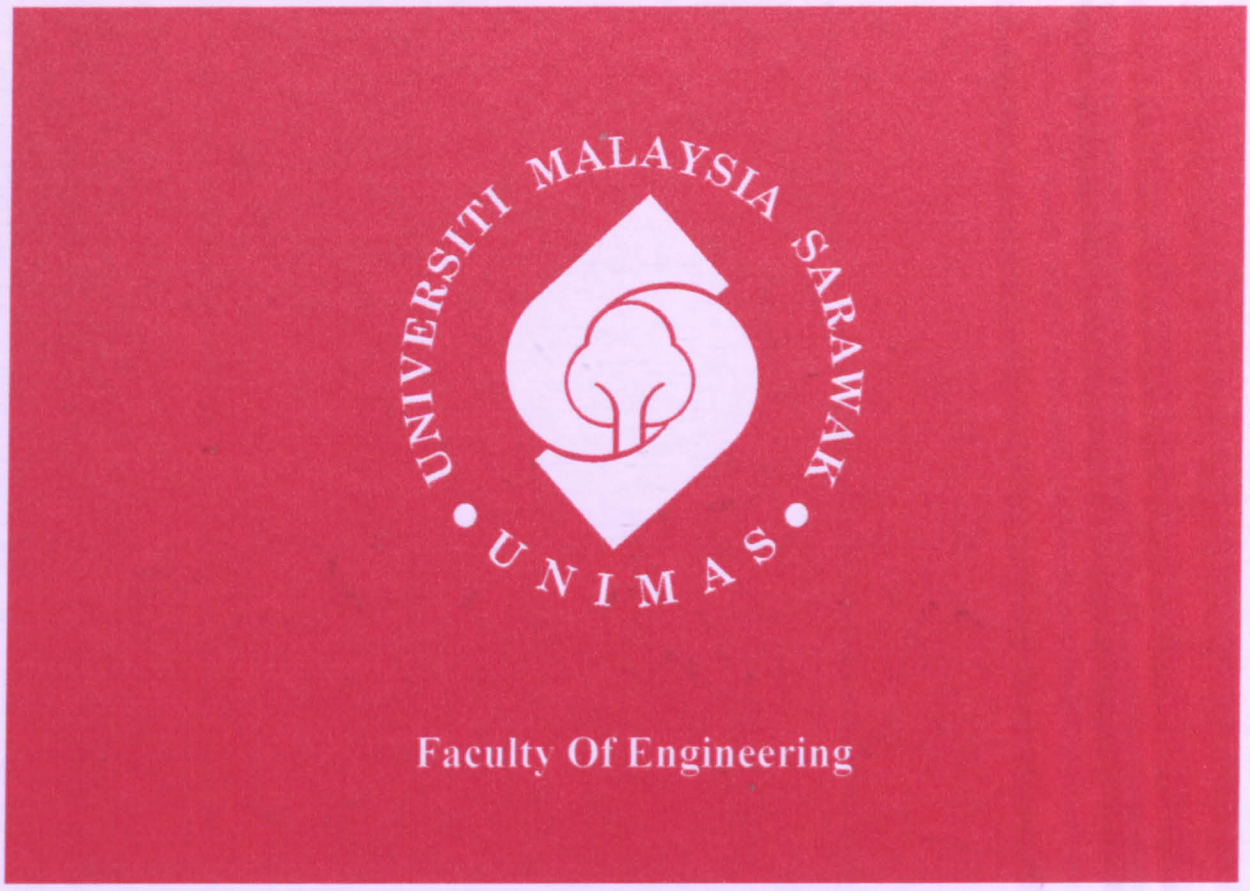

THE EFFECTIVENESS OF THE PERFORATED POLYMER CONCRETE PLATE (PPCP) TO TRAP SEDIMENT

MUHAMMAD IHSAN BIN ZABIDI

Bachelor of Engineering with Honours
(Civil Engineering)
2020

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

Please tick (√)

Final Year Project Report	√
Masters	
PhD	

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This declaration is made on the 24th day of August 2020.

Student's Declaration:

I MUHAMMAD IHSAN BIN ZABIDI (58820) from FACULTY OF ENGINEERING declare that the work entitled **THE EFFECTIVENESS OF THE PERFORATED POLYMER CONCRETE PLATE (PPCP) TO TRAP SEDIMENT** is my original work. I have not copied from any other students' work or from any other sources except where due reference or acknowledgement is made explicitly in the text, nor has any part been written for me by another person.

24th august 2020
Date submitted

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Supervisor's Declaration:

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HASMIDA BINTI HAMZA

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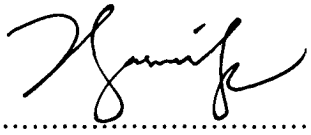
The following Final Year Project Report:

Title	:	The Effectiveness of The Perforated Polymer Concrete Plate (PPCP) To Trap Sediment
Name	:	Muhammad Ihsan Bin Zabidi
Matric No.	:	58820

has been read and approved by:



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Date: 28/08/2020

THE EFFECTIVENESS OF THE PERFORATED POLYMER CONCRETE PLATE (PPCP) TO TRAP SEDIMENT

MUHAMMAD IHSAN BIN ZABIDI

A dissertation submitted in partial fulfillment

Of the requirement for the degree of

Bachelor of Engineering with Honors

Faculty of Engineering

University Malaysia Sarawak

2020

To my beloved family, friends and everyone.

ACKNOWLEDGEMENT

For this past few month, our country has been affected by the outbreak of Covid-19 pandemic. Not only in Malaysia, but this global pandemic has spread out throughout the world and it does not stop until today. It gives great impact on my sector and economy all around the world until this very moment. Besides, this pandemic also has affected the work of my final year project. I cannot finish my laboratory work after "Perintah Kawalan Pergerakan" (PKP) has been introduced by the Government of Malaysia. I had to change my experimental work to the modelling during the PKP period. So, I had to learn the FLOW-3D simulation process in a short amount of time and finish my report in the allocated time. However, I want to give my special gratitude to my beloved supervisor, Ms. Hasmida Hamza for all her support, guidance and encouragement for me to finish writing my thesis. Without her guidance, I cannot finish up writing my thesis as she keeps gives me the idea and guidelines on how to finish and write a proper thesis.

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Last but not least, most importantly I would like to express my appreciation to beloved family they have always been there for me through thick and thin. They always give me encouragement, support and had pray for me to finish my work and this research. Without them none of this was possible.

ABSTRACT

Coastal erosion is a growing problem that is driven by natural processes which are intensified by the clearing of mangrove systems in beach area. This research is to introduce a wave breaker using perforated polymer concrete plate (PPCP) to replicate the mangrove function in the nearshore zone which is primarily to overcome beach erosion occurred at Kampung Serpan, Asajaya, Kota Samarahan. The focus of the research is the effectiveness of the PPCP to trap the sediment. Past studies demonstrated the implementation of various software tools such as FLOW-3D, Delft 3D and SWAN to simulate the interaction of wave with coastal structure. This paper serves to present the application of FLOW-3D software aimed to simulate the sediment flow and deposition of it through the PPCP by investigating the effective hole size and location of the PPCP. Results shows that the PPCP wave breaker is effective in trapping the sediment at the shoreline that had a value of 10.6% for 60-second simulation. Significantly, this study will enable future researchers to develop economical and effective coastal structure such as the PPCP through studies using the FLOW-3D software.

ABSTRAK

Hakisan pantai adalah masalah yang semakin meningkat yang didorong oleh proses semula jadi yang diperhebat oleh penebangan pokok bakau di kawasan pantai. Penyelidikan ini adalah untuk memperkenalkan pemecah ombak menggunakan plat konkrit polimer berlubang (PPCP) untuk menggantikan fungsi bakau di zon pantai yang terutama untuk mengatasi hakisan pantai yang berlaku di Kampung Serpan, Asajaya, Kota Samarahan. Fokus penyelidikan adalah untuk menkaji keberkesanan PPCP untuk memerangkap sedimen. Kajian lepas menunjukkan pelaksanaan pelbagai alat perisian seperti FLOW-3D, Delft 3D dan SWAN untuk mensimulasikan interaksi ombak dengan struktur pesisir. Kajian ini juga berfungsi untuk menyajikan aplikasi perisian FLOW-3D yang bertujuan untuk mensimulasikan aliran sedimen dan pemendapannya melalui PPCP dengan menyelidiki ukuran lubang dan lokasi PPCP yang berkesan. Hasil kajian menunjukkan bahawa pemutus ombak PPCP berkesan dalam memerangkap sedimen di garis pantai yang mempunyai nilai 10.6% untuk simulasi berdurasi 60 saat. Secara ketara, kajian ini akan membolehkan para penyelidik masa depan mengembangkan struktur pesisir ekonomi yang berkesan seperti PPCP melalui kajian menggunakan perisian FLOW-3D.

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Coastal erosion is produced by a highly complex interaction between natural beach conditions such as the forcing waves, currents, winds and the effects of human negligence (Seelig, 1983). In many area, coastal erosion is usually the result of a combination of factors both natural and human induced operating on different scales as the erosion is defined as the encroachment of land by the sea after average over a period which is sufficiently long to eliminate the impacts of weather, storm events and local sediment dynamics such as sand waves (Prasad & Kumar, 2014).

The Department of Irrigation and Drainage Malaysia, (2017) stated that 29% or 1394 km out of 4800 km of the Malaysia's coastlines are facing erosion. To prevent erosion to worsen, wave breaker as shown in Figure 1.1 are proposed that will prevent a strong wave force from hitting the cliff or beach that cause erosion by slowing down the wave energy. In addition, the wave breaker will also trap the sediment from returning to the sea and thus forming a natural beach.

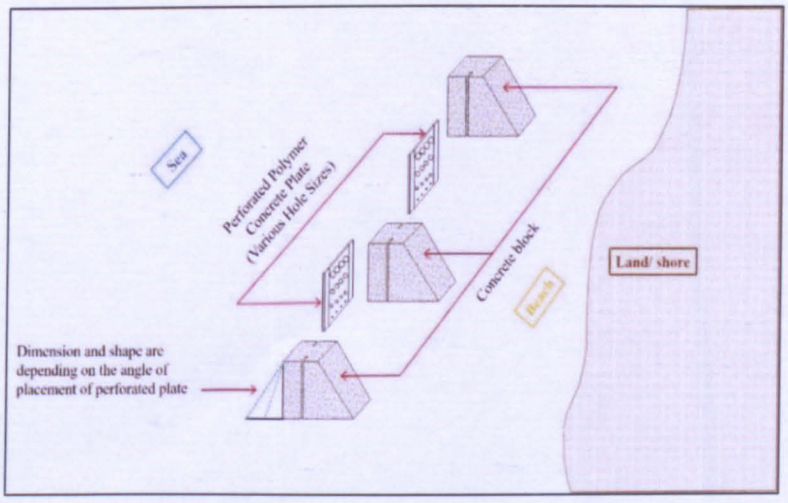

Figure 1.1: Wave Breaker Model

1.2 Problem Statement

Malaysia 's coastline is suffering from a severe erosion that consists of easily eroded alluvium for around 4,800 km of total coastal length and sand is the most abundant coastal soil in Sarawak which covers around 1,234 km along the eastern coast of peninsular Malaysia (NCES, 2015). In Sarawak, coastal erosion that occur at Kampung Serpan, Asajaya also contribute to the statistics from the NCES. The main cause of the beach erosion at Asajaya is because of the lack of mangrove along the shoreline. The mangrove-vegetated areas are now decreasing due to wave action, natural phenomena and human activities. According to World Wide Fund (WWF) more than 35% of the world's mangroves are already gone (Adam, 2013). Mangroves tree at Kampung Serpan, Asajaya had becomes vital to their coastal protection as they protect them from damage caused by tsunami waves, erosions and storms, and serve as a nursery for fish and other species that support coastal livelihoods. The mangrove deforestation that occurred had caused many problems to them such as landslides, overflows and floods that affect the crops and habitat of the locals.

Many ways had been tried such as replanting of the mangrove tree and installation of gabion coastal wall to reduce the impact of the wave energy to the beach. The results of the attempt to replanting the mangroves is dreadful due to strong wave energy that constantly hit the area and the gabion wall is also unsuccessful to secure the banks of the beach from collapse as shown in Figure 1.2. Therefore, a wave breaker is designed as the breakwater structure to replicate the function of the mangrove tree and the gabion wall in the area that serve as wave dampener and sediment trapping. Based on Figure 1.1 Perforated Polymer Concrete Plate (PPCP) will act as the wave dampener that should be able to reduce the wave energy that hit the beach and also act as sediment trapper that going through the wave-breaker that can eventually forming a natural beach.

Figure 1.2: Gabion Wall before and after wave hit at Kampung Serpan Laut, Asajaya

1.3 Objective

This study focuses on the modelling test, data collection and analysis of the effectiveness of the PPCP by using FLOW-3D to achieve the following objectives:

i. To measure the effectiveness of three (3) sediment size that flow through the PPCP
ii. To evaluate the effectiveness of the PPCP to trap sediment with two (2) different set of hole size.
iii. To measure the sediment flow through the PPCP with two (2) different distance of placement of the PPCP to the shore.

1.4 Limitation of Study

Limitation of study is the flaws or any sort of shortcomings that limits the research findings. Therefore, there is some limitation that applied to this research. First, the research main object of study. This study of the wave breaker will only be focusing on the Polymer Perforated concrete plate (PPCP) rather than full elements of the wave breaker that are designed based on Figure 1.1: Wave Breaker Model. Second, the material used for this research is polymer concrete only. The polymer concrete will be used as the material to produce the plate. Other than that, computer processor to run the simulation is lacking that may affect the accuracy of the results due to the large meshing size.

1.5 Significant of Study

This study of the effectiveness of the Perforated Polymer Concrete Plate (PPCP) to trap the sediment is important to reduce the effects of beach erosion and deposition. This study can be used by the researcher or authorities as reference for further studies of the wave breaker and the sediment behavior along the coastal line. The data collection and analysis of this study provides information on the beach erosion factor and the sediment transport relation to the grain size. This study enables the researcher to create and improve the coastal protection that are more economical and effective. Other coastal protection such as beach nourishment will need more cost to achieve it. Reduction of the erosion on the beach can helps to ensure the safety of the area increase and enable the sustainability of the future socio-economic development.

1.6 Project Planning

This research has been divided by chapters that discuss various elements of the study. It is necessary to follow proper planning by revising the previous research to accomplish the stated objective, the project planning for the final year Project study is shown in Figure 1.3 below.

	WBS	Task Mode	Task Name	Duration	Start	Finish
1	1		**Title Selection**	**1 day**	**Mon 02/09/19**	**Mon 02/09/19**
2	1.1		Decide the project titl	1 day		
3	2		**Introduction**	**14 days**	**Mon 09/09/19**	**Thu 26/09/19**
4	2.1		Background of Study	4 days	Mon 09/09/19	Thu 12/09/19
5	2.2		Aim and Objectives	3 days	Fri 13/09/19	Tue 17/09/19
6	2.3		Significant of Study	8 days	Tue 17/09/19	Thu 26/09/19
7	3		**Literature Review**	**25 days**	**Wed 18/09/19**	**Tue 22/10/19**
8	3.1		Sediment Transport	15 days	Wed 18/09/19	Tue 08/10/19
9	3.2		Beach Types	15 days	Thu 19/09/19	Wed 09/10/19
10	3.3		Wave Breaking	15 days	Mon 23/09/19	Fri 11/10/19
11	3.4		Factor of Sediment Transport	11 days	Wed 02/10/19	Wed 16/10/19
12	3.5		Previous Study	11 days	Fri 04/10/19	Fri 18/10/19
13	3.6		Dimensional Analysis	11 days	Tue 08/10/19	Tue 22/10/19
14	4		**Methodology**	**40 days**	**Tue 22/10/19**	**Tue 17/12/19**
15	4.1		Experiment Setup	40 days		
16	5		**FYP 1 Presentation**	1 day	Wed 18/12/19	Wed 18/12/19
17	6		**Formatting and Finalize Proposal**	7 days	Thu 19/12/19	Fri 27/12/19
18	7		**Report Submission**	1 day	Mon 30/12/19	Mon 30/12/19

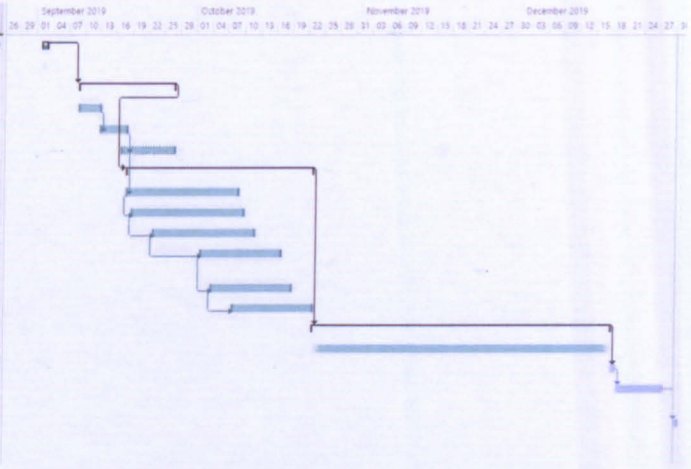

Figure 1.3: Gantt Chart of Thesis Planning

For Final Year Project 2, the study is continued with discussion and findings, conclusion and recommendation after Final Year Project 1 has been done. Final Year Project 2 is involving the modelling simulation and data analyzing where the data will be used in assessment of the sediment deposition at the beach. 6 months has been given to complete full report of final year project where it consists of Chapter 1 until Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Wave breaker is a structure that is designed to absorb the wave energy that hit the beach to reduce coastal erosion. This wave breaker will prevent a strong wave force from hitting the cliff or beach that cause erosion and trapping the sediment from returning to the sea that will eventually forming a natural beach and slowing down the wave energy. This chapter will explain about the sediment trapping by the wave breaker (PPCP) that are influenced by many factors to be considered such as the types of beach, types of wave breaking, the sediment grain size, sediment transport and factors that influence sediment transport.

2.2 Sediment Analysis

The essence of the sediment is dependent on the dynamic interactions between various variables that define sediment composition, movement, deposition and sediment post-deposition. Sediment concentrations in deep sea influence the composition of the benthic population and therefore play the significant role in defining the marine ecosystem (Morni, 2017). Etter, 1992 stated that the sediment plays an essential part in the structuring of deep-sea ecosystems, because of the deposit feeders that contain most marine species in the sea depends on sediment nutrition. According to Kao et al. (2006), about 80% of the total organic matter deposited on the continental shelf is produced from quick sedimentary deposition and strong organic production. Hence, the huge amounts of nutrients obtained from the decomposition of organic matter at the bottom of the sea would therefore decide the primary producer 's productivity which is the phytoplankton.

Therefore, the analysis of particle size provides important clues on the sediment origin, depositional condition, and transport history. Sediment transport is one of the factors that are much more influenced by water current and the mobility of particles which depends on roughness velocity, threshold velocity, settling velocity, and water velocity (Gray, 1981). Basically, coarse particles are found on the bottom of the fast-flowing area, while fine sediments are deposited at deep and quiet waters in the offshore areas. Coarse sediment such as pebbles and cobbles from the beach origin can be transported to the deep-sea area by the force of waves (Clements, 1944). The analysis for sediment started with the types of the beach and their corresponding wave energy that slams the beach. The energy that hits the beach are vary with every beach that resulted in different sediment size.

2.3 Beach Types

Sediment transport rate is varied with different types of beach because of different size of grain size and wave energy. Beach is generally a narrow gently sloping strip of land that borders a body of water, such as lake or ocean. A beach can have many different characteristics based on the location of it on the world. Types of beach can be referred to several characteristics such as the nature of the beach, the tidal and currents energy and the width and shape of the surf zone. The sediments that are deposit at the beaches is at various sizes. There are three different types of beach which are dissipative beach, reflective beach and intermediate beach (Short, 1999) that had different steepness of slope. The difference in steepness of slopes of beaches can affect the sediment size (Flemming, 2011).

Beaches are the outcome of wave action by which waves, or tides shift sand or other loose sediments that form up the beach as these objects are suspended. Alternatively, beach materials come from offshore rock erosion, as well as headland erosion and slumping producing scree deposits. An offshore coral reef is an important source of particles of sand. The beach's composition depends on the nature and quantities of upstream sediments on the shore, as well as the intensity of water and wind movement and turbidity. Based on particle size and compaction condition, sediments are shifted by moving water and wind.

2.3.1 Dissipative Beach

Dissipative beach occurs when fall velocity, Ω is more than 6, Ω > 6. The characteristics of the dissipative beaches are fine sand, high of wave energy and had short wave periods (Short, 1996). The forming of foamy, bubbly surface on the ocean surface when the wave break to shore is called surf while swash formed after the breaking of ocean in the surf as they run up onto the sloping front of the beach creating an uprush of water. Swash zone is the zone of wave action on the beach. A characteristic of dissipative beach is being the high energy beaches with a wide surf zone and low gradient of swash zone as shown in Figure 2.1. Dissipative beach had fine to medium sand due to the high wave energy that hit the shore. The high wave energy of the beaches has greatly influenced the coarseness of the sediment. Repeated oscillations of high wave energy on the beach caused the beach to scrap off the beach profile that finer the sediment. The repeated oscillation can also expose the beach to erosional processes.

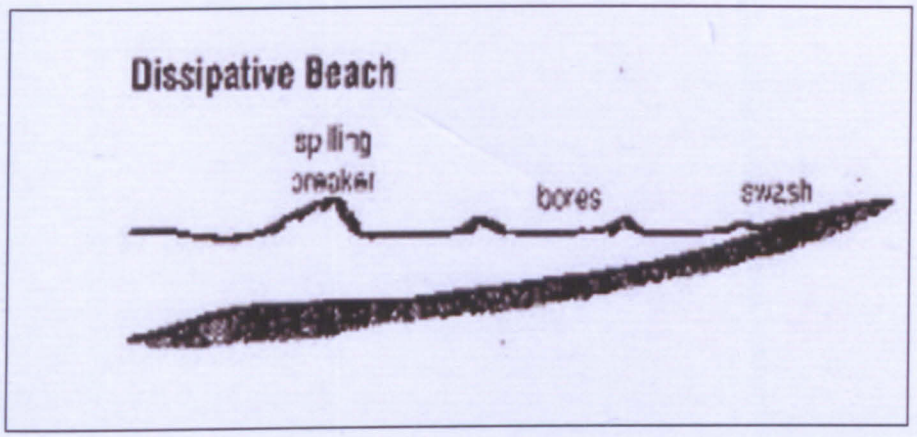

Figure 2.1: Dissipative Beach

2.3.2 Reflective Beach

Aagaard (2013) stated that reflective beach has a steep slope beaches exposed to relatively small waves that tend to be reflective. The waves break through plunging or surging, and the wave energy are mostly reflected back offshore. The fall velocity of the reflective beach lower than one as $\Omega < 1$ as stated by Short (2001). When the height wave is low, the steep gradients of the beach will be produced low surf scaling parameter. The sediments that deposited on the beach are coarse sand that includes gravel. The ensuing strong swash rushes up the beach, combining with the coarse sediments to build a steep beach face, commonly capped by well-developed beach cusps and/or a berm as shown in Figure 2.2. The coarser grains combine as a coarser steep step below the zone of wave breaking, at the base of the beach face (Short, 2001).

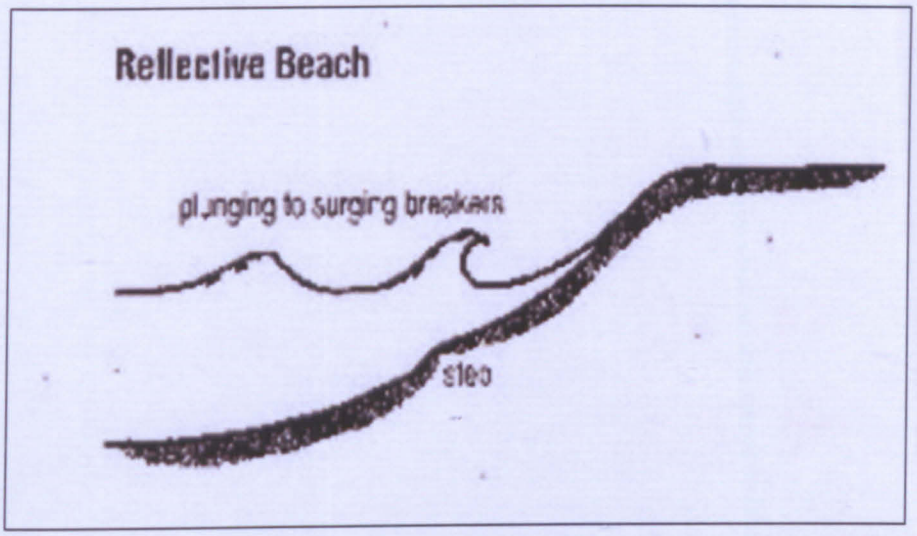

Figure 2.2: Reflective Beach