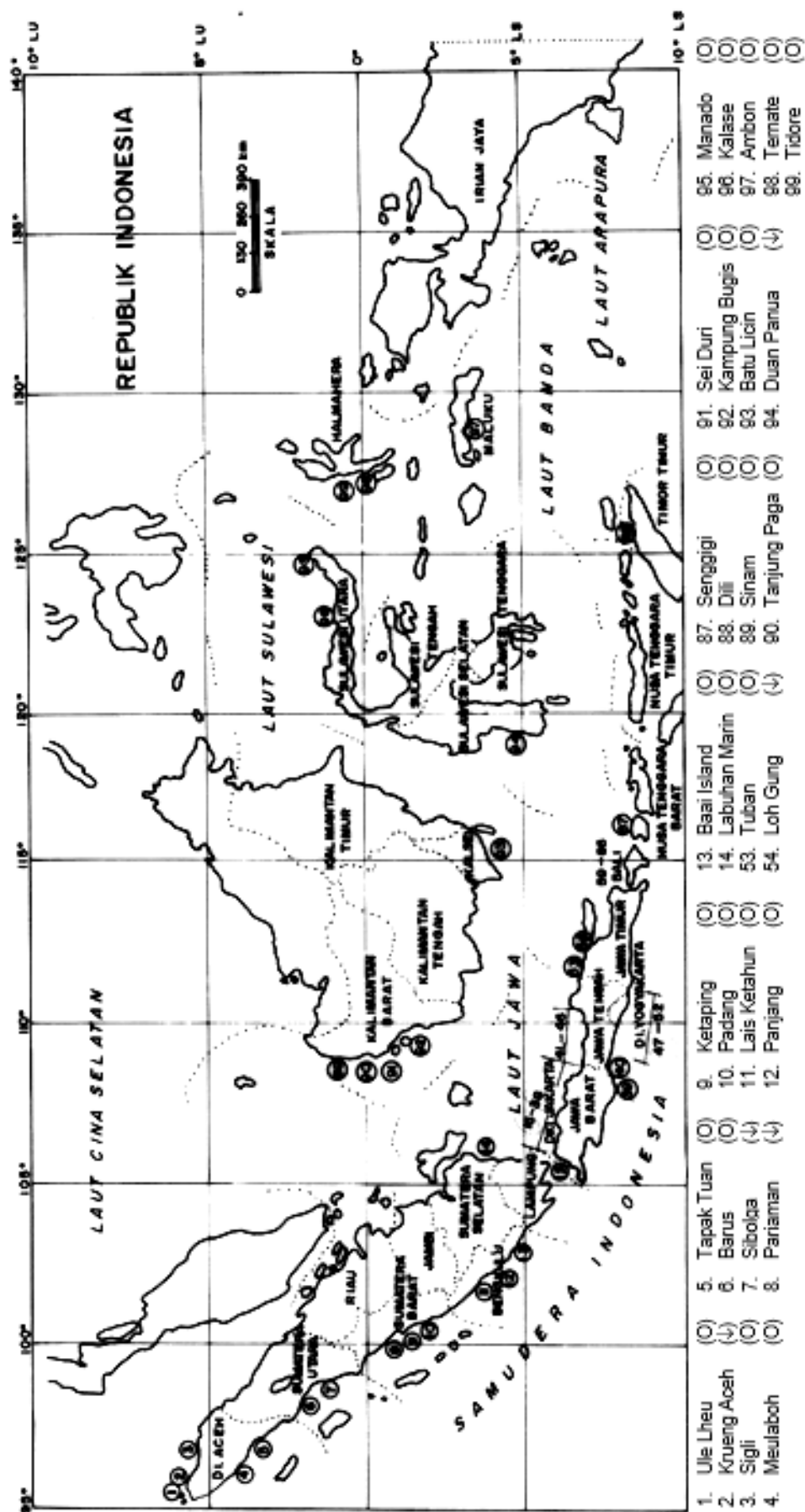
Dadap river mouth located at north beach of West Java is one of river mouths used for fish harbor. At dry season (between May to August), Dadap river mouth is closed by sand deposit because lower river discharge could not flush the sediment. Closing of river mouth made difficulties for fishermen to enter and exit the river. An effort to countermeasure was carried out by constructing a pair of jetties at right and left hand of river mouth in 1985. But those jetties only functioned about 3 years. In 1989, longshore sediment transport from eastward with the amount 7000 m³/year closed the river mouth. Figure 5 shows the situation of Dadap river mouth. That figure shows that after construction of jetties, sedimentation has occurred at updrift and erosion at downdrift of the jetties. Sand bypassing should be carried out periodically with the amount of 7000 m³/year to keep the jetties in function and to avoid coastal erosion at downdrift. Kardana et al (1998) have introduced the integrated countermeasure at Indramayu beach including Dadap river mouth.

5. Conclusion

From above explanation concluded that the most of coastal engineering problem in Indonesia is mining of beach and river material; involve 69 % of all problems, due to increasing of the development since 1970 which need material for construction. The countermeasures to prevent that problem are to stop mining activity at coastal area and constructing coastal protection structure. The most of structures have been constructed to protect beach is sea wall because that structure gives direct function and is relatively easy to make.

6. Reference

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3. Research Institute for Water Resources Development, *Erosion Problem at Karawang Beach, West Java*, Annual Research Report, 2000
4. Syamsudin, Kardana, and Y. Tsuchiya, *Beach Erosion at Kuta Beach, Bali, and its Control*, Proceeding 6th Cong. APD IAHR, 1988
5. Tsuchiya, Y., *On the Long-term Beach Change along the Bali Strait*, UNDP, OTC/SF Project, INS-70/527, 1975.



Legend : (o) River Mouth
(∨) Coastal

no. 15 - 40 on West Java Map
no. 55 - 88 on Bali Map

no. 41 - 52 on Central Java Map

Fig. 1. LOCATION OF RIVER MOUTH AND COASTAL PROBLEMS IN INDONESIA

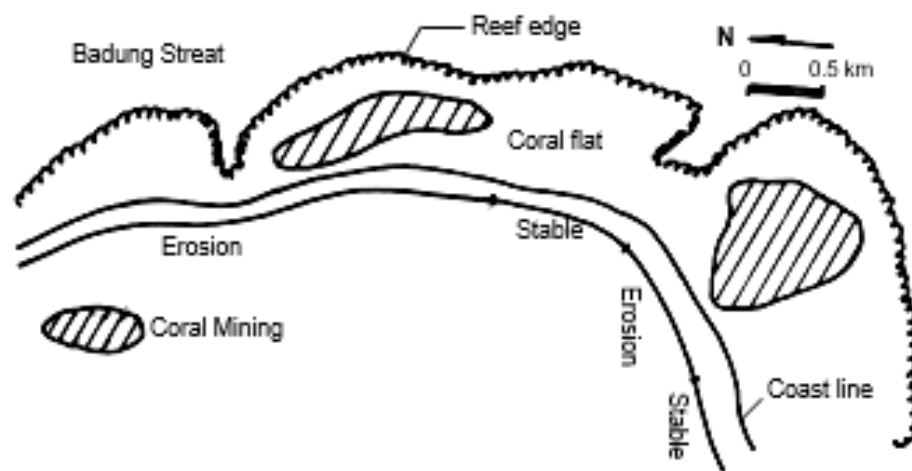


Fig. 2. Situation of Sanur Beach – Bali

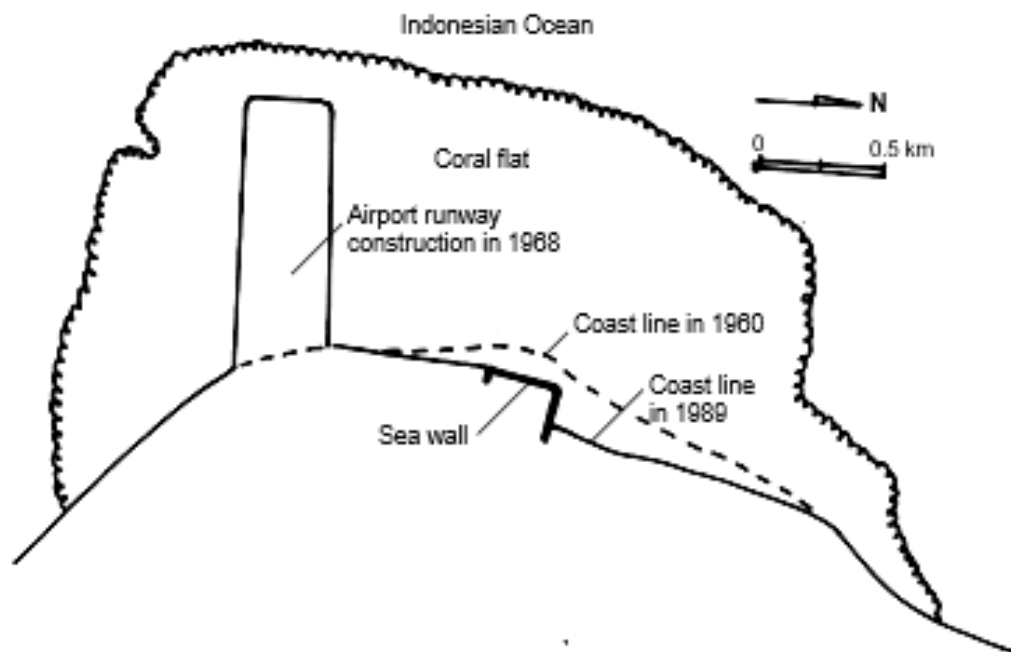


Fig. 3. Situation of Kuta – Bali

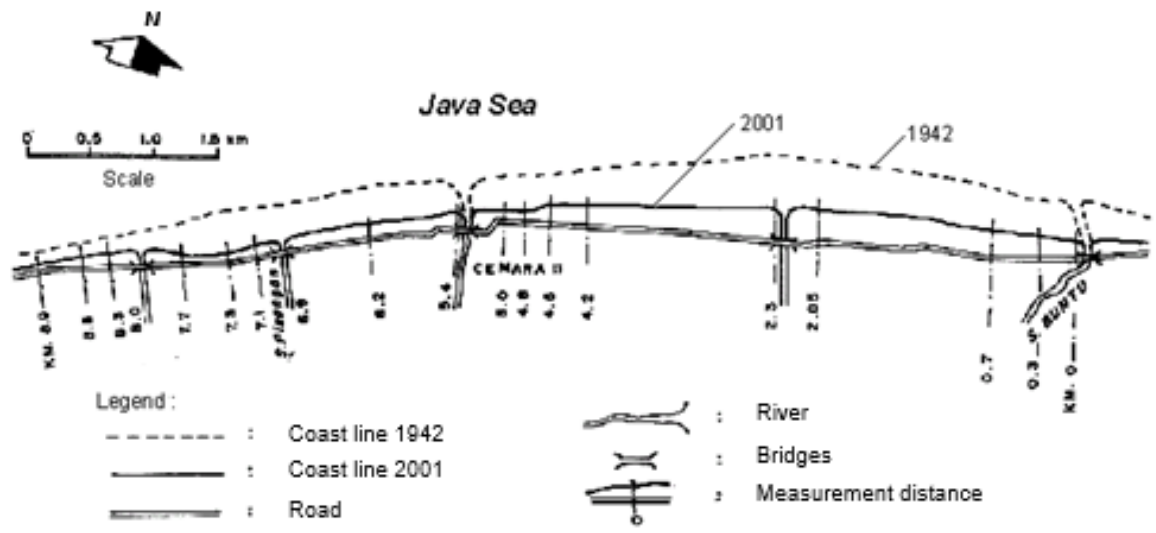


Fig. 4. Situation at Karawang Beach – West Java

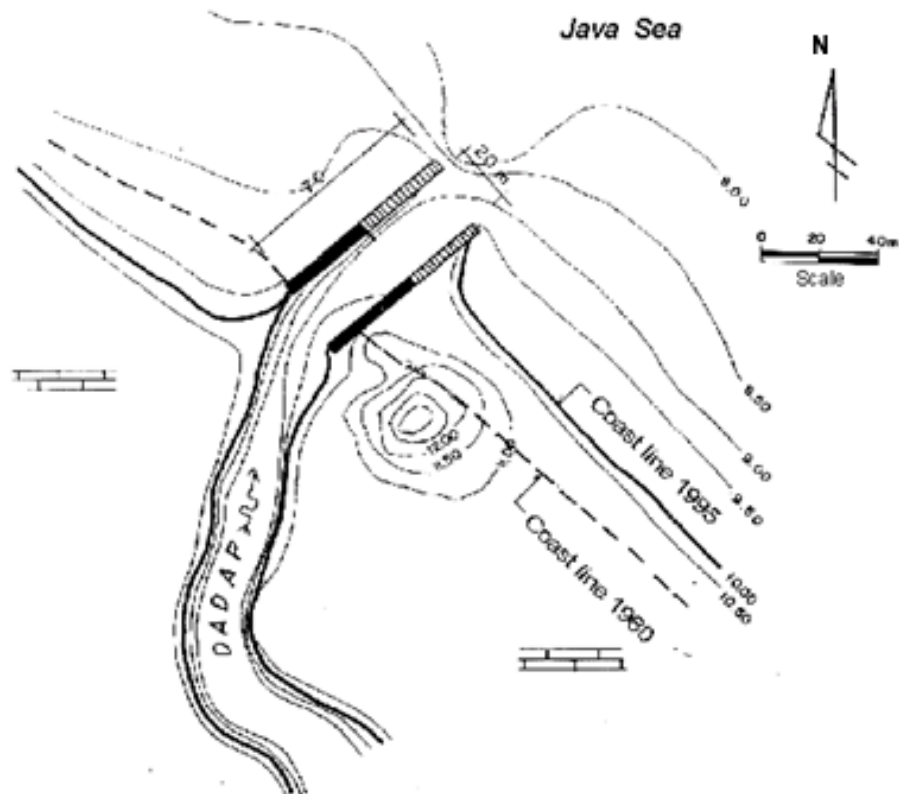


Fig. 5. Situation at Dadap River Mouth – West Java