BEACH PROFILING OF UMS JETTY

NURAISYAH BINTI FADZIL

DISERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF BACHELOR OF SCIENCE (MARINE SCIENCE) WITH HONOURS

MARINE SCIENCE PROGRAMME
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITI MALAYSIA SABAH

2005

PUMS 99:1

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS@

JUDUL: BEACH PROFILING OF UMS JETTY

Ijazah: SARJANA MUDA SAINS MARIN DENGAN KEPUJIAN

SESI PENGAJIAN: 2002/2005

Saya NURAISYAH BINTI FADZIL

(HURUF BESAR)

mengaku membenarkan tesis (LPS/Sarjana/Doktor Falsafah)* ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (/)

[ ]	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
[/]	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
[ ]	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS) (TANDATANGAN PUSTAKAWAN)

Alamat Tetap: NO 24, Jalan Penyiaran 49, Taman Universiti, 81300 Skudai, Johor

Miss Zarinah Waheed.

Nama Penyelia

Tarikh: 21 / Mac 2005

Tarikh: 21 /Mac /2005

CATATAN: * Potong yang tidak berkenaan.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.

@ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (LPSM).

CONFESSION

Hereby, I confessed that this work is all my own research except the quotations and statements that had been clearly explained the sources before.

21 Mac 2005

NURAISYAH FADZIL

HS 2002-4203

APPROVAL BY

Signature

1. **SUPERVISOR**

   (Zarinah Waheed)

2. **CO-SUPERVISOR**

   (Dr. Shahbudin Saad)

3. **1st EXAMINER**

   (Puan Ejria Saleh)

4. **2nd EXAMINER**

   (Dr. Md Azharul Hoque)

5. **DEAN**

   (Prof. Madya Dr. Amran Ahmed)

ACKNOWLEDGEMENT

Alhamdulillah, I thank Allah S.W.T for His blessings that I have completed this dissertation successfully. First and foremost, I would like to show my gratitude to my supervisor, Miss Zarinah Waheed and co-supervisor, Dr. Shahbudin Saad and not forgotten to Mrs. Ejria Saleh for their guidance and help throughout the project in order to make this project a successful one.

Sincere appreciation is given to laboratory staff of Borneo Marine Research Institute (BMRI) especially Encik Ismail Tajul for his useful and meaningful assistance during the research programme and also UMS library's staff who always helping me in gaining any information I needed.

Not forgotten to Nurul Aini Salih who is willing to give a hard every time I need her to help me in fieldwork research. Thanks for all other who had contributed more or less a successful one. Especially for my family in Johor Bahru who always give me support and encouragement to me since I stepped in UMS.

All your good deeds and helpfulness will remain in my thought forever. Thank you to all for your contributions.

Nuraisyah Binti Fadzil
Universiti Malaysia Sabah
Kota Kinabalu
Mac 2005

ABSTRACT

The beach profile study along the Universiti Malaysia Sabah beach was conducted within a period of 5 months. Six stations were identified for this study, where each station were divided to high tide (HT), mid tide (MT) and low tide (LT). The aim of this study are to identify the beach profile, sediment size characteristics and physical processes that affected the changes along the beach. In this study, the mean sediment size have been classified in between the medium sand and fine sand values with the sorting value between moderately sorted and poorly sorted that showed the sorting of the sediments size were not well sorted at each station. Wave action, tidal cycles, monsoon changes and human activities are the factors that influence changes in the beach profile. Skewness and kurtosis values showed good regression, due to the changes in the beach profile in each station. Activities such as sand replenishment and land clearance for construction project that caused by human had occurred at the study sites.

ABSTRAK

PEMONITORAN PANTAI DI JETI UMS

Kajian profil pantai telah dijalankan di sepanjang pantai Universiti Malaysia Sabah dalam tempoh sepanjang 5 bulan. Sebanyak 6 stesen kajian telah dikenalpasti untuk melakukan pengukuran di mana setiap stesen mempunyai bahagian kawasan air pasang tinggi (HT), air pasang sederhana (MT) dan air pasang rendah (LT). Kajian ini bertujuan untuk menentukan profil pantai, kriteria-kriteria saiz sedimen dan proses-proses fizikal yang bertindak di sepanjang pantai tersebut. Kajian mendapati purata saiz sedimen adalah sederhana kasar dan halus bagi setiap stesen dengan nilai sisihan sederhana sempurna dan tidak sempurna menunjukkan pengasingan saiz sedimen yang kurang baik di setiap stesen. Faktor ombak, kitaran pasang surut, perubahan monsun dan aktiviti manusia menyebabkan perubahan profil pantai UMS berlaku. Nilai kepencongan dan kurtosis pula tidak menunjukkan perhubungan yang baik kepada perubahan profil pantai bagi setiap stesen. Sementara itu, terdapat juga aktiviti-aktiviti manusia seperti penambakkan pasir dan pembukaan tanah untuk projek pembinaan yang dilakukan berhampiran kawasan kajian.

CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF NOTATIONS

D_{50}	median grain diameter
M_{φ}	phi median diameter
α_{φ}	phi skewness measure
β_{φ}	phi kurtosis measure
σ_{φ}	phi standard deviation measure
φ	phi grain size measure
m/s	meter per second
%	percent
mm	millimeter
m	meter
μm	micrometer

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

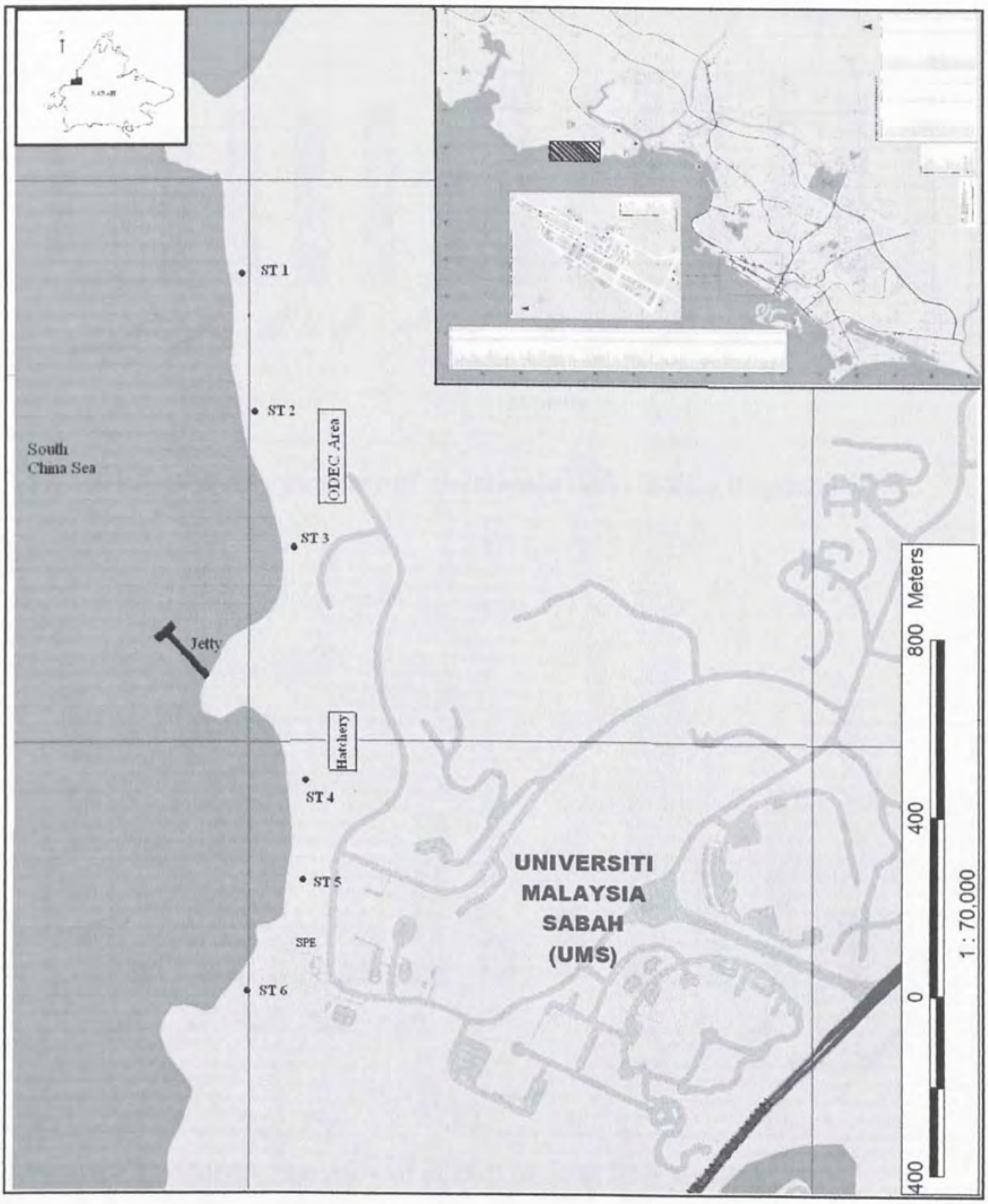
Coasts play a central role in our lives. We take advantage of the food and living areas on coastal zones by forming initial settlements called beaches. The beach refers to a larger zone which acts as a boundary that separates ocean water and land. A beach is dynamic and changes rapidly. Siever (1988) cites that beach dynamics requires the interaction of wave actions, winds, tidal circulation, sand movement, physical properties of rock or sediments behind the beach and the shoreline shape.

Beaches are formed locally by the wearing down of land erosion affected by strong wave action or the redistribution of material by sediment transport and deposition. Other than natural beach processes, human activities such as beach replenishment and breakwaters also influence the changing of a beach profile.

Furthermore, sediments on the beaches consist of any material that is available in significant quantities, mainly sand grains or pebbles. Normally, sediment size distribution will determine the rate of sediment transport on the beach. The sediment on the high tide mark of a beach face usually consists of coarser sediment. In contrast, at the low tide mark, the sediments are finer. The finer sand is easily moved by waves and currents. These movements will cause the beach to change.

1.2 Background

The beach face along the beach of Universiti Malaysia Sabah (UMS), which is approximately 1.5 kilometers long, was identified as the study site (Figure 1.1). The backshores of the eastern areas of the beach are used for Out-Door Development Centre (ODEC) as a recreational place. There is some embankment area consisting of stone structures because of the jetty which is placed parallel to the shore (Appendix 3: Photo 1). The embankment supports the area from collapsing. The jetty divides the study site into 2 sides. The first site is situated along the beach nearest to the Out-Door Develop Centre (ODEC). This beach area is more exposed to waves and current flows. The second site stretches from the hatchery building to the area nearest to the School of Business and Economic (SPE). Morphologically, the beach curves slightly inwards on this side of the study site. In addition, the jetty and headland protect the beach from strong wave action, so the probability of accretion occurring on this beach is high. Data on wind speed and rainfall in the study area for 2004 is depicted in Figure 1.2 and 1.3.



(Source :Bahagian GIS dan Pemetaan, Jabatan Pengurusan dan Pelaburan Harta, Dewan Bandaraya Kota Kinabalu, Sabah.)

Figure 1.1 Location of beach profiled station in this study

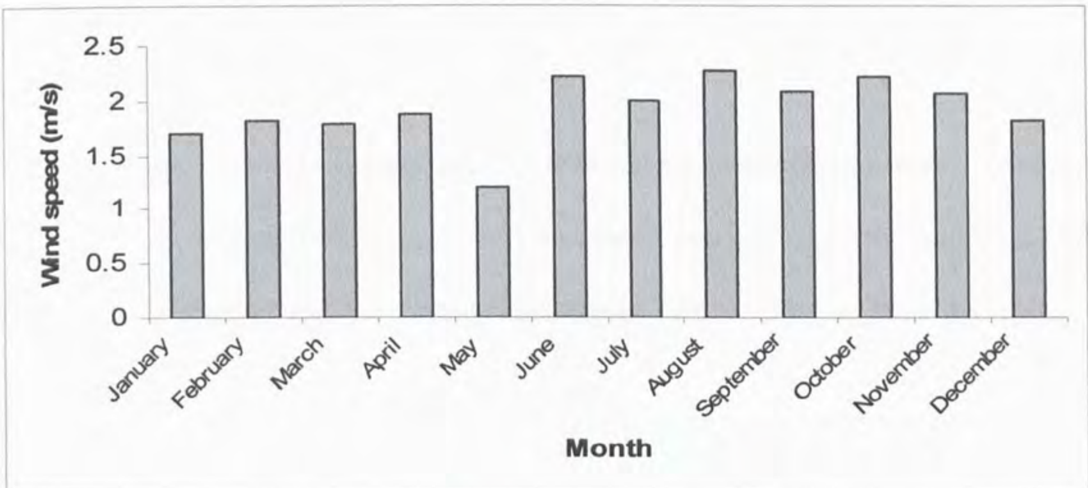


Figure 1.2 Monthly summary of winds speed (m/s) in Kota Kinabalu, 2004

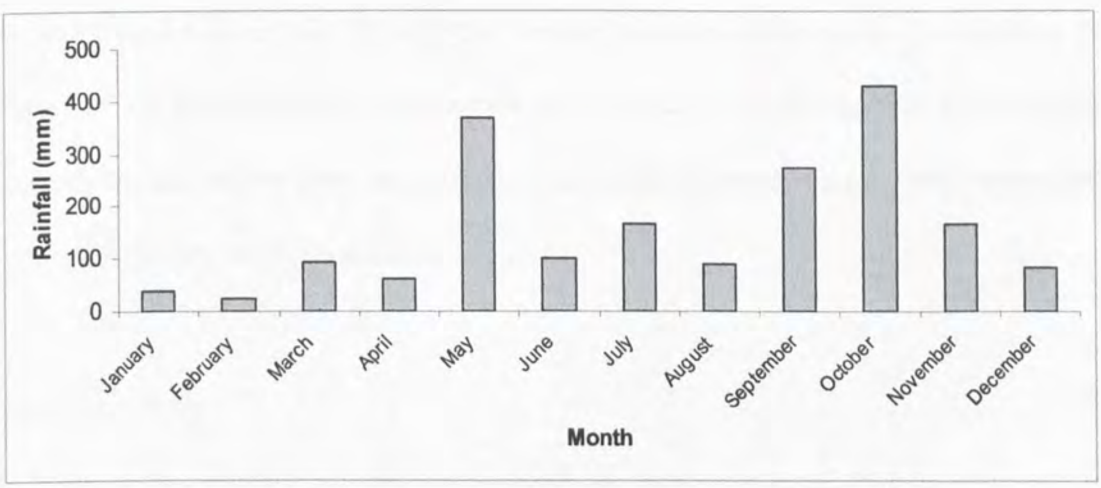


Figure 1.3 Monthly summary of rainfall (mm) in Kota Kinabalu, 2004

(Source: Meteorological Department, Kota Kinabalu, Sabah.)

1.3 Importance Of Study

Beach profiling or beach monitoring, is a technique to measure the beach topography. The erosion or accretion of the beach can be determined by using this technique. Beach profiling is a simple and inexpensive technique, which only requires surveying the actual beach.

Through this study, important beach profile data can be collected to clearly understand beach processes such as wave actions and the related interaction of the beach topography with these processes. Furthermore, the data will provide an understanding of beach erosion and accretion process that gives an indication of trends in beach sand loss or gain for each profile over time. In addition, the combination data from Littoral Environmental Observation (LEO) such as wave data will also contribute towards understanding how fast and why our beaches are changing. Thus, better beach management can be implemented.

1.4 Objectives

The objectives of this study are:

1. To identify the significant features of the UMS beach from August 2004 until December 2004 and how the beach topography changes from month to month.
2. To understand how the waves and tides shape the beach and redistribute sand each month through LEO.
3. To identify the sediment characteristics (sediment size) on the study area.

CHAPTER 2

LITERATURE REVIEW

2.1 Beach

A beach is defined as an unconsolidated sediment area that extends from the low tide mark to the uppermost point of wave action can reach (Davis, 1978). According to Komar (1976), a beach acts as a buffer, that is it protects sea cliffs and coastal characteristics from the active wave action. However, in the long term, the beach will have less effort of serving as a buffer if the sediment from that beach is significantly eroded.

Beaches temporally change, from seconds to decades, and spatially from millimeters to hundreds of kilometers, affected by many processes including waves, tide cycles, winds and human activities. Examples of these changes can be seen with the main types of beach profile developed in sand depending on the steepness of the waves. Steep waves will produce a storm profile, characterized by a bar at the break-point of the waves while the flat waves produces a summer profile where a swash bar will be formed at the point where the wave action is limited (King, 1972). The long term effect of flat waves that it builds up the beach, also known as the constructive effect. In contrast, steep waves are destructive.

The beach face slope mostly depends on the rate of percolation through the water lost absorbed into beach surface (Komar, 1976). Water molecules easily enter into a shingle beach surface rather than into a fine-sand beach. The slopes of shingle or gravel beaches are steeper than the beaches that consist of fine sand.

2.1.1 Waves

Waves are formed by wind blowing across the water surface of the sea and sets up small undulation in that surface. Most of the beach processes is the direct or indirect result of wave action. The changes in a beach results from waves of different characteristics consisting of their height and wavelength and also the direction they come from. Waves are a major factor influencing the changes on a beach profile. Waves also generate currents which flow to the shore such as longshore currents and rip currents. Leeder (1982) indicated that wave breaking occurs when peak wave crests and flatten troughs exist until oversteepening. Three types of wave breaking are spilling, plunging and surging.

Wave steepness is the most important wave characteristic determining the type of beach profile. Steep waves produce 'storm' profiles, while flat waves produce 'summer' profiles. The 'storm' profile is formed when sand is transported seaward by steep waves resulting in an accumulation of sand at the break-point forming the break-point bar (King, 1972), which is one of the distinct features of a storm profile. He also cited sand is moved landwards with flatter waves and an accumulation of sediments occurs at the area where wave action is weakened. This indicates that the wave steepness also can change the beach morphology. The effects of storm wave activities induced by the high energy causes the beach changes suddenly.

2.1.2 Tides

The beach topography might also show alterations that which correspond to the tides. Tides play a passive role in beach topography. Hourly changes resulting from high and low tides may cause changes to the beach profile and also other long-term effects, due to the differences in the range of spring and neap tides. During one tidal cycle, sediment from the swash zone is moved and deposited at the upper part of this zone. According to Davis (1978), the relationship between tidal circulation and beach processes represents a direct link. As the tides rise, the accumulation of beach sediments occur at the area between the swash and backwash zone and this deposit of sediments are moving up to the upper swash zone when the high tide (Komar, 1976).

2.1.3 Winds

Both direct and indirect effect of winds play an important role in beach changes through the movement of beach material. A landward movement of the surface water caused by onshore winds that may be indemnity by a seaward current at a lower level (Komar, 1976 ; King, 1972). Usually, without winds the sands shift onshore and a swash bar will be formed. On the other hand, with the strong onshore winds the swash bar is completely absent. The combination of winds and waves are destructive to the beach profile. King (1972) indicated that the waves that combine with strong onshore winds are more destructive than waves accompanied by an offshore wind alone.

A strong offshore wind results in a decrease of wave height. Hence, the waves flowing to the shore are flattened (King, 1972). So the beaches tend to be constructive. These circumstances will affect the sand movement and therefore have a bearing on the response to the beach profile.

2.1.4 Currents

The beach face or foreshore is continuously facing a complex variety of coastal currents. The constant change that occurs along the foreshore indicates that the currents vary in speed and direction (Davis, 1978). Generally, coastal currents flow parallel to shorelines. These currents are mainly driven by winds and they also can form, disappear or change their directions within a few hours or a few days. On the other hand, winds often control the currents that flow to shore.

According to Davis (1978), when waves move into shallow water at an angle to the shoreline, the waves are deflected and provide wave energy parallel to the shore. This wave energy generates currents called longshore currents. These wave-induced currents are responsible for the largest percentage of the alongshore sediment movement in the nearshore zone (Davis, 1978; Sorensen, 1997).

Other types of currents which operate in the nearshore zone are rip currents. A longshore current will be deflected seaward as a rip current if it is hindered by a cape or structure such as groyne oriented normal to the shore (Sorensen, 1997). Davis (1978) determined that the rip current may also form as the result of water piling up between the shallow sand bars as waves moving shoreward. Rip currents are caused by a large amount of water that moves offshore at any one time. This type of current is narrow and more rapid. Rip currents are also called undertows. According to Leeder (1982), the narrow zones of the rip currents will make up the powerful 'undertow' on many beaches. Their high velocities can reach up to 2 ms^{-1} and can be very dangerous to swimmers. Rip currents also transport significant quantities of sediments. During storms, rip currents are most important in moving sand offshore from the beach because the current is powerful and the sand will return back onto the beach by swells when the storm ceases (Cook and Gorsline, 1992).

2.1.5 Sand Grain Distribution

Sediment found in the beach face has a variety of sizes and divided into four size categories; cobble/boulder, gravel, sand and mud based on grain diameter. Grain size of beach sediments can vary in size from larger than 256 millimeters in diameters for boulders, to slightly less than 0.125 millimeters on beaches, which consists of very fine sand (Komar, 1976). The sizes of beach sediments are controlled by the sources of sediment such as the erosion of the subaerial terrestrial environment and the energy from wave action. From the observations of Liu and Zarillo (1989), they have concluded investigated that the grain size distribution on the beach face is always associated with the various dynamic zones. Generally, beach sediment also consists of various biogenic carbonate grains especially in reef barrier areas.

According to Clayton (1979), coarse sediments mean steeper beach slopes because of increasing percolation. Davis (1972) cited that the energy from wave action is absorbed over a swash zone on steep beaches. The rate of percolation decreases if the wave length increases (Komar, 1976). So the beach slope will lift. In contrast, the very fine sediment will cause a flatter beach slope. Observation of beaches made in California showed that, good relation between foreshore slope and sediments size (Bascom, 1951). The gradient of shingle beaches is steeper than sand beaches where the coarse shingle is very permeable and a large volume of swash is lost by percolation. The volumes and force of the swash and backwash are very different. The gravity force tends to equalize the force of the swash and backwash. To render gravity more effective, the slope must be steep.

The distribution of sand size on the foreshore varies as it associates with the various areas. The area of high tide is composed of the coarser sediment while the low tide area is characterized by fine sand and more abundant infauna. Sorensen (1997) states that the sand sizes of most beaches are typically comprised of grain diameters between 0.1 and 1.0 millimeters. Distributions of beach sediments are fairly well sorted but not as well as dune sands (Friedman, 1961). The differential movements of coarse and fine sediments are caused by wave action, tidal cycle, monsoon changes and winds. Negative skewness was characterized as an overabundance of coarse sediments that can cause erosion while the accumulations of fine sediments are shown by positive skewness (Duane, 1964).

REFERENCES

Ahrens, C. D., 2000. *Essential of Meteorology : An Invitation to Atmosphere*. 3rd Edition. Brooks/Cole. Thompson Learning, USA.

Bagnold, R. A., 1940. Beach formation by waves: some model experiments in a wave tank. *Journal Institute of Civil Engineering* **15**, 27-52.

Bascom, W. H., 1951. The relationship between sand size and beach face slope. *Trans. Am. Geophys. Union* **32**, 866-874.

Briggs, D., 1977. *Sources and Methods in Geography: Sediment.* Butterworth and Co. (Publ.) Ltd. London.

Clayton, K., 1979. *Coastal Geomorphology*. Macmillan Education, London.

Cook, D. O., and Gorsline, D. S., 1992. Field observations of sand transport by shoaling waves. *Marine Geology* **13**, 31-55.

Davis, R. A.(eds), 1978. *Coastal Sedimentary Environments*. Springer-Verlag, New York.

Duane, D.B., 1964. Significance of skewness in recent sediments West Pamlico Sound, North Carolina. *Journal of Sedimentation Petrology* **34** (4), 864-874.

Folk, R. L., and Ward, W. C., 1957. Brazos River bar, a study of the significance of grain size parameters. *Journal of Sedimentation Petrology* **27**, 3-27.

Friedman, G. M., 1961. Distinction between dune, beach and river sands from their textural characteristics. *Journal of Sedimentation Petrology* **34**, 514- 29.

Jamaluddin Md Jahi, 1989. *Pengantar Geomerfologi*. Dewan Bahasa dan Pustaka, Kuala Lumpur.

King, C. A. M., 1972. *Beaches and Coasts*. 2nd Edition. Edward Arnold, London.

Komar, P. D., 1976. *Beach Processes and Sedimentation*. Prentice-Hall, New York.

Krumbein, W. C. and Graybill, F. A. 1965. *An Introduction to Statistical Methods in Geology.* McGraw Hill, New York.

Leeder, M. R., 1982. *Sedimentology Process and Product.* George Allen and Unwin, London.

Liu, J. T., and Zarillo, G. A., 1989. Distribution of grain sizes across a transgressive shoreface. *Marine Geology* **87**, 121-136.

Siever, R., 1988. *Sand.*Scientific American Library, New York.

Tongkul, F., 2000. *Sedimentologi.* Universiti Kebangsaan Malaysia, Bangi.

Sorensen, R. M., 1997. *Basic Coastal Engineering.* 2nd Edition. International Thompson Publishing, New York.

Wright, C. D and Short, A. D., 1984. Morphodynamic variability of surf zones and beaches : A synthesis. *Marine Geology* **56**, 93-118.