Development of Coastal Protection Scheme Database for Peninsular Malaysia

by

Muhammad Aminuddin Zulkefli

Dissertation submitted in partial fulfillment of
the requirement for the
Bachelor of Engineering (Hons)
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Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Civil Engineering Programme
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Approved:

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AP. Ahmad Mustafa Hashim
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

June 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Muhammad Aminuddin Zulkefli

ABSTRACT

Nowadays, coastal erosion along the Malaysia shorelines had become a major issue. Global warming problem had increase the sea level due to the rapid melting of glaciers also become one of the leading factor to the erosion problem along the coastline. Instead, there are others reason such as natural weathering, reduced sediment discharge from rivers into coastal areas and human impacts. In order to solve this problem, the Government had set up the Coastal Engineering Centre in the Department of Irrigation and Drainage (DID) in 1987 to implement coastal erosion control program throughout the country. Although the action was taken, there were some deficiencies on it which is the data gathering of the coastal protection structures which had been implemented were not provided properly. To improve the systems, the author is taking initiative to create a database scheme of coastal protection along the Peninsular Malaysia coastline. The gathering of this database is hoped to develop better understanding on design criteria about coastal protection scheme along Peninsular Malaysia coastlines performances and failure mode of structure. In presenting the database of coastal protection scheme along Peninsular Malaysia's shoreline, software called GIS (MapInfo Professional 7.0®) is used. Easy access to acquiring information from this database would produce a general framework in helping designing the coastal protection structures and gives benefit to contractors owners and developers in Malaysia for future development

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LIST OF ABBREVIATIONS

km	=	kilometre
km^2	=	kilometre square
mm	=	millimetre
cm	=	centimetre
m	=	meter
m^2	=	metre square
D_{85}	=	Nominal rock diameter equivalent to that of a cube (m)
D_{15}	=	Nominal rock diameter equivalent to that of a cube (m)
n_v	=	volumetric permeability
kN/m	=	kilo Newton per metre
kN	=	kilo Newton
g/m^2	=	gram per metre square
W	=	Weight of an armour unit (N)
H	=	Design wave height at the structure (m)
K_D	=	Dimensionless stability coefficient
α	=	Slope angle of structure
ρ_r	=	Mass density of armour (kg/m^3)
g	=	Acceleration due to gravity (m/s^2)
Δ	=	Relative mass density of armour = $(\rho_r / \rho_w) - 1$
ρ_w	=	Mass density of sea water (kg/m^3)
H	=	Design wave height, taken as the significant wave height (m)
H_s	=	Design wave height in meters
D_{50}	=	Nominal rock diameter equivalent to that of a cube (m)
Δ	=	Relative mass density of armour = $(\rho_r / \rho_w) - 1$
P	=	Notional permeability factor
N	=	Number of waves
S	=	Damaged level = A / D_{n50}^2
A	=	Erosion area in cross-section (m^2)

ξ_m	=	Surf similarity parameter for mean wave period = $(\tan\alpha)/\sqrt{s_m}$
s_m	=	Offshore wave steepness based on period = $2\pi H / gT_m^2$
T_m	=	Mean wave period (s)
g	=	Acceleration due to gravity (m/s^2)
W_r	=	Unit weight of seawater

CHAPTER 1
INTRODUCTION

1.0 INTRODUCTION

1.1 Background of Study

Malaysia covers a land of area of 332 556 km^2 comprising two regions; Peninsular and Sabah and Sarawak. It has 4800 km of coastlines encircle two distinctly different formations, namely the mangrove fringed mud flats and sandy beaches. The east coast of Peninsular Malaysia consists of straight sandy formation in the north and a series of hook – or – spiral – shaped bays to the south. The west coast of Peninsular Malaysia, however, comprises mainly muddy formations with limited areas of pocket sandy beaches. In Sabah and Sarawak, the coastlines are about equal divided between sandy beaches and mud coast.

The coastal zone is broadly defined as the areas where terrestrial and marine processes interact. These include the coastal plains, deltaic areas, coastal wetlands, estuaries and lagoons. It is difficult to demarcate a fixed-geographical limit on coastal zone due to the complex interaction and inter-dependence of fluvial and coastal processes (Abdullah, 1993).

1.2 Problem Statement

Continuous energy dissipation takes place where the land meets the sea. As a consequence, coasts are subject to deformation, of which coastal erosion poses greater problems. This must combated to prevent loss of high valuable land and properties, structures and recreational areas.

It has been well interpreted that possible cause of erosion include sea level rise and coastal subsidence, natural weathering, reduced sediment discharge from rivers into coastal areas and human impacts such as caused by structures.

Erosion takes place in monsoon when and the level of water rise, resulting waves to break directly against the scarp, causing material losses. Some of them might come to the shore by swells after the monsoon but the quantities are less; hence the nett result is erosion. The need of coastal protection has become a major criterion in protecting shorelines. Table 1.0 shows the status of coastal erosion in Malaysia.

State	Length of coastline (km)	Length of coastline having erosion			Total Length of coastline having erosion	
		Category 1	Category 2	Category 3		
		CRITICAL EROSION (km)	SIGNIFICANT EROSION (km)	ACCEPTABLE EROSION (km)	(km)	(%)
		Length Critically Eroded				
Perlis	20	4.4	3.7	6.4	14.5	72.5
Kedah	148	31.4	2.2	6.9	43.5	29.4
P.Pinang	152	42.4	19.7	1.1	53.2	41.6
Perak	230	28.3	18.8	93.1	140.2	61
Selangor	213	63.5	22.3	66.1	151.9	71.3
N.Sembilan	58	3.9	7.7	12.9	24.5	42.2
Melaka	73	15.6	15.1	6	36.7	50.3
Johor	492	28.9	50.3	155.6	234.8	47.7
Pahang	271	12.4	5.2	37.6	52.1	73.4
Terengganu	244	20	10	122.4	152.4	62.5
Kelantan	71	5	9.5	37.6	52.1	73.4
W.P.Labuan	59	2.5	3	25.1	30.6	51.9
Sarawak	1035	17.3	22.3	9.6	49.2	4.8
Sabah	1743	12.8	3.5	279.2	295.5	17
Total	**4809**	**288.4**	**193.3**	**932.8**	**1,415**	**29.41%**
		6.00%	**4.00%**	**19.40%**		

Table 1.0: List of Coastal Erosion Areas in Malaysia (Annual Report DID, 2007)

1.2.1 Problem Identification

The problem of coastal erosion attracted serious attention to Government in the early 1980s largely as a result of public complaints and pressures. Realizing it, they had carried out the National Coastal Erosion Study from 1984 to January 1986, and the study results indicates that out the country's coastline of 4809 km about 29% or 1380 km was facing erosion (Annual Report DID, 2004).

In order to solve this problem, the Government set up the Coastal Engineering Centre in the Department of Irrigation and Drainage (DID) in 1987 to implement coastal erosion control program throughout the country.

According to the research done by National Coastal Erosion Studies 1986 (NCES), Malaysia's shorelines can be classify into three categories of erosion and the threat to existing shore-based facilities of substantial economic value and defined as follows (*www.water.gov.my*):

- Category 1: Shorelines currently in a state of erosion and where shore-based facilities or infrastructure are in immediate danger collapse or damage
- Category 2: Shoreline eroding at a rate whereby public property and agriculture land of value will become threatened within 5 to 10 years unless remedial action is taken;
- Category 3: Undeveloped shoreline experiencing erosion but with no or minor consequent economic loss if left unchecked

In the past, protection works were focussed only on solving the local problem. For example, the selection of certain protection methods involving shore normal structures such groynes interrupt the natural littoral drifting depleting sediment supply to downdrift beach. Similar problems arise due to construction of rivermouth breakwaters which are improving navigation.

When considering coastal restoration, it is useful to differentiate between protecting shoreline and the coastline. Shoreline protection slowly stops the retreat of the shoreline while safeguarding, persevering or restoring the shore and the dynamic coastal landscape. Nowadays, coastal protection strategies can be better planned under a shoreline management plan which takes into account the response of the neighbouring shoreline and its potential affect on economic activities, habitats and ecosystems. More importantly, shoreline management plan studies have been instrumental in bringing engineers and scientist together to solve coastal protection, resource management and develop strategies.

1.2.2 Significance of Project

The significance of this project is that in the future, when the database of every coastal defence structure is tabulated, it will be able to be referred by the companies or even the Government to make their work easier in designing the structures. Companies as well as universities would be able to use this research to update the uncertainties and more understanding when dealing with coastal defence structure and sea conditions.

1.3 Objectives and Scope of Study

Since there is no database regarding coastal protection structures in Malaysia, the objectives of this work are to compare various methods of coastal protection structures and gather the database.

Instead, the creation of this database would develop better understanding of design approach about coastal protection scheme along Peninsular Malaysia coastlines performance and failure mode of structure.

It also could produce general framework in helping designing the coastal protection structures and gives benefit to contractors owners and developers in Malaysia for future development.

CHAPTER 2
LITERATURE REVIEW/THEORY

2.0 LITERATURE REVIEW/ THEORY

2.1 Literature Review

2.11 Brief Statement Regarding Coastal Protection Measures

As definition by Coastal Engineering Manual (CEM), coastal is referring to the zone where the land meet the sea to the first major change in topography where else influenced by wave processes (oscillatory flow dynamics). Bays, lakes and estuaries are included, but river, primarily influenced by generally unidirectional currents.

Ghazali (2005) has classify coastal protective technical measures into two component; "hard" and "soft" version. "Hard" means anything built of materials which shall stay permanently in a structure does not move, although it may be damaged and has to be maintained. Floating measures, like pontoons are also considered "hard", because they stay in one location. Hard protections do not generate new materials. They only distribute existing materials in a sometimes less democratic way often or usually causing more erosion than accretion.

"Soft" means that no fixed structure or structural element is included in the protection which consists of granular materials, sand or gravel. This material is moved by waves, winds and currents in all direction. Some of it moves perpendicular to shore, other along the shore as "littoral drift" away from the sea. A soft protection has to be maintained by replacement of material lost in the process for the shore in question, but it may be transported to other shores and serve a protective mission there. Soft measures have only beneficial effects, because they generate new materials for the stabilization of a shore and its neighbouring shores.

The development towards soft measures has been supported by regulatory agencies which realized the problem, often associated with hard structures of adverse effects on neighbouring properties (Brunn, 1995).

The interruption of the natural long shore drift by structures like jetties, breakwaters and navigation channels has been realized and is responsible for the development of "bypassing techniques" (Brunn 1990, 1996 and Visser & Brunn 1997). This field still not satisfactorily developed and better and more efficient equipment and procedures are highly desirable.

2.12 Initial Considerations (CIRIA, 1996)

The coastal processes which give rise to the need for beach management scheme will continue after such schemes have been implemented. If a scheme is implemented with no control structures installed to modify processes, then any beach loss is likely to continue, and may even accelerate if the volume of mobile sediment has been increased by recharge. Depending on the shoreline situation, erosion can be seen in two ways: the first is to undertake maintenance recharges at regular interval, while the second is to integrate beach management with construction of beach control structures, which will modify the erosion processes, resulting in a more modest beach recharge programme.

Control protection structures include groynes, breakwaters, revetment, concrete blocks and training walls. The advantages are to improving navigation channels, providing safe mooring sites or for creating amenity facilities. Usually the heavy hydraulic loading associated with the marine environment distinguishes these structures from conventional land and inland applications.

Design of control structures should be integrated with beach design and management to maximize the advantages that they can offer and reduce harmful impacts. Reduction of long shore transport along length of the shoreline must cause a reduction of input to the sediment budget of adjacent lengths with consequent erosion. Therefore it is fundamental that the acceptable level of impact on adjacent shorelines is determined. Designs of structures within the context of an overall shoreline management strategy are normally appropriate but were difficult to achieve. It is only appropriate to disregard other parts of the shoreline in situations where the shoreline to be protected forms an independent littoral process unit, or where a considered decision has been made to allow retreat in area of low value.

When discussing the subject of coastal structures, it is useful to indicate briefly the type of structures and their terminology, and where coastal structures play a role in the marine technology. (See Figure 1.0)

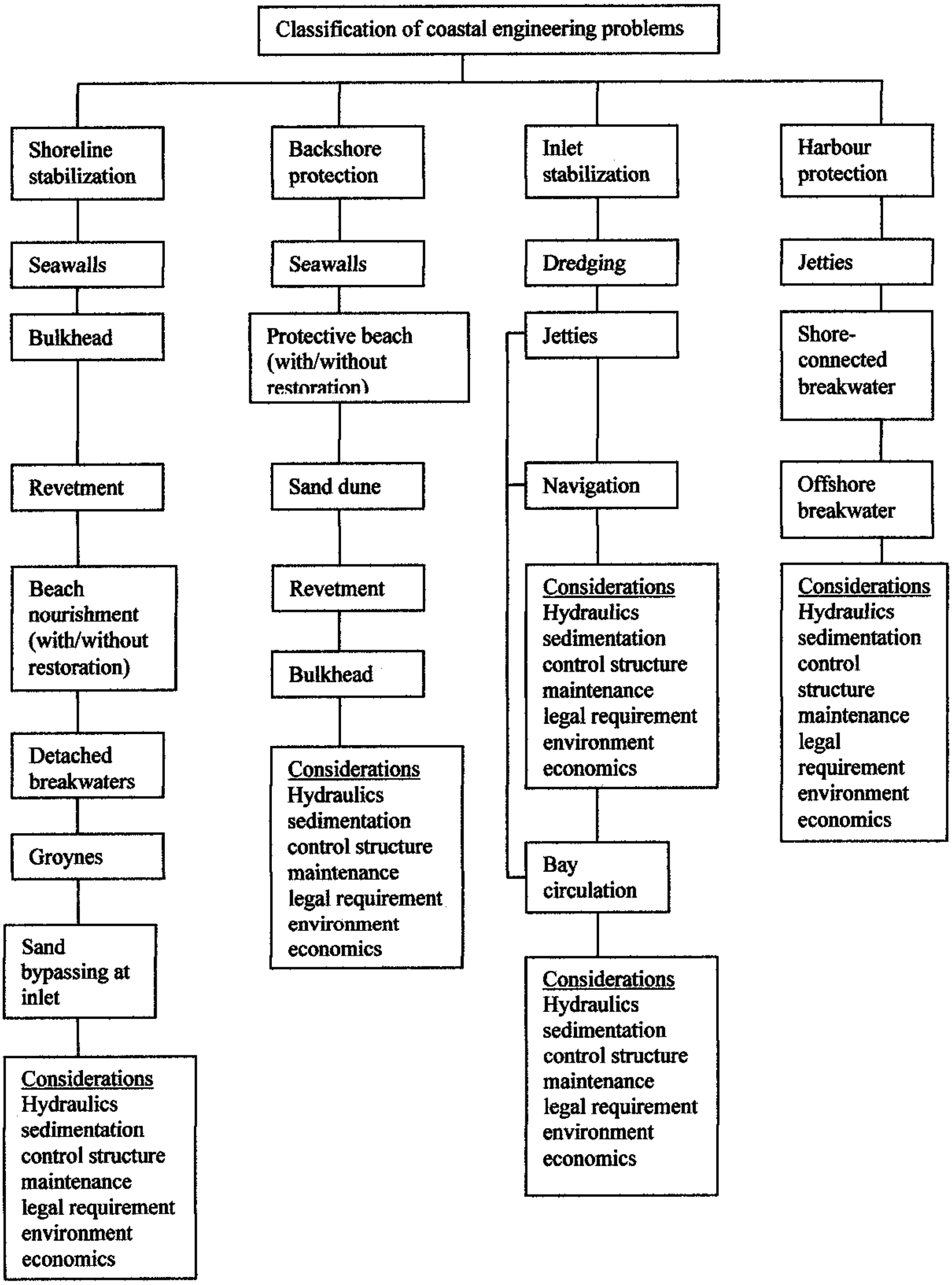


Figure 1.0: Classification of coastal structures (SPM, 1984)

Other harmful impacts should also be considered. Many forms of structures are visually intrusive. Structures can affect the shoreline ecology by changing localised wave and current regimes and by altering the human use of the area; examples include damage to inshore shell fisheries, loss of rare shingle beach plant communities, loss of unique algal communities, and development of cohesive sediment communities on formerly rocky or sandy shoreline.

Beach control structures may also alter the use of the shoreline for commercial and leisure use; submerged structures may create navigation hazards, protected areas will allow deposition of mud and silt, large expanses of sand can be subjected to wind transport, structures could represent a public hazard, and localised current and wave focusing may be hazardous.

Finally, the problems of attempting to control different types of beach material should be understood. Shingle transport is dominated by wave action and is primarily limited to a relatively narrow zone of the beach and to limited elevation above the sea bed, and therefore various control structures can be used successfully. Sand transport, in contrast, can be dominated by either waves or tidal currents, can take place at any point from the backshore dunes (wind transport) to depth of over 10m and at any level in the water column due to suspension. Wide flat sand beaches in meso (2 – 4 metre) or macro (>4 metre) tidal situation can only be controlled effectively by using massive structures that would influence the whole foreshore to at least low water, although more modest structures can be used to influence sand movement across the high tide zone. (CIRIA, 1996)

2.2 Common Coastal Protection in Peninsular Malaysia

As stated by Mokthar (2001), topographic change to be controlled are related to problems such as erosion of foreshore due to storms, local erosion due to current, sedimentation in harbor , blockage of rivermouth and etc. Coastal protection structure has been used to trap longshore sediment movement at one location whilst erosion persists at the downstream side. There are two types of coastal protective measures; "hard" and "soft" version which is used in protecting the shoreline in Peninsular Malaysia:

Hard Engineering

- Revetment
- Groynes
- Breakwater
- Concrete Blocks
- Training wall

Soft engineering

- Beach nourishment
- Mangrove replanting
- Sediment filled geotextile breakwaters
- Pressure Equalization Module (PEM)

2.3 Theory

2.31 Revetment (Kirsty McConnell, 1998)

Introduction

Revetments are used to provide protection against erosion of fine material or fill materials by waves and currents on the coast, in river channels and in reservoirs. They may also serve other purposes such as limiting wave overtopping or wave reflections.

Revetments rest on the surface being protected and depend on it for support. A revetment is a form of cladding or protection placed on sloping surface or structure to stabilize and protect against erosion as a result of waves or currents.

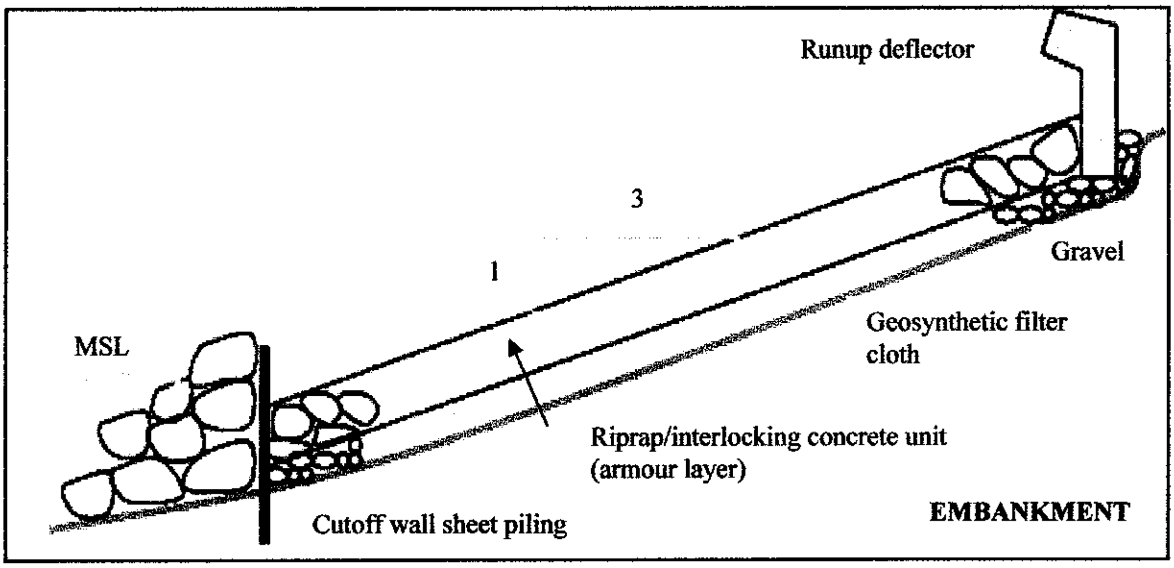


Figure 2.0: Typical revetment cross section (Sorensen R. M. 1997).

Description

1. *Armour layer*, can be whether rigid or flexible depending on the material used for construction. A flexible revetment will allow for some limited degree of movement or deformation of the structure due to settlement of the underlying material, while maintaining contact with the underlying formation. A rigid revetment will not allow for such movements except by settlement of complete rigid element

2.*The filter layer* (Geosynthetic filter cloth), of a revetment lies beneath the cover layer and ensures drainage of the system, avoiding the bild-up of excess hydraulic pressures beneath the armour, and prevent the migration of fines.

3. *Toe details* (Cutoff wall sheet piling) may form a part of the revetment where there is a need for toe stabilisation or protection from possible scour of the beach in front of the structure

Materials for construction

In the construction of revetment structure, there are different materials can be used such as:

i. Rock – riprap, rock armour
ii. Concrete blocks and slabbing
iii. Concrete mattress

i. *Rock*

The used of rock in the construction of revetment, either as riprap is carefully selected rock armour. An armour layer about 2 to 3 stones thick which is placed in bulk are from riprap (widely graded rock, $D_{85}/D_{15} \sim 2$ - 2.5). It is choose from selected rock of a narrow size range, $D_{85}/D_{15} \sim 1.25 - 1.75$, which carefully paced in layers, usually about 2 rocks thick, to form an open construction. The porosity of a rock armour revetment generally is n_v =35-40% and porosity of riprap is slightly lower, n_v = 30-35%.

Rubble, which is usually rock or stone fragment, but it may include broken concrete, brick or asphalt, can be dumped to provide protection. The rock armour placement, shape and grading are seldom entirely regular. In many ways regular close placement of rock armour may be indeed be undesirable as this leads to be "paved" surface, with reduced energy dissipation, increased run-up levels and/or overtopping, and increased reflections.

Preparations and placement of the closely packed stone can be labour intensive. This will normally adopted in reasonably sheltered locations as removal of a single block can lead to rapid failure of the whole revetment. Construction of rock revetment is relatively simple, generally requiring standard plant and a small work force. Minor damage to rock or riprap armour can be easily repaired, provided the under layers are not exposed.

ii. Concrete block and slabbing

To form an armour layer for revetment construction concrete block is placed. Concrete blocks that are or can be assembled into mats using steel cables, the size of which can be varied according to site requirements. An essential condition for the successful performance of the system is that the underlying ground is properly prepared before the plastic or natural fiber filter fabric is placed (lower permeability than armour elements).

Simple blocks can be placed freely on the slope, relying on unit mass, friction with the under layer and inter block friction to provide stability. Inter blocking blocks can provide greater stability than simple blocks. These can be cast with void which help to provide permeable cover layer and help prevent the built up of uplift pressures on the underside of the blocks.

Precast or in situ concrete slabs (generally of plan area 2 m x 2 m or larger) may also be used to form an armour layer. Slabbing is designed to resist uplift pressures in much the same manner as block work, by the self-weight. The covering space area per unit of slabbing is larger than blocks, will extend substantially outside the region of localized uplift pressures. Therefore slab elements covering larger areas can have smaller thickness than blocks.

iii. Concrete Mattresses

When two layers of geotextile material, with micro concrete are pumped between the geotextile layers, it creates concrete mattresses. The two layers of high strength synthetic fabric can be woven together at intervals to form filter points.

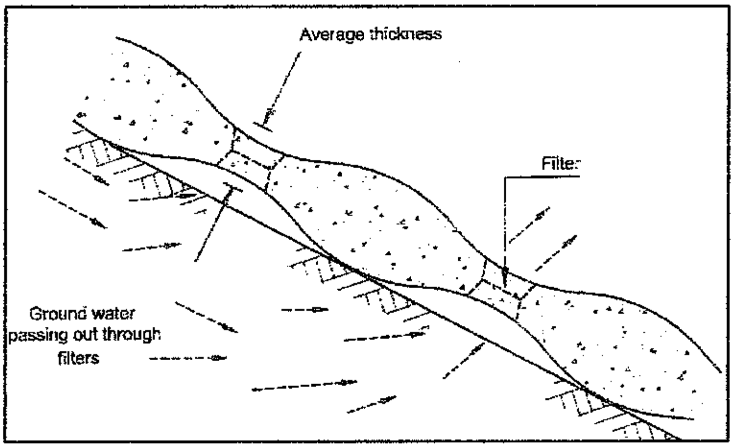


Figure 2.10: Details of filter point mattress (Kirsty McConnell, 1998)

Thickness typically ranges from 75 mm to 225 mm. Mattresses are particularly suitable for locations where accessibility is limited, such as under piled jetties. Concrete mattresses form a rigid slab protection layer, which should only be used over invert and consolidated soils that will not be subjected to settlement.

Concrete mattresses are readily laid on dry revetment slopes, and underwater by divers. Rolls of mattresses are normally prefabricated into mat sizes of 50 – 100 m^2 using "ball" and "socket" joints. Adjacent mattresses are normally zipped together, also in the form of ball and socket joints. Mattresses may be terminated by burying the end of the mattresses in a trench which is back-filled with beach material or rubble.

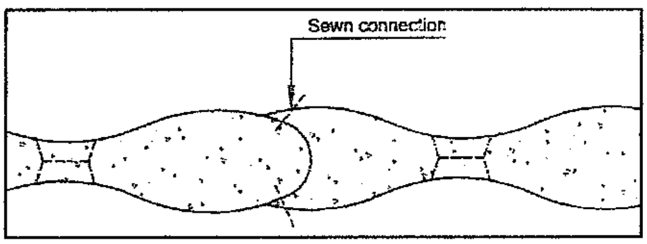


Figure 2.11: Ball and socket joint (Kirsty McConnell, 1998)

2.32 Groynes

Introduction

Groynes may be collectively to as shore normal structures, and they are constructed so that they lie at approximately right angles to the coastline. Groynes are long, narrow structures built approximately normal to the shoreline. They extend across part, or all, of the intertidal zone, and may have small lateral extensions to the seaward end or head. Groynes are normally built in groups, known as groynes systems or fields, which are designed to allow continued longshore transport. They also can be single structures designed as total barriers to transport (i.e. terminal groynes), though structures of this type tend to be classified as shore connected breakwaters.

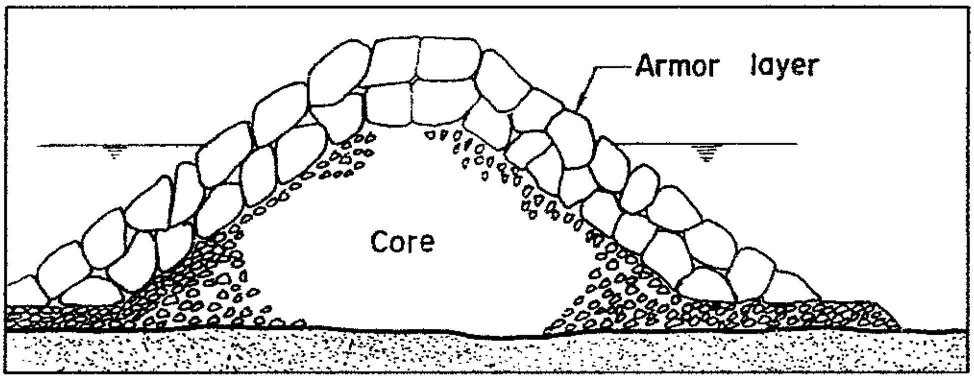


Figure 2.20: Section of groynes (NCES, 1985)

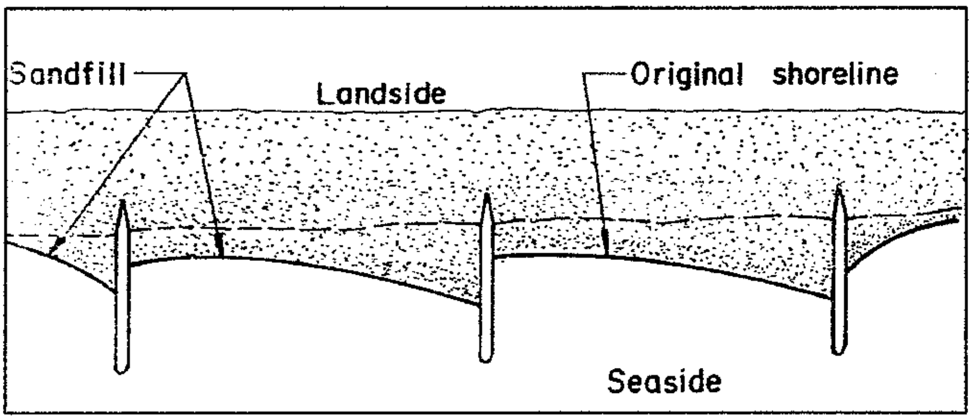


Figure 2.21: Groynes field (NCES, 1985)

Description

Generally groynes only effective as beach control structures on sand beaches in micro – tidal, low wave energy environments where the special distribution of wave and tidal current transport across the foreshore is limited. Sand beach groynes are not normally intended to trap all the longshore drift but should be long enough to control a sufficient part of the beach profile to protect upper beach from severe erosion.

For the fact, groynes are not recommended in protecting clayey - silty areas. Where groynes are used, they must be carefully designed and particular attention must be given to adverse effects on down – drift shorelines areas.

Materials for construction

Groynes can be built with permeable sloped faces of rock, asphalt or concrete armours unit, or with impermeable vertical faces of masonry, concrete, sheet piles or timber. Their purpose is to interrupt longshore transport, causing a build-up of beach material on their updrift side, until transport can resume over or around structure. If downdrift erosion is a potential problem, then a recharge scheme should always accompany groynes construction.

One of the most preferable materials to construct groynes is rock mound. The reasons of using these materials are hydraulic efficiency due to energy absorption. It is suitable at low to high energy sand or shingle beaches with low net drift in areas where the rock is available.

2.33 Breakwaters

Introduction

Breakwaters are constructing in purpose of to reduce the amount of wave energy reaching the protected area. Generally it's shore-parallel structures. The performance of breakwater can be compare to natural bars, reef or nearshore islands because of is plays a role to dissipate wave energy. The reduction of wave energy slowdown the littoral drift produces sediment deposition and shoreline bulge or "salient" feature in sheltered area behind breakwater, but some longshore sediment transport may continue along the coast behind the nearshore breakwaters.

Types

There are two types of breakwater; shore – connected (e.g. a harbor breakwater) or detached (and usually shore – parallel). Comparison between shore – connected and groynes is that the former usually extends into deeper water and gives more significant barrier to waves than groynes. Construction of shore – connected breakwaters consists of land-based plant, although the materials may well be delivered by sea.

Detached breakwaters, also sometimes referred to as offshore breakwaters, are generally set parallel to the shorelines. They are constructed away from the shoreline, usually a slight distance offshore and are designed to promote beach deposition on their leeside.

i. Shore - connected breakwaters

Shore - connected breakwaters include a variety of hybrid structures; combine cross-shore and longshore elements which are connected to the shorelines either by a structural link or by the development of the beach into a permanent tombolo.

It creates areas of reduced wave and tidal energy in which fine sediments and pollutants can accumulate creating a potential public hazard and causing a local alteration to the ecology.

Terminology

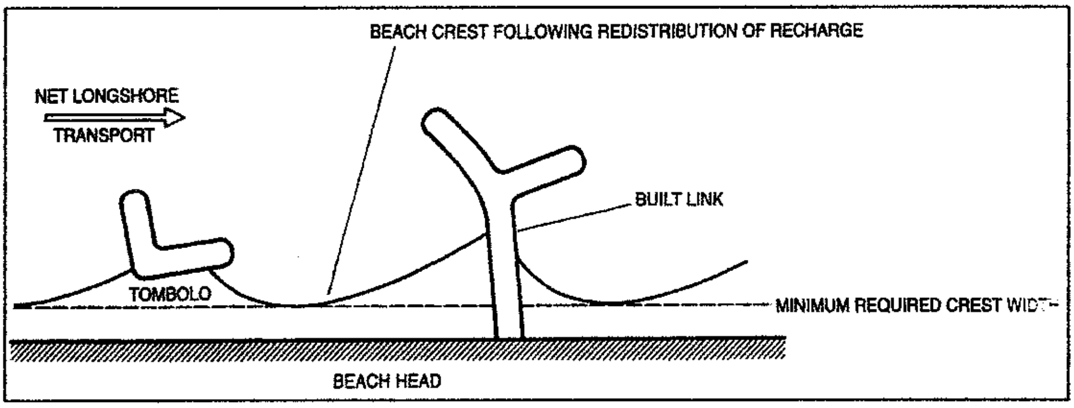


Figure 2.30: Shore – connected breakwaters (CIRIA, 1996)

Materials for construction

Rock or randomly placed concrete units are the most preferable materials for constructing shore – connected breakwaters. Specification of size, and slope, must ensure stability under storm conditions.

ii. Detached breakwaters

The reduction in wave height along the shoreline behind detached breakwaters, together with reduced cross-shore and longshore sediment transportation, causes a 'broadening' of the beach and its lee also known as 'salient'. In some cases, the salient may extend out to reach the landward side of a detached breakwater due to the length of breakwaters is greater than its distance offshore. These phenomena called 'tombolo'. Accumulation of sediment can be helpful such as increasing beach levels in front of vulnerable section of defences.

Instead, tombolo is very efficient in preventing the transport of beach material along the coast behind a breakwater and solving downdrift erosion problem.

Terminology

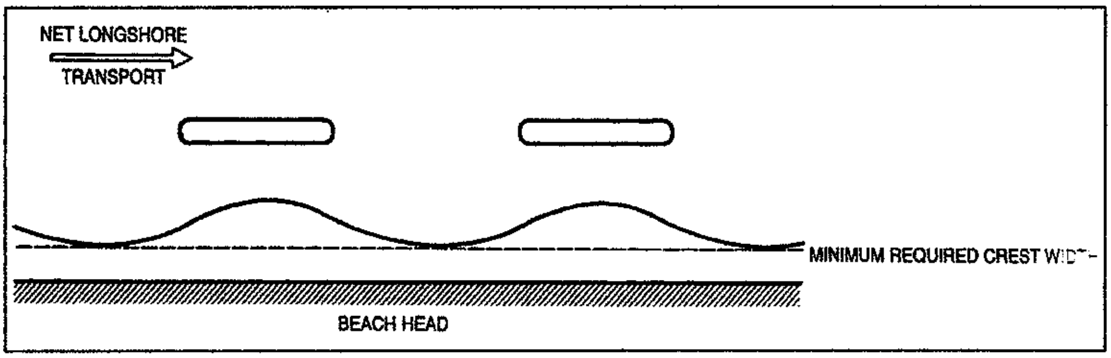


Figure 2.31: Detached breakwaters (CIRIA, 1996)

Materials for construction

Looking for the durability and economic factor, rock is the best materials for its construction. Concrete armour units, either a single layer or random placed, can replace rock. Both materials must be carefully designed and specified to ensure stability under the design storm conditions.

2.34 Beach nourishment

Introduction

Beach nourishment is also known as beach replenishment, beach feeding or beach recharge. Beach nourishment is a soft structure solution used for prevention of shoreline erosion. In Malaysia, beach nourishment is done to a beach where there are highly recreational places or tourism attraction.

Material of preferably the same, or larger, grain size and density as the natural beach material is artificially placed on the eroded part of the beach to compensate for the lack of natural supply of beach material. The beach fill might protect not only the beach where it is placed, but also downdrift stretches by providing an updrift point source of sand. Wave energy is absorbed by the added length of beach slope introduced.

Beach nourishment restores the eroded beach, but erosion will still continue. The economic justification for beach nourishment is that restoring exceed the cost of restoration, there can be a compelling economic justification for nourishment. It becomes popular because it avoids possible problems of downdrift erosion that can be produced by structures.

Beach nourishment works entails finding a suitable source of material that is compatible with, but not necessarily identical to the material on the beach to be nourished. This method is often the preferred means of protecting a sandy shoreline as it provided the necessary reservoir of material that allows a beach to respond to wave action and achieve equilibrium. The typical interval for renourishing a beach is about 5 years. (*www.water.gov.my*)

Methods of and Dredging Equipment for Beach Nourishment

There are a few methods of nourishment that can be implementing such as placement by dredge, trucks and conveyor belts. The extension of the beach can be serving by placing the sand onto it. (Robert G. Dean, 2002)

Dredge Placement and Dredge Types

i. *Pipeline Dredges*

The function of pipeline dredges is to pump sand/water slurry mixture to the nourishment location. The operation usually at a particular location until it determined that the proportion of sand being pumped is below an optimum value. Pipeline dredges are basically a dredge pump and associated pipe mounted on a rectangular barge and thus are not very seaworthy.

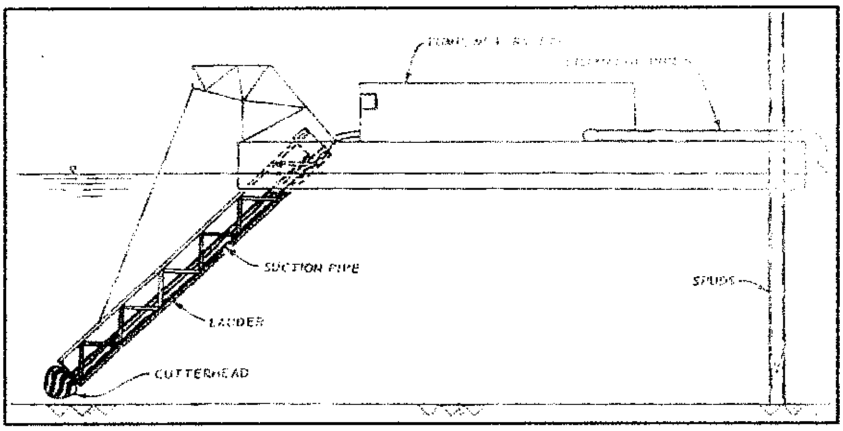


Figure 2.40: Schematic of cutter head pipeline dredge

(Richardson, 1976)

ii. Hopper Dredges

Basically hopper dredge is a ship equipped with dredge pumps and "drags" arms that extend over one or both sides of the vessel down to the sea floor with a capability of removing material from the sea floor by pumping the sand/water slurry mixture up through the arms into the ship hull.

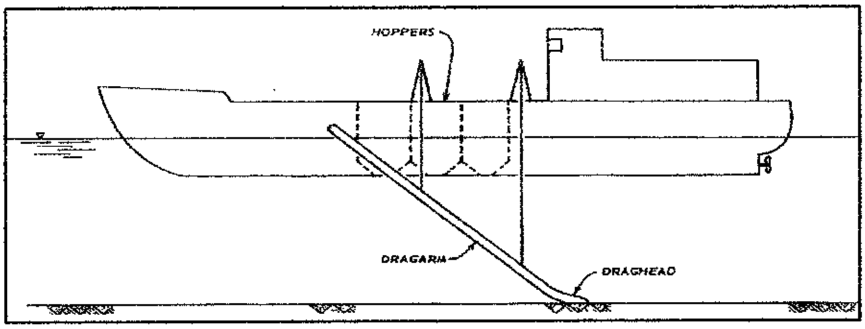


Figure 2.41: Schematic of a hopper dredge (Richardson, 1976)

Placement by Conveyor Belts

The used of conveyor belts is to transport dry granular material in a variety of commercial applications including unloading or loading grain and coal from ships. The sand was dredged some distance from the nourishment location and transported to immediately offshore of the beach to be nourished.

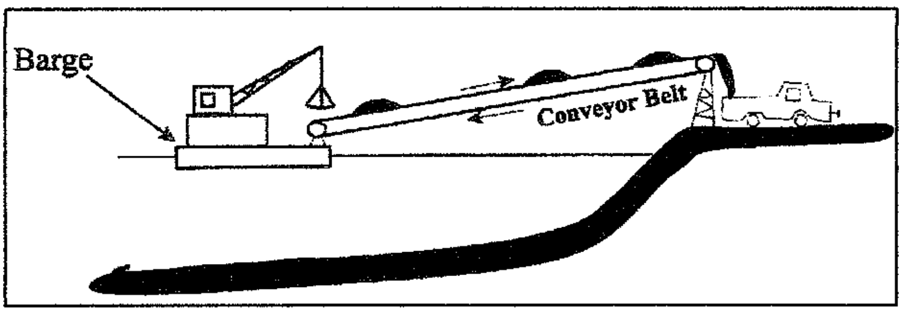


Figure 2.42: Schematic of offloading of a barge by a conveyor belts system. (Robert G. Dean, 2002)

2.35 Sediment filled geotextile breakwaters

Introduction

Sediment filled geotextile breakwaters can be used in both coastal and river environments and they are filled hydraulically with slurry of sand and water. An apron of geotextile wider than the geo-tube base may be included as part of the design to protect the seaward edge of the geo-tube from the effects of scouring. On the open coast, geo-tubes are laid parallel to shore as a beach or nearshore breakwater with the primary function of limiting the wave height in its lee. (*www.water.gov.my*)

Ghazali and Ong (2005) stated that there was a series of partially submerged woven geotextile breakwaters have recently been built in front of the mangrove-fringed shoreline of Tanjung Piai (state of Johor). The design and placement of the geotextile breakwaters takes into account the height of the incident waves, depth, tidal range and site conditions. The geotextile sand-filled breakwaters create a calmer wave environment in their lee as larger waves break upon them. The calmer state behind the breakwaters induces substrate build-up allowing a setting for the regeneration of mangroves either naturally or through re-planting. In the other words, Ghazali (2005) suggested that their utilization is however not intended as a solid wall against all waves but purely to eliminate the damaging storm waves and reduce their energy within the project locality.

Terminology

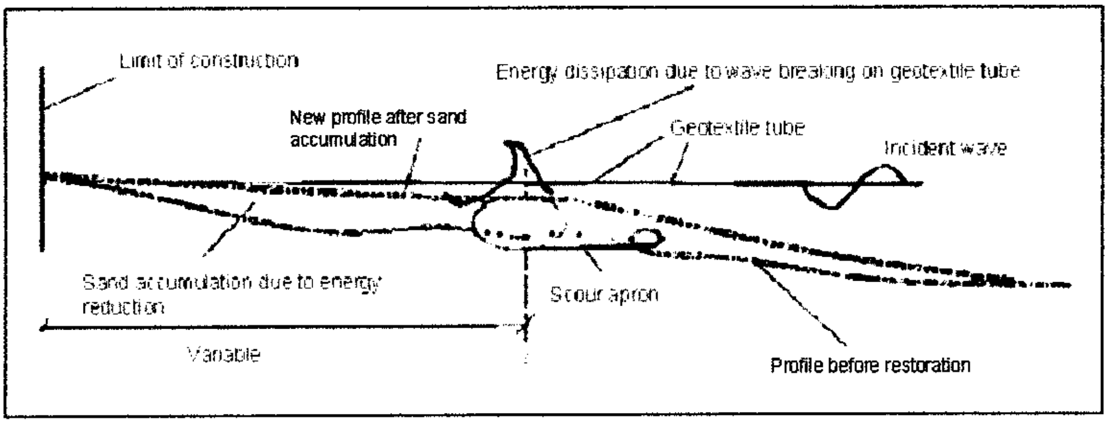


Figure 2.50: Schematic section of wave energy reduction
(Messrs. Alvarez, Rubio and Ricalde, 2005)

From the above figure, the term geotextile tube is a large tube (greater than 2.5 m in circumference) fabricated from high strength woven geotextile in lengths greater than 6 m, used in coastal and riverine applications and typically filled hydraulically with slurry of sand and water.

Scour apron is apron of geotextile designed to protect the foundation of the main Geo-tube from undermining effect of scour. In coastal and riverine applications, scour can be present at the base of Geo-tube due to wave and current action. Scour apron may be on both sides of the Geo-tube, or on only one side. Scour apron also reduce local erosion and scour caused by hydraulic filing process of the tube. Scour apron are typically anchored by a small tube at the water's edge or by sandbags attached to the apron.

Geo-tube Specification

The Geo-tube shall be in a complete factory-sewn-up tubular from with filling ports at internal no greater than 15 m apart. The Geo-tube shall be in length of 50 m, circumference of 9.4 m and have been closed up at both ends. The geotextile used to make the Geo-tube shall be a woven polypropylene geotextile conforming to Table 2.01.

Mechanic Properties	Unit	Value	Test Method
Wide width tensile strength in both direction Ultimate tensile strength Extension at ultimate tensile strength	kN/m %	$\geq$120 $\leq$ 15	ISO 10319 : 1993 ISO 10319 : 1993
CBR puncture resistance	kN	$\geq$10	ISO 12236 : 1996
Drop cone	mm	$\leq$ 6	EN 918 : 1996
Hydraulic properties Apparent opening size, O_{90} Water permeability, Q_{100}	mm $l/m^2/s$	$\geq$120 $\leq$ 15	NEN 5168 NEN 5167
Fabric weight Mass per unit area	g/m^2	$\geq$500	EN 965

Table 2.01: Specification for Geotextile Tube (DID, 2009)

Scour Apron Specifications

The scour apron shall be in a complete factory-sewn-up planar from with 2 edge tubes. The scour apron shall measure 55 m long by 5 m wide. The edge tube (55 m long each edge) shall have a circumference of 0.6 m. The geotextile used to make the scour apron shall be a woven polypropylene geotextile conforming to Table 2.02.

Mechanic Properties	Unit	Value	Test Method
Wide width tensile strength in both direction Ultimate tensile strength Extension at ultimate tensile strength	kN/m %	≥80 ≤ 15	ISO 10319 : 1993 ISO 10319 : 1993
CBR puncture resistance	kN	≥10	ISO 12236 : 1996
Drop cone	mm	≤ 6	EN 918 : 1996
Hydraulic properties Apparent opening size, O_{90} Water permeability, Q_{100}	mm $l/m^2/s$	≥0.2 ≤ 15	NEN 5168 NEN 5167
Fabric weight Mass per unit area	g/m^2	≥350	EN 965

Table 2.02: Specification for Scour Apron. (DID, 2009)

2.36 Pressure Equalization Module (PEM)

Introduction

Pressure Equalization Module (PEM) system is a new innovative system originated from Denmark for beach erosion control. The system was successfully installed in many countries all over around the world including Australia, Ghana, Denmark as well as Malaysia. It is designed to stimulate accretion of sand on certain beaches and to slow down the erosion process in some other beaches. PEM system is radically different from other protection measures where hard structures like concrete walls, rock embankment and groynes are used.

This system has low impact on the aesthetics of the beach area and thus represents a more environmental friendly coastal protection method. It is assumed that under PEM influence the groundwater table in the beach will be lower and the swash infiltration-exfiltration rate will decrease, that will cause decreasing of intensity of the beach erosion in the swash zone. (Abd Razak, 2008)

Description (Ghazali, 2005)

The PEM functions in the uprush zone of the beach where wave runs up the beach face and, upon reaching its limit, runs down and at the same time infiltrates into the bed. Figure 260 shows a schematic diagram of PEM.

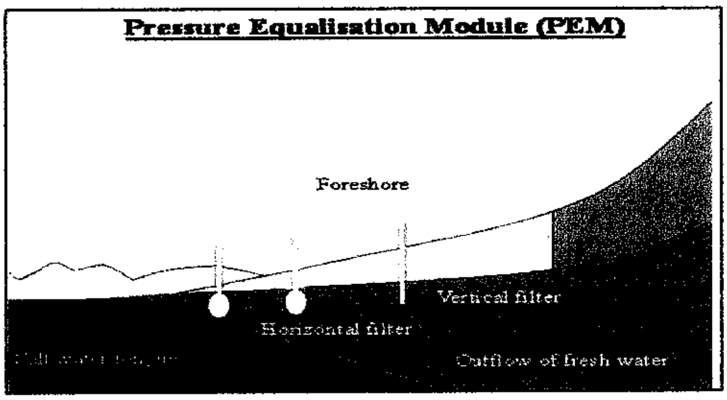


Figure 2.60: Pressure Equalization Module – schematisation

(Poul Jakobsen, 2003)

The infiltration of seawater into the bed is limited by the existing level of groundwater. Hence, if the groundwater can be lowered, more water from the run-up can percolate into the bed and less will run down the surface dragging sediments with the flow. The lowering of the local groundwater table can be achieved with the PEM system which relieves the pressure within the beach by physically 'connecting' it with the atmosphere.

Design and Installation (Ghazali, 2005)

Rows of perforated PVC pipes about 15 cm in diameter are installed normal to the shoreline in the area between the uppershore limit of the swash zone (area influenced by wave run-up) and the mean low water line. The pipes behave as a vertical filter which equalises groundwater pressure within the beach allowing increased circulation of seawater within the beach profile.

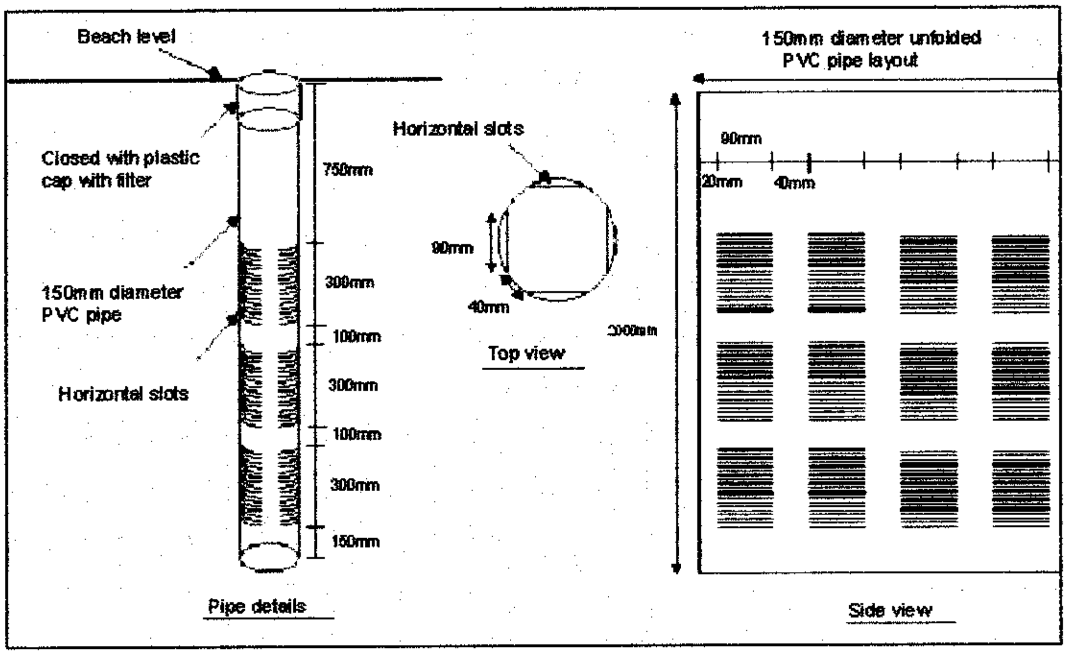


Figure 2.61: Design of Pressure Equalization Module (PEM)

Each PEM pipe is 2.0 m long with perforations measuring 400 to 900 microns (1 micron = 0.001 mm) and are placed vertically into the beach with the bottom end penetrating the phreatic line. Any water pressure build-up within the beach will be transferred into the pipes. The PEM system is suited for littoral coastlines with a natural supply of sand from the coast. In cases where the natural sand supply has been depleted, beach nourishment is necessary.

The presence of the PEM system causes the beach to retain more material on the foreshore area (between the low water line and the high water line) and form a more erosion-resistant beach. Its immediate affect will be in lowering the sediment transport capacity of wave down-rush. In the medium term, the shoreline undergoes a change whereby sediment mounds will form normal to the shore along the position of the PEM pipes. These then behave like groynes and trap sediment movement in the alongshore direction (Jakobsen, 2002).

With a more erosion-resistant beach, beach nourishment replenishment intervals are expected to increase. Another notable benefit is that the PEM system creates minimal disruption to the shoreline both in the physical and ecological sense. The construction phase of a PEM project, unless beach nourishment is required, uses very little machinery causing minimal disturbance to beach activities (Ghazali, 2005).

CHAPTER 3

METHODOLOGY/PROJECT WORK

3.0 METHODOLOGY/ PROJECT WORK

3.1 Methodology

To complete this thesis, a proper procedure must be decided so that the flow of the project is on track. The methodology is as follow:

3.1.1 Research

The research is focused to the coastal protection structures which had been constructed along Peninsular Malaysia coastline. The elements of research needed are the location, type of structures constructed, general performance of the structures, geographical condition and hydraulic boundary conditions. Table 3.0 below interpreting the research element for each structure:

DESIGN CHARACTERISTICS OF COASTAL PROTECTION	COASTAL EROSION PROJECTS			
	REVETMENT	GROYNES	BREAKWATERS	BEACH NOURISHMENT
Hydraulic boundary condition	MUST BE CONSIDERED			
1. Tide level (m)				
2. Significant or design wave height (Hs)				
3. Design return period				
4. Mean Wave Period (T_m)				
5. Current (m/s)				
General Description of Structure				
1. Length (m)	★	★	★	★
2. Side Slope Angel (Θ)	★	★	★	
3. Armour Size	★	★	★	
4. Crest Elevation	★	★	★	
5. Crest Level	★	★	★	
6. Crest Width	★	★	★	
7. Groynes Head Extension		★		
8. Spacing (m)		★	★	
9. Volume of sand used (m^3)				★
10. Beach slope				★
11. Dry beach width				★
12.Median Grain Size				★
13. Design Life	★	★	★	★

DESIGN CHARACTERISTICS OF COASTAL PROTECTION	COASTAL EROSION PROJECTS			
	REVETEMENT	GROYNES	BREAKWATERS	BEACH NOURISHMENT
Geographical and Morphological Condition	MUST BE CONSIDERED			
1. Type of Coast				
2. Net longshore sediment transport & direction				
3. Net longshore current				
4. Length of erosion				

Table 3.0: Research element of the project

NOTES:

(★) Recorded data

3.1.2 Data Gathering

The data needed can be collected from Department of Irrigation and Drainage (DID) from each state in Peninsular Malaysia by setting an appointment with a representative from the Coastal Management Department to develop the database. It also can be gathering from the consultant who had designed the structures.

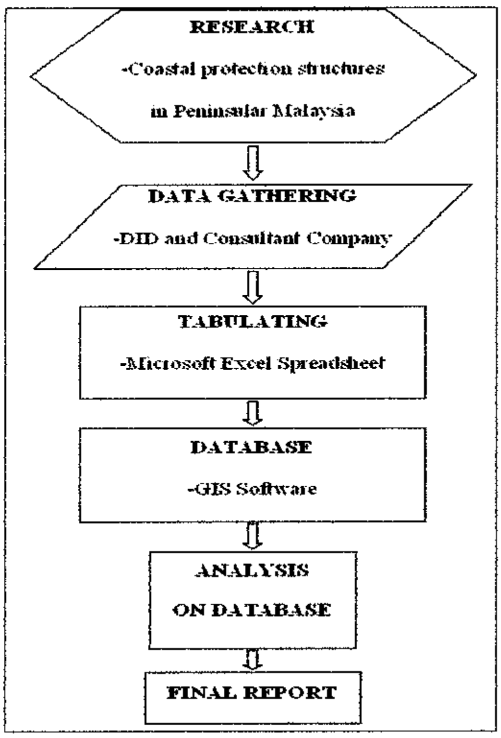


Figure 3.0: Work flow of the project

3.1.3 Data Presentation

All the data gathered will be tabulate in Microsoft Excel. Then, the author will transform the data into GIS Software (MapInfo Professional 7.0®). The data will be arranged layer by layer for easy access and analysis later on. The raw data (i.e. map from each state) can in raster image format.

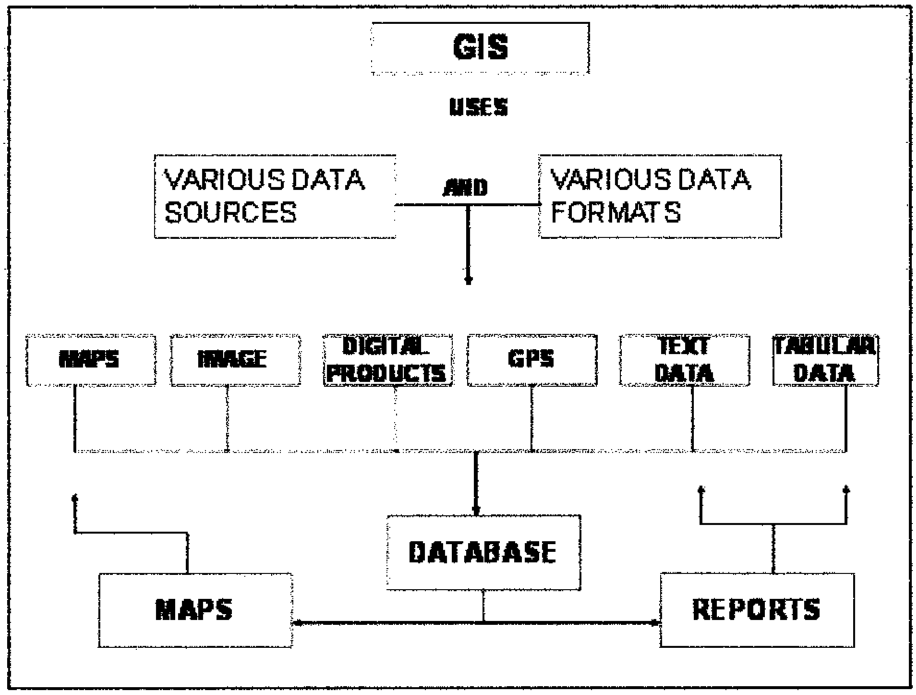
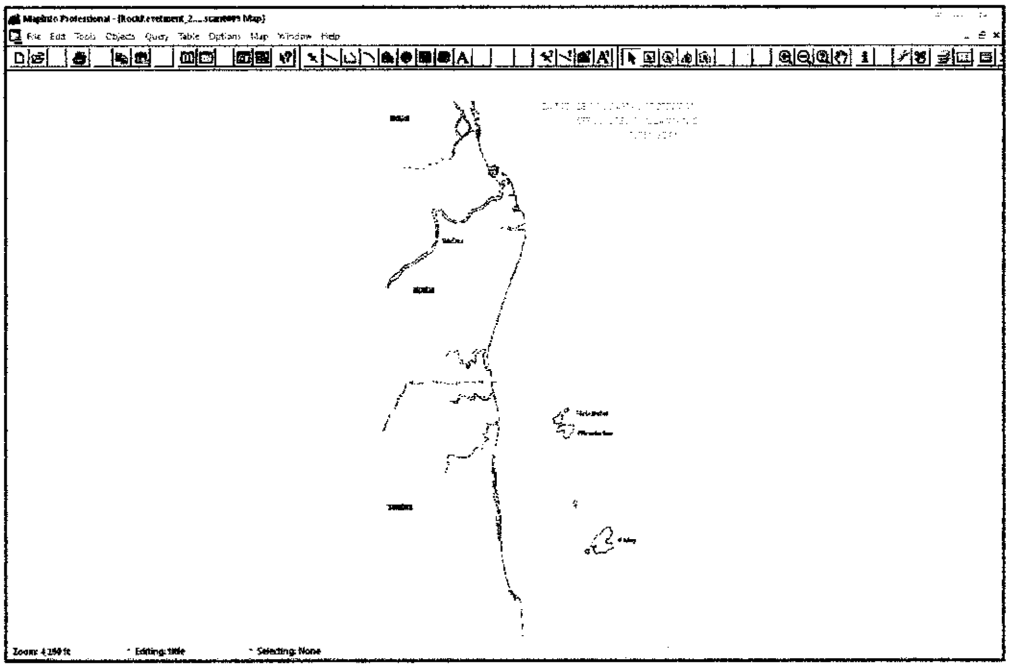


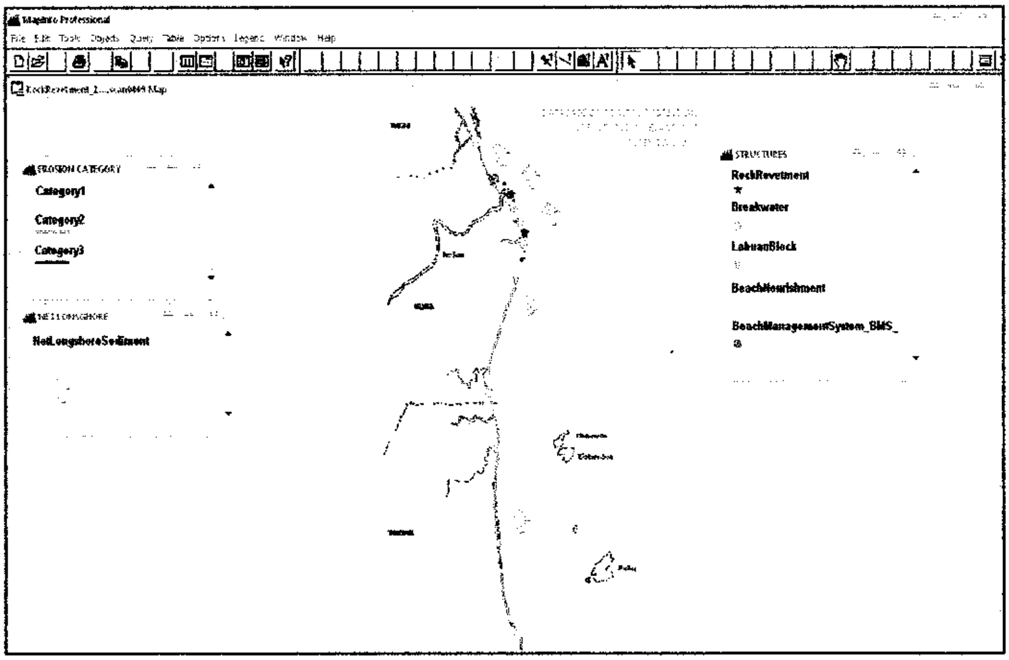
Figure 3.1: Work flow of GIS Software

GIS Software gives a wide framework where different discipline and topic can be accommodating into one database. The specific application play an important role in adapting different type of GIS tool and in many instance provide the basis for unification of these system. GIS can act like central information hub.

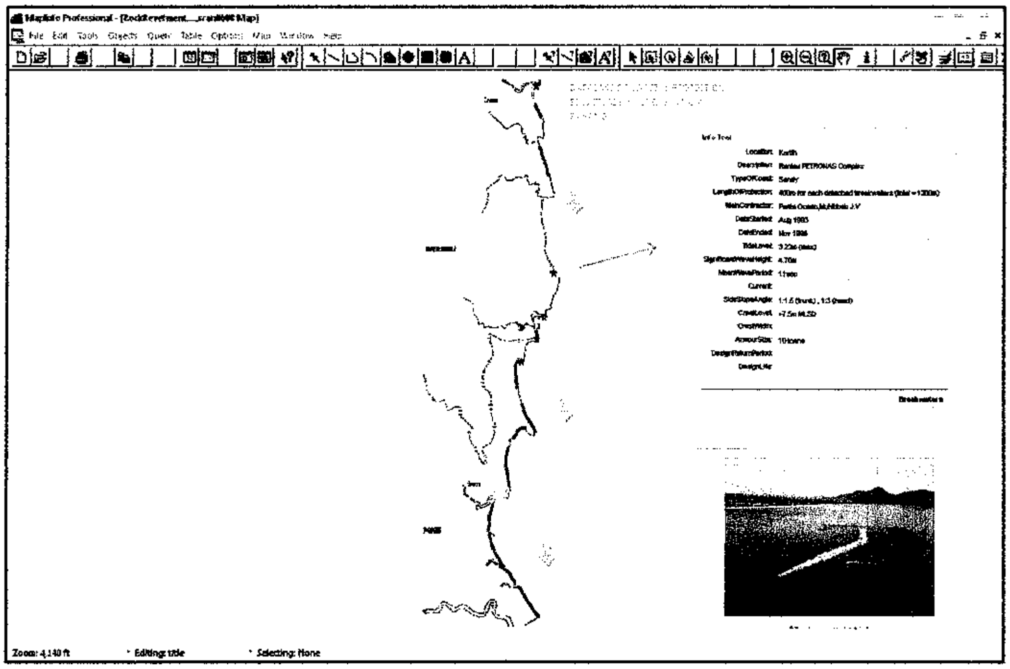
By using mapping wizard tool in the Tool menu, the JPEG map can be converted to info Tab. Below is the example of map layout which has been converted.



Then, on different layer the author mark the place where the coastal structure was constructed. The structures are marked with a variety of shape and colour for a differences in type.



For every mark on the map, the author had keep in the database and by just clicking on the mark it will show the information needed. Picture of the structure also will appear at the same time.



3.2 Tools/Equipment Required

The tools and equipment which are required in this Final Year Project are a Windows based PC together with the programs such as Microsoft Office and GIS Software (MapInfo Professional 7.0®) which is used to analyse the data obtained from the site, equipment needed basically would be data from on site results as well as from the internet and other references. Microsoft Office programs include Microsoft Word used to type reports and Microsoft Excel to tabulate data and rearranging of data

3.3 Gantt chart

i. Final Year Project I

No.	Detail / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	**Selection of Project Title**																			
2	**Preliminary Research Works**																			
	Scope of work (explain by Supervisor)																			
	Journal review																			
	Submission of journal																			
3	**Weekly Meeting with Supervisor**																			
4	**Submission of Progress Report**																			
5	**Project Work**																			
	Writing letter to DID for an appointment																			
	Software learning for GIS																			
	Data collection																			
	Tabulating data and creating database																			
	Data Analysis																			
6	**Submission of Interim Report**																			
7	**Preparation for Oral Presentation**																			
	Slide review																			
8	**Oral Presentation**																			

Table 3.1: Gantt chart for FYP I

LEGEND:

Completed Progress/Process Suggested milestone Mid semester break

ii.Final Year Project II

No.	Detail / Week	1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	**Project Work Continue**															
	a.Data Gathering															
	b.Data Analysis															
	c.Creation of Database															
2	**Meeting with supervisor**															
3	**Seminar**															
4	**Submission of Progress Report**															
5	**Poster Exhibition**															
6	**Submission of Dissertation** (soft bound)															
7	**Oral Presentation**															
8	**Submission of Final Report** (hard bound)															

Table 3.2: Gantt chart for FYP II

LEGEND:

Completed

Progress/Process

Suggested milestone

Mid semester break

CHAPTER 4
RESULTS AND DISCUSSION

4.0 RESULTS

4.0.1 Initial Findings

The construction of coastal protection defence in Peninsular Malaysia basically is based on National Coastal Erosion Studies (NCES) which was done in 1985. Table 4.0 shows the criteria of selecting coastal protection at certain location while Table 4.1 indicate effects on environmental if the structures are constructed.

	TYPE OF STRUCTURE				
	BREAKWATERS	**SEAWALLS**	**REVETMENTS**	**GROYNES**	**PROTECTIVE BEACHES**
Applicability to small projects	Yes	Yes	Yes	No (1)	No
Recreational beach provision	Yes	No	No	Limited unless filled	Yes
Backshore erosion prevention (2)	Yes	Yes	Yes	No unless filled	Yes (3)
Backshore wave protection	Yes	Yes	Yes	Limited if filled	Limited
Backshore slope retention	Yes	Yes (secondary)	Limited	No	No

Table 4.0: Criteria for selecting coastal structures (NCES, 1985)

	BREAKWATERS	SEAWALLS	REVETMENTS	GROYNES	PROTECTIVE BEACHES
Beach profile with flat backshore slope	None	Negates secondary earth retaining function	None	None	None
Beach profile with steep backshore slope	None	Earth retaining capability may be exceeded	Bank may need to be graded	None	None
Beach profile with flat foreshore slope (4)	None	None	None	Longer length structure required	Lower fill volume required
Beach profile with steep foreshore slope	None	Larger wave with more force could reach the structures		Higher structure required	Higher fill volume required
Waves	Size and strength of structure are dependent on wave height				Steep waves eroded (5) Flat waves help maintain (6)
		Reflected waves cause beach erosion			
Longshore sand movements	Longshore currents trap sediments in the lee shadow	None	None	Provides fill for trapping-High volume required for success	Longshore currents distribute fill along shores
Windblown sand	None	None	None	Provides fill for trapping	None

Table 4.1: Effects on environmental conditions (NCES, 1985)

NOTES:

(1) In some cases a single structure may suffice, but usually a series of groynes required.

(2) That upper zone of the beach which is acted upon only during severe storms.

(3) Provided periodic renourishment is maintained.

(4) That part of the shore that is ordinarily exposed to the uprush and backrush of wave action as the tides rise and fall.

(5) Distances between successive crests are 10 to 20 times their height.

(6) Distances between successive crests are 30 or more times their height.

4.1 Data Analysis

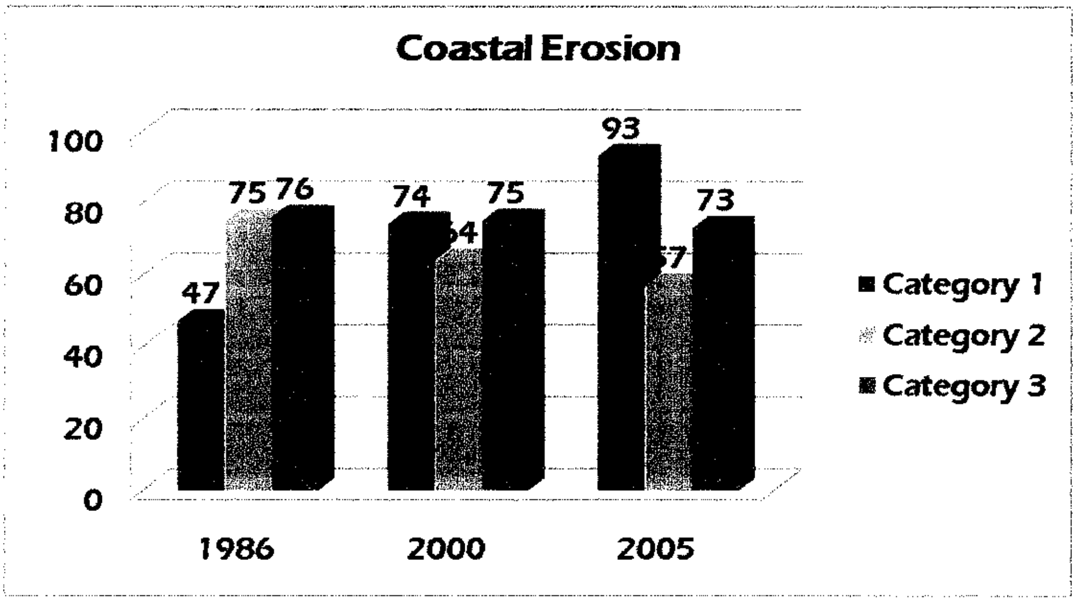


Figure 4.0: Percentage of Coastal Erosion problem from 1986 – 2005

From the result above, we can clearly see that percentage of erosion Category 1 is increasing dramatically from 47% (percent) to 93% (percent). The difference in percentage is 46% (percent) which cover 288.4 km shorelines in Malaysia. It is differ comparing to Category 2 which decreasing in 19 years time. In these period also, the percentage of erosion in Category 3 only show a bit difference in area of erosion having these problems.

When shorelines is identify laying in Category 1 and 2 responsive action is taken by the DID but ignoring erosion Category 3 also can lead to worst scenario. If there no action in controlling the erosion, valuable losses to land and property will increase. The act was create; National Coastal Zone Management Plan Guidelines (Garis Panduan JPS 1/97, 1997) by Department of Irrigation and Drainage (DID) to counter the problems and limit its consequence.

4.1.1 Percentage of Implemented Coastal Protection Structures in Peninsular Malaysia

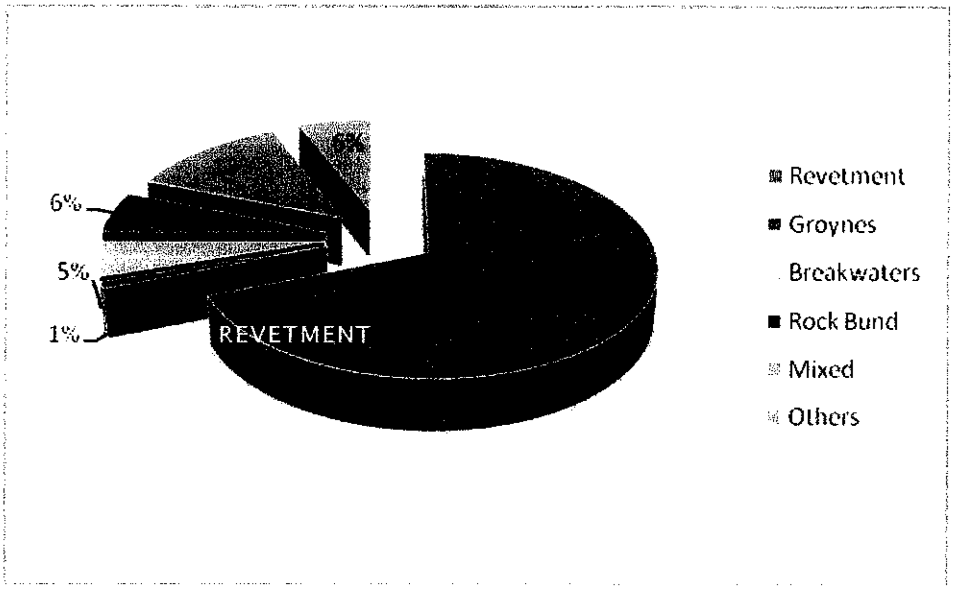


Figure 4.1: Percentage of coastal protection structure build in Peninsular Malaysia

From the result, the author manages to differentiate the percentage of selection coastal protection structures in Peninsular Malaysia. Obviously, revetment is the most preferable coastal structures in protecting the shorelines. Indicating 69 % (percent), half from the total structures were built, followed by mixed. Percentage of mixed is 13% (percent). Combining the method of protection structures had been classified to mixed by the author. Its include combining beach management and groynes, rock revetment and beach nourishment and etc.

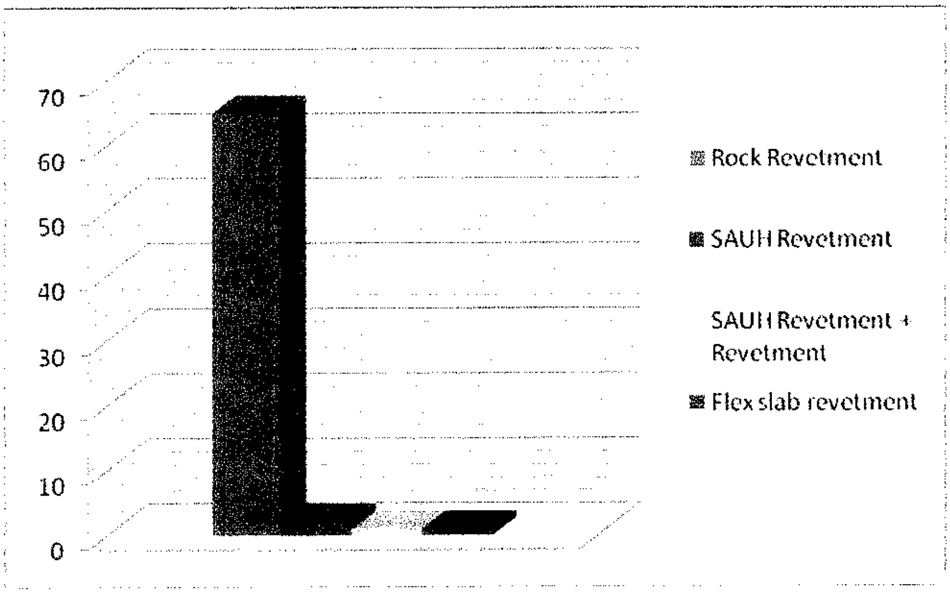
The purpose of constructing rock bund (coastal earth work) is to exclude seawater from the agricultural area, was previously built inland with a belt of mangroves protecting. This method was the first structure implemented by DID the step of protecting Malaysia coast from eroding. Most of the structures is applied in the state of Perak. By looking to the results, it covers 6% (percent) and followed by breakwater structure.

Groynes only cover 1% (percent) in the selection of the structures. Usually it is built combining with others measure such as beach nourishment. The percentage of selecting breakwaters structures is 5% (percent). It is discover that Kelantan and Terengganu possessed a large numbers of breakwater structures in their state. The purpose of constructing is to protect the shorelines from the erosion causing by disrupting net longshore sediment transport. East Peninsular Malaysia is very affecting from these. Due to it, selection of using breakwater is an effective choice.

Actually others on the pie chart are referring to the soft measures such as beach nourishment, Pressure Equalization Module (PEM), and Beach Management System (BMS). Both PEM and BMS are new innovation to DID and are proven very effective and successful.

The method of selection for constructing coastal protection structures is very important. Failure in the case study could lead to disaster and loss to the valuable coastlines whilst greater performance of the structures is highly related to successful design. It is a mandatory requirement by the approval authorities that certain investigate studies need to be carried out to assess the viability thus provide detailed engineering drawings for optimum design support Guidelines in developing a structures had been introduce in 1987 by DID Malaysia which include in the Appendices.

4.1.2 Revetment classification



Types of Revetment	Percentage (%)
Rock Revetment	65
SAUH Revetment	2
SAUH Revetment + Revetment	1
Flex slab revetment	1

Figure and Table 4.2: Percentage selection revetment types

Revetment is the most common structures used in protecting the shorelines from erosion problems in Peninsular Malaysia. Types of revetment in Peninsular Malaysia generally consist of:

- Rock Revetment
- SAUH Revetment
- Flex Slab Revetment

Proven by the result from the author thesis, the reason of taking the revetment as the alternative is because of its flexibility and typically consists of armour rock or concrete block. Designing better revetment structure can cut cost especially the armour size. Granite is the best material to be armour.

By referring to Ghazali (2005), he mention that revetments are typically constructed with seaward slopes of 1:3 to 1:4 (1 vertical to 4 horizontal) and a crest level based on an allowable run-up distance. Critical to the design is the mean weight (in kilograms) of the individual armour unit, W_{50} which can be calculated using the Hudson's Formula (CERC, 1984) below:

$$W_{50} = (W_r H_s^3)/K_D (S_r - 1)^3 \cot\theta$$

where:

W_r = unit weight of seawater

H_s = design wave height in meters

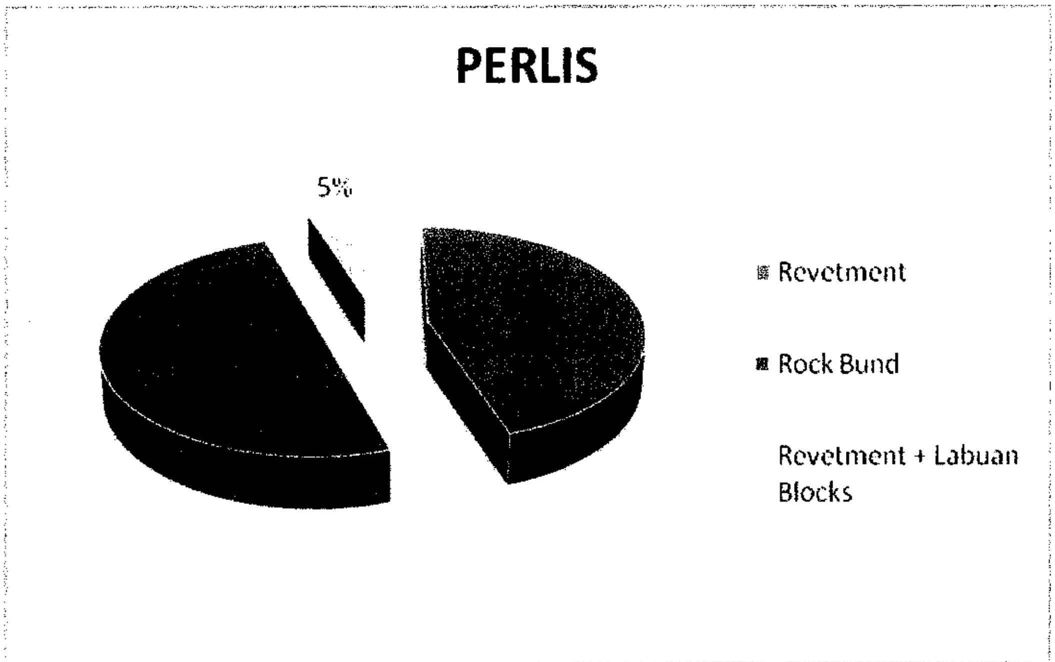
K_D = coefficient of stability; varies primarily with shape, roughness of armour unit surface, sharpness of edges and degree of interlocking in placement

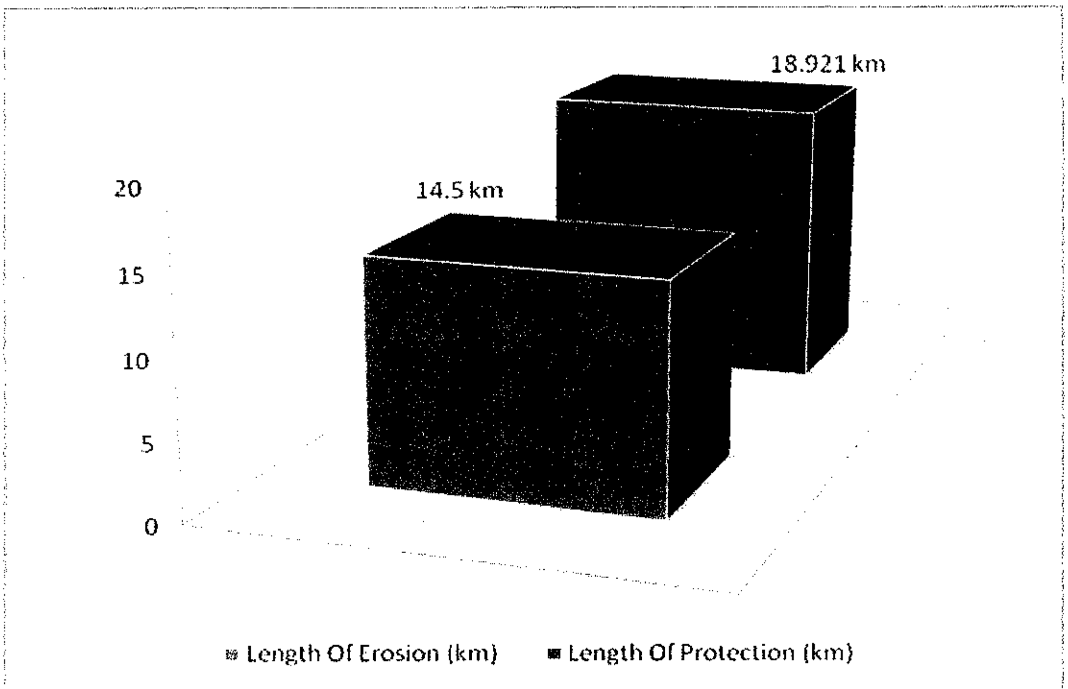
S_r = relative weight of armour unit W_r/W_s

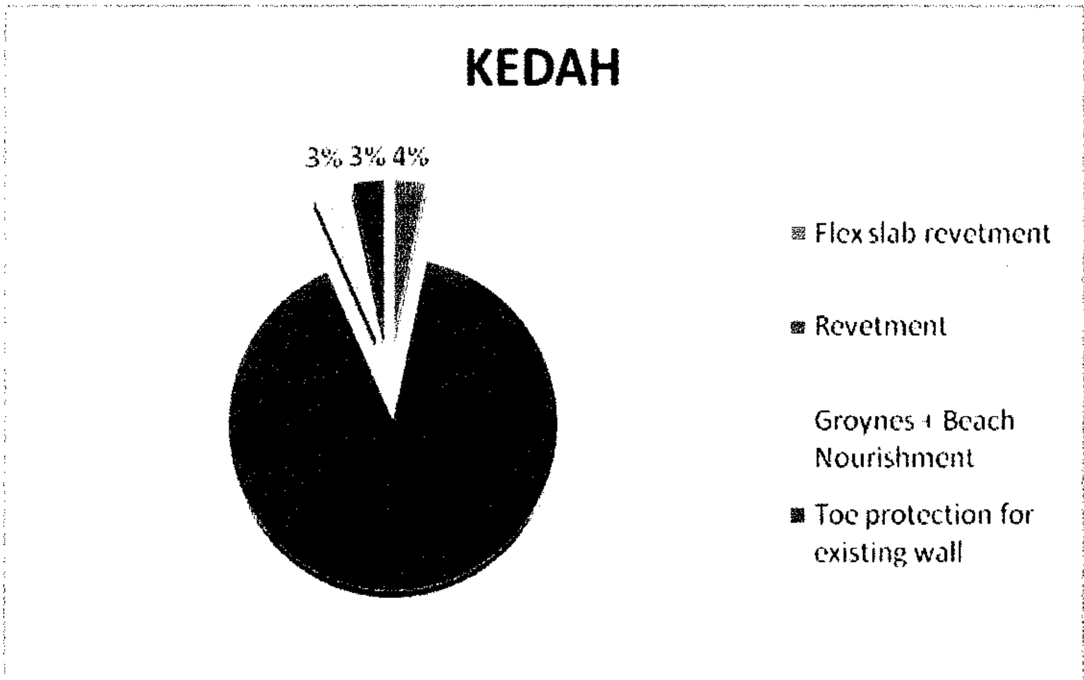
θ = angle of structure slope measured from horizontal

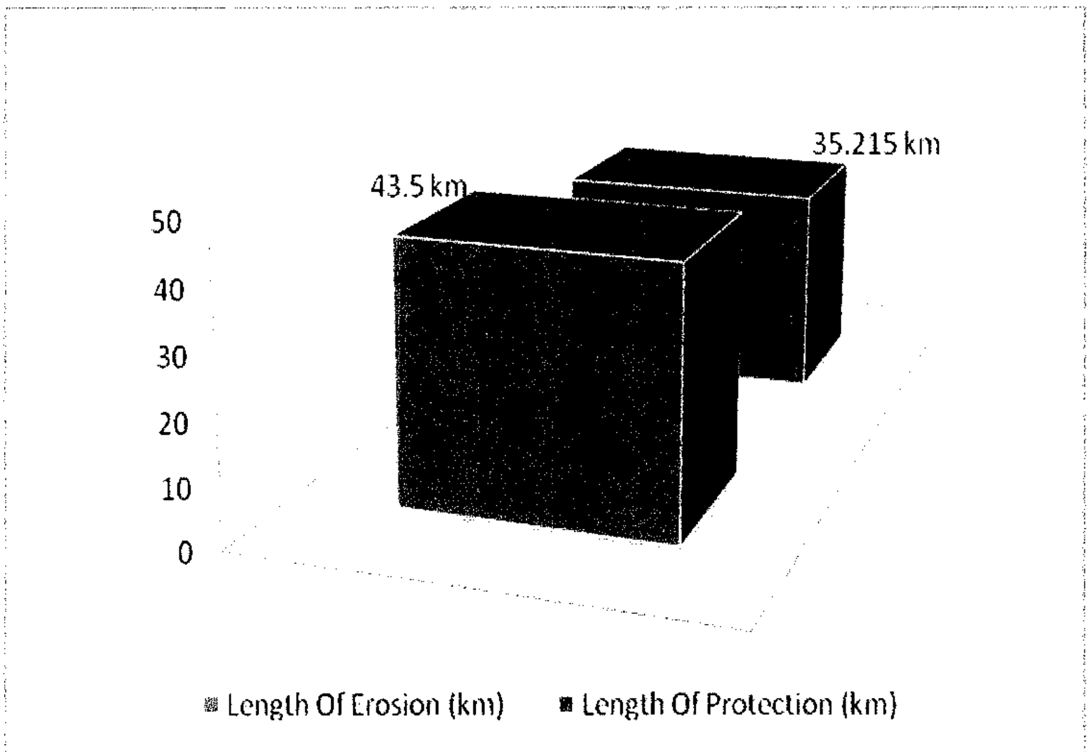
By developing interlocking concrete unit (armour) which are lighter and have higher K_D values, it suit the structure with stability of heavier quarry stone armour.

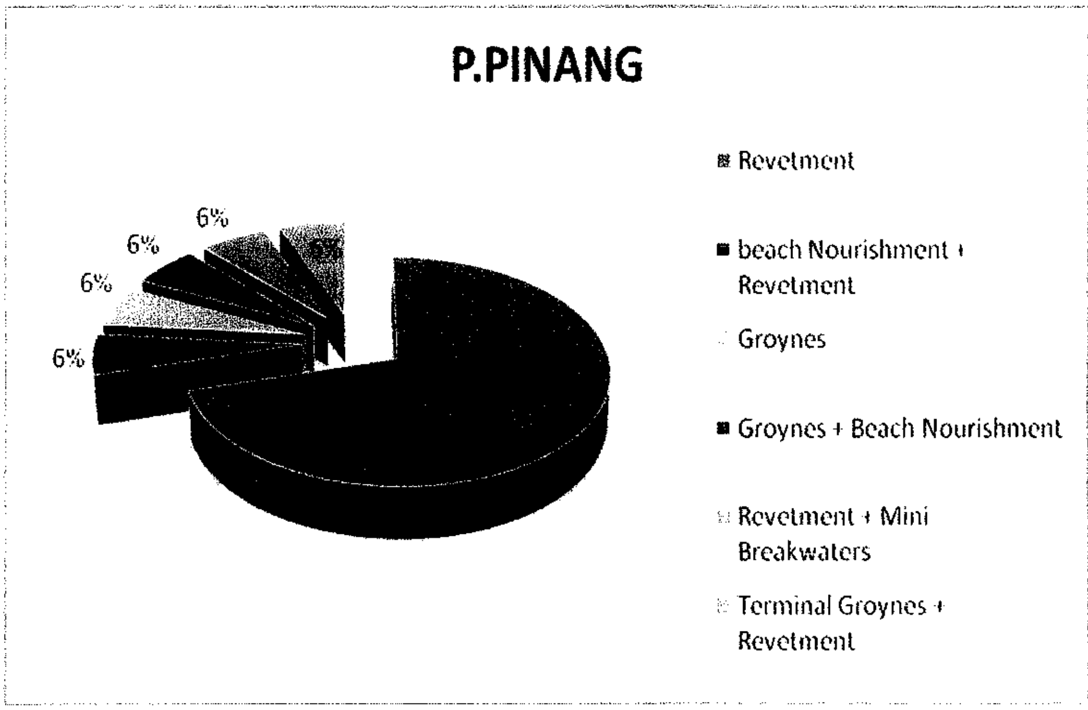
4.1.3 Overview on the selection of coastal structures with respect to its length of erosion and protection cover in every state of Peninsular Malaysia

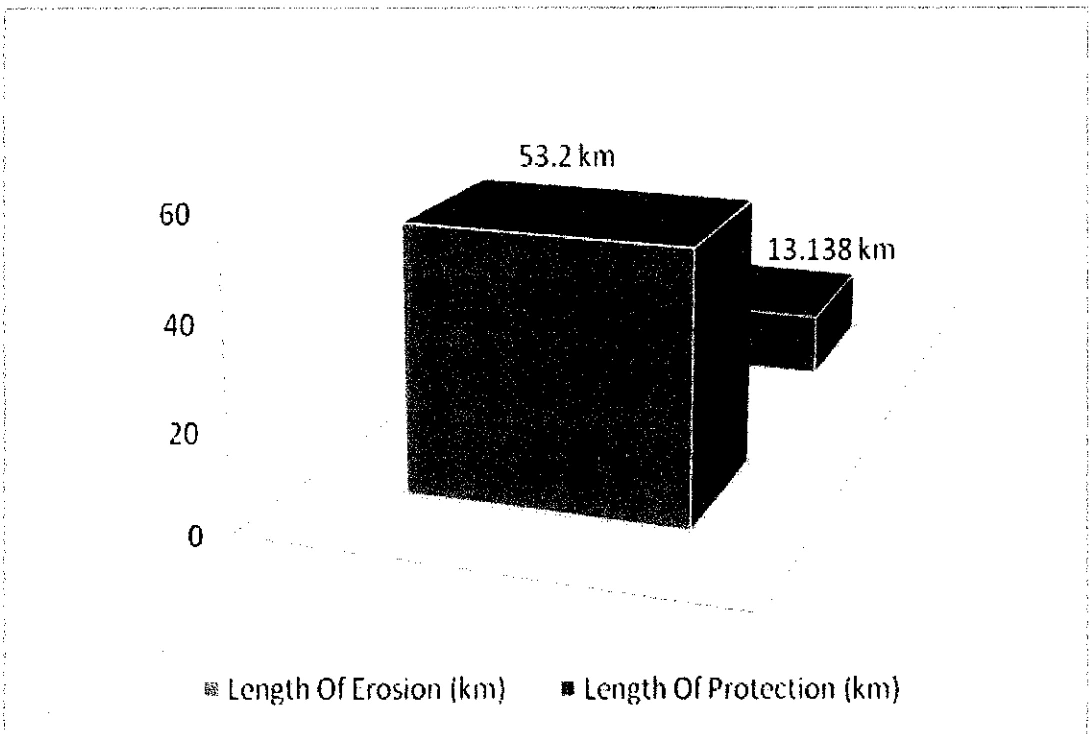


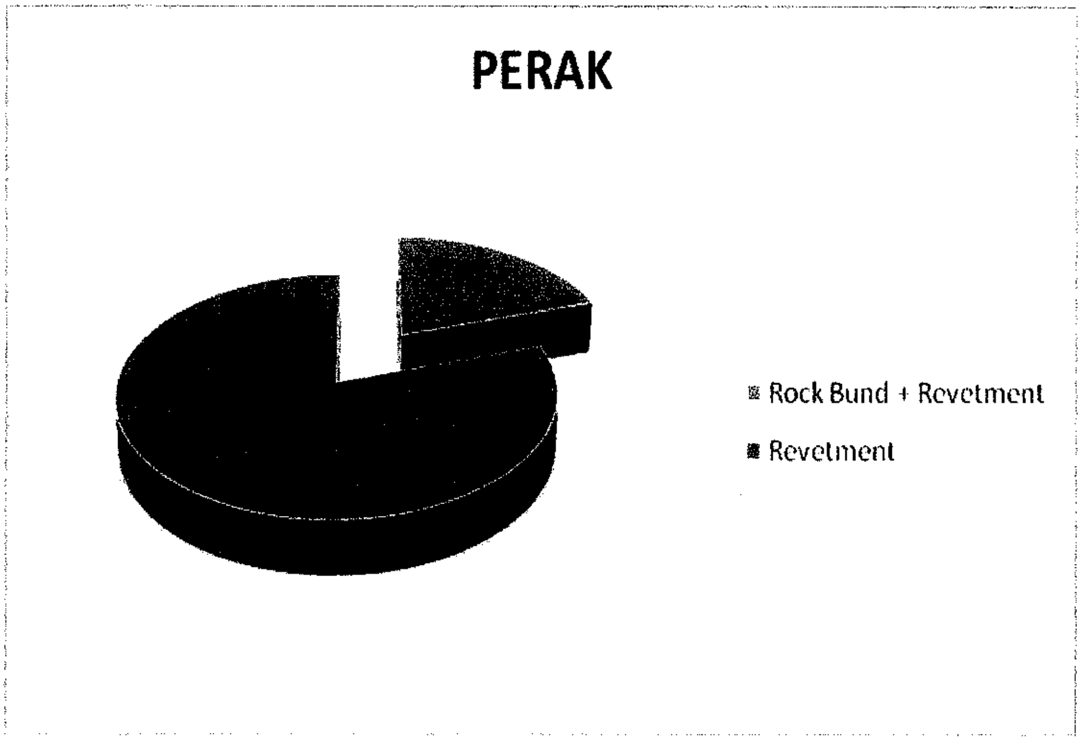


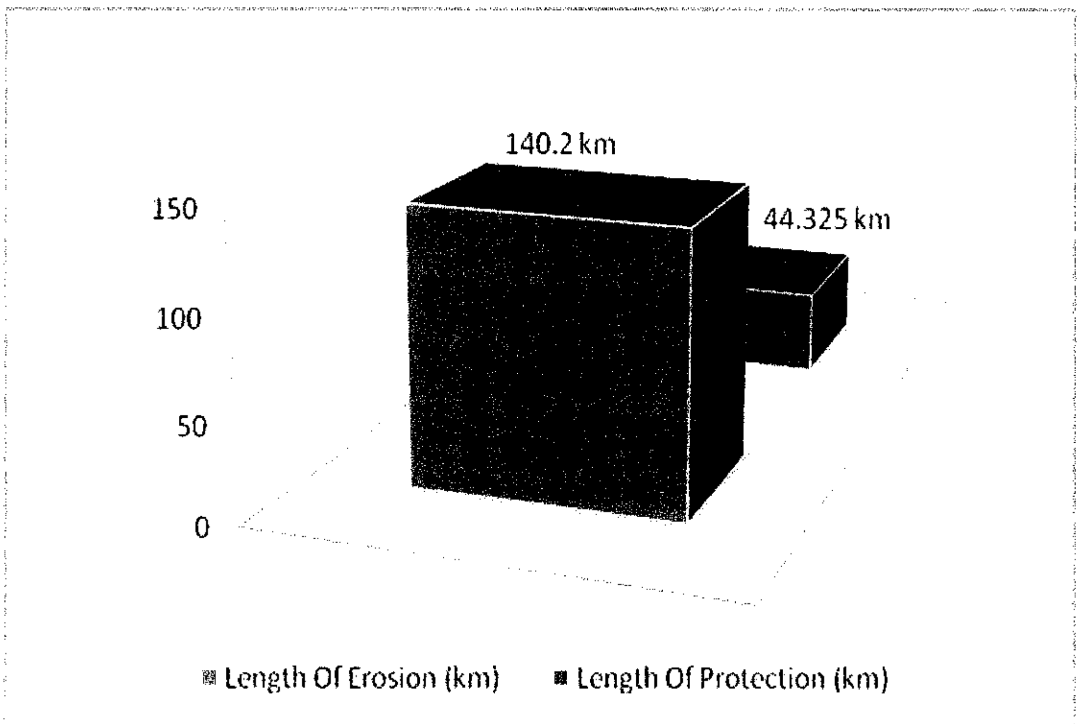

KEDAH
3% 3% 4%
Flex slab revetment
Revetment
Groynes + Beach Nourishment
Toe protection for existing wall

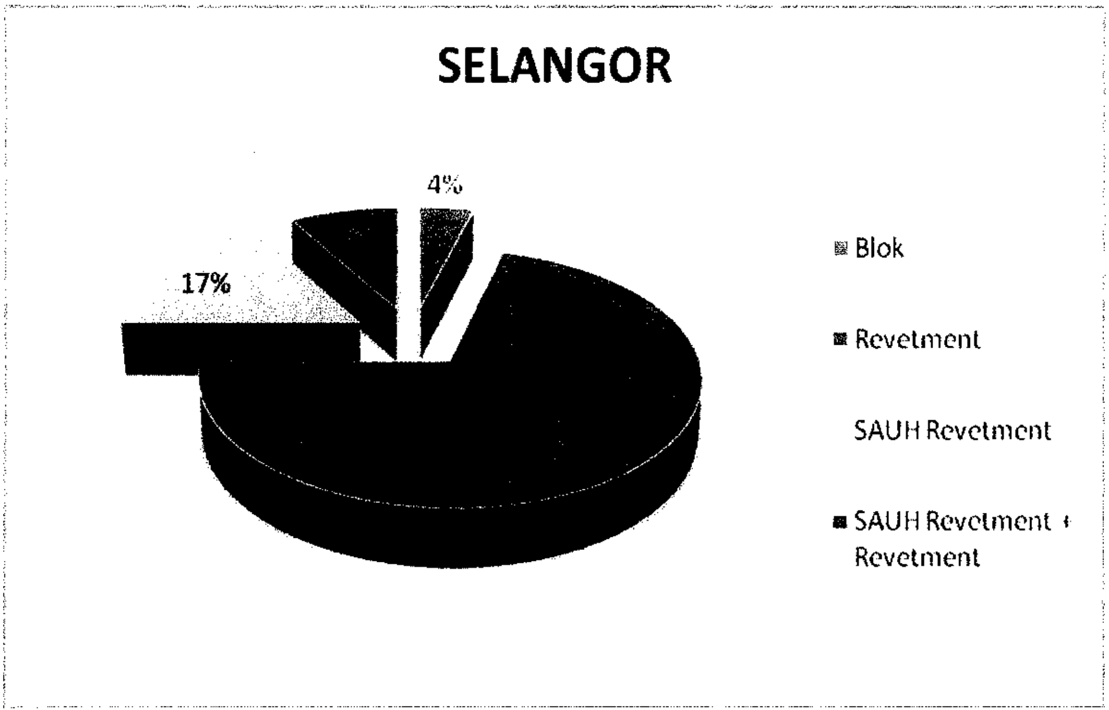

35.215 km
43.5 km
50
40
30
20
10
0
Length Of Erosion (km)
Length Of Protection (km)

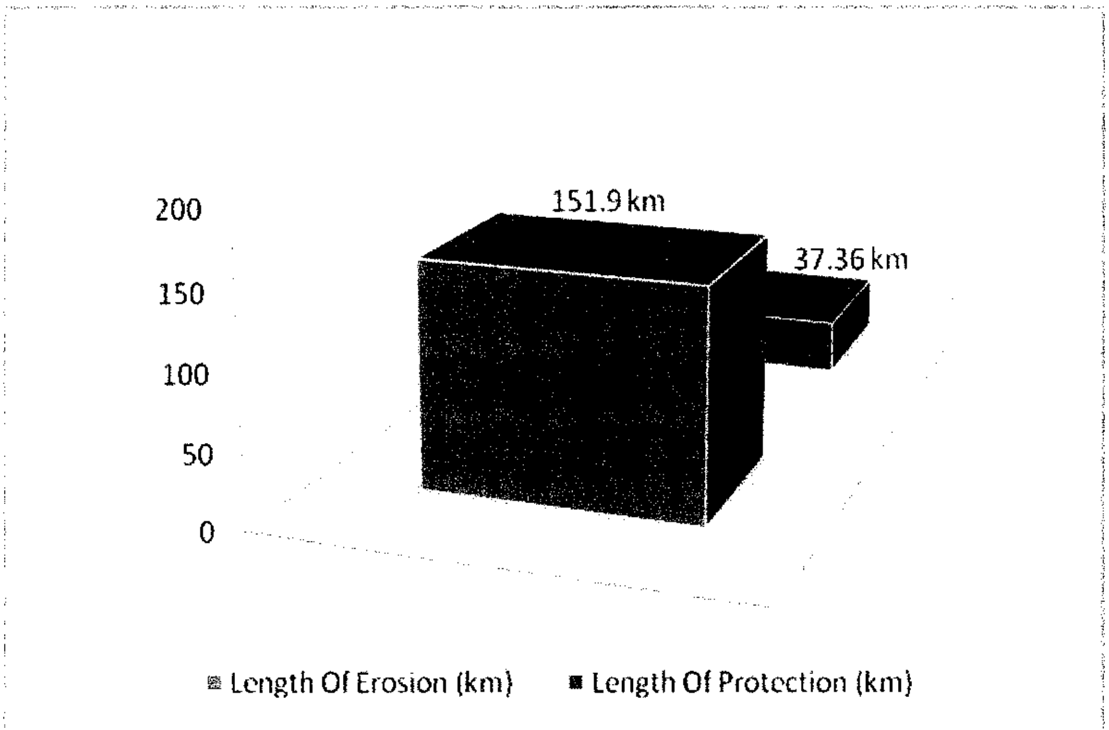

P.PINANG
6%
6%
6%
6%
Revetment
beach Nourishment + Revetment
Groynes
Groynes + Beach Nourishment
Revetment + Mini Breakwaters
Terminal Groynes + Revetment

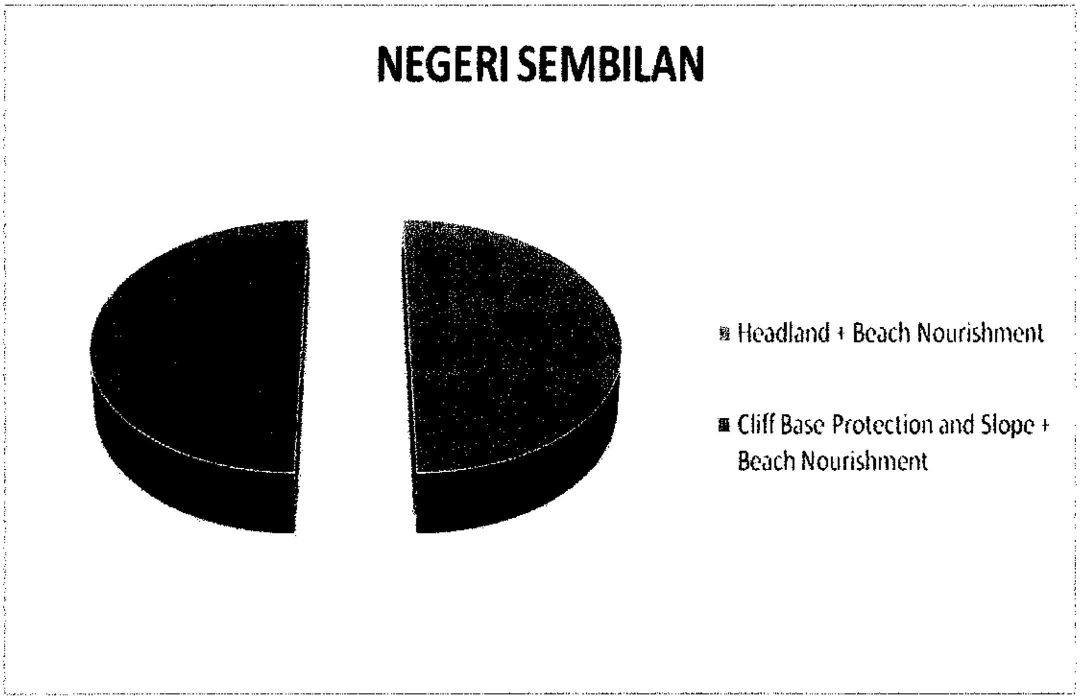

53.2 km
13.138 km
60
40
20
0
Length Of Erosion (km)
Length Of Protection (km)

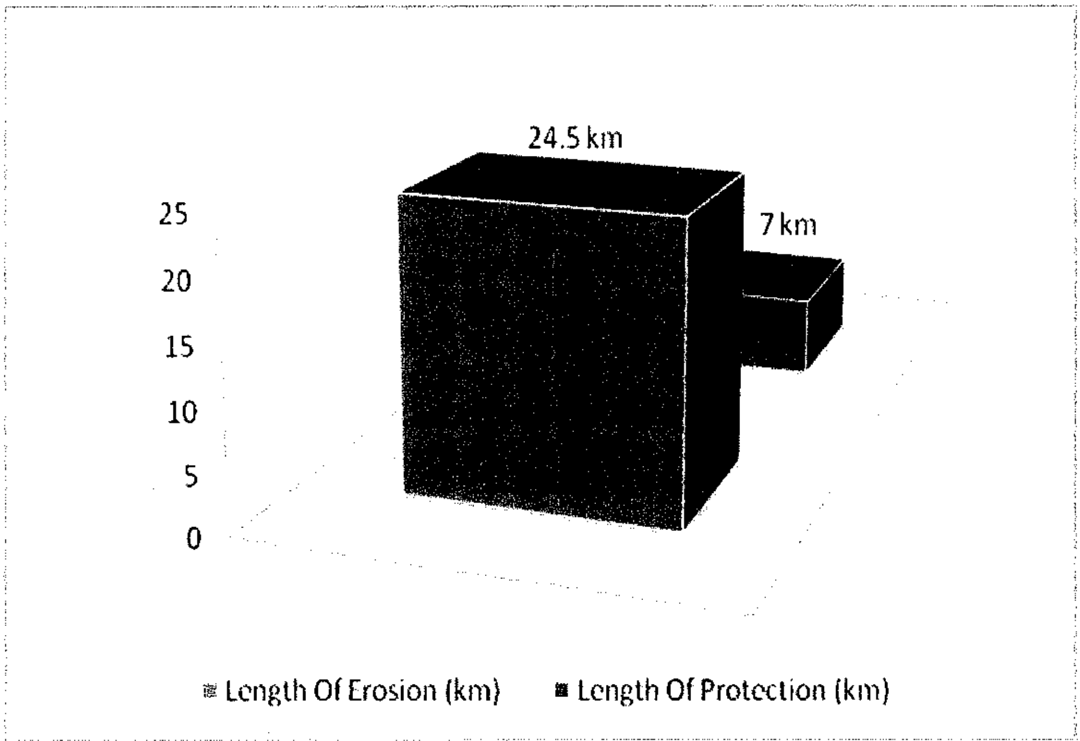

PERAK
Rock Bund + Revetment
Revetment

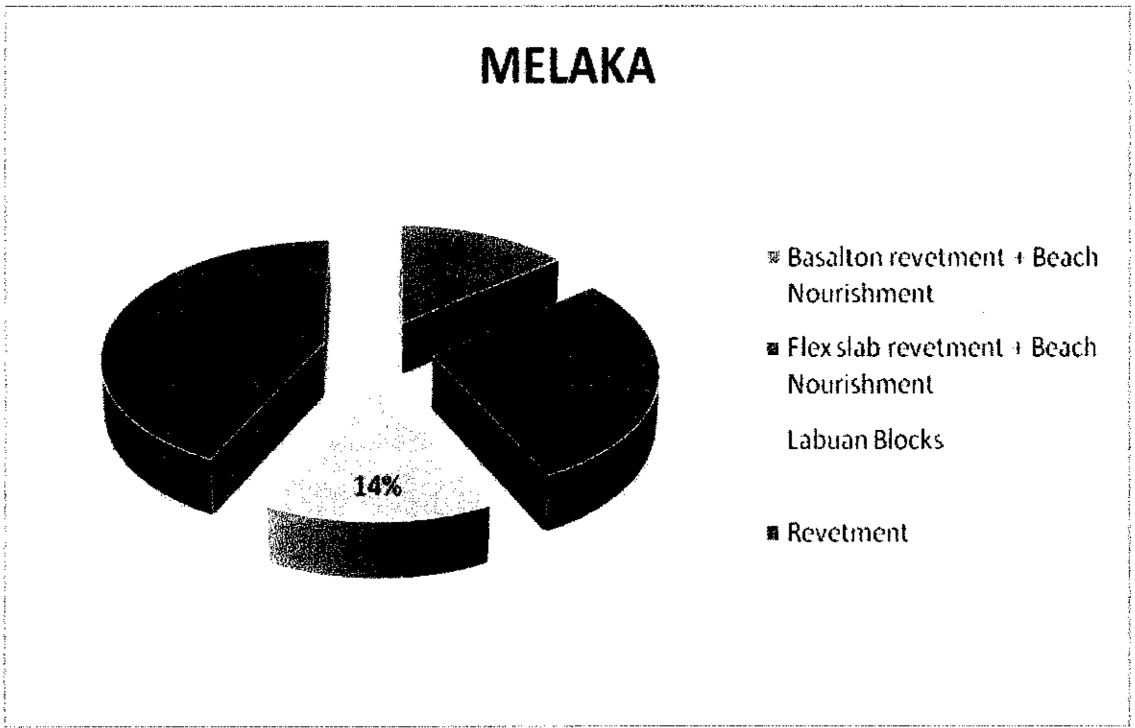

140.2 km
44.325 km
150
100
50
0
Length Of Erosion (km)
Length Of Protection (km)

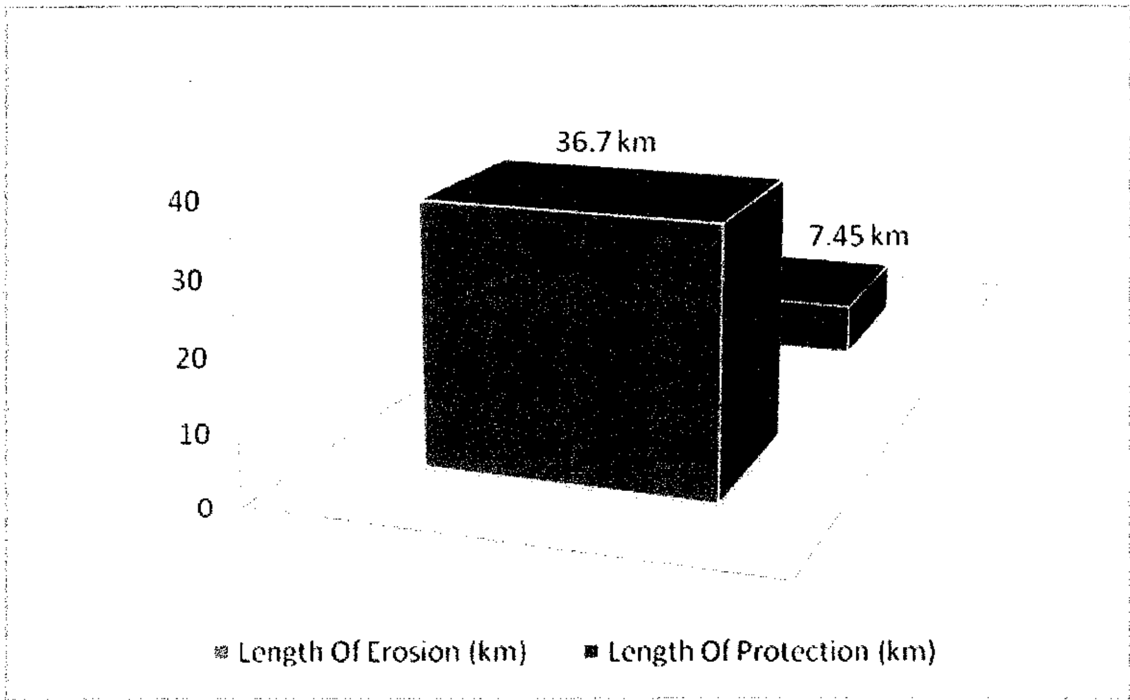

SELANGOR
4%
17%
Blok
Revetment
SAUH Revetment
SAUH Revetment + Revetment

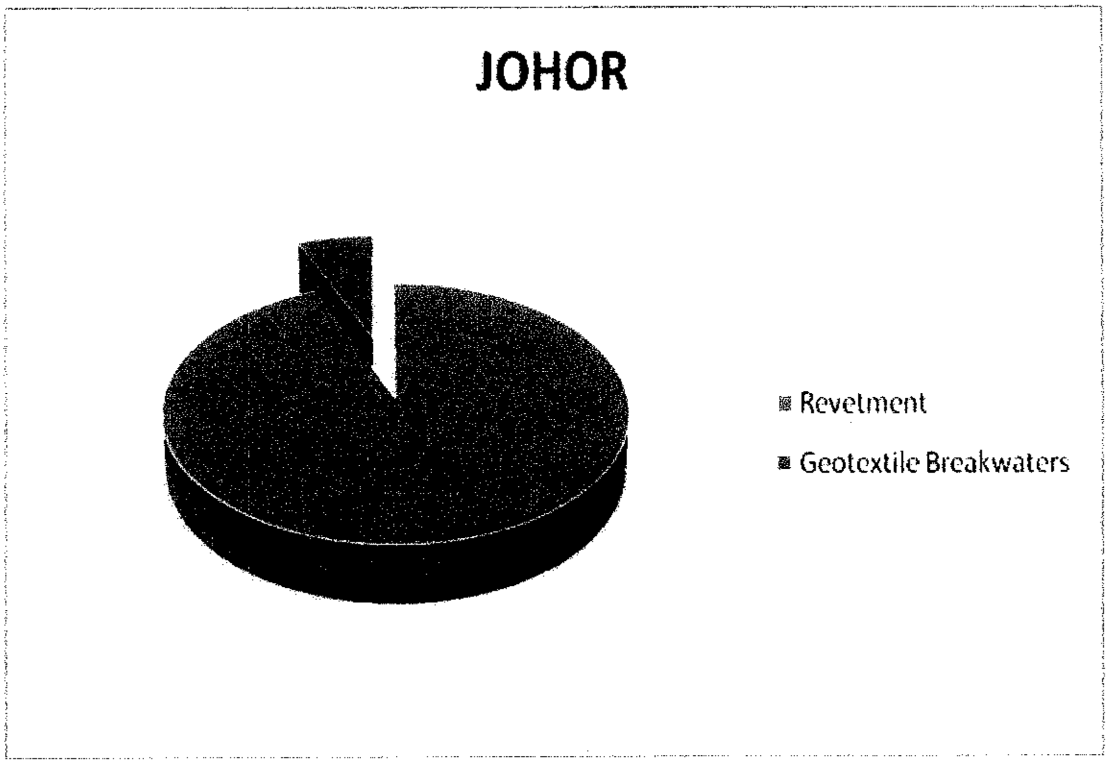

200
150
100
50
0
151.9 km
37.36 km
Length Of Erosion (km)
Length Of Protection (km)

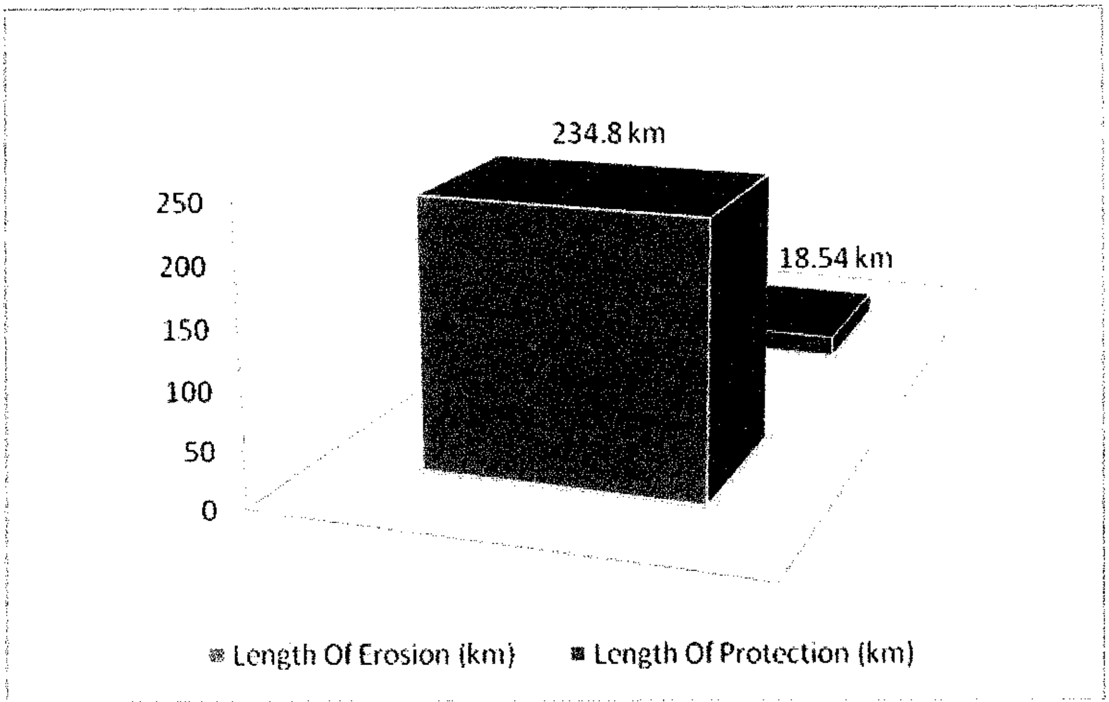

NEGERI SEMBILAN
Headland + Beach Nourishment
Cliff Base Protection and Slope + Beach Nourishment

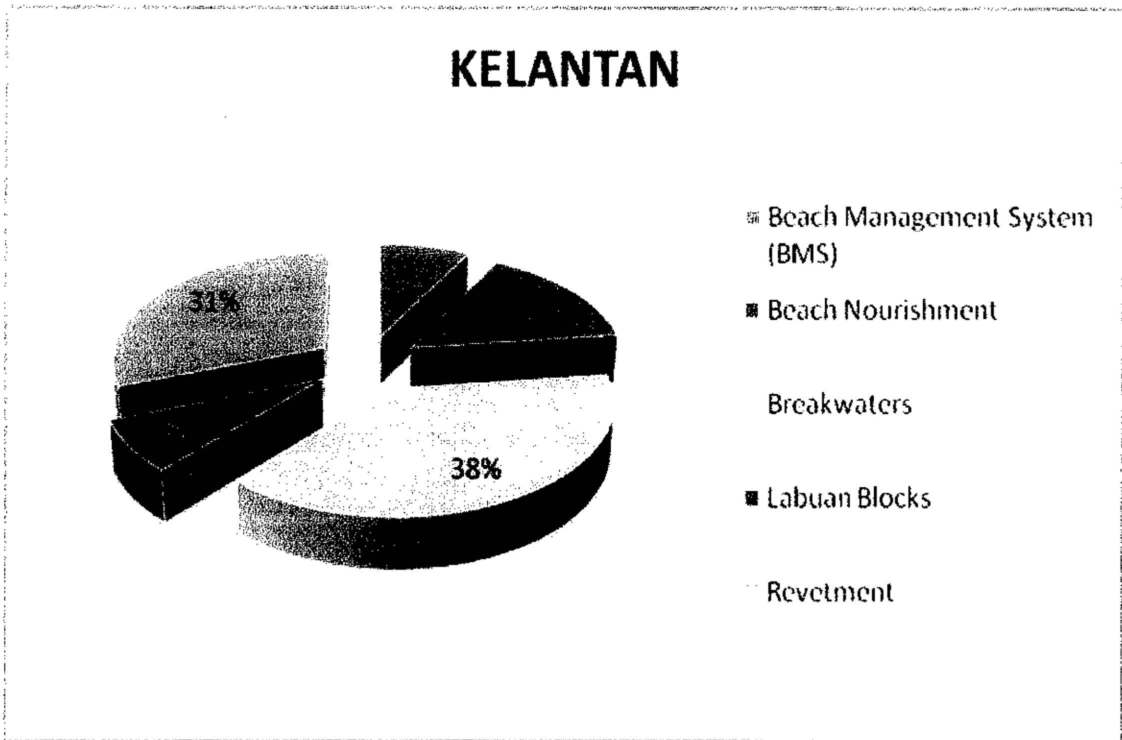

24.5 km
7 km
25
20
15
10
5
0
Length Of Erosion (km)
Length Of Protection (km)

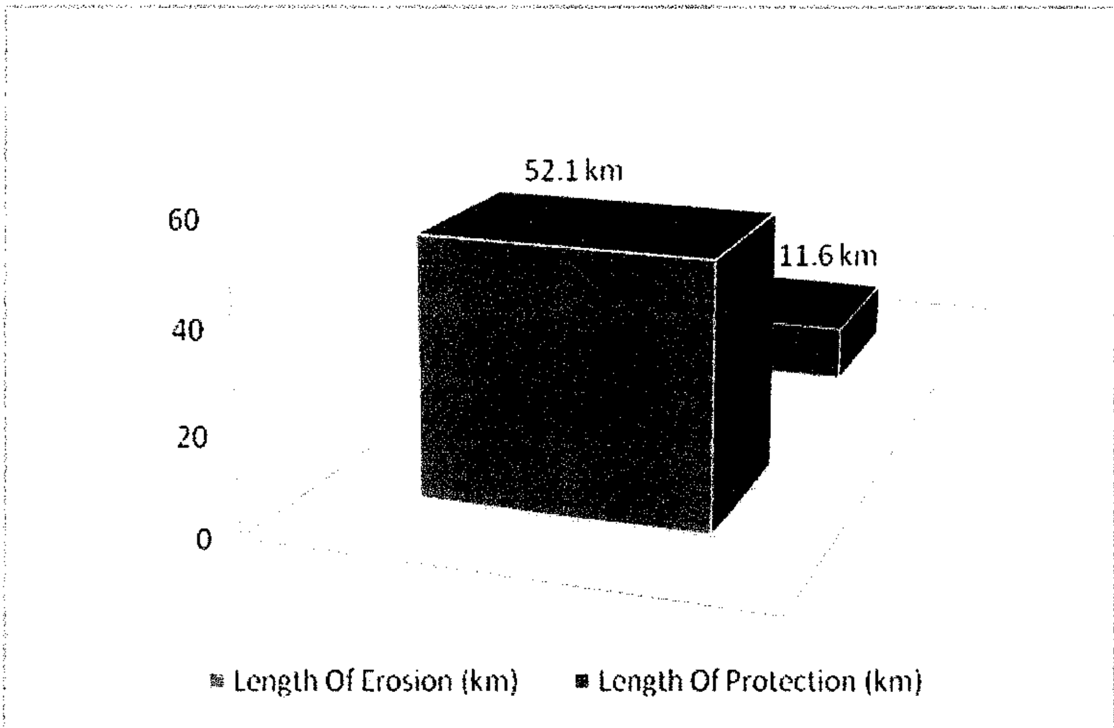

MELAKA
14%
Basalton revetment + Beach Nourishment
Flex slab revetment + Beach Nourishment
Labuan Blocks
Revetment

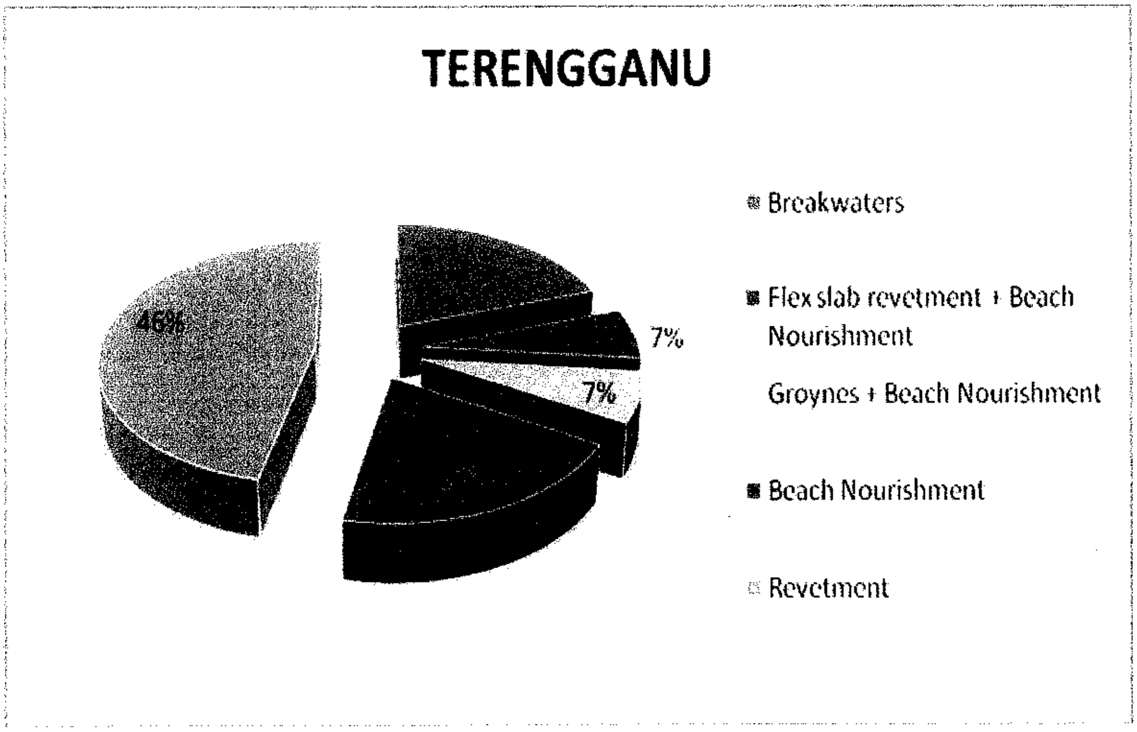

36.7 km
7.45 km
40
30
20
10
0
Length Of Erosion (km)
Length Of Protection (km)

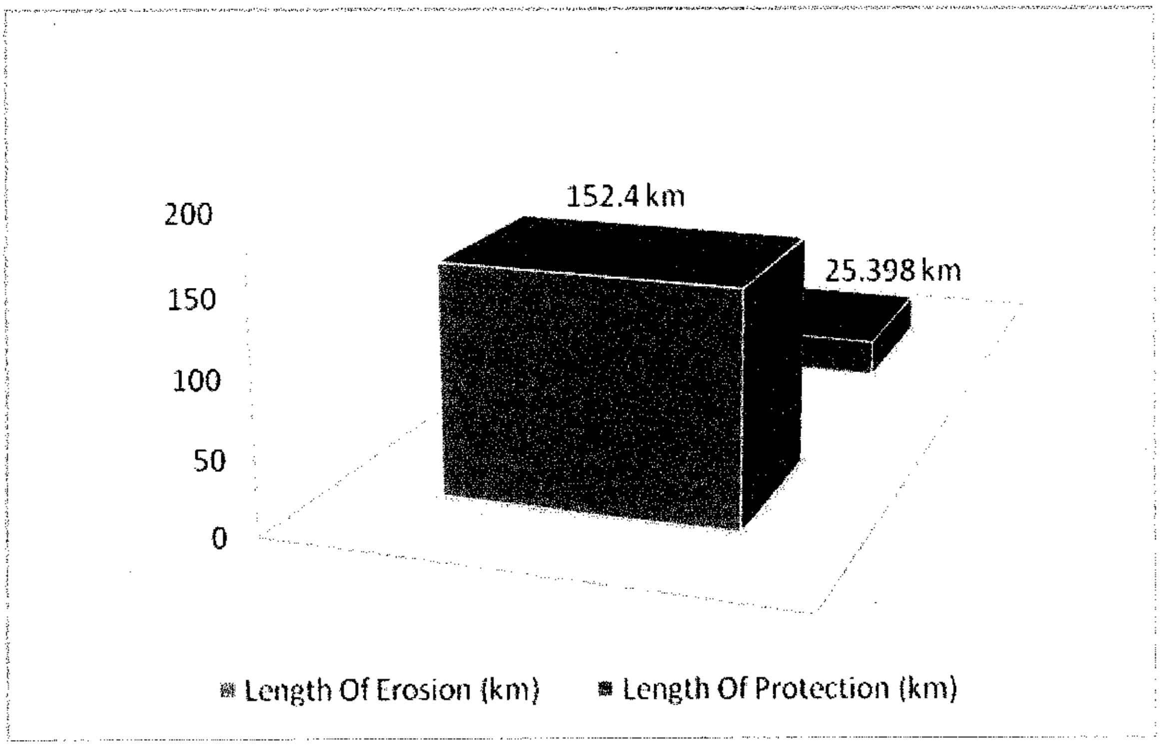

JOHOR
Revetment
Geotextile Breakwaters

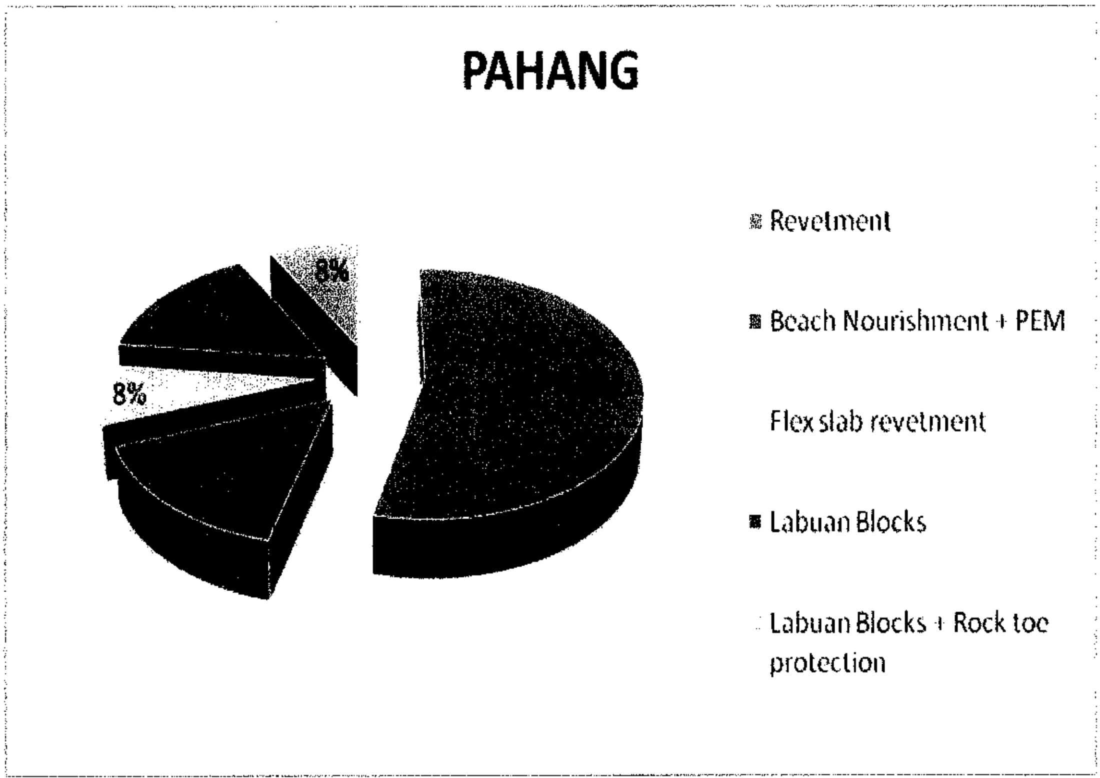

234.8 km
18.54 km
250
200
150
100
50
0
Length Of Erosion (km)
Length Of Protection (km)

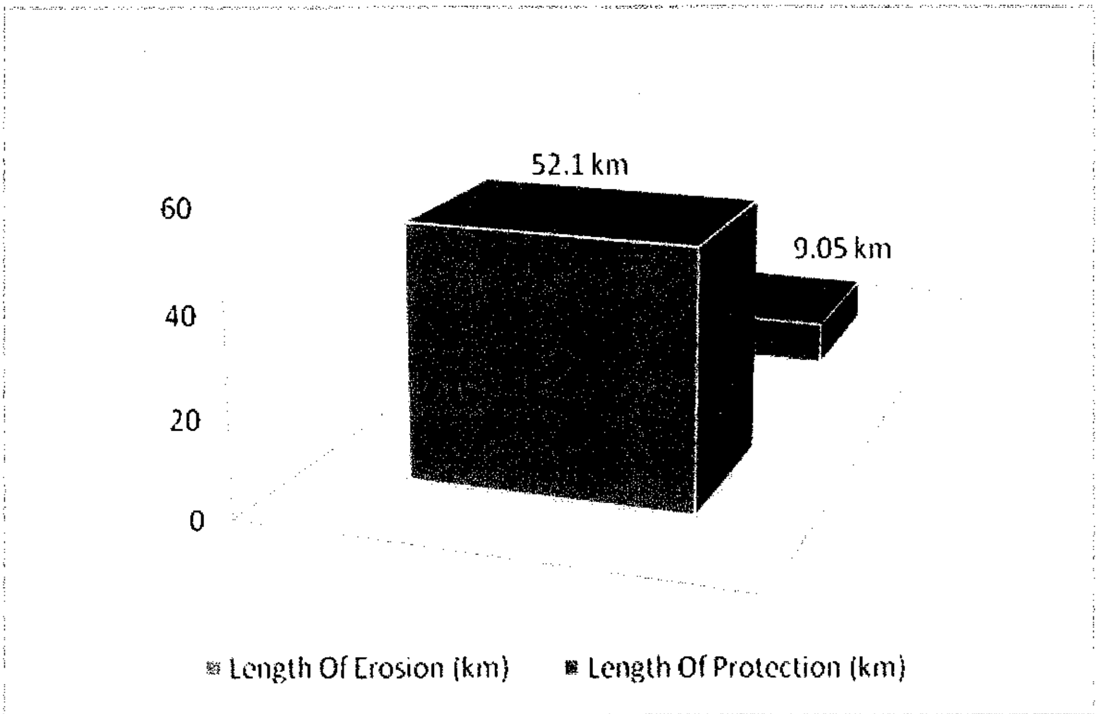

KELANTAN
31%
38%
Beach Management System (BMS)
Beach Nourishment
Breakwaters
Labuan Blocks
Revetment


52.1 km
11.6 km
60
40
20
0
Length Of Erosion (km)
Length Of Protection (km)


TERENGGANU
46%
7%
7%
Breakwaters
Flex slab revetment + Beach Nourishment
Groynes + Beach Nourishment
Beach Nourishment
Revetment


200
150
100
50
0
152.4 km
25.398 km
Length Of Erosion (km)
Length Of Protection (km)


PAHANG
8%
8%
Revetment
Beach Nourishment + PEM
Flex slab revetment
Labuan Blocks
Labuan Blocks + Rock toe protection


52.1 km
9.05 km
60
40
20
0
Length Of Erosion (km)
Length Of Protection (km)

4.2 Failure mechanism

a. Structures

From the previous research done by Dehua Gua (2009) and Pilarczyk (not stated), the failure mechanisms of slope in every coastal protection structure including revetment, groynes, and breakwaters are caused by:

i. *Wave impact*

Wave attack on structures will lead to a complex flow over and through the structure (filter and cover layer). During wave run-up the resulting forces by the waves will be directed opposite to the gravity forces. Therefore the run-up is less hazardous then the wave run-down.

ii. *Uplift (pressure difference)*

In the case of loose blocks an individual block can be lifted out of the structure with a force exceeding its own weight and friction. It is not possible with the cover layers with linked or interlocking blocks. Wave loads must be distributed (balanced) adequately over the sand (shear stress) and the cover layer (uplift pressure). Too much emphasis on one failure mechanism can lead to another mechanism.

iii. *Abrasion*

In the case of blocks connected to geotextiles (i.e. by pins), the stability should be treated as for loose blocks in order to avoid the mechanical abrasion of geotextiles by moving blocks.

iv. *Structure change (settlement, etc)*

- First, cavities under the mattress will form as a result of uneven subsidence of the subsoil. The mattress is rigid and spans the cavities.
- With large spans, wave impacts may cause the concrete to crack and the spans to collapse. This results in a mattress consisting of concrete slabs which are coupled by means of the geotextile.
- With sufficiently high waves, an upward pressure difference over the mattress will occur during wave rundown, which lifts the mattress.
- The pumping action of these movements will cause the subsoil to migrate, as a result of which an S-profile will form and the structure will collapse completely.

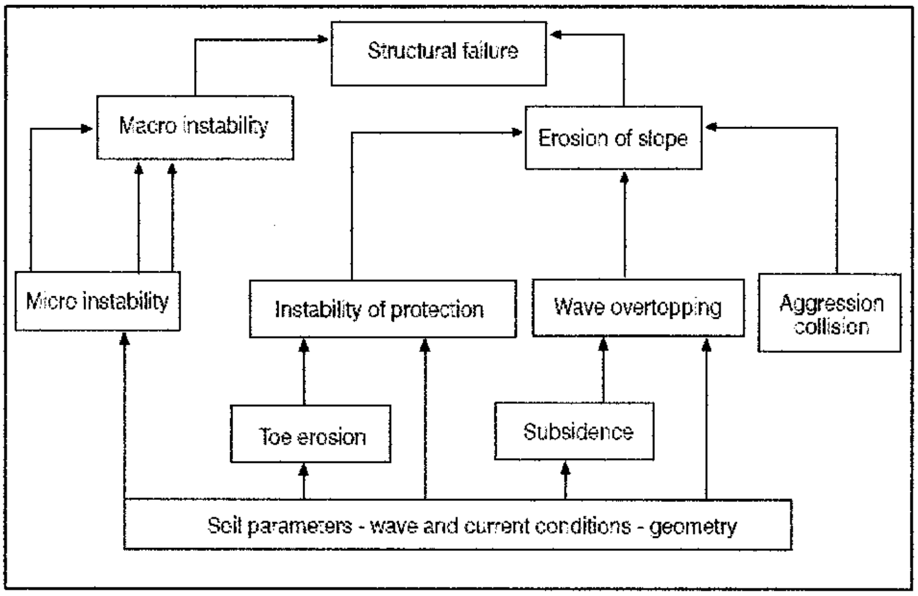


Figure 4.31: Factors contributing to structural failure (Mokhtar, 2001)

b. Faulty Design

In the stage of designing coastal protection structures, every detail must be calculated correctly without any mistakes. Slightly error could proceed to greater loss of cost and environment. Common misapprehension for:

i. *Short Groynes*

Short groynes cause a local depression in the littoral drift along the beach face, but allow the majority of the littoral drift to pass by un-interrupted. This has two effects, firstly it reduces the local sediment deficit and secondly, the groynes act as local hard points about which the shoreline can rotate.

On an actively eroding coast short groynes tend to only retard erosion as, although the shoreline is initially stabilized, profile steepening occurs and in the medium term failure of the groynes tends to occur unless they are extended landward. The effectiveness of short groynes is therefore very site specific.

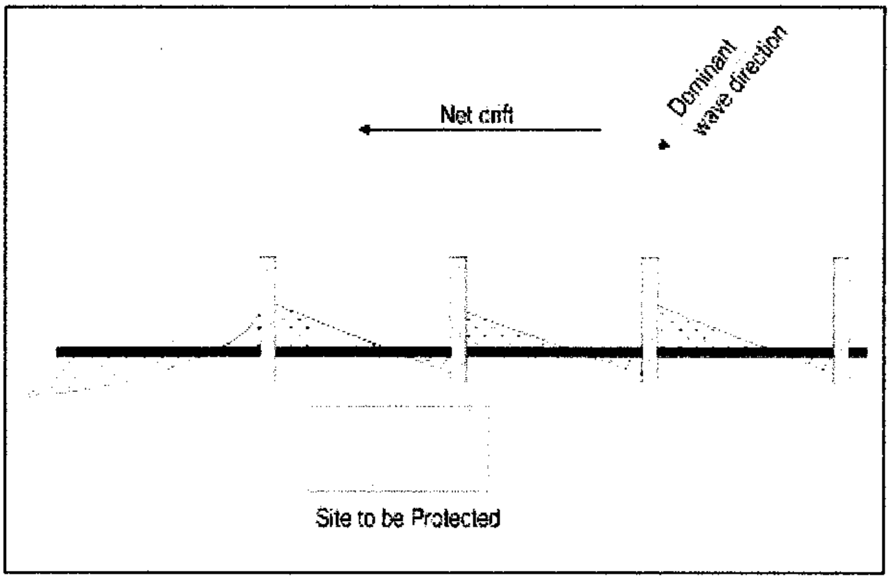


Figure 4.32: Outline Function of Short Groynes

ii. *Seawall*

When designing seawall, it is important that the structure can hold accordingly as active pressure behind the seawall could stand the passive pressure from the wave impact. Figure 4.33 explained the concept in designing the seawall.

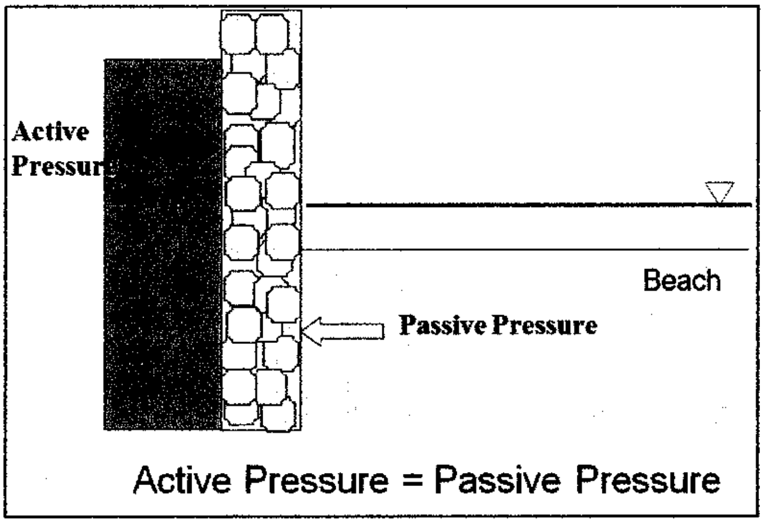


Figure 4.33: Fundamental in designing seawall (DID, 2009)

If the seawall has a reflective, rather than absorbent profile: Figure 4.34, and beach levels are low enough to allow regular wave contact with the wall, then long term scour problem is likely and the stability of the wall foundation may be reduced.

Wave attack on seawalls resulting in overtopping and potentially flood damage. However, DID Malaysia did not recommend this type of structure now for rehabilitation of coastlines.

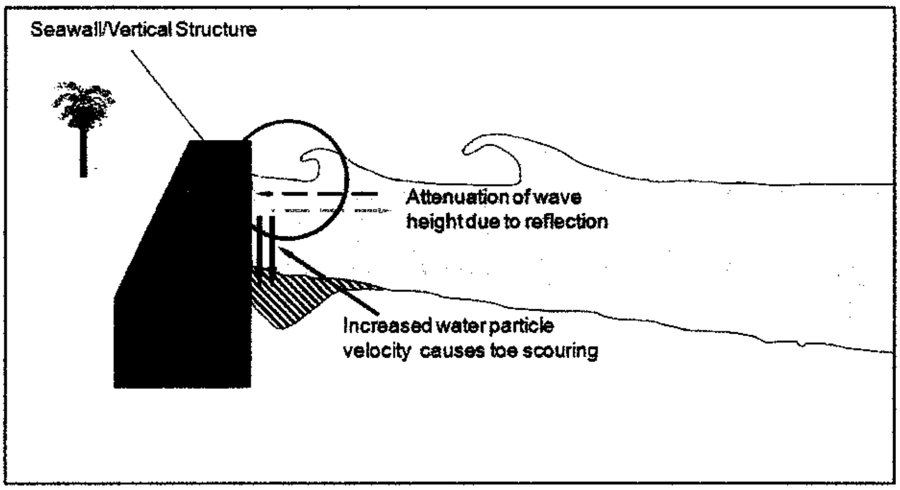


Figure 4.34: Concept of seawall failure (DID, 2009)

c. Example on Structures Failure

i. Rock Revetment

Description : -Collapse revetment at Sungai Tiang Selatan, Daerah Bagan Datoh, Perak.

-Approximately 30m of structures was failed.

Date : 2005, August

Caused by :

- Greater wave impact
- No mangrove growth (in breaker zone)

ii. Rock Bund

Description : - Structure failure (rock bund) at Pantai Sg. Tiang Utara, Perak: cause the entering of sea water behind the structure.

Caused by :

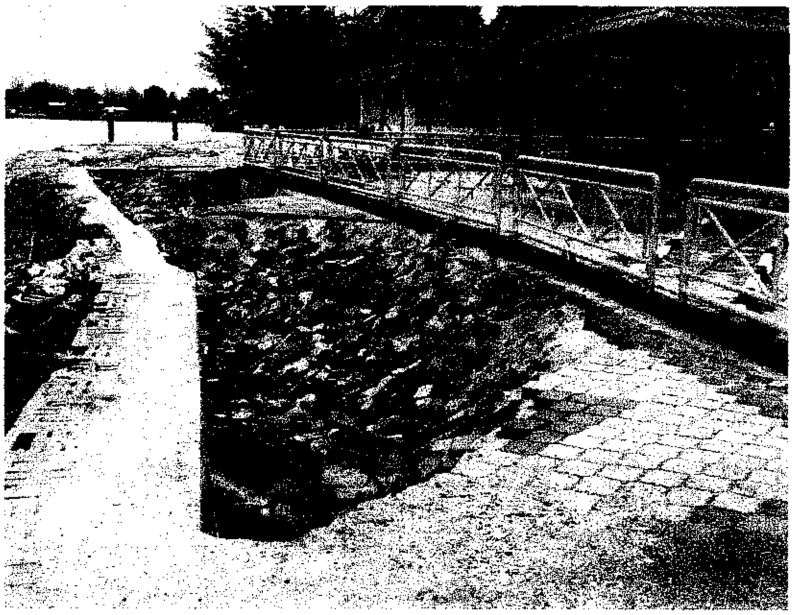
- Unstable soil condition
- Settlement underneath - cause the ineffectiveness design towards protecting area. Crest level had been allocated from original position.
- Buffer zone was distracted by the absence of mangrove
- Present of crab. Hole spotted as their habitat.

iii. Flex-slab Revetment

Description : - Failure of flex-slab revetment structure at Pantai Dataran Kuala Besut, Terengganu.

Caused by :

- In monsoon season, maximum wave height attacking the structure
- Greater impact and pressure to the structure limiting the resistant toward the waves
- Wave overtopping



iv. Rock Toe Protection

Description : - Failure of toe protection at Taman Gelora, Kuantan, Pahang.

- Nearly 62m of structures was eroded.

Date : 2004, May

Caused by :

- Unstable soil condition
- No mangrove growth (in breaker zone)

v. Groynes

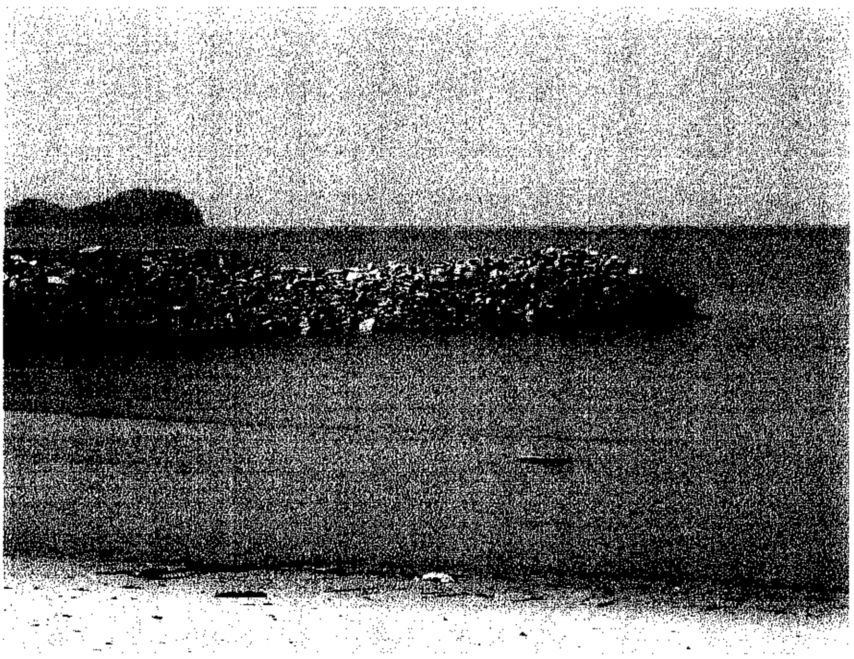
Description : - Tsunami attack on the structures causes severe damage to the structure.(groynes tip)

Location : Mouth of Sungai Batu,Penang.

Date : 2004, December

Caused by :

- Large waves occur
- Overtopped the protection and inundated the tarred road in the hinterland
- The inundation to be sudden and preceded by a drop in sea water level
- Backshore inundation was estimated to be 1 meter deep



4.3 Determination of size of armour

a. *Hudson Formula*

The Hudson formula was derived from a series of regular wave tests using breakwaters model. The formula is given by:

$$W = \frac{\rho_r g H^3}{K_D \Delta^3 \cot\alpha}$$

where W = Weight of an armour unit (N)

H = Design wave height at the structure (m)

K_D = Dimensionless stability coefficient

α = Slope angle of structure

ρ_r = Mass density of armour (kg/m^3)

g = Acceleration due to gravity (m/s^2)

Δ = Relative mass density of armour = $(\rho_r / \rho_w) - 1$

ρ_w = Mass density of sea water (kg/m^3)

ρ_r and ρ_w may be taken as 2600 kg/m^3 for rock and 1025 kg/m^3 for sea water respectively for design purpose.

For non breaking wave condition, the design wave height may be taken as $H_{1/10}$ at the side of the structure. For condition where $H_{1/10}$ will break before reaching the structure, the wave used in design should be the breaking wave height or significant wave height, whichever has the more severe effect (BSI, 1991).

Suggested values of KD for rock armour at the trunk and head of structures under non breaking and breaking wave condition can be found in BS6349 : Part 7: 1991(BSI, 1991). These quoted values do not take account of the differences in factors such as wave period and spectrum, shape of armour rock, placement method, interlocking, and angle of wave incidence, size of under layer and porosity which will have influence on stability. They should not be used without careful reviews of the factors involved.

The main advantages of Hudson formula are its simplicity and the wide range of armour units and configurations for which K_D value have been derived. The Hudson formula also has many limitations which include:

- Potential scale effects due to small scales at which most of the tests were conducted
- The use of regular waves only
- No account taken in the formula of wave period or storm duration
- No description of the damage level
- The use of non overtopped and permeable core structures only

b. Van der Meer Formulae

Van der Meer derived two formulae for plunging and surging waves. The formulae take account of the influence of wave period, storm duration, armour grading, and spectrum shape, groupies of waves, core permeability and damage level on rock armour and therefore they are described as practical design formulae for rock armour. The formulae are (BSI, 1991):

For plunging waves,

$$\frac{H}{\Delta D_{n50}} = \sqrt{\xi_m} = 6.2P^{0.18} = \left(\frac{S}{\sqrt{N}}\right)^{0.2}$$

For surging waves,

$$\frac{H}{\Delta D_{50}} = 1.0P^{-0.13}\left(\frac{S}{\sqrt{N}}\right)^{0.2}\left(\sqrt{\cot\alpha}\right)\xi_m^{\ P}$$

where H = Design wave height, taken as the significant wave height (m)

D_{50} = Nominal rock diameter equivalent to that of a cube (m)

Δ = Relative mass density of armour = $(\rho_r / \rho_w) - 1$

P = Notional permeability factor

α = Slope angle of structure

N = Number of waves

S = Damaged level = $A / D_{n50}^{\ 2}$

A = Erosion area in cross-section (m^2)

ξ_m = Surf similarity parameter for mean wave period $= (\tan\alpha)/\sqrt{s_m}$

s_m = Offshore wave steepness based on period = $2\pi H / gT_m^{\ 2}$

T_m = Mean wave period (s)

g = Acceleration due to gravity (m/s^2)

The transition from plunging to surging waves is calculated using a critical value of ξ_c (CIRIA, 1991) :

$$\xi_c = \left(6.2P^{0.31}\sqrt{\tan\alpha}\right)^{1/(P+0.5)}$$

Depending on the slope angle and permeability, this transition lies between ξ_c = 2.5 to 3.5. When the value of surf similarity is greater than ξ_c, the formula for surging waves should be used. For cot $\alpha \geq 4$, the transition from If in plunging to surging does not exist and for these slope, only formulae for plunging waves should be used.

The national permeability factor P should lie between 0.1 for a relatively impermeable core to 0.6 for a virtually homogenous rock structure. The choice of P depends on designer's judgement. Where data are not available for detailed assessment, P may be taken as 0.3 for rock armoured breakwater, unless an open core is provided. If in doubt, it is recommended that the permeability be underestimated rather than over-estimated.

The damage level S is the number of cubic stones with a side of D_{n50} being eroded around the water level with a width of one D_{n50}. The limits of S depend mainly on the slope of the structure. The start of damage of S = 2 to 3 is the same as that used by Hudson, which is roughly equivalent to 5% damage. Failure is defined as exposure of the filter layer.

The formulae can be used when the number of waves N, or storm duration, is in the range of 1000 to 7000. For N greater than 7000, the damage tends to be overestimated. Unless data are available for more detailed assessment, values of N from 3000 to 5000 may be used for preliminary design purpose (BSI, 1991).

The slope of the armour structure, *cot α,* should lie between 1.5 and 6. The wave steepness s_m should be within the range of 0.005 and 0.06. Waves become unstable when the steepness is greater than 0.06.

For shallow water conditions, the parameter ($H_{2\%}$ /1.4) should be used in the above Van der Meer formulae instead of significant wave height $H_{1/3}$. This is based on the analysis of some test results of breaking waves on the foreshore of a structure. These results indicated that if the structure is located in relatively shallow water and that if the wave height distribution is truncated, the 2% value of the wave height exceedance curve gives the best agreement with results showing a Rayleigh distribution (Van der Meer, 1990).

4.4 Limitations and Problems on Study

i. Data gathering

The process in data collection is a very crucial in finishing this thesis. A meeting with certain department managing the data regarding coastal protection structures is difficult to set up. Some of the past coastal rehabilitation plan projects was disposed due to its time. Instead, some data are scattered. Not all are kept in one place. More effort had to be show up in travelling for the data to the authority (consultancy or Government). Furthermore, most of the data are very private and only certain people can access into it. The author had to work very hard to convince these people for the data. So, there are limit in gathering the data.

ii. Predicting proper design criteria

As the process in accumulating the data is very hard to conduct, analysis of design criteria for better understanding in constructing of coastal protection structures in the future could not be achieve as stated in the objectives of this thesis. Only a few place in the Peninsular Malaysia that the author with his supervisor can discuss more about the characteristics of it. Lack of data such as plan is one of the major reasons why this problem arises. However, the author manages to gather a basic data about coastal protection structures in Peninsular Malaysia. The accesses of referring the coastal structures in Peninsular Malaysia can be done by using MapInfo Professional 7.0® develop by the author.

4.5 Benefits of using GIS

MapInfo Professional 7.0® has the ability to handle much larger databases and integrate and synthesises data from a much wider range of relevant criteria than might be achieved by manual methods. Application of this software has encouraged the development and use of standards for coastal data definition, collection and storage which promotes compatibility of data processing techniques.

The use of shared database (especially if the access is provided via a data network) also facilitates the updating of records and the provision of a common set of data to the many different departments or offices that might typically be involved in management of coastal shorelines.

It also provides a stable platform for integration of disparate data from different sources and allowed a large quantity of data to be stored and processed. Instead, advance facilities for displaying and visualisation of data to a wider audience are the characteristic of this application.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.0 CONCLUSION

In these present days, Department of Irrigation and Drainage (DID) Malaysia, especially Coastal Management Department are aware towards coastal erosion problems. Coastal protection structures such as revetment, breakwaters, groynes and etc. was build to prevent this matter from getting worse. Although the development running smoothly, there were still weakness in certain part that they couldn't resist.

Since the database was created by the author, it is hoped that it will contribute in deriving an appropriate and successful coastal protection structures in the future. We must understand that the principal concept that in the process of designing coastal protection structures, proper initial study and investigation in the area must be conducted before proceeding to the construction works. Failing to take initial consideration as a first step would lead to disaster and loss in the end.

Instead, the construction of coastal protection structures also depends on suitability of places and related on local climatic, oceanographic and morphologic condition.

5.1 RECOMMENDATION

The development of Malaysia nowadays is in faster phase if we compare to its past. By considering that, improvement in the database technology also needs to be emphasised. Instead of having this database, the author would like to suggest that the next step must be taken in fulfil the missing data so that a perfect database could be created.

CHAPTER 6
ECONOMIC BENEFITS

6.0 COST

Mainly this thesis is more related to research studies and software development. Information, knowledge and skills are needed to complete it. Money is spending for travelling in gathering the data across the Peninsular Malaysia. By the way, the author only managed to get the data from Department of Irrigation and Drainage Malaysia (Headquarters) located in Kuala Lumpur due to lack of time and cost. The amount of spending is approximately two hundred and fifty ringgit (RM 250) equivalent to four time of travelling to Kuala Lumpur.

6.1 ECONOMIC VALUES

The database created by the author can be described clearly in perspective for long term benefits. The benefits in the view of economic relevant include saving time for many parties whether the government, consultant or contractor. They can refer to this database as an initial consideration for developing coastal protection structures. However, site visit, survey and other field measurement need to be carried out prior to the detailed engineering design.

Knowledge and understanding from this database hopefully can help in future design process. The comparison can be made by referring to this database create by the author. Over design of the coastal protection structures and failure mode can be prevented thus improve the efficiency in designing the successful structures.

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APPENDICES

RAW DATA

i. Location of coastal protection structures for all state in Peninsular Malaysia
ii. Types of coastal protection structures which had been implement by DID
iii. Length of protection area cover by the structures
iv. Date of project started
v. Date of project ended

PERLIS

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURE
1	Kampong Sg. Dua	2600	14-Jun-89	7-Aug-90	Rock bund
2	Utara Tok Pandak	1237 (total length = 3821)	11-Oct-79	14-Dec-80	Rock bund
3	Selatan Sg. Padang	233 (total length = 3821)	11-Oct-79	14-Dec-80	Rock bund
4	Utara Sg. Padang	757 (total length = 3821)	11-Oct-79	14-Dec-80	Rock bund
5	Selatan Sg. Baru	1594 (total length = 3821)	11-Oct-79	14-Dec-80	Rock bund
6	Utara Sg. Bugis	(total length = 2064 - refer to remark)	9-Dec-85	8-May-87	Rock bund
7	Selatan Sg. Bugis	(total length = 2064 - refer to remark)	9-Dec-85	8-May-87	Rock bund
8	Selatan Sg. Bugis	727 (total length = 1736 - refer to remark)	15-Jul-80		Rock bund
9	Utara Sg. Bugis	738 (total length = 1736 - refer to remark)	15-Jul-80		Rock bund
10	Kampung Siput	271 (total length = 1736 - refer to remark)	15-Jul-80		Rock bund
11	Kuala Perlis	1200	1-Nov-1999	29-Oct-00	Revetment
12	Sg Padang, Tok Pandak	1400	10-Apr-2001	15-Jan-02	Revetment
13	Sg. Perlis	800	Dec-90	Aug-91	Rock Revetment
14	Sg. Perlis	1200	Nov-91	Nov-00	Rock Revetment
15	Sanglang	1500	Apr-01	Dec-01	Rock Revetment
16	Perlindungan Ban Sungai Baru	900	Jul-04	Jul-05	Rock Revetment
17	Kuala Perlis	1700	Dec-07	Jul-08	Rock Revetment & Labuan Blocks

KEDAH

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Alor Ibus	2725	26-May-93	12-Oct-93	Revetment
2	Kuala Kedah	500	29-Jul-89	30-Mar-90	Revetment
3	Alor Melaka, Kuala Kedah	875	23-May-94	11-Sep-94	Revetment
4	Kampung Padang garam	222	6-Aug-90	23-Dec-90	Revetment
5	kampung Padang Garam	1000	1-Jan-87	25-Mar-87	Revetment
6	Kampung Padang Garam	1785	14-Apr-82	12-Apr-83	Revetment
7	Kuala Dulang Kecil	45m (repair) 45m (construction)	7-Jun-98	24-Oct-98	Revetment
8	Sg. Kubang Bongor	2208	14-Nov-89	7-Jan-91	Revetment
9	kampung Jeruju	4100	4-Jun-90	15-Dec-91	Revetment
10	Kuala Tunjang	400	16-Oct-95	4-May-96	Revetment
11	Pg. Jeruju- Kuala Jerlun Kubang	1620	26-Sep-95	23-Sep-96	Revetment
12	Sg. Limau	700	18-Sep-95	16-Jun-96	Revetment
13	Sg. Raga - Sg. Ruat	2000	1-Nov-95	29-Dec-96	Revetment
14	Sg. Muda	600	17-May-93	20-Feb-94	Revetment
15	Tanjung Dawai	1200	12-Jun-93	30-Mar-94	Revetment
16	Pantai Merdeka	800	21-Apr-90	20-Aug-91	Revetment
17	Tanjung Dawai	590	6-Nov-90	5-Sep-91	
18	Pantai Murni	300	21-Jan-91	5-Oct-91	Revetment
19	Kg. Padang Garam	2100	29-Aug-00	19-Dec-00	Revetment
20	Pantai Murni	300	Jan-91	Oct-91	Toe protection for exisiting seawall
21	Pantai Merdeka	800	Apr-90	Aug-91	Flex-slab revetment
22	Tanjung Dawai (Phase1)	800	Nov-90	Sep-91	Rock groynes + Sand nourishment
23	Tanjung Dawai (Phase2)	1300	Jun-93	Mar-94	Rock Revetment

24	Kg. Tepi Sungai Kula Muda	600	May-93	Feb-94	Rock Revetment
25	Kg.Jeruju - Kuala Jerlun,Kubang Pasu	1600	Sep-95	Sep-96	Rock Revetment
26	Kuala Sungai Limau,Yan	600	Sep-95	Jun-96	Rock Revetment
27	Sungai Raga - Sungai Ruat,Yan	2000	Nov-95	Dec-96	Rock Revetment
28	Kg. Singkir Laut	2500	5-Mar	6-Sep	Rock Revetment
29	Kg. Huma	900	5-Jun	6-Jun	Rock Revetment
30	Kuala Sala Kecil & Kuala Kangkong		6-Nov	8-Aug	Rock Revetment
31	Kg. Kelantan, Mukim Dulang,Yan		6-Jul	8-Jan	Rock Revetment

[redacted]

PULAU PINANG

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Sg. Abdul		1-Jun-95	24-Aug-95	Groynes
2	Balik Pulau	800	15-Jan-01	14-May-02	Rock Revetment
3	Balik Pulau	1600	Nov-88	May-91	Rock Revetment
4	Seberang Perai Utara (SPU)	263	Feb-91	Aug-91	Rock Revetment
5	Seberang Perai Utara (SPU)	225	Apr-91	Apr-92	Rock groynes + Sand nourishment
6	Butterworth	3600	Apr-91	Dec-94	Beach nourishment + Rock revetment
7	Seberang Perai Utara (SPU)	1700	Apr-92	Sep-92	Rock Revetment
8	Seberang Perai Utara (SPU)	350	Sep-94	Jun-95	Rock Revetment
9	Butterworth	2000	Aug-95	Nov-96	Rock Revetment
10	Bayan Lepas	500	Apr-96	Nov-96	Terminal groyne + rock revetment
11	Seberang Perai Utara (SPU)	600	Jul-03	Oct-04	Rock Revetment + mini breakwater
12	Butterworth	1500	Oct-04	Oct-05	Rock Revetment
		13 138m = 13.138 km			

PERAK

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURE
1	Sg. Belukang, Bagan Datoh	1210	2-Jun-93	1-Mar-96	Revetment
2	Sg. Belukang, Bagan Datoh	945(r. bund) and 510 (improvement work)	22-Jul-96	18-Jul-98	Revetment
3	Sg. Belukang - Tebuk Semani	2000	21-Sep-98	19-Dec-99	Revetment
4	Sg. Tiang	1490	22-Jun-93	21-May-95	Revetment
5	Bagan Lipas	260	25-Oct-93	24-Jun-94	Revetment
6	Bagan Lipas	220	15-May-95	25-Feb-96	Revetment
7	Sg. Belukang	1000	10-Aug-98	6-Feb-00	
8	Sg. Burung, Kerian	1750	8-Sep-97	15-Dec-98	Revetment
9	Tanjung Piandang	1000	14-Feb-95	12-Feb-96	Revetment
10	Sg. Tiang	0			
11	Sg. Belukang	0			
12	Sg. Belukang	0			
13	Sg. Belukang	0			
14	Sg. Belukang	0			
15	Kerian	850	26-Jun-99	30-Jun-00	Revetment
16	Bagan Datoh	2000	27-Apr-99	30-Jun-00	Revetment
17	Bagan Datoh	2000	21-Sep-98	31-May-00	Revetment
18	Bagan Datoh	3000	10-Aug-98	6-Feb-00	Revetment
19	Bagan Datoh	3000	13-Nov-00	12-Nov-01	Revetment
20	Kerian	800	4-Sep-00	10-Apr-01	Revetment
21	Hilir Perak	400	Oct-93	Jun-94	Rock Revetment

22	Hilir Perak	200	Aug-95	Feb-96	
23	Bagan Datoh	900	Jun-93	Aug-94	
24	Bagan Datoh	1200	Jun-93	Jan-96	
25	Bagan Datoh	2000	Jul-96	Jul-98	Rock revetment + retreat bund
26	Sungai Belukang	5000	Aug-98	Feb-00	Strengthening of retreat bund
27	Bagan Datoh	2000	Sep-98	May-00	Rock Revetment
28	Kerian	1600	Sep-97	Jul-98	
29	Kerian	900	Sep-99	Jun-00	
30	Tg. Piandang	1000	Feb-95	Feb-96	
31	Tg. Piandang	700	Sep-00	Apr-01	
32	Kerian	1500	Jul-03	Jun-04	
33	Sg. Tiang Selatan (naik taraf ban)	400	Oct-03	Oct-05	Rock Revetment & bund improvement
34	Parit C ke Sg. Batang Padang Bagan Sg. Belukar	5000	Sep-05	Sep-07	Bund construction & revetment
		44 325m = 44.325km			

SELANGOR

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Sg. Pulai - Sg. Banting	2860	24-Jan-95	30-Nov-95	Revetment
2	Bagan Pasir	700	14-Sep-98	7-Nov-99	Revetment
3	Sg. Burung	700	20-Oct-95	31-Jul-96	Revetment
4	Sekendi	1930	18-Dec-90	16-May-92	Revetment
5	Sg. Limau	1500	26-Dec-90	18-Jun-92	Revetment
6	Hj. Sirat	2800	15-Sep-93	29-Oct-94	Revetment
7	Tanjung Sauh - Benting Kepah	1900	22-Dec-97	20-May-99	Revetment
8	Hj. Sirat	400 &1000	5-Apr-91	2-Aug-92	Revetment
9	Hj. Sirat	870	15-May-95	18-Nov-95	Revetment
10	Kg. Batu Laut	3300	3-Jan-00	31-Dec-00	Revetment
11	Sekinchan	1600	Dec-88	Feb-90	SAUH revetment
12	Sekinchan	1200	Apr-91	Aug-92	SAUH revetment
13	Sekinchan	2700	Sep-93	Oct-94	Rock Revetment
14	Sekinchan	900	May-95	Nov-95	Rock Revetment
15	Sungai Besar	1500	Dec-90	Jan-92	SAUH revetment
16	Sungai Besar	1600	Dec-90	Jun-92	SAUH revetment
17	Sabak Bernam	1000	Oct-95	Aug-96	Rock Revetment
18	Sabak Bernam	2900	Feb-95	Dec-95	Rock revetment
19	Sabak Bernam	1900	Dec-97	Feb-99	Rock revetment
20	Tanjung Karang	700	Sep-98	Apr-99	Rock revetment

21	Kuala Langat	1500	Jan-00	Dec-00	Rock revetment
22	Sabak Bernam	1500	Dec-04	Dec-05	SAUH revetment & Rock revetment
23	Tanjung Karang	400	Aug-05	Aug-06	SAUH revetment & Rock revetment
24	Kuala Langat		Dec-07	Oct-08	Blok
		37 360m = 37.36km			

NEGERI SEMBILAN

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Batu 4	2000	May-95	Nov-96	Headland + beach nourishment
2	Baitul Hilal	1000			Cliff base protection and slope
3	Bagan Pinang- Tg. Lembah, Port Dickson	4000			closed tender: Tourism Malaysia
		7 000m = 7km			

MELAKA

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Tj. Dahan	450	17-Aug-98	15-Aug-99	Revetment
2	Klebang	850	17-Aug-98	15-Aug-99	
3	Pantai Kundur	1050	27-Apr-93	25-Dec-95	Revetment
4	Pantai Kundor (now Pantai Puteri)	3000	May-93	Dec-95	Flex-slab revetment_beach nourishment
5	Pantai Klebang & Tanjung Dahan	1400	Aug-98	Nov-99	Flex-slab revetment @Klebang rock
6	Pantai IMM, Pulau Besar	200	Dec-03	Jun-04	Basalton revetment + beach nourishment
7	Padang Kemunting, Alor Gajah	500	Jul-06	Apr-07	Labuan Blocks
		7450m = 7.45km			

JOHOR

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	K.Sg. Koris dan Sg. Senggarang	4486	16-Aug-78	15-Aug-80	Revetment
2	Kuala Sg. Lurus & Sg. Senggarang	2360	28-Aug-75	28-Jul-76	Revetment
3	Sg. Lurus	1000	1-Oct-76	31-Mar-77	Revetment
4	Parit Hylam	850	14-Dec-84	14-May-85	Revetment
5	Sg. Rambah	1372	10-Jun-77	10-Mar-78	Revetment
6	Kuala Sg. Rambah	482	24-Sep-86	22-Apr-87	Revetment
7	Sg. Rambah	610	15-Apr-89	13-Aug-90	Revetment
8	Rimba Terjun	500	27-Feb-86	12-Aug-86	Revetment
9	Kg. Rimba Terjun	450	4-Jan-95	10-Oct-95	Revetment
10	Sg. Buntu	280	15-Jun-85	8-Nov-85	Revetment
11	Sg. Senggarang	250	21-Oct-93	20-Jun-94	Revetment
12	Batu Pahat	300	Oct-93	Jun-94	Rock Revetment
13	Rimba Terjun	900	Jan-95	Oct-95	Rock Revetment
14	Tanjung Piai	1200	5-Jul	6-Feb	Geotextile Breakwaters
15	Kuala Sg. Pontian Besar	1500	6-Aug	7-Aug	Rock revetment
16	Parit Rabu- Tg. Tohor, Sri Menanti, Muar	2000	4-Nov	5-Sep	Rock revetment
		18 540m = 18.54km			

KELANTAN

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Kg. Teritam - Pengkalan Datu	3000	10-Jul-95	9-Jan-97	Nourishment
2	Sabak	0			Breakwater
3	K. Semerak	0			Breakwater
4	Sg. Golok	0			Breakwater
5	K. Kemasin	0			Breakwater
6	K. Tekoh Dua	0			Breakwater
7	Pantai Cahaya Bulan	1000	Apr-01	Dec-01	
8	Pengkalan Datu - Kg. Teritam	3000	Jul-95	Jan-97	Beach Nourishment
9	Pantai Cahaya Bulan, Kota Bharu	1000	Apr-01	Nov-01	Beach Management System (BMS)
10	Pantai Cahaya Bulan, Kota Bharu	700	Dec-04	Jun-05	Rock revetment
11	Pantai Sabak Fasa 1	200	Jul-03	Oct-03	Rock revetment
12	Pantai Sabak Fasa 2	400	Jan-04	Feb-04	Rock revetment
13	Pantai Sabak Fasa 3	1500	Apr-05	Jun-06	Rock revetment
14	Pantai Irama, Bachok	800	Mar-07	Mar-08	Labuan Blocks
		11 600m = 11.6km			

TERENGGANU

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Seberang Takir	3000	19 Feb 1992	16 Nov. 1992	Nourishment
2	Batu Buruk	6000	8 Mac 1993	16 Oct 1993	Nourishment
3	Tebing Kanan Muara Sungai Terengganu	530	23. July 1991	20 June 1992	Revetment
4	Tebing Kanan Muara Sg. Merang	350	3 Mei 1997	25 Dec 1998	Breakwater
5	Tebing Kanan Muara Sg. Merang	350	26 July 1993	20 Aug 1995	Breakwater
6	Pupuk Semangat, Telok Puchong, Kemaman	385	20 Dec 1992	9 Nov 1993	Revetment
7	Telok Lipat	2083	7 Mei 1997	5 January 1999	Mixed
8	Telok Sura	1200	24 Feb 1997	11 Nov 1997	Revetment
9	Muara Sungai Kemaman	2400	28 June 1996	30-Jul-97	Nourishment
10	Breakwater at Kuala Besut	0	1 Aug 1995	15 March 1998	Breakwater
11	Pelabuhan Chendering	500	28 March 1996	23 April 1997	Revetment
12	Kerteh	600			Revetment
13	Kuala Terengganu	2400	May-97	Apr-99	Revetment
14	Dungun/Kemaman	2000	Feb-97	Nov-97	Mixed
15	Dungun	2100	May-97	Apr-99	Groynes + Beach Nourishment
16	Dungun	1100	Feb-97	Nov-97	Rock Revetment
17	Kemaman	400	Dec-92	Nov-93	Flex-slab revetment, beach nourishment,
		25 398m = 25.398km			

PAHANG

NO	LOCATION	LENGTH (m)	DATE STARTED	DATE COMPLETED	STRUCTURES
1	Kual Rompin	950	24-Jun-95	18-Nov-96	Revetment
2	Jalan TLDM	940	17-Dec-92	14-Jun-94	Revetment
3	Pulau Tioman	960	17-Dec-92	15-Nov-93	Revetment
4	Rompin	900	25-Oct-99	23-Oct-00	Revetment
5	Kg.Tekek	700	27-Aug-98	8-Apr-99	Rock Revetment
6	Jalan TLDM	900	Dec-92	Jun-94	Rock revetment
7	Pulau Tioman	600	Dec-92	Nov-93	Flex-slab revetment
8	Rompin	1000	Jul-95	Nov-96	Rock revetment
9	Kuantan	400	Mar-05	Sep-05	Labuan Blocks & rock toe protection
10	Kuantan	1000	Jul-03	Mar-05	Beach nourishment & PEM design
11	Pulau Tioman	400	Sep-05	Sep-06	Labuan Blocks
12	Pulau Tioman	300	Aug-05	Aug-09	Total solution-PEM,beach nourishment,
		9050m = 9.05km			

GUIDELINES ON EROSION CONTROL FOR DEVELOPMENT PROJECTS IN THE COASTAL ZONE

GUIDELINES ON EROSION CONTROL FOR DEVELOPMENT PROJECTS IN THE COASTAL ZONE

1.0 INTRODUCTION

These guidelines are to be used for processing applications for development in the coastal zone in accordance with the General Administrative Circular No. 5 of 1987 issued by the Prime Minister's Department. The aim of these guidelines is to ensure proper planning and development of coastal projects for sustainable development in line with the directions stipulated in the erosion control management plan of the National Coastal Resources Management Policy. These guidelines together with the General Administrative Circular No. 5 of 1987 also act to supplement the Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 and the Natural Resources and Environment Ordinance (Sarawak) 1949 (As Amended 1994).

2.0 DATA REQUIREMENT

2.1 The data required for the processing of all development applications in the coastal zone shall meet the mandatory requirements as stipulated in the Development Proposal Report under sections 21A, 21B and 21C of the Town and Country Planning Act, 1995 (Act A 933). In addition, the following data are required: -

2.1.1 Key Plan

Key Plan with a scale of 1:50,000 or equivalent which includes the following information: -

a) type of land use within the range of 10 km from the project site;
b) latitude and longitude; and
c) types of flora and fauna available in the coastal zone.

2.1.2 Location Plan

Location plan/ revenue sheet with a scale of 1:5,000 or equivalent which includes the following information:-

a) the position of the lots planned to be developed and the position of the neighbouring lots within 1 km of the boundary of the project site;
b) location of all existing infrastructure such as canals, drains rivers, bunds, coastal structures as well as roads within the area;
c) latitude and longitude; and,
d) location of all existing aquaculture and marine fisheries activities including turtles habitat.

2.1.3 Site Plan

Site plan or layout plan with a scale of 1:500 or equivalent which includes the following details:-

a) all the buildings and structures that are to be constructed;
b) the high water mark (mean high water spring);
c) the existing and proposed drainage system, coastal erosion control structures, jetties, and drainage outfall structures if any;
d) any existing ground features such as sand-spit, sand bar, erosion scarp, alor and rivers;
e) spot levels at 20 metre intervals including contour lines at 1 meter intervals to be plotted on the site/layout plan;
f) latitude and longitude; and,
g) information on existing aquaculture and marine fisheries activities including turtles habitat.

2.1.4 Design Calculation and Plan

Design carried out by professional engineers registered with the Board of Engineers Malaysia including the detail calculation and plans for all erosion control structures and systems need to be submitted. The design calculation and plans for those structures which can interfere with the natural coastal processes including those related to marine fisheries, turtle habitat and aquaculture activities also need to be submitted. In this context, all structures constructed into the sea fall within the ambit of this category.

2.1.5 **Photographs**

Photographs showing the existing condition of the project site to be developed are required. They should show the view of the shoreline covering the landward and seaward areas of the project site which depict clearly the conditions of the existing shoreline i.e. stable, eroding or accreting. Photographs of existing neighbouring buildings and structures on both sides of the project site are also required.

2.1.6 **Additional Information**

The above general data or information are required for all types of development applications in the coastal zone. Additional information, maps and data required for the processing of a specific type of development in the coastal zone will be mentioned under the respective type of development which follows.

3.0 TYPES OF COASTAL DEVELOPMENT

For the purpose of these guidelines, development projects in the coastal zone may be classified into four broad types:-

a) Shore front development
b) Back shore development
c) Land reclamation
d) Sand mining and river mouth dredging.

3.1 SHORE FRONT DEVELOPMENT PROJECTS

3.1.1 **Preamble**

Shore front development projects are those projects located on the shoreline or foreshore such as the construction of ports, marinas, breakwaters, groynes, jetties, causeway, bridges, undersea tunnels, sewerage outfalls, and laying of submarine cables and pipelines. These development projects can interfere with the equilibrium of natural coastal processes which may result in coastal erosion/siltation problems, damage to marine eco-systems, aquaculture systems and water pollution, although the severity of the adverse impacts may differ from one case to another. Hence they should be subjected to proper impact evaluation study using appropriate technology commensurate with the nature and scale of the development project.

3.1.2 Activities Captured Under Environmental Impact Assessment Order 1987 (EIA)

Some of the above activities are captured under the purview of the Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 such as:-

a) Activity 8 (f) - Construction of shipyard with Dead Weight Tonnage greater than 5,000 tonnes;

b) Activity 10 (a) - Construction of ports and port expansion involving an increase of 50 % or more in handling capacity per annum;

c) Activity 12 - Construction of petroleum related activities such as construction of oil refineries Activity 12 (d)) and construction of off-shore and onshore pipelines in excess of 50 km in length (Activity 12 (b));

d) Activity 13 (d) - Construction of power generation and transmission facilities such as construction of combined cycle power stations;

e) Activity 18

(c) (ii) - Construction of marine outfall.

3.1.3 Scope of Impact Evaluation Study

For shore front development projects, the study for coastal engineering works done for the purpose of Administrative Circular No. 5 of 1987 can also be used for the purpose of EIA review. For coastal engineering works a comprehensive impact evaluation study should typically include:

a) preparation of key plan, location plan and site plan showing the siting and layout of proposed development or engineering works as outlined in paragraph 2.1 above;

b) topographic, hydrographic, natural and physical conditions of the project site and its vicinity as outlined in paragraph 2.1 above as well as the existing socio-economic conditions;

c) determination of the local wave climate, current, tides, storm surge, and sediment characteristics;

d) study of historical information to determine the trends and rates of accretion and erosion;

e) prediction or measurement of the movement of sediment, littoral transport, sediment budget analysis under the without and with project assumptions;

f) determination of the immediate and long term influence of the proposed development works on the neighbouring sections of the coastlines and future trends. This should include quantitative estimation of shoreline changes such as erosion and accretion and their socio-economic implications;

g) evaluation of environmental impact with regard to all of the uses of the shoreline/estuaries such as aquaculture, fishing activities, recreation, including potential impacts on water quality and marine ecology; and,

h) identify, describe and map feasible mitigative measures to overcome the various adverse effects arising from (f) and (g) above. This should cover capital works as well as the operation and maintenance measures, where applicable.

3.1.4 Use of Computer Modelling

a) For the larger and more complex projects, physical and/or computer modelling studies are strongly recommended. Computer models, however, are less time consuming and more suitable for problems involving coastal sediment transport. For some projects, it may be possible to resort to expert opinions of experienced coastal engineers for a preliminary impact assessment and to decide on the need and/or scope of more detailed modelling studies.

b) Where computer models are used in the analysis, they must be proven or well-tested. In addition, proper attention must be given to data collection, model calibration and verification. All raw data and boundary conditions must be clearly stated and made available to enable the Coastal Engineering Technical Centre (CETC), Department of Irrigation and Drainage to verify the model predictions by similar or independent means. It is advisable that the Consultant have prior consultation with CETC regarding the acceptability of particular computer software for project-specific applications.

3.1.5 Other Guidelines

The other guidelines for shore front development activities are:-

a) for the construction of jetties, bridges and causeway, an open piling system is preferred over solid barriers because the latter could interfere with the continuity of littoral sediment transport;

b) the use of vertical faced shore front protection works (for example sea wall) is not encouraged; and

c) sewage outfall pipes should be extended to beyond the Mean Low Water Spring (MLWS) and buried with a minimum cover of 1 meter to avoid any obstruction to the littoral drift. Likewise submarine cables and pipelines should also be buried with a minimum cover of 1 metre along the entire stretch.

3.1.6 Flow Chart

The flow chart for the processing of shore front development projects is as shown in Figure 1.

3.2 BACK SHORE DEVELOPMENT PROJECTS

3.2.1 Preamble

Back shore development projects include works such as construction of hotels, housing, agricultural and industrial development. These projects, by far represent the bulk of economic development activities in the coastal zone.

3.2.2 Activities Captured Under Environmental Impact Assessment Order 1987

Some of the back shore development activities that are captured under the Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 is:-

a) Activity 7 - Housing development covering an area of 50 hectares or more; and,

b) Activity 17(a) - Resort and recreational development such as construction of coastal resort facilities or hotel with more than 80 rooms.

3.2.3 Scope of Impact Evaluation Study

The impact of such projects can be wide-ranging. In the case of projects involving extensive clearing of vegetation, backfilling of land and bunding and construction of inland lagoon, full impact evaluation studies along the lines of paragraph 3.1.3 and 3.1.4 would be required. However, in cases comprising of small scale housing, resort and industrial development, it is advised that such development be sited at a suitable distance from the shoreline (development setback) to minimize the risk of damage or losses due to coastal erosion and undue interference on the near shore biological and marine environment. If this is complied with, an impact evaluation study (on the coastal erosion aspect) is not necessary. It is, however, cautioned that the need for an environmental impact study is still required by the Department of Environment if it falls within the purview of Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities)(Environmental Impact Assessment) Order 1987 (for example Activity 17 (a)) or Natural Resources and Environment Ordinance (Sarawak).

3.2.4 **Setback Limits**

a) The following setback limits are proposed :-

   i. 60 metres for sandy coast measured from Mean High Water Line; and;

   ii. 400 metres for muddy coast measured from the seaward edge of mangrove vegetation/forest. However, no development should be allowed in areas where mangrove vegetation/ forest have been gazetted as permanent forest reserve under the National Forestry Act 1984.

b) Where beach dunes are present, they should be preserved in their natural state. New development or re-development activities on sand spits and sandbars should not be permitted.

c) The above setback limits are not entirely dependent on the current stability of the coastline or classification of erosion hazard (critical, significant or acceptable). They are considered as good management/engineering practices for shoreline development in recognition of the dynamic nature of coastal processes and the potential risk of shoreline erosion which requires substantial funds for their redressal.

d) The minimum setback requirements may be reviewed on account of site specific conditions. Examples of conditions warranting such review are :-

   i. where it is within 1 km of a well developed area with high value permanent buildings located at distances less than the recommended setback;
   ii. ii) where the proposed development is landward of an existing public access for example Public Works Department (JKR) road or coastal bund, the loss or failure of which is unacceptable;
   iii. where the developer undertakes to provide coastal erosion protection works based on a design acceptable to the government;
   iv. where the prevailing backshore is an erosion – resistant headland; and;
   v. where the developed area is on high ground at levels exceeding five meters above the Mean Sea Level
   vi. where turtle nesting site facilities are required.

3.2.5 Other Guidelines

For development projects sited in critical erosion areas, the developers shall be required to construct feasible erosion protection works at their own cost. The use of vertical faced shore front protection works (for example sea wall) is not encouraged.

3.2.6 Flow Chart

The flow chart for processing backshore development projects is as shown in Figure 2

3.3 LAND RECLAMATION

3.3.1 Preamble

The potential impact of a reclamation project is governed by a number of factors such as its location, wave and tidal regime, size and the geometrical planform of the reclamation area. In this respect, hydraulic study/modelling is a useful tool for optimizing the layout of large-scale reclamation works and in identifying potential adverse impact. Piece-meal reclamation involving uncoordinated effort of a large number of small, individual land owners is highly undesirable because it often results in a highly irregular coastline which is difficult to manage from the viewpoints of coastal erosion control and for recreational use of the beach. Some typical impacts of coastal land reclamation projects are:-

a. complete or partial loss of recreational beaches and undue obstruction of public access to these beaches;
b. interference with the normal coastal processes resulting in erosion of coastlines or siltation of natural or man-made drainage channels;
c. lack of effective works for protection against coastal erosion;
d. interference with the natural drainage of hinterland areas;
e. destruction of mangrove eco-systems and other environmental habitat for flora and fauna;
f. pollution of coastal waters; and,
g. complete or partial loss of aquaculture and fishing activities and access to fish landing sites.

3.3.2 **Scale of Reclamation Captured Under Environmental Impact**

Assessment Order 1987 Coastal reclamation involving an area of 50 hectares or more is captured under Activity 4 of Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987 where an EIA study is mandatory under the law.

3.3.3 **Scope of Impact Evaluation Study**

However, all land reclamation projects irrespective of paragraph 3.3.2 should be subjected to impact evaluation studies as detailed in paragraphs 3.1.3 and 3.1.4 above. The impact assessment should capture the hydrodynamics and morphological changes using a modelling approach.

3.3.4 **Provision of Drainage Facilities to The Hinterland**

There should be proper provisions for discharging the drainage or flood flows of the hinterland catchment intercepted by the reclamation landfill.

3.3.5 **Setback Limits**

For the reclaimed shoreline, there should be a setback of 60 meters measured from the landward edge of the Mean High Water Spring. However, if coastal erosion protection works are provided, the developer needs to provide a sufficient setback to be agreed upon by the CETC for the maintenance of the structures. This setback zone should also be equipped with a service road built by the developer for public access to sea frontage.

3.3.6 **Flow Chart**

The flow chart for processing land reclamation projects is as shown in Figure 3

3.4 OFFSHORE SAND MINING AND RIVER MOUTH DREDGING

3.4.1 Preamble

Offshore sand mining activities change the bathymetry of the sea bed which can alter beach dynamics, waves and swell patterns, as well as coastal current circulation, which may lead to erosion or sedimentation. Mining activities can influence the coastal processes through:-

a. erosion of beaches from drawdown due to the backfilling of the dredge pit during calm period;

b. interception of sediment movement by the dredged pit, which results in sand depletion onshore or downdrift;

c. removal of protection afforded by offshore banks, which leads to bigger waves impinging on the coast;

d. changes in the waves refraction pattern, which concentrates waves energy at a particular place; and

e. destruction of aquatic eco-systems and adverse effects on aquaculture systems.

3.4.2 Federal and State Jurisdiction

The approval for sand mining falls under the purview of either the Federal or State jurisdiction, depending on the location of the operation. All land, including the foreshore up to 3 nautical miles seaward from the low-water mark, is controlled by the state. The seabed and water beyond this limit, up to the continental shelf boundary, falls under federal jurisdiction. Under Emergency (Essential Powers) Ordinance No. 7/1969, the territorial sea is extended to 12 nautical miles measured from the low-water mark, in all states except Sabah and Sarawak. This law applies for all purposes except for those covered under the Continental Shelf Act (1966), the Petroleum Mining Act (1966), the National Land Code (1965) and written laws relating to land in Sabah and Sarawak.

3.4.3 Sand Mining Activities Captured Under Environmental Impact Assessment Order 1987

Sand mining activities involving an area of 50 hectares or more are captured under Activity 11 (c) of Environmental Quality Act, 1974 Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987.

3.4.4 Additional Data Requirement

In addition to the data requirement as stated in paragraph 2.1, the following information/reports are also required to be submitted to enable the application to be processed:-

a. the location on a hydrographic chart of the sand source where the project proponent intends to mine;
b. site investigation report on the availability of the sand source;
c. quantity of sand to be mined per month and per year; and,
d. the sequence / procedure of sand mining and the equipment / machinery to be used.

3.4.5 Guidelines for Sand Mining

As a general rule, sand mining is not permitted in near shore areas which are less than 1.5 km from the Mean Low Water Line or 10 meter water depth (from Lowest Astronomical Tide) whichever is further from the shore. This is to ensure that this will not result in any major disruption to the delicate balance of sediment movement in the near shore littoral cell.

If it is not possible to comply with the para above due to technical, practical or economic reasons, a suitable study as outlined in paragraphs 3.1.3 and 3.1.4 should be conducted to demonstrate that the proposed site of sand mining operation would not lead to adverse impacts on the coastal processes, aquatic eco-systems and the stability of the adjacent shorelines. Notwithstanding the above, if there is an existing study which shows that any sand mining activity in a particular area will have adverse impacts, all mining activities in these sensitive areas shall be prohibited even if the general guidelines for sand mining have been adhered to.

3.4.6 River Mouth Dredging

Dredging or deepening of natural river mouths may result in the creation of sediment sinks leading to problems of erosion in adjacent coastlines. As such sand mining at river mouth or sandspit for commercial uses without proper hydraulic study as outlined in paragraph 3.1.3 and 3.1.4 shall be prohibited.

3.4.7 Flow Chart

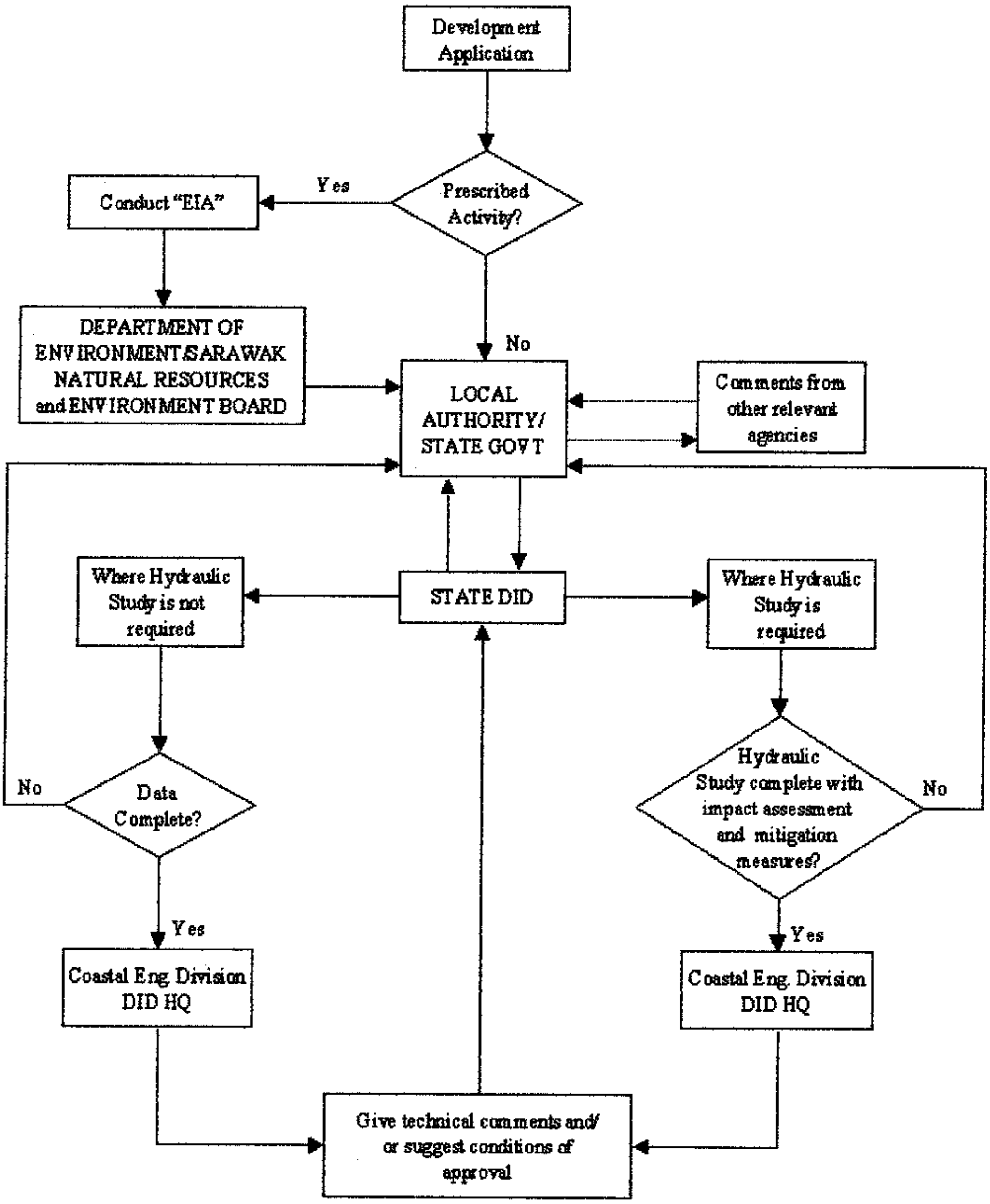
The flow chart for processing sand mining applications is as shown in Figures 4 and 5.

4.0 CONCLUSION

These guidelines are to be read together with the guidelines prepared in respect of the management plans for the other sectors in the National Coastal Resources Management policy for example coastal forests; mangrove forests; aquaculture; fisheries; coastal/offshore sand mining; land use and water quality and tourism in processing development applications in the coastal zone in accordance with the General Administrative Circular No. 5 of 1987. It is to be reviewed when necessary to keep abreast with current technology in coastal engineering, Government policies and current legislation.

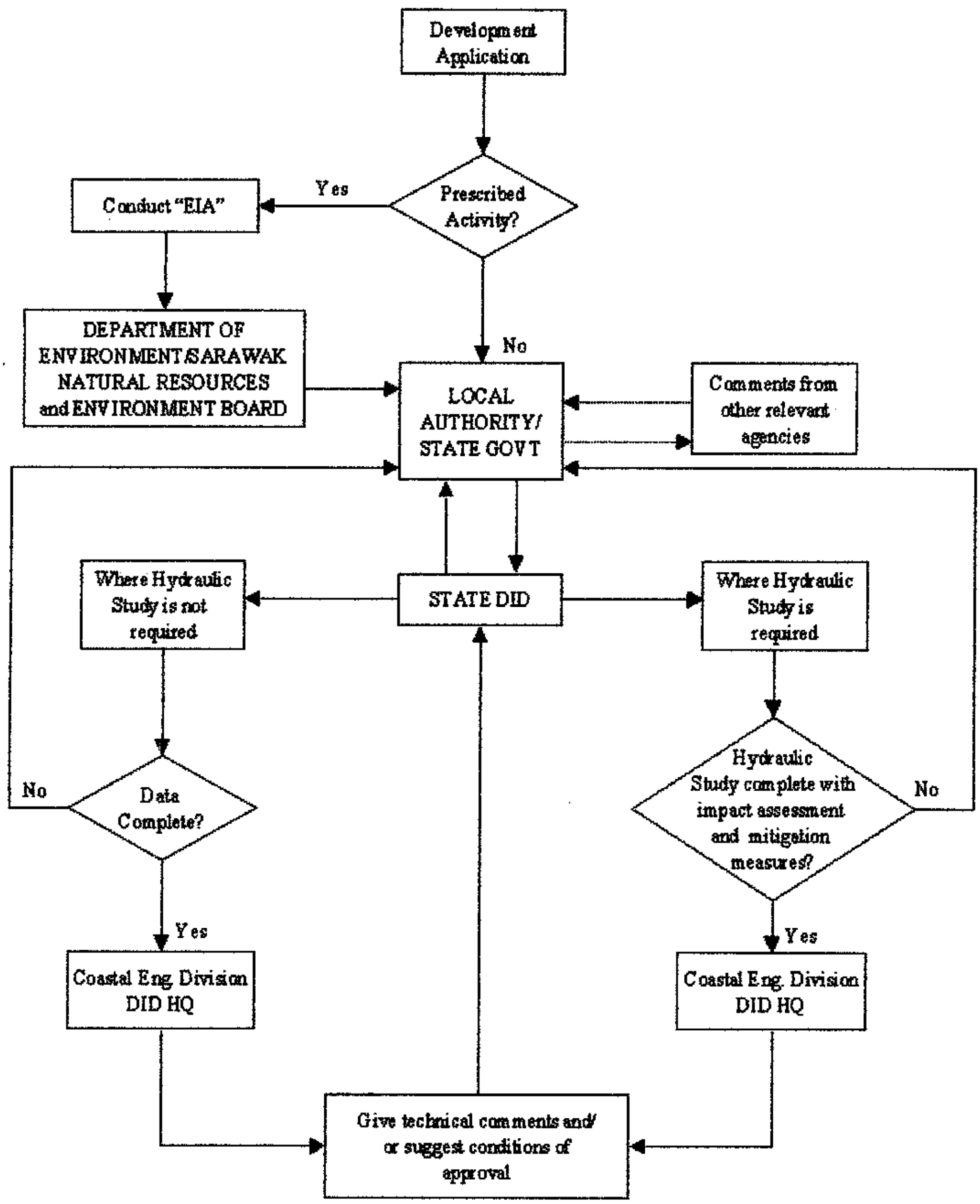
FLOWCHART FOR PROCESSING SHORE FRONT DEVELOPMENT

FIGURE 1



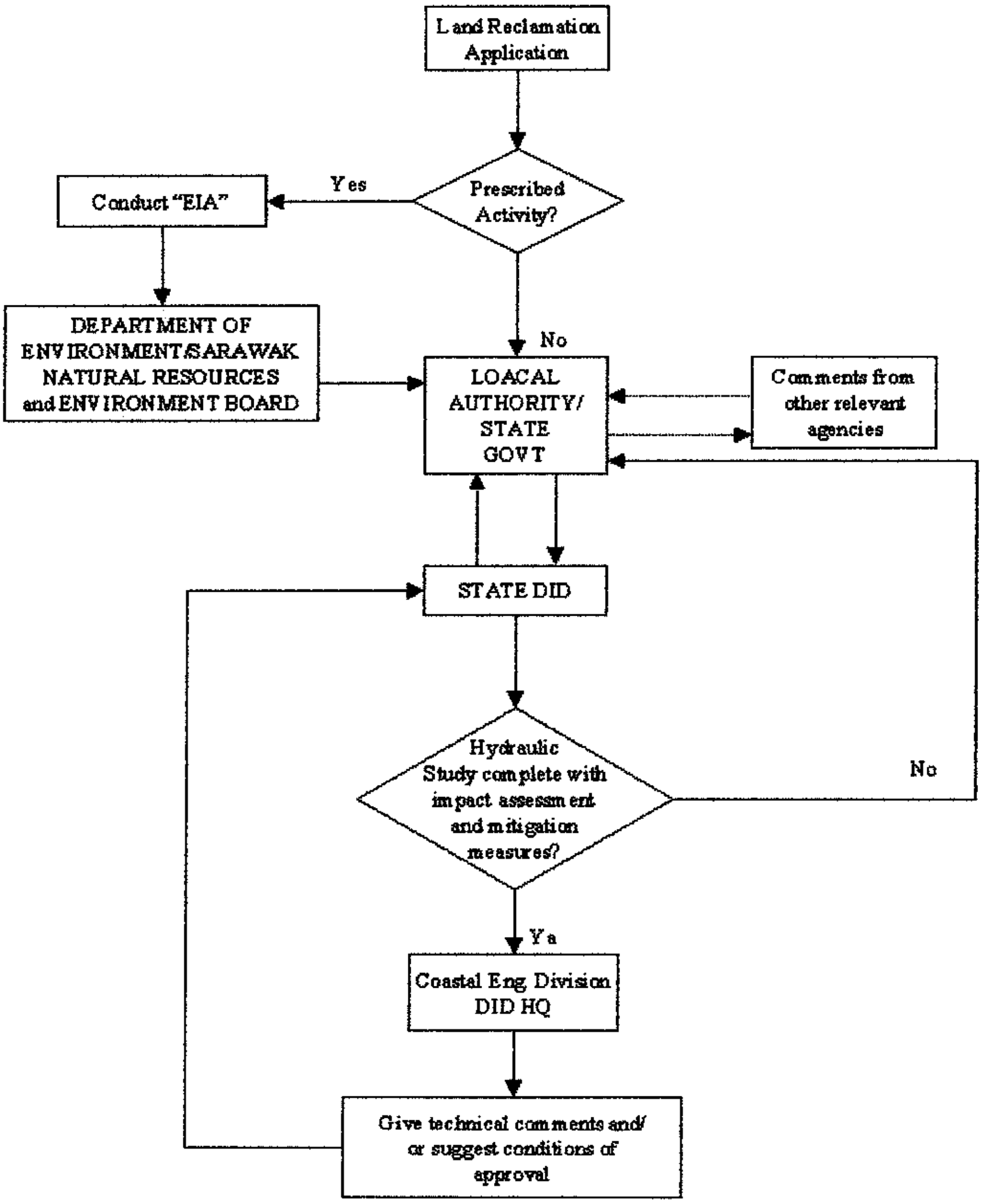
FLOWCHART FOR PROCESSING BACKSHORE DEVELOPMENT

FIGURE 2



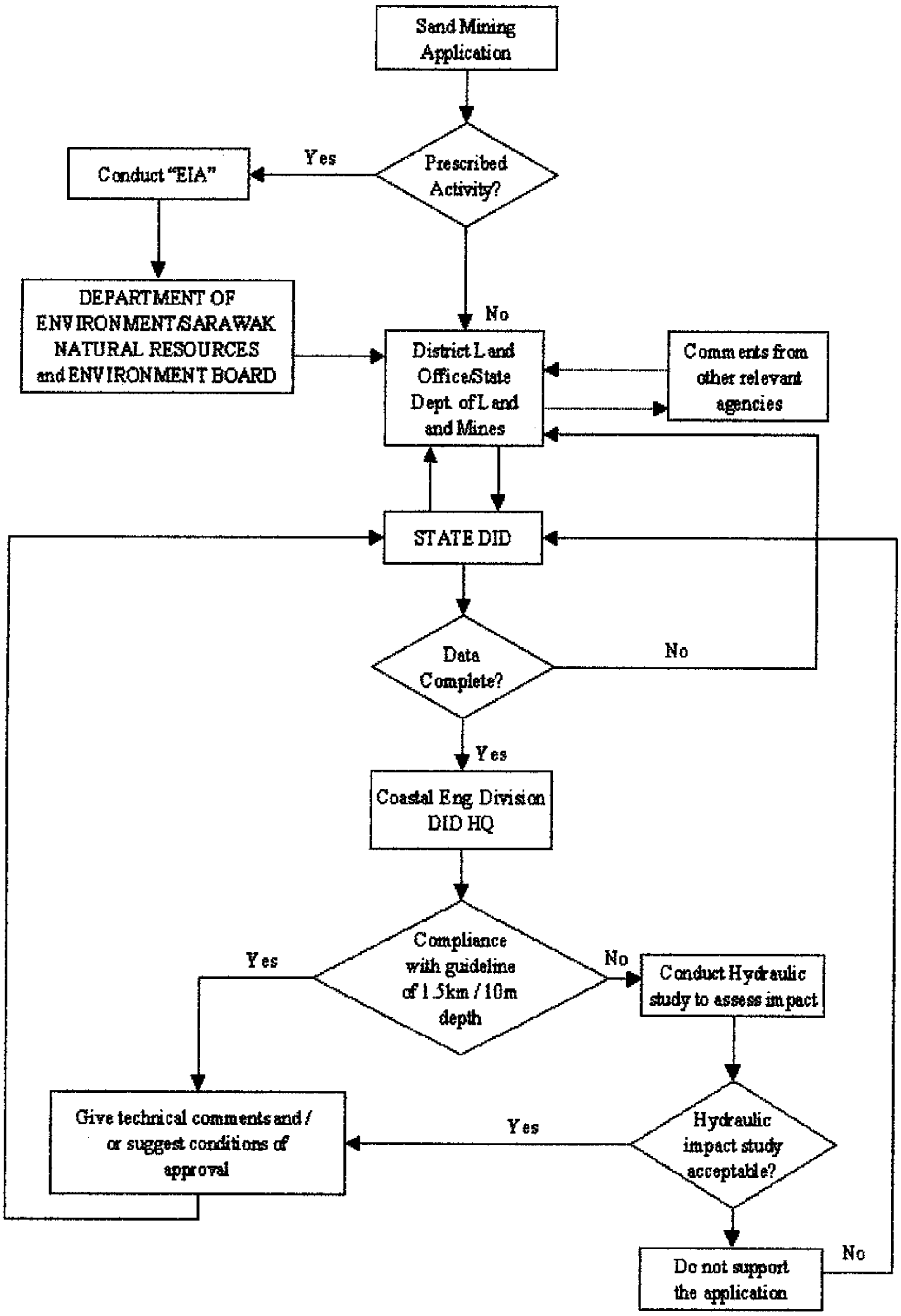
FLOWCHART FOR PROCESSING LAND RECLAMATION

FIGURE 3



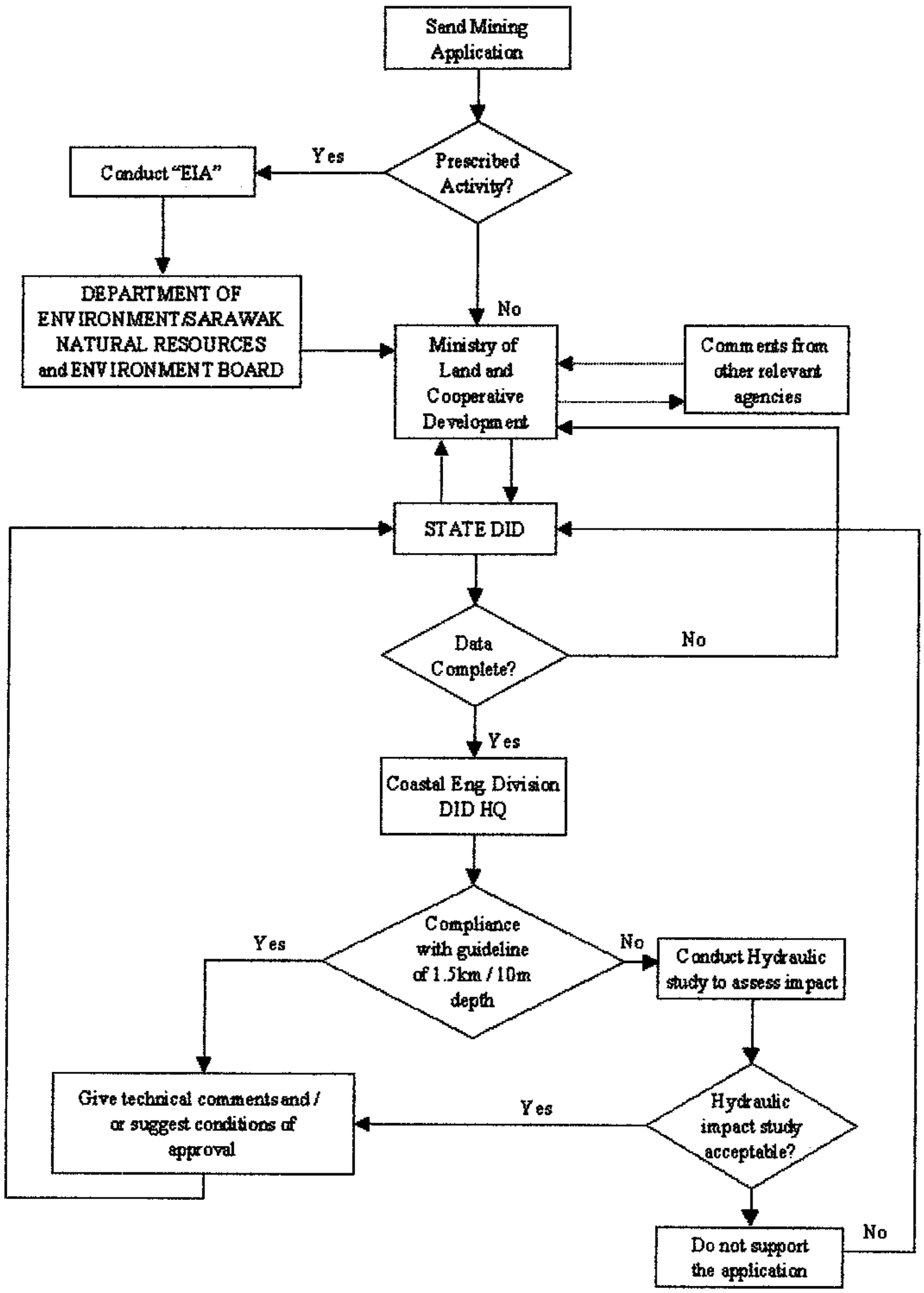
FLOWCHART FOR PROCESSING SAND MINING AT STATE LEVEL

FIGURE 4



FLOWCHART FOR PROCESSING SAND MINING AT FEDERAL LEVEL

FIGURE 5



APPENDIX 1

GENERAL ADMINISTRATIVE CIRCULAR NO 5 OF 1987

PERATURAN MELULUS DAN/ATAU
MELAKSANAKAN PROJEK PEMBANGUNAN
DI KAWASAN PANTAI NEGARA

Jabatan Perdana Menteri Malaysia,
Jalan Dato' Onn,
50502 Kuala Lumpur
Telefon : 23221957
Kawat : PERDANA

Rujukan Kami : 0.93/380/7-1A/1
Tarikh : 10 September 1987

Ketua-Ketua Setiausaha Kementerian,
Y.B. Setiausaha-Setiausaha Kerajaan Negeri,
Ketua-Ketua Jabatan Persekutuan,
Ketua-Ketua Badan Berkanun Persekutuan.

SURAT PEKELILING AM BIL.5 TAHUN 1987
PERATURAN MELULUSKAN DAN/ATAU MELAKSANAKAN PROJEK PEMBANGUNAN DI KAWASAN PANTAI NEGARA

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1. TUJUAN

1.1 Surat Pekeliling ini bertujuan untuk menetap dan menjelaskan peraturan yang perlu dipatuhi oleh setiap Kementerian, Jabatan dan Badan Berkanun yang terlibatserta semua Kerajaan Negeri ketika melulus dan/atau melaksanakan projek-projek pembangunan di kawasan pantai.

2. LATARBELAKANG

2.1 Sejak beberapa tahun kebelakangan ini, hakisan pantai telah menyebabkan kerosakan dan kemusnahan kepada kawasan pertanian, hutan paya bakau, perumahan, rangkaian jalan perhubungan dan pantai rekreasi. Daripada sepanjang 4,800km pantai di Negara kita ini, lebih kurang 1,300km (atau 27%) sedang mengalami hakisan pantai. Anggaran kasar nilai harta benda yang terancam oleh fenomena semulajadi ini adalah kira-kira RM200 juta untuk tempoh lima (5) tahun akan datang.

3. KAWALAN HAKISAN PANTAI NEGARA

3.1 Pengawalan ke atas kesan hakisan pantai Negara sekarang ini telah menjadi satu keperluan dari segi ekonomi dan sosial. Untuk tujuan ini, Kerajaan akan melaksanakan strategi pengawalan hakisan pantai yang berbentuk dua peringkat. Sebagai langkah jangka pendek, harta benda dan kemudahan awam di kawasan kritikal yang terancam oleh fenomena ini akan dilindungi, sekiranya didapati ekonomokal berbuat demikian. Langkah jangka panjang pula, adalah untuk mengawal kesan hakisan pantai melalui penyelarasan perancangan dan pengawalan pembangunan di kawasan pantai secara bersepadu.

4. PELAKSANAAN STRATEGI

4.1 Untuk melaksanakan strategi ini Kerajaan telah, antara lain mengujudkan dua Institusi kawalan iaitu majlis Kawalan Hakisan Pantai Negara (MKHPN) dan Pusat Teknikal Kejuruteraan Pantai (PTKP).

4.2 Majlis Kawalan Hakisan Pantai Negara (MKHPN) adalah merupakan badan penasihat mengenai kawalan hakisan pantai dan fungsi utamanya ialah untuk memperakukan kepada Kerajaan mengenai program, pembiayaan dan penyelarasan tindakan, bukan sahaja di antara Kerajaan Persekutuan dan Negeri tetapi juga dengan sektor swasta. Pusat Teknikal Kejuruteraan Pantai (PTKP) pula telah ditubuhkan di Jabatan Parit dan Taliair Malaysia dan bertanggungjawab untuk melaksanakan kajian teknikal dan memberi khidmat nasihat hakisan pantai.

4.3 Kajian Hakisan Pantai Negara yang telah dijalankan baru-baru ini menunjukkan bahawa kebanyakan kemusnahan yang berlaku adalah kerana pembangunan telah dilaksanakan di kawasan yang berpotensi untuk terhakis, di mana kerja-kerja kejuruteraan untuk pengawalan hakisan memerlukan perbelanjaan yang tinggi. Kemusnahan berlaku juga akibay pembinaan struktur-struktur yang tidak dirancang di sepanjang pantai serta aktiviti-aktiviti di luar pantai yang telah menyebabkan berlakunya hakisan ataupun memburukkan lagi keadaan hakisan.

4.4 Sebagai langkah pertama ke arah mengurangkan kesan hakisan pantai dan kos pencegahannya, perlu dipastikan supaya segala usaha pembangunan di kawasan pantai yang dilaksanakan di masa hadapan hendaklah mengambil kira kemungkinan risiko hakisan serta kesan-kesan negatif lain yang mungkin timbul. Demikian juga dengan pembinaan struktur-struktur di sepanjang pantai seperti jeti, pelabuhan, tembok penahan dan lain-lain serta aktiviti-aktiviti di lautan berhampiran seperti pengambilan pasir, pembinaan pelantar minyak, pemasangan paip/kabel dasar laut dan lain-lain hendaklah pada masa akan datang dirancang supaya tidak akan menyebabkan atau memburukkan lagi hakisan pantai (contoh struktur/aktiviti pantai yang mungkin dibina/dijalankan adalah seperti di Lampiran A). Sehubungan dengan ini setiap Kementerian, Jabatan dan Badan Berkanun yang terlibat serta semua Kerajaan Negeri adalah dinasihatkan supaya merujukkan segala cadangan pembangunan, aktiviti dan pembinaan struktur di kawasan pantai termasuk di lautan yang berhampiran, untuk ulasan kepada:

Ketua Pengarah
Jabatan Parit dan Taliair, Malaysia
Jalan Mahameru, 50626 Kuala Lumpur
(u.p.: Pengarah. Pusat Teknikal Kejuruteraan Pantai)

5. TANGGUNGJAWAB KETUA JABATAN

5.1 Dengan berkuatkuasanya Surat Pekeliling ini, Ketua-Ktua Setiausaha Kementerian, Ketua-Ketua Jabatan, Ketua-Ketua Badan Berkanun yang terlibat serta semua Setiausaha-Setiausaha Kerajaan Negeri adalah bertanggungjawab melaksanakan peraturan yang termaktub dalam Surat Pekeliling ini. Sebarang kemusykilan yang timbul dari Surat Pekeliling ini hendaklah dirujukkan kepada:

Ketua Pengarah
Unit Penyelarasan Perlaksanaan, Jabatan Perdana Menteri
Jalan Dato' Onn, 50626 Kuala Lumpur

6.0 TARIKH KUATKUASA

6.1 Tarikh kuatkuasa peraturan ini adalah dari tarikh Surat Pekeliling ini.

"Berkhidmat Untuk Negara"

(tt)

(Tan Sri Dato' Sallehuddin Bin Mohamed)
Ketua Setiausaha Negara

Nota:

Perenggan 4.4 baris 16 hendaklah ditukar kepada

Ketua Pengarah
Jabatan Pengairan dan Saliran, Malaysia
Jalan Sultan Salahuddin
50626 Kuala Lumpur

(u/p: Pengarah,
Bahagian Kejuruteraan Pantai)

Lampiran A

A. Contoh Pembangunan Di Kawasan Pantai

1. Jeti
2. Pelabuhan
   i. Dermaga
   ii. Pemecah Ombak
   iii. Groyne (Kemola Kekubah)
   iv. Pontoon
   v. Revetment
3. Tembok Penahan Laut
4. Perumahan/Kondominium/Hotel
5. Taman Rekreasi
6. Pelantar Minyak
7. Struktur di dasar laut
   i. Paip minyak/air
   ii. ii) Kabel letrik/telekom
8. Tambak (Causeway)
9. Empangan (di hulu sungai)
10. Saluran keluar (Outlets/outfalls)

B. Contoh Aktiviti Si Lautan

1. Penambakan tepi laut
2. Pengambilan Pasir Pantai/Laut
3. Pengorekan dasar laluan kapal
4. Pengubahsuaian muara sungai

Unit Penyelarasan Perlaksanaan
Jabatan Perdana Menteri
Kuala Lumpur
Tarikh : 10 September 1987